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THE POLITICAL ECONOMY OF SEED POLICY AND FOOD SECURITY IN GHANA

BY

PROMISE EWEH

(10397014)

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DECLARATIONS

I hereby declare that this thesis is the result of my own work carried out in the Institute of African Studies, University of Ghana under the supervision of Professor Dzodzi Tsikata, Professor Kojo Amanor, Professor Ruth Hall and Prof. Fred Dzanku. No part of this thesis has been presented to any institution for the award of an academic degree. All research materials and other literature consulted during the preparation of the thesis are duly acknowledged and I remain solely responsible for any shortcomings of the study.

Promise Eweh (10397014) Student Name and ID	Signature	05/11/2024 Date

Supervisors

Prof. Dzodzi Tsikata	Signature	05/11/2024 Date
Prof. Kojo S. Amanor	Signature	5/11/2024 Date
Prof. Ruth Hall	Signature	05/11/2024 Date
Prof. Fred Dzanku	Signature	5/11/2024 Date

ABSTRACT

In mainstream agricultural policy, food insecurity, poverty and underdevelopment in sub-Saharan Africa are attributed to the low uptake of commercial seeds and other productivity-enhancing inputs. This view is derived from neo-Malthusian concerns of population expansion, and the impacts of climate change and pest and diseases on agricultural production. The discourse argues for an increasing role of the private sector in improving agricultural production, but remains silent on the implications of the expansion of agribusiness for the rights of farmers to freely save and exchange seed.

This study seeks to gain a broader understanding of these issues through a combination of theoretical viewpoints and multiple levels of analysis. This includes a political-economic approach that examines interventions promoted by the state and other actors within different economic contexts. Historically, the state and non-state actors have intervened in food production. The first major interventions in agricultural development in Ghana was a state-led approach involving mechanised cereal production on state and cooperative farms in the 1960s. Following this phase was a publicly funded archetypal green revolution programme involving large-scale commercial farmers in the 1970s. The third intervention focused on the development of technologies for smallholder farmers after the withdrawal of state support for large-scale farmers in the 1980s. In the contemporary period, the state has created an environment for private enterprise through the liberalisation of markets, renewal of input subsidies, attempts to commercialise genetically modified crops, and support for intellectual property rights.

Using farm-level and other socio-economic data for four rural districts in Ghana, the study also examines the factors that underpin cropping systems, agricultural commercialisation and their related social relations of production, and the extent to which technology adoption differs among geographic and agro-ecological zones, and different groups of farmers. In the Garu-Tempane district of North-eastern Ghana where land is scarce and farming environments are more difficult, farmers are adopting improved crop varieties (especially maize and sorghum), organic manure and chemical fertilisers, as part of efforts to prevent significant declines in crop output. However, millets (which receive little support in agricultural research) continue to be an important crop due to different uses of the available varieties, and their ability to perform well in this difficult environment. In contrast to Garu-Tempane, land availability and fertility are the most important assets for rural livelihoods in the East Gonja district located in the lower part of Northern Ghana. Here, the cropping system comprises the cultivation of tubers, roots crops, and cereals. Technology adoption in this district is reflected in the high use of machinery services and weedicides than in the adoption of improved seed. There is also a discernible class of large commercial farmers who rely extensively on hired labour, agricultural machinery and weedicides. In spite of relative land availability in East Gonja, women's rights to land are weak. In contrast, there is a greater participation of women in agriculture and rural labour markets in Garu-Tempane, and their rights to land are stronger. In both Garu-Tempane and East Gonja, technology adoption does not occur in a vacuum but is mainly mediated by local level institutions comprising non-governmental organisations, farmer based organisations and government programmes, small seed and agro-input companies and shops, and small banks. These institutions receive critical support from international development agencies and actors such as AGRA that promote green revolution interventions.

In contrast to the Northern districts, agricultural commercialisation in the Asunafo North and Kwaebibirem districts of Southern Ghana mainly involves cocoa production for the world market. This reflects a long history of state and agribusiness support for the development of industrial tree crops. The production of forest tree crops involving sharecropping arrangements, the establishment of forest reserves in the colonial period, and land sales and scarcity, have resulted in weak land rights for women and rural youth in the Southern districts. Further, although Southern farmers can produce food without much dependence on commercial seeds and chemical fertilisers, food production receives less attention, resulting in seasonal food shortages and high food prices. While Asunafo North has two rainy seasons, its four month period of food shortages is comparable with that of the East Gonja district, where rainfall is unimodal.

In conclusion, this study argues that attempts to improve well-being in rural areas should simultaneously pursue participatory research and learning between farmers and agricultural scientists (especially for those crops that receive little attention in agricultural research and production), promoting land rights for women and other poorer classes (including improving their access to forest resources), and the formalisation of agricultural employment. Importantly, the crucial role of government policy and dynamics in the global economy on food security requires that primary attention is given to broader economic policy and preventive measures that ameliorate the negative impacts of economic crisis.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADB	Agricultural Development Bank
ADC	Agricultural Development Corporation
AGRA	Alliance for a Green Revolution in Africa
AISP	Agricultural Input Subsidy Programme
CAADP	Comprehensive Africa Agriculture Development Programme
CGIAR	Consultative Group for International Agricultural Research
CIDA	Canadian International Development Agency
CIMMYT	International Maize and Wheat Improvement Center
CMB	Cocoa Marketing Board
CPP	Convention Peoples' Party
CRI	Crops Research Institute of Ghana
CWR	Crop Wild Relatives
DANIDA	Danish International Development Agency
FAO	Food and Agriculture Organization of the United Nations
FBO	Farmer Based Organisation
FDC	Food Distribution Corporation
FHH	Female-headed household
FSP	Fertiliser Subsidy Programme
FSR	Farming Systems Research
G8	Group of Eight
GDC	Gonja Development Corporation
GDP	Gross Domestic Product
GE	Genetically Engineered Crops
GGDP	Ghana Grains Development Project
GHG	Greenhouse Gas
GLDB	Grains and Legumes Development Board
GM	Genetically Modified Crops
GOPDC	Ghana Oil Palm Development Corporation
GR	Green Revolution
GSC	Ghana Seed Company
GSID	Ghana Seed Inspectorate Division
GSS	Ghana Statistical Service
HYV	High Yielding Varieties
IITA	International Institute of Tropical Agriculture
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights
ITFC	Integrated Tamale Fruit Company
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
LEAP	Livelihood Empowerment Against Poverty
MD2	Del Monte Gold
MDGs	Millennium Development Goals
MoFA	Ministry of Food & Agriculture
MVP	Millennium Villages Project
NDPC	National Development Planning Commission
NEPAD	New Partnership For Africa's Development
NGOs	Non-Governmental Organisations

NLC	National Liberation Council
NPC	National Planning Commission
NPP	New Patriotic Party
NRC	National Redemption Council
OFY	Operation Feed Yourself
OPV	Open-Pollinated Varieties
PBC	Produce Buying Company
PFJ	Planting for Food and Jobs
PSI	Presidential Special Initiative
PVPA	Plant Variety Protection Act
SARI	Savannah Agricultural Research Institute
SFC	State Farms Corporation
SG 2000	Sasakawa Global 2000
TNC	Transnational Corporation
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UGFCC	United Ghana Farmers' Cooperative Council
UN	United Nations
UPOV	International Union for the Protection of New Varieties of Plants
USAID	United States Agency for International Development
WTO	World Trade Organization

Chapter One

Introduction: Context of Recent Green Revolution Interventions and the African Green Revolution Literature

1.1 Background to the Study

Efforts to eradicate poverty in Africa have not been impressive. Between 1990 and 2012, the proportion of the African population living in extreme poverty declined from 56 percent to only 43 percent (Beegle et al., 2016). In the course of this period, the number of people living in extreme poverty increased by 100 million. This brought the total number of people who lived in poverty – based on an international poverty line of $1.90 a day – to 330 million in 2012 (Ibid). Africa's poor performance in improving well-being is also reflected in assessments of food insecurity (a twin concept of poverty). While some achievement has been made in reducing hunger over the past three decades, progress has stalled over the last few years (FAO et al., 2019:6). Hunger is a problem for more than 20 percent of Africa's population, and close to 282 million people were unable to meet their food needs in 2020 (FAO, 2021:v).

Among the countries in sub-Saharan African, Ghana was often praised for its poverty reduction efforts. This was in part signified by its ability to meet the Millennium Development Goal target of reducing by half the population living in extreme poverty and hunger ahead of 2015. In spite of this, poverty and food insecurity continue to be major developmental issues. In 2016, more than 20 percent of Ghana's population was poor, and 2.4 million people could not meet their daily food needs "even if they were to spend all their expenditures on food." (GSS, 2018:14). Thus, poverty and food insecurity continue to be major issues of concern in Ghana and Africa at large. Although urban areas have their own share and experiences of poverty and food insecurity, these issues are by far a rural phenomenon.

Over the last several decades, a dominant interpretation emanating from research of the agricultural sciences, as well as socioeconomic and policy analysis, has been that increased agricultural productivity is the most important solution to these challenges. The broad literature argues that productivity increases will result in the increased supply of food for small farming households, and for producers of cash crops incomes which can be used to procure food. Urban dwellers who do not produce their own food stand to benefit through reduced food prices while manufacturing enterprises can also gain access to sufficient high quality raw materials for processing, which would in turn promote employment and increased consumption. Increased agricultural productivity and output would also reduce Africa's reliance on food aid, and help address the high expenditures of many governments on food imports. Crucially, improvements in agricultural productivity were an essential condition of economic development in the United States, Europe and Asia. Thus, its role for Africa's development cannot be downplayed if the experiences of the world's industrialised nations are anything to go by (Toenniessen, Adesina, & DevRies, 2008:234; Pinstrup-Andersen & Cohen 2000:160).

In the last 20 years, much of this discussion about the central role of agricultural productivity in economic development has revolved around the idea of an 'African Green Revolution'. This idea represents the coming together of a number of important policy processes and agricultural interventions. Key among these was the Comprehensive Africa Agriculture Development Programme (CAADP), the African Union's programme of agricultural development. CAADP diagnoses Africa's agriculture as an agriculture in *crisis*, which it seeks to reverse through a number of strategies that mainly focus on production. These include investments in irrigation and other rural infrastructure, increasing farmers' access to agricultural technologies, and addressing problems that stand in their way of greater market participation (NEPAD, 2003:1–21).

CAADP highlights a critical role for partnerships between African states and a broad range of actors from the local to the global level. The initial draft of the CAADP document itself was "prepared by FAO in co-operation with the NEPAD Steering Committee" (NEPAD, 2003:1), while a significant part of the funding for the programme's activities was expected as aid from donor countries, and credit from the domestic and global private sector. CAADP also argues for the state to take on roles such as the provision of physical infrastructure – where the incentive and capacity of the private sector is limited – and to enhance the policy conditions that will enable the private sector to flourish.

In addition to CAADP and more crucial in the processes leading to the 'African Green Revolution' was the unveiling of the Millennium Development Goals (MDGs) in 2001. The human development focus of the MDGs represented an important shift from the structural adjustment programmes of the 1980s which highlighted economic growth through the export of traditional and non-traditional cash crops, and the extraction of timber and mineral resources. According to Hulme (2007), the late former Secretary General of the United Nations (UN), Kofi Annan, and a range of other actors, played an important role in determining the content of the MDGs. They had supposedly worked to ensure that poverty-related issues were not eclipsed by issues such as peacekeeping in the UN's agenda. The first of the eight MDGs sought to reduce by half the proportion of the global population living in extreme poverty and hunger by 2015.

As part of preparatory activities to implement the MDGs, Kofi Annan also established the UN Millennium Project, whose role was to hold discussions with national governments and local communities about practical solutions that could bring the MDGs to fruition. The work of the UN Millennium Project itself was divided among various task forces, with specific task forces responsible for one of the MDGs.

The Hunger Task Force, which presided over issues of poverty and hunger recommended the increased access of farmers to improved seeds, chemical fertilisers, irrigation and extension, as well as facilities for storing grain harvests as the key requirements for addressing poverty and hunger in rural communities (Sachs, 2005:226-238; Sanchez, Denning, & Nziguheba, 2009). The work and recommendations of the Millennium Project would influence Kofi Annan's call for "a uniquely African Green Revolution" (Nziguheba et al., 2010:77). Annan would go on to repeat the call in other fora (Annan, 2008a; Annan, 2008b).

The proposals by the UN Millennium Project did not stay on the shelf but found life in the Millennium Villages Project (MVP) where they were implemented in 80 communities across 10 African countries (Sanchez et al., 2009:38). The uptake of the MVP recommendations was associated with yield increases ranging between 2.4 – 3 tonnes per hectare, and the Project's impacts on crop production were pronounced in those communities where maize was the main crop (Sanchez et al., 2009; Nziguheba et al., 2010). In Malawi, a national programme of distributing subsidised hybrid maize seed and chemical fertilisers started in October 2005 in response to poor harvests in the previous planting season, caused in large part by a severe drought. This intervention was also associated with an increase in maize production from 1.2 to 2.6 million tonnes in 2006, followed by a subsequent increase of 800,000 tonnes that brought maize production to 3.4 million tonnes in 2007 (Sanchez et al., 2009). The success of this input subsidy in Malawi was reported widely in the mainstream press (Chinsinga, 2011:59).

A wide range of influential institutions and initiatives have emerged in support of the African Green Revolution (henceforth the African GR). These included consultative processes as well as long term concrete initiatives that seek to promote particular means of achieving impacts on the ground. The initiatives mainly embody a private sector led approach, financed by philanthropies and donor governments through their development cooperation agencies.

For instance, Yara International – a global fertiliser manufacturing company – organised conferences on the subject of the African GR between 2006 and 2008 (de Cleene, 2014:70), while the Rockefeller Foundation supported the 2006 African Fertiliser Summit, resulting in The Abuja Declaration, where African leaders agreed to increase fertiliser use among farmers by creating the conditions that promote the development of private input markets (Toenniessen et al., 2008:238). Private foundations also provided financial support for the Millennium Villages Project (Sanchez et al., 2009:38; Sachs, 2005:228). By far the most popular of the initiatives that has arisen in the context of the African GR is the Alliance for a Green Revolution in Africa (AGRA). AGRA was established in 2006 by the Rockefeller and the Bill and Melinda Gates Foundations. It focuses on the human and institutional capacity development for plant breeding as well as the establishment of input delivery systems that link seed companies at the national level to small shops in rural communities. Thus, AGRA provides strong intellectual and material support for the African GR. No single initiative evokes the idea of an African GR the way that AGRA does.

Although the above processes contributed to shaping the African GR, it was the 2007-2008 food crisis that brought international attention to food as a crucial issue in Africa, and of measures to increase its production. Prices of major cereal crops more than doubled during the crisis, with food riots reported in 14 African countries (Poulton et al., 2014:2). The crisis was the result of rising prices of fuel and agricultural inputs, and agricultural policies that encouraged farmers to produce agro-fuels at the expense of food (Moyo, Jha, & Yeros, 2019). The food crisis gave a greater impetus to policies such as CAADP that prioritised productivity increases in agriculture (Poulton et al., 2014), and steered the wide range of actors coalescing around the African GR into action. Among the world's powerful nations, the food crisis would also drive foreign policy and development assistance.

This is reflected in the United States Lugar-Casey Global Food Security Act (Ejeta, 2009) and its Feed the Future programme. In 2009, leaders of the world's largest economies (i.e. the G8) announced US$20 billion in support of agriculture and food security programmes in the Third World. In Ghana, the government, with support from its external donors, initiated a fertiliser subsidy programme in response to the crisis (Resnick & Mather, 2016).

This study examines the linkages that are made between seeds, other productivity enhancing inputs and poverty reduction and food security in Ghana. It views seeds as only one element in agricultural production whose adoption is influenced by the relationship between land and labour, and agro-ecological factors. However, access to commercial seeds and inputs significantly involve market relations that are mediated by institutions such as local NGOs. Moreover, the larger agricultural sector has to be examined within the context of state agricultural policy, which in turn has been influenced by the integration of the state into the world economy and the expansion of agribusiness. Because commercial seeds have again acquired the status of being the most important element in agricultural production, little attention is given to the relationships between these inputs and other factors of production. Further, inadequate attention is given to the social relations of production, and their gender and intergenerational dimensions.

In choosing to frame this research from the perspectives of farming systems research, the Boserupian theory of technological change, social relations of production and political economy critiques of commoditisation, the study seeks to address those issues that are rarely discussed in the African green revolution literature, but have important implications for livelihoods in rural areas.

1.2 Problem Statement

In emphasizing the inadequate adoption of hybrid seeds and other commercial inputs as the main challenges in agricultural development, African GR discourses and the interventions that originate from them correspond to neo-Malthusian attempts to solve the problems of poverty, food insecurity, and economic underdevelopment through expansion in food production. In this regard, an African GR is seen to be even more crucial not only because the green revolution of the 1960s *bypassed* Africa, but also because of the current predicaments (e.g. climate change and the high cost of imported agricultural products) that the African continent faces.

Beneath these standard arguments for the replication of the 1960's GR are important assumptions that tend to equate Africa's agroecological conditions with those of Asia. For example, the Asian GR involved the monocropping of cereals such as wheat and rice in regions with the most favourable agroecological conditions (e.g., areas with better soils and irrigated land), physical infrastructure and other supportive services[1]. In India the processes which made it possible for Punjab (which together with Haryana were emblematic of India's green revolution) to outpace other areas in wheat production were laid in the late nineteenth century: the British invested in the development of railways and farms, and induced the migration of labour to the area for the purpose of stimulating wheat production which would later be exported to Britain (Friedmann, 2005:237). In contrast to Asia, agricultural production in Africa is constituted by a greater diversity of crops (Richards, 2001), while agroecological conditions are not so favourable in many areas. For instance, poor soil quality due to inadequate moisture is a key constraint to crop production in some parts of sub-Saharan Africa.

[1] Thus even in Asia, the GR was criticised for exacerbating the disparities between geographic regions and different economic groups due to its focus on areas with greater endowments in environmental and economic resources (Chambers & Jiggins, 1987; Boserup, 1975)

Another important contrast between many areas of the 1960s GR and sub-Saharan Africa is the share of cropland under irrigation. Irrigation in some areas of Asia date back several millennia (Boserup, 1976:26), and in India the expansion in irrigation potential from 19 million hectares in 1947 to 60 million in 1981 points to its critical role in the whole green revolution approach (Chambers, 1984:365). At present, the portion of cropland under irrigation in South Asia, and East Asia and the Pacific are approximately 40 percent and 30 percent, respectively (The World Bank, 2007:51). In sub-Saharan Africa, the corresponding figure is only 4-5 percent (ibid; Makin, 2016:3). Thus, rain-fed agriculture continues to be the predominant form of agricultural production for the majority of farmers.

The failure of the initial GR among small or 'resource-poor farmers', due to the lack of favourable production conditions suited to green revolution technologies, was the subject of the farming systems research in the 1970s and 1980s (Norman, 1978; 2002; Fresco, 1984). However, the new African GR literature has failed to engage with that debate. Farmers are sometimes treated as an undifferentiated whole; little attention is given to resource-poor farmers, and there is the tendency to use the term 'farmers' to connote more commercial-oriented (more likely male) farmers compared to resource poor farmers. For example, medium-scale farms are seen to have a greater potential to achieve the increases in yields and production expected under the African GR compared to small farms, which are often described in the literature as subsistence farms to denote their use mainly for self-provisioning (Otsuka, Larson, & Hazell, 2013:3-5). Thus, social differentiation and the social relations of production are to a large extent left unattended in the African GR literature.

In cases where differences in agro-ecological conditions have been recognised, this was insufficient to re-think the approach to agricultural production and livelihoods, and the standard package of inputs have been recommended across board.

Further, there is inadequate discussion in the GR literature from a systems point of view. Much of the attention is given to seed and other inputs, mainly chemical fertilisers. While factors such as land and labour are central to agricultural production in most rural communities, they receive little attention in the African GR literature.

In the Asian GR, productivity increases among relatively wealthy farmers were in part achieved through the application of external inputs imported from abroad. However, in this case, the commoditisation of agriculture was mediated by public programmes such as India's Integrated Agricultural Development Programmes or the use of public hybrids in China. In contrast, increases in food production under the African GR are expected to be achieved through the integration of farmers into a commercial seed system based on purchases of seed and other agro-inputs produced or imported by private companies. The prevailing seed system is deemed inefficient and is seen as an obstacle to the release of seed varieties or the imports of seed from abroad (Tripp & Ragasa, 2015). To overcome these challenges, the African GR literature argues for a value chain or commercial seed system approach for strengthening seed production and distribution. Emphasis is also given to seed policy and regulatory reform, and the necessity of intellectual property rights (IPR) legislation. Again, several assumptions are embedded in these policy recommendations, while other important issues are overlooked or rejected. First, since rural poverty in Africa is mainly attributed to inadequate adoption of improved seed and other agro-chemical inputs (Paarlberg, 2008), a supplanting of prevailing seed systems by a more efficient commerce-driven system would significantly contribute to poverty reduction. However such a stance reflects a failure to examine the commoditisation of agriculture, which does not only apply to seeds and agro-inputs, but also to more crucial resources such as land. It is assumed that lack of access to commercial inputs is the main challenge encountered by majority of farmers, and that the availability of such inputs will provide enormous benefits to all groups of farmers.

Issues such as the appropriation of farmers' genetic resources, concentration in agribusiness, and the focus of commercial seed systems on a narrow set of crops (Holt-Gimenez, 2008) receive little attention. Also not given adequate attention are farmers' indigenous knowledge and informal seed systems, the implication of IPR for mutually beneficial interactions between farming communities and public research scientists, and farmers right to save and exchange seed (Thompson, 2012). These issues underlie the need for research that examine the different actors and interests involved in Ghana's green revolution experiences, the purposes which policies ultimately serve, and the role of the state in this whole process, especially in relation to the current neoliberalism context. However, these questions rarely receive adequate attention.

Research based on political ecology frameworks have emerged as a major source of criticism of the standard African GR literature in recent years. Political ecology perspectives question the commercial value chain approach of GR projects and examine relationships between the actors involved in such projects (Gengenbach et al. 2018; Moseley & Ouedraogo, 2022; Boafo & Lyons, 2022). In addition, they have explored the social relations of production – especially of gender – that have gone unaddressed in most of the African GR literature (Nyantakyi-frimpong & Kerr, 2015). For example, Moseley & Ouedraogo (2022) argue that local level impacts of GR projects also depend on factors such as gender roles and power relations, which are in turn linked to access to important production resources such as land. These factors are argued to vary considerably, and are inadequately addressed by standard GR approaches. Other studies also examine farmers' agency and resistance (Vercillo & Hird-younger, 2019). However, with a few exceptions (for e.g. Vercillo, Weis, & Luginaah, 2020), issues of *change* have not been adequately explored.

In general, there is the tendency in both mainstream and critical perspectives to treat the new attempts to promote commercial agro-inputs as a somewhat exceptional period in African agriculture. This is possibly the result of a failure to examine current green revolution programmes in relation to similar agricultural programmes in the recent past. Another aspect of change not adequately addressed in the new literature relates to farmers' own changes in technology in response to environmental change (Maxwell, 1986). In some of the available literature critiquing dominant GR approaches, emphasis is given to local impacts of 'visible' green revolution projects, and it is common to suggest that farmers' adoption of commercial agro-inputs is mainly influenced by the actors that are actively working to bring about the African GR. These studies do not provide a strong theoretical basis for explaining technological change in circumstances where interventions by governments or NGOs to increase farmers' adoption of modern inputs do not exist or are ineffective.

1.3 Research Questions

In the light of the problem statement, the study will examine the following research questions:

1) What have been the major shifts in seed and food policy in Ghana within the context of broader economic change?

2) What different farming systems exist among different geographic areas of Ghana, and how do these and their related social relations of production influence the adoption of seed and other technologies?

3) How do different contexts of land, labour and agroecology shape cropping patterns and the adoption of seed and other technologies in different rural areas of Ghana?

1.4 Objectives of the Study

The study seeks to achieve the following objectives:

1) To examine seed, food and agricultural policy in Ghana in order to understand the factors that drive government policy, and changes in the nature of the Ghanaian state over the decades.

2) To examine the differences in farming systems among different rural areas of Ghana, and understand the relationships between these farming systems, social relations of production, and the use of seed and other technologies.

3) To examine the impact of key factors of production such as land and labour, and agroecological conditions on cropping patterns and the adoption of technology.

1.5 Significance of Study

The African green revolution has generated much interest among African governments and its donors, charity organisations and the private sector, and the research community. This resurgence sometimes has the effect of presenting recent attempts to increase food production through the adoption of high yielding seeds and chemical fertilisers as a somewhat new enterprise. However the newness that these strategies give rise to overshadow similar agricultural programmes of the early post-independence period. Also, while issues of food and farming appear so simple on the surface, the debates on these issues are old and have undergone changes due to extensive discussions in academic research and development policy institutions. Thus, the interest in an African green revolution over the last 20 years is a contemporary supplement to these old debates to which this study seeks to make a contribution.

While this study notes that social relations of production have not been adequately explored in the African green revolution literature, there is a large body of research on the topic in Ghana. In the light of this, the study hopes to highlight the peculiarities of social relations among various geographic areas through comparative analyses of four research districts. The study also attempts to contribute to discussions on the human-development-environment nexus. In particular, it examines the role of land and labour in technology adoption. Instead of the underlying assumption in much of the African green revolution literature that poverty and food insecurity are the result of low uptake of modern inputs, this study analyses technology in different contexts of agricultural production, and examines the circumstances under which farmers are likely to turn to an increasing use of external (commercial) inputs. Even where there are necessary factors that drive farmers to seek improvements in production, the practices that they adopt for this purpose are also shaped by the options that are available to them. In relation to this, the study also contributes to the discussions by examining actors at both national and local levels, the types of agriculture they promote, and the implications of these for small farmers. Further, the study examines seed, food and agricultural policy in Ghana from the independence to the contemporary period. In so doing, the study contributes to debates about the changing role of the African state throughout this period.

1.6 Outline of the Study

This study is organised into seven (7) chapters. The next chapter situates contemporary African green revolution discourses within broader debates about the role of hybrid seeds and agri-inputs in food production dating to the Asian green revolution of the 1960s. The dominant green revolution discourse, which highlights food availability as the most important solution to hunger and well-being, and represents a top-down and private-sector led approach to technology adoption, is set alongside alternative discourses about technological change.

Thus, the chapter also examines political economy critiques of commodification and the increased influence of transnational corporations in the seed sector. The main goal of the chapter is to explore how different theoretical viewpoints on food production, seeds and commercialisation can help to frame research about food, farming and technology in Africa. Chapter three focuses on research methods and data sources. It outlines the study's research districts, the different kinds of data examined, and the analytical methods that informed the findings, discussions and conclusions reached in the empirical chapters of the study. Chapter four draws on policy documents and the academic literature to examine the green revolution experience in Ghana vis-a-vis agricultural commercialisation and wider economic change. It pays attention to the triggers and ideologies that influence agricultural and economic policy, the actors in agricultural policy, and how the state has responded to problems in the food and agricultural sector. It also examines the social groups that have ultimately benefitted from agricultural interventions. Chapter five addresses the issue of differences in farming systems across different geographic areas of Ghana. It compares farming systems in the Garu-Tempane and East Gonja districts of the Northern savanna, with those of the Asunafo North and Kwaebibirem districts of the semi-deciduous forest.

While factors such as land and agro-ecological conditions influence the kinds of crops that are produced, the chapter highlights social relations of production as an essential component that contributes to the totality of farming systems. The chapter thus examines issues of land tenure and labour, as well as the actors in agricultural production; it analyses how these factors affect men, women, and other groups in farming communities. Chapter six examines the maize crop system in relation to farming systems of the four research districts. It analyses how changes in land availability and differences in agroecological conditions shape cropping patterns, and reliance on commercial input markets.

Through the focus on the maize crop system, the chapter explains technological change in Garu-Tempane relative to the other districts and examines the role of gender and class in the use of improved seed, other commercial inputs and agricultural machinery. It concludes by highlighting implications of the changes for women and poor farmers' access to land, labour and livelihoods. Chapter seven concludes the study. It reflects on the green revolution discourse and the theoretical framework for the study in light of the evidence presented in the various chapters.

Chapter Two

Food and Seed Debates: The Green Revolutions, Neo-Malthusianism, and Alternative Discourses

2.1 Introduction

In what is commonly described as an African Green Revolution, contemporary agricultural development discourses highlight the intensification of agriculture through the adoption of certified seeds, chemical fertilisers and other agricultural inputs as the main solution to the problems of food insecurity and rural poverty in sub-Saharan Africa. These policy prescriptions are underpinned by a neo-Malthusian view of the relationship between people and the environment that emphasise the physical limits of environmental resources, and increased food production as the sole means of addressing poverty in rural Africa. However, proposals for the intensification of agriculture often overlook the complexity of history and ecology in Africa, and how commercial seeds and agri-inputs have been, and continue to be central to the expansion of agribusiness, which in turn has important implications for farmers.

This chapter situates the renewed importance of commercial seeds and agri-inputs within broader debates about the relationship between population, development and the environment, with the goal to understand how different theoretical viewpoints can help to frame research about food, farming and technology in Africa. It offers a criticism of agricultural modernisation embodied in the African green revolution by drawing on the following approaches:

1) The Boserupian theory of incremental development – which carefully examines the responses and adaptation of farmers to changing factors of production, and the rationale of technical developments in relation to changing factors of production;

2) Farming systems research, which examines the influence of agroecology factors in technology development and farmers responses to complex environments in which there is a high element of risk; and
3) The political economy critique of the Green Revolution that argues that agricultural development has been heavily influenced by commercial pressures and interests of agribusiness, and that the nature of technology development has been influenced by technologies that bring profit to agribusiness rather than security to farmers.

The chapter is organised into eight (8) sections. Section 2.2 revisits the 1960s Asian Green Revolution which serves as the inspiration for contemporary agricultural development interventions in Africa. This is followed by Section 2.3 which examines the main arguments and prescriptions of the African Green Revolution. Both green revolutions are underpinned by a neo-Malthusian view of the relationship between people and the environment, an issue discussed in Section 2.4. The next section (Section 2.5) examines the Boserupian theory of technological change which offers a different perspective of the relationship between people, food and the environment. The failure of the 1960s green revolution to deliver increased agricultural productivity to resource-poor farmers also led to a shift in technology development with focus on farming systems research and farmer participatory approaches. This is examined in Section 2.6 while Section 2.7 shifts attention from the farm environment to examine political economy critiques of commodification and the increased influence of transnational corporations in the seed sector. Section 2.8 draws on various critiques of the green revolution to make a case for how to examine food, farming and technology changes in Africa's small farming systems.

2.2 The Asian Green Revolution: Its Origins, Implementation and Criticisms

The current focus of agricultural development on enhancing productivity by promoting commercial seeds and chemical fertilisers represent attempts to renew previous programmes of agricultural modernisation in the Third World. More frequently, these interventions are contrasted with the green revolution programmes of the 1960s which mainly targeted Asia and had little influence in sub-Saharan Africa. The following section examines the development of the Asian green revolution, its impacts and criticisms.

Between the late nineteenth and early twentieth century, experiments by researchers in U.S state universities and other public institutions led to the development of hybrid maize. Since this research was publicly funded, information and breeding materials were shared with both public and private entities (Duvick, 2001). However the unique feature of hybrids – that their higher yields can only be achieved by planting fresh seeds every season – gave rise to a commercial seed industry in the 1930s. Thus, the public sector became a critical source of information and breeding materials for a commercial seed industry that would profit from seed production and sales from the 1930s. After the Second World War, cereal yields and production in the United States increased dramatically. This was not only due to the expansion of the area under hybrid seeds, but also the increased application of agro-chemicals – nitrogen fertilisers in particular – in crop production. While nitrogen production as an industrial activity commenced in 1913, its use as a farm input only received widespread attention after 1945. This is because nitrogen production was mainly driven by its use in the manufacturing of explosives in the First and Second World War; in the intervening period between the two wars, demand had been slackened as a result of the U.S depression (Borlaug 2000).

"It is only since WWII that fertilizer use, and especially the application of low-cost nitrogen derived from synthetic ammonia, has become an indispensable component of modern agricultural production" (Borlaug 2000:3). Like hybrid seeds, agro-chemicals also spurred the development of agribusiness as public war infrastructure for producing explosives were privatised and used to produce chemical fertilisers for agricultural production (Amanor 2019:9). From the 1950s onwards, interventions to increase cereal yields and production through the promotion of hybrid technology and chemical fertilisers became the centrepiece of U.S development assistance in the non-industrialised world. This was mainly aimed at countering the growing influence of the Soviet Union (Harwood 2012:117; Richards 2001; Perkins 1997:140-156), and radical national movements that emphasized land reform and the nationalisation of natural resources in the Third World (Amanor 2019). Thus U.S agricultural programmes in the non-industrialised world were also successful in further expanding the market for U.S. agribusiness, and were essential to the establishment of an international system of agricultural research (Borlaug 2007:288). Mexico and India became seminal among U.S agricultural programmes during this period.

In 1944, Norman Borlaug joined a team of biological and agricultural scientists in the newly created Office of Special Studies established by the Rockefeller Foundation and Mexico government to conduct research on the constraints to agricultural production. While the research programme was expected to focus on a relatively wider set of crops (maize, wheat, beans, and potato), wheat evidently took centre stage, hence the description of the programme sometimes as 'the Mexican wheat improvement program'. The main achievement of the research programme was the breeding of 'shorter, stiff-strawed varieties' of wheat.

This development was crucial because it allowed for a greater increase in the amount of fertiliser that could be applied to the new wheat varieties without them falling over as was typically experienced with earlier taller varieties: "The new dwarf varieties were able to stand two or three times as large quantities of artificial fertilizer" (Lionaes & Borlaug 1972:6). Similarly, the new 'semi-dwarf' varieties did not fall over under increased amounts of water and could thus be produced in irrigated fields. The combination of these traits ensured that wheat plants were able to produce more grain. The research from the Mexican programme also made it possible to transfer desirable plant traits between different cereal crops (FAO 2004:12), and to adapt the varieties to different agro-climatic zones other than the geographic locations where they were first developed. Lastly, it was also argued that the newer wheat varieties were more resistant to diseases compared to farmers' varieties. According to Borlaug (2007:290), adoption of the new wheat varieties by Mexican farmers increased yields to 5 – 8 tonnes per hectare, and "Mexico became self-sufficient in wheat production in 1958".

In India, attempts to increase rice and wheat productivity through the development of fertiliser and water responsive seeds began in the 1950s. But initial efforts to develop the required seed varieties seemed unsuccessful, leading to a reliance on Taiwan and the International Rice Research Institute in the Philippines for rice seed (Swaminathan 2003:12). For wheat, the high-yielding varieties were first obtained from the United States and the Mexican programme. In 1965, 200 tonnes of the newly developed Mexican wheat varieties were imported into India, followed by another import of 18,000 tonnes of seed in 1966 (Borlaug 2007:292). Pakistan also received 250 tonnes of wheat seed from the Mexico programme in 1965, and imported an additional 42,000 tonnes in 1967 (Ibid).

In addition to India and Pakistan, the new wheat and rice varieties were cultivated widely in other parts of Asia and North Africa. The adoption of the *modern*, *improved* or *high-yielding varieties* of wheat and rice was described as the "Green Revolution", a term attributed to Dr. William Gaud (administrator of the Agency for International Development, now USAID, between 1966 and 1969).

The dramatic increases in cereal production following adoption of the modern varieties (MVs) became the hallmark of the green revolution (henceforth GR)[2], with wheat production in India increasing from "10 million tonnes in 1964 to 17 million tonnes in 1968" (Swaminathan 2003). Among its proponents and international development organisations, the GR is celebrated for its wide-ranging benefits across multiple sectors and divergent social groups. For example, Serageldin (1999:387) described it as "One of the greatest achievements since the Second World War", while The World Bank (2007:159) referred to it as "one of the major success stories of development." Arguments about the success of the GR have again been underlined by the significant increases in agricultural production that it propelled. For instance, it has been argued that adoption of GR technologies have contributed to half of the increase in agricultural production, which has "more than tripled between 1960 and 2015" (FAO 2017:4). However a more balanced assessment of the impact of the GR is presented by Evenson and Gollin (2003) who distinguish between two phases of the GR.

[2] However, in Southern Rhodesia, the agricultural research of the 1930s which culminated in the development of the SR-52 hybrid maize variety in 1960 clearly preceded the Mexican wheat programme and the Asian Green Revolution (McCann 2011;Eicher et al. 2006). SR-52 was developed under production conditions approximating those of large commercial farmers, although uptake among smallholders was reportedly high. However, high yields resulting from uptake by small farmers has been questioned, and the reportedly high rate of adoption was derailed in the late 1990s and early 2000s as a result of inflation, high seed and input prices, an unpredictable climate and disruptions in seed multiplication resulting from demands for land reform (McCann 2011).

In the first phase of the GR (1961 – 1980), the impacts of the modern varieties were mainly restricted to Asia and Latin America; they contributed 21 percent to the growth in yields, and 17 percent of the increases in production in all developing countries. "Area expansion accounted for about 20% of the increases in production… [while] the rest came from intensification of input use." (Evenson & Gollin, 2003:760). In the latter phase of the GR (1981 – 2000), the contribution of modern varieties to yield growth and production in developing countries was much larger: they accounted for 50 percent of the growth in yield and 40 percent of the increase in production. The contribution of area expansion and other agricultural inputs to increases in production reduced to 18 percent and 43 percent, respectively. The green revolution's impact on cereal production has generally been associated with lowered food prices, increased food consumption and improved nutrition. Thus, it has been argued to help "avert famine and permanent food aid dependence" (Paarlberg, 2008:7). Ehrlich (2009:674) similarly comments that "There is no doubt that millions more people are alive today than would have been in the absence of his efforts [referring to Norman Borlaug]."

The GR is also argued to have resulted in increased farmer incomes and poverty reduction (Paarlberg 2008; Pinstrup-Andersen & Cohen 2000), increased opportunities for employment of non-farm and landless households, and improved wages due to the greater demand for work (Paarlberg 2008). It was also associated with boosting local manufacturing capacity, and the importation of machinery that could not be procured from local sources (Lionaes & Borlaug, 1972). Lastly, it has been argued that the GR contributed immensely to environmental conservation. For example, Borlaug (2007:293) argued that the global cereal production of 1.9 billion tonnes in 2000 was in large part due to the adoption of GR technologies, which helped to save 1.1 billion hectares of land that would have been lost to traditional methods of agricultural production.

Criticisms of the Asian Green Revolution

In spite of the successes often highlighted by its proponents, the Asian GR has also been the subject of much debate. This includes critiques of farmers' greater dependency on input markets and the reliance on credit for that purpose, and high cost and unsustainable government subsidy programmes (Conway & Barbier, 1988:662). The mechanisation of agriculture following the GR has also been linked to the displacement of labour and low wages (Harwood, 2012). Other scholars have also noted that the focus on a few select GR crops was not compatible with cultivation systems in some parts of the developing world, especially Africa (Richards, 2001). With respect to productivity and food production, the impact of the GR is little debated. However increased food production did not address the problems of food insecurity and poverty, especially among children and women. This has primarily been attributed to the neglect of food accessibility, which is mediated not only through employment and wages, but in some cases the cultural ideologies that underlie the differential access to food within households (Harwood, 2012; Negin et al. 2009). Thus hunger continued to be an important challenge in some of the GR countries in spite of increased food production. The GR's impact on food security is also questioned on grounds of the little attention to crops consumed by poorer farmers and the lack of an explicit focus on addressing undernutrition (Harwood, 2012; Negin et al. 2009).

Shiva (1991) argues that the GR, with its focus on a few cereal crops, and the mono-cropping of a handful of varieties of these crops contributed immensely to environmental destruction. She links these arguments of the environmental consequences with the rise in conflicts and violence following adoption of green revolution practices in Punjab. She comments: "two decades of the green revolution have left Punjab ravaged by violence and ecological scarcity. Instead of abundance, Punjab has been left with diseased soils, pest-infested crops, waterlogged

deserts, and indebted and discontented farmers. Instead of peace, Punjab has inherited conflict and violence" (Shiva 1991:11-12). This critique of the green revolution and related perspectives underlie campaigns for alternative forms of farming such as *sustainable agriculture* which "encourages development within agricultural systems, in order to minimise if not totally eliminate, non-renewable external inputs, such as chemical fertilisers and pesticides" (GRAIN 2002:3). In some of the green revolution literature, the environmental effects have been recognised, with their own calls for an *evergreen revolution* "that increases productivity in perpetuity without causing ecological damage" (Swaminathan 2012:8). In some quarters they have been downplayed as undue criticism by environmentalists, although Borlaug himself talked about a *blue revolution* where "water-use productivity must be wedded to land-use productivity" (Borlaug 2000:8).

Perhaps, the most widely shared critique of the Asian GR was its focus on geographic regions with fertile soils, irrigation and other infrastructure and support systems conducive to GR technologies (GRAIN 2002; Chambers 1984). For instance in India, Punjab was described as "the heart of the green revolution" (Agarwal 1984:49). In sub-Saharan Africa, the failure of the GR has mainly been attributed to the "diverse and risk-prone agroecological and socio-economic conditions" (Farrington 1995:131) that dominate farming systems. Small-scale agriculture in sub-Saharan Africa is also characterised by a dependence on rainfall, with important roles for root and tubers and cereal crops such as millet, sorghum and teff which were not the main target crops of the green revolution. Further, in contrast to Asia, there appears to have been little concerted effort to truly bring about a green revolution until perhaps in the 1980s. In addition to the focus on the most favourable geographic regions, GR programmes also benefited large commercial farmers who produced mainly for the market; they adopted GR technologies earlier than other farmers, and benefited from lower input prices since they could purchase large quantities of inputs. However, small farmers who produced for markets

but were unable to adequately adopt GR technologies lost out since increased production lowered prices to levels that were no longer profitable (Evenson & Gollin 2003:761-762).

2.3 Framing of the (New) African Green Revolution

Themes of the African Green Revolution Literature: Population Expansion, Climate Change and Pests and Diseases

The African Green Revolution literature argues that technology adoption (principally hybrid seeds and synthetic fertilisers) is a *sine qua non* for development not only because of currently high levels of hunger and undernutrition, but also projected increases in population which could only compound these problems. For instance, while pointing to the need for seed conservation, and the benefits that can be derived from different plant and tree species, Swaminathan (2012:9) notes that:

> "Because the population is growing rapidly and may reach ten billion by 2050, we are very worried that the population supporting capacity of the ecosystem has already been exceeded in many parts of the world. Indeed, it is a daunting challenge to feed the billions of new mouths without compromising our freedom and security."

In addition to the challenge of producing sufficient food for current and future populations, yields from cereal production are noted to be either stagnating or declining, rendering them incapable of meeting the future demands for food (Shiferaw et al. 2011; Graff et al. 2006). However, the relationship between population and food production goes beyond simple statements about how the growth in agricultural yields are lower than the rates of population growth. Among others, these increasingly nuanced discussions draw attention to fairly recent demographic changes and the considerable implications these have for food security. For instance, Serageldin & Persley (2000) point out that much of the growth in population is expected to occur in urban areas of the Global South. Consequently, an expanding urban population will be depending on a shrinking rural population for its food. In addition,

urbanisation itself, and improvement in incomes in some parts of Asia have also been associated with an increasing demand for a diversity of foods including livestock, fish and milk.

The use of maize as feed in livestock production, in addition to its prominence in biofuel production in the U.S – in search of more environmentally friendly means of generating fuel – could result in higher prices of maize (Shiferaw et al. 2011; Ehrlich 2009). For majority of people who depend on the U.S and other major maize exporting countries, these new developments could constrain supply of a commodity which is a key ingredient in the preparation of diets in sub-Saharan Africa. Shiferaw et al. (2011:308) commented that "maize prices [had] increased by 43% since 2008 and [were] projected to increase in the future in response to increasing demand and constraints for expanding supplies". These neo-Malthusian themes about the need to accelerate the growth in yields in line with population growth pay little attention to issues of access and distribution (Scoones 2002), although they also hardly echo the 'doomsday scenarios' that were so central to Paul Ehrlich's call for population control in the late 1970s (Ehrlich 1978[3], Chapter 1).

Climate change is another key theme of the African green revolution literature. Like population expansion, the African green revolution literature highlights climate change as another important reason to increase agricultural productivity. Studies of climate change suggest that

[3] The cover of *The Population Bomb* reads: "WHILE YOU ARE READING THESE WORDS, THREE CHILDREN ARE DYING OF STARVATION – AND TWENTY-FOUR MORE BABIES ARE BEING BORN." The first two sentences of the prologue also read: "The battle to feed all of humanity is over. In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now." (Ehrlich 1978:xi). While they are not central to his argument of the link between 'overpopulation', starvation and death, it is interesting to note that Ehrlich (1978) recognised the complicity of the United States in preventing land reform in the Global South. In addition, he was sceptical of green revolution technologies because of their high input requirements; in fact, Ehrlich was critical of commodities such as pesticides due to their adverse effects on the environment, insects, and their likely implications for human health. He argued that their production stemmed from the fact that they were a source of profit for agribusiness (See pp. 23-24; 31-35; 40).

countries in the Global South will be heavily affected by climate change impacts (FAO 2017; Parry & Swaminathan 1992). In Africa, the distribution and severity of impacts will vary across space and time. However one aspect of climate change applicable to most of Africa relates to observations and expectations of increasing temperatures (Swaminathan 2012:8). Increases in temperatures without corresponding adequate rains at specific time periods has serious implications for plant growth through loss of soil moisture and increased plant water requirements. This is crucial given that a reliance on rain is an important feature of crop production in Africa, and drought is already recognised as a major cause of low productivity.

In the African green revolution literature, these concerns about uncertainty in rainfall patterns have duly informed recommendations for the development of drought-tolerant crops (Paarlberg 2008:158-159). However, concerns about the impacts of drought on agricultural output has been associated with increasing focus on maize (Thomson 2008:911; Paarlberg 2010:611; McCann, 2011:32; Tripp & Ragasa 2015:4-5), as exemplified by the Drought-Tolerant Maize for Africa initiative, while little attention is given to other cereal crops such as millet (Serageldin, 1999; Pinstrup-Andersen & Cohen, 2000:163). The Intergovernmental Panel on Climate Change (IPCC) has also in its Fifth Assessment Report reported grim findings about the future of cereal crops in Africa based on predictions of unfavourable weather conditions (Niang et al. 2015, 1218-1219). In light of these findings the authors argue that "Given cassava's hardiness to higher temperatures and sporadic rainfall relative to many cereal crops, it may provide a potential option for crop substitution of cereals as an adaptation response to climate change" (Niang et al. 2015, 1218-1219). But this suggestion also fails to recognise the central role of millets and sorghums to livelihoods in some of the more difficult and drought prone environments in the savanna.

Other environmental issues of concern besides climate change include land and water scarcity, and poor quality of soils resulting from salinity and acidity (Graff et al. 2006; Pinstrup-Andersen & Cohen 2000). The paradox is that while yield improvement is suggested as the means to tackle future crop losses resulting from climate change, agriculture itself, together with forestry and other land uses, account for 21 – 26 percent of greenhouse gas (GHG) emissions (FAO 2017). Thus, collectively, agriculture and related activities are among the most significant contributors to GHG emissions, second only to energy. And while it may be argued that a shift towards high-input agriculture may limit the destruction of forests caused by agricultural extensification, it is also important to note that the use of synthetic fertilisers represents one of the important ways through which agriculture contributes to GHG emissions.

Lastly, pests and diseases are identified as another category of factors which underpin the urgent need for an African Green Revolution. Together, pests and diseases are noted to account for significant losses of agricultural produce and revenues for both cash and food crops. Maize yields, for example, depend significantly on the negative effects of the maize streak virus (MSV) and stem borers. According to Wambugu (1999), the former could result in losses of up to 100% while the latter "are the most damaging group of insect pests in maize cultivation" (Shiferaw et al. 2011:317). Striga, a plant which competes with maize for soil nutrients, "infests as much as 40 M ha of smallholder farmland in the region and causes losses ranging from 20% in a normal year to as much as 80% under severe infestation. It affects the livelihoods of more than 100 million people, causing annual crop losses estimated to be worth $1 billion" (Thomson 2008:910). In another instance, Thomson (2008; 2006) has pointed to how the outbreak of the Cassava Mosaic Disease in Uganda led to nearly total yield losses in the 1990s, and how the disease eventually spread to other African countries. In Kenya, banana yields are also determined by diseases and pests such as black and yellow sigatoka and weevils (Wambugu et al. 2011). Putting aside their current effect on crop productivity, it is expected that the role of

pests and diseases in reducing crop yields will increase in the future as temperature increases expected under climate change will provide the weather conditions more suitable for their growth and spread (Niang et al., 2015:1221; Negin et al. 2009:357).

The Route to the African Green Revolution: Commercial Seeds, Chemical Fertilisers, and Private Markets

Current analyses of agricultural development reflected in the African green revolution do more than give justifications for the crucial role of increased agricultural productivity in addressing hunger and poverty in Africa. They, in addition, articulate a particular pathway through which these goals are to be achieved, namely, through the increased adoption of commercial seeds, chemical fertilisers and other agri-inputs. Thus, agricultural interventions formulated within this framework focus on the design and implementation of systems which enhance physical and economic access to inputs, and prevent delays in the distribution and application of these inputs. Malawi's Agricultural Input Subsidy Programme, which from 2005 involved the provision of subsidised input to farmers has come to symbolise the African Green Revolution. Due to the substantial increases in maize production associated with the implementation of this programme, it is sometimes used as evidence of a success story that can be replicated in the rest of Africa (Denning et al. 2009).

Due to the liberalisation of African economies in the 1980s, current interventions for enhancing agricultural productivity also stress a central role for private markets. As noted by Toenniessen et al. (2008:236) regarding the Rockefeller foundation's decision to increase the scale and scope of its agricultural programmes in Africa, "The program strategy is based on a rather simple theory of change referred to as "market-led technology adoption." While a general

reference is made to both input and output markets, the former appears to be the main source of attention, and the primary goal is to ensure greater physical access to seed and input markets. Emphasis is placed on rural farming communities where there remains limited presence of input companies and agricultural services in many parts of Africa after the liberalisation of agricultural services in the 1980s. There is an expressed intention to increase the number of African seed companies through various financing mechanisms that enable seed companies of various sizes to gain access to the finance needed to commence or expand already existing seed production operations (Toenniessen et al. 2008; Tripp & Ragasa 2015).

The critical role of the private sector is again reflected in the attention given to 'agrodealers' and 'agrodealer networks' in current agricultural interventions (Scoones & Thompson 2011; Denning et al. 2009; Toenniessen et al. 2008). Consistent with the promotion and strengthening of local seed companies, agrodealers reflect the greater role for markets and the private sector. Agrodealers operate retail shops in rural communities where they sell seed and other inputs which have been specially packaged into quantities that farmers can afford. They are organised into groups for the purposes of group purchasing from local seed companies, and group borrowing from financial institutions. They are expected to receive training from local Non-Governmental Organisation (NGOs) in relation to the operation and management of small businesses and specific training relating to agricultural production. Thus, beyond performing the conventional roles associated with the market, agrodealers are also being trained to take on functions such as the provision of extension services which are mostly reserved for state institutions. When Malawi initiated implementation of its input subsidy programme in 2005-2006, the national government was the main financier of the programme. In subsequent years when donors decided to provide support to the programme, "they argued for increasing the participation of the private sector, especially the agro-dealer network" (Denning et al. 2009:0005).

Indeed, within the dominant paradigm, the role of the private sector remains crucial to the extent that in the case of Ethiopia where interventions in the country's wider agricultural sector have resulted in improved productivity and economic growth (Alemu 2011), the dominant role of the state and limited private sector participation is viewed as a weakness that needs to be remedied.

Ejeta (2010:832) comments that:

> "In East Africa, Kenya and Uganda have done well in their investments to strengthen their educational institutions and in encouraging private-sector investments. The emergence of a number of small but functional private seed businesses in these two countries is one of the more encouraging developments in African agriculture in the past several years. Ethiopia has made more substantive and sustained investments in its agricultural research and development enterprise than any other country in Africa. It has developed its agricultural research infrastructure and created a large army of agricultural extension agents. However, Ethiopia has not encouraged the development of its private sector initiatives."

While the private sector is expected to play a critical role in enhancing agricultural productivity, some commentators have raised issues with its lack of interest in pursuing research and investments that it does not consider to be profitable, but are crucial to the livelihoods of poor and small farmers (Serageldin 1999; Pinstrup-Andersen & Cohen 2000; Serageldin & Persley 2000). This, together with the private sector's stringent control of knowledge and products through intellectual property rights have informed calls for public-private partnerships.

2.4 The Theoretical Basis of The African Green Revolution's Approach to Food Security and Poverty Reduction (Alleviation)

Like the Asian green revolution, the African Green Revolution's emphasis on increased food production as the most important approach for addressing the problems of hunger, malnutrition and well-being in the Third World is derived from a particular formulation of the relationship between population, human well-being and the environment that can be traced to the classical economists, and to Thomas Malthus in particular.

From the Malthusian point of view, the population of an area increases at a rate that is faster than the rate of food production. This results in a situation in which available food supplies are only sufficient to meet the needs of some people, while many others are left without it. This, according to Malthus, distorts the balance between population and food, which then has to be restored through 'misery and vice'.

Thus, population size is the most important determinant of human welfare above all other factors, and attempts to address welfare challenges through such measures as taxation of the rich and social policy exacerbate rather than improve the problems. Thus, for Malthus, the main answer to 'misery and vice' seemed to lie in population control, which in eighteenth century Europe was achieved through delayed marriages. From the Malthusian point of view, the low standard of living associated with high population is also the result of the impact of population growth on land and the natural resource base in general. Informed by strong assumptions of the physical limits of land and environmental resources, neo-Malthusians argue that available land resources can only serve a certain number of people, and population increases beyond this number leads to land scarcity, declining output and environment destruction (Leach & Mearns, 1996).

John Stuart Mill (1871:194-202; 236-246), another Classical Economist, sometimes suggested that the greater demand for food resulting from population growth could be met through an increase in the number of working hours and 'improvements'[4] in techniques and land quality (these issues are central to Ester Boserup's theory of technological change and will be discussed later). On the whole however, Mill strongly shared Malthus' view of the relationship

[4] "Improvement must here be understood in a wide sense, including not only new industrial inventions, or an extended use of those already known, but improvements in institutions, education, opinions, and human affairs generally, provided they tend, as almost all improvements do, to give new motives or new facilities to production" (Mill 1871:239).

between population and human well-being: “The increase of labour is the increase of mankind; of population. On this subject the discussions excited by the Essay of Mr. Malthus have made the truth, though by no means universally admitted, yet so fully known” (Mill 1871:197).

Mill’s shared views with Malthus includes his affirmation of the tendency of population to double itself every 20 or 30 years, where the resources to support it are available, and how the expansion in population is eventually reduced by starvation, war and disease. Thus, land scarcity – and its obstacle to sufficient food production – is the main factor that limits population growth. Mill considered restraint, exercised either by the individual or as state policy, as the more effective approach to solving the problem of scarcity. Similar to Malthus, he asserted that the possibility of improving living standards through restraint seemed only applicable to those in the middle class, while any attempts to raise the standards of those in the labouring class had to be sought through other ‘improvements’.

Scoones et al. (2018:3) have contrasted Malthusian views of scarcity with a ‘relative’ conception of scarcity by David Ricardo that places emphasis on land quality, ‘financial capital’ and technology. Ricardo, had also pointed to the role of unemployment and low wages in restricting access to food even in a context of high food availability (Sen 1990:40). In general, however, Malthusian views have had a great influence on debates about development and the environment, and they have co-existed with similar ideas in other disciplines outside of the social sciences.

2.5 Overturning Malthusianism: Boserup's (1965) 'Conditions of Agricultural Growth'

In *The Conditions Of Agricultural Growth: The Economics Of Agrarian Change Under Population Pressure*, Boserup (1965) draws on the disciplines of history, anthropology, and farm management studies to examine experiences of agricultural change in Western Europe and the Third World. While maintaining the centrality of population growth to economic development, Boserup challenged the dominant view of the inverse relationship between the two, and argued that a 'moderate' and 'sustained' increase in population is the main factor that spurs agricultural change and economic development, i.e. population growth creates dynamics that result in technology development.

Boserup mainly examined the impact of population growth on agricultural change in relation to changes in cropping frequency, which are in turn accompanied by changes in agricultural techniques and tools. In areas of low population density, land use is extensive: thus, under forest fallows, an area is cultivated for only 1 or 2 years and is left to fallow for 20 – 25 years. However population growth results in a change towards increased cropping activity, and cultivation becomes dominated by bush fallowing where the fallow period is shortened to only 6 – 10 years. Further increases in population give rise to short fallows that last for only a few years, followed by another phase of annual cultivation where land is left for only a few months between the cultivation and harvesting of crops. Under multi-cropping (the most intensive of the cultivation systems), "the same plot bears two or more successive crops every year" (Boserup, 1965:9). In the changeover from extensive to intensive cultivation, the population that is added is used to undertake activities such as fertilisation using animal manure, irrigation and terracing. These activities help to prevent declines in output that were secured under the previous cultivation system.

However, the change from long fallow to more intensive cultivation does not necessarily imply a dramatic (one-off) transition as the new system often evolves along with the old one. Thus in the transition from short fallow to annual cropping, the added population is used to undertake activities such as "ploughing, irrigation and weeding" on those parts of the farm with the best 'natural conditions', while the remaining land – often of lower quality - is reserved for grazing or used to produce pasture for draught animals. From the Boserupian point of view, population growth does not only lead to changes in cultivation systems, the types of tools and crops that are cultivated, but also has wide ranging impacts on other aspects of economic and social life, including changes in settlement patterns and working habits. Lastly, Boserup argued that changes in cultivation systems associated with population growth are in turn correlated with different forms land tenure, and investments in land.

Tiffen and Mortimore (1994) applied the Boserupian perspective to explain farmers' investment decisions and changes in technology in the Machakos district of Kenya – a semi-arid area with two rainy seasons that experienced rapid population growth between 1930 and 1990. In so doing, the authors also countered Malthusian views of the negative effects of high population growth on agricultural production and the environment. Thus, instead of a decline, the authors argue that increased population density in the Machakos district was generally associated with considerable increases in the volume and value of agricultural output, and per capita income. This was achieved principally through terracing, and a host of other investments in soil and water conservation. While the government, foreign donors, and local organisations provided initial support for the investments, local changes to the terracing technology and the major costs associated with the investments were borne by the farmers. The investments not only improved maize and legumes yields, but also enhanced the cultivation of coffee and horticultural crops for markets.

The added population was also a source of labour for other activities in the Kenyan economy, and incomes derived from such wage earning work were used to buy food. Tiffen and Mortimore (1994) argue that farmers' willingness to make the investments necessary to improve livelihoods in contexts of rapid population growth could be greatly enhanced by effective government investments in road (transport) infrastructure, and human capital developments ranging from a combination of efforts to improve education for school-aged children, to investments in local extension services and national agricultural research.

2.6 The Farming Systems and Participatory Research of the 1970s and 1980s

The study by Evenson & Gollin (2003) previously referred to highlighted a crucial role of modern varieties to yield improvement and production in the developing world generally, especially from the 1980s. However, in some difficult farming environments of the developing world, modern varieties did not produce exceptionally high yields, and there was also low adoption of such seeds and other modern technologies among some farmers. These challenges highly reflect sub-Saharan Africa's experience of the green revolution. Thus, in contrast to the developing world as a whole, the figures by Evenson & Gollin (2003:760; Table 1) point to a negligible role of modern varieties to yield and crop production in sub-Saharan Africa in both phases of the green revolution. Between 1961 and 1980, MVs contributed only 8 percent to yield growth while the remaining 92 percent was accounted for by other inputs. Further, they represented only 5.7 percent of production while area expansion and other inputs accounted for 31 percent and 63 percent of production, respectively. In the second phase (1981-2000), MVs contributed 15 percent to production, while area expansion accounted for more than 80 percent of production.

Among agricultural scientists and within the international centres of agricultural research[5], the limited uptake of GR technologies by small and 'resource-poor farmers' led to a focus on Farming Systems and Participatory research in the 1970s and 1980s. Farming Systems Research (FSR) argued that resource-poor farmers were rational decision makers, and that their reluctance to adopt modern technologies was not due to ignorance or some other cultural factors, but was part of their attempts to manage risks within their local and complex natural and socioeconomic environments (Simmonds, 1986; Norman & Collinson, 1985). Thus, the overarching goal of farming systems research was to improve the well-being of resource-poor farmers through a focus on their needs, crops, and conditions (Dillon et al. 1978).

In contrast to the *reductionism* of *disciplinary and commodity research* that predominantly focus on bio-physical factors such as seed, water and soil, FSR views the farm as comprising of a broader range of components (social, biological, technical and managerial) and examines the interactions between these sub-systems. With respect to the difference in the methodological approach between commodity and farming systems research, Dillon et al. (1978:9) comment:

> "[The] traditional approach is generally disciplinary focused and emphasizes a positive stance of "understanding what is" so as to solve problems. In contrast, the systems approach is more oriented to be conditionally normative. It involves specifying a target and assessing alternative ways of reaching it. This implies both an expansion of knowledge (how to reach the target) and problem solving"

Farming Systems Research also takes a slightly different view of technology and agricultural productivity: "*Effective technology choice* for small farmers in Africa is the only means of improving their productivity" (emphasis mine) (Norman & Collinson 1985:16). Similarly, its

[5] Ceccarelli & Grando (2019) trace the emergence of participatory research ('participatory plant breeding') to the international centres of agricultural research. Paul Richards however emphasises that calls for attention to local conditions, and a greater collaboration between farmers and agricultural researchers in West Africa started with civil servants of the colonial administrations in West Africa (Richards, 2001; 1983).

aim is to achieve "*sustainabl[y]* increased agricultural productivity" (emphasis mine) (Dillon et al. 1978:17) through the development of *relevant* and *improved* technologies. As a result, farmer participation is crucial to technology development, with the expectation that farmers will adopt the technologies. While research in experimental stations is not totally excluded in FSR, there is an increased role for farmers in technology development through 'on-farm trials'. This involves the testing of technologies by farmers in their own agro-climatic and socioeconomic environments, which provides both farmers and researchers with an opportunity to share ideas about how to further improve technologies. Norman & Collinson (1985) further argue that on-farm trials should also be supported by policies that enhance technology uptake. In contrast to on-farm trials where farmers assess the technologies initially developed by research scientists, Dillon et al. (1978:19) suggest that the process of technology development could also proceed from the bottom.

In this case:

> "FSR is seen as a major asset in constraint determination, problem identification and subsequent analysis, which in turn can both assist research institutions to focus more clearly on key problems currently facing, or likely to face, producers and assist policy makers in the formulation of agricultural development policies."

While the goal to develop farm technologies acceptable to poor farmers can be primarily met through time-consuming research, a combination of factors contributed to the demise of farming systems and participatory research in 1980s. A review of some programmes in Eastern and Southern Africa by Norman & Collinson (1985) indicate that FSR was hindered by some of the leadership of agricultural institutions who were uncertain about its importance. Related to this were challenges in recruiting personnel with interest in pursuing FSR work. Crucially, funding for agricultural research by donors and African states in the 1980s declined considerably in the midst of structural adjustment (Amanor, 2010). Lastly, Ceccarelli & Grando (2019) have recently argued that the lack of participatory research in plant breeding does not

arise from concerns of workability, but that they raise questions about whether agricultural researchers can claim ownership of new seed varieties if farmers are involved in the seed development process.

2.7 Political Economy Perspectives on Plant Breeding and Seed Commercialisation

Within the large body of research on seeds and agricultural technology is the political economy literature. This mainly shifts attention from the farm environment and emphasises the linkages between technology development, commercialisation and the development of agribusiness. A significant contribution to this literature is Kloppenburg's (2004) historical study of plant breeding in the United States, which examined changing relations between the public and private sectors as a result of scientific developments, government policy, and the development of agribusiness. The study argues that prior to the 1930s, the public sector exercised significant control over agricultural research and seed production: this included the collection of germplasm from all corners of the world, the establishment of institutions for agricultural research, and direct involvement in the production and marketing of quality seed at prices that farmers could afford, without restrictions on the saving and exchanging of seeds.

However, the influence of the public sector diminished rapidly from the 1930s primarily through a social division of labour and allocation of public resources. The activities of public agricultural institutions became restricted to basic research, while government funding for applied research was directed to the private sector. Kloppenburg (2004) argues that this social division of labour, and the corresponding distribution of resources ensured that the private sector was able to appropriate public sector research and transform it into the production of

commodities for the market[6]. The highlight of this change in relations between the public and private sectors was the development of commercial proprietary hybrid maize in the 1930s. Through hybridisation, seed production became an important enterprise for the realisation of profits by commercial interests.

In *Stealing into the wild*, Montenegro (2016) argues that primitive accumulation and commodification are being extended to Crop Wild Relatives (CWR) – the wild relatives of currently cultivated crop varieties. Within the context of anticipated challenges to agricultural production due to climate change and pests and diseases, CWR have been identified as possessing traits that can be resilient to climate change and enhance agricultural production. A new attention has thus been brought to the conservation of CWR, where 'in-situ' (conserving plants in their natural environments) and 'ex-situ' (conservation in seed and gene banks) methods are no longer seen as opposing but 'complementary'. Montenegro (2016) argues that in spite of the importance attached to both methods, conservation on the whole is tilted toward the 'ex-situ' method. As a result, conservation makes available genetic material which can and are used by breeders and the biotechnology industry for developing new crop varieties. The ability to extract commercial benefits is central to conservation efforts within CWR, but this effectively aligns the crops and sites that are targeted for conservation with the interests of industrial agriculture. This effectively marginalises farmers, indigenous knowledge and local farming systems that are not integrated into industrial agriculture.

In the political economy literature, advances in plant breeding are associated with the increased role of the private sector in research and commercialisation of seeds. This development is

[6] Following Kloppenburg (2004) on the supposed separation between basic and applied science – with the latter being closer to the market and private industry – Amanor (2010a) points to how attempts to restructure the Ghanaian seed sector during structural adjustment focused on a determination of functions in which the public sector would be responsible for the production of breeder and foundation seeds, while control over production of certified seeds would be left to the private sector.

commonly traced to the production of hybrid seeds in the 1930s which constituted a turning point in seed breeding. However, the literature also argues that alongside technical sophistication has occurred promulgation and implementation of Plant Breeders Rights – a specific form of intellectual property rights (IPRs) – which justify the need to reward private seed corporations through 'royalty payments' or 'technology fees'. IPRs are central to claims of exclusive ownership of products and processes, which have further strengthened the dominant role of transnational corporations (TNCs) in the seed industry (FAO 2004:31). In the U.S. IPR legislation specifically targeting agricultural crops is traced to passage of the 1930 Plant Patent Act. However, this act applied to *asexually produced* agricultural commodities but not cereal crops (Roberts 2003). Subsequently, IPRs were extended to cereal crops through the 1970 Plant Variety Protection Act (PVPA). However, consistent with the International Union for the Protection of New Varieties of Plants (UPOV) Convention, *"farmers [were] allowed to save seed for their own use (but not to sell the seed), and public-sector scientists [were] allowed to conduct research and develop innovations using patent-protected varieties"* (emphasis mine) (National Academies of Sciences 2016:318).

These exceptions granted by the PVPA to farmers and scientists in public research institutions do not apply to seeds of genetically modified/engineered (GM) crops. This is because the approval and sales of GM seeds from the 1990s coincided with the implementation of 'full utility patents'. Under 'full utility patents', it is not only illegal for farmers to sell and exchange seeds, but to save them as well. In addition, researchers in public institutions cannot conduct research on the 'inventions' or 'discoveries' of private corporations without permission granted through arrangements such as licensing agreements. This is occurring at a time when funding

for national and international public research institutions have significantly reduced[7]. Worse, 'full utility patents' appear not to be applicable to GM crops alone, but to 'conventional' hybrids as well. According to the United States National Academies of Sciences (2016:319) "there was an ongoing contestation over the validity of utility patents on non-GE crops until 2001 when the U.S. Supreme Court in J.E.M. Ag Supply v. Pioneer Hi-Bred endorsed the application of utility patents to newly invented or developed GE and *non-GE crop varieties*" (emphasis mine). Further, the National Academies of Sciences commented that: "In 2015, the legal constraints were such that when a crop invention— GE or non-GE—was patented, users had to pay a licensing fee or otherwise gain permission for the right to plant it and to conduct research on it." (2016:321).

Criticisms of patents (which have also been linked with high seed prices), and the fact that they prohibit farmers from freely carrying out practices that have always been part of their production processes are ignored, downplayed or justified by some proponents of the productivity literature. Such viewpoints, and critiques of agribusiness more broadly, are characterised as part of the ploy deployed by the "anti-biotechnology" groups to prevent the approval and eventual adoption of GM crops in Africa. In spite of this, the consequences of patent infringements by small farmers and researchers of public institutions are quite clear and recognised more widely. The granting of patents and recognition of breeders rights through plant variety protection reflect the comparatively wide scope of commercialisation of agriculture in the global North. As was noted earlier, in the United States, this dates back to the passage of the Plant Patent Act of 1930 while the protection of plant varieties in Europe took the form of the Convention of the International Union for the Protection of New Varieties of

[7] "$1.5 billion spent each year by private global plant science research companies. The CGIAR is only spending around $40 million of its $450 million budget on biotechnology research for crops and livestock in 2005." (Eicher, Maredia, & Sithole-Niang 2006).

Plants – the first version of which was adopted in 1961. Over the past 25 years, many countries in the South have also sought to introduce IPRs into agricultural research and development. But this development is not the result of individual or collective action of countries in the South; rather, it arises from undue pressure from countries of the North and their institutions. For instance, the application of patents and variety protection is primarily expected to occur through implementation of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization (WTO).

With the adoption of TRIPS in 1994, 'least-developed countries' were given up to 11 years to design and implement an IPR system for plant varieties – or in the case of existing regulations – to ensure that these were harmonised with the TRIPS agreement. However the inclusion of IPRs as an important agenda of the WTO in the Uruguay round of negotiations was primarily driven by the United States. According to Yamin (2003), TNCs based in the United States – which were initially responsible for the extension of IPRs to the diverse sectors of that country – were also behind the incorporation of IPRs into global trade through TRIPS. Concerning the influence exercised by the South in the TRIPS negotiations, she notes that "it is clear that few developing countries were properly represented at the meetings at which TRIPs was finally agreed, few fully understood the implications of the TRIPS agreement at the time of its signature and fewer actually agreed with its content" (Yamin 2003:7). In addition to TRIPS, countries of the North rely on other mechanisms outside of the WTO to further impose IPRs in the agricultural sectors of the global South. The World Bank itself recognises that "North-South bilateral and regional trade agreements often put pressure on developing countries to adopt even stronger protection— such as that based on the 1991 Convention of UPOV, which makes selling and exchanging seed of protected varieties illegal" (2007:167). TRIPS is heavily criticised as an agreement that enables TNCs to appropriate value and gain ownership rights of

seed varieties developed by farmers, allowing them to further restrict farmers practices of saving and exchanging seeds (Amanor 2010a; Shiva 2014). The World Bank claimed that protections for seed varieties had had limited influence in the South "mainly because the IPRs are still under development in most countries" (2007:167). However, in Malawi's national input subsidy programme, the lack of IPR was used as a justification by TNCs (which were in charge of supplying seeds for the programme) to sideline national agricultural research institutions as a source of breeder seed (Chinsinga 2011).

In contrast to TRIPS and the 1991 version of the UPOV are several international conventions and treaties in which the recognition of farmers' rights is paramount. These include the United Nations Convention on Biological Diversity (which the United States refused to ratify (Yamin 2003)), and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA 2001). But even these appear to be weak and ineffective concerning the restrictions on saving and exchanging of seeds. As for the ITPGRFA, Golay (2017:3) comments that it "has not been interpreted as obliging states to protect farmers' rights at the national level, and the overwhelming majority of states have not adopted domestic legislation for that purpose". Regarding the same treaty, Kloppenburg (2004: xiii) notes that: "There is recognition of "Farmers' Rights" in principle, but of intellectual property rights in practice. The treaty is harmonized with the requirements of the World Trade Organization (WTO), but not with the interests either of peasant farmers or indigenous peoples". Shiva (2014) even suggests that TRIPS supersedes national legislation.

Howard (2015; 2009) argues that the granting of patents to private corporations involved in cereal seed research and production in the 1970s resulted in the entry of TNCs with origins in the pharmaceutical, chemical and oil industries into the seed industry. This process intensified with the approval of GM crops in the 1990s. As such the issue is longer of the role of private

actors in the seed industry, but of the types of private actors involved in the industry and the implications of these for costs of seeds and rights of farmers. Previously constituted by 'small, family-owned firms', the seed industry is now dominated by agribusiness with a considerable degree of 'consolidation', or 'seed market concentration'. "From 1996 to 2013…the top 10 seed firms fully subsumed nearly 200 seed companies and purchased equity stakes in dozens more" (Howard 2015:2492). Due to mergers and acquisitions occurring from the 1990s onwards, the seed industry is now dominated by a small group of TNCs described as the 'big six' namely: Monsanto, DuPont, Syngenta, Bayer, Dow and BASF. In June 2018, Bayer reported that it had "successfully completed the acquisition of Monsanto" and that it was "the sole owner of [the] Monsanto Company." (Bayer 2018:1). "…just three companies controlled 85 percent of patents on GE maize in 2008, and three companies controlled 70 percent of patents on non-maize GE crops…" (Glenna and Cahoy 2009 cited in National Academies of Sciences). According to National Academies of Sciences, "That constitutes substantial concentration" (2016:325).

The introduction of GM crops is symbolic of global-local linkages. The phenomena of patents and agribusiness expansion which have become defining features of agricultural production in the U.S., Europe and Japan are also rapidly taking shape in the Global South. Within Africa, South Africa is expected to play a significant role in this trajectory of the global domination of agriculture by a few TNCs. Within South Africa itself, there has been considerable consolidation of agribusiness, a process which intensified with the end of apartheid, and the commencement of liberalisation and multiparty democracy from 1994 onwards (Bernstein 2013).

Liberalisation has allowed TNCs to move into South Africa. The seed market was in the recent past dominated by three companies namely, Panner, Monsanto and Pioneer. Among these, Panner – with presence in 19 African countries, as well as other countries in the North and global South (Bernstein 2013) – was a South African company, while the other two were based in the United States. Monsanto was able to gain entry into the seed market and now controls a significant share of that market partially due to its acquisitions of Sensanko and Carnia, two local South African companies, (Paelo et al. 2018; Bernstein 2013). In May 2012, Pannar merged with Pioneer. That merger was justified on the grounds that Pannar was increasingly losing its ability to compete with the other major players in the market due to its lack of "advanced breeding technologies". These were technologies that Pioneer had access to, and a merger of the two firms was viewed as complementary as Pannar had access to the local germplasm needed for breeding seeds suitable to the agroecologies of South Africa and perhaps its neighbouring countries. That justification was initially rejected by the South African Competition Commission and Tribunal due to concerns that the merger "would result in a duopoly and significant price increases, incentivise collusive behaviour and raise barriers to entry." (Paelo et al. 2018:10).

However, the merger was eventually granted as a result of an appeal filed at the South African Competition Appeal Court. One of the conditions of the merger, among others, was that increases in prices of Pannar products would not exceed the rate of inflation within three years of approval of the merger. Paelo et al. (2018) conclude that this condition was strictly adhered to after implementation of the merger and would probably had not been the case if restrictions on price increases had not been determined by the court. What remains to be seen is the changes in prices after the 3 year period set by the court expired. Meanwhile, South Africa is viewed as the lever through which TNCs can gain access to the larger African market (Amanor 2019;

Hall & Cousins 2018; Bernstein 2013). South African agribusiness is moving out to other African countries as a result of "constrained domestic demand due to high levels of unemployment and poverty and stagnating growth…" (Hall & Cousins 2018:12). Favourable trade policies have enabled the movement of these enterprises primarily to countries in Southern and East Africa, due to South Africa's membership of the Southern African Development Community (SADC) and the Common Market for East and Southern Africa (COMESA). But the expected trend is that South African business will be able to move to Africa more broadly. Accordingly, "There has been…a displacement of local seeds by South African products" (Amanor 2019:16).

2.8 Looking Ahead: Conceptualising Technological Change in Africa's Small Farming Systems

In contrast to the focus on productivity-enhancing inputs highlighted in mainstream agricultural policy, this study argues that the analysis of poverty and food insecurity in rural areas requires the consideration of a wide range of factors. Even where there is a clear change in technology in favour of commercial inputs, it is important to examine the specific local factors that drive these changes (patterns), as opposed to a universal explanation of poverty and food insecurity based solely on the lack of adoption of modern inputs. But, in addition to factors that favour or constraint production, agriculture is also characterised by social and gender relations that have important implications for the well-being of different groups of farmers. To address the roles of these varying factors, this study draws on the following concepts: the social and gender relations of production, the effect of agro-climatic conditions and population pressures on cropping patterns using the Farming Systems Research approach and Boserupian theory of technological change, respectively, and the 'politics of seed policy' approach that

provides a set of questions for examining green revolution interventions (Scoones and Thompson 2011).

i) Social Relations of Production

Thus, an important starting point for the analysis of these issues in Africa is the integration of the region into the world economy during the colonial period. This has been demonstrated to have taken different forms in different parts of the subcontinent. Thus, in Eastern and Southern Africa, European mining and large scale agriculture were based on the dispossession of the indigenous African population, who then become the source of labour for productive activities (Amin 1972). In the case of the colonial trade economies of West Africa where export-oriented agriculture was emphasised, the supply of labour was guaranteed from "internal migrations from regions which were deliberately left in their poverty so as to be used as labour reserves" (Amin 1972:520). In Ghana, this pattern was strongly reflected in the establishment of native authorities in the early part of the twentieth century, which increased the control of chiefs over land. Chiefs and lineage heads in the parts of southern Ghana with the ecological conditions conducive for cocoa production sold or gave out land to migrant labour for sharecropping arrangements. In contrast, colonial subjects of the northern territories who were required to pay taxes under British colonial policy were organised by their chiefs as migrant labour for mining and cocoa producing areas in the south (Amanor 2010). Current patterns of agricultural production, investments in economic and social infrastructure, and differences in wellbeing between northern and southern Ghana still greatly mirror the integration of Ghana into the world economy in the nineteenth century. The integration intensified social differentiation and the social relations of production that existed prior to the colonial period. However, these issues are generally neglected in mainstream agricultural policy, which mainly attribute food insecurity and poverty in Africa to the lack of adoption of modern agricultural technologies.

The concept of social relations also brings to the fore issues such as the extent to which farmers are subsistent producers or are rather more involved in petty commodity production. More explicitly, it addresses the issue of the control of means of production, the wage-labour relation, and examines the processes by which one group of people are able to get others to work for them, and how the gains made from the sale of surplus produce is shared among these different classes in society. The following quote by Mooney (2019:263) is instructive for the analysis of the social relations of production:

> "Thus, four criteria form the basis for the development of a theoretical model of class structure in agriculture. First, the appropriation of surplus value from direct producers via relationships which traverse household or immediate family boundaries indicates a proletarianization process. The retention of surplus value within the household or family indicates the reproduction of simple commodity production. The direct producers' control over the physical means of production and investments indicate petty bourgeois class location. Loss of such control implies proletarianization. Finally, control over the labor power of others indicates transformation toward the capitalist mode of production with the party exercising control being nearer a capitalist class location to the extent that direct production is performed by hired labor."

Mooney (2019) further emphasises the analysis of tenancy arrangements (in which the farm operator has to pay rent to the landlord, and has limited control over the type of commodity and quantity to produce); debt (and its accompanying interest payment); contract farming (associated with varying levels of loss of control over production decisions and means of production); off-farm work (especially when this provides additional income to farmers who continuously face the problem of how to meet their basic needs); and hired labour (where capitalist farmers mainly rely on the labour of others).

ii) Feminist Analyses of Agrarian Change

However, feminist scholars argue that gender relations are deeply embedded within these social relations of production, although they are often unaddressed in much of the agrarian relations literature. Razavi (2009) outlines some of the critical gender issues that should inform analysis of the social relations of production, including the following: (a) women's preeminent and heavy social reproduction roles, which is unpaid but is the source of labour for productive activities; (b) the unequal distribution of land and other household resources, usually at the expense of women; and (c) women's overrepresentation in the low-earning and precarious segments of the informal economy. Within feminist scholarship itself, there are conceptual and methodological differences in how these issues should be handled in social research. For example, with respect to household members' contribution to different activities (including care work) and questions of access to or ownership of productive resources, one important approach is to use structured questionnaires to identify, collect and analyse data on the individual men and women within the household (Doss 2013). One merit of this approach is that it allows for the analysis of relations within the household, as opposed to the case where the household head is used as the unit of analysis. Data is also collected on specific farm plots, and the crops and technologies adopted by individual household members on these plots. As a result, sufficient attention is also given to women's productive activities. Ultimately, this framework serves the purpose of identifying the challenges that women face in agricultural production, and the strategies that can be implemented to bring their agricultural performance to the level of men. The framework is also useful in addressing the issue of a unitary household model that is devoid of power relations and unequal distribution of household resources.

However, these same strengths are the subjects of criticisms by other feminist scholars. For example, Okali (2012) argues that a rigid application of this framework ignores the different contexts and complexities of society, and women's changing social positions throughout their life cycles. She and other scholars argue for "a social relational gender perspective" that analyses "the entire structure of society, and all relations between men and women within it" (Okali 2012:3, 4). Both the 'gender roles' and 'social relations' frameworks are used in this study – not as competing frameworks – but as 'tools' with different merits and limits but which together are important for understanding gender relations. In addition, the attention that feminists draw to issues of kinship and inter-generational relations, and patron-client and host-migrant relations among others (Tsikata, 2015) could perhaps be seen as part of the continuum of the social relations approach to gender analysis.

iii) The 'Politics of Seed' Literature: The Role of the State, Markets, and Non-State Actors (e.g., Donors, Transnational Corporation, NGOs, etc.)

In mainstream agricultural policy discourses, the role of commercial seeds and other agro-inputs for increased food production is often portrayed as the result of a technocratic evaluation of African agriculture. In policy debates, this has been effective in shifting attention from the different interests and actors in seed policy, and the purposes that agricultural programmes ultimately seek to serve. Two studies from Ethiopia and Malawi help to illustrate the relevance of perspectives centred on the different actors involved in seed policy. Alemu's (2011) study of Ethiopia shows that the formal seed sector has been the target of regional policies and donor interventions aimed at increasing the supply of improved seeds in order to increase crop productivity. Perhaps the most important finding from this study is the significant influence that the state wields in the formulation and implementation of seed policy. A case in point is the Crash Seed Multiplication Programme – which among other things – seeks to supply hybrid maize seed to farmers.

The programme is dominated by the state from planning all the way to the use of state farms in the production of certified seed. Ethiopia has a history of state-led agricultural programmes that equally applies to the seed sector and has not diminished in spite of the involvement of donors and the private sector. The Ethiopian state looms large even when private sector participation is encouraged; restrictions are clearly delineated, with the private sector relying on the state for basic seed and also following its directives in determining seed prices. The role of transnational corporations in the Ethiopian seed sector is limited due to regulations about the "repatriation of foreign currency" (Alemu 2011:74). There is a keen interest by politicians on developments in the seed and agricultural sector, as the improvements in welfare resulting from agricultural growth are tied to political legitimacy. The author comments: "In practice, despite the policy rhetoric and profile, the private sector remains weak and fragmented, and state interests – particularly those which are centrally directed with a strong political push – continue to dominate the formal seed sector." (Alemu 2011:74).

In Malawi, agricultural support has similarly focused on hybrid maize to the neglect of other cereal crops since the late 1990s. In contrast with Ethiopia, implementation of Malawi's Agricultural Input Subsidy Programme (AISP), which commenced in 2005, has been an important source of profit to the transnational corporations that dominate the seed market. It has also furthered the interests of local elites and large commercial farmers who participate in the programme as retail distribution agents, or as seed growers for the transnational companies (Chinsinga, 2011). Thus, Malawi's AISP highlights a confluence of interests of the state, donors, private sector and NGOs. The state, having withdrawn its funding for seed research, production, and marketing, prefers to invest in input subsidies whose products are supplied by the transnational companies; it goes along with the market-oriented approach promoted by donors and the private sector in a bid to ensure continuity in the distribution of inputs that have become so central to the country's electoral politics.

These studies from Ethiopia and Malawi highlight the ways in which farmers are integrated into commercial input markets, and the implications of interventions for different groups of farmers. They also raise issues of agribusiness concentration and intellectual property rights, which has implications for the rights of farmers to freely save and exchange seeds. They provide an alternative frame for examining subsidy programmes and seed sector policy reforms outside of the emphasis on fertiliser use and increased productivity. Relatedly, because of its focus on government interventions and formal seed and fertiliser systems, the 'Politics of Seeds' literature highlights the role of the state, markets and the diverse range of non-state interests involved in technology adoption programmes.

iv) Farmers' Decision-Making and Behaviour, especially in Difficult (Risky) Farm Environments.

At the farm level, green revolution prescriptions of increased adoption of commercial seeds and chemical fertilisers are underpinned by assumptions of similar and unfavourable agroecological conditions across sub-Saharan Africa. But this fails to take account of regional-specificity in agroecological conditions even within one national territory, not least the whole of sub-Saharan Africa. Further, commercial seeds and agro-chemicals constitute only some of the elements of a total farm system, and farmers' technology choices are ultimately shaped by a host of other farm system components, crucial among which is the relationship between land and labour. In relation to this, the study seeks to explain changes in technology using a more *dynamic* framework that pays attention to different contexts of land and labour instead of standard green revolution prescriptions that are assumed to apply across-the-board. Here, the Boserupian perspective on technological change is argued to be more meaningful in sub-Saharan African contexts. In this framework, agroecological factors such as climate are generally treated as secondary, and a *moderate* and *sustained* increase in population is not a problem in itself but rather the key determinant of technological change.

As Boserup argued, population growth provides the labour needed to undertake the *investments* (thorough clearing and weed control, irrigation works, and other activities for improvement in soil fertility) necessary to prevent declines in food production. The Boserupian perspective does not necessarily treat agroecological factors as unimportant factors, but as factors that are linked with population density and are responded to by different investments and techniques. The strength of the Boserupian perspective ultimately depends on how information on land and labour can be combined with information on agroecological factors to examine technological change across different geographic regions instead of making assumptions about how the lack of uptake of modern technologies – assumptions which are usually made for large geographic areas – are due to institutional constraints.

Although Farming Systems Research has been criticised as another form of technology transfer, and that farmers in fact have little say in determining research priorities (Chambers & Jiggins, 1987), it is at least in theory parallel to the Boserupian perspective in conceptualising technology change. One of its strong points is its expressed focus on resource-poor farmers, and the idea that farmers' decisions are informed by their complex environmental and socio-economic circumstances. Dillon, Plucknett, & Vallaeys (1978:8) define a farming system as:

> "…a complicated interwoven mesh of soils, plants, animals, implements, workers, other inputs and environmental influences with the strands held and manipulated by a person called the farmer who, given his preferences and aspirations, attempts to produce output from the inputs and technology available to him. It is the farmer's unique understanding of his immediate environment, both natural and socioeconomic, that results in his farming system."

The interrelationships between technologies and different components of a farm highlighted by Farming Systems Research can be likened to Boserup's cultivation systems (which are usually accompanied by a set of farming activities, techniques, tools, and labour requirements, etc.).

Together, both frameworks come close to an understanding of complex agricultural systems that can be expected for Africa and are typically lacking in standard green revolution approaches. In following through with this framework, it is still important to highlight how differences between farmers – underlined by their control of productive resources – influences decisions about their agricultural enterprises and the technologies they adopt for that purpose.

v) Technology

'Technology' is the main outcome variable of this study. Schatzberg (2006) has explored the changing meanings of the term since the nineteenth century. Throughout most of this period, *technology* referred to the study of the *useful* or *practical arts*. This particular meaning of *technology* persisted in some places even up to the twentieth century. However, the concept of *technology* also evolved from the middle of the nineteenth century, taking on new and important meanings by the 1930s and 1940s. By this time technology not only referred to *the science* of the *practical arts*, but to "the practical arts as a whole, especially those associated with engineers and modern industry" (Schatzberg, 2006:487). As such, the concept of technology also came to be applied to *artifacts, objects*, and *material equipment*. Another significant aspect of the changing meanings of *technology* was that it later also incorporated the idea of *technique*. Thus, in addition to *material equipment*, technology also embodies the different *methods, processes, and procedures* that are applied to meet certain desirable ends.

Similarly, Boserup (1987:692) argues that analysis of *technological change* should not focus on only *tools* and *equipment*, but also the changing *methods* of food production. She referred to the increased production of legumes in Europe between the eighteenth and nineteenth century as a *technique* (Boserup, 1965:30). This is because legumes helped to improve soil fertility and were fed to draught animals whose droppings were further used as manure to improve soil quality.

Boserup (1976:22) even regards the nature of a society's social and political organisation as some sort of *administrative technology*. Thus, in general, the use of the term *technology* in agricultural production has a much wider application than the images of tractors and harvesters that it often evokes. For example, the use of *fire* in land clearing operations equally qualifies as *technology*. The greater attention to rice production in Ghana has involved the promotion of a technology known as the *sawah system*. This is essentially a system for holding and reducing the loss of water through the making of embankments, tilling, and levelling of the farm plot. (Ragasa et al., 2013; DeGraft-Johnson et al. 2014). In much of the literature on the African GR however, the term *technology* is often used to refer to improved seed (hybrid seed in particular), and other agro-inputs – chemical fertilisers in particular. In this study, GR technologies, and others, including fallowing, organic manure, and bullock plough are examined. In general, each of these technologies is analysed individually and not as a combined scale variable.

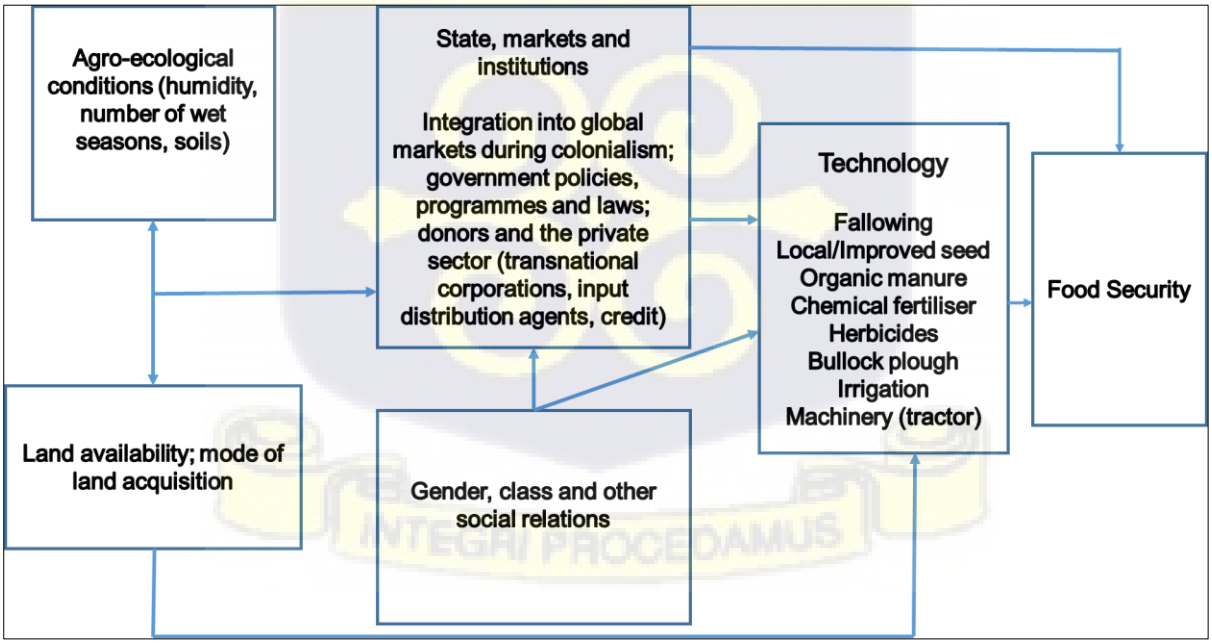
Relationships among the Components of the Framework

The conceptual model is presented in Figure 2.1 below. The model is divided into three parts. Informed by the farming systems research and technology change literature, the first part shows important elements such as the number of wet-seasons, and land availability. The middle section of the model shows the social relations of production, while the third part shows the outcome variables. The model points to pathways to different kinds of technology, which has important implications for food security. For example, agro-ecological conditions and land availability have a strong influence on technology. In areas where land is available, farmers can produce crops such as yam through fallowing. However, difficult farming environments (as a result of only one wet-season or the inability to fallow land due to the impact of long-term population pressures on land) may require that farmers participate in input markets for commercial seeds and fertilisers, although a shift to commercial inputs may also occur when

farmers are selected for a seed and fertiliser subsidy programme. It is also important to note that gender and class influence access to certain technologies (for e.g., tractors and herbicides) and participation in input subsidy programme.

On the other hand, farmers may respond to difficult farming environments through strategies that do not require much participation in markets. For example, they may practice crop combinations or cultivate different varieties of the same crop (for e.g., the case of millet cultivation in Garu-Tempane noted in chapters five, six and seven). Again, with respect to agro-ecological conditions, a change to improved seed and chemical fertilisers may not be required at all to produce food in certain rural areas, and food insecurity in part stems from the lack of livelihood diversification and the devotion of most land and labour to the production of non-food cash crops for foreign markets. This is the case of the two Southern districts of Asunafo North and Kwaebibirem, and as is detailed in chapters five and six.

Figure 2. 1 Conceptual framework



Source: Author's construct.

Chapter Three

Research Methods and Data Sources

3.1 Introduction

This chapter discusses the research methods and data sources that constitute the base on which findings and conclusions of the study were derived. It outlines the research tools, data types and analytical methods, and the research districts and communities in which data was collected. The chapter underlines the necessity of a mixed-methods research design due to the varied nature of the questions posed by the study, and their associated data requirements and analytical methods.

The following sections discuss the above stated issues in detail.

3.2 Research Design

A mixed-methods research design undergirds this study. The study draws on both qualitative and quantitative data and analytical methods to arrive at its findings and conclusions. These comprise analyses of secondary and primary qualitative data, analyses of survey data, and the review and analyses of academic literature and policy documents. The use of these different methods was mainly influenced by the nature of the research questions, and their associated levels of analyses. For example, quantitative methods played an important role in addressing the first research question which, among other things, seeks to analyse the diversity of farming systems, and the ways in which farmers adapt their production to different environments.

Although these data can be collected using qualitative methods, quantitative methods allow for the capture of specific plot-level data that, if proper storage and retrieval protocols are

followed, can be made available for analyses at any point in time. Further, a large amount of data can be collected, and analyses of patterns and differences can be undertaken for men and women, communities and large geographic areas. However, quantitative methods, especially cross-sectional surveys are limited in the analysis of long-term change. In this instance, qualitative methods are more appropriate as they allow researchers to delve into experiences of changes that have occurred at the individual, household or community level.

Also, there are just some research questions (or sub-questions) for which quantitative methods can only have a limited role. This specifically relates to questions of social relations of production. In this case, quantitative methods cannot do much more than generate information on, for example, the modes of land acquisition. Information and analyses of contexts, deeper meanings, experiences, and struggles – which would be expected for analyses of livelihoods and social relations – are not typically addressed by quantitative methods. This data and analytical needs are more easily met by qualitative methods that are more flexible and provide more room for discussions not captured by structured questionnaires.

The use of different kinds of data and analytical methods in this study also highlight that local level impacts and processes occur within broader intermediate and structural contexts. The combination of several methods allow for comparisons and attempts to reach conclusions that approximate the realities in farming communities, as opposed to methods that rely on only one kind of data and analysis. Thus, the research design adopted for this study ensures that the limitations inherent in one method are catered for by another. Qualitative data have been analysed alongside quantitative data, and an attempt has been made to situate these findings within different agro-ecologies, geographical contexts, and a long process of agricultural production and commercialisation.

The following sections discusses the research methods and data sources in some detail.

3.2 Qualitative Research Methods

3.2.1 Qualitative Document Analysis (QDA)

The QDA method was used to examine agricultural, food and seed policy in relation to broader processes of economic change in Ghana. Thus, it was applied to the institutional-level analysis. QDA involves the collection and analysis of available text and other data on a specific topic. In this study, it was used to analyse changes in policy, and the evolving role of actors in the promotion of different kinds of agricultural technology. While "themes" or "areas of analysis" (which comprise the pivot around which analyses revolve) may sometimes be identified *a priori*[8], other important ones (if not more significant ones) may emerge during an initial or more focused review of the documents themselves (Wesley, 2010; Morgan, 2022). These themes then become the basis for charting trends.

In this study, the QDA method was used to analyse publicly available documents. This included book chapters, journal articles, development plans, and working papers among others. The varied nature of the documents also helped to address the issue of bias that is seen to be associated with QDA. For example, one of the documents included in the analysis was a book authored by Ghana's first President Dr. Kwame Nkrumah, titled *Dark Days in Ghana*. While the inclusion of this book helped to provide an insider perspective, other documents (such as the two papers on state and cooperative farms in Ghana by Miracle and Seidman, 1968a; 1968b) that were critical of the strengthening of this approach in the early 1960s were equally included in the analysis.

[8] For e.g., an assessment of sustainability policies and activities by organisations working in the water sector of three African countries was expected to be based on some 21 themes, and later the "ten Building Blocks for sustainability" identified by the research team (IDS, 2013:2-3).

In addition to the QDA, the study relied on more conventional qualitative data and analysis methods. The research districts and communities from which these were collected, and data collection tools and techniques are described below.

3.2.2 Research Districts and Communities

Within Ghana, this study draws on several kinds of data that were collected in four administrative districts. These comprise the Garu-Tempane and East Gonja districts of Northern Ghana, and the Asunafo North and Kwaebibirem districts of Southern Ghana. These four districts are located in four administrative regions of Ghana. The Garu-Tempane and East Gonja districts are located in the Upper East and Savannah regions, respectively, whereas the Asunafo North and Kwaebibirem districts are located in the Ahafo and Eastern regions, respectively.

The districts constitute the research districts of The Gender, Land and Right to Food (DEMETER) Project[9]. The location of the four research districts in different geographic and agroecological zones with different histories of economic development is crucial because it provides a broad scope for the analysis of different farming or cultivation systems. Similarly, the four districts allow for detailed analyses of cropping patterns, the behaviour of farmers in different environments, the attitudes of governments and agribusiness to different geographic areas, and how all of these factors are connected with land and labour relations.

[9] The DEMETER Project was a 6-year (2015-2021) study that examined the different effects of processes of land and agricultural commercialisation on women and men. The project was implemented in Cambodia and Ghana and examined livelihoods, local, national and international policies and politics, and the right to food.

The Garu-Tempane and East Gonja districts belong to the Sudan and Guinea Savanna agroecological zones, respectively, whereas Asunafo and Kwaebibirem are located in the semi-deciduous forest. The former districts, previously part of the Northern Territories during the colonial period, were neglected in human capital development and investment in infrastructure. Their main role during the colonial period was to provide the labour needed for the mines and cocoa producing areas of the forest zone (Amanor 2010; Amin 1972). Poverty and out-migration continue to be high in Northern Ghana compared to other parts of the country (GSS, 2018:17; GSS, 2013:209). In contrast to the North, colonial policy facilitated the establishment of native authorities in the forest zones of Southern Ghana. This increased the control of chiefs and lineage heads over community and family land resources: they sold or gave out land to migrant labour for cocoa sharecropping arrangements (Amanor 2010). Thus, these differences in environmental and economic conditions between the research districts serve as important case studies for examining the study's research questions.

3.2.3 Secondary and Primary Qualitative Data

Secondary Qualitative Data

Qualitative data analysed in this study include summaries and transcripts of interviews conducted in 12 communities among the four research districts in the months of February and March, 2016[10]. These data come from the first set of field research undertaken for The Gender, Land and Right to Food (DEMETER) Project[11]. The data comprise in-depth interviews and focus group discussions that mainly focused on rural livelihoods. They were particularly useful for exploring cropping systems and the social relations of production among the four districts.

[10] The communities visited are shown in Table 3.2.

[11] I received a scholarship from the DEMETER Project to undertake the Ph.D. programme in African Studies at the University of Ghana and participated in the Project's many activities. I requested for and was granted access to the wealth of data that had been collected by the Project.

For both in-depth interviews and focus groups, data were collected separately for men and women. In addition, interviews were conducted with local political leaders, development and other professionals working in the public and private sector, and non-governmental organisations.

Primary Qualitative Data

Another important source of qualitative data for the study comes from fieldwork undertaken in the Garu-Tempane district between February and early March, 2017. Conducting fieldwork in Garu-Tempane was important for a number of reasons. Among the four research districts, it is the one with the highest rate of poverty and food insecurity (WFP, MOFA, & GSS 2012:57). The farming environment in Garu-Tempane is an extremely difficult due, in part to inadequate land and poor soils. Thus, households in Garu-Tempane embody the resource-constrained farmers that is at the centre of farming systems research.

Several data collection tools and techniques were used in the course of the fieldwork. In all, a total of seventeen (17) qualitative interviews were conducted with farmers, development professionals in the local public and private sector, and NGOs. Key informant interviews with development professionals were conducted in the Garu town, while in-depth interviews (IDIs) and focus group discussions (FGDs) were held with farmers in Zaare and Gagbiri. No formal procedures were followed in the selection of participants for the IDIs and FGDs as qualitative interviews seek to examine "meanings, experiences, and views of all participants" (Clancy, 2002) rather than to generalise results to the larger population based on principles of randomisation.

However, attempts were made to ensure the representation of both men and women in the interviews: the ten (10) IDIs conducted were split equally between men and women. Six (6) of the IDI participants produced sorghum for sale to the Faranaya Agribusiness Centre (which aggregates sorghum in communities of the Garu-Tempane district for sale to Guinness Ghana Breweries Limited), while the remaining four (4) sold their produce through informal channels. While participation by farmers in this "contract farming" arrangements with Faranaya perhaps points to the commercial orientation of the 6 participating farmers, it also important to mention that the company also buys produce from farmers who do not have any contract with it, whether through written or oral agreements. Discussions in the IDIs and FGDs revolved around agricultural production, and the dimensions of food security, including food cultures. Some information was also collected on cropping systems and food preservation. Interview guides were used to facilitate discussions, and two field assistants translated questions and responses from English into Kusaal and vice versa. Interviews were recorded, transcribed and analysed.

Table 3. 1 Types of Qualitative Data Analysed For the Study

Research districts	In-depth interviews (male)	In-depth interviews (female)	Focus group discussions (male)	Focus group discussions (female)	Interviews with social services, local government and development professionals, and local political leaders
Garu-Tempane	18	17	4	2	10
East Gonja	17	15	2	2	13
Asunafo North	6	12	1	1	6
Kwaebibirem	9	8	--	--	3
Total	**50**	**52**	**7**	**5**	**32**

Source: compiled from different types of interviews analysed in the study

Analyses of Secondary and Primary Qualitative Data

The secondary and primary qualitative data were analysed using the method of thematic analysis. This involves reading textual material to identify "ideas" or "themes", which are then applied to the rest of the qualitative data (Namey et al., 2008). In this study, thematic analysis informed the identification of discernible themes and patterns in the text, and the extent to which these varied across individuals, communities and districts. The choice of the method has not only been influenced by the interview guides, which although open-ended, are divided into different sub-sections focusing on issues such as cropping patterns, land, labour and technology. More importantly, thematic analyses has been necessitated by the need to go beyond the analysis of keywords and phrases to a more careful reading of the text in order to gain a better understanding of the issues that were investigated. The patterns that emerged from analyses of texts for one district were compared with the other, and since the districts in both parts of the country were similar to each other with respect to agroecology and crop enterprises, they in turn constituted "recommendation domains" which could be compared with each other.

3.3 Survey Data

In addition to qualitative data, the study also analysed quantitative data collected in two surveys. The first of these surveys was conducted in 10 communities of the four research districts between February and March of 2017, with detailed livelihood and other data collected from 484 households. These households were selected using the method of simple random sampling. This first involved the identification and listing of structures and households; from this exercise, a total of 3,062 households were listed, from which 484 households were randomly selected for interviews. From the number of households listed, the sample size is expected to range between 341 and 346 households (See Table 1, Krejcie and Morgan 1970).

Thus, the number of households interviewed was more than the number needed to generalise findings to the study population. The decision to interview 484 households was informed by different reasons. For example, because of the interest in conducting a panel study, a larger number of households was sampled in anticipation that some households would not be available for interviews in the follow up survey. Steps were also taken to prevent the under-representation of female-headed households (FHHs) due to the generally small number of such households in some communities. Thus, in four communities of the East Gonja district where only a small number of FHHs were available, all the FHHs were selected for interviews (Dzanku et al. 2017:9).

The first survey was followed by a similar one in March 2020, with some changes. It was planned to interview all households that participated in the first survey. However, only 375 of such households were available. An additional 396 households were selected for interviews, bringing the total number of households interviewed in the second survey to 771. This increase in the number of households interviewed was carried out to collect data from a larger number of households involved in contract farming arrangements. Four new communities were also added to the 10 communities of the first survey, bringing the total number of communities to 14. Like the first survey, the second survey also collected livelihood and other data. There were specific questions on land tenure, the crops that were produced, persons in the household responsible for decision-making, and seed and input use among others.

Usually, a household head or household member provided information for the household unit (e.g., questions on household dwelling, sources of drinking water), while for other questions a main male and female respondent (including the household head) answered questions. In male-headed households in which household members cultivated different plots, men and women

independently provided answers for the plots they farmed. This separate collection of data allows for a greater representation of women and other individuals production activities and decision-making within the household (Doss, 2013). Due to the collection of data for different levels, data were available for households, farm plots and farmers, all of which are accepted as units of analysis in farming systems research (Richards, 1983:1). From the 771 households interviewed in 2020, data were collected on 1,799 plots (Table 3.2 below). Much of the analysis in chapters five and six come from this plot-level data. Other sources of data for the study include crop production data from secondary sources, official statistics, annual and technical reports, and government policy documents.

Table 3. 2 Research Districts, Communities and Number of Farm Plots for which data was collected in the DEMETER Survey, 2020

District	Communities	Total
Garu-Tempane	Gagbiri	84
	Zaare	147
	Barboaka*[12]	99
	Gozesi*	62
	Kpatia*	2
	Kunnating*	47
East Gonja	Gbung	53
	Grushie Zongo	61
	Kpalbi	122
	Upando	98
	Adamupe*	136
Asunafo North	Asumura/ Anyimaye	96
	Kasapin	137
Kwaebibirem	Abaam	404
	Bomso	251
	Total	1,799

DEMETER Survey, 2020

3.3.1 Analyses of Survey Data

Univariate and bivariate methods of analyses were used to analyse the survey data. These are briefly described below.

a) Univariate analyses: several methods were used to describe the data. These comprise percentages, averages (particularly the median), and graphs.

[12] Communities marked in asterisks were not included in the qualitative interviews conducted in 2016; similarly these communities were not included in the first survey carried out in 2017.

a) Bivariate analyses: these analyses were performed to examine relationships between two variables. Examples of these included: the relationship between household holdings and cropping patterns, and the relationships between geographic districts, class and gender and the use of different farm technologies. In many of these analyses, the chi-square test was performed to examine if the relationship between two variables of interest was statistically significant. Generally, a relationship was determined to be statistically significant if the significance level (p-value) was either 0.05 or lower. In addition to the chi-square tests, two-sample t-tests (also referred to as the independent sample t-test) were performed to determine if differences in the sizes of farms cultivated by men and women were statistically significant. Two important assumptions are required for this test. Firstly, it is assumed that the samples are drawn from populations that are normally distributed, and that the variances of the two populations (in this case men and women) are equal (Park, 2009). For more conservative tests, however, the variances are assumed to be unequal (UCLA, n.d).

3.3.2 Description of the Survey Respondents

Data collected in the first round of the survey indicate that household heads and members in Kwaebibirem and Garu-Tempane are relatively older than those of Asunafo North and East Gonja. Also, in these two districts, children (0-14 years) form a larger part of the sample relative to the first two districts (See Table 3.3). Even though the sample in Kwaebibirem and Garu-Tempane are relatively older, Kwaebibirem has more youth (almost 60 percent). Similarly, Asunafo North and East Gonja have more youth.

In contrast, the size of the youth in Garu-Tempane is smaller relative to the other districts, while the proportion of persons aged 65 years and older is relatively higher. Male out-migration

is high in the Garu-Tempane district (GSS, 2014:16-17), and the relatively smaller youth in the communities sampled for this study could be attributed to this higher mobility to other parts of the country. With the exception of the age structure, there are important differences between the Northern and Southern districts. For example, the portion of household heads who are married is relatively higher in the North than the South, while female-headed households are higher in the latter. The data on education point to clear disparities between the Northern and Southern districts. The portion of persons aged 15 years and older who have ever attended school in the South is more than twice the rate reported for the Northern districts. However, in general, the number of years of schooling is not up to 9 years – the number of years required for the completion of basic education. Thus, in the Southern districts most persons who reported that they had ever attended school may have completed only primary education. The situation is of course discouraging in the Northern districts where the maximum number of years of schooling is only 4 years, a number that is sufficient to complete only lower primary. This discrepancy in education is also related to the history of economic development in Ghana noted earlier.

Table 3. 3 Selected Characteristics of Household Heads and Members

		District			
	Overall	Kwae-bibirem	Asunafo North	East Gonja	Garu-Tempane
Percent female headed households	30.2	43.0	34.4	8.3	19.6
Mean age of household head	50	52	48	45	56
Mean age of household members	24	28	23	21	26
Mean household size	5	4	5	7	6
Household age composition:					
Share of household members 0-14 years (%)	36.0	28.6	39.1	42.5	37.4
Share of household members 15-64 years (%)	55.4	59.6	55.5	53.2	48.2
Share of household members > 64 years (%)	8.6	11.9	5.4	4.3	14.4
Percent of household heads married	68.3	52.7	67.8	88.8	78.3
%of household members (>14 years) ever attended school	60.6	86.8	83.0	37.2	44.8
Mean years of schooling	5	8	7	3	4

DEMETER Survey 2017

3.4 Challenges of the Study

Several challenges were encountered in the course of this study. One of these was related to the listing and interviewing of households in the Garu-Tempane district. For example, in the Gagbiri community, the terrain and distribution of residential units made accessibility to households quite difficult. Thus, fieldwork in Gagbiri (and Garu-Tempane in general) was time consuming and labour intensive. However, the provision of necessary resources by the DEMETER Project enabled the research team to overcome these challenges.

The experience in Garu-Tempane pointed to the difficulties that independent researchers and students would encounter if they planned to conduct a scientific random sample without the necessary human and financial resources. Another issue related to the survey was the inability to identify some of the households that were interviewed in 2017. One hundred and ten (110) households, representing close to 23 percent of the households interviewed in 2017 could not be located for interviews in 2020. Although this challenged the Project's goal of creating a panel data set, it was compensated for by the inclusion of new households that had not been surveyed in the first round of the study.

Another challenge encountered in the study was the manipulation and analysis of the survey data. The DEMETER Project collected data on different topics important for understanding both productive and unproductive work in rural areas, and there were separate data files for the themes that were investigated. The complexity of the data sometimes posed challenges for the merging of different files into one coherent data file. Although the merging of relevant variables could perhaps have increased the scope for undertaking analyses beyond those presented here, there were also concerns that any errors in the merging of data would eventually lead to the production of faulty results. However, the analyses and results generated from the separate data files were important for reaching the conclusions of the study, while the combination of the survey and qualitative data helped to enrich the research.

3.5 Conclusion

This study was based on different types and sources of data, and the use of different analytical techniques. The two main empirical chapters of the study (Chapters five and six) were based on qualitative and survey data collected in four research districts between 2016 and 2020. An initial set of qualitative data analysed for the study was collected in 2016.

This was followed by the collection of survey data in the research districts in 2017, and was accompanied by the collection of a smaller number of qualitative data in one of the four research districts. Lastly, a second round of survey data was collected in 2020. In this study, both qualitative and survey data were analysed alongside each other, with the survey data providing descriptive statistics on general patterns, while the qualitative data helped to understand the deeper meanings behind the observed patterns. This combination of different data sources and analytical methods were crucial in arriving at findings and conclusions that were grounded in rich data and reflected the diverse reality of rural livelihoods.

Chapter Four

Crises, Interventions and Transformation: Food, Seed Policy and Agricultural Commercialisation in Ghana

4.1 Introduction

A large amount of research has been published on the subject of an African Green Revolution since the 2008 food crisis. These range from mathematical models that examine the possibility of increasing agricultural production through improvements in crop yields (Breisinger et al. 2011), to studies that use actual field data to analyse the effects of recent input subsidies on agricultural production (Ragasa & Chapoto, 2016). Much of this research focuses on crops such as maize and rice, and analyses of the effects of agricultural technologies, particularly improved (hybrid) seed and chemical fertilisers. In contrast to this is another body of research that examine, among others, the components and workings of public cereal seed systems, the weaknesses of these systems and the challenges they present for newly established local seed companies (Poku, Birner, & Gupta, 2018; Tripp & Ragasa, 2015). Other studies pay more attention to the different actors involved in input subsidy interventions, the dominant role of transnational companies in such interventions, and the implications of the new developments for small farmers (Chinsinga, 2011). This second body of research also focuses on, or shows that interventions emphasise maize production.

This chapter addresses the first research question of this study. It seeks to specifically examine the following question: What have been the major shifts in seed and food policy in Ghana within the context of broader economic change? The chapter contributes to the discussions on the African Green Revolution by placing food and seed policy within a broader context of agricultural commercialisation and economic change in Ghana. It argues that Ghana's integration into the world economy has focused on the export of primary commodities (mainly

cocoa, timber and mineral resources) for the generation of foreign exchange, which have in turn not only being used to finance imports of commodities produced outside Ghana, but also basic products that could have been produced in Ghana, including food. The nature of this trade has been problematic as unpredictable world markets combined with other factors (e.g., weather-related shocks, internal political factors) have created the conditions for constant crises. Thus, whereas Ghana has for the most part being a predominantly agricultural economy since its independence, it has been unable to meet its food needs and attain other social and economic goals, with important consequences for the well-being of ordinary people. Thus, Ghana's integration into the world economy and trade with the rest of the world has adversely affected its ability to provide for the needs of its people.

The problems associated with Ghana's economic relationships with the rest of the world became particularly acute in the 1950s. Since that time, different governments have sought to find solutions to the problem. In the early 1960s, the approach to the food problem rested on state farms, farmers' co-operatives, mechanisation, and the development of irrigation infrastructure as the basis for increasing food production and the diversification of agricultural exports. These faced several challenges, with some privatised while others were abandoned in the second half of the 1960s. Since the late 1960s agricultural policy and interventions have prioritised large-scale commercial agriculture with focus on rice and maize production in Northern region. In the forest areas, the state joined forces with the World Bank to embark on the development of outgrower schemes for commodities such as oil palm in the 1970s. These interventions for the production of food and industrial crops are seen to have mainly benefitted wealthier farmers and not small farmers.

From the 1980s through to the 1990s, structural adjustment programmes disrupted state support for agriculture through the dissolution and privatisation of agricultural services, the removal of input subsidies and liberalisation of agricultural markets. Agricultural policy in this period focused on providing incentives for cocoa and the production of a few non-traditional cash crops. However state and donor support in the form of subsidised improved seed and chemical fertilisers was renewed in response to the food, fuel and financial crisis of 2007 and 2008. Similar to previous programmes, the extent to which these subsidies have benefitted resource poor farmers continues to be debated.

These developments in agriculture associated with strategies of the Ghanaian state and its partners to find solutions to agricultural and economic problems at large, can be summarised into five phases comprising the following:

1. Phase one (1962 to 1965): Consolidation of the state's direct role in production initiated in the 1950s. This was triggered by a continuous decline in the world price of Ghana's main export commodity – cocoa. The state's approach to agriculture in this period is embodied in state and co-operative farms, the development of agricultural infrastructure, mechanisation, and some subsidies and access to credit mediated by co-operatives.
2. Phase two (1966-1971): Liberalisation of the economy, including privatisation of state enterprises such as the agricultural projects. There was an initial and smaller green revolution focusing on large-scale rice production in Northern Ghana.
3. Phase three (1972-1978): An expansive green revolution comprising the subsidisation of improved seeds, chemical fertilisers, mechanisation services, and increased access to credit. Focus was largely on large-scale commercial rice production in Northern Ghana. This phase was also one of consolidation in contract farming

involving partnerships between the state, international financial institutions and agribusiness.

4. Phase four (1981-1999): An unprecedented liberalisation of the Ghanaian economy and withdrawal of agricultural support and services. Agricultural strategy emphasised provision of incentives for production of export crops. Little attention was given to food production, but this was also an important period of research and technology development in the cereal seed sector.

5. Phase five (2000 – 2015): This phase is characterised by attempts to reduce poverty at the dawn of the new millennium. There was a return to the subsidisation of fertilisers, seeds and interventions to promote private investment in land. The state also seeks to promote a private seed and agro-chemical industry.

Out of the crises and changes in agricultural policy has emerged a tremendous change in Ghana's agricultural sector. This is reflected in the state's diminished role in agricultural production and its loss of control over the internal marketing of cocoa. The state has also relinquished its control over other areas of economic activity such as seed production, and imports and distribution of agro-chemical products. The state now exists to regulate agriculture. However 'regulation' is a euphemism for creating the conditions for the consolidation of commercial agriculture through such measures as promotion of genetically modified crops, the granting of intellectual property rights, and facilitating the acquisition of large parcels of land by domestic and international investors.

This chapter examines the five phases in detail and concludes by reflecting on the changing role of the state in Ghana's agricultural sector.

4.2 Phase One: The Public Green Revolution of the First Republic

In the early 1960s, the Ghana government embarked on a major programme of economic transformation with significant attention to the agricultural and industrial sectors. In the agricultural sector, the main priority was to expand food and other agricultural output as the basis for achieving a set of related objectives. Large increases in maize, rice and legume production (especially groundnuts) were expected to improve nutrition and farmers' incomes. Secondly, the agricultural programmes sought to diversify industrial crop production from cocoa to crops such as oil palm, and rubber, while greater importance was also attached to tobacco, sugar cane and cotton production as the raw materials for an emerging agro-industrial sector. Lastly, since many of the interventions in food and agricultural production were expected to be implemented in Northern Ghana, it was argued that the programmes would also serve the purpose of bridging the developmental gap between Northern and Southern Ghana. Northern Ghana was expected to become the bread basket for the rest of the country.

This need to increase food production was frequently expressed in Malthusian terms. However the economic reasoning underlying the government's plan to increase food and agricultural production was much stronger. From the first decade of the twentieth century, cocoa had overtaken oil palm as the main source of foreign exchange, and cocoa exports would later result in the accumulation of a large amount of money in Ghana's foreign reserves from the 1940s through to the early 1950s (NDPC, 2009:ii). This accumulation was made possible by the establishment of the Cocoa Marketing Board (CMB) during the Second World War and the monopoly it exercised over cocoa exports (Marshall, 1976).

Cocoa contributed immensely to state revenue through export duties and other levies, and the funds generated were used to finance education, health, transportation, the CMB and other public services. In the 1950s and 1960s, cocoa accounted for close to 60 percent of foreign

exchange (Due, 1969:639). The trade in cocoa had not only allowed for the import of manufactured items from the industrial world, but also food products that could have been produced in Ghana. Between 1951 and 1961, the value of imports of fruits and vegetables increased by 1,109 percent, while that of rice increased by 706 percent (NPC 1964:55). A total of £G26 million – representing 18 percent of all annual imports – was spent on food imports in 1961 (NPC 1964:53). However, cocoa prices began to fall from the late 1950s, while prices of other important exports did not increase appreciably to make up for the fall in the value of cocoa exports. Thus, it was no longer possible to finance imports with a reliance on the trade in cocoa and other exports. It is in relation to these circumstances in which the Ghana government would embark on its seven-year development plan with key focus on the agricultural and industrial sectors. Increases in agricultural outputs were thus expected to address Ghana's dire economic situation by reducing the expenditure on food imports, and to provide the raw materials required for processing in an emerging industrial sector. Other short-term economic measures such as bans and high tariffs were also used in light of the economic crisis to restrict imports of non-essential commodities.

The application of *science* and *improved technology* was central to the government's strategy to increase food and agricultural production. Increases in yields were expected to occur through the adoption of improved and dressed seed, chemical fertilisers, and the development of irrigation infrastructure. However, the government expressed reservations about chemical fertilisers, citing the high costs that imports of such inputs would impose on government expenditure. After all, key among the reasons for the radical shift in government policy was the necessity of dealing with the high cost of imports. Thus, crop rotations were viewed as a more practical approach for increasing agricultural output.

In addition to crop rotation, gains in output in the large-scale state and co-operative farms, which would serve as the main engines of the government's agricultural programme, were expected to be achieved through area expansion, and the farms would later be criticised for having cleared only a small amount of land that had been acquired for the programmes (See Miracle & Seidman, 1968a:32; 1968b:13-14). In spite of its arguments against the imports of fertilisers, the government would invest heavily in the imports of agricultural machinery and equipment.

As previously noted, the large-scale farms under the management of the State Farms Corporation (SFC), the United Ghana Farmers' Cooperative Council (UGFCC), the Agricultural Wing of the Workers Brigade, and the Young Farmers League represented the pivot of the government's agricultural programme. Farms were also established by other government institutions such as the Volta Resettlement Schemes Unit and the Academy of Sciences. By 1965, there was a total of 1,205 such farms, comprising 123 state farms[13] and 870 co-operative farms (Due 1969:646). The remaining 212 farms was divided among the other public institutions. The public farms involved the acquisition of a land area of 1,114,315 acres (Ibid), approximately 445,726 hectares.

In addition to the direct role of state institutions in agricultural production, there was an attempt to establish and/or re-organise a public institutional infrastructure for the Green Revolution. This included state agencies such as the Food Marketing Board which was mandated to purchase cereal crops and legumes at minimum prices, to presumably serve urban food markets. The SFC and the Academy of Sciences were expected to undertake agricultural research and breeding while the seed services, the Extension and Development Service were

[13] Authors report different figures for the numbers and sizes of state farms that were established. For instance Due (1969) makes reference to 123/125 state farms covering a land area of 345,000 acres, while Miracle and Seidman (1968b:13) state that the SFC had a total of 105 farms in 1965 with a total land area of 250,268 acres.

responsible for the production and distribution of improved seed. An Irrigation Division was also established within the Ministry of Agriculture. In the area of finance, a National Investment Bank was established to provide loans for commercial agricultural projects, while the Agricultural Credit and Development Bank, which would later become the Agricultural Development Bank, was established in 1965 to provide financial assistance for small farmers. Subsidies and credit for purchases of seeds and fertilisers were to be delivered to farmers through co-operatives and the Extension Service. Much of the financial resources that went into the agricultural programmes came from the Ghana government. However, the Soviet Union and other Eastern European countries provided a substantial amount of aid. These were particularly important for mechanisation and irrigation projects, and those projects that involved the setting up of factories. Lastly, the government also supplemented funding with credit from both foreign and domestic sources.

Antecedents of the State and Co-Operative Programmes of the 1960s

Although the direct role of state agencies in agricultural production became major state policy in the early 1960s, precedents of state interventions in agriculture were established in the colonial period. Of major importance was the Second World War and the period following the end of the War. In the War years, an urgent need to stimulate food production and marketing developed. Similar to the agricultural programmes of the 1960s, the main goal during this period was to increase local food production in order to reduce food imports and prevent shortfalls in export revenues (Graham, 1993:165; Hansen, 1981:106; Shepherd 1981:170). Other factors that influenced the focus on food production included the need to export food to European markets and African troops participating in the War, and a maize rust epidemic which resulted in food shortages in the 1950s (Hansen, 1981:107).

Perhaps, the most important of the colonial government's pursuits in agricultural production after the War was the establishment of the Agricultural Development Corporation (ADC) in 1949. The ADC established its own banana plantation in the Western region and encouraged banana production among small farmers. It also acquired and expanded oil palm and rubber plantations (Miracle & Seidman, 1968a; Miracle & Seidman, 1968b). These acquisitions also occurred in the Western region and sometimes involved partnerships with private companies. In addition, the ADC marketed coffee, and sought to provide a range of other services, including mechanisation services to farmers' co-operatives at a fee.

In Northern Ghana, the state's intervention in agriculture was embodied in the Gonja Development Corporation (GDC) which was established in 1950 and sought to undertake mechanised agricultural production in the Gonja district. While groundnuts was a key crop in the scheme as the project – like several African projects of its kind – was also designed to supply Western markets with the raw material for the processing of vegetables oils (Graham, 1993:180-181), cereals (maize, millet/sorghum, rice) and other crops (yam, tobacco) received attention. It was planned to resettle and allocate land to households from the densely populated north-eastern part of Ghana for these productive activities. This did not seem to generate much interest, while mechanisation efforts were hampered by terrains that were not too conducive to the available machinery. There were frequent breakdowns of equipment, and lack of spare parts and technical personnel to undertake repairs (Miracle & Seidman, 1968b).

While it is sometimes acknowledged that the GDC and the ADC in general were established to 'experiment' with large-scale mechanisation, both projects are highly criticised for their limited production, high costs, and the large amount of debt they incurred (Lambert, 2019; Akoto, 1987). The GDC was liquidated in 1957, and the SFC took over the ADC after it was also liquidated in 1962.

Similarly, attempts to encourage the formation of co-operatives date to the late 1920s. However, most of these were marketing co-operatives in the cocoa sector (Egyir, 2010). Overtime, similar marketing organisations were established for export crops such as coffee, copra, banana and palm kernel (Miracle & Seidman, 1968a). Through the efforts of the Departments of Agriculture and Social Welfare, and the ADC, co-operatives were also extended to the production and marketing of food crops such as rice, maize, legumes and vegetables. In Northern Ghana and other food producing areas, farmers were encouraged to form co-operatives from the 1950s (Miracle & Seidman, 1968a). Co-operatives outside of the cocoa sector encountered several challenges and met with varying degrees of success. Their continuous operation was often influenced by factors such as the availability of marketing opportunities and better prices, the availability of storage facilities and qualified technical and administrative personnel, and members' practices such as side-selling.

Impacts of the 1960s Public Green Revolution

Assessments of the impacts of the agricultural and agro-industrial programmes of the first republic have for the most part been negative and are only rarely mixed. For instance regarding the latter, Addo (1988) argued that investments in the industrial sector did lead to increases in manufactured output and some progress in the substitution of locally manufactured goods for imported goods. Textiles and shoe production constituted two areas in which some of the progress in manufacturing and import substitution were experienced. However, in the case of textiles, Miracle & Seidman (1968b:32) note that most of the cotton was imported from abroad.

In the food sector, the potential of agricultural machinery to contribute to increased food production was hindered by several factors. Key among these was the frequent breakdown of machinery resulting from landform features such as rocks. This was not helped by the lack of

spare parts and qualified technicians who could undertake repairs. Also, the main use to which agricultural machinery was put, namely land clearing and ploughing, was associated with soil erosion in areas with heavy rainfall (Miracle & Seidman, 1968b). In other places, the available machinery were not used because they were inappropriate for the farming environments to which they had been deployed (Miracle & Seidman, 1968a:43). Thus in the short-term, no remarkable achievements were made to improve the food situation due to limited production, and challenges with food storage and marketing. As a result, food shortages and high food prices were experienced particularly in urban areas between 1965 and 1966 (Rake, 1966:27, 28; Miracle & Seidman, 1968b:37).

In spite of interventions to diversify agriculture, cocoa continued to dominate the Ghanaian economy. Production more than doubled from 264,000 tonnes in 1956/57 to 590,000 tonnes in 1963/64 (Nkrumah 1968:81). Although the government had sought to improve production through the supply of improved seedlings and the control of capsid and the swollen shoot disease, its investments and effectiveness in undertaking actual practices have been questioned (Beckman 1981). Thus, much of the increase in cocoa output during this period was attributed to an expansion in the area cultivated to cocoa than to improvements in yields (Miracle, 1970). In the Eastern Region – the main cocoa producing area in Ghana during the colonial period – the cost of replanting old cocoa farms affected by the swollen shoot disease was deemed too high. Thus, from the late 1940 onwards, farmers moved to the Ashanti, Brong Ahafo and Western regions in search of forest lands for cocoa cultivation (Amanor & Diderutuah, 2001:6). Again, in some of the old cocoa producing areas, the high cost involved in re-establishing diseased cocoa farms would also play an important role in some farmers abandonment of cocoa for commercial maize production (Tripp & Marfo 1991:97).

However, the problem with declining cocoa prices which became evident in the late 1950s, and had in part inspired the interventions to diversify agricultural exports and increase food production continued to worsen. There developed what was described as an *over-production* of cocoa, resulting from the increased supply of cocoa from Ghana and the other cocoa producing countries (NPC, 1964:70-71), which would in turn be associated with a dramatic fall in world cocoa prices. The price of a tonne of cocoa fell "from £476 in 1954 to £87 10s." in 1965 (Nkrumah 1968:94). In addition to the fall in cocoa prices, there was no marked improvement in the price of timber, Ghana's most important export commodity after cocoa, or any of its major mineral commodities (Rake, 1966:27; Due 1969:640). As a result, there was a sharp decline in Ghana's export revenues, while a large amount of debt continue to pile up. Kwame Nkrumah's CPP government had in its latter years sought the assistance of the International Monetary Fund (IMF), the World Bank and other Western donors to make up for the decline in its financial resources. A request was also made to the United States for food aid (Rake, 1966:26). But all of these attempts proved futile. In the context of high food prices and prices of other commodities, a group of senior police and military officers comprising the National Liberation Council (NLC) staged a coup against the CPP government on 24 February 1966.

4.3 Phase Two: The First Roll Back Of the State (1966-1971)

Ghana was governed by two governments after the overthrow of Nkrumah's CPP government. These comprise the NLC which staged the coup, and an elected civilian government under the leadership of Dr. K.A Busia in 1969. Both governments are not seen to be distinct from each other – at least with respect to economic policy – which also underlines why they are sometimes classified as one entity in economic analysis: i.e. the NLC/Busia years.

With support from the IMF, the NLC embarked on a *stabilisation* programme and liberalisation of the Ghanaian economy. There was a reversal in the direct role of the state in production, and the economic measures that were introduced by the CPP in its latter years. The currency was first devalued in 1967 while restrictions on imports and price controls were removed. State industries and enterprises were privatised while others were abandoned. One estimate suggests that the number of farms under the control of the SFC reduced from 123[14] to only 62, covering an area of only 9,000 hectares (Nweke, 1978:205). The UGFCC was dissolved and many workers in state organisations such as the SFC and the Workers Brigade were laid off. It is estimated that a total of 63,000 workers were retrenched from all state enterprises (Marshall 1976:56).

However, some state enterprises were allowed to operate in spite of the privatisation drive. Two reasons have been offered for this: that the state was unable to attract the needed private investment in certain sectors, or that the government sought to exhibit a national posture through its continued ownership of some enterprises. Thus, Beckman (1981:151) argues that the privatisation drive of the NLC/Busia governments was *largely abortive*. Two of the agricultural projects that survived amid the general privatisation of state enterprises were the Asutsuare and Komenda sugar production and processing schemes (Graham, 1993:164-179). The research and development of infrastructure for both schemes date to the 1950s. However, they began to operate in 1966 and 1967, respectively. Sugar cane production and supplies to the processing factories was initially expected from irrigated estates, but this idea was abandoned for rain-fed production as a means of managing the high cost associated with irrigated production.

[14] According to Due (1969:648) only 39 of the 123 state farms were operating in 1969.

However, like other projects, these two projects encountered various problems and were never able to produce sufficient sugar to meet domestic demand for the commodity. These included the inadequate supply and poor quality of sugar cane, poor linkages between sugar production and processing, technical challenges with machinery, and poor management and supervision of the sugar production and processing process. The issue of management and technical personnel in part relate to the general climate of hostility towards personnel from Eastern Europe after the overthrow of the CPP government. In general, the change in political power brought an end to the relationships between Ghana, the USSR and other eastern European countries. In the case of Asutsuare and Komenda, Polish and Czechoslovakian firms and expertise had contributed significantly to the establishment of the sugar projects. However, local capacity had yet to be developed to take up responsibilities.

In the late 1960s, government policy in food production emphasized large-scale commercial agriculture as the basis for meeting the domestic demand for food. Attention was given to rice production in the Northern savanna, and commercial farmers were encouraged to take advantage of several government incentives. In addition to subsidised improved seeds, chemical fertilisers and licenses for the import of agricultural machinery, the government also planned to provide a guaranteed minimum price for rice (Akoto, 1987). The ADB's role in providing credit was important during this period, as was the support of The United States Agency for International Development (USAID) which favoured the focus on large-commercial farmers (Shepherd 1981).

However, the emphasis on large-scale commercial production implies that the relevance of the programme for resource poor farmers was not seriously considered. The impact of the programme on the food situation is also questionable due to generally high food prices in spite of food imports and the receipt of food aid (Beckman 1981:152,153). In spite of the limited

relevance of its food policy to livelihoods in small farming communities, the Busia regime is acknowledge by some for its achievements in the area of *rural development* and decentralisation, with the provision of clean water, electricity, agricultural credit and extension in rural communities cited as key examples (Addo 1988:11).

Consistent with its interests in promoting private enterprise, the Busia government also attempted to liberalise the internal trade of cocoa. The UGFCC which had formerly controlled the internal trade in cocoa was dissolved and some private agents and cooperatives were licensed to operate. The CMB provided these entities with cash for the purchase of cocoa from farmers. However, they performed poorly and incurred debt, leading the CMB to withdraw their licenses (Beckman 1981:151-152). The CMB itself, through the Produce Buying Company, took over the activities, personnel and equipment of the dissolved UGFCC and controlled 75 percent of the trade in cocoa (Beckman 1981:152; Kolavalli and Vigneri 2011:204).

After the massive decline in 1965, cocoa prices on the world market improved in response to unfavourable weather in West Africa. In the months of August and December 1968, a tonne of cocoa sold for £305 and £464 respectively, while the price for 1969 was £422 (Mettrick, 1971:5). However the improvement in cocoa prices did not translate into better prices for farmers, and a *chit system* based on *promissory notes* replaced the more conventional means through which farmers were paid.

One of the more dramatic episodes in the cocoa sector during the Busia administration was the expulsion of migrants from neighbouring African countries following the passage of the government's Aliens Compliance Order in November 1969. Since the late nineteenth century, the colonial administration had found it favourable to rely on the African population for cocoa

production than to encourage the development of plantations (Amin, 1972; Clarence-Smith, 1995:161). However, cocoa production was also greatly facilitated by British and French colonial policies which forced persons in the Northern Territories, the Upper Volta and Togo to frequently migrate to the forest zones of the Gold Coast in search of work so as to meet their tax obligations (Amanor, 2010). This has led those critical of the co-operative programmes of the first republic to argue that Nkrumah's CPP government decided against organising these labourers due to concerns that such measures would antagonise wealthy cocoa farmers and the landowning class, with negative implications for the revenue generated from cocoa sales (Miracle and Seidman 1968a).

However, the Busia government, in response to Ghana's poor economic situation, ordered non-Ghanaian migrants who were unable to acquire work and residence permits within two weeks to leave the country. The order affected migrants involved in Ghana's informal trade economy in the major cities as well as the rural areas (Peil, 1974:373). In the rural areas, the effects of the Compliance Order were particularly felt in the cocoa sector due to the important role of migrants in the supply of labour and sharecropping arrangements. One estimate suggests that in 1960, more than 40 percent of agricultural labourers and caretakers were migrants from neighbouring African countries (Peil 1974:374). Thus, the expulsion of non-Ghanaian migrants has been linked with labour shortages in cocoa producing areas (Beckman 1981; Shepherd 1981). However in some farming communities, local youth who lost access to land as a result of chiefs and lineage heads appropriation of land for sharecropping arrangements with non-Ghanaian migrants would take advantage of the new opportunities in sharecropping opened up by the expulsion (Amanor & Diderutuah 2001). Local youth would later resist attempts by a new military government to induce labour movements from places outside Ghana which served as the labour reserves (Ibid). Peil (1974:374) also suggests that the Compliance Order provided

an opportunity for farm owners who had devoted much of their land to cocoa production to confiscate food farms that had been cultivated by migrants.

The removal of restrictions on imports and price controls during the NLC/Busia years was facilitated by financial support from the IMF, a general improvement in cocoa prices and an expansion in timber production. However cocoa prices again tumbled to £194 a tonne in December 1971 (Marshall, 1976:57). Faced with this crisis the government re-introduced restrictions on imports and price controls but this only caused food prices to rise (Graham, 1994:163). Having already imposed a ban on trade unions, the government went ahead to withhold work benefits for publicly employed persons, including army personnel (Hutchful, 1979:37). It also imposed a development levy and undertook another devaluation of the currency in December 1971. These measures ultimately resulted in a coup in January 1972 by members of the military comprising the National Redemption Council (NRC).

4.4 Phase Three: The Green Revolution for the Elite Class and the Consolidation of Contract Farming (1972-1978)

Besides maintaining the import and price controls, the NRC embarked on several measures that contrasted with policies of the Busia/NLC government. It revalued the currency, removed the development levy, and reinstated the Trades Union Congress. Privatisation of state institutions was not at the centre of the new government's efforts, and it further sought to prevent foreign companies from repatriating profits. It also requested for shares in the major foreign companies for the government and individuals. This included banking institutions such as Barclays and Standard Bank, as well as companies in the long established extractive sector.

While it noted that it would honour long-term debts, the government stressed that it would not pay those debts that were due, and stipulated a 50 year time frame and low interest rates as

conditions for the repayment of medium-term debts (Kraus, 1977:215). Ultimately, negotiations on repayment of the debts were held in 1974, and the agreements reached are described to have been very favourable to the government (Hutchful, 1979:38; Kraus, 1977:215). The negotiations was also followed by a resumption of donor support to the government by the Western nations (Hutchful, 1979:38).

Agricultural production was a key area of government investment in the 1970s. In the food sector, government interventions were framed around ideologies of self-reliance and self-sufficiency. This was first symbolised in the roll out in February 1972 of the Operation Feed Yourself (OFY) programme which focused on rice production in Northern Ghana. OFY rested on the increased adoption of improved seed[15] and agro-chemicals, the mechanisation of agriculture, and increased access to credit. Thus, it embodied the green revolution that is now emphasized in the contemporary period. Under OFY, the distribution of improved rice seed increased from 3,200 tonnes in 1970 to 34,000 tonnes in 1975 (Akoto, 1987, Table 7). In 1974, the government subsidised 75 percent of the price of improved seed and chemical fertilisers (Akoto, 1987:248-249). Measures to promote agricultural mechanisation, including subsidisation of mechanisation services and the removal of duties on imports of agricultural machinery, also received great attention in OFY than is usually recognised. Between 1974 and 1978, nearly 52 percent of the expenses on imports of agricultural inputs was spent on machinery (Akoto, 1987:251-252). In addition to encouraging production through the import and subsidisation of inputs, the state was involved in food procurement and marketing through agencies such as the Food Distribution Corporation (FDC) and the Meat Marketing Board.

[15] In contrast to imports of agro-chemicals, improved rice seed was sourced from the Seed Multiplication Unit of the Ministry of Agriculture (See note on sources by Akoto, 1987, Table 7), although the mandate of this Division – aside seed multiplication – also included the imports of seed from abroad (Amanor 2010:7).

In spite of the significant investment, OFY achieved little in its quest to address the food issue in Ghana. Only two years – 1973 and 1974 – were recognised as the success years of the programme[16] (Akoto, 1987; Shepherd 1981; Kraus, 1977; Marshall, 1976). Food production in the period following these two years were not so impressive, and wages in the 1970s were in general much lower than they had been in the 1960s while food prices and prices of other commodities remained high. There developed a *national food problem*, with food shortages occurring in both urban and rural areas (Hansen, 1981). Ghana continued to import food and had to accept food aid from the United States and other Western governments in 1977 as a result of a reported famine in parts of what today comprises the Upper East region. But these efforts provided little relief to the communities and persons most affected by food shortages as food items were diverted to less needy persons by local officials in charge of the emergency programme (The New York Times, 1977a; 1977b).

The poor performance of the government's agricultural programme and the economy at large have been attributed to several factors. Key among these were three years of severe drought in the 1970s amid general drought in the Sahel. Added to this was the oil price hikes of the 1970s which increased government expenditure on oil imports from 28 million to 130 million cedis between 1972 and 1974 (Marshall, 1976:58). With respect to OFY, its major problem was not so much that it had failed to produce sufficient food, but that it had not been designed with resource-poor farmers in mind. Despite being sold as a programme of self-reliance and self-sufficiency, OFY mainly benefitted large-commercial farmers. The provision of credit by the ADB and other commercial banks expanded greatly in the 1970s.

[16] For instance rice and maize production more than trebled between 1971 and 1973. Rice production increased from 11,000 to 61,000 tonnes while maize production increased from 53,000 to 430,000 tonnes (Marshall 1976). FAO data however indicate that the most noticeable increases in rice production during the 1970s occurred in 1977 (109,000 tonnes) and 1978 (108,000 tonnes). Increases in rice production matching these levels did not occur again until rapid increases in production that have occurred since 1991 (FAOSTAT 2022).

Most farmers who received loans from these banks operated farms that were 50 acres or larger (Shepherd 1981:174). While previously criticising the ADB for mainly responding to the needs of large-commercial farmers (Beckman 1981:152), senior military officers would take turns, and together with senior civil servants, large commercial farmers and chiefs secured loans and subsidised government services. The distribution of fertilisers, and imports of agricultural machinery also mainly benefitted large commercial farmers, while simple tools such as machetes used by small farmers were in short supply (Hansen, 1981:110).

Shepherd (1981) has contrasted the impacts of the interventions in rice production between the middle and land available part of Northern Ghana, with areas in the northeast (the Upper East) where land scarcity has been a major constraint on agricultural production. This is also associated with the creation of labour reserves in that area during the colonial period, and frequent movement of rural youth to the former areas – and Southern Ghana more generally – for seasonal employment. In the former, for e.g. within the environs of the Tamale metropolis, which accounted for a large share of the investment in rice production, small farmers and rural communities lost land to large commercial rice farmers. These were increasingly constituted of military officers, senior civil service personnel and other persons in gainful employment with little or no prior involvement in food production. These persons were able to acquire lands from chiefs and cultivated large rice farms due to their greater access to machinery and ploughing services. Large commercial farmers also dealt with high labour wages by hiring and transporting relatives from the urban centres than by recruiting labour from the rural communities. Only a handful of small farmers previously involved in agriculture were able to seize the opportunities provided by government's incentives. The greater attention to commercial rice production in the Northern region affected the Upper East through its loss of labour as seasonal migrants no longer returned home to help with farm production like they used to. Also, persons in urban centres of the Upper East who were able to access credit from

the ADB invested in rice production in either the Northern region or the few places in the Upper region where rice could be produced. Thus, the incentives for rice production shifted production away from other local crops, while the demand for rice created by state marketing agencies and private markets increased prices to levels that many poorer households in rural communities could not afford. Shepherd (1981) argues that these factors contributed greatly to the famine in the Upper East in 1977.

The capture of subsidised services by the elite extended beyond food production to include procurement and distribution by government agencies (Hutchful, 1979). The most notable example among these was the Food Distribution Corporation (FDC). Access to food supplies of the FDC was also restricted to military officers, public officials and entrepreneurs who purchased food at state controlled prices, which were often deliberately kept below prices prevailing in the market. The food supplies were then diverted to private markets, where they were sold at higher prices for profit (Hansen, 1981:111-112). In 1975 and 1976, commercial farmers also diverted rice from state marketing outlets to the private informal market as the government refused to increase the minimum price although the demand for food was high (Shepherd 1981).

Similar to previous decades, state support outside of the food sector in the 1970s continued to focus on disease control in the cocoa sector through subsidies for the purchase of insecticides, hand and motorised spraying equipment. Direct cash payments also replaced the chit system of the previous government[17]. However the cocoa sector and export crops in general fared no better during the 1970s. Smuggling of cocoa to nearby Cote d'Ivoire was quite high. This was

[17] This system seemed to have persisted until the 1980s when a cheque system which allowed farmers to receive cash from the country's banking institutions was introduced (Puplampu, 1999:345).

attributed to the overvaluation of the cedi (Addo 1988) and the government's practice of appropriating more and more of the income from cocoa sales.

The Consolidation of Contract Farming Under the NRC

Several agricultural projects with features akin to contract farming were established from the 1950s to the early 1970s. Perhaps, among the earliest of such projects was the encouragement of tobacco production in the Volta, Eastern and Central regions in the 1950s. Farmers received credit from the Pioneer Tobacco Company for the purchase of agro-inputs, while the Tobacco Marketing Board provided seedling and was the exclusive buyer of tobacco (Miracle & Seidman, 1968b:29-30). Another example, perhaps, was the Cotton Development Board's interventions in Northern Ghana in the late 1960s and early 1970s. Cotton farmers received agro-inputs, mechanisation services, and favourable producer prices for cotton (Shepherd 1981).

The more notable among the outgrower schemes in the early 1970s were those related to the sugar production and processing schemes in Asutsuare and Komenda. In addition to their plantations, both schemes relied mainly on outgrowers for sugar cane. However, supplies of sugar cane for the factories appeared to have been a major problem, especially in Komenda, leading to a shutdown of operations in 1967/1968. Graham (1993) has examined in detail the major issues surrounding these outgrower schemes. In the years of the CPP government, both schemes were under the Sugar Products Corporation and the State Farms Corporation. During the NLC/Busia years, they were first transferred into the Sugar Products Division of the Ghana Industrial Holding Company, before their final reconstitution into the Ghana Sugar Estates Limited (GHASEL) as part of a rehabilitation programme supported by the World Bank in 1973. In both schemes, outgrowers farmed on their own plots and received planting materials, chemical inputs, and extension from GHASEL, while ADB provided credit.

In return, outgrowers had to adhere strictly to regulations concerning cultivation, application of chemical inputs, and harvesting. Further, they were required to take precautions against fire outbreaks. GHASEL mainly determined the price that was paid to farmers, using such criteria as the sucrose content and weight of the cane supplied by farmers. It also reserved the right to enter farms to undertake inspections. Part of outgrowers' earnings was set aside for repayment of the credit from ADB, and the cost of inputs supplied by GHASEL. In Asutsuare, the outgrowers totalled 250 and farmed a total of 3,400 ha of sugar cane. They were mainly individual *absentee capitalist farmers* who farmed relatively larger plots, lived in Accra, and benefited from the favourable terms under which the ADB offered credit. They shared nearly the same social characteristics as those farmers who benefitted from the large commercial rice production programme promoted in Northern Ghana. In Komenda there was another 250 outgrowers, but the total area farmed by these farmers was only 1180 hectares. Plots cultivated by most farmers were one acre or smaller, and more than 50 percent of the farmers were still members of co-operatives. In contrast to Asutsuare, absentee farmers constituted only 6.5 percent of the total number of farmers.

Contrary to the less vigorous attempts of the previous decades, contract farming took on new significance with the launch in 1974 of the Operation Feed Your Industries programme by the NRC government. The unparalleled support for contract farming during this period was enabled by its endorsement as state policy, the availability of loans for such projects by the international financial institutions, and involvement of the foreign private sector. In the case of the foreign private sector, the government presented investments in contract farming projects as an opportunity for repatriating profits that were being held by the government as a result of the difficulties it faced in making payments. Thus, if companies invested in contract farming, they were assured of repatriating some of their profits. Other incentives to encourage private sector participation was the removal of tariffs on imports of machinery and exemptions from

other taxes. The importance of contract farming in the second half of the 1970s is reflected in the size of the three main oil palm production and processing schemes that were established in the forest zones. These comprise the Twifo Oil Palm Plantation, the Benso Oil Palm Plantation, and the Ghana Oil Palm Development Corporation (GOPDC). These three schemes involved the expropriation of 20,250 hectares of land (Graham, 1993:188).

The GOPDC scheme, established by the Ghana government and the World Bank in 1976, has been modestly researched (Amanor 1999; Daddieh 1994; Graham 1993). Initially, GOPDC expropriated 5,143 hectares of land in the Kwae area of the Eastern Region, out of which some 1,200 hectares was given to outgrowers (Daddieh 1994). By 1990, the total land area under the control of the company amounted to 7,700 hectares. This was shared equally between GOPDC's plantation and processing facilities, and the company's outgrowers. Outgrowers undertook land preparation and cultivation, and the carting of harvested oil palm fruits to designated locations. Strict adherence to regulations, such as not intercropping oil palm with other crops, and ensuring strict conformity to specific activities and timing of such activities was emphasized. The company, for its part, was involved in the initial preparation of the farms by helping to clear forests. It also provided improved seedlings and other inputs on credit, and collected fruits from the specified locations. Part of the produce supplied by farmers was used as payment of the cost of inputs and other credit provided by the company.

Contract farming is associated with the rapid adoption of modern agricultural technology than would typically be expected of farmers under normal production conditions. This is necessitated by the desire of the processing firms to source raw materials that meet certain standards. However, contracts have different impacts on direct participants, and those who are indirect parties to the contract but who are somehow involved in or are affected by its operations. This is clearly evident in the GOPDC scheme and the Asutsuare sugar scheme noted

earlier. In the case of GOPDC, most of the outgrowers were men who were 50 years or older with low levels of education. One of the key criteria for selecting outgrowers, besides having lost family land to the expropriation by GOPDC was that the farmer should be married and have at least 5 children living with him (Daddieh 1994). Thus, GOPDC outgrowers relied extensively on household labour for farm work. In a model such as this, the gains – whatever they are – of the contract are first captured by the male household head, and the well-being of the remaining household members are dependent on his disposition. The expropriation of land for the GOPDC scheme was also linked with inadequate land for food cultivation, the development of a local food market, high food prices, and landlessness among youth (Amanor, 2010:120). In contrast, outgrowers of the Asutsuare sugar scheme, as noted earlier, were *absentee capitalist farmers* comprising senior military officers and civil servants, and businessmen (Graham, 1993). They were able to obtain credit on favourable terms from the ADB and relied presumably on waged labour, as the plantation of the sugar scheme was also known to do so.

4.5 Phase 4: Food and Agricultural Policy under Neo-Liberalism I (1981 – 1999)

In spite of the significant investments to promote large commercial agriculture, the 1970s is generally viewed as a decade of agricultural crisis and economic decline. Cocoa production declined from 320,000 to 158,000 tonnes between 1976-77 and 1983-84 (Kraus, 1991, Table 1). Quite a large amount of the cocoa produced in Ghana was also smuggled to Cote d'Ivoire in the 1970s, while food production reduced by 30 percent between 1971 and 1982 (Graham, 1988:44). These problems were compounded by another round of increments in the prices of petroleum products in 1979-80, and a severe food crisis in 1982-83 caused by droughts and bush fires. Having expelled an estimated 200,000 persons from other African countries after it passed its Alien Compliance Order in 1969, Ghana would have its own experience of eviction

after one million of its citizens, mainly working in Nigeria, were forced to leave that country in 1983. Many of these people had left Ghana as a result of the poor economic situation of the 1970s. These factors provided the context for a long IMF-World Bank structural adjustment programme that was carried out from 1983 to the late 1990s.

Structural adjustment sought to improve economic performance through an emphasis on increased production in the export sectors. It also sought to deal with inflation and high government expenditures through massive job cuts in the public sector. Other economic measures such as devaluation of the currency and privatisation of state industries were pursued among many others. In this way, the principles underlying the 1980s adjustment programme were no different from the programme designed for Ghana by the World Bank and IMF following the overthrow of Nkrumah's government in 1966.

However, the 1980s adjustment programme was peculiar in terms of its long duration, depth and application across different sectors, eventually culminating in devastating effects on the well-being of ordinary people. Estimates of job cuts from COCOBOD range from 50,000 to 80,000 workers (Kraus, 1991:32-33; Hilson & Potter, 2005:106). COCOBOD also privatised some of its plantations (World Bank, 1989:iii). In the civil service and among non-teaching professionals of the Ghana Education Service, another 48,000 people would lose their jobs (Kraus, 1991). Tens of thousands of workers in state industries and the formal private sector would also lose their jobs. Thus a reduction in formal employment and the expansion of the informal economy which had been observed in the 1970s ensued.

In agriculture, the overarching goal of promoting growth in the export sectors led to a focus on cocoa production. This included support for a rehabilitation programme and better prices for cocoa farmers. Cocoa production began to increase from the low level of 158,000 tonnes

recorded in 1983-1984, but increases in production from 1984 up to 1991 were not particularly impressive especially when compared with cocoa production in the earlier decades preceding the agricultural crisis (See Krauss 1991, Table 1). Further, it has also been argued that some of the increase in production may have been the result of smuggling from nearby countries (Gibbon et al 1993:118, cited in Oya, 2007:280). The impact of the interventions in cocoa may also not have been that strong because there occurred again, as in the 1960s, a decline in world market prices resulting from *over-production* from the cocoa producing countries. Cocoa's share of the value of primary exports decreased from 60 percent to 52 percent between 1987 and 1988; by 1991, the figure had dropped to only 40 percent (World Bank, 1989, Annex B Page 2; Ghana: Exports in Current Prices). In turn, the value of logs, timber and gold increased from 28 to 33 percent between 1987 and 1988. In general, the value of these goods hovered around 34 percent between 1987 and 1995 (Ibid). However, the extraction of mineral resources and timber was dominated by private foreign companies that enjoyed incentives such as land concessions and tax breaks (Hilson & Potter, 2005).

Another development in the cocoa sector associated with structural adjustment was the liberalisation of the internal trade of cocoa. Thus, a large number of licensed buying companies now participate in the internal purchase of cocoa. While the Produce Buying Company (a division of the Cocoa Board) has operated alongside these private companies and did buy a large part of the cocoa, its share of the market has fallen considerably. In the early 1990s, the Produce Buying Company (PBC) purchased 80 percent of the cocoa produced in Ghana. By 2016-2017, PBC handled only close to 30 percent of the cocoa produce. In that year, close to 45 private companies were involved in the purchase of cocoa, with Armajaro Ghana Limited and Olam Ghana Limited handling 14 percent and 11 percent of the total cocoa produce, respectively (Ghana Cocoa Board, 2017:1-2). By 2018-2019, Olam marketed 17 percent of the

cocoa produced in Ghana while the PBC marketed only 16 percent (Ghana Cocoa Board, 2019:2).

Again, in line with its export-led growth strategy, the government introduced incentives to promote exports of non-traditional cash crops. Companies involved in the exports of these commodities were allowed to keep all of their earnings in foreign currency and paid little or no taxes at all (Puplampu, 1999:349,352). The outcomes of promotion of production and exports in two of these non-traditional sub-sectors, namely, banana and pineapple have been examined by Puplampu (1999:352) and Amanor (2019:21-27), respectively. In the case of bananas, the attempt of Dutch-owned company to participate in the export trade was impeded by its inability to secure a market as the European Union preferred to deal with companies that had a long history of banana cultivation and exports.

In contrast, the pineapple sub-sector started out quite well, but, it would also collapse in the mid-2000s. Before the collapse, pineapple production was undertaken by 3 groups of farmers comprising "12 large farms (300-700 ha), about 40 medium farms (20-150 ha) and possibly as many as 10,000 smallholders (0.2-10 ha)." (Buur & Whitfield, 2011:31). These farms produced and exported the smooth cayenne variety of pineapple to European markets. In the 1990s, Ghana became the third most important supplier of pineapple to the European market. While smallholders were involved in pineapple production, production and exports were eventually dominated by Golden Exotics and Hans Peter Werder, two European companies that moved to Ghana in response to prospects in Ghana's emerging pineapple industry. Together, both companies controlled 80 percent of pineapple exports in the 2000s. However, Ghanaian producers were under pressure to shift from the production of smooth cayenne to Del Monte Gold (MD2), a new variety that was increasingly preferred by European supermarkets and customers.

MD2 was also controlled by Del Monte, a transnational company whose involvement in pineapple production dates to the 1920s. However the stringent requirements for MD2 production, along with an increasing trend towards fair trade certification made its production expensive for majority of smallholders. This initially resulted in the displacement of smallholders and contract farmers, although the large producers and exporters would follow suit as they were also unable to withstand competition from the dominant global companies. Ivory Coast, which had long been involved in pineapple production and exports, and held a substantial share of the European market by the 1970s also collapsed as a result of the competition from Del Monte and in its attempts to switch to the production of MD2. Thus, in contrast to Buur & Whitfield (2011:31-32) who argue that the collapse of the pineapple sub-sector in Ghana was mainly due to the lack of political support, Amanor (2019) highlights the importance of intense competition, domination of markets, and control over technology by Del Monte and other major global players such as Dole. Since the 1960s, Del Monte and Dole had been involved in the acquisition of other pineapple production and processing firms. They moved around the world to avoid labour conflicts and in search of more business-friendly environments. They have favoured production on their own plantations than to enter into contractual arrangements with smallholder farmers.

The food sector received little attention in the early adjustment period, and input subsidies were finally removed by 1992. However, this period coincided with the implementation of the Ghana Grains Development Project (GGDP), an agricultural research project than run from 1979 to 1997. The project focused on the development of technologies for maize and legume production. It involved collaboration between the Crops Research Institute of Ghana (CRI), the International Maize and Wheat Improvement Center (CIMMYT), and the International Institute of Tropical Agriculture (IITA). The project was mainly financed by the Canadian

International Development Agency (CIDA), although Sasakawa Global 2000 (SG 2000) would become a significant donor from 1986 (Borlaug, 1997:6). The GGDP focused on breeding improved seeds, developing recommendations for use of chemical fertilisers, as well as guidelines for plant spacing and seeding. The project combined on-station research with extension and farmer participatory methods comprising on-farm testing, demonstration trials, and farmer field days. Extensive trials were conducted in different agro-ecological zones. The GGDP resulted in the release of many maize varieties. In 1984 alone, 5 maize varieties were released (Morris, Tripp, & Dankyi, 1999:6; Table 2). An important milestone in the GGDP's breeding efforts was the release in 1992 of *Obatanpa*, whose advantage include the better human utilisation of the protein content in maize, and resistance to the Maize Streak Virus.

Farmers' adoption of improved maize seed was one of the key criteria that was used to evaluate the GGDP, and the project was deemed successful due to the high uptake of improved maize seed varieties, with estimates of the adoption ranging between 50 and 54 percent (Badu-Apraku et al., 2006:1393; Morris, Tripp, & Dankyi, 1999:15). Further, the release of improved maize seed and other recommendations for maize production was argued to have played an important role in the rebound in maize production and improvement in yields that began to be experienced from 1984 after the long decline in agricultural production. In this light, the adoption of GGDP technologies are also argued to have contributed to the general increase in maize production, improvement in maize yields and decline in maize prices (The World Bank, 2007:169; Tripp & Marfo, 1991). In addition to maize, increases in production were observed for crops such as millet, cassava, yams, groundnuts and rice after 1983 (Puplampu, 1999:349-350; Kraus, 1991). However, the difficult economic situation of the 1980s, with its associated massive jobs losses and an increase in the size of the informal economy was such that increases in the supply of food alone was inadequate to guarantee the food and nutrition needs of the poor.

The impact of the increase in food production on food prices may also have been negated by low earnings among different groups of the working population. Thus, although food production increased considerably compared to the 1970s, food prices in the 1980s and 1990s were still considered to be high (Kraus, 1991:28). Incomes did not improve for most food farmers, and hunger continued to be a major problem in Northern Ghana where food production is the main occupation (Puplampu, 1999:353). Even among persons engaged in waged-employment, the minimum daily wage in 1984 was sufficient to meet the food needs of only one adult (Graham, 1988:50).

Despite the fact that most of the funding came from CIDA and private foundations, GGDP still embodied a public approach to technology development. It showed great interest in developing technologies that were relevant for small farmers through its countrywide extension activities and the distribution of improved seeds to farmers for trials in their own farms. The GGDP was largely seen to be led by the CRI which was established in 1964, and continues to be a leading state institution in the development of breeder seed. In 1994, the Nyankpala Agricultural Experiment Station, a division of CRI, was organised into the Savannah Agricultural Research Institute (SARI) (Tripp & Marfo, 1991:97). Its research focuses on the development of crops produced in the Northern savanna, whereas the CRI focuses on crops produced in the transitional zone, the forest, and coastal savanna (Poku, Birner, & Gupta, 2018:35).

GGDP also strengthened the capacity of the Grains and Legumes Development Board (GLDB) and the Ghana Seed Inspectorate Division (GSID) – both state institutions – to undertake the production of foundation seed, and ensure compliance with standards for the production of certified seed, respectively. The project also contributed to human resource capacity development through support for advanced training of agricultural personnel.

However the cereal seed sector would also undergo some changes partly as a result of the GGDP, as well as reforms consistent with structural adjustment at large. In addition to the implementation of demonstration trials, GGDP supported farmers to acquire inputs on credit. The Ghana government would join in this effort by making credit available to some estimated 85,000 farmers (Kraus, 1991:28). Thus, despite its public approach to the development of relevant agricultural technologies, GGDP facilitated farmers' participation in private markets. Further, the inception of GGDP coincided with the establishment of the Ghana Seed Company (GSC) that was mandated to undertake commercial seed production. But the GSC lacked the support that the GGDP gave to other agencies. It faced challenges in the funding of its operations, lacked the human resources it needed, and produced inadequate and low quality seed. Morris, Tripp, & Dankyi (1999:9) argue that GSC's ineffectiveness was the main reason why Obatanpa was developed as an OPV. This would allow farmers to select seeds from harvests for planting in the absence of "a functional seed industry" (ibid). GSC was eventually privatised in the midst of structural adjustment. The GGDP showed more interest in the emergence of a private seed industry. It provided training and start-up capital for NGOs and private seed producers (The World Bank, 2007:153) who produced and distributed some of the maize seed that were developed in the course of the GGDP. However, the emergence of a commercial seed industry with a significant farmer base is yet to occur, and attempts to develop such an industry has been renewed in recent years. SG 2000, which provided considerable credit to enhance farmers' adoption of inputs experienced difficulties as farmers were unable to pay for the loans they had received (Amanor, 2010:10-11). The GGDP itself would come to an end after the Canadian government finally pulled back funding for the project (Morris et al., 1999:2).

4.6 Phase 5: Food and Agricultural Policy under Neo-Liberalism II (2000 – 2015)

Ghana's government showed strong commitment to the implementation of structural adjustment from the 1980s to the early 1990s. And in the light of the faltering of adjustment programmes in several African countries, western donors provided all the financial assistance the country needed in order to present it to the world as a successful case of structural adjustment (Ake, 2001:89,91). However, the terms under which loans were contracted were not so favourable, and the debt accumulated during the adjustment years was larger than had ever been incurred in any other period since Ghana's independence (Osei & Quartey, 2001). Thus, an increasingly large amount of foreign exchange was devoted to debt repayment. Structural adjustment was also associated with cutbacks in social spending and a deterioration in human well-being.

In the early 2000s, economic and development policy in Ghana shifted from the typical adjustment programmes of the 1980s. Even though measures to stabilise the economy remained important, The World Bank and IMF increasingly focused on debt relief, poverty reduction, and improvements of the terms under which loans were given to Third World countries (Whitfield, 2005). Between 2006 and 2007, expenses on poverty reduction programmes, which mainly focused on education, health and rural electrification, constituted 10.5 percent of Ghana's GDP (Whitfield, 2010:732).

There were several government interventions in agriculture in the 2000s. For example, the government imported agricultural machinery and facilitated the setting up of farm mechanisation centres. These attempts to promote mechanisation focused on individual farmers (Amanor & Chichava, 2016:18; Whitfield, 2010:732) rather than public forms of organisation such as cooperatives. In the land sector, the government promoted reforms to facilitate land acquisition by investors and large commercial farmers (Tsikata, 2016).

A Presidential Special Initiative (PSI) was also launched in the early 2000s, with a specific component focusing on the production and processing of crops such as cassava and oil palm. In the case of the latter, Buur & Whitfield (2011:30) argue that with the exception of some increase in the adoption of improved planting materials, and a further expansion of the area under oil palm production by 25,000 hectares, the oil palm project – and the PSIs in general – suffered from inadequate government support and resources (Buur & Whitfield, 2011:27-30). Other assessment of the PSIs similarly point to the programme's limited success (NDPC, 2009:112; 2005:59). In general, Whitfield (2010) argues that the performance of the agricultural sector between 2001 and 2008 was not impressive, the only exception being the cocoa. A generally high increase in cocoa production began to be observed from the mid-1990s. In 1996, 403,000 tonnes of cocoa was produced compared to 288,075 tonnes in 1994 (FAOSTAT 2023). This improvement in production continued into the 2000s, with 740,000 tonnes of cocoa produced in 2005 (Ibid). In addition to the improvement in production, cocoa farmers received much better prices for the period 2001 – 2011, compared with 1991 – 2000s.

In the wake of the 2008 food crisis, the Ghana government introduced a number of policies. This included a temporary reduction of taxes on imported rice. More important and consistent with the pattern in agricultural policy across Africa was the renewal of fertiliser subsidies.
The government also established a National Food Buffer Stock Company, with functions similar to those of the Food Distribution Company of the 1970s.

The following section examines the nature, performance, and actors involved in the implementation of the fertiliser subsidy programme between 2008 and 2015.

The Green Revolution returns: State-donor aided corporate-smallholder green revolution

In 2008, the Ghana government introduced fertiliser subsidies for food production after its suspension during structural adjustment. This programme was mainly supported by the World Bank, the Canadian government and other Western donors. Initially, in each of the ten administrative regions of Ghana, regional directors of agriculture held discussions with district directors about how vouchers would be distributed among the districts (Banful, 2011). Upon allocation, district extension officers distributed vouchers to farmers. In 2010, this process was modified to one in which farmers presented passbooks to input retailers for the collection of subsidised fertilisers. Importantly, all the major actors involved in the subsidy programme (importers, distributors and retailers) were required to present to the Ministry of Food and Agriculture, receipts of the distribution of subsidised fertilisers to each of the actors in the chain. The change in the strategy was reportedly necessitated by the workload and restriction that distribution of vouchers placed on the activities of extension personnel.

Under the subsidy programme, the government absorbed 45 percent of the market price of fertiliser between 2008 and 2012. Between 2013 and 2016 (excluding 2014 when the programme was put on hold), the subsidy rate was reduced to only 23 percent (Houssou, Andam, & Asante-Addo, 2017, Table 5.1). The amount of subsidised fertiliser distributed also changed overtime. Between 2008 and 2010, the amount ranged between 43,176 metric tonnes (MT) and 91,244 MT. This was followed by a substantial increase for the period 2011 and 2016, with the amount of fertiliser subsidised ranging between 166,807 MT and 180,000 MT (Ibid). Alone, these figures would suggest that a greater quantity of fertiliser was imported as the subsidy rate was reduced. In general, an average of 25 percent of the budget of the Ministry of Food and Agriculture was spent on fertiliser subsidies between 2008 and 2016.

Resnick & Mather (2016:29) cite a number of studies that argue that the subsidy programme resulted in higher fertiliser use, high yields, and increased maize and rice production. However this ignores other evidence that point away from the positive effects of the subsidies on productivity, and the poor targeting of the programme. In the case of rice, the general data on yields does not seem to be open to debate. Ragasa et al. (2013) put national rice yield at 2.5 tonnes per hectare while FAO data show that rice yields have only been slightly below 3 tonnes per hectare since 2010. Even in this case there are important differences in yields between irrigated (3.9 tonnes per hectare), lowland (1.8) and upland (1.6) areas (Ragasa et al. 2013, Figure 5.1). However, maize yields – the crop which appeared to be of outmost priority than rice under the subsidy programme – have for the most part been lower than 2 tonnes per hectare. While Ragasa & Chapoto (2016) recognise the importance of the subsidies to increased fertiliser use, they also argue that production under irrigation conditions is *necessary* for improvement in rice yield and production (Ibid:34). Further, fertiliser application was much lower in areas of upland rice cultivation compared with irrigated areas. The authors' further note that between 2004 and 2014, area expansion contributed more to increased rice production than improvements in productivity.

Poverty reduction did not seem to have been at the centre of the subsidy programme as non-poor farmers appeared to have ultimately benefitted from the programme than those farmers it had initially been announced for. Tsimpo & Wodon (2012) argue that the subsidy programme may well have been pro-poor. However, this conclusion was partially informed by their findings about how tax cuts for imported rice vastly benefitted relatively wealthy households. Thus, they suggest that adequate measures are taken to ensure that subsidies benefit poorer farmers. Banful (2011) argues that in the 2008 national elections, the governing party ensured that the districts that it lost to the opposition in the previous election – especially those districts

where it suffered heavy losses – received more fertiliser vouchers as a strategy to improve electoral performance. More importantly, relatively wealthy districts were more likely than poorer districts to benefit from the programme.

Beginning from 2013, a criteria was used to select beneficiaries for the subsidy programme (Houssou, Andam, & Asante-Addo 2017:19-22). Thus, the subsidies were expected to benefit cereal farmers whose farms were 2 hectares or smaller. Women farmers represented another group of farmers that were singled out for subsidies in 2013. In addition to food crops, farmers in Northern Ghana who produced vegetables and cotton were also included as beneficiaries in 2015. In all of the above cases, farmers involved in contract farming schemes recognised by the government – but not necessarily schemes involving state institutions – were eligible for selection. In spite of the emphasis on farmers whose farms were 2 hectares or smaller, Houssou et al. (2017) argue that the subsidy programme mainly benefitted medium and large commercial farmers instead of poorer farmers. These findings suggest that the subsidy policy was not strictly used as a tool for poverty reduction; in contrast, they helped relatively wealthy commercial farmers to save money that would have been spent on fertiliser purchases.

Fertiliser importers comprise another group of actors that benefitted from the subsidy programme. This has occurred in two ways. First, the liberalisation of the fertiliser import market in the 1990s has reduced the role of government agencies in the procurement of fertilisers from abroad. Thus, fertiliser imports has provided another opportunity for private companies to make profits. Second, the fertiliser subsidies have also benefitted fertiliser manufacturers and importers as the willingness of the government and its donors to support the programme may likely have expanded a market that was once suffered from reduced demand as a result of the removal of subsidies in 1990s. In addition, the role of the private sector in

fertiliser markets is not only limited to imports, but also distribution and retailing. Thus, in recent years, the private sector has dominated the subsidy programme from imports to the ports, all the way up to retail shops.

The central role of the private sector to the subsidy programme was also something that was stressed by external donors, and increased demand and transactions in commercial markets was one of the programme's key objectives. However issues have been raised about the lack of consultation and inequity in the distribution of benefits among the different players in the private sector. The major fertiliser companies are seen to have dominated important processes such as negotiations with the government about the subsidies, while input dealers at the district level had little say in decision-making (Tsimpo & Wodon, 2012:88). In 2015, the input dealers were entitled to only GH₵2 for a 50kg bag of fertiliser distributed under the subsidy programme (Resnick & Mather, 2016:32). However, the Ghana government was also not entirely forthwith in the delivery of its financial obligations to the fertiliser importers. Major fertiliser companies such as Olam and Yara Ghana Ltd no longer showed interest in the programme after the government failed to pay fertiliser importers in 2014 (Resnick & Mather, 2016).

Input companies have also sought to increase farmers' access to their products outside of the subsidy programme. This has mainly involved a collaboration with some of the key donors of the current green revolution, commercial banks, NGOs and consultancy firms with a strong inclination to market transactions and the private sector. One example of these is the Ghana Grains Project (Guyver & MacCarthy, 2011). In this project, farmers in groups ranging between 5 and 10 members belonging to the larger Masara N'Arziki (Maize for Prosperity) Association were encouraged to acquire and cultivate adjoining farm plots, with each farmer operating a plot of 2 hectares. This was meant to facilitate the delivery of inputs and extension

to farmers participating in the scheme. Yara Ghana and Wienco – which also helped establish Masara N'Arziki – had formal contracts with farmers for the supply of fertilisers, hybrid maize seed, and other agro-chemicals. The inputs were supplied on credit and deducted from the produce that farmers supplied to the farmer association for sales. This practice is no different from that associated with contracting schemes involving the cultivation of industrial tree crops.

Besides Yara and Wienco, several actors have imported seed from some of the world's major seed companies. Two companies, AgriServ and Dizengoff, as well as USAID imported hybrid maize seed from the Pioneer-Dupont Company (Tripp & Ragasa, 2015). In the case of USAID, the seeds were meant for distribution to farmers in Northern Ghana. Even the Ghana government imported seed for its national service farms and some of its outgrower schemes (ibid). In addition to seed imports, there is a vigorous attempt to increase the presence of private enterprises in the seed sector. This includes AGRA's support for the establishment of private seed companies (Amanor, 2010:12), with some focusing on the production of hybrid seed. AGRA has also facilitated seed companies' access to breeder seed from the Crops Research Institute (Tripp & Ragasa, 2015:9). In addition to the production of certified seed, private seed companies are now involved in the production of foundation seed, a function that was previously undertaken by the state Grains and Legumes Development Board.

The Planting for Food and Jobs Programme (2017-2020)

Planting for Food and Jobs (PFJ) was launched in 2017 and came into effect in 2018 as the replacement for the fertiliser subsidy programme (FSP) that had been implemented from 2008. According to the government, PFJ was necessitated by the low uptake of fertilisers under the FSP, which it attributed to the "lack of a comprehensive approach in galvanizing the outreach

and impact of subsidies." (MoFA, 2017:3). Planting for Food and Jobs was designated a "flagship Programme", and ranked high among the government's other flagship programmes. In 2020, it was the fourth in terms of budgetary allocations for the government's 21 flagship programmes and received more funding than other poverty-related interventions such as LEAP (Table 2.6. 1, NDPC 2021:50-51). Planting for Food and Jobs sought to use increased food production and productivity as the basis to increase farm incomes, improve food security, reduce poverty, and generate employment. The programme was associated with the creation of a small workforce comprising a PFJ secretariat at the national level, and the recruitment of PFJ desk officers and Nation Builders Corps (NABCO) Officers to register farmers and monitor the delivery and sale of inputs at the district level (Aberman, Kufoalor & Gilbert 2021).

Planting for Food and Jobs was built around five main components. The most important among these were the seed and fertiliser components, where the government sought to increase the availability and adoption of commercial seeds and chemical fertilisers by subsiding 50 percent of the market prices of these inputs. Besides the subsidies was an extension component that mainly emphasised greater technical assistance to farmers with respect to appropriate input use, particularly fertilisers. The marketing component of the programme stressed linkages between farmers and private markets and actors, while a secondary role was reserved for interventions such as the setting of producer prices and food procurement by public agencies (MoFA 2017:14, 29). Lastly, an E-agriculture component was expected to facilitate targeting of farmers and monitoring of the programme. However, PFJ was heavily skewed towards the seed and fertilisers, with some estimates indicating that these two components accounted for 90 percent of the total programme budget (Pauw, 2022:1325). Thus, seeds and fertilisers dominated Planting for Food and Jobs.

Initially, maize, rice, sorghum, and soybean were designated as the 'priority crops' for support under PFJ. The focus on this set of crops is also reflected in the kinds of fertilisers that were supplied under the programme. For example, Pauw (2022) notes that there was a greater import of fertilisers such as NPK 23:10:15, which is generally recognised to be more appropriate for maize production. Millet was not specifically mentioned as a 'priority crop', although this would not have prevented access to subsidised fertilisers since farmers (especially those in more difficult environments) rarely cultivate only one crop. However, the lack of identification of millets as a crop for support under PFJ is indicative of the lack of support for millet breeding within formal agricultural research institutions, and the lack of demand for the crop by agro-processing industry, as compared with sorghum. In 2020, the distribution of "29,109.72 metric tonnes of seed" under PFJ was restricted to maize, rice, sorghum, soybean and vegetables (Table 2.7 8, NDPC, 2021:63). Also, only 10 percent of the quantity of sorghum seeds planned for PFJ had been distributed by 2020 (Pauw 2022:1325).

The inadequate attention to millets and other legumes is not only a weakness of PFJ, but several other agricultural development programmes. In recent years, however, some attention has been given to the development of groundnut and cowpea, with four varieties of groundnuts and three varieties of cowpea in 2012/2013 (Table 3, KIT 2020). However, questions about farmers' participation in the development of these varieties and their access to released materials require further research. Starting from 2018, however, crops that were not initially designated as 'priority crops' were added to the list of crops for support under PFJ, and some evaluations (NDPC 2021:13) analyse the programme's impact on a wider range of crops including vegetables, groundnut and cowpea, as well as crops such as cassava and plantain that are produced in the forest zone and may not require fertilisers.

How did PFJ perform with respect to increased Agricultural Production and Productivity?

In general, cereal and legume production have increased substantially since 2016. But, production increases have been uneven among the crops. For example, maize production increased by 18.9 percent per annum compared to sorghum (14.7%), millet (13.2%), soybean (10.5%) and rice (10.2%). The average annual increase in production for groundnut and cowpea have been lower: 9.4% and 6.4%, respectively (Table A1 of supplementary material, Pauw 2022).

A number of district-level studies that examine PFJ compare differences in crop yields between PFJ beneficiaries and non-beneficiaries of the programme. For example, Lambongang, Ansah & Donkoh (2019) reported that farmers in the Bunkpurugu-Yunyoo District who received inputs from the PFJ programme obtained four (4) more bags of maize per acre compared to non-beneficiaries. Other studies similarly report higher yields among PFJ beneficiaries compared to non-beneficiaries (Prah et al. 2023; Tanko, Ismaila & Sadiq 2019). Although the differences in yield between beneficiaries and non-beneficiaries are reported to be higher, these are not always large. For example, a study of 21 districts located in the Northern, middle and Southern Ghana found that although crop yields were higher for households participating in PFJ, these were *marginal* compared to the yields obtained by non-participating households (Asante and Bawakyillenuo 2021). For example, maize yield for participating households was 1.5 metric tonnes per hectare compared to 1.2 metric tonnes per hectare for non-beneficiaries. For rice, the figures were 2.0 metric tonnes per hectare compared with 1.7 metric tonnes per hectare for non-beneficiaries.

National-level estimates (Table 2.1.8, NDPC 2021:13) indicate that crop yields are quite high for maize (2.04 – 2.58 metric tonnes per hectare), compared to the 1990s when they ranged between 1.19 and 1.54 tonnes per hectare (Morris, Tripp & Dankyi, 1999:4), or to the 3 tonnes per hectare reported for South African commercial farmers (Thomson, 2006:xiv). Rice yields (2.96 – 3.57 metric tonnes per hectare) are even higher. However, Pauw (2022:1328) argues that yield growth for maize and rice during the course of PFJ was not exceptional, and that area expansion continues to be the more important factor in total crop production. In contrast to maize and rice, crop yields for sorghum, millet, groundnut and soybean remain low (below 2 metric tonnes per hectare). For soybean, yields range between 1.2 and 1.8 metric tonnes per hectare, while the land area devoted to the crop increased from 87,000 hectares to 103,000 hectares between 2016 and 2018 (MoFA 2019:12). This growth in soybean area is partly due to the package of inputs distributed to PFJ beneficiaries (MOFA-IFPRI 2020). In addition to seed, each beneficiary farmer received "*six bags of bio-fertilizer to produce soybeans*, ten bags of NPK, and five bags of urea or sulfate of ammonia for other crops" (Taylor 2022:2, emphasis mine). Similar interventions by non-state actors to boost soybean production, and other initiatives (e.g., the release of 8 soybean varieties between 2012 and 2019[18]) point to the prioritisation of the crop in the recent years. Although its low cholesterol and high protein content make it an important crop for human nutrition, much of the soybean produced in Ghana is used as feed in the livestock and fish industry (MOFA-IFPRI 2020).

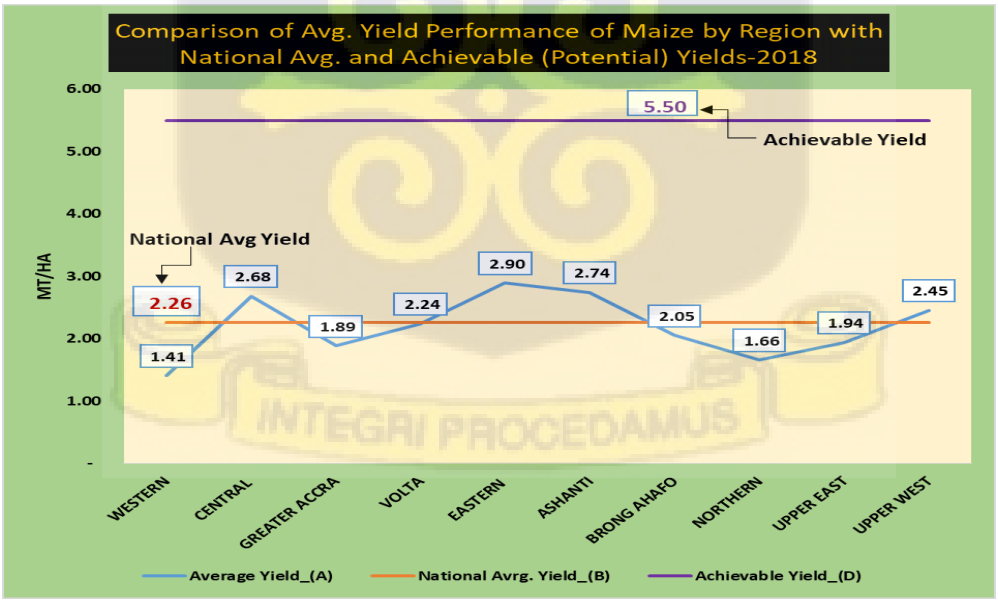
For crops such as maize and rice where yields are relatively high, there are important disparities in yield among the geographic regions. For example, in the regions where agricultural production is the main occupation (e.g., Brong Ahafo) or where poverty is high, maize yields (excluding the Upper West region) are relatively low compared to the national average.

[18] KIT (2020: Table 3).

Similarly, rice yields are lower for the Brong Ahafo and three Northern regions compared with the Greater Accra, Volta, Eastern and Ashanti regions (See Figures 4.1 and 4.2).

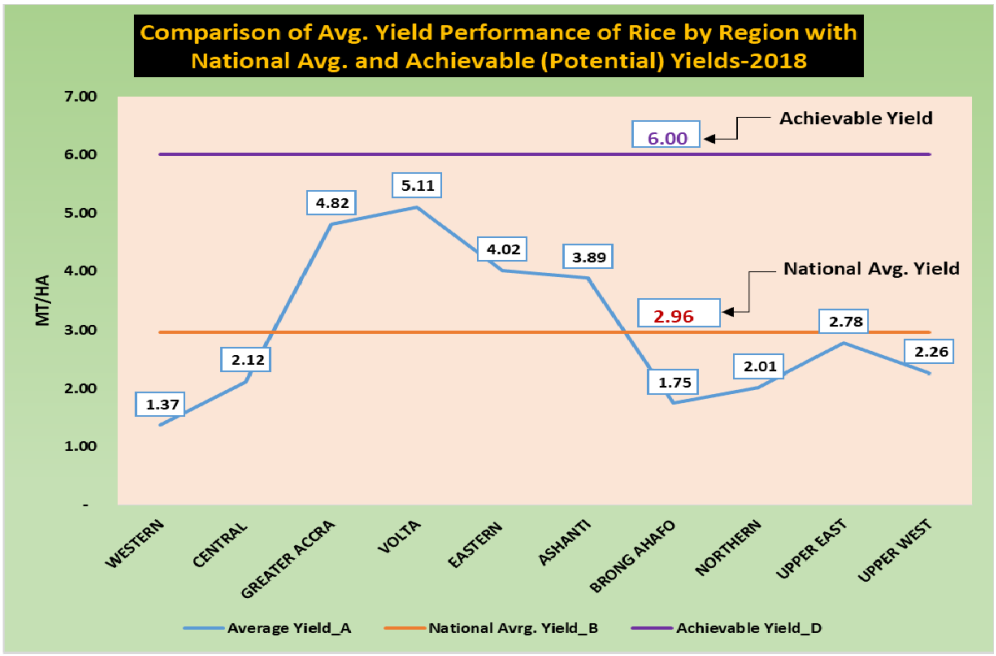
Higher maize and rice yields are indicative of the attention given to these crops by the formal cereal seed system and agricultural policy in general. But, high yields also reflect more than the rapid the adoption of improved seeds and chemical fertilisers. For example, as previously noted for rice, the use of irrigated land comprises a critical requirement for yield improvement. In addition, the low yields reported for soybean raise questions about the immediate take off in crop yields that are often linked to the adoption of new seeds and fertilisers. In this case, the contribution of commercial inputs to productivity have been limited. Rather, their availability has facilitated the expansion of the area cultivated to the crop. Increasing crop yields thus appears to be a long-term process involving different phases of adaptive research, and a set of agroecological conditions, with important implications for the extent to which they are beneficial to poorer farmers.

Figure 4.1 Disparities in Maize Yield among Ghana's Ten (10) Regions



Source: MoFA (2019:78)

Figure 4.2 Disparities in Rice Yield among Ghana's Ten (10) Regions



Source: MoFA (2019:78)

To what extent has PFJ benefited Seed Producers and the Agro-Chemical Industry?

The demand for commercial seed is low in Ghana due to farmers' ability to recycle or obtain seed from informal networks. Costs of commercial seeds are deemed high, and their performance depends on factors such as seed quality and the adoption of other agro-inputs (KIT, 2020:31-32). Others attribute the low uptake of certified seeds to lack of awareness, but this underestimates the diverse sources from which farmers obtain seed and their willingness to participate in trials. Due to the low demand for commercial seed, a thriving seed industry is yet to develop.

In 2012, a seed subsidy accounting for 36 percent of the market price of certified seed was introduced for crops such as rice (Ragasa et al., 2013:8). Under PFJ, seed subsidies constituted 50 percent of the market price of certified seed. This resulted in increased seed production by small seed producers and companies as the government's demand for seed expanded beyond the quantities that were previously marketed (KIT, 2020). The government's seed subsidies have benefitted seed companies, producers, and distributors as it awards contracts for the production of certified seed and other services. With the exception of 2017 when seeds were imported, seed production and distribution for PFJ have been carried out by actors in the local seed 'industry'. The quantity of certified seed distributed in 2019 was four-fold the amount supplied in 2017 (See Table 4.1 below). This massive growth in seed distribution would not have occurred without PFJ.

Table 4. 1. Distribution of Subsidised Certified Seeds and Fertilisers 2017-2020

Type of Input	**2017**	**2018**	**2019**	**2020**
Quantities of Certified Seeds Distributed in Metric Tons (MT)	4,400	6,822	18,333	29,211
Quantities of Fertilizer Distributed (MT)	291,021	247,094	331,349	423,473
Total Number of Beneficiary Farmers	202,000	677,000	1,183,313	1,736,510

Source: Taylor 2022

Compared to seeds, farmers were more interested in the fertiliser component of the subsidy programme. For example, the proportion of farm households that accessed and used fertilisers was higher (89%) than those who accessed and used improved seeds (36%) (Asante & Bawakyillenuo 2021). Further, 70 percent of the households showed interest in receiving subsidised fertilisers for the subsequent farming year compared to 33 percent for improved seeds (Ibid). The higher demand for subsidised chemical fertilisers can be attributed to the

completely external form of this technology: compared to seeds, chemical fertilisers cannot be recycled, and their higher prices may lead farmers to prioritise gaining access to them first before other inputs. In general, fertiliser imports to Ghana have been high since 2016 (Table 4.1). Imports increased by 46 percent between 2019 and 2020 (IFDC, 2021:3), and Ghana's imports constituted 26 percent of all shipped to West Africa in 2020 (International Trade Administration, 2021). Because majority of imported fertiliser is subsidised for distribution to PFJ beneficiaries or farmers in the cocoa sector, government's demand for fertilisers has created a 'ready market' for the fertiliser industry. This, and tax waivers for importing companies (Aberman et al., 2021:7) has provided a tremendous opportunity for agribusiness to make profits. Between 2019 and 2021, the value of Ghana's imports of chemical fertilisers amounted to $361 million[19].

The trade in fertiliser imports is dominated by a small number of companies comprising: Yara Ghana, Chemico, MacroFertil, Louis Dreyfus Company Ghana, OmniFert, GloFert, Agricultural Manufacturing Group and Farmer's Hope (IFDC 2021; IFDC & AFAP 2018:5). These companies exert significant control over wholesalers and the small retail shops in towns and cities where farmers buy agro-inputs. In addition, there are reports that some of the subsidised fertiliser is exported to neighbouring countries, particularly Burkina Faso (IFDC & AFAP 2018:12).

How did PFJ perform with respect to targeting of Poor-Farmers, Women and Youth?

While the cost of fertiliser subsidies certainly raise concerns about the economic sustainability of PFJ, the more important issue is that the programme served wealthier farmers instead of

[19] "Ghana's imports of all types of fertilizers were $173 million in 2019, $109 million in 2020, and $79 million in 2021" (International Trade Administration, 2021). Another source notes that $401 million was spent on the fertiliser component of PFJ between 2017 and 2020 (Taylor 2022:1).

poorer farmers. Planting for Food and Jobs beneficiaries were more likely to own[20] and operate larger farms (Abdallah et al. 2021; Asante & Bawakyillenuo 2021). They were also more educated (Prah et al. 2023), and older experienced farmers (Lambongang et al. 2019). Lastly, the programme's beneficiaries were more likely to be members of FBOs, acquire additional income from the non-farm sector, and had greater access to credit, input and output markets. However, the above noted studies generally fail to recognise how participation in the subsidy programme was influenced by farmers' social characteristics, and the need to evaluate the programme from the point of view of resource-poor farmers. The characteristics of PFJ beneficiary farmers also suggest that the indicators that are used to measure the programme's performance (e.g., increased productivity and profitability) are to some extent a reflection of the social positions of the farmers, and not only of the farm subsidies made available under the programme. Asante & Bawakyillenuo's (2021) study of the 21 districts showed that a high proportion (37%) of PFJ beneficiaries were wealthy households, whereas most non-beneficiaries (41%) were poor. Further, Aberman et al. (2021) highlight how agro-input dealers were selective in their registration of farmers who would receive the subsidised inputs, often prioritising those farmers who they believed would be able to pay the remaining price of the inputs, as opposed to those who would not be able to honour the payments.

The propensity of better-off farmers to benefit from PFJ shows that shows that little attempt was made to target poorer farmers. An initial PFJ programme document distinguishes two groups of potential beneficiaries: this comprises those farmers "who are willing to participate and raise their current productivity levels (productive poor) and [those] whose land, water, labor and capital constrain productivity (resource poor)" (MoFA, 2017:14). This distinction

[20] Implying that they established access to farms through purchases as opposed to other tenure arrangements such as inheritance.

between *productive poor* (and other targeting criteria that approximate the 'progressive farmer' and contract farming models, see MOFA 2017:15) and *resource poor* farmers widens the inclusion criteria, making it possible for all groups of farmers (and more likely better-off farmers) to receive subsidised inputs from the programme. Actually, a farmer's simple expression of interest in the programme was a key criterion for inclusion. The only stipulated restriction, which also failed to consider farmer differentiation and thus applied to rich and poor farmers alike, was that farmers could only receive inputs for only two (2) hectares of their total farmed area.

Detailed discussions of the gender and generational dynamics of PFJ (beyond the male-headed households and older farmers are more likely to receive inputs) are lacking in the literature. However, Aberman et al. (2021) point to interesting findings about how subsidised inputs are sometimes shared among households members, while in other cases individuals seek to exercise control and prevent the use of their inputs by other household members. Thus, inputs, as elements of production, also reflect in co-operation within households, independent production, and the joint operation of farm enterprises by household member. The following quotes from Aberman et al. (2021:17) shed light on these dynamics:

1) "A female beneficiary in a dual-headed household, when asked if she shared inputs with her spouse, responded, No, he used all on his farm and I also used mine. In Ghana, we don't work together with the men because when they get the money, they won't give you (Beneficiary female, Ashanti Region)."

2) "When asked if he shared inputs with wife, another farmer responded: Yes, she used my own. We farm on the same plot so when I buy it, we are all use it (Beneficiary male, Greater-Accra Region)."

3) "Me, my husband, and my rival (second wife of husband) use the input. Our husband does the buying and give us each ours to use for our various farms (Non-beneficiary female, Northern Region)".

Planting for Food and Jobs is contrasted with the initial Fertiliser Subsidy Programme because of its intent to integrate input subsidies with extension services and the creation of linkages between farmers and other output markets. This distinction between both programmes is

however unwarranted given how they have actually performed during the course of time. Fundamentally, Planting for Food and Jobs is not different from FSP in terms of programme objectives and design. In both programmes, the government directly created the demand for inputs (chemical fertilisers in particular), leading the private-sector to respond to the demand and making profits thereof. There is also not much to suggest that the use of ICT to capture data, register farmers and monitor input sales (the E-agriculture component of PFJ) was effectively carried out. In 2019, efforts to integrate E-agriculture to the PFJ process were abandoned as a result of technical difficulties (Aberman et al., 2021:12). Perhaps, the main stated element that separated PFJ from FSP was its employment goals: the government projected that a total of 4.6 million jobs would be created under PFJ between 2017 and 2020 (MoFA 2017:32). The subsidies were expected to result in a spur in agricultural activity, which would in turn generate additional employment in agriculture.

Much of the projected employment was expected to occur in direct production and post-harvesting and processing activities. However, job creation suggests that people in the labour force – previously unemployed in agriculture – would take up new jobs in the sector due specifically to the subsidy programme. However, this is difficult to substantiate due to the lack of immediate labour market information and the seasonality of agriculture in Ghana. The assumptions underlying the employment estimates give too much power to subsidies, while ignoring critical factors that hinder involvement in agriculture (e.g. the ability to earn a decent living in the sector). The employment estimates are highly unrealistic, even if the assumption that agricultural growth will generate employment can be accepted. The estimates thus have to be seen as part a justification for the intervention – the selling of the project – rather than a genuine effort to understand labour market dynamics in the rural economy.

However, Planting for Food and Jobs was important in the sense that it reflected continuity in the implementation of input subsidies by two different governments. As a result, the subsidies have been in place outside of the context for which they were initially justified in 2008. However, political support for the subsidies has also been possible because of the continuous support for the programmes by the development partners[21]. Despite claims that FSP was terminated due to its high cost[22], funding for PFJ increased substantially, as shown by the quantities of inputs distributed under the programme. Between 2008 and 2016, the amount of subsidised fertiliser averaged 135,507 metric tonnes[23], while the figure under PFJ was 323,234[24]. Similarly, the number of farmers who benefitted from input subsidies expanded rapidly under PFJ. In 2017, more than 200,000 persons had benefitted from PFJ. This number trebled to 677,000 in 2018. By 2020, the number of PFJ beneficiary farmers had reached 1.7 million. Planting for Food and Jobs has also occupied a more central place in politics as compared with FSP. However, the programme's benefits have mainly accrued to better-off farmers, questioning the extent to which it has truly contributed to poverty reduction and improved food security among poorer farmers.

Seed Laws

In addition to attempts to increase farmers demand for commercial inputs are several important developments that show that the overarching goal of agricultural policy is to satisfy commercial interests. This includes the enactment of several laws that are mainly concerned with the commercial seed industry. In 2010, the Ghana government passed the Plants and Fertilizer Act (Act 803), the second part of which emphasises the production and marketing of registered

[21] "MOFA committed US$114 million to PFJ, whereas other development partners committed US$260 million." (KIT 2020:47).
[22] The total cost of FSP (2008 – 2016) is estimated to have been $90.6 million (Taylor 2022:1).
[23] This figure is based on the data provided in Table 5.1 by Houssou et al. (2017:14).
[24] This figure is based on the data in Table 4.1 above.

seed varieties. The law also outlines requirements for the local production of imported seed. In general, the Plants and Fertilizer Act is mainly concerned with the formal seed sector and the regulation of the commercial seed industry.

The state seeks to regulate through such measures as registration of seed producers and seed varieties, inspections and tests, certification of seeds, and to ensure compliance with standards. The law does not attempt to promote the parallel development of the informal seed sector but seeks to crowd it out in favour of the commercial industry. Only persons registered with the Ministry of Agriculture as seed producers can participate in the production and sales of "seed in commercial quantities." This is stated explicitly, but is also implied by requirements such as seed producers' use of seed conditioning facilities, the importance attached to inspections and tests, and conformity to quality standards. These are meant to root out fake seed dealers who sell low quality seed to farmers. In the year following enactment of the Plants and Fertilizer Act, the Ghana government passed a legislation for trials of genetically modified crops. This is seen as part of a process for the commercialisation of genetically modified crops, with attention initially given to *insect-resistant cowpea* and *climate-resilient rice* (NAS, 2016:283; Schurman, 2017:453).

Perhaps the most important piece of legislation that signifies the extent to which commercialisation has become the driving force behind seed policy was the passage of the Plant Variety and Protection Act, 2020 (Act 1050). The law grants special rights to plant breeders for their *discovery* or *development* of plant varieties. These rights are fully extended to non-Ghanaian persons and private enterprises that do not reside or operate in Ghana. Under Act 1050, seed varieties are privately-owned property, and with the exception of

experimentation, the permission of the breeder is required before the seed can be put to any commercial use. The extent to which this law is indeed beneficial to those plant breeders who have long yearned for its passage is questionable. This is because breeders cannot apply for breeders rights if the research leading to the development of the variety was undertaken as part of their responsibilities as employees of an organisation (Clause 8, 4). Further, the law's approach to resolving any potential disputes in cases where different plant breeders apply for rights for a similar variety is to prioritise the person (or group of persons) who first applied for the right (Clause 8, 5). The law's position on farmers' seed saving practices and exchanges among informal seed networks is also less emphatic. This is because while it is explicitly stated that plant breeders rights does not apply to cases where seed is used for experimental purposes, farmers' rights to save and exchange seed is an issue that has to be considered by the Minister of Justice and Attorney General in the formulation of the law's regulations.

Large-Scale Land Acquisitions

As previously noted, the renewal of fertiliser subsidies in Ghana was in large part influenced by the 2007/2008 food, fuel and financial crises. Another significant development associated with these crises has been the acquisition of large parcels of land in Africa by foreign private companies. A large amount of research has been published on these large-scale land transactions, with Ghana cited as one of the key destinations. However much has changed from the initial period when land grabs received much attention, and current data perhaps reflect the mixed nature and extent of transactions. In the case of Ghana, recent data indicate that land transactions approximating 89,000 ha were in operation (Land Matrix Africa Regional Focal Point, 2020). Many deals have been abandoned (113 000 ha), while information about others are unavailable (137 000 ha). Recent land grabs also involve the transfer of ownership of large parcels of land that were acquired in the past.

Tsikata & Yaro (2014) have examined two cases of these large-scale land acquisitions in Northern Ghana. These involved the acquisition of 552 hectares of land in Dipale by the Integrated Tamale Fruit Company (ITFC), and another acquisition of 13,600 hectares of land in Kpachaa and its surrounding communities by Solar Harvest Ltd. Because of the large amount of land involved in the acquisitions, farmers lost lands they used to cultivate, and had to move to less fertile land. The acquisitions were also associated with reduced farm sizes and crop diversity. There was also a reduction of the commons and fallow period, and a pattern of continuous cultivation on the same plot of land. Some farmers had to relocate to other communities as a result of the acquisitions. Because women gained access to land by cultivating the fallowed plots of their husbands, or by using family and community lands whose access were brokered by male relatives, the authors argue that the consequences of the acquisitions on women were relatively dire. Women's livelihoods, which frequently involved the collection of common resources such as shea fruits and fuel, were adversely affected as areas which previously constituted the commons were included in land transactions. Women now have to walk longer distances in order to access these resources. Even though the activities of both companies created opportunities for employment, women were mainly employed for those jobs that were of a casual and seasonal nature. In contrast, the more secured positions with employment benefits were dominated by men. However, it is also important to note that in spite of the adverse consequences of the land acquisitions for the rural communities, the economic performance of the two companies involved in the transactions have not been really encouraging. ITFC's operations, which involved a mango outgrower scheme suffered severely from bush fires and low production, while Solar Harvest Ltd eventually abandoned its project in 2012.

Cases of land grabs such as the one described above have received much attention in recent years due to concerns about their implications for rural livelihoods and land rights. However transactions in large parcels of land also include cases of privatisation of state lands, or joint ventures between the state and private companies. An example of this was the acquisition of 4,652 hectares of oil palm plantations in Prestea, which was previously under the management of the state-owned National Oil Palm Plantations established in the 1960s. This plantation was acquired by Norpalm Ghana Limited in the year 2000 and can be seen as part of the broader privatisation of state assets during structural adjustment. But there have also been fairly recent acquisitions of state lands. This includes several grants of leases by the Forestry Commission to private companies for the use of forest reserves. In addition to the direct acquisition of state lands, large-scale land acquisitions also include cases of transfers between private companies following an initial acquisition of state lands by a private company. For example, Plantations Socfinaf Ghana Ltd acquired 19,880 hectares[25] of rubber and oil palm farms at Daboase in 2012. This acquisition was initially made by Subri Industrial Plantation Limited in the 1990s, but was abandoned in 2002 before its transfer to Socfinaf in 2012.

4.7 Conclusion

This chapter of the study was an attempt to examine food and seed policy, and developments in the seed sector in relation to broader changes in agricultural commercialisation and economic change in Ghana. The chapter examined different forms of the organisation of agriculture promoted by the state, and changes in the policy perspectives and roles of the key actors that influence the direction of agricultural policy. The chapter also attempted to examine the

[25] This figure comes from the Land Matrix database and is similar to the 18,880 hectare figure reported by Bissell (2020:41). Loh, Asubonteng and Adanu (2022:18) report that land under the control of Socfinaf comprises 6,178 hectares of oil palm, and 1,012 hectares of rubber. This information was based on an interview with a company official.

distribution of agricultural programmes among geographical areas and different social classes. It is quite clear that state policy and interventions in food and agriculture have been influenced by crises in international markets and other external factors, the economic philosophy of governments (which are not static but malleable during periods of crises), and what is politically feasible at a given time given the disposition of the world's most important financial institutions and external donors.

In relation to the above, there is a clear distinction in the approach of the Ghana government to food and agriculture in the early 1960s. This was a period in which state farms, cooperatives, and mechanised agriculture represented the main means of producing sufficient food and diverting exports away from cocoa. An important conclusion has been reached in much of the literature that the state-centred agricultural programmes failed due to poor planning and challenges with requisite and adequate managerial and technical personnel, which was further linked with the rapid expansion of state's role in production. Other factors associated with the poor performance of the state projects include inadequate experience with the forms of agricultural production that were promoted, and conflicts among state institutions over the administration and supervision of the agro-industrial projects. Most criticisms of the programmes emphasise their high costs, unprofitability and inefficiency. For example, the mechanisation component of the cooperatives programme is criticised for targeting producers of *unprofitable crops*, and for charging farmers fees that were too low to generate sufficient revenues to repay suppliers. Thus, Miracle and Seidman (1968a:40) suggest that it would have been economical to import food than to import expensive machinery for food production. Others argue that the state programmes were used to achieve political objectives – for e.g. the recruitment of party members for employment – than their stated economic goals (Due 1969). The programmes have also been the subject of corruption and misappropriation of financial

resources. Lastly, state farms were also linked with labour shortages in rural areas. Thus, while they constituted only 1.2 percent of cultivated agricultural lands in 1964, Due (1969:647) argues that the expropriation of land for the state and cooperative farms resulted in land dispossession and labour shortages as many farmers moved to urban areas in search of employment.

Because of the poor performance of the state programmes, some authors argue that the government should have given more attention to the development of small-scale agriculture. For example, Akoto (1987) argues that investments in transport infrastructure, which he argues were reduced in the early 1960s in place of other programmes, might have facilitated the delivery of agricultural produce to urban food markets. However, not all of the state and cooperative farms were as terrible as they are often portrayed to have been. In spite of the intent to increase food production, significant attention was also given to the production of industrial crops. Half of the cultivated area under state farms were devoted to the production of industrial crops. Majority of these lands were acquired in the Western Region and were used to produce oil palm and rubber. The cooperative farms appear to have given more attention to food crops: 34 and 14 percent of the cultivated area were devoted to rice and maize, respectively (Miracle & Seidman, 1968a). Even in this case, a quarter of the cultivated area of cooperative farms was devoted to rubber production. Because most of these farms were not yet bearing at the time of the coup, the general conclusion – which are mostly informed by production, profitability and efficiency analyses – that the state projects failed, has not been strictly applied to the oil palm and rubber projects even by those authors most critical of the decision of the government to intervene directly in agriculture (See Miracle, 1970:327; Miracle & Seidman, 1968b:43-44). After the 1966 coup, some of the rubber projects in the Western region were acquired by The Firestone Corporation as part of the liberalisation of the economy following the overthrow of the CPP government (Beckman 1981). Those state agricultural projects – including oil palm

estates – which were not privatised were abandoned. During this period of liberalisation, Addo (1988) noted the tendency of the NLC/Busia governments to privatise those state assets that had the potential to be profitable, while those viewed in another light were left to the state.

Liberalisation of the economy, which commenced after the overthrow of the CPP government was put on hold in the 1970s, and there was a greater presence of the state in economic activities. In agriculture, the government intervened through imports and distribution of improved seed, chemical fertilisers, agricultural machinery, and the provision of credit. Attention was also given to the development of valleys and other irrigation infrastructure for rice production. The government also undertook interventions to reduce imports and increase oil palm output for agro-processing processing industries. On the surface, these interventions are similar to other projects that were promoted by the government in the early 1960s. However there are also striking differences between government interventions in these two periods.

In the 1970s, the government's green revolution was not centred on state farms, cooperatives or a general support for small-scale agriculture. Despite espousing the ethos of self-reliance and food self-sufficiency, government programmes mainly benefitted large-scale commercial farmers, including a discernible group of new entrants – army personnel and members of the public bureaucracy – with ties to the state. This appropriation of benefits associated with government investments was not restricted to commercial rice production but applied to other sub-sectors as well. The fact that the government's rice programme benefitted large-scale commercial farmers – whether this was a strategy that was determined from the outset, or whether it was an unintended outcome of agricultural policy – also demonstrates a convergence between the economic philosophy of the military government of the 1970s and the civilian government it had overthrown. This is because a focus on large-scale commercial rice

production had already been piloted by the private-sector friendly civilian government in the late 1960s.

Another important contrast between the 1970s and early 1960s is that, in the former, the government's role in agricultural production – particularly the three oil palm estates – were based on partnerships between international financial institutions such as the World Bank and large foreign private companies such as Unilever. Thus, the government's role in agricultural production and other economic sectors is seen as a *compromise* between the private and public sectors (Graham, 1993). Similarly, Hutchful (1979:51) argues that the mixed economy of the 1970s was not envisioned – as had been done by the CPP government – as part of the process of the *transition to socialism*. Rather, its purpose was to maintain a balance between the public and private sectors, ensuring that one sector did not upset the other.

Since the 1980s, the state has withdrawn significantly from direct production, and the role of undertaking economic activity has tilted heavily in favour of the private sector. This removal of the state from economic activity has been occurring on several fronts. Compared with its expropriation of land for state farms and outgrower schemes in the 1960s and 1970s, the state now seeks to undertake interventions that facilitate private investment in land and large scale commercial agriculture. Although the state still holds monopoly over cocoa exports, its role in the internal marketing of the crop has declined precipitously: compared to the 1980s when it marketed 80 percent of cocoa, the state's Produce Buying Company now markets only 16 percent of crop. In the seed sector, the state is not involved in the production, multiplication and distribution of certified seed. Its roles are mainly limited to research and the production of breeder seed that are farther away from the market. The state is more concerned with regulation, the purpose of which is to promote and protect an emerging commercial seed industry through its support for genetically modified crops and intellectual property rights, whose positive

impacts on the well-being of the poor is debated. Also, the participatory nature of seed development in the 1980s, with elements such as including farmers in trials of newly developed seed have been diminished. Recent interventions focus on how to increase farmers' access to agro-inputs. Thus, instead of being seen as participants in seed development, farmers are viewed as customers who have to be provided with commodities and other services for a profit.

Despite the decline in the role of the state, recent interventions to revive some elements of agricultural policy in the 1970s also points to contrasts in agricultural policy under neoliberalism. Perhaps, the most important example of these is the renewal of fertiliser subsidies. During the 1980s and 1990s, subsidies for inputs were removed. These actions were presumably justified on grounds of improving efficiency and managing government spending at a time when public revenues were dried up. However, fertiliser subsidies were renewed in 2008 in response to the global food crises. Similar measures had been introduced in several other African countries prior to the 2008 food crisis. As in the case of the 1970s, there is not much to suggest that the subsidies and other interventions (for e.g. the distribution of tractors to individuals) have mainly served resource-poor farmers. Also because the state is no longer involved in the import and distribution of fertilisers, the subsidies have benefitted the major fertiliser manufacturers and importers as it has allowed them to expand markets that were lost following the removal of subsides in the 1990s. Nonetheless, the fact that the state embarked on the subsidy programme – with significant support from the World Bank and other Western donors – also raises the issue of whether these institutions have had a change of heart and recognise an intervening role of African states in agricultural markets.

Another important feature of Ghana's relationship with the rest of the world over the last two decades has been the entry of 'new' development partners outside of the Washington based

institutions and Western donors. In general, these are reminiscent of the increased aid from the Soviet Union and Eastern Europe for the development of agriculture and agro-processing facilities in the early 1960s. Those efforts were evidently brought to an end with the overthrow of the CPP government in 1966. Since then, economic aid has mostly come from the World Bank, IMF, and other Western donors such as the West-German and Canadian governments, and USAID among others. However, Ghana has received considerable aid from countries such as China and India, which had little influence in financing development in the 1970s and 1980s. China, in particular, has been involved in infrastructural development in Ghana. In the agricultural sector, it has been committed to the development of irrigation infrastructure for commercial rice production. However, it has found more success in the agro-chemicals market, especially in the supply of herbicides. However, Chinese investments in Ghana – like interventions promoted by other development partners – are led by Chinese private companies, and thus represent an *agribusiness as usual* agenda rather a uniquely different form of cooperation.

Chapter Five

Intersections of Population Pressures, Agro-Ecologies, and Integration into the National Economy: A Comparative Analysis of Farming Systems of Four Districts in Ghana

5.1 Introduction

Agricultural development initiatives inspired by green revolution approaches make broad assumptions about African farming environments. These interventions are predicated on the availability of irrigated land, or that agricultural production mainly involves the cultivation of a handful of cereal crops. Further, there is a failure to highlight how production is organised, the result being that the role of labour in agricultural production is sometimes ignored, although this has important implications for livelihoods. In contrast to the generalisations, agricultural production in many parts of sub-Saharan Africa are rain-fed, usually involving different crop combinations beyond assumptions of the mono-cropping of the major cereals promoted in green revolution interventions. In addition, there are significant variations in land quality in most parts of sub-Saharan Africa, and where mono-cropping exists, these may apply to other agricultural products other than cereal crops. In short, inadequate attention is given to the diversity of farming systems, the factors that underpin these differences, and how farming systems have changed overtime.

This chapter examines the second research question of this study. It seeks to answer the question: what different farming systems exist among different geographic areas of Ghana, and how do these and their related social relations of production influence the adoption of seed and other technologies? The chapter addresses this question of diversity through a comparison of farming systems of four rural districts in Ghana. The selected districts help to illustrate the impacts of important factors, including, land availability and tenure, ecology, and history of

commercialisation on farming systems. The districts comprise the Garu-Tempane and East Gonja districts in Northern Ghana, and the Asunafo North (henceforth Asunafo) and Kwaebibirem districts in Southern Ghana. The districts are sometimes classified as the Northern and Southern districts to highlight their similarities. However, even among the districts, there are important variations, with each district embodying some particular characteristics that significantly separates it from others.

The Northern districts – Garu-Tempane and East Gonja districts – are located in the dry climates of the Sudan and Guinea savanna. Mean annual temperature in both areas range between 27.8 and 28.5^{0}C (Gordon et al. 2013:295). These are areas of relatively low humidity, with one rainy season that lasts from May to September (Table 5.1). However, there is a difference in the ecology of the two areas. East Gonja is located in the Guinea savanna woodland, where vegetation is dominated by many small drought-tolerant and fire resistant trees, shrubs and grassland. Among the trees, there are species that are preserved by farmers due to their economic benefits. These include: Baobab (*Adansonia digitate)*, Shea tree (*Vitellaria paradoxa)*, dawadawa *(Parkia biglobosa*), and neri *(Tamarindus indica)*. Although the plant and tree species in Garu-Tempane are similar to those in East Gonja, its vegetation, consistent with that of the Sudan Savanna as a whole, is dominated by grassland and has fewer trees (Siaw, 2001:6).

In contrast to the Northern districts, Asunafo and Kwaebibirem are located in the semi-deciduous forest zone in Southern Ghana. Compared to the North, these are areas of relatively low temperatures and high humidity (Table 5.1). There are two-wet seasons, the first and main one of which spans from March to July, while the minor season is experienced between September and November. The ecology of the semi-deciduous forest provides favourable conditions for the production of industrial tree crops, and this was crucial to the integration of

Ghana into the world economy in the colonial period. During this initial period, agricultural production for export markets was greatly assisted by labour migration from northern Ghana, especially from places with high population density. In Asunafo, commercial agriculture is mainly characterised by cocoa production. Many farmers from the Ashanti, Brong Ahafo, and Eastern regions moved into this area to produce cocoa after the end of the Second World War (Adomako-Sarfoh, 1974). In contrast, cocoa production in Kwaebibirem appears to have gained relevance only in recent decades as most farmers focused on citrus and oil palm production (Amanor, 1999:101-105). The establishment of the GOPDC in the late 1970s was a high point in land and agricultural commercialisation in the Kwaebibirem district.

Land availability, ecological factors, the historical integration of different areas into the national and world economy during the colonial period, and labour relations have resulted in particular configurations of farming systems in Northern and Southern Ghana in general, and the four districts in particular. The cases of the two districts in Northern Ghana are examined in Section 5.2. Agriculture in these areas is dominated by food production for household consumption and domestic markets. In Garu-Tempane, the main crops produced are cereals, and production revolves around the use of household labour. Population pressures in Garu-Tempane have resulted in continuous cropping and attempts to improve land yields through the application of organic manure and chemical fertilisers. Similar to Garu-Tempane, household production is important in East Gonja. However, there is a class of commercial farmers who cultivate large plots of land and rely mainly on hired labour. East Gonja is also significantly different from Garu-Tempane in terms of its high herbicide application, and the reliance on machinery for ploughing. In turn, farming systems in the Southern districts of the semi-deciduous forest are examined in Section 5.3. In contrast to the North, commercial agriculture in these areas mainly involve the production of cash crops for domestic and external markets. The convergence of agricultural commercialisation and inheritance norms have

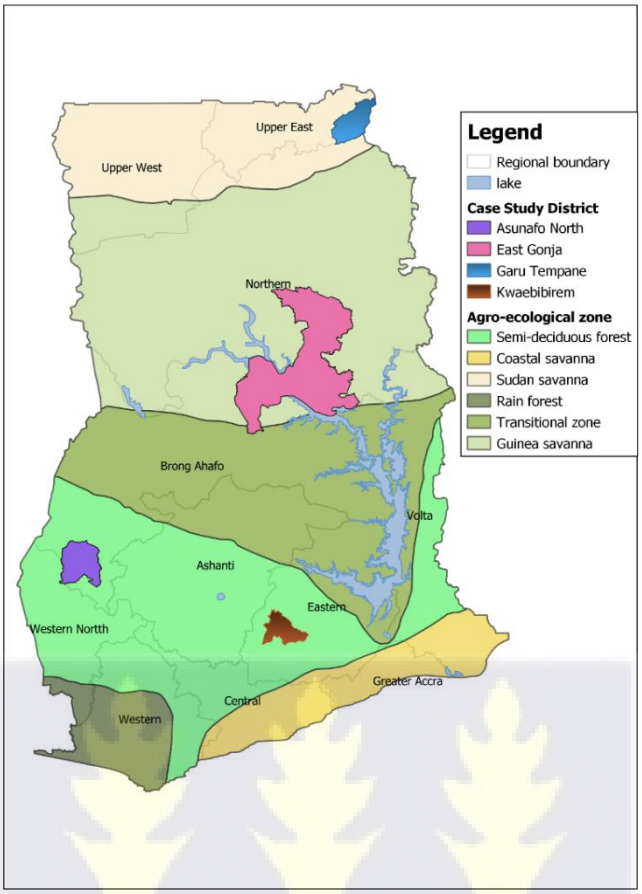
resulted in land shortages, and weak land rights for women and youth. In Kwaebibirem, land shortages are exacerbated by small-scale mining, whereas in Asunafo it is due to forest reserves that were established in the colonial period. The chapter concludes by revisiting the relationship between agroecological characteristics, factors of production, and social relations of production, and how cropping systems, agricultural commercialisation, labour relations, and access to land influence the processes of agrarian change.

Table 5. 1 Features of the Six (6) Agroecological Zones of Ghana

Agro-ecological zone	Area (km^2)	Relative Humidity	Mean annual rainfall (mm)	Range (mm)	Major rainy season	Minor rainy season
Rain Forest	9 500	75 – 90%	2 200	800-2 800	March-July	Sept.-Nov.
Deciduous Forest	66 000	80% in the dry season; 90% in mornings and wet seasons	1 500	1200-1 600	March-July	Sept.-Nov.
Transitional Zone	8 400	85 – 88% in the morning; 70 – 74% during midday	1 300	1100-1 400	March-July	Sept.-Oct.
Coastal Savanna	4 500	55 – 65% in the day; 40% in "the major dry season"	800	600-1 200	March-July	Sept.-Oct.
Guinea Savanna	147 900	40% in the dry season; up to 84% in the rainy season	1 000	800-1 200	May-Sept.	
Sudan Savanna	2 200	40% in the dry season; up to 84% in the rainy season	1 000		May-Sept.	

Source: FAO 2005; Gordon et al. (2013); Castaldi et al. (2013).

Figure 5.1 The Four Research Districts in Their Respective Regions and Agroecological Zones in Ghana



Source: Osei & Stein (2017), modified to include research districts of the DEMETER Project.

5.2 Cereal and Tuber Crop Production under Intensive and Extensive Systems of Cultivation in the Northern Savanna

Rural Livelihoods

The Northern districts are predominantly rural, especially Garu-Tempane, where 84 percent of the population live in rural areas (GSS 2021). In East Gonja, the rural population is only slightly lower (79 percent). Agriculture is the main livelihood in both Northern districts. However employment in agriculture is slightly higher in Garu-Tempane (85 percent) compared with East Gonja (77 percent). Also, the gap in the employment of men and women in agriculture is more marginal in Garu-Tempane than in East Gonja where 86 percent of men were engaged in agriculture compared with 66 percent of women (Table 5.2).

In general, the majority of farmers were small producers whose main priority was the production of food for household consumption and markets. In Garu-Tempane, large scale-commercial agriculture was limited, with only approximately 2 percent of farms being 4 hectares or larger (Table 5.3). In contrast, there was a significant segment of commercial farmers in East Gonja who operated large farms and relied substantially on mechanised equipment.

Animal husbandry is an important supplement to food cultivation, and farmers mainly keep animals such as poultry and ruminants. In some instances, as in the case of goats, men are more likely than women to keep these animals. Deaths of animals due to diseases is a major drawback to livestock rearing, especially in East Gonja. Pastoralism, as a distinct form of animal husbandry, is practised in both Northern districts. However, this occasionally resulted in tensions between herders and crop farmers due to competition over water resources and the destruction of crop farms by animals. These negative consequences are perceived by farmers and development professionals to be associated with pastoral activities of the Fulani, although similar tensions sometimes occur between indigenous livestock owners and crop farmers.

In the Kafaba and Makango communities in East Gonja, fishing is an important livelihood for a small but predominantly 'non-indigenous' population whose activities are concentrated along the Volta River. Other activities combined with agriculture include male-dominated artisanal work such as masonry and carpentry, and among men in Garu-Tempane, labour movements to Southern Ghana for farm work. Women are also involved in petty trading, soap making, shea butter processing, the selling of charcoal and firewood, cassava processing, and the selling of locally brewed beer (*pito*).

They also trade forest resources such as *dawadawa* and shea nut. Income from women's production and selling of charcoal and firewood enables households to acquire food in the wet-season when farm activities are at their peak but food stocks are low.

Table 5. 2 Social and Economic Characteristics of the Two Northern Districts

		Districts	
Indicators	Ghana	Garu-Tempane	East Gonja
Population (2010)	24,658,823	130,003	135,450
Population (2021)	30,832,019	158,767[26]	157,159
Percent female (2021)	50.7	52.3	49
Percent rural population (2021)	43.3 (47.2)[27]	84.4 (92.5)	79.2 (100)
Population density (persons/km^2) (2010)	103.4	122.5	16.2
Population density (persons/km^2) (2021)	129.3	146[28]	21.16
Household size (2021)	3.6	5.4	4.5
Percent female headed households (2010)	34.7	16.3	14.0
Percent migrant population* (2010)	1.0	4.7	14.5
Percent employed in agriculture (2010)	42.0	85.2	77.3
Female	38.3	82.8	66.5
Male	45.9	88.4	86.4
Percent of households engaged in agriculture (2010)	45.8	95.4	72.6
Rural	76.1	97.2	81.3

Source: GSS (2021) and Dzanku et al. (n.d.).

[26] Data were presented separately for Garu and Tempane in the 2021 census due to the creation of the Tempane district in 2018. Similarly, East Gonja is now administered as two separate districts: East Gonja, and North East Gonja. However the districts are still examined in this study based on their constitution prior to their separation in 2018 and 2019 respectively.

[27] In the 2021 census, the GSS produced two figures for the population living in rural areas: these were based on its standard definition of rural areas as "localities with population less than 5,000", and a new criterion which defined rural areas as "Localities without urban infrastructure" (GSS, 2021:99).

[28] For the Tempane district, the population density was as high as 211.5

* "The national figure is based on foreign nationals living in Ghana, whereas the district level figures are based on the definition of crossing and living outside the administrative boundary of one's birth" (Dzanku et al. n.d:8).

Table 5. 3 Farm Sizes (Hectares) in the Two Northern Districts

District	Median farm size (ha)	<1 ha	1.0 – 1.9 ha	2.0 – 3.9 ha	4 – 30 ha	Total
East Gonja	1.2	212	121	92	45	470
		45.11	25.74	**19.57**	**9.57**	100
		43.44	51.49	68.15	84.91	51.59
Garu-Tempane	0.8	276	114	43	8	441
		62.59	25.85	9.75	**1.81**	100
		56.56	48.51	31.85	15.09	48.41
Total	1.2	488	235	135	53	911
		43.47	29.96	18.62	7.95	100
		100	100	100	100	100

Source: DEMETER survey, 2020

One of the main features of agriculture in Northern Ghana is the production of food crops in close proximity to residential units. This cultivation system is clearly evident in Garu-Tempane where close to 80 percent of the 441 farms were within 30 minutes of the place of residence. In contrast, longer distances between dwellings and farms were more pronounced in East Gonja: only 12 percent of farms were within 30 minutes of the residential unit, while 38 percent of farms were more than 100 minutes away from the dwelling (Table 5.4). This points to land availability and extensive cultivation in East Gonja in contrast to Garu-Tempane.

Table 5. 4 Distances to Farm in the Northern Ghana (Minutes)

District	Median	1-30	35-60	70-90	>100	Total
East Gonja	90	58 (12.34%)	161 (34.26%)	72 (15.32%)	179 (38.09%)	470
Garu-Tempane	10	350 (79.37%)	55 (12.47%)	4 (0.91%)	32 (7.26%)	441
Total		408 (44.79%)	216 (23.71%)	76 (8.34%)	211 (16.90%)	911

Source: DEMETER survey, 2020

Cropping Systems and Land Availability

In East Gonja, the main crops produced are yam, rice, maize and cassava. Production is for both household consumption and local markets. Yam is a particularly important commodity crop. It is traded in local town markets, and major towns and cities in both Northern and Southern Ghana. The trade in food is primarily mediated by women traders, including those from outside the district. Other crops cultivated in East Gonja besides those noted above are groundnuts, okra, cowpea, Bambara beans, millet, and sorghum. Although men may produce these crops, they are mainly associated with women's productive activities. While some women cultivated some of the main staples, their farms were generally smaller (See Appendix, Tables 5.16 – 5.19). In Garu-Tempane, the main crops are maize, millet, rice, and sorghum. Both men and women cultivate these crops, but as compared with East Gonja, differences in the sizes of farms cultivated by men and women are not significant, although maize is an exception (See Appendix, Table 5.15). Again, the main cereals are produced for food and trade in local town markets and beyond. Sorghum and soya beans are important commercial crops. There is an important market for sorghum due to its use by the Guinness Ghana Breweries Limited (GGBL) as an ingredient in beer production. The supply of sorghum to GGBL is coordinated by the Presbyterian Agricultural Station in Garu (PAS-GARU), which also facilitates farmers' access to inputs. Women in Garu-Tempane have also participated in the commercialisation of sorghum, soybean and onion.

In East Gonja, some farmers in the Makango community are involved in dry season tomato farming along the banks of the Volta River. The development of irrigation infrastructure for crop production throughout most of the year is generally lacking. Thus much of agricultural production of the main staples occurs in the major rain-season.

The planting and harvesting of different crop varieties, and the timing and distribution of labour activities sometimes makes crop farming a year-long activity. This is particularly the case for yam where harvesting is immediately followed by another cycle of land clearing and preparation, raising of the mounds, planting and weeding. For instance, a male farmer in *Grushie Zongo* mentioned that he cleared and prepared his land for early planting in January, while late planting was done in April. Cassava production is also sometimes viewed as a year-long process since important activities such as its processing into flour or *gari* occur outside of the main wet-season. In contrast with East Gonja, dry season vegetable production is more vibrant in Garu-Tempane. This is due to the availability of some irrigation facilities that enable some farmers to cultivate crops such as onions, pepper, okra and watermelons for sale between the months of December and May. Incomes from these activities are used to purchase staples such as maize when food stocks have dried up, and to cater for other expenses. The possibility of improved livelihoods resulting from irrigation are apparent, however, many farmers are unable to participate in the dry-season farming due to lack of access to water and land in the irrigated areas. Development professionals at the local level argue that the expansion and development of additional irrigation infrastructure will promote production throughout the year and help stem the migration of young people to Southern Ghana.

In both Northern districts, the main staples are sometimes produced as monocrops. In some instances, even crops such as soya, Bambara beans, groundnut, okra and pepper are produced as monocrops. However, intercropping is practised widely. For example, cassava and maize are sometimes intercropped with yam in East Gonja. Intercropping is similarly applied to different sets of cereal and vegetable crops including the following: millet and maize, sorghum and millet, and pepper and okra. Intercropping also involves the combination of cereal and legume crops. For example, it is common for farmers to intercrop maize or millet with soya, Bambara beans and groundnuts.

The practice of mono-cropping and intercropping are strongly influenced by land availability, land ownership rights and a sexual division of labour regarding household food provisioning. East Gonja has a population density of 16 persons per square kilometre and is endowed with vast and fertile agricultural lands suited to different agricultural production activities. Indigenous farmers mentioned that they did not need the permission of others to access land, and could freely move in search of land for cultivation, to the extent that such lands had not been cultivated by another farmer. This relative access to fertile land accounts for the production of tuber crops – especially yam – and the practice of bush fallowing associated with it. The 'removal', 'killing', and 'uprooting' of trees and 'burning' of vegetation were thus commonly associated yam cultivation. However, it is increasingly becoming difficult to find arable lands that have not been used before. This is because what is considered as new land is also likely to be land that is being fallowed by another farmer, without whose consent cultivation cannot be successfully undertaken. The permission of previous users helps to prevent disputes arising from the cultivation of the same plot by different farmers. The increasing difficulty of gaining access to 'fresh' lands in East Gonja is reflected in the length of the fallow period, with yam farmers now leaving their lands to fallow for only a short period of two to three years while continuing with production on other lands, as compared to six to ten years in the past. Further, in spite of wide recognition by most people of the availability of arable land, some respondents still complained about poor soils and associated it with low yields, indicating that soil infertility is also location specific even in a large area such as East Gonja where it was not generally regarded as a problem.

In stark contrast to East Gonja, land scarcity is a major problem in Garu-Tempane where the population density is 123 persons per square kilometre. Fallowing is rare, and farming very often involves cultivation of the same plot of land on an annual basis. Related to inadequate

land is a general problem of soil infertility, to which many farmers have responded by several attempts at soil improvement. For instance, chemical fertilisers were applied to more than 80 percent of farms cultivated by both men and women in 2020 (Table 5.6).

Table 5. 5 Median Farm Size (hectares)

	All farm plots		Maize		Millet		Yam		Groundnut		Cassava	
Districts	Men	Women	Men	Women	Men	Women[29]	Men	Women	Men[30]	Women	Men	Women
East Gonja	1.2	0.8	1.6	0.8	0.8	–	1.2	0.8	1.2	0.8	1.2	0.8
Garu-Tempane	1.0	0.6	1.2	0.8	1.2	1.2	–	–	–	0.4	–	–

Source: DEMETER survey, 2020

Median Farm Size (hectares) (continued)

	Rice (paddy of dry season)		Rice (paddy of wet season)		Sorghum		Soybean	
Districts	Men	Women[31]	Men	Women	Men	Women	Men	Women
East Gonja	2.6		1.6	0.4	1.2	0.8	1.21	1.8
Garu-Tempane	1.2	0.5	1.6	0.4	1.0	0.8	1.61	0.8

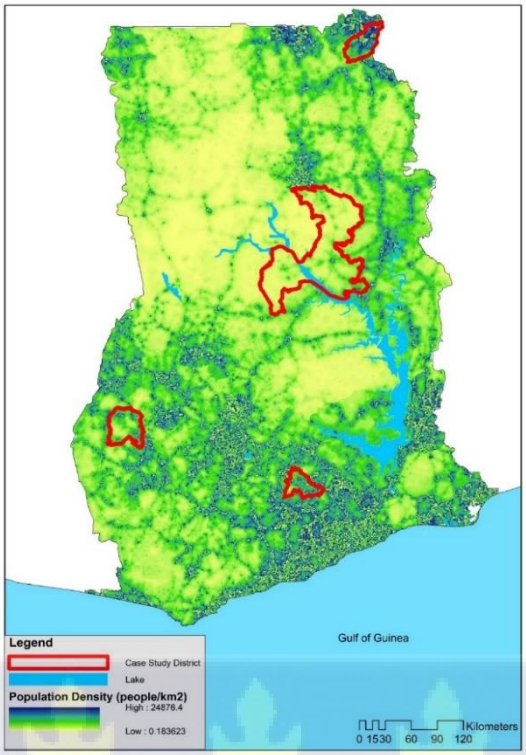
Source: DEMETER survey, 2020

[29] No figure was presented for women in East Gonja, suggesting that women surveyed in the district did not farm millet.

[30] No figure was presented for men in Garu-Tempane, suggesting that men surveyed the district did not produce groundnut.

[31] While men's farms were generally larger than farms cultivated by women, this disparity was further wider for rice farms. In both Garu-Tempane and East Gonja, the size of rice farms cultivated by men in the wet-season (1.6ha) was four times the figure estimated for women (0.4ha). In East Gonja, none of the dry-season rice farms were cultivated by women, suggesting that interventions to boost dry season rice production may perhaps have benefited male commercial farmers.

Figure 5.2 Population Densities of the Four Research Districts



Source: Map was generated by Raphael Edem Fiave for the Candidate

Table 5. 6 The Use of Improved Seed (Planting Materials), Other Agro-Inputs, Machinery and Irrigation (Percentages)

Inputs	Garu-Tempane	East Gonja
Organic manure	**40**	**8**
Men	52	7
Women	26	13
Chemical fertilizer	**85**	**30**
Men	86	29
Women	84	33
Pesticides	**24**	**4**
Men	28	3
Women	18	9
Weedicides	**38**	**79**
Men	39	81
Women	35	72
Improved seeds	**36**	**7**
Men	33	7
Women	38	4
Machinery (e.g. tractor)	**4**	**74**
Men	3	74
Women	5	71
Bullock ownership	**35**	0.00
Men	43	0.00
Women	24	0.00
Irrigation (Is plot irrigated in the dry season)	**16**	**4**
Men	15	4
Women	18	4

Source: DEMETER Survey, 2020

Land Tenure

In both Garu-Tempane and East Gonja, much of agricultural land is acquired through inheritance (Table 5.7). This in most cases represented a household's portion of family land. However, inheritance practices greatly favour men: land is inherited either by a man's sons or his brothers. Men's dominant control over land resources is first underpinned by an ideology that their produce (which are the main local starch-based staples of the family farm) belong to the family. In addition, women's rights to land are weakened by the residential norms that relate to marriage. Thus, it was frequently noted that "women…cannot inherit land because they will marry some people elsewhere and they can't send the land to their marital home" (a participant in a women's FGD in East Gonja, 2016). These ideologies are reflected in the smaller farm sizes of women, and in some instances their limited role in agriculture. Thus, in East Gonja where land availability is widely recognised as a potential for development, men dominate the production of even those crops that are regarded as women's crops. For example, 80 percent of the groundnut farms in East Gonja were farmed by men (Table 5.8).

In contrast, differences in the distribution of farm plots among men and women are less stark in Garu-Tempane (Table 5.9). In spite of the uneven distribution of land and farm plots – especially in East Gonja – there are several mechanisms which enable women to navigate their rights to land. Women are able to continue farming on plots that are cultivated by their fathers or husbands upon death. In the latter case, access is granted on the grounds that food has to be produced for household consumption, until the children are old enough to take up farming. Women are also able to gain access to land through their husbands. Men may also play an important role in introducing their wives or female relatives to landowners for the purposes of making a request for land. Further, women are able to collect forest resources such as *dawadawa* and shea nut from family farms.

In East Gonja, women frequently gain access to land by cultivating farms that are being fallowed by their husbands. This is particularly common with yam production. Thus, as men move in search of more fertile land for yam production, women gain access to old farms to which they plant legume crops such as groundnuts. Thus, even the short-term fallows are not strictly adhered to since it is common for women to take up production on these farms. However legumes are nitrogen-fixing crops and play a role in restoring soil fertility. Thus, women cultivate legume on fallowed plots because they are crops that perform favourably in soils depleted of nutrients. In general, the differences in crops cultivated by men and women, which are strongly tied to soil fertility, indicate that women's crop choices and more intensive use of land, as evidenced by practices of intercropping, are in part due to inequalities in access to fertile land.

In East Gonja, chiefs exercise significant control over land resources due to claims of custodianship or landownership. Thus they are able to give out large parcels of farmland to non-indigenes and large-scale farmers for commercial production. The acquisition of land from chiefs frequently involves the giving out of 'gifts' or 'kola', which sometimes raise questions about whether these are items of limited monetary value required as part of mere customary procedures, or that they are used to symbolise cash transactions. For example, when the acquisition of land by a commercial farmer had resulted in disputes between two community chiefs, one of them was unable to bring the matter before the *Kpembewura* (the political head of the *Kpembe* division of the Gonja state) for resolution "because of the cola he had collected from the people." (Male, Key-informant; East Gonja, 2016). In another instance, a commercial farmer lost access to land he had acquired for rice production because he failed to settle a dispute with an indigenous farmer whose cattle had destroyed part of his farm before the community chief.

Instead, the settlement was determined in a law court, and the amount expected of the indigenous cattle owner "was bigger than the cola he paid." (ibid). In general, however, outright land purchases appear to be non-existent in the farming communities of East Gonja and Garu-Tempane. More commonly, lands are given out for only one farming season, and commercial farmers are required to provide landowners with some farm produce after the harvesting season before further agreements for the impending season are sealed. A commercial rice farmer who cultivated "hundred acres of rice" in 2015 mentioned that he negotiated to pay "two bags of rice per every ten acres." (Man; East Gonja, 2016). In Garu-Tempane, the annual negotiation for land is partly informed by fears of loss of control over land resources, especially when lands are given out to local farmers for an extended period of time. Research from other districts of Northern Ghana similarly highlight that land transactions involving cash exchanges have only become an important feature of land commodification in urban and peri-urban areas, but not so much in rural farming communities (Akaateba 2019; Yaro 2010; Zackaria 2010).

Table 5. 7 Modes of Land Acquisition in the Northern Savanna

Mode	Garu-Tempane	East Gonja
Inheritance	94.0	78.3
Sharecropping	1.7	0.0
State allocation	0.9	18.3
Purchase	2.6	0.8
Gift	4.3	1.7
Rentals	1.7	0.0
Other (free, contract farming etc.)	4.3	2.5

Source: DEMETER Survey 2017

Table 5. 8 Food Crop Production among Men and Women in the East Gonja District

Crop	Male	Row percentage	Female	Row percentage	Total no. of farms
Maize	137	87	21	13	158
Groundnut	117	80	30	20	147
Yam	119	91	12	9	131
Cassava	69	95	4	5	73
Rice (paddy of wet season)	55	96	2	4	57
Okro	40	74	14	26	54
Sorghum	30	77	9	23	39
Soybean	11	65	6	35	17
Cowpea	12	71	5	29	17
Millet	5	100	0	0	5
Rice (paddy of dry season)	4	100	0	0	4
Total number of farms	599		103		702

Source: DEMETER Survey 2020

Table 5. 9 Food Crop Production among Men and Women in the Garu-Tempane District

Crop	Male	Row percentage	Female	Row percentage	Total no. of farms
Maize	139	54	118	46	257
Sorghum	55	55	45	45	100
Soybean	40	53	36	47	76
Millet	35	66	18	34	53
Rice (paddy of wet season)	15	37	26	63	41
Onion	13	54	11	46	24
Rice (paddy of dry season)	3	43	4	57	7
Groundnut	0	0	3	100	3
Total number of farms	300		261		561

Source: DEMETER Survey 2020

Labour Relations

Farming activities greatly involve the use of human labour, the main sources being farmers themselves, family labour, and hired labourers. Some farmers rely on what can be described as 'self-help' labour groups whose members are often rewarded with cooked food or farm produce when they assist in harvesting. However, this is a less prominent form of labour. Hired labourers include individual labourers who are engaged for specific tasks for which they receive a daily wage, commonly described as 'by day' in the farming communities. However large commercial farmers prefer to hire labourers in groups, including women's labour groups. At the household level and in the rural labour market, there is a gendered division of labour, with women and men preferred for specific activities. For example, women were more likely to be engaged for planting and harvesting while men performed activities such as weeding, land preparation, and raising of mounds on yam farms. In East Gonja, labourers are hired from communities within the district, however, many also come from places outside the district and the Northern region in general. Most of these labourers are men who are engaged for yam production activities. However, the supply of labour appears to be reducing due to attraction by economic sectors such as small-scale mining. On the other hand, human labour is equally being substituted by cheaper inputs and machinery. This is evidenced by the substantial use of weedicides and tractors for weed control and ploughing, respectively (Table 5.6). In Garu-Tempane, women do not only contribute substantially to work on household farms but also dominate the rural labour market, which in large part is constituted by their labour groups. Women's increased participation in agricultural labour markets is principally due to their inadequate access to land. Labour provides them with an opportunity to earn incomes, no matter how small, that they can control.

They are also preferred "Because they are hardworking and can easily be managed", and because of the higher cost of men's labour: "Men do request for cigarette, cola nuts and drinks, while women do not." (Man, 41-year-old, Garu-Tempane, 2016). Further, women in Garu-Tempane are engaged for a broader range of activities than women in other places. In addition to sowing, watering and harvesting, women are greatly involved in weeding and fertiliser application, tasks which are conventionally associated with men's work in other places. The only activity dominated by men is land preparation (which sometimes involves tilling using animal traction). Much of agricultural labour is supplied from within farming communities. However labour shortage is a major challenge in the main farming season since women's first labour obligation is to the household. Labour supply has also reduced due to the increased participation of younger household members in schooling. The demand for women's labour by the household, and their greater involvement in the agricultural labour market indicates that they may be overburdened with work.

This section of the chapter compared farming systems among the Garu-Tempane and East Gonja districts of Northern Ghana. While agriculture is the predominant economic activity in both Northern districts, there are important contrasts between the two districts with respect to scale, labour and technology. Production in Garu-Tempane is predominantly small-scale, with majority of farms being smaller than 1 hectare. Production is also mainly carried out with the use of family labour. Population pressures have resulted in severe land shortages, and farming is characterised by continuous cropping, with increased application of organic manure and chemical fertilisers as measures to improve soil fertility. In contrast, land fertility in East Gonja is achieved through fallowing, which is made possible by relative land availability in the district. Like Garu-Tempane, agriculture in East Gonja is dominated by small-scale production based on the use of household labour.

However, farms are relatively larger, and there is a discernible class of large commercial farmers who rely on hired labourers, including seasonal migrant labourers who come from other districts. Farming in East Gonja is also characterised by the high use of weedicides and tractors.

5.3 Tropical Tree Crops under Permanent Farming, Seasonal Cultivation of Local Staples, and the Intensification of Rice and Vegetables in the Semi-Deciduous Forest

Rural Livelihoods

Similar to the Northern districts, agriculture is the main livelihood activity in the Asunafo and Kwaebibirem districts of the semi-deciduous forest. However, employment in agriculture is much lower. Only 40 percent of the working population in Kwaebibirem was engaged in agriculture in 2010 compared with 60 percent in Asunafo (Table 5.10). Men in Kwaebibirem are more likely than women to be employed in agriculture. This is also true for Asunafo, but the difference is less stark (Table 5.10). In both districts of the deciduous forest, crop farming is the most important of all production activities, and is sometimes combined with the rearing of poultry and livestock. The main crops produced are cocoa, plantain, cassava and cocoyam. Other crops produced include oranges, oil palm, maize, rice, vegetables (garden eggs, tomatoes, pepper, okra, cabbage, carrots and onion), pineapple and cashew. Food crops are produced for both household consumption and markets. In Kwaebibirem, rice and maize are important commodity crops, however, some farmers complained about the low demand for rice in spite of its high production. In addition to food crops, animals such as goats are occasionally sold when the need for cash is most pressing. There are also other livelihoods beyond the direct participation in agriculture. For example, women are involved in the trade of local farm produce (e.g., rice, cassava, and vegetables).

Others sell cooked food, local gin, charcoal and other consumables. Men also work as artisans, performing roles relating to construction and painting, while others participate in trades such as tailoring and the operation of retail shops. In Kwaebibirem, labourers comprise an important part of the rural economy. Although women undertake oil processing on their own, many are also employed in a range of roles related to the oil processing activities of the *krama* ('smaller oil processing groups'). In the Asuom community, many women are informally employed as fruit cleaners by Serendipalm, a small-medium agro-company that exports its semi-finished oil palm products to the U.S and Germany for further processing. Sometimes, there are strong connections between these other livelihoods and direct involvement in agriculture. For example, women involved in oil processing activities obtain palm fruits from their own farms or relatives; similarly, women rely on the food crops they cultivate for their food vending businesses. For men, employment as farm workers, or labourers in the small-scale mining industry has been an important source of income for investment in land and labour for cash crop production.

Table 5. 10 Social and Economic Characteristics of the Two Districts in the Semi-Deciduous Forest of Ghana

		Districts	
Indicators	Ghana	Asunafo North	Kwaebibirem
Population (2010)	24,658,823	124,685	113,721
Population (2021)	30,832,019	150,198	121,698
Percent female (2021)	50.7	49.2	50.6
Percent rural population[32] (2021)	43.3	47.1	57.4
Population density (persons/km^2) (2010)	103.4	88.3	99.1
Population density (persons/km^2) (2021)	129.3	105.2	151.3
Household size (2021)	3.6	3.5	3.2
Percent female headed households (2010)	34.7	31.4	34.1
Percent migrant population* (2010)	1.0	39.4	31.1
Percent employed in agriculture (2010)	42.0	60.3	39.6
Female	38.3	57.7	33.7
Male	45.9	62.8	45.6
Percent of households engaged in agriculture (2010)	45.8	71.8	55.9
Rural	76.1	85.9	72.8

Source: Compiled by Dzanku et al. (n.d.) from various District Analytical Reports of the 2010 Population and Housing Census.

Table 5. 11 Farm Sizes (Hectares) in the Semi-Deciduous Forest

District	Median farm size (ha)	<1 ha	1.0 – 1.9 ha	2.0 – 3.9 ha	4 – 30 ha	Total
Kwaebibirem	1.2	229 (34.96%)	243 (37.10%)	132 (20.15%)	51 (7.79%)	655
Asunafo North	1.6	65 (27.90%)	61 (26.18%)	68 (29.18%)	39 (**16.74%**)	233
Total	1.2	294 (33.11%)	304 (34.23%)	200 (22.52%)	90 (10.14%)	888

Source: DEMETER survey, 2020

[32] The figures reported here are based on the definition of rural areas as settlements with populations of 5,000 persons or less (GSS 2021:24).

Farm distances are slightly longer in Asunafo than in Kwaebibirem (Table 5.12). In general however, farm distances are longer in the deciduous forest compared to Garu-Tempane. This suggests that cultivation in the deciduous forest is extensive relative to Garu-Tempane, where a more intensive cultivation was previously noted. In contrast, farm distances are longer in East Gonja relative to the Southern districts, indicating greater extensification in the former. However many farms in the deciduous forest are under permanent cultivation due to incentives for export crop production. In Asunafo, one-third of all cocoa farms are more than 100 minutes away from farmers' places of residence compared to 18 percent for Kwaebibirem.

Table 5. 12 Distances to Farms in the Southern Districts

District	Median distance	1-30	35-60	70-90	>100	Total
Kwaebibirem	60	179 (27%)	293 (45%)	65 (10%)	118 (18%)	655
Asunafo North	60	63 (27%)	78 (33%)	29 (12%)	63 (27%)	233
Total		242 (27%)	371 (42%)	94 (11%)	181 (20%)	888

Source: DEMETER Survey, 2020

Cropping Systems

Cocoa is the most important of all crops and is produced on nearly half of the total area devoted to crop production in Asunafo. In Kwaebibirem, the rate is 40 percent. The development of new cocoa farms often involves the intercropping of young cocoa plants with food crops such as plantain, cocoyam and cassava. Plantain, in particular, is important because its high water content and shade provide the microenvironment conducive to the survival of young cocoa plants. A 48-year old male cocoa farmer in Asunafo noted: "We cut the trees and then plant plantains, cassava and in the ninth month we intercrop with cocoa, we keep weeding every 3 months." Plantain is thus used to 'bring up the cocoa' as other farmers mentioned. Further, the intercropping of food crops with cocoa provides farmers with food for several years before cocoa trees start to bear fruits that can then be marketed for cash.

In this instance, intercropping does not necessarily signify attempts at intensive cultivation but rather underlines a strategy of successful cocoa development and access to food in the years preceding the maturation of the cocoa trees. In fact, the relationship between food crops and cocoa ceases to be complementary when matured cocoa trees, with fully formed canopies, prevent the cultivation of food crops. This gradation from intercropping to the mono-cropping of an industrial tree crop comprises one of the major causes of seasonal food shortages in Asunafo.

Other cash crops cultivated by farmers besides cocoa include oranges, cashew, and pineapple. In Asunafo, teak is even being taken up by some farmers. However, these crops often lack major support and present farmers with challenges similar to those of cocoa. For example, cashew was reported to be labour intensive and took up too much land. Crucially, these 'new' commercial crops are mostly planted when the quality of land is too poor to support cocoa. In Kwaebibirem, farmers are converting old citrus farms to cocoa or building plots due to low prices. In both Asunafo and Kwaebibirem, vegetables are increasingly being cultivated as commercial crops. In Asunafo, the uptake of vegetable production has sometimes involved farmer support and training by agribusiness supported-NGOs seeking to find alternative livelihoods for farmers outside of the main cocoa season. Commercialisation has occasioned some changes in production methods and the extent of men and women's participation in vegetable production. Vegetable crops were commonly cultivated in close proximity to streams, or were intercropped with the main food staples by women. However, commercialisation has also involved a reliance on modern equipment and an increasing participation by men due to high demand and better prices for such commodities. These changes were best captured by a 46-year-old woman in Asunafo who noted:

> "Men even grow vegetables in this community more than women do. Women only intercrop vegetables with other crops in their farms but men are the ones who grow vegetables on commercial basis because it demands so much capital. Especially now that rains are a bit scarce, vegetable farmers have to lay pipes and pump water from streams to their farms, and how many women can afford that?" (Woman, 46-year-old, Asunafo-North, 2016).

Still, farmers are motivated to allocate much (if not all) of their farmlands to cocoa for several reasons. Cocoa has been at the heart of the Ghanaian economy and has remained central to its politics since the twentieth century. Revenues appropriated from cocoa sales in the 1920s "had been so remunerative that Governor Gordon Guggisberg had felt emboldened to write a long-term development plan" (NDPC 2009:i). Ghana's first President, Dr. Kwame Nkrumah, had planned to rely on cocoa exports to finance a seven year development plan, although cocoa prices later tumbled "from £476 in 1954 to £87 10s. a ton" in 1965 (Nkrumah 1968:94). Ghana's 'transition' to a lower-middle income country in 2010 was in addition to revenues from gold and oil exploration, also partly shaped by favourable cocoa prices from the year 2000 (Tsikata 2016). Thus, since the colonial period "governments have been highly sensitive to developments in the cocoa sector and are quick to respond to low levels of production by implementing reforms and … interventions that have positive impacts on cocoa production" (Tsikata 2021:40).

During much of the structural adjustment period when subsidies on inputs for food crops were removed, special programmes were established to boost export crop production. In the cocoa sub-sector, this took the form of the Cocoa Rehabilitation Project which sought productivity increases by offering farmers better prices for their produce and compensating them for removal of diseased cocoa trees (Kolavalli & Vigneri 2011). Other measures included the provision of improved planting materials and other inputs. Such interventions continue to this

day within the context of the 'Cocoa Rehabilitation Programme' (Ghana Cocoa Board 2017; 2016).

State support for cocoa production in recent years is widely acknowledged in the distribution of free fertilisers and other agrochemicals for the control of pests and diseases. Improved seedlings, which take about two to three years to bear fruits, are also increasingly being made available to farmers through the establishment of community nurseries, but can also be accessed from agrochemical shops in the nearby towns. In the communities surveyed in Asunafo North in 2020, more than 60 percent of cocoa farms were planted with improved varieties. In addition to the role of the state, farmer cooperatives have become important nodes for the distribution of agrochemicals and equipment, and the dissemination of information on modern agricultural practices. However their initial establishment and main goals are heavily influenced by NGOs which have strong links to private cocoa marketing companies or agribusiness. Agribusiness has become involved in agricultural interventions to the extent that they are known by their names in cocoa farming communities. In Asunafo, Mondelez International – one of the largest cocoa processing companies in the world – has sought to stimulate cocoa production through incentives such as the payment of premiums. The considerable support for cocoa by both state and private sector account for farmers' limited interest in food production, where they feel they lack the voice and incentives (especially state controlled prices) which have kept them in cocoa production. However it is the large gap in the devotion of resources to cocoa, compared to other livelihoods, which is associated with food insecurity.

While interventions by the state and private sector appear to be generally well-administered, farmers still complain about delays in delivery and the high transportation cost to nearby towns

for the collection of agrochemicals. Further, the support for cocoa is viewed by some farmers as inadequate since they increasingly rely on their own financial resources to purchase agrochemicals and hire equipment and labour for activities such as spraying.

Thus, input and labour costs represent the most important expenditure items and constitute a major drain on the margins of some farmers. A 45-year-old woman in Asunafo North comments:

> I just want to say that currently, farming is not very lucrative because the inputs that the government supplies, many of us do not get it. Besides the prices are very high on the market so we are not able to buy. The effect is a reduction in our harvests. Thus, we farmers are continually poor. It is part of the reasons why many young people are not interested in farming anymore. I will not even advise any of my children to go into farming because I cannot even get GHC1000 to show for all these years that I have been working as a farmer. I had to even borrow money from my younger sister who just carries baby diapers on her head to sell to pay my child's school fees. It is so sad.

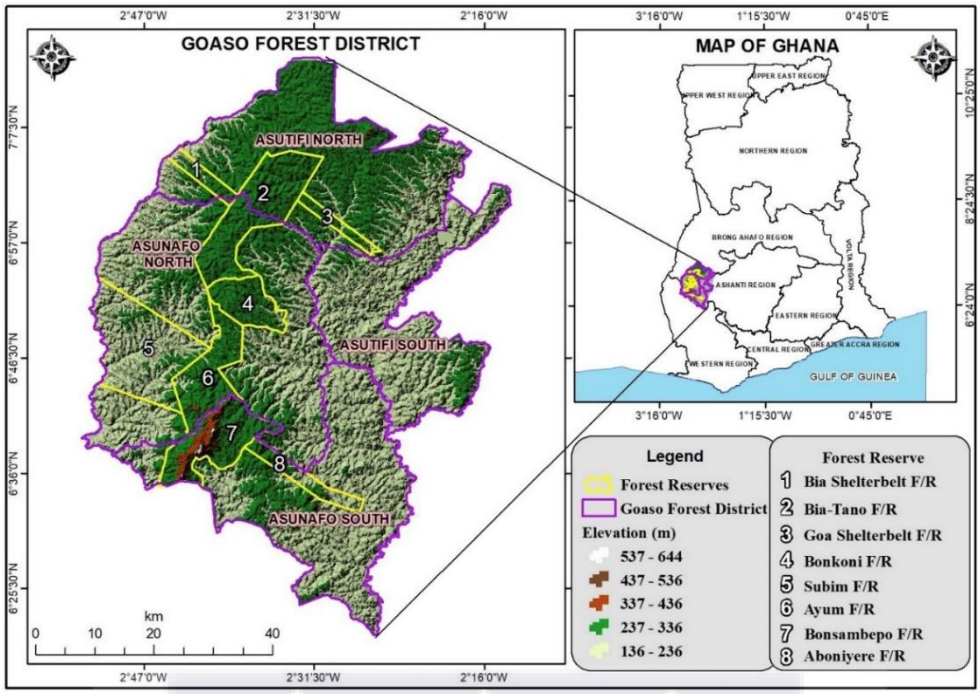
While cocoa is produced in Kwaebibirem, oil palm, which comprises 14 percent of the total farmed area, has been an important part of the rural landscape since the 1970s for several reasons. This includes the establishment of the World Bank funded Ghana Oil Palm Development Corporation (GOPDC) in 1976, whose operations involved land expropriation and contracting arrangements with farmers beyond those resettled by the company (Amanor, 1999). The GOPDC had an in-house plant breeder (Graham, 1993:216), however, implementation of the project was long preceded by research into the development of improved planting materials by the state-run Oil Palm Research Institute at Kusi in the 1960s (Amanor 1999:94). Farmers who enrolled into GOPDC's contract farming scheme were provided with planting materials which they later paid for through their supply of produce to the company. GOPDC's influence appears to have waned in recent years. But oil palm production remains important due to a vibrant domestic small-scale processing and marketing industry. Serendipalm Company Limited has also become an important actor in the oil palm sector in Kwaebibirem, although its regulations concerning the prohibition of agro-chemicals and lower prices deters some farmers from engaging with it. Thus, some farmers prefer to produce oil

palm under the production practices they are familiar with, and which they argue to be associated with high output. They can then transact their produce with domestic oil processors at better prices. For many farmers, oil palm is a more regular source of income as the fruits can be harvested and sold on a monthly basis, compared to cocoa whose harvesting and marketing are limited to a few months of the year.

Land Availability

Cocoa and oil palm cultivation in the Asunafo and Kwaebibirem districts are emblematic of the 'permanent cropping system' commonly associated with the forest zone of Southern Ghana. This has contributed to a reduction in the land area available for other agricultural activities. However, land scarcity has also been influenced by settlement expansion as previously cultivated lands are now being given out for housing development. In Kwaebibirem, land shortages have also been exacerbated by the acquisition of land for small-scale mining. Mining activities have also impacted agriculture through the pollution of the Birim River, where many farmers have sited their farms in order to easily access water for their vegetable crops. In the Bomso community, many farmers have lost access to their farms due to land disputes with the Twapease community. Notwithstanding, land scarcity is more severe in Asunafo. This is because more than 40 percent of the district (578.63 km^2) is covered by forest reserves (Figure 5.3), most of which were established in the colonial period (Edusah, 2011:14), while close to 50 percent of the land currently under cultivation is devoted to cocoa. Private operators have been involved in the extraction of timber from the reserves, while the access of local farming communities to the reserves is restricted.

Figure 5.3 The Goaso Forest District



Source: Lossou et al. (2019)

Land Tenure

In both Asunafo and Kwaebibirem, much of agricultural land is acquired through inheritance. This includes lineage land, which among the matrilineal Akan, is usually passed down from a man (brother) to a sister's eldest male son. In other cases inheritance is also entrusted to a selected male sibling of the late brother. This ultimately results in a situation in which majority of lineage land is controlled by male elders, while women are left with little land.

Thus, to ensure that women have some land for productive activities, a woman is typically succeeded by other women, notably her daughters, but other female siblings as well. These standard inheritance practices very much informed the acquisition of property in the research communities, especially in Kwaebibirem. However inheritance practices in Asunafo are diverse, and do not always lend themselves to a particular interpretation of standard norms. Thus, there were women and children (both male and female) who inherited property (more likely gifts) from their husbands and fathers. Similarly, it was suggested that property of a deceased person are shared equitably among family members.

There were also cases in which the eldest male sons of wives were favoured for inheritance. In others cases, women inherited farms which they had worked with their husbands, or which their husbands had acquired through sharecropping arrangements. Further, there were several cases where children (including male children) inherited property that their mothers had initially acquired through the husband. However, the above instances more likely relate to privately acquired land that were subsequently inherited or given out as gifts. The giving of land to children and wives is not new among the Akan, and in Asunafo such practices may have been reinforced by the role of migration and sharecropping arrangements in cocoa production. In 2010, close to 40 percent of the population in the district were migrants, and some residents in the major cocoa farming communities even described the communities they lived in as 'migrant communities' (for e.g., Kasapin). Initial establishments of cocoa farms in Asunafo was traced to the 1950s and was followed by successive migration by male farmers and their wives, male children and grandchildren. These initial movements may have been dominated by Akan groups from the Brong Ahafo, Ashanti and Eastern regions. However migration from other parts of Ghana, where inheritance norms and practices differ from those associated with Akan communities, were equally important. For example, migration from Northern Ghana has been a long-term process which has resulted in a younger generation, some of whom have been able to acquire their own farmlands through involvement in sharecropping arrangements and outright purchases. In the 2021 census, the Akan constituted 61 percent of the district's population followed by the Mole-Dagbani (18.5 percent) and the Ewe (6 percent).

Labour Relations: Sharecropping Arrangements in Cocoa and Oil Palm Production

For those without access to land, sharecropping arrangements are an important medium for land acquisition. Sharecropping takes two forms. This comprises the *abunu* system, where the sharecropper starts and manages the cocoa farm for about five or six years when the cocoa trees are matured and ready to bear fruit. The farm is then divided into two parts with the sharecropper taking one part while the remaining part is retained by the landowner. However *abunu* is now rarely practiced in Asunafo North due to increased land scarcity. Consequently *abusa* tenancies (which do not provide labourers with an opportunity to own land) have become the more dominant sharecropping arrangement, especially for 'non-indigenes' or new migrants without rights to any family or inherited land. *Abusa* labourers undertake activities such as weeding, spraying (fumigation), cutting the mistletoe and harvesting. The farm owner pays for the cost of chemicals and other inputs, and the harvest (or money value of the harvest) is divided into three with the labourer receiving one part while the two remaining parts are given to the farm owner. In some cases the farm owner may also pay for the hiring of labour for harvesting and drying of cocoa beans due to the time-sensitive nature of these activities.

While *abusa* tenancies are generally associated with farmers without secure access to land, land scarcity is changing the dynamics of such arrangements. For example, *abusa* also involved arrangements between ageing farmers and their children/grandchildren. In other instances, the exhaustion of family land has necessitated sharecropping arrangements between youth and landowners outside of the family. For some farmers, this has further been associated with gaining access to land outside of the communities they live in. In Kwaebibirem, however, *abunu* remains the most important sharecrop arrangement for cocoa due to land availability in the district relative to Asunafo.

Still, the *abunu* arrangement operates alongside two variants of the *abusa*: where major expenditure and farm establishment are undertaken by the labourer, proceeds from the harvest are divided into 3 parts with the labourer receiving two-thirds, while the remaining part is given to the land owner; in contrast, the labourer keeps one-third of the proceeds of the harvest where he is only engaged after the full establishment and maturation of the cocoa. *Abusa* tenancies are also dominant with oil palm in Kwaebibirem. Proceeds from harvests are usually divided into three parts, with the labourer and landowner receiving one part each, while the remaining part is used to cover the expenditure for labour and inputs. Landowners regain absolute control of the land after the fruits have been harvested over a time period usually ranging between twenty and thirty years. In general, since *abusa* does not guarantee land ownership but the sharing of the harvest or its money value, tenants interested in owning their own farms have to resort to other means, for example, saving to purchase already established farms or acquire land elsewhere for their own production.

Abusa labourers may be allowed to intercrop the cocoa with food crops which they can subsist on. In other cases they may be able to gain access to a small portion of the farm for food production. However in the cases of fully matured cocoa farms, labourers have to rely on food markets. This suggests that food insecurity is a much bigger challenge for sharecroppers and their families. Terms under which *abusa* tenancies are contracted are also changing in accordance with land commercialisation and scarcities. "Some landowners can even ask for a third of the food crops as payment for the land that has been given for that arrangement" (woman, 46 years old; Asunafo North, 2016), while "the amount paid for sharecropping lands are like what was paid in the past for outright purchase for the same size of land" (woman, 45 years old; Asunafo North, 2016).

In Kwaebibirem, the weeding of oil palm farms, in return for the intercropping of such farms with rice and maize was recognised and mentioned independently of conventional sharecrop arrangements which allow labourers to intercrop food with cocoa and oil palm. These arrangements, which were re-negotiated on a seasonal or annual basis, signal difficulties with access to land and the extension of sharecropping arrangements into food production.

In addition to sharecropping, land is acquired through more direct monetary transactions. This includes land sales and the renting out of land. Even though long decades of commercialisation has resulted in the transfer of land to individuals, chiefs appear to maintain significant control over arable land resources, which they sometimes transact. Their claims to land ownership even continue to play an influential role in the context of settlement expansion, which has resulted in the conversion of old cocoa farms to areas for new housing. As a result, persons who acquired lands in the past for agricultural production cannot simply transact those lands without recourse to chiefs. Thus, in addition to agricultural land, chiefs are actively involved in the division of plots for residential development. Through this process, they are able to receive their share of housing plots which they can later transact. For families and individuals, the selling or renting out of land is underlined by several reasons. For example, land sales is sometimes used as a means to settle land disputes among family members. In relation to this, some inheriting groups may find it more profitable to share monies accruing from land sales than to continue with investment in agricultural production since decades of inheritance has resulted in land fragmentation. For individual farmers, land sales are sometimes due to distress. Farmers sometimes have to sell part, or the whole farm, in order to raise funds for their children's higher education, or to send them abroad. In other instances, farmers rent out their farms in order to repay debts. This enables the creditor to control earnings from sales of the harvest until the period defined for loan repayment elapses. Lastly, other farmers sell their farms when they relocate to other communities.

Table 5. 13 Modes of Land Acquisition in the Semi-deciduous Forest

Mode	Kwaebibirem	Asunafo North
Inheritance	87.4	58.3
Sharecropping	12.6	39.2
State allocation	0.8	0.0
Purchase	4.2	19.2
Gift	7.6	5.0
Rentals	4.2	8.3
Other (free, contract farming etc.)	5.9	10.8

Source: DEMETER Survey, 2017

Impacts of Land Tenure on Men and Women's Access to Land

Even though the principles guiding land inheritance in Asunafo, especially among the Akan, may be expected to engender equitable land distribution, women's rights and access to land are rather weak. In practice, men are prioritised for land inheritance, with women sometimes given small parcels of land or infertile land. "The lands are divided and first given to the men and the rest to the women", a 49-year-old woman in Asunafo noted. In large part however, inequitable land distribution is the result of land commodification, which is reflected in sharecropping arrangements and outright land purchases. Women are inevitably excluded from sharecropping arrangements since many of the activities associated with the management of cocoa farms are undertaken by men. Further, landowners are reluctant to give women land for agricultural production for fear that they may use such lands for food crops: "They think women *destroy* lands because they cannot plant the cocoa for the landowner as many of the women only concentrate on their food crops" (woman, 46 years old; Asunafo North, 2016). When women are involved in cocoa production, their farms are smaller than farms cultivated by men (See Appendix, Table 5.20).

However, land commercialisation and scarcity has also resulted in sharecropping arrangements between older and younger members of the family, implying a deterioration in the terms under which migrant farmers are able to gain access to land.

Table 5. 14 Median Farm Size (ha)

	All farm plots		Cocoa		Plantain		Cassava		Oil Palm	
Districts	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Asunafo North	1.94	1.21	2.43	1.62	1.62	1.42	1.62	1.21	2.23	2.43
Kwaebibirem	1.21	1.21	1.21	1.21	1.21	1.21	0.81	1.15	1.62	1.21

Source: DEMETER Survey, 2020

Median Farm Size (ha) (continued)

	Rice (paddy of dry season)[33]		Rice (paddy of wet season)	
Districts	Men	Women	Men	Women
Asunafo North	4.05	–	1.82	3.84
Kwaebibirem	–	–	2.02	–[34]

Source: DEMETER Survey, 2020

Other Labour Relations

Landowners commonly depend on sharecroppers for the maintenance of cocoa farms. However, households and individuals who cultivate smaller cocoa farms rely on household labour, and other labour sources such as hired labour and 'labour groups' for several farm activities. Household and hired labour are the main sources of labour for these small farmers. In both the household and in the labour market, there is sexual division of labour regarding farm activities. Activities such as land preparation, weeding, spraying, harvesting, pruning, the breaking of cocoa pods and drying of the beans are dominated by men.

[33] Data was not available for women in both districts, and for men in Kwaebibirem, suggesting that dry season rice cultivation was extremely limited among these groups.

[34] Data was not available for women in Kwaebibirem, suggesting that rice cultivation in general was dominated by men.

Women sometimes control weed on young cocoa farms by uprooting them with their hands, but they are generally engaged to cart produce such as cocoa pods, oil palm and citrus to designated locations; women also fetch water and cook for farmworkers. Labourers are recruited from the cocoa farming communities, with some farmers even participating in the labour market. However, the hired labour market in Asunafo is dominated by young men from the North and other parts of the Brong Ahafo region who move on a seasonal basis to major cocoa producing districts such as Asunafo North. Weeding is the main task for which these labourers are engaged. They earn a daily wage when engaged as 'by-day labourers', or receive a lump sum when they are engaged as members of 'contract labourer' groups to weed larger farms. Many farmers note that labour is increasingly becoming scarce. This is attributed to reduced movement of labourers from Northern Ghana, increased schooling in both cocoa farming communities and Northern Ghana, and the movement of young people from agriculture to trade, craft and artisanship related training and employment. In Kwaebibirem, harvesting of palm fruits is done by men, and many oil palm farmers state that the labour cost of harvesting takes away from their earnings. Labour is required for rice planting and harvesting and is normally done by women who are remunerated in kind. Women are offered food during the planting season and receive one-sixth of the quantity of rice they are able to harvest during harvesting. While there is some migrant labour, it appears that a substantial portion of labourers in Kwaebibirem are local youth who resort to labour because they do not own farms. However higher paying labouring activities in the small-scale mining industry have recently attracted many young people, leaving labour supplies for agriculture inadequate and driving up the prices of agricultural labour.

5.4 Conclusion

This chapter sought to examine differences in farming systems across different geographic areas of Ghana, and their related social relations of production. The chapter argues that population pressures, agroecological characteristics, and the ways in which different areas were integrated into the national and world economy in the colonial era are the most important factors that have shaped farming systems of the four districts that were examined. These have in turn been correlated with particular ways in which production is organised, with implications for land rights and livelihoods. In Northern Ghana, agricultural production mainly involves crop production, and is sometimes combined with some livestock rearing. However, the factors outlined above have resulted in particular configurations of farming systems among the two Northern districts that were studied. In Garu-Tempane, population pressures have resulted in the farming of small plots of land by households. Land shortages prevent fallowing, and cultivation is intensive, taking the form of annual and multi-cropping. The main crops are cereals, which are produced in close proximity to residential units. The availability of irrigation infrastructure allows for the cultivation of vegetable crops between the months of December and May. However, this is restricted to a smaller number of plots located within the perimeter of the irrigation infrastructure. Due to land scarcity and poor soils, farmers have attempted to improve land through the use of organic manure, and the high application of chemical fertilisers. However, severe land shortages have not eroded women's land rights, and their participation in a broad range of farms activities – among other factors – have helped some women to secure these rights. The rural labour market in Garu-Tempane is also dominated by women, although the wages offered are low.

In contrast to Garu-Tempane, population pressures have not had much influence on agricultural production in the East Gonja district. Relative land availability and fertility, and the ease with which indigenous farmers can acquire land is associated with short-fallow cultivation, involving the production of yam and cassava, cereals and legume crops. These are sometimes produced as monocrops, although various crop combinations are also practiced. Similar to Garu-Tempane, agricultural production in East Gonja is dominated by small-scale household production, although farms are relatively larger. However, there is a class of large commercial farmers who have been able to acquire land parcels of land from chiefs. These farmers rely on hired labourers, including seasonal migrant labourers who come from other districts. The use of weedicides and tractor ploughing services in East Gonja is extensive. In contrast to Garu-Tempane, women's role in agricultural production is limited and their rights to land are weak in spite of relative land availability.

In the two districts of Southern Ghana, ecology, and the history of agricultural commercialisation have also combined to produce particular farming systems. The location of both districts in the semi-deciduous forest is associated with the production of industrial tree crops for domestic and foreign markets. In both of the districts, the focus on cocoa production for the world market is greatly aided by incentives provided by the state and agribusiness. The emphasis on cocoa has resulted in a permanent farming system, and little land is left for food production as the formation of canopies prevent the intercropping of food with cocoa. However, cash crop production is slightly more diversified in Kwaebibirem due to oil palm production. In both Southern districts, the production of these tree crops is associated with sharecropping arrangements, land sales and scarcity. Thus, compared to the Garu-Tempane district in Northern Ghana, land shortages in the two Southern districts is the result of land and agricultural commercialisation. In Asunafo, land scarcity is further exacerbated by forest

reserves that were established in the colonial period, whereas settlement expansion, and the acquisition of land for small-scale mining are more important in Kwaebibirem.

Sharecropping arrangements for cocoa and oil palm, and outright land sales have displaced women from food production, and they are increasingly been edged out of an emerging small-scale vegetable production sector due to pressures to intensify production. Women's lack of access to land is particularly acute in Asunafo. Thus for some women, petty trading – engaging in the sale of food produce, charcoal, cooked food, snacks and other consumer goods – is the main economic activity. Many of the women who regard farming as their main economic activity also frequently combine it with petty trading. Within some households, these non-farm activities are complementary, rather than substitutes for cocoa production. In these households, cocoa is seen as more of a seasonal activity whose incomes comes in bulk, and are invested in more capital intensive activities, for e.g., investment in children's education. Part of the cocoa money is also invested in women's non-farm activities since incomes from these activities, although small, are more regular and help to provide the daily needs of the household. Further, incomes from these activities are used to purchase agro-inputs and hire labour for work on cocoa farms.

The effect of commercialisation on land scarcity has also resulted in sharecropping arrangements, not only between indigenous people and migrants, but also among members of the same family, including between parents and their children. In Kwaebibirem, the control of land by chiefs and lineage male elders has resulted in the creation of a male youth labour reserve in rural communities, whereas in Asunafo seasonal migrant labour from Northern Ghana and other parts of the Brong Ahafo region continue to be important.

Chapter Six

Technological Change and the Commercialisation of Maize Production in the Northern Savanna and Semi-Deciduous Forest of Ghana: Underlying Factors and Implications

6.1 Introduction

This chapter draws on insights from Boserup's (1965) theory of technological change, the Farming Systems Research of the 1970s and 1980s, and the agrarian relations literature (Moyo, 2011; Akram-Lodhi, 2005), to examine the maize crop system in relation to larger farming systems in Ghana. These frameworks are used to examine dominant policy perspectives that mainly attribute poverty and food insecurity to the lack of adoption of certified seeds, chemical fertilisers, and other agro-inputs. This chapter examines the third research question of this study. It examines the question: how do different contexts of land, labour and agroecology shape cropping patterns and the adoption of seed and other technologies in different rural areas of Ghana?

The chapter examines the extent to which this broad assumptions that are made in African Green Revolution literature holds up for different contexts of land and labour, different agro-ecological zones, and the implications of changes in agricultural technology for men and women, and different groups of farmers. The attempt to incorporate diversity in farming environments and agrarian relations into debates about technological change is conducted through a comparison of data collected from the Garu-Tempane and East Gonja districts of Northern Ghana, situated in the Northern Savanna with the Asunafo and Kwaebibirem districts of the semi-deciduous Forest in Southern Ghana.

Maize is an important crop in the four districts studied, but it receives more attention in some districts than others. In the Southern districts of the semi-deciduous forest where farmers focus on cocoa production due to favourable agroecology and relatively strong state and agribusiness support, maize is less important and is produced as a substitute for consumption in the lean season in place of the more preferred forest food crops.

In contrast, maize is the most important crop in the Northern districts of the Guinea and Sudan savanna where agriculture is dominated by food production. The relative importance of maize reflects the importance attached to export or food crop production in each district, agro-ecological conditions and the nature of policy support for agricultural production. While mainstream agricultural development discourses often argue that lack of adoption of commercial seeds and chemical fertilisers is the main obstacle to agricultural production, farmers' adoption of new technologies and commercial inputs reflect agroecological conditions and land pressures, as well as the nature of commodification of agriculture and pressures on farmers to adopt external inputs. Thus, in some areas, farmers may well undertake food production without depending on commercial seeds and fertilisers, and food insecurity may result from factors other than the non-adoption of commonly prescribed recommendations.

However, farmers' adoption of new technology and commercial inputs are not only limited to commercial seeds and chemical fertilisers that are the foci of green revolution efforts. Farmers are increasingly adopting technologies such as herbicides, and agricultural machinery (which are not at the heart of green revolution efforts but has received support from government and private-sector programmes in recent years). Again, adoption of these technologies are more important in some districts than others, and result from changing market dynamics and the history of agricultural commercialisation. Technology adoption, especially of these latter

technologies are not gender and scale-neutral, with wealthier farmers and men more likely to adopt them than poorer and women farmers. These have important implications for labour and land rights that are often ignored in mainstream agricultural policy.

The rest of the chapter is organised as follows: Section 6.2 situates maize in relation to cropping systems of the different districts and agro-ecological zones. This helps to examine the importance of maize production in different areas, the factors underlying its relative importance, and the extent to which its production has changed within the cropping systems of the four districts. This is followed by the analysis of commercialisation in maize production in Section 6.3. Commercialisation is explored with respect to scale and the purpose for which maize is produced, and the extent to which maize producers are involved in input markets. While it has been argued that maize production is not a heavily commercialised activity, Section 6.4 takes the analysis a step further by exploring differences in the reliance on commercials seeds and other agricultural technologies within the four districts, and the factors behind these differences. It argues that land availability and agro-ecological conditions are key factors that induce technological change but class, gender and other factors outside the household also play influential roles in the uptake of agricultural technology by different groups of farmers, and by men and women. Thus, Section 6.5 examines the extent to which agricultural technologies are gender and scale neutral, and the reasons behind equitable and uneven use of technologies. The last section of the chapter draws on the different findings to examine the implications of agricultural technologies for land, labour and livelihoods.

6.2 The Role of Maize in the Semi-Deciduous Forest and Northern Savanna of Ghana

Maize is among the most important crops cultivated in both the Northern and Southern research districts. However, its role in farming systems depends on agro-ecology and other geographic factors. In the Asunafo North and Kwaebibirem districts of the semi-deciduous forest, less than 10 percent of the total cultivated area was devoted to maize (Table 6.1). The agro-ecology in these areas favour the production of food crops such as plantain and cassava, which comprise the main local staples. Thus, in Kwaebibirem close to 18 percent of the total farmed area was devoted to plantain in 2016, and 16 percent to cassava. Similar figures can be observed for Asunafo North. Crucially, the most noticeable pattern in crop production in Kwaebibirem and Asunafo is the prioritisation of export-oriented cash crops such as cocoa. In Asunafo, nearly 48 percent of the total farmed area was devoted to cocoa, and in Kwaebibirem, cocoa and oil palm jointly accounted for nearly 55 percent of the total farmed area. In both of these districts, maize-based diets – as well as rice – are mostly eaten between December and March when plantain and cassava are in short supply. Maize is an important lean season crop since it can be produced and stored for a longer time period compared to the highly perishable locally preferred staples.

In contrast to the semi-deciduous forest, food production is a more discernible feature of agriculture in the districts of the Northern Savanna, with maize being one of the most important crops. The majority (88 percent) of the 470 fields planted to maize in this study were located in the Northern Savanna. Within the Northern Savanna itself, maize production is more prominent in the Sudan than the Guinea Savanna. Farms planted to maize in Garu-Tempane (257 farms) represented 62 percent of farms in the Northern Savanna and 55 percent of the total number farms planted to maize in all of the four districts. In contrast, maize was produced on 158 plots in East Gonja; this accounted for 38 percent of plots planted to maize in the

Northern Savanna, and 34 percent of farms planted to maize in all of the four districts. Maize is similarly important with respect to the land area under its cultivation compared to the area reserved for other crops. In Garu-Tempane, 45 percent of the total farmed land was devoted to maize. In East Gonja, maize was produced on 27 percent of total farmed area and was followed by yam (21 percent), which was equally of great social and economic importance in the district (Table 6.1).

Despite its enormous importance, maize is generally viewed in both districts of the Savanna as a 'new' crop. However, given that maize has been produced on the coast of Ghana since at least the 17th century (Akyeampong & Ntewusu 2014:11), the use of the term 'new' more likely connotes the increasing expansion of production and land area devoted to maize, relative to other 'local' crops. For instance maize production in Garu-Tempane is seen to be associated with the displacement of sorghum and millet. A 45 year old female farmer noted "Our fathers used to cultivate all kinds of millet but now improved seeds of maize and other new crops are preferred because of their early maturity and their suitability for the weather." Similarly, maize was contrasted with yam in East Gonja, with the latter being viewed as the more indigenous crop. Thus the current role of maize represents a significant shift in production since it was still not considered as an important crop in the Northern Savanna in the late 1990s (Doss & Morris, 2001).

In Garu-Tempane, the expansion in maize production and area appears to have occurred in the last 20 years. In 2008, maize production was estimated at 5,781 metric tonnes, which was more than a three-fold increase in the production reported for 2006. Farther increments in production were reported after 2008 (Table 6.2). In addition to maize, rice production also increased from an initial 2,270 metric tonnes in 2006 to 19,825 metric tonnes in 2016. In contrast, millet, sorghum and groundnut production have declined with no consistent patterns in production

levels. Relatively higher yields have been more significant in the rise of rice production than in maize, although maize yields have also been higher than millet, sorghum and groundnuts yields (Table 6.2). Thus in Garu-Tempane, much of the increase in maize production is due to the expansion in the maize cultivated area, which has increased from 1,878 hectares in 2006 to 15,169 hectares in 2016. The area cultivated to millet, sorghum and groundnut were still larger than the total area cultivated to rice in 2016, and have remained somewhat stagnant.

Table 6. 1 Land Area Devoted to the 5 Main Crops Cultivated in the Four Research Districts

Kwaebibirem	Cocoa	Plantain	Cassava	Oil Palm	Maize
All households	40.3	17.8	15.9	14.2	5.8
Up to 1 hectare	29.2	22.1	25.3	10.3	9.1
>1 to 5 hectares	42.2	16.1	13.0	17.5	5.3
Above 5 hectares	58.3	15.1	6.2	8.7	0.4
Asunafo North	Cocoa	Plantain	Cassava	Maize	Vegetables
All households	47.5	15.8	13.6	7.8	3.6
Up to 1 hectare	20.6	23.3	22.5	14.6	9.5
>1 to 5 hectares	55.5	14.1	11.1	5.8	1.8
Above 5 hectares	63.1	9.0	7.5	4.1	0.4
East Gonja	Maize	Yam	Groundnut	Cassava	Other
All households	26.6	21.1	17.5	16.5	13.0
Up to 1 hectare	24.0	26.6	8.6	28.0	10.1
>1 to 5 hectares	25.2	20.2	19.0	16.0	14.1
Above 5 hectares	32.2	19.9	19.2	10.1	11.7
Garu-Tempane	Maize	Millet	Other	Vegetables	Rice
All households	45.3	33.0	14.6	3.9	2.4
Up to 1 hectare	52.0	30.6	9.3	3.6	3.7
>1 to 5 hectares	41.8	33.8	17.8	4.0	1.8
Above 5 hectares	36.2	41.9	17.0	4.8	0.0

Source: DEMETER Survey, 2017

Table 6. 2 Production, Yield and Area of Selected Food Crops in the Garu-Tempane District, 2006-2016

	Maize			Rice			Millet		
Year	Area (Ha)	Production (Mt)	Yield (Ton/Ha)	Area (Ha)	Production (Mt)	Yield (Ton/Ha)	Area (Ha)	Production (Mt)	Yield (Ton/Ha)
2006	1878	1653	0.88	1544	2270	1.47	5900	4130	0.70
2007	2486	1392	0.56	2920	6336	2.17	6168	3269	0.53
2008	3613	5781	1.60	3190	8358	2.62	11433	5602	0.49
2009	5266	6898	1.31	2433	6814	2.80	7401	3256	0.44
2010	5660	9056	1.60	3904	10150	2.60	6000	2940	0.49
2011	7300	10950	1.50	4340	6076	1.40	7640	4890	0.64
2012	10200	14280	1.40	4880	9760	2.00	6800	6120	0.90
2013	10500	17850	1.7	4920	10077	2.048	6950	7645	1.1
2014	10200	14280	1.4	4796	10886.9	2.3	6890	5512	0.8
2015	14790	32538	2.2	6489	16222.5	2.5	7079	5663.2	0.8
2016	15169	36405.6	2.4	5763	19824.7	3.4	7979	7021.50	0.9

Source: Department of Agriculture (Garu-Tempane District) 2017

Table 6.2 Production, Yield and Area of Selected Food Crops in the Garu-Tempane District, 2006-2016 (continued)

	Guinea corn (sorghum)			Groundnut		
Year	Area (Ha)	Production (Mt)	Yield (Ton/Ha)	Area (Ha)	Production (Mt)	Yield (Ton/Ha)
2006	3684	3426	0.93	11440	11898	1.04
2007	3746	2585	0.69	12362	6676	0.54
2008	9714	7480	0.77	10152	10254	1.01
2009	11916	8580	0.72	7805	3434	0.44
2010	8800	6688	0.76	6980	6980	1.00
2011	7800	7410	0.95	5850	2048	0.35
2012	6970	4182	0.60	6600	3960	0.60
2013	6901	5521	0.8	6521	3652	0.56
2014	6950	4448.0	0.6	6000	3600	0.6
2015	7850	5102.5	0.7	7589	4932.9	0.7
2016	7979	8776.90	1.1	7968	8765.20	1.1

Source: Department of Agriculture (Garu-Tempane District) 2017

National data provide a more long-term view of changes in production, yield and the area cultivated to the main cereal crops. The estimates show that while maize production has generally been larger than the production of other cereals and groundnut since the 1960s, the gap in production has widened substantially in the past four decades. This change can be divided into two phases, with the first starting from the early 1980s to 2001, followed by a second phase of expansion starting from 2002 to date (Figure 6.1). The high maize production has been followed by rice in recent years, especially after 2008. While they previously followed similar production patterns, there has been a large gap in sorghum and millet production, with sorghum production being higher than millet since the 1990s (Figure 6.2). Millet has generally been the least impressive of the five crops. Consistent with data for Garu-Tempane, the national estimates show that rice yields have generally been higher than maize yields since the 1990s (Figure 6.3).

Figure 6.1 Rice and Maize Production in Ghana (1965 – 2020).

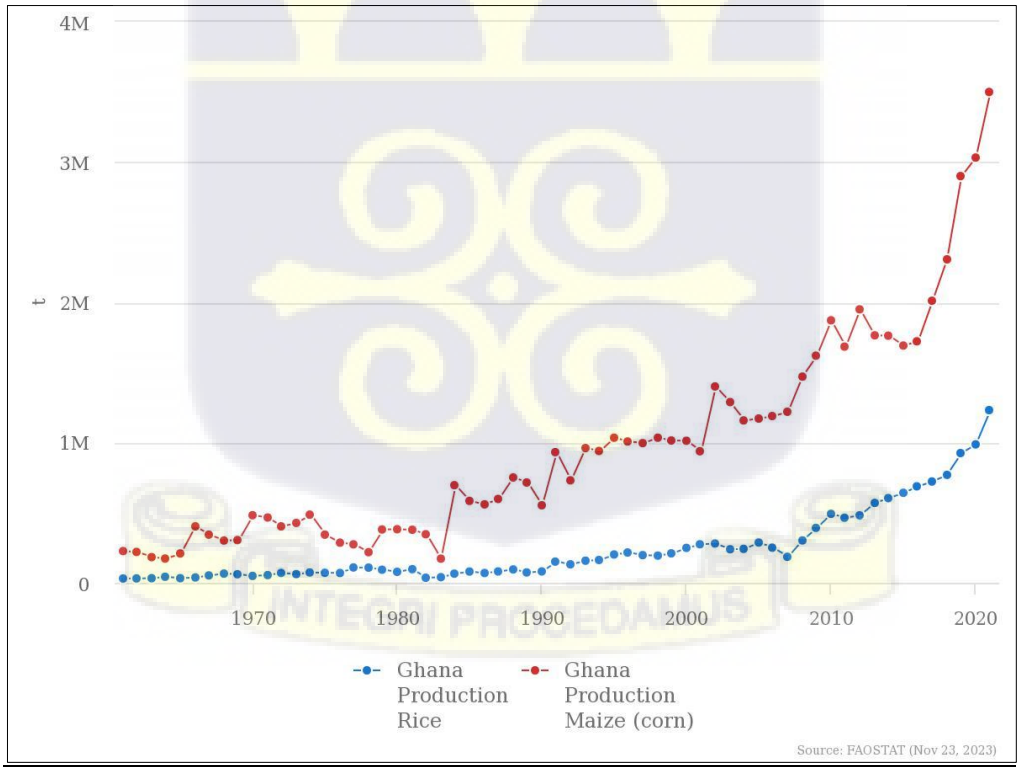


Figure 6.2. Groundnut, Millet and Sorghum Production in Ghana (1965 – 2020)

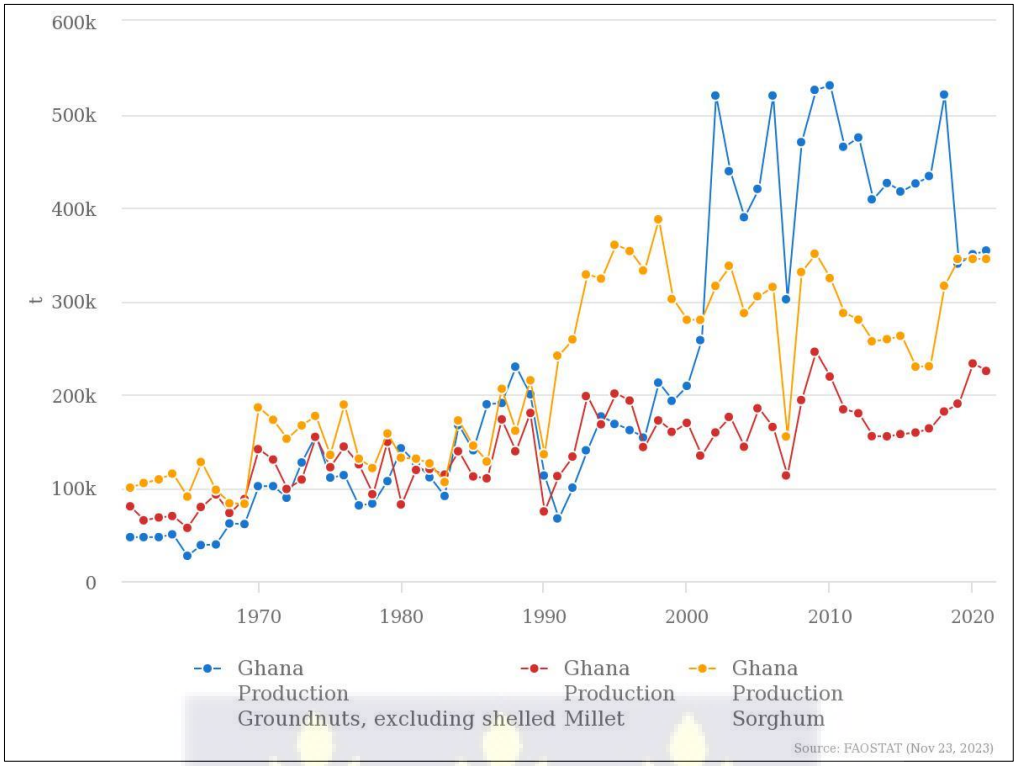
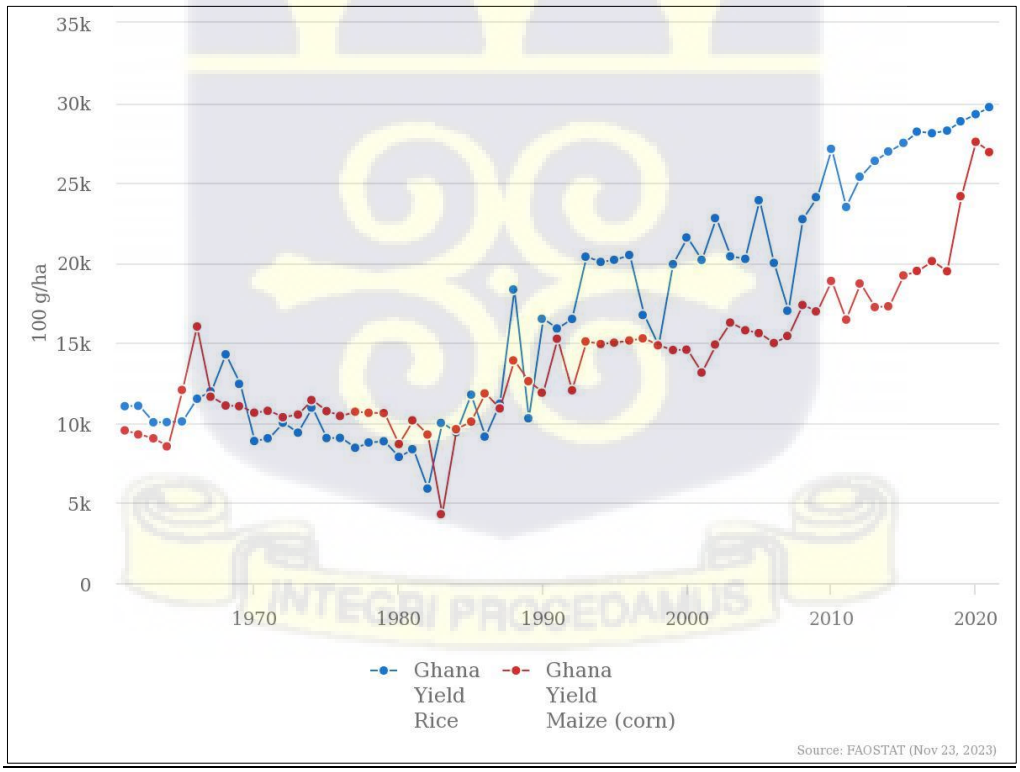


Figure 6.3 Rice and Maize Yields in Ghana (1965 – 2020)



Millet and sorghum yields seemed to have improved from the early 1990s but are still generally lower than groundnut yields and are nowhere near maize and rice yields (Figure 6.4). Thus, again, the expansion in maize production over the past four decades has in part been due to increases in the area cultivated to the crop, especially since the 1980s (Figure 6.5). Between 1980 and 2001, the national average maize area was 580,444 hectares compared to an average of 897,392 hectares for the period 2002 and 2016.

Figure 6.4 Groundnut, Millet and Sorghum Yields in Ghana (1965 – 2020)

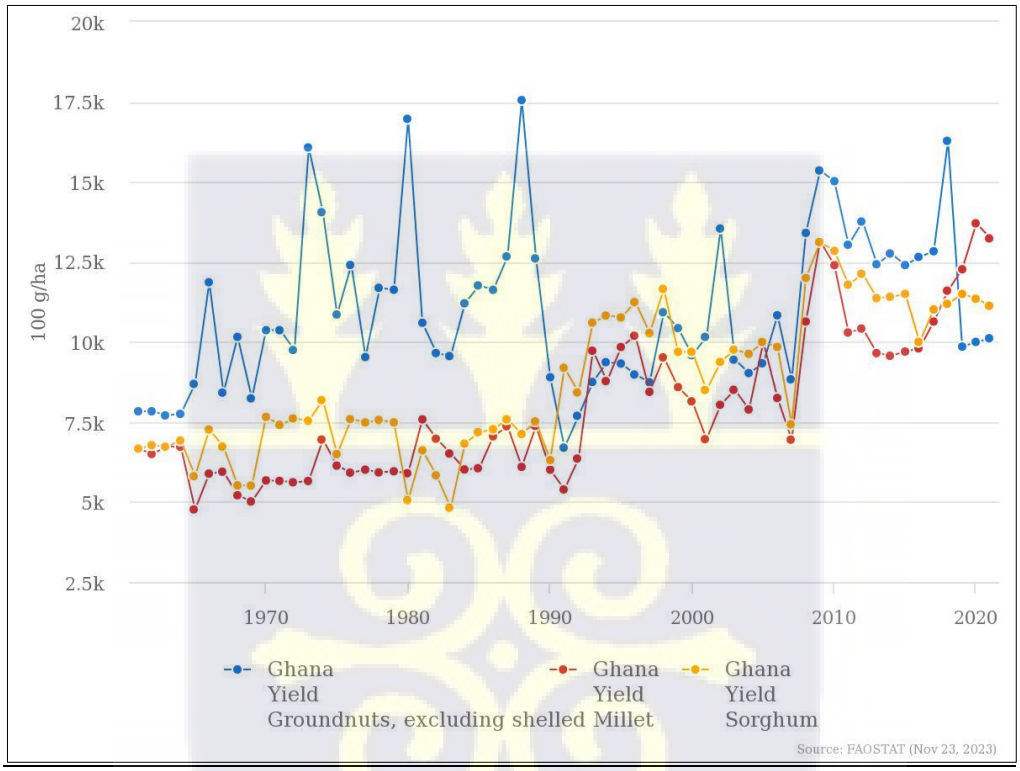
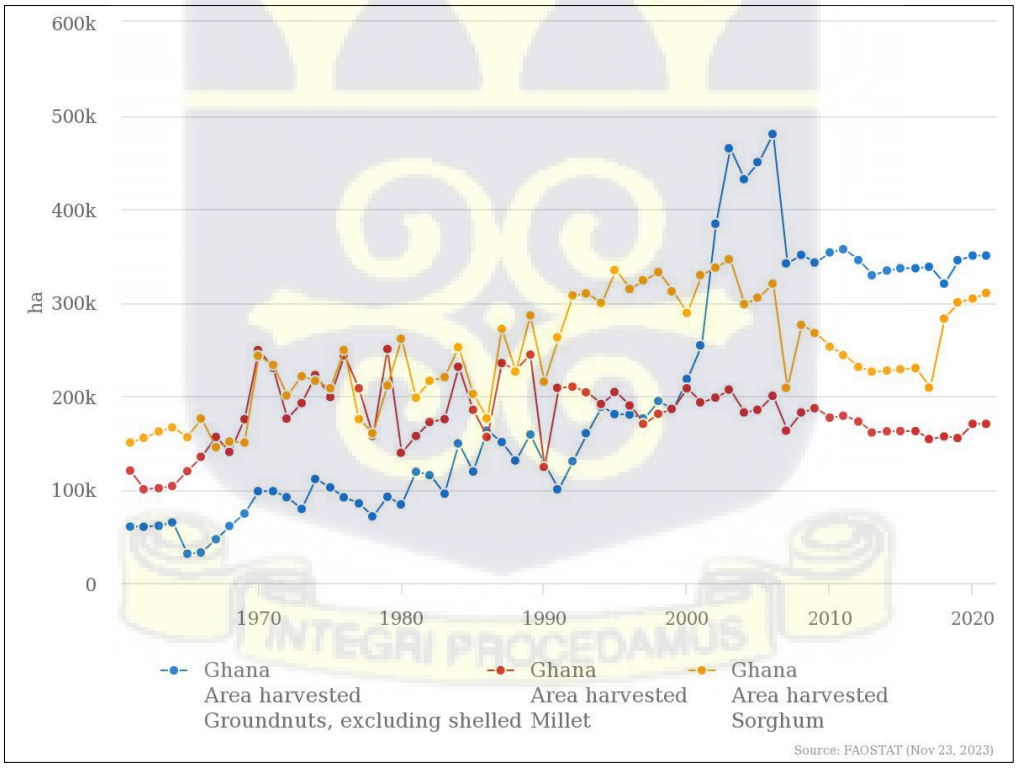


Figure 6.5 Rice and Maize Area Harvested in Ghana (1965 – 2020)

Figure 6.6 Groundnut, Millet and Sorghum Area Harvested in Ghana (1965 – 2020)



Part of the change may be attributed to a preference for maize for the preparation of local diets. However, the increasing role of maize in farming systems (particularly in the districts of the Northern Savanna) is also the result of donor-supported programmes. For instance, the expansion in national maize production and area from the early 1980s to the late 1990s was in part due to implementation of the Ghana Grains Development Project (GGDP). "Annual maize production jumped from 380,000 tons in 1979, when the project started, to more than 1 million tons by the project's end in 1998" (World Bank 2007:169). However maize yields were not particularly impressive (generally less than 2 tonnes per hectare) throughout the course of the programme, and the large increase in maize production may have in part been due to expansion in maize area (Amanor, 2010:11). Morris et al. (1999) argue that both improved yields and area expansion contributed to the growth in maize production. In recent years, government programmes such as the Northern Rural Growth Programme (2007 – 2015), the Ghana Fertiliser Subsidy Programme (2008 – 2016) and the Planting for Food and Jobs Programme (2017 to date) have been crucial to increased maize production and land area. However as will be argued later on, farmers are on their own increasing their use of improved maize seed and inputs such as fertilisers due to soil infertility, the high calorie content of maize compared with millet and sorghum, and the relatively low labour required for its production.

The increase in maize production in the Northern districts (particularly Garu-Tempane) due to area expansion and high yields, and farmers' perceptions of the displacement of other cereals and legumes as a result of these increases, reflect experiences of the larger green revolution dating back to the 1960s; that is, technology change sometimes results in the expansion of production and land area of a few select crops (wheat, rice and maize), while other crops (millet, sorghum and legumes) are left behind.

Thus while the GGDP, and the new subsidy programmes of the contemporary period intended to boost production and yields for a wide array of crops (e.g., maize, cowpea, soybean and groundnut for the GGDP, and maize, rice, sorghum, soya bean, tomato, onion and chilli pepper for PFJ), results suggest that maize and rice are somehow prioritised over other crops. Again, these findings are not really surprising when placed in the context of the larger GR experience. For example, in the North Arcot district of India, rice production by both small and large commercial farmers increased substantially between 1973 and 1983. However large farmers had already adopted GR technologies before 1973, and their increases in rice production over the 10-year period "were entirely due to an expansion of the paddy area" (Hazell et al. 1993:33). This expansion of the rice farm area was associated with the displacement of groundnut, as such farms had been converted to rice (Ibid).

6.3 The Commercialisation of Maize Production in Ghana

In general, maize production was not heavily commercialised within the four research districts. In Garu-Tempane, the median maize farm was 0.8ha, which was the same as the median for sorghum farms (Table 6.3). Maize farms were also larger than farms cultivated to other crops, except millet (1.2ha). In East Gonja, maize farms (1.6 ha) were larger than farms cultivated to other crops. Maize farms in East Gonja were also larger than farms cultivated to maize in the other districts. In contrast, maize farms were the smallest of all farms in Asunafo North and Kwaebibirem.

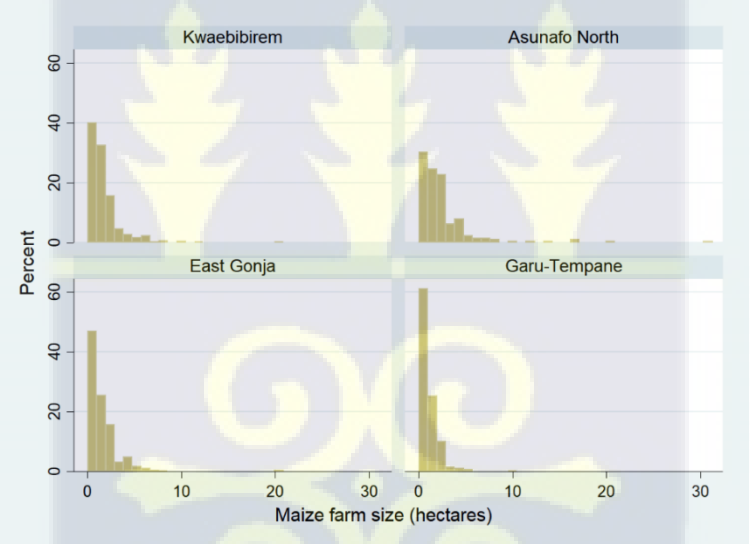
In the latter districts, some farmers were able to access land for maize production as part of sharecropping arrangements which primarily targeted tree crops. Such farmers were sometimes allocated a small plot of land for food production, or were allowed to, as in the case of Kwaebibirem, intercrop maize or rice with oil palm. In general however, such contractual agreements did not constitute an important feature of maize production, especially in Garu-Tempane and East Gonja. Maize was mainly produced for human consumption, although some farmers traded some of their produce. Consequently, the production of white maize took precedence over that of yellow maize, which is mostly used as livestock feed. In Asunafo North, it appeared that much of the maize traded in markets were imported from nearby major food producing districts.

Table 6. 3 Median Farm Size (in Hectares) for Maize and Other Crops

Districts	Maize	Rice (paddy of dry season)	Rice (paddy of wet season)	Yam	Millet	Sorghum	Groundnut	Cocoa	Plantain	Cassava	Oil Palm
Garu-Tempane	.80 (N=256) [35]	.60 (N=7)	.4 (N=41)		1.2 (N= 53)	0.8 (N=100)	0.4 (N=3)				
East Gonja	1.6 (N=158)	2.8 (N=2)	1.6 (N=56)	1.2 (N=131)	0.8 (N=5)	1.2 (N=39)	1.2 (N=147)			1.2 (N= 73)	
Asunafo North	.80 (N=23)	4.04 (N=1)	2.0 (N=8)	1.2 (N=15)				2.1 (N=138)	1.6 (N= 66)	1.2 (N=55)	2.4 (N=7)
Kwaebibirem	.80 (N=32)		2.0 (N=3)	1.1 (N=18)				1.2 (N=314)	1.2 (N=128)	1.0 (N=121)	1.6 (N= 277)

Source: DEMETER Survey 2020

Figure 6.7 Maize Farm Sizes by District



Source: DEMETER Survey 2020

Commercialisation in maize production has also been circumscribed by the essential role of the informal seed system. For example, local seeds were the main source of seed for maize production and were planted to 58 percent of all maize farms. Farmers prefer local seed for several reasons.

[35] The figures in parenthesis represent the number of plots to which crops were produced.

In Asunafo and Kwaebibirem where maize was primarily produced as a lean season crop because it could be stored for a longer time period, some local seed varieties appeared to distinctly serve that purpose. In 2016, a 46-year-old woman in Asunafo North commented:

> "We are not able to store plantain. It is cocoyam that we are able to store for a while. We harvest them, put them in a fertiliser sack and bury them in the ground to keep it fresh. Then maize is stored in barns. If it is the local maize, it can be stored on the cob but with the … [improved] maize, the grains have to be removed from the cob, be dried very well, some chemicals added, …before we can store it in sacks."

In addition to storability, some local seed varieties are preferred because they perform better when planted late in the farming season. The preference for local seed is further underlined by the dominant semi and non-market relations embedded in informal seed systems. Farmers can save part of their own seed for later production, receive seeds as gifts from friends and neighbours, or exchange their labour for seed (Table 6.5). These practices are strongly linked with farmers' long-term involvement in domestication and their own practices of seed development prior to the evolution of the formal seed system. The relevance of non-market relations is again reflected in the lack identification of seed varieties based on the names of proprietary products. Instead, farmers commonly relied on features such as seed colour as the basis for differentiating seeds. While 58 percent of maize farms were planted with local varieties, farmers did not assign specific names to these varieties but simply described them as 'local' seeds. This was followed by improved white maize which was planted on 26 percent of farms while local yellow maize varieties were planted on 12 percent of farms (Table 6.6). The only maize seed varieties specifically identified by name were *Abeleehi*, *Abrohoma* and *Obatanpa*. None of the hybrid maize varieties that have been developed in Ghana, namely, *Mamaba*, *Dadaba*, and *Etubi*, were specifically mentioned by farmers.

In spite of the important role of the informal seed system, there is an increasing commercialisation of maize production. This is first signalled by the high use of improved seeds, which were planted to 42 percent of maize farms. However, some improved seeds were recycled, and in more than 40 percent of those farms, they had been planted for more than three seasons prior to the survey. This perhaps points to challenges with acquiring new seeds for every farming season, or a selection of improved seeds with features (being able to save, share and replant) comparable with those of local varieties. In general, however, the adoption of improved seeds has mainly been driven by the need for high yielding, early maturing and robust varieties as farmers search for alternatives in their difficult farming environments.

Among the improved seed varieties, 'Obatanpa' deserves some attention due to its relatively high use: close to 6 percent of maize farms were planted with this variety. This figure may seem low, but it was the highest recorded for a named maize variety in the study. Morris et al. (1999:16) even suggest that most of the maize area planted to improved varieties are perhaps of the *Obatanpa* variety. 'Obatanpa' is an open-pollinated variety that was developed by the Ghana Crops Research Institute, the International Institute of Tropical Agriculture, and the International Maize and Wheat Improvement Center in Mexico (Badu-Apraku et al., 2006). Funding for the research leading up to the development of Obatanpa was provided by the Government of Ghana, the Canadian International Development Agency (CIDA), and Sasakawa Global 2000 (SG2000) (Afriyie 2007:407). First released in 1992, the adoption of Obatanpa has increased rapidly over the past three decades and was planted to 41 percent of the total maize area in 2012 (Ragasa et al. 2013). 'Obatanpa' is also an important variety in other African countries, although it is known by different names, and has been identified as "the world's most widely-sown quality protein maize (QPM) variety" (CIMMYT 2013).

Most farmers in this study who cultivated 'Obatanpa' mentioned high yield as the main reason for its preference. Afriyie (2007) has also argued that the adoption by farmers has also been high since it does not require any significant changes in production practices compared with those required for other popular maize varieties.

Related to adoption of improved seed is the increasing importance of the formal seed system: for instance, more than 14 percent of maize seed was sourced from agro-shops and the open market. When this figure is added to the supply of seed from farmer-based organisations (FBOs)[36] and the government, seed delivery from formal system represents a third of seed from all sources. The supply of seed from government programmes (13 percent) indicates the extent of seed and other input distribution programmes that were being implemented in 2020. Again, such programmes have gained attention since the 2008 food crisis and have become an important feature of agricultural policy and national politics. Among such programmes are the Fertilizer Subsidy Programme and the National Food Buffer Stock Company, both of which were established in 2008. The increasing commitment to such policies was again reflected in the launch of the Planting for Food and Jobs (PFJ) programme by a newly elected government in 2017. PFJ was expected to provide a 50 percent subsidy for improved seeds and fertilisers for farmers cultivating maize, rice, sorghum, soya bean, tomato, onion and chilli pepper (MoFA 2019).

Like other programmes before it, PFJ has been promoted as a programme for reviving agriculture and generating employment. It occupies an important part of discussions about government performance and plays a key role in political discourse[37].

[36] FBOs may receive seeds from government programmes, NGOs and private corporations, but they can also be influential actors in participatory research.

[37] In the last quarter of 2020 leading up to the general election, the government released about 10 documentaries celebrating its achievements in various socio-economic spheres of Ghana, with one of them highlighting the success of the PFJ programme (See https://www.facebook.com/watch/?v=325904682009794).

Table 6. 4 Main Types of Maize Seed Planted in the Previous Farming Season

Types of seed	Frequency	Percent
Local	273	58.09
Improved	116	24.68
Improved, but recycled	81	17.23
Total	470	100.00

Source: DEMETER Survey 2020

Table 6. 5 Farmers Rationale for their Choice of Maize Seeds

Reason	Frequency	Percent of responses
I do not have to buy them	138	29.4
High yields	92	19.6
They mature early	84	17.9
Good for household consumption	63	13.4
They are affordable	40	8.5
They are easily accessible	18	3.8
They store well	16	3.4
They are resistant to pests and diseases	6	1.3
Other	4	0.9
Nice aroma	3	0.6
High market demand	3	0.6
Low input requirements	2	0.4
They grow well in poor soils	1	0.2
Total	470	100.0

Source: DEMETER Survey 2020

The President, in his first inaugural address upon re-election also noted: "Food production has increased significantly, and a conscious effort has been made to improve the living standards of our farmers. The newly constructed warehouses dotted across the country are storing the surpluses for export to our neighbours, and the programme for Planting for Food and Jobs has become the veritable rock on which the successful future of our agriculture is being built." The governing party also claimed that 762,300 jobs were created between 2017 and 2019 as a result of the PFJ programme (NPP, 2020:9). In contrast, the National Development Planning Commission has assessed the PFJ programme with respect to the number of farmers reached by the programme, and its impacts on production and productivity. It states that "A total of 1,736,510 farmers benefited from subsidised fertilizers and improved seeds under the PFJ programme" NDPC (2021:31), and that "The programme also generated a 56.6 percent increase in exports of foodstuff to neighbouring countries between 2016 and 2019" (ibid).

Table 6. 6 Maize Seed Variety Planted in the Previous Farming Season

Main seed variety	Frequency	Percent
Don't know name of seed, but it is local	215	45.74
White maize (improved)	123	26.17
Yellow maize (local)	56	11.91
Obatanpa (improved, OPV)	29	6.17
Yellow maize (improved)	22	4.68
Don't know name of seed, but it is improved seed	11	2.34
Other	6	1.28
Red maize (local)	5	1.06
Abeleehi (improved, OPV)	2	0.43
Abrohoma[38] (local)	1	0.21
Total	470	100.00

Source: DEMETER Survey 2020

Table 6. 7 Sources of Seed

Source of seed	Frequency	Percent
Own saved seeds	290	61.7
From the government	62	13.19
From an agro-chemical shop	36	7.66
From the open market	32	6.81
From another farmer (neighbour) for free	20	4.26
From a Farmer Based Organisation (FBO)	20	4.26
Purchased seeds from another farmer	7	1.49
Other	2	0.43
From a non-governmental organisation (NGO)	1	0.21
Total	470	100.00

Source: DEMETER Survey 2020

[38] According to Afriyie-Debrah et al. (2018:), Abrohoma is a local seed variety.

In addition to the use of improved (commercial) seed, there was extensive use of chemical fertilisers (75 percent compared with 31 percent for organic manure[39]) and weedicides (57 percent). However, machinery (32 percent) and pesticide use (21 percent) were relatively low. Again, farmers are turning to improved maize seed and chemical fertilisers due to their higher yields, and as a measure to improve poor soils, respectively. However, high seed, fertiliser and labour costs comprise major challenges for most farmers. Thus while they have come to play a key role in helping farmers to continue with productive activities in difficult farming environments, the benefits associated with their uptake are negated through the high costs they impose. For some poorer farmers, increasing commercialisation has placed limits on their productive activities and even makes them vulnerable to food insecurity.

These challenges are not adequately addressed by input subsidy programmes due to poor implementation. In 2016, many farmers complained about delays in delivery and the distribution of expired fertilisers. Farmers also received smaller quantities of fertilisers or purchased them at higher prices than they expected. In addition, there were accusations of theft. Lastly, fertiliser distribution was 'purely by protocol', leading to the exclusion of poorer farmers who face more difficulties in market transactions. Thus, instead of serving the poor, the subsidy programme was viewed as being captured by local elite, some of whom were not even directly involved in food production. In 2020, only 15 percent of farmers in the two districts of the Northern Savanna benefitted from input subsidies (DEMETER Survey 2020), including in Garu-Tempane where more than 60 percent of farms were less than one hectare. It also appears that farmers who cultivated only millet were less likely to benefit from the programme compared to farmers who produced maize and rice.

[39] This comprises animal droppings and farm residues such as the stalks of harvested sorghum.

Thus ineffective input subsidy programmes have resulted in a greater involvement of farmers in commercial markets. More often, farmers depend on earnings from sales of agricultural produce, remittances, and the Livelihood Empowerment Against Poverty (LEAP) programme – which has been found to be more effective at targeting beneficiaries (Houssou et al. 2017)– for the purchase of commercial inputs. Alongside these strategies is a range of Non-Governmental Organisations and small-medium financial institutions which facilitate market participation through the provision of credit. These actors, with the support of U.S and European development programmes, have become directly involved in the procurement and distribution of commercial seeds, agro-inputs and provision of other agricultural services to farmers.

Poorer farmers who are unable to afford the high input prices have had to fall back on organic manure for soil improvement. For others, the high fertiliser requirements of maize production has led them to focus on other crops with lower input requirements. A 75 year old widow whose 10 year old granddaughter helped her with watering her onion farm in the dry season noted:

> "I do nothing apart from farming which I started with my husband about 30 years ago. I now farm alone. I cultivate only millet because it does not require fertilizer. Other crops such as maize, require fertilizer to be able to do well, but since I do not have money to purchase it, I felt millet is the best option for a widow like me to manage with" (Woman, 75-year-old, Garu-Tempane, 2016).

This ability to produce millets without the need to apply much chemical fertiliser was again confirmed by many farmers in Garu-Tempane in 2017. For example, when a male farmer was asked "What crops do you grow now", he responded: "Farming … has not been okay because the land has gotten spoilt, it is this millet that is helping us a little."

6.4 Geographical Differences in Intensification, Technological Change and Commercialisation of Maize Production

Technological change and commercialisation of maize production in large part correspond with the cultivation systems and agro-ecological conditions in the Northern Savanna and Semi-Deciduous forest. In all of the four research districts, population increase has played an important role in land scarcities. In Garu-Tempane, the population density was 122.5 persons per square kilometre in 2010. Figures for the other districts were much lower; for example in East Gonja, the population density was only 16.2. Thus, in East Gonja, land shortages does not generally appear to be a severe challenge, and farmers are able to fallow their lands for two to three years. However in the districts of the semi-deciduous forest, land scarcity is also the result of the settled, export-oriented cash crop production. In Asunafo, this was compounded by the reservation of 40 percent of the district as nature reserves. As a result of the land scarcities, fallowing was not a prominent practice relied on for the regeneration of soil nutrients. Consequently, cultivation mainly takes the form of annual cropping.

In one respect, the adoption of improved maize seed can, in itself, be viewed as part of technological change since farmers have found such seeds to be high yielding and more reliable within a context of poor soils. This explains the relatively high adoption of such seeds in Garu-Tempane (42 percent) compared to other districts, although the rate for Kwaebibirem (47 percent) is higher (Table 6.8). In addition to improved seed, technological change is reflected in other attempts at soil improvement as land scarcity has imposed limits on the possibility of improving soil fertility through fallowing. In Garu-Tempane, close to 45 percent of maize farms were fertilised using organic manure, the corresponding figure for East Gonja was 19 percent. In both districts of the semi-deciduous forest, organic manure was applied to only one farm which was in Asunafo.

In contrast to organic manure, chemical fertilisers are not only indicative of technological change, but also of the commercialisation of production. They were the most widely used input in maize production. Similar to organic manure, the use of chemical fertilisers was preponderant in Garu-Tempane (95 percent) and East Gonja (64 percent) compared to districts of the semi-deciduous forest (16 percent in Kwaebibirem and 9 percent in Asunafo). In the latter districts, many farmers noted that they did not apply chemical fertilisers simply because they did not have to. Further, while free fertilisers were distributed as part of state support for cocoa development, many farmers mentioned that they only applied these fertilisers to matured cocoa.

The influence of agro-ecological factors and land availability on the use or non-use of chemical fertilisers has been observed in two other important studies. The first of these is a study of rice production in Ghana based on data collected from 576 farmers in 23 districts, spread across the different agro-ecological zones (Ragasa et al. 2013). While 66 percent of all the rice farmers used fertilisers, the authors reported relatively low fertiliser use among farmers in the forest and Northern savanna zones, although for different reasons. "The main reasons reported by nonusers were fertile soils and no need for fertilizer (mostly in the forest zone) and the expense of fertilizer or lack of funds to purchase fertilizer (mostly in the northern Savanna)." (Ragasa et al. 2013:26). The second example of the influence of agro-ecological factors and land availability on the use of improved crop technologies comes from the Bonsaaso community, one of the study sites of the Millennium Villages Project (Nziguheba et al., 2010). Bonsaaso is located in the forest and has two rainy seasons, and its cropping system comprises the cultivation of cocoa and annual food crops (Nziguheba et al., 2010). Thus, it is similar to the communities in the Asunafo and Kwaebibirem districts, although its "system of slash and burn" (Nziguheba et al., 2010:83) points to relative land availability compared with the Asunafo

district. Efforts by the MVP to increase maize yields through the adoption of improved seeds and chemical fertilisers showed that while these interventions were associated with higher yields, adequate maize could have been produced in Bonsaaso without a reliance on chemical fertilisers due to the high quality soil in the community.

Thus, the results for improved seeds, organic manure and chemical fertilisers points to technological change in the Northern districts, especially in Garu-Tempane relative to the Southern districts of the semi-deciduous forest. Farmers, especially women farmers, in the Northern districts frequently mentioned that maize performance was enhanced by chemical inputs. While this is true, chemical fertilisers were also commonly used with other cereals: more than 80 percent of millet and sorghum fields were fertilised with chemical fertiliser. Thus in general, many farmers in the Northern districts (Garu-Tempane in particular) have responded to inadequate land and poor soils, which are associated with long-term population pressures, as well as other agro-climatic conditions by increasing their use of chemical fertilisers. Without such inputs, farmers would "toil in vain without any harvest" (Man, 39-year-old, Garu-Tempane, 2016).

Human labour remains crucial to maize production. However, there is a shortage of labour in agriculture which is commonly ascribed to increasing formal education, and the inability to rely on family labour as young people are starting their own farms. Similarly there is the movement of youth labour to more attractive economic activities such as artisanal and small-scale mining. Farmers have responded to inadequate labour by increasing their use of weedicides. Rates of weedicide application were high in East Gonja (86 percent), Asunafo (52 percent), as well as Garu-Tempane (43 percent) (Table 6.8).

However, high weedicide use is not only the result of labour shortages *per se*, but because farmers have found them to be cheaper. Some farmers mentioned that it takes a longer time for grass to grow back when weedicides are applied, as compared to human labour that has to be engaged regularly for weed control. Weedicide use has also helped some farmers to circumvent other labour processes, as some farmers are able to plant seed without necessarily having to till the soil.

Machinery use (tractors in particular) was restricted to the North and to East Gonja in particular, where they were used on 89 percent of maize farms. In addition, East Gonja accounted for 94 percent of tractor use on maize farms in all of the four districts and 90 percent of tractor use on other farms besides maize. Tractor use in the Gonja area can be traced to the establishment of the Gonja Development Company (GDC) in the 1950s (Miracle & Seidman 1968). The GDC made an attempt at large scale mechanised agriculture with a focus on food crops including maize. However, it appears that initial efforts to introduce tractors and other machinery were restricted to Damongo and not Salaga (the capital of the East Gonja district). Currently, tractor services in East Gonja appear to be predominantly privately mechanised schemes involving government programmes such as the Northern Rural Growth Programme. Other important players include Non-Governmental Organisations (for e.g., SEND Ghana) and small financial institutions such as Sinapi Aba Savings and Loans Ltd. A key informant and commercial farmer in Salaga commented:

> "We have a contract with DANIDA [Danish Development Agency] which gives us money to buy tractors for farmers; due to that, they define the interest rate and terms of repayment for us and the amount of interest we Sinapi Aba Loans and Savings should charge and we cannot go beyond that."

Payments for tractor services were either in the form of produce or cash. In 2015, cash payments for a one hectare farm ranged from GHC40-GHC50 while service providers sometimes collected "two bags of rice and maize from every ten bags of rice and maize harvested" as payment from farmers who did not pay cash (Man, 56-year-old, East Gonja, 2016).

Pesticides were the least used of all agro-inputs in maize production, and were used more commonly in the South relative to the North. For instance they were applied to 43 percent of maize farms in Asunafo North. This was followed by Kwaebibirem (28 percent), although this rate is only slightly higher than what was reported for Garu-Tempane (26 percent).

While changes in technology are influenced by systems of cultivation and agro-ecological conditions, adoption is not uniform across all groups of farmers, which further has important implications for land, labour and livelihoods.

Table 6. 8 The Use of Seed, Other Agro-Inputs, and Machinery on Maize Farms (Percent)

Inputs/technologies	Total	Garu-Tempane	East Gonja	Asunafo North	Kwaebibirem	p-value
Improved seeds	32.34	41.63	13.29	39.13	46.88	0.000
Organic manure	31.06	44.75	18.99	4.35	0.00	0.000
Chemical fertiliser	75.11	95.33	63.92	8.70	15.63	0.000
Pesticides	21.06	26.46	7.59	43.48	28.13	0.000
Weedicides (herbicides)	56.38	43.58	86.08	52.17	15.63	0.000
Machinery (tractor)	31.70	3.11	89.24	0.00	0.00	0.00
Bullock ownership	8.95	35.44	0.00	0.00	0.00	0.000

Source: DEMETER Survey 2020

6.5 The Class and Gender Dimensions of Technological Change and Commercialisation in Maize Production

Class

It is frequently stated that both small and large commercial farmers can adopt and enjoy the benefits of modern technologies. Viewed from this perspective, social class is not a factor that may hinder the uptake of GR technologies. This argument neglects the role that commercialisation may play in determining access to technologies, and is unduly focused on a single element, namely, the seed. However the commercialisation of agricultural production often revolves around a combination of several technologies (e.g. improved seeds, irrigation, pesticides and fertilisers), rather than a single element. In some circumstances, the adoption of a seed may even trigger the need for another technology. It is thus important to examine how different classes of farmers adopt or are affected by different technologies within the diverse agro-ecological and socioeconomic contexts within which they undertake their productive activities.

In the larger agrarian literature, the ownership or control of a specified amount of land has often informed the classification of farmers into social classes. Thus in his analyses of agricultural households in the Taurida province, Lenin classified households which cultivated lands that were 10 *dessiatine* (11 hectares) or smaller as the poor group (Lenin 2009:71). Agarwal (1990:353), in her analysis of the different benefits of 'common property resources' in 12 districts of India also defined poor households as "landless household[s] and those owning less than 2 ha." In Ghana, rural households that operate farms that are 2 hectares or smaller are explicitly identified as the main targets and beneficiaries of agricultural policy and other development interventions (Chamberlin 2007).

The use of land area controlled by households as the basis for examining the relationship between class and commercialisation of production in constrained by a methodological challenge in this study. Firstly, in each household, there are likely to be different practices occurring on different plots depending on the household member who has more direct control over the plot in question. This may also be linked with the purpose for which a specific plot is cultivated, although in this study the main aim of maize production was to produce food for the household. In addition, there is also a feminist critique of the household which highlights the complexity of relations within the household, the non-recognition of women's reproductive work, and discrepancies in the well-being and allocation of important household resources (Razavi 2009:197-205). Thus, although farm size was central to analyses of the class implications of commercialisation, this was done not in relation to the lands controlled by households, but on the general distribution of separate maize farm plots. Consequently, maize farms were divided into four categories: a) farms smaller than 1 hectare (46 percent); b) farms ranging from 1.0-1.9 hectares (29 percent); c) farms ranging from 2.0-3.9 hectares (17 percent), and farms that were 4 hectares or larger (8 percent) (Table 6.9).

Table 6. 9 Maize Farm Sizes (hectares)

Farm sizes	Frequency	Percent	Cum. Percent
<1 ha	217	46.17	46.17
1.0 – 1.9 ha	135	28.72	74.89
2.0 – 3.9 ha	82	17.45	92.34
4 – 30 ha	36	7.66	100.00
Total	470	100.00	

Source: DEMETER Survey 2020

Results from the analyses did not show any direct linkage between farm size and the use of improved seeds. This finding similarly applied to chemical fertilisers and pesticides (Table 6.10). These findings would suggest that poor farmers were as likely as wealthier farmers to adopt improved seeds, fertilisers and pesticides in maize production, although with respect to chemical fertilisers and pesticides, they do not take account of the quantity and timing of application. On the other hand, there is a clear relationship between farm size and use of organic manure: a larger proportion of smaller maize farms were fertilised with organic manure compared to larger farms. For instance, such fertilisers were applied to 31 percent of maize farms smaller than 1 hectare, while they were applied to only 11 percent of farms that were 4 hectares or larger (Table 6.10). Thus, poorer farmers increasingly relied on organic manure for soil improvement compared to wealthier farmers. In contrast, weedicides were used more extensively on larger farms than on smaller ones. For instance, they were applied to 69 percent of farms that were 4 hectares or larger compared to 48 percent of maize farms that were smaller than 1 hectare. This relationship was similarly found for machinery (tractors), and the gap is wider when the results are compared with weedicides: tractors were used on only 22 percent of maize farms that were smaller than 1 hectare, compared with weedicides which were used to 48 percent of such farms.

Table 6. 10 Farm Sizes and the Use of Improved Seed, Other Inputs and Machinery (Percent)

Inputs/technologies	Total	<1 ha	1.0 – 1.9	2.0 – 3.9	4 – 30	p-value
Improved seeds	32.34	31.34	32.59	37.80	25.00	0.550
Organic manure	31.06	31.34	37.04	29.27	11.11	0.028
Chemical fertilizer	75.11	73.27	80.00	75.61	66.67	0.320
Pesticides	21.06	19.35	22.96	25.61	13.89	0.422
Weedicides	56.38	48.39	59.26	67.07	69.44	0.006
Machinery (tractor)	31.70	22.58	29.63	45.12	63.89	0.000

Source: DEMETER Survey 2020

In examining the relationship between class and technology adoption, it is important to consider separately the role of gender due to the often large disparities in ownership and access to land between men and women. With a few exceptions, with women's larger maize farms in Kwaebibirem being one such example, women generally farmed smaller plots than men. In the case of maize, the disparities in farm sizes are wider in the Northern districts, where maize is a more important crop. For example, in East Gonja, the median maize farm for men was twice that of women (Table 6.11). In general, 64 percent of women's maize farms were smaller than 1 hectare compared to 37 percent for men. In contrast, 10 percent of the maize farms cultivated by men were 4 hectares or larger compared to 4 percent for women (Table 6.12).

The results however show that women were more likely than men to use improved maize seeds. Improved seeds were planted to 40 percent of women's maize farms compared to 28 percent for men (Table 6.13). In Garu-Tempane, the higher use of improved seed among women compared to men can be observed for maize, but it is more easily noticeable for sorghum where 40 percent of women used improved seeds compared to 22 percent of women (Table 6.14). The high use of improved maize and sorghum seed among women in Garu-Tempane is mainly due to the supply of seed from farmer-based organisations and government-supported programmes (Table 6.17). In East Gonja, however, the use of improved seed is generally low, and there are no remarkable differences among men and women in the use of these seeds (Table 6.15).

Similar to improved seed, chemical fertiliser use in maize production is higher among women as compared to men. In general, chemical fertilisers were applied to 82 percent of maize farms cultivated by women compared to 72 percent for men. However, as with the previous analysis on farm sizes, this does not indicate that there was an appropriate and timely application of fertilisers on women's farms.

In Garu-Tempane, there are no wide differences in the use of chemical fertilisers between men and women, except perhaps for millets, where they were applied to 86 percent of men's plots compared to 78 percent women's plots (Table 6.14). In East Gonja, slightly more women apply chemical fertilisers to their maize, sorghum and groundnut farms compared to men. This can be attributed to women's inadequate access to land. When they are able to access land, these are usually lands that have been used by their husbands or other male relatives and are now being left to fallow. However, the differences in men and women's use of chemical fertilisers are not large enough to draw any specific conclusions. Again, however, this analysis does not take into account other factors such as the quantity and timing of application, which may be more useful in explaining differences between men and women in the use of this input.

These findings are surprising and would support the 'scale-neutral' hypothesis since it is frequently suggested that women are constrained in their access to agricultural inputs. The results are again surprising because although the previous analysis showed no clear pattern in farm sizes and the adoption of improved seeds and chemical fertilisers, women farmed significantly smaller maize farms compared to men.

I would argue, in light of these gender differences, together with the lack of clear patterns in the adoption of improved seeds and chemical fertilisers by poor and wealthier farmers, that women were perhaps more likely to adopt these inputs due to the lower quality of the lands they cultivated. In contrast to this study, Morris et al. (1999) found that large farmers were not only more likely to adopt improved seed and fertilisers, but also adopted these technologies on a larger part of their maize farms compared to smaller farmers. However they also found no clear statistical differences in the application of chemical fertilisers – the technology which they considered more difficult to adopt – between men and women. Further, Doss & Morris (2001) did not also find any statistical differences between men and women in their adoption

of improved seed and fertilisers. The authors did not also find any significant differences in the adoption of improved seed between men and women living in male-headed households. However women in male-headed households were more likely to adopt improved seed than women in female-headed houses, but there were no statistical differences between both groups of women with respect to fertilisers. Doss (2013) has further argued that such findings may have been due to the focus on individuals in the household instead of relying on the household head as the unit of analysis.

My suggestion that women adopted improved seeds and chemical fertilisers due to the lower quality of their land is further complicated by the results on the utilisation of organic manure by men and women. Previously, poorer farmers were found to be more likely to use organic manure. Given that most maize farms cultivated by women were smaller, it was expected that their use of organic manure would be high. However, the results on gender differences do not show any statistically clear patterns in the use of organic manure by men and women. Further, there were no major differences in the use of organic manure by large and small women maize farmers. However men who cultivated smaller maize farms were more likely to use organic manure than men who cultivated larger farms. Additional evidence of this pattern was again found among men who cultivated maize in East Gonja, but not for men in Garu-Tempane (Table 6.18).

While organic manure is not usually viewed as a commodified external input, whose access is determined by the ability to participate in commercial markets, the differences in its use among men and women is rather stark in Garu-Tempane: their use among men (52 percent) was twice the rate for women (25 percent) (Table 6.14). This is because in Garu-Tempane, the available organic manure is usually divided among the male household heads, and are usually applied to farms around the compound (Kudadjie, Struik, Richards, & Offei, 2004). This is also confirmed

by the higher use of organic manure on sorghum plots (Table 6.14), which are usually located around the compound in order to scare away birds, and easily dry the grains during and after harvest, respectively. Due to the general land availability, good soils and extensive cultivation by men in East Gonja, the tight restriction over access to organic manure in Garu-Tempane may not equally apply to East Gonja, and it is perhaps this laxity that explains the slightly higher use of organic manure among women (13 percent) compared to men (7 percent) (Table 6.15).

In contrast to improved seed and chemical fertilisers, men were more likely than women to use weedicides and tractor services. This confirms previous results on the relationship between farm sizes and the adoption of these technologies given that men generally cultivated larger maize farms. Among men, larger farmers were more likely to use tractor services compared to male farmers who cultivated relatively smaller plots. However this pattern was not found for women. In general, wealthier farmers do not experience much difficulty in gaining access to tractors due to their own ownership and ability to rent in such machinery when they are most needed for farm preparation. For most women and poor farmers, however, tractors are scarce and the high demand for them during the peak of the production season usually means that they are the last to be served, often after the rains have started.

Table 6. 11 Average Size of Maize Farms Cultivated by Men and Women in Comparison to Other Types of Farms

	Maize (ha)		All other farm plots excluding maize (ha)	
Districts	Men	Women	Men	Women
Garu-Tempane	1.2	0.8	0.8	0.4
East Gonja	1.6	0.8	1.2	0.4
Asunafo North	1.0	0.8	2.4	1.6
Kwaebibirem	0.8	1.1	2.0	1.2

Source: DEMETER Survey 2020

Table 6. 12 Distribution of Sizes of Maize Farms Cultivated by Men and Women

Sex	<1 ha	1.0 – 1.9	2.0 – 3.9	4 – 30	Total
Male	117	98	69	30	314
Row percentage	37	31	22	10	100
Column percentage	54	73	84	83	67
Female	100	37	13	6	156
Row percentage	64	24	8	4	100
Column percentage	46	27	16	17	33
Total	217	135	82	36	470
Row percentage	46	29	17	8	100
Column percentage	100	100	100	100	100

Source: DEMETER Survey 2020

Table 6. 13 Use of Improved Seed, Other Agro-Inputs and Machinery by Men and Women Maize Farmers (Percent)

Inputs/technologies	Total	Male	Female	p-value
Improved seeds	32.34	28.34	40.38	0.009
Organic manure	31.06	33.12	26.92	0.172
Chemical fertilizer	75.11	71.66	82.05	0.014
Pesticides	21.06	20.06	23.08	0.451
Weedicides	56.38	62.10	44.87	0.000
Machinery (tractor services)	31.70	40.13	14.74	0.000
Bullock ownership	18.93	21.43	17.97	0.457

Source: DEMETER Survey 2020

Table 6. 14 Use of Improved Seed and Other Inputs in Garu-Tempane

	Improved seed		Organic manure		Chemical fertilisers		Weedicides	
	M (%)	W (%)	M (%)	W (%)	M (%)	W (%)	M (%)	W (%)
Maize	38.41	45.76	56.52	31.36	96.40	94.07	46.04	40.68
Millet	37.14	38.89	48.57	44.44	85.71	77.78	22.86	16.67
Sorghum	21.82	40.00	67.27	28.89	83.64	86.67	36.36	35.56
Groundnut	--	66.67	--	33.33	--	66.67	--	0
All crops	33.48	38.35	52.49	25.24	85.97	84.47	39.37	34.95

Source: DEMETER Survey 2020

Table 6. 15 Use of Improved Seeds, Other Inputs and Machinery in East Gonja

	Improved seed		Organic manure		Chemical fertilisers		Weedicides		Machinery	
	M[40] (%)	W (%)	M (%)	W (%)	M (%)	W (%)	M (%)	W (%)	M (%)	W (%)
Maize	13.87	9.52	18.25	23.81	62.77	71.43	86.86	80.95	89.78	85.71
Millet	0	--	100	--	0	--	60.00	--	40.00	--
Sorghum	6.67	0.00	100	100	36.67	44.44	73.33	55.56	76.67	100.00
Groundnut	5.98	6.67	0	6.67	23.93	33.33	82.05	76.67	87.18	90.00
All crops	7.48	4.35	7.48	13.04	28.93	33.33	80.55	72.46	74.31	71.01

Source: DEMETER Survey 2020

[40] Men in East Gonja cultivated maize on 158 plots; out of this number improved seeds were planted on only 19 (13.87 percent of those plots. On the other hand, women cultivated maize on 21 plots, and only 2 (9.52 percent) used improved seeds.

Table 6. 16 Source of Maize Seed among Men and Women in East Gonja

Sex	Own saved seeds	From another farmer (neighbour) for free	Purchased seeds from another farmer	From the open market	From an agro-chemical shop	From a Farmer Based Organisation (FBO)	From the government	Total
Male	100	3	1	16	15	1	1	137
	72.99	2.19	0.73	11.68	10.95	0.73	0.73	100
	86.21	75	100	88.89	88.24	100	100	86.71
Female	16	1	0	2	2	0	0	21
	76.19	4.76	0	9.52	9.52	0	0	100
	13.79	25	0	11.11	11.76	0	0	13.29
Total	116	4	1	18	17	1	1	158
	73.42	2.53	0.63	11.39	10.76	0.63	0.63	100
	100	100	100	100	100	100	100	100

Source: DEMETER Survey 2020

Table 6. 17 Source of Maize Seed among Men and Women in Garu-Tempane

Sex	Own saved seeds	From another farmer (neighbour) for free	Purchased seeds from another farmer	From the open market	Agro-chemical shop	NGO	FBO	Government	Other	Total
Male	90	3	2	4	3	0	8	28	0	138
	65.22	2.17	1.45	2.90	2.17	0	5.80	20.29	0	100
	62.07	37.50	50	40	37.50	0	42.11	46.67	0	53.0
Female	55	5	2	6	5	1	11	32	2	119
	46.22	4.20	1.68	5.04	4.20	0.84	9.24	26.89	1.68	100
	37.93	62.50	50	60	62.50	100	57.89	53.33	100	46.30
Total	145	8	4	10	8	1	19	60	2	257
	56.42	3.11	1.56	3.89	3.11	0.39	7.39	23.35	0.78	100
	100	100	100	100	100	100	100	100	100	100

Source: DEMETER Survey 2020

6. 18 The Use of Organic Manure and Machinery by Men and Women Farming Varying Farms Sizes (Percent)

Inputs/technologies	Total	<1 ha	1.0 – 1.9	2.0 – 3.9	4 – 30	p-value
Organic manure use on maize plots cultivated by men	33.12	37.61	39.80	27.54	6.67	0.004
Organic manure use on maize plots cultivated by men in East Gonja	18.25	40.00	15.38	8.33	0.00	0.000
Organic manure use on maize plots cultivated by women	26.92	24.00	29.73	38.46	33.33	0.662
Machinery (tractor) use on maize plots cultivated by men	40.13	32.48	33.67	47.83	73.33	0.000

Source: DEMETER Survey 2020

6.6 Conclusion

The role of maize in the farming systems of the Northern Savanna has increased rapidly in the last 20 years. Its production and land area now surpasses the area allocated to 'indigenous' crops such as millet, sorghum and groundnut. These changes are in part attributable to donor-supported agricultural research and seed development of the 1980s, and more recently to several GR initiatives, with government input subsidy programmes being the most prominent. However, the new programmes have failed to effectively deliver seed and chemical fertilisers to the farmers who need them the most. Thus maize production has also involved greater market participation by farmers for commercial seeds and other agro-chemicals as they look for solutions in their difficult farming environments. However, the constraints to agricultural production vary greatly within and across districts, and agro-ecological zones. These in turn determine the extent to which farmers rely on commercial seed varieties and inputs. Together, the outcome of input subsidy programmes and farmers own adoption of commercial seeds and inputs, has been the prioritisation of crops such as maize and rice, while millet, sorghum and groundnut have been left behind.

From a nutritional point of view, crops such as maize are primarily an important source of calories, although the development of quality protein maize has further increased the body's utilisation of protein from maize diets. However, staples such as millet and sorghum, whose roles in agricultural production and food consumption appear to be diminishing, also have clearly distinguishable nutritional benefits. Millet consumption has recently been found to be crucial in the prevention and management of diabetes (Anitha et al., 2021). This calls for publicly funded agricultural research suited to the needs and production conditions and practices of small farmers. Increasing research into millet and sorghum, legumes, and even tuber crops such as cassava and yam, with a clear goal to develop technologies that can be adopted by peasants, would provide farmers with alternatives and perhaps, several options for cultivation instead of the overwhelming focus on maize and rice which have come to define the GR in sub-Saharan Africa.

Increasing commercialisation also has important implications outside of the commonly stated impacts on agricultural yields and production. For example, instead of helping them to meet their daily food and nutrition needs, farmers in difficult farming environments who are unable to frequently participate in the market for agro-inputs are at a greater risk of experiencing low crop yields. While this may be seen to primarily affect poorer farmers, the increasing role of agrochemicals in food production has important implications for other groups of farmers, and for urban populations that depend on rural farmers for food. This is because most agrochemicals are imported commodities whose prices are subject to change depending on global events or policies pursued by states in which they are manufactured. Russia, China, Canada and the U.S are the main global suppliers of nitrogen and phosphate fertilisers, while Russia and Belarus supply "41 percent of potash-based fertilizers" (CGIAR, 2022:2).

Similarly, fertiliser prices move hand in hand with global fuel and energy prices (Moyo et al. 2019:24) and are thus subject to price changes depending on the nature of these markets at a particular time. Thus, an increasing reliance on imported agro-inputs subordinates Africa's food security needs to concentrated and unpredictable markets, as it did with the 2008 fuel crises, and more recently with Russia's invasion of Ukraine, and the sanctions that followed it. These usually unpredictable patterns in the supply of agricultural inputs raise concerns about the sustainability of input subsidy programmes due to the additional budgetary allocations that may be required to import inputs. For poorer farmers, higher input costs increases dependency on credit and the risk of defaulting payment.

In the contemporary period, questions of land tenure and labour have also not been sufficiently factored into debates and GR interventions, which is reminiscent of earlier critiques by some that GR programmes were a distraction from land reform. In the semi-deciduous forest of Ghana, this is compounded by the focus on enhancing productivity in the export-crop sector which similarly eclipses issues of inequitable land distribution. Incentives and strong state and agribusiness support for cocoa have resulted in increased land commercialisation, scarcity and the reservation of little land for food. This has resulted in the displacement of poor and women food producers and the extension of sharecropping arrangements originally associated with cocoa and oil palm to food crops. Interestingly many farmers in the semi-deciduous forest believe that the increasing use of agrochemical products has reduced the quality of tuber crops such as cassava and cocoyam. Farmers also attribute the extinction of natural occurring food which were formerly available in the commons for collection to the use of agrochemicals. Further, while vegetable production comprises an important activity in the semi-deciduous forest, farmers raised concerns about the safety of such produce due to high application of agrochemicals.

Farmers in the Northern Savanna similarly stated that agrochemical use was associated with deterioration in the quality of yam produce, while others raised concerns that seepage of such chemicals into water sources may pose a threat to the livestock that depend on such sources for drinking water.

In general, labour scarcity was attributed to the loss of youth labour due to increasing school enrolment and as young people continue to establish their own farms. In addition, labour is attracted to better paying jobs in economic activities such as small-scale mining. However farmers are increasingly relying on weedicides for weed control as they have found it to be cost-effective to apply these chemicals than to engage labour.

High application of weedicides has been attributed to the intrusion of cheaper herbicide products from China (Ragasa et al. 2013), and it has been noted that many labourers also use weedicides in land clearing activities (Amanor and Chichava 2016). Still, the results from this study suggest that class determines the adoption of technologies such as weedicides and tractor services, with wealthier farmers being more likely to utilise these inputs and services than poorer farmers. This has important implications for land and labour. To a large degree, particularly in the East Gonja and Asunafo North districts, the key disparity between poor and women farmers on the one hand, and wealthier farmers on the other hand was not in relation to seeds and chemical fertilisers but to land. In Garu-Tempane, an important outcome of women's lack of ownership, and access to fertile land was the availability of their labour for the household and agricultural labour market. Women were preferred as hired labour and had organised themselves into labour groups to work collectively for daily wages. With the exception of land preparation where their involvement was limited, these women's groups were primarily responsible for sowing, weeding and harvesting.

Within the context of technological change, I would argue that women's increased role in agricultural production in Garu-Tempane arises out of necessity of the increasing labour required to produce food under systems of frequent cropping compared to fallow systems[41]. In East Gonja, women's increasing role in those activities that define farming – in its 'traditional' terms – are unlikely for several reasons. In places like Garu-Tempane, women combine their reproductive roles with direct involvement in agricultural production. As a result, women are more likely to be recognised as farmers in their own right, which then places them in a better position to negotiate for land rights (Apusigah 2008). In contrast, women's involvement in agriculture in East Gonja is limited to activities such as planting, harvesting, and cooking for farmworkers. In contexts such as this, women are less likely to be recognised as farmers and their rights to land are weak. Consequently, women have found it more beneficial to engage in activities such as trading, pottery making and the sale of forest resources where they are able to exercise greater control (ibid 2008). Thus in spite of the relative land availability, inequitable land distribution is starker in East Gonja than in other districts: 87 percent of the maize farms in East Gonja were managed by men while women controlled only 13 percent of the farms. However it is in East Gonja where the use of weedicides and tractor services (which have been found to be determined by both class and gender) was extensive. This is crucial because in East Gonja, activities such as land clearing and preparation are important in establishing access to land.

[41] Agarwal (1984) also reported demands for women's labour under a system of intensive rice cultivation characterised by a reliance on irrigation and adoption of high yielding varieties (HYVs) in three Indian states. In general, the adoption of HYV was associated with a greater demand for male and female labour for activities such as sowing, weeding and harvesting. In the state of Tamil Nadu, the adoption of HYVs also involved a greater participation of female family labour in fieldwork. In the case of Orissa (where irrigation was less important compared to the other states), no clear relationship was established for cultivation of HYVs and the engagement of female family labour. But in Andhra Pradesh, adoption of HYVs resulted in the retreat of female family labour from casual work. Thus, while intensive cultivation including the adoption of HYVs may in general be associated with a greater demand for labour, their impacts on women also depend on the classes to which they belong, with women in the lower classes being more likely to be involved in fieldwork, while their counterparts in households with a "larger farm size, a higher percentage of area under irrigation and a higher percentage of area under HYV rice" (Agarwal 1984:46) were more likely to be secluded from such work.

This puts wealthier farmers in a position to further accumulate more land, while ensuring increasing land alienation for poor and women farmers. Thus, poor and women farmers right to land are not only threatened by large irrigation projects, large-scale land acquisitions and neo-liberal land reforms (Tsikata, 2016; Tsikata & Yaro, 2011), but also through the commodification of agricultural production.

Chapter Seven

Conclusion: Reflecting on the African Green Revolution Discourse, Technological Change and Agricultural Policy in Ghana

7.1 Introduction

In mainstream agricultural development policy, rural poverty, food insecurity and underdevelopment in Africa are attributed to farmers' inadequate adoption of commercial seeds, chemical fertilisers and other modern agricultural technologies. This is the shared view of the most important actors in rural development policy comprising African governments, the main external donors and philanthropic organisations, and the private sector. This view of the relationship between modern agricultural technology and welfare, in combination with factors such as the 2007/2008 food crisis, has had an important influence on the implementation of interventions to increase agricultural productivity in Africa since the 2000s. There is also a common agreement among the main actors that efforts to increase rapid adoption of the modern technologies through private markets remain the main (if not only) route for achieving the increases in agricultural productivity that are associated with improvements in the well-being of the poor.

This study sought to examine these main arguments and policy recommendations advanced by the dominant agricultural development policy. The study has relied on insights from farming systems research, the Boserupian theory of technological change, the social relations of production, and political economy critiques of agribusiness to examine the factors that underpin farmers' productive activities and their decision making.

The study analysed qualitative interviews and quantitative farm level data from four rural districts of Ghana to arrive at an understanding of the conditions under which different groups of farmers adopt different kinds of technology. The study also attempted to situate contemporary agriculture and food security within the development of colonialism in the nineteenth century. In doing this, the study relied on government policy documents and the academic literature to explore previous and contemporary governmental interventions to introduce technology and the outcomes of these interventions.

The insights gained from the case studies and other data analysed show that the lack of access to private markets for commercial seeds and chemical fertilisers are inadequate to explain poverty and food insecurity across different geographic and agroecological areas. The study thus raises questions about the almost universal explanations that are posited by the green revolution literature which emphasises the pre-eminence of commercial seeds and other inputs for increasing food production over other measures for improving livelihoods in rural areas. Further, there are differences among households and individuals in their access to technology, with factors such as class and gender sometimes playing important roles in determining access to certain technologies.

This concluding chapter reflects on the arguments and policy prescriptions of the dominant policy discourse in light of the key findings emanating from the previous chapters of the study. Section 7.2 examines the extent to which food production (and food security) are constrained by the low uptake of improved seed and chemical fertilisers among the four research districts. Using the case of the Southern districts, it questions the pre-eminence of commercial seeds and chemical fertilisers in food production. Instead, it highlights how food availability and access are in large part influenced by households' devotion of most productive resources to the

production of non-food cash crops. The cases of the two Northern districts are also examined in this section. The next section discusses the role of local-level actors in technology adoption. It notes that while population pressures and agro-ecological conditions are extremely important in shaping technology change, change does not occur in a vacuum but often involves the mediating role of local-level actors such as NGOs. Section 7.4 notes that while food production is important, sustainable food security ultimately requires a consideration of factors that do not often feature in discussions of food security. The section signals the importance of increasing access to adequate and quality education and other social services, and prudent economic management as important policy issues for achieving food security. Section 7.5 points to the linkages between population pressures, commercialisation and women's land rights, while section 7.6 outlines topics for future research.

7.2 The Role of Technology in Food Production and Food Security

In the Asunafo North and Kwaebibirem districts of the semi-deciduous forest, farmers' low uptake of commercial seeds and chemical fertilisers in particular, is not due to factors such as lack of knowledge or lack of private markets but simply because they do not need these inputs to produce the quantity of food they need. The low demand for improved seed and chemical fertilisers in these two areas – Asunafo North in particular – is due to agroecological factors. However, pesticides and weedicides were used to control pests and lower the cost of labour, respectively.

Crucially, agricultural commercialisation in these two areas – which is reflected in the devotion of most productive resources to cocoa production – is implicated in food insecurity. This is particularly the case of the Asunafo North district. While there are two farming seasons, food cultivation is not a major priority in the district. Thus, farmers increasingly rely on markets for

food, especially between the months of December and April. Thus, in Asunafo North, households experience four months of food shortages and high food prices. This is similar to the number of months of food shortages in East Gonja, which has one main rainy season (May to September). In contrast to Asunafo North, food crop production (and some livestock rearing) comprises the main agricultural enterprise pursued in East Gonja. This has enabled farmers to produce food for subsistence and commercial markets through fallowing (the result of relative land availability), and a limited use of chemical fertilisers. However, there is an extensive use of herbicide and machinery in East Gonja. In contrast, in Asunafo North, 40 percent of the district is under forest reserves, and farmers devote most of their productive resources to cocoa. Farmers have been unable to cultivate food on these cocoa farms as food crops do not thrive well in matured cocoa farms with fully formed canopies.

On the other hand, Garu-Tempane performs poorly relative to the other districts with respect to food availability. In a year, there are almost five and sometimes six months of food shortages. In contrast with East Gonja, farmers in Garu-Tempane are faced with the challenge of small farm sizes and a general lack of land for fallowing. Truly, in Garu-Tempane, farmers have sought to improve crop yields through soil improvement involving not only the application of organic manure, but also the increased use of chemical fertilisers purchased from private markets. Due to the constraints in access to land, the use of organic manure, improved seed and chemical fertilisers are more pronounced in Garu-Tempane than in the three remaining districts. The case of Garu-Tempane essentially points to how an extremely difficult farming environment has pushed farmers to rely on commercial input markets in order to meet their subsistence needs. This has also resulted in the increased adoption of improved OPV maize and improved varieties of sorghum that tend to provide better yields than other crops.

However, farmers' efforts to improve crop yields sometimes results in a focus on a narrow set of crops. For example, groundnut production in Garu-Tempane has declined tremendously. Because improved varieties of maize and rice have the potential to provide better yields in farming environments where access to land is constrained, they are sometimes promoted as crops that should receive maximum attention in the efforts to bring about a green revolution (Tsusaka & Otsuka, 2013). This sometimes raises concerns about the displacement of other crops such as local varieties of millet. On the other hand, the higher amounts of chemical fertiliser required to produce improved maize varieties has sometimes resulted in poorer households that lack money to purchase inputs to settle for millet. Millets may not provide yields comparable to those of improved maize, but they can thrive in difficult farming environments, do not require much fertiliser and can be depended on for a satisfactory harvest. Another crop that does not require much fertiliser is beans. However these crops receive little attention in efforts to improve farmer productivity.

Even in Garu-Tempane where land scarcity and poor soils have resulted in the increased uptake of improved seeds and chemical fertilisers, it is still important to examine other factors associated with food insecurity in the district. This is because the *early millet* crop is harvested in April before the start of the main planting season, whose crops are harvested in September. Frequently, crops intended for consumption were sold to cater for other household needs. Principal among these was 'school fees' (tuition), health and other social expenditures. Also, in areas such as Garu-Tempane, timeliness in agricultural production is important for securing a good harvest. However access to inputs is a major constraint for many farmers. Key among these is chemical fertiliser. High fertiliser prices prevent use or allow for the application of only small amounts of fertilisers. Bullock plough is another technology that is rarely mentioned in the green revolution literature, but it is of considerable importance in Garu-Tempane. Ploughing is done twice: after the initial rains before sowing, and to control grass after sowing,

after which fertiliser is then applied to crops. But not all farmers own bullock ploughs and they often have to rent in bullocks from other households. This comprises an important obstacle to the timely ploughing and sowing operations that are needed for securing a good harvest.

7.3 The Role of Local-Level Actors in Farmers' Adoption of Commercial Seeds and Chemical Fertilisers

The attempts by farmers in Garu-Tempane to prevent declines in crop output through the adoption of improved seeds and chemical fertilisers does not of course occur in a vacuum. This is because farmers' technology choices and the strategies they pursue have also been influenced by the work of local development institutions. In Garu-Tempane, the most influential organisations in agriculture were The Presbyterian Agricultural Station in Garu (PAS-Garu) and the Department of Agriculture of the Garu-Tempane District Assembly. In East Gonja, the key organisations were the Department of Agriculture, two NGOs (USAID SPRING and SEND GHANA), and SINAPI ABA (a small financial institution). Some of these organisations had made attempts to stimulate methods of production that did not require the high application of commercial inputs, hence reducing farmers' reliance on input markets. For example, the Departments of Agriculture in both Garu-Tempane and East Gonja organised programmes to encourage production through methods such as composting. Some farmers, including women farmers, mentioned that they had benefited from such programmes through direct participation, or by learning the practices from other farmers who actively participated in the programmes. In Garu-Tempane, PAS-Garu had been supporting some households to implement what was described as a *Zai-micro dosing* technology that "involves burying manure in holes and planting the seed directly in the manure together with a small quantity of inorganic fertilizer at the time of planting. This practice helps to boost yield and also reduces the cost of production by cutting down the quantity of NPK applied" (PAS-Garu, 2016:6).

However, activities of this nature lie on the fringes of the main programmes of local development organisations as they pursue an approach of agricultural modernisation to which commodity transactions remain crucial. In Garu-Tempane, PAS-Garu has facilitated adoption of the 'Obatanpa' maize variety (although this is an OPV), improved varieties of soghum and soya, and chemical fertilisers. PAS-Garu is itself involved in the marketing of seeds and chemical fertilisers and has links with input importers including Yara Ghana Limited and Louis Dreyfus Commodities. In addition to its own input sales activities, PAS-Garu also links farmers with other input distributors. This has been achieved through group lending – the organisation of farmers into groups to facilitate access to loans that are used to purchase inputs. In addition to seeds and fertilisers, the Station has also provided farmers with credit for ploughing services. Similar to Garu-Tempane, the organisations in East Gonja were also involved in procurement and distribution of improved seeds and agro-inputs to farmers. They also provided credit for tractor ploughing services, and were involved in several post-harvest activities comprising *aggregation, bagging and storage*. In Garu-Tempane, farmers complained that interests on loans were too high, making repayment a problem for some groups.

Efforts by the most influential actors in agricultural policy to modernise small-scale agriculture through commercial seeds and agro-inputs serve the purpose of incorporating small farmers into input markets for the benefit of private enterprise. These efforts increasingly eschew previous attempts to understand and find solutions to problems based on greater collaboration between agricultural scientists and farmers. In recent years the interest in organising farmers into cooperatives is intended to enhance the demand for commercial inputs and reduce the risks of default not only for individual farmers but for the organisations that provide credit services. Agricultural research in the contemporary period is also aimed at generating private goods for a narrow set of cereal crops, with the implication that legumes, root and tuber crops receive little attention in agricultural research agendas. In addition, modern agricultural technologies

have important implications for the rights of farmers to save and exchange seeds. For example while it may be possible to produce some genetically modified crops as OPVs, this does not receive the necessary research attention because it does not make business sense. “Currently, no open-pollinated varieties have been subjected to genetic modification. The reason is simple. There is very little economic incentive for seed companies to produce such seed.” (Thomson 2006:xvii). Thus, little has been done to provide farmers with different choices outside of efforts to encourage the adoption of commercial inputs.

High increases in fertiliser prices following the war in Ukraine have again generated commentaries in mainstream media about the problems associated with the reliance on external input markets and the need to break this dependency. In Ghana, some of this discussion has revolved around the need to develop the infrastructure and capacity for the manufacturing of chemical and organic fertilisers. In neighbouring Nigeria, the rise in fertiliser prices during this period coincided with the opening of a large fertiliser manufacturing plant (Reuters 2022). While this approach may symbolise one that seeks to reduce dependency on external markets, the fact that it intrinsically embodies the production of commodities for profits raises questions about whether it can be a source of relief for local farmers during periods of crisis, or whether it largely constitutes a shifting of the beneficiaries of input markets from foreign to domestic private enterprises.

In the cocoa sector, while the state imports fertilisers, pesticides and fungicides, it has not yet abandoned its role in the production and distribution of planting materials as it has done with the cereal crops sector. The Seed Production and Cocoa Health and Extension Divisions of COCOBOD produce and distribute seedlings to cocoa farmers. Communities also receive support for the development of community seed nurseries. In Garu-Tempane, PAS-Garu has given support for cereal seed multiplication projects in some communities. However, these

progressive initiatives in the cereal seed sector sometimes generate tension between local organisations and seed growers since such projects have the potential to reduce the market for commercial seeds (Amanor, 2010).

7.4 Food Production Represents Only One of the Important Approaches for Addressing Food Insecurity and Poverty

A fundamental assumption, central to green revolution interventions, is that increased food production represents the most important (if not only) approach for achieving food security. However, farmers' reliance on markets (for inputs whose prices are subject to dramatic changes, or to sell produce in order to acquire cash to purchase other commodities) show that the sole attention on food production can be problematic. Poor farmers do not make substantial profits from their produce, and they also do not have much control over the inputs that have become important for food production in difficult farming environments. In contrast to the image of a food farmer who has very little connection with the urban and world economy, and only consumes what s/he producers, food crop farmers are as much consumers who participate in transactions on food markets as they are producers. Many examples from Garu-Tempane attest to how farmers often have to sell food when they do not intend to, only to have to buy food back, sometimes at higher prices.

The multifaceted nature of food insecurity thus requires that a much broader approach, embracing a range of policy measures that have the most important implications for the well-being of farmers and poor people are simultaneously addressed instead of the sole attention on increased food production. For example, while food farmers generally comprise the poorest segment of Ghana' population, it is the other sub-groups of the rural poor comprising the aged,

and persons with disabilities among others, that are noted to be heavily impacted during periods of starvation. For the members of these population sub-groups who are unable to directly participate in agricultural production or labour markets, productivity enhancing inputs may not mean much for their well-being. The informality of agricultural employment itself is another hindrance to long-term improvements in well-being. In recent years, the Ghana government has made pronouncements regarding the implementation of a social security scheme for cocoa farmers. But food farmers, who comprise the poorest segment of the Ghanaian population, have received no attention on this issue.

The multifaceted nature of food insecurity is also highlighted by the food situation in Ghana over the last two years. Food prices have increased substantially since 2020. For example, cassava prices increased by 78 percent in 2020/2021 (Okou, Spray, & Unsal 2022). This was followed by more rapid increments in food prices in 2022. On 26 April 2022, the government announced a ban on the export of maize, rice and soybeans that was expected to last until 30 October 2022 (The World Bank 2022). By January 2023, prices of the main cereals produced in Ghana had either nearly doubled or more than doubled compared with the prices from a year in January 2022 (FPMA 2023). The skyrocketing in food prices is occurring at a time of not particularly bad weather, and food production has not declined tremendously as it did in the 1970s. Further, the Ghana government has continued with its support for input subsidies through the Planting for Food and Jobs programme. Instead, high food prices have occurred in tandem with the depreciation of the local currency, an expanded national debt, and the high cost of fuel and transportation. The national government has also responded to difficulties with securing credit by raising taxes and imposing new ones.

The contemporary context thus underlines the importance of attaching equal weight to other developments and changes in the national and overall global economy rather than to place the current food situation solely on inadequate local food production. In this regard, the recent food situation is in a way parallel to that of the 1970s. Beckman (1981) identified low agricultural productivity as the primary factor that laid the foundation for other factors to exacerbate the food crisis of the 1970s. On the other hand, his recognition of the contribution of developments in the national and global economy to the food crisis cast doubt on the extent to which enhancing agricultural productivity alone is sufficient to address the challenges with food security.

He comments:

> "The growth of the non-agricultural population and stagnant productivity were basic causes of the food problem. It made the market more vulnerable to such other factors as poor harvests, shortage of transport, and disruptive intervention in trading by the state. The immediate cause of the food crisis of the late Acheampong years, however, was government's loss of control over money supply. According to Akuffo's 1978 budget statement the average rate of increase was 80 per cent per annum between 1971 and 1977. Government borrowing from the banks (primarily the Central Bank) grew from 17m. cedi in 1973 to 719m. cedi in 1976/77… Much of the inflation can be explained by this fact alone. It was linked to a growing gap between the official and the black market price of the cedi which added to the distortion of the market. Agricultural produce from Ghana was illegally exported to neighbouring countries and the illegal importation of and trade in foreign currencies further inflated money supply. While the oil crisis may have triggered off the inflationary spiral, monetary policy did the main job. *The food crisis was therefore as much a crisis of public finance as one of agricultural production*. In fact much caution is required when drawing conclusions as to what actually happened to the production and distribution of agricultural surplus in this period. We must remember that there was a substantial shift in the terms-of-trade in favour of the food producers in the commodity market, both *vis-a-vis* export crops and non-agricultural consumer goods. Much of the shift, on the other hand, may have been absorbed at the level of trading with little being passed on to the actual producers." (Beckman 1981:155-156, emphasis mine).

Thus, long-term poverty reduction and improvements in food security also requires that the anticipation and prevention of economic crises resulting from external shocks – but more particularly internal factors – become central to the legitimacy and existence of the state.

7.5 Commercialisation, Land Rights and Tenure

In Garu-Tempane, land scarcity and small farms are the main constraints to agricultural production. These are the results of population pressures which, as compared with similar areas in Northern Ghana of high population density, have been attributed to population movements from former French colonies in the nineteenth century as people sought to find safe havens away from areas where measures of forced labour had been imposed (Shepherd 1981). However, the impact of this squeeze on land resources for women's land rights is somewhat limited. This is because while women in Garu-Tempane encounter challenges in gaining access to land, their land rights are judged to be relatively better compared to women in other areas. As previously noted, this has been attributed to their enormous contribution to farm work (including in performing tasks that are typically associated with men's work). While Garu-Tempane has historically been an area of high population density, it has also been an area of high male out-migration. Thus, women are sometimes able to negotiate access to lands that are inherited by their male sons who travel to other places in Northern and Southern Ghana to look for employment. In addition, women's access to land has been enhanced by The Presbyterian Agricultural Station, whose advocacy involves engagements with families about the importance of reserving an acre of family land for women's productive activities – particularly for women's participation in the Station's sorghum production and marketing scheme.

In contrast to Garu-Tempane, population pressure has less influence on land resources in the Asunafo North and Kwaebibirem districts, and land scarcity in these areas is mainly due to the nature of land and agricultural commercialisation. Women and other food producers have been edged out of food production as the land-owning class prefer giving land to male sharecroppers for cocoa and oil palm production. In Asunafo North, this has been compounded by the creation of forest reserves during the colonial period, from which communities are not even allowed to

collect dead wood and other forest resources. In Kwaebibirem, the rights of women and youth to land has in recent years been exacerbated by the acquisition of land for small-scale mining – although some male youth are able to find work in the mining industry. Also, land disputes between two neighbouring communities, fuelled by accusations that one of the community chiefs has sold the land in question to a private company has posed an important challenge to food production.

The land issue is similarly crucial in East Gonja because although uncultivated land is still widely available, inheritance norms act to weaken women's rights to land. This poor state of women's land rights exists alongside a drive towards commercial agriculture involving the use of weedicides and machinery that allow the upper strata of rural society to acquire land and increase their scale of production at the expense of women and other poorer farmers. In this context, efforts to strengthen women's rights to land may do more for women's welfare (Agarwal, 1997:1-13), perhaps, rather than a focus on their integration into input markets. However, government measures such as land registration and the distribution of machinery to individuals are frequently not sensitive to the needs of women and poor farmers. While land and agricultural policy frequently argue that they seek to improve the lives of poor farmers, in practice they do not target ordinary resource constrained farmers but favour medium and large scale agricultural farmers.

7.6 Contribution of the Study to Knowledge

This study contributes to different bodies of knowledge. First, it contributes to the literature on technology change in agriculture by examining the impact of population pressures on the intensification of production and cropping patterns. Using data from the Garu-Tempane district, the study argues that farmers are increasing their production of improved maize and

sorghum varieties in order to prevent significant declines in crop output. However, this has not resulted in the complete abandonment of indigenous crops such as millet and sorghum. Thus, while population pressures have resulted in changes in cropping patterns, this has not necessarily resulted in the production of a single crop or variety. This is because farmers working on poor land and lacking the resources required to purchase commercial inputs, continue to cultivate millets which perform satisfactorily even in the absence of external inputs. Therefore, there is evidence of crop diversification as opposed to the cultivation of single crop. Overall, the study continues to highlight the importance of Boserup's (1965) thesis in explaining technology change in agriculture.

Related to population pressures is the issue of the impact of agro-ecological conditions on agricultural production. Here, the study argues that while land availability enables farmers to improve land and cultivate different groups of crops, favourable agro-ecological conditions (which should be distinguished from improved soil fertility resulting from fallowing in areas of low population densities) such as two wet-seasons and humidity are equally important in shaping food production and cropping systems. Thus, whereas land access is a major challenge in the Asunafo-North district, farmers would still be able to produce forest foods in the absence of fallowing and reliance on external inputs. However, as has been argued, food availability and access in Asunafo-North are not so much about the constraint to production, but the result of lack of crop diversification as farmers devote most productive resources to cocoa production. In contrast, the Garu-Tempane and East Gonja districts are not so different from each other in terms of agro-ecological conditions: both districts have only one wet season and similar temperatures, although farmers in the latter are able to produce yam while this crop is non-existent in the former.

The study also contributes to the literature on women's work by analysing the impact of population pressures and difficult environmental conditions on women's participation in farm work. Using the cases of Garu-Tempane and East Gonja, I argue that the high labour requirements needed to produce food (and perhaps other goods and services) in difficult farming environments push women into productive work and labour markets. This is the case for Garu-Tempane, a predominantly rural district, where the gap in women's and men's participation in agriculture is not so wide. In contrast, women's involvement in those activities that embody "real" agricultural production is limited. I argue that this is due to relative land availability – as well as a host of other factors, such as inheritance norms – that make it possible for men to dominant productive activities. By implication, when the environmental conditions under which production has to be carried out become increasingly difficult, women have to increase their participation in those activities that were previously dominated by men. Thus, in some circumstances, difficult farming environments may create the conditions for the decay of the gendered division of labour and inheritance norms. Therefore, in some contexts, the extent to which women and men participate in productive work should not be treated as solely a cultural issue but seen as arising from environmental conditions.

The study also contributes to knowledge by examining the extent to which attempts to create demand for commercial inputs through the establishment and spread of small agro-shops are likely to result in change towards the use of hybrid and chemical fertilisers in small farming communities. Using the case of the Southern forest districts, I argue that such initiatives would not generate the expected responses as farmers could undertake their farming without the use of commercial inputs. There are a few instances in which such initiatives could result in the high uptake of commercial seeds inputs among small farmers. This includes heavily subsidised programmes that reach a majority of the farming population. In addition, high uptake can occur

among medium and large commercial farmers through state support for medium and large commercial agriculture, or when these groups of farmers are able to obtain inputs on credit or favourable terms from input dealers. Among small farmers in the Southern forest districts, the use of new seed technologies should be expected to occur through participatory seed breeding programmes. However, findings from resource-poor farmers in the Garu-Tempane district shows that farmers participate in commercial input markets in order to prevent declines in crop output. This evidence shows how farmers working in difficult farming environments and lacking viable alternatives outside of their integration into external markets have become the 'clients' of transnational seed and chemical fertiliser corporations.

7.7 Questions for Future Research

A number of issues relating to technology and crop production were not explored in this study. Moreover, insights from the study have in turn generated interest in other questions that can be explored in future research. These are outlined below.

1) There is the need to understand – in rural areas of high population density –farmers' management of environmental resources and their attempts at land improvement outside of the application of commercial agro-inputs. This will require examining what farmers are doing on their own, or in conjunction with local governments and NGOs (local initiatives) with the aim of preventing further deterioration in land quality. In the past, attempts to improve agricultural production also involved the promotion of measures such as terracing, hedging and tree planting. These methods rarely feature in current interventions to improve productivity. Scoping and analyses of these interventions, the contexts within which they emerged, what farmers thought of those

measures and how they responded to them, and the reasons why they have disappeared from attempts to achieve productivity increases in agriculture would be worth investigating.

2) As previously noted, although technology development programmes in Ghana's seed sector were intended to target several crops, efforts and achievements have mainly occurred in the maize and rice sectors. This highlights the need to place crops such as millet, groundnut and cowpea at the centre of farming systems and agrarian research in Ghana, and to critically examine – with small farmers in mind – the impacts of state and donor-funded technology development programmes on these crops. Interestingly, although groundnut production in the Garu-Tempane district has declined, national estimates by the FAO show that relative to millet and sorghum, groundnut production has been on the rise since the 2000 (see Figure 6.2). It would be interesting to examine the factors and actors behind this rise in production, the geographical distribution of production – why production has stagnated or declined in some areas, while other areas are experiencing a boost in production. Also important are the gender and generational dimensions of groundnut production, and attempts at agro-processing in local industries.

3) Another issue that is not examined in this study is the recent debate on the food security implications of genetically modified crops in Africa and the Global South. This is an important area for future research.

4) Another issue not addressed in this study is the resistance to state efforts to commodify seeds. An important example was the opposition of civil society (particularly, Food

Sovereignty Ghana) to the passage of the Plant Breeders Bill and later the Plant Variety Protection Act (PVPA). The PVPA was initially passed by Ghana's parliament as the Plant Breeders Bill in 2013, but it met opposition from actors such as Food Sovereignty Ghana before it was finally assented to by the president in 2020. It would be interesting to examine in detail the processes and actors involved in the formulation and promulgation of the PVPA, those aspects of the bill which civil society was most opposed to, and whether it was successful in securing any concessions from the major actors.

5) Reports about small-scale mining in rural areas and the fringes of peri-urban areas abound in the national press. These issues are not examined in this study, and research on the impacts of mining or linkages between mining and agriculture in Ghana is much needed. Given the attention to this issues in the forest areas of Southern Ghana, it would be particularly interesting if the research focuses on areas in Northern Ghana which can be considered as the new frontiers of small-scale mining. Understanding the linkages between small-scale mining and agriculture, as they relate to land, labour and capital is important.

6) There is the need for research that specifically examines the effects of monetary policies, particularly monetary expansion, during periods of economic crisis on well-being, and food security in particular.

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Appendix

Sample of Questions on Seeds Integrated into the Survey

General questions to be answered by all participants interviewed for the survey

1. Farmers in Ghana can plant traditional, modern seeds or both, which one among these do you prefer?
    a. Traditional/indigenous/local seeds
    b. Modern seeds/Agric
    c. Both (If c, skip to question 3)

2. Starting with the most important, please provide three reasons why you prefer this particular seed?
    a. I do not have to buy them
    b. They are affordable
    c. They are easily accessible
    d. They mature early
    e. Good for household consumption
    f. High yields
    g. Nice Aroma
    h. High market demand
    i. They are resilient to drought
    j. They grow well in poor soils
    k. Low input requirements
    l. They are resistant to pests and diseases
    m. They store well

Other reason (please specify)

3. Three most important reasons for choosing both traditional and modern/agric seeds

	Traditional/indigenous/local seeds			Modern seeds/Agric		
	3A. Starting with the most important, please provide three reasons why you prefer local seeds?			3B. Starting with the most important, please provide three reasons why you prefer modern/agric seeds?		

CODES FOR QUESTION 3A-3B

a. I do not have to buy them
b. They are affordable
c. They are easily accessible
d. They mature early
e. Good for household consumption
f. High yields
g. Nice Aroma
h. High market demand
i. They are resilient to drought
j. They grow well in poor soils
k. Low input requirements
l. They are resistant to pests and diseases
m. They store well
n. Other reason (please specify)

MAIZE

1. What was the **main** type of maize seed that you planted in the **last farming season**?
    a. Traditional/indigenous/local seeds
    b. Modern seeds/Agric
    c. Recycled

2. What is the name of the maize seed that you planted in the last farming season? (Tick all that apply)	3. Starting with the most important, please provide two reasons why you chose this seed?	4. Starting with the most important, what are the two things you don't like about this seed?	5. What proportion of your maize farm did you devote to this seed?	6. Where did you get or purchase this seed(s) from?	7. How much did you spend on purchasing the seed? GHC	8. Who introduced you to this seed?	9. How long have you used this seed? Years?	10. Did you apply organic fertiliser to the plot on which you planted this seed? a. Yes b. No	11. Did you apply chemical fertiliser to the plot on which you planted this seed? a. Yes b. No	12. Did you apply pesticide to the plot on which you planted this seed? a. Yes b. No	13. Did you apply weedicide to the plot on which you planted this seed? a. Yes b. No	14. Was the maize seed you used in the previous season a recycled seed? a. Yes b. No	15. How many seasons are you able to recycle these seeds before replacing them?
1. Abeleehi													
2. Abrohoma													
3. Dobidi													
4. Yellow Maize													
5. Obatanpa													
6. Popcorn													
7. Red maize (local)													
8. Safita													
9. White maize (agric/modern)													
10. Yellow maize (local)													
11. Other, please specify													
12. Don't know, but the seed is a local seed													
13. Don't know, but the seed is a modern/agric seed													

CODES FOR Q3

a. I do not have to buy them
b. They are affordable
c. They are easily accessible
d. They mature early
e. Good for household consumption
f. High yields
g. Nice Aroma
h. High market demand
i. They are resilient to drought
j. They grow well in poor soils
k. Low input requirements
l. They are resistant to pests and diseases
m. They store well
n. Other reason (please specify)

CODES FOR Q4

a. They are expensive
b. They are difficult to come by
c. They take long to mature
d. Not good for household consumption
e. Low yields
f. They do not have a nice aroma
g. Low market demand
h. They are not resilient to drought
i. They do not grow well in poor soils
j. High input application
k. They are not resistant to diseases, insects and weed
l. They do not store well
m. Other reason (please specify)

CODES FOR Q6

a. From my own saved seeds
b. From another farmer (neighbour) for free
c. I purchased seeds from another farmer
d. From the open market
e. From an agro-chemical shop
f. From a non-governmental organisation (NGO)
g. From a Farmer Based Organisation (FBO)
h. Seeds are supplied by the government
i. Other, please specify

CODES FOR Q8

a. I have always used this seed
b. Another farmer introduced me to the seed
c. My parents (other family relations) introduced me to the seed
d. An extension officer introduced me to the seed
e. An NGO introduced me to the seed
f. Other, please specify

Q17. Have you **ever** made any changes to the varieties that you plant on your maize farm?

a. Yes, I changed the variety completely➔ 18A & 18B.
b. Yes, I plant the previous seed but I added a new variety ➔18A &18C.
c. No changes made (Skip to Q19)

Q18. If yes, what variety were you planting at first and what was the new seed you adopted?

Q18A. What maize variety were you using previously?	Q18B. What maize variety did you use to replace the previous seed? (Skip to 18D)	Q18C. What maize variety did you add to the previous variety	Q18D. What is your main reason for using the new seed?	Q18E. How long have you been using the new seed? (record number of years or months if less than 1 year)

CODES FOR Q 18A, 18B, 18C

a. Abeleehi
b. Abrohoma
c. Dobidi
d. Yellow Maize
e. Obatanpa
f. Popcorn
g. Red maize (local)
h. Safita
i. White maize (agric/modern)
j. Yellow maize (local)
k. Other, please specify
l. Don't know, but the seed is a local seed
m. Don't know, but the seed is a modern/agric seed

CODES FOR Q 18D

a. I do not have to buy them
b. They are affordable
c. They are easily accessible
d. They mature early
e. Good for household consumption

f. High yields
g. Nice aroma
h. High market demand
i. They are resilient to drought
j. They grow well in poor soils
k. Low input requirements
l. They are resistant to diseases, insects and weed
m. They store well
n. An extension officer advised me to use that seed
o. I was introduced to the seed by an NGO
p. Other reason (please specify)

Q19. Starting with the most important, please give three reasons why you have not made any changes to the maize variety?

a. I do not have to buy them
b. They are affordable
c. They are easily accessible
d. They mature early
e. Good for household consumption
f. High yields
g. Nice aroma
h. High market demand
i. They are resilient to drought
j. They grow well in poor soils
k. Low input requirements
l. They are resistant to diseases, insects and weed
m. They store well
n. Other reason (please specify)

Table 5. 15 Differences in Maize Farm Sizes among Men and Women in Garu-Tempane (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male	138	1.360683	.0770523	.9051591	1.208318	1.513049
Female	118	.9825639	.0751423	.8162541	.8337485	1.131379
combined	256	1.186394	.0552532	.8840506	1.077583	1.295205
diff		.3781195	.1076263		.1661711	.5900679
diff = mean(Male) - mean(Female)					t =	3.5133
Ho: diff = 0					Welch's degrees of freedom =	255.289
Ha: diff < 0		Ha: diff != 0			Ha: diff > 0	
Pr(T < t) = 0.9997		Pr(|T| > |t|) = 0.0005			Pr(T > t) = 0.0003	

Source: DEMETER Survey, 2020.

Table 5. 16 Differences in Maize Farm Sizes among Men and Women in East-Gonja (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male	135	2.021931	.1310054	1.522145	1.762825	2.281037
Female	21	1.214058	.2028242	.9294573	.7909742	1.637142
combined	156	1.913179	.1185114	1.480207	1.679073	2.147285
diff		.8078732	.2414541		.320238	1.295508
diff = mean(Male) - mean(Female)					t =	3.3459
Ho: diff = 0					Welch's degrees of freedom =	40.9757
Ha: diff < 0		Ha: diff != 0			Ha: diff > 0	
Pr(T < t) = 0.9991		Pr(|T| > |t|) = 0.0018			Pr(T > t) = 0.0009	

Source: DEMETER Survey, 2020.

Table 5. 17 Differences in Yam Farm Sizes among Men and Women in East-Gonja (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male	119	1.912907	.1275015	1.390878	1.660419	2.165394
Female	12	.9611293	.1898881	.6577916	.5431884	1.37907
combined	131	1.825721	.1194306	1.366945	1.589442	2.062
diff		.9517773	.2287228		.4804969	1.423058
diff = mean(Male) - mean(Female)					t =	4.1613
Ho: diff = 0					Welch's degrees of freedom =	24.7751
Ha: diff < 0			Ha: diff != 0		Ha: diff > 0	
Pr(T < t) = 0.9998			Pr(|T| > |t|) = 0.0003		Pr(T > t) = 0.0002	

Source: DEMETER Survey, 2020.

Table 5. 18. Differences in Groundnut Farm Sizes among Men and Women in East-Gonja (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male	116	1.754802	.1344243	1.447794	1.488534	2.021071
Female	30	1.153355	.1490862	.816579	.8484395	1.458271
combined	146	1.631217	.1127263	1.362077	1.408418	1.854016
diff		.6014471	.2007401		.2023023	1.000592
diff = mean(Male) - mean(Female)					t =	2.9961
Ho: diff = 0					Welch's degrees of freedom =	84.7093
Ha: diff < 0			Ha: diff != 0		Ha: diff > 0	
Pr(T < t) = 0.9982			Pr(|T| > |t|) = 0.0036		Pr(T > t) = 0.0018	

Source: DEMETER Survey, 2020.

Table 5. 19. Differences in Cassava Farm Sizes among Men and Women in East-Gonja (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male	69	1.689124	.1552364	1.289491	1.379355	1.998894
Female	4	.9105435	.1011715	.202343	.5885706	1.232516
combined	73	1.646462	.1482291	1.26647	1.350973	1.941952
diff		.7785807	.1852944		.4035688	1.153593
diff = mean(Male) - mean(Female)						t = 4.2019
Ho: diff = 0						Welch's degrees of freedom = 38.3018
Ha: diff < 0			Ha: diff != 0			Ha: diff > 0
Pr(T < t) = 0.9999			Pr(|T| > |t|) = 0.0002			Pr(T > t) = 0.0001

Source: DEMETER Survey, 2020.

5. 20. Differences in Cocoa Farm Sizes among Men and Women in Asunafo North (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[90% Conf. Interval]	
Male	94	2.624862	.178084	1.726588	2.328993	2.920732
Female	42	2.166033	.2800459	1.814905	1.69475	2.637316
combined	136	2.483165	.1509598	1.760479	2.233143	2.733188
diff		.4588291	.3318729		-.0937041	1.011362
diff = mean(Male) - mean(Female)						t = 1.3825
Ho: diff = 0						Welch's degrees of freedom = 76.9638
Ha: diff < 0			Ha: diff != 0			Ha: diff > 0
Pr(T < t) = 0.9146			Pr(|T| > |t|) = 0.1708			Pr(T > t) = 0.0854

Source: DEMETER Survey, 2020.

5. 21. Differences in Cocoa Farm Sizes among Men and Women in Kwaebibirem (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[90% Conf. Interval]	
Male	210	1.737468	.1044127	1.513084	1.564959	1.909976
Female	102	1.622711	.1282602	1.295365	1.409789	1.835634
combined	312	1.699951	.081775	1.444435	1.565041	1.834861
diff		.1147561	.1653865		-.1583688	.387881
diff = mean(Male) - mean(Female)					t =	0.6939
Ho: diff = 0					Welch's degrees of freedom =	232.483
Ha: diff < 0		Ha: diff != 0			Ha: diff > 0	
Pr(T < t) = 0.7558		Pr(|T| > |t|) = 0.4885			Pr(T > t) = 0.2442	

Source: DEMETER Survey, 2020.

Table 5. 22. Differences in Oil Palm Farm Sizes among Men and Women in Kwaebibirem (Two-Sample T Test with Unequal Variances)

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Male	196	2.186234	.1138938	1.594513	1.961612	2.410855
Female	80	1.52516	.1325789	1.185822	1.261269	1.789052
combined	276	1.994618	.0912291	1.515612	1.815022	2.174214
diff		.6610732	.1747826		.3163979	1.005749
diff = mean(Male) - mean(Female)					t =	3.7823
Ho: diff = 0					Welch's degrees of freedom =	197.904
Ha: diff < 0		Ha: diff != 0			Ha: diff > 0	
Pr(T < t) = 0.9999		Pr(|T| > |t|) = 0.0002			Pr(T > t) = 0.0001	

Source: DEMETER Survey, 2020.