

FS-TIP Brief: Ghana

Food Systems Transformative Integrated Policy

Healthy and sustainable diets for all from a food systems perspective

Ghana Food Systems Assessment

John Asafu Adjaye, ACET
Felix Ankomah Asante, University of Ghana

Amos Laar, University of Ghana
Irene Susana Egyir, University of Ghana

Ismael Fofana, AKADEMIYA2063

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1. Introduction

Ghana, as a lower middle-income country continues to depend significantly on agriculture for economic development, even as the sector's share of Gross Domestic Product (GDP) has consistently declined over the past several decades. In 2019, agriculture contributed about 18.5 percent to GDP (GSS, 2020a). However, the agricultural sector remains a major employment provider, providing employment for about 36 percent of Ghana's labor force (GSS, 2020b; GSS, 2019). The sector is dominated by smallholders who cultivate approximately 2 acres per season on average and farming activities are highly dependent on rainfall (GSS, 2020b; MoFA, 2019). At the same time, food demand and the expectations of consumers are shifting making food systems increasingly complex (FAO, 2017). The significant growth in production levels has not been uniform across regions, while distribution of food from areas of abundance to those experiencing scarcity has been inefficient and inequitable. A critical component of the food system is the agricultural supply chain.

Prospects for future economic growth and development of sustainable food systems in Ghana are under serious threat from environmental degradation and climate change. Deforestation and other forms of land degradation are already harming Ghana's most vulnerable populations, especially those living in rural areas, entrenching them more deeply in poverty. Climate change is expected to further exacerbate land degradation, adversely affect crop yields, reduce farm household incomes and worsen food security.

The government's development agenda is anchored in its Medium-Term National Development Policy Frameworks (MTNDPF) such as the Ghana Shared Growth and Development Agenda (GSGDA 2) (2014-2017) and the Agenda for Jobs: Creating Prosperity and Equal Opportunity for All (AFJ) (2018-2021). Specific programs for the agricultural sector have been developed based on these frameworks, including the Food and Agriculture Sector Development Policy (FASDEP 1 and 2), Medium Term Agriculture Sector Investment Plan (METASIP 1 and 2), and Planting for Food and Jobs (PFJ). The common aspect underpinning these programs and strategies is the central role that the agricultural sector is expected to play in economic development and job creation.

Ghana also shares the global and regional African concerns for inclusivity expressed by the Sustainable Development Goals (SDGs) and the African Union's Agenda 2063. These emphasize equity within and across the entire food system. The Comprehensive Africa Agriculture Development Programme (CAADP) monitoring and evaluation report on gender and equity in food systems are in line with the 2019 Biennial Review, which has three women- and/or gender-related indicators: 1) the proportion of men and women engaged in agriculture with access to financial services; 2) the proportion of women empowered in agriculture; and 3) the growth rate of minimum dietary diversity for women. A dedicated Ministry of Gender, Children and Social Protection works with other ministries to ensure gender mainstreaming in all project design and implementation around food systems transformation. The Gender and Agricultural Development Strategy is the guiding framework for ensuring the inclusivity and empowerment of women and youth in all flagship and development projects initiated by the government and non-governmental organizations (NGOs) in the agricultural sector. Advocacy action by civil society groups, trade associations, and the private sector takes the form of media campaigns as well as representation in the Agricultural Sector Working Group (ASWG), a multi-stakeholder platform for discussing implementation of the FASDEP and its medium-term investment plans.

The objectives of this report are: a) to describe and analyze the characteristics and performance of Ghana's food systems; and, b) to identify the policy opportunities to transform its food systems to deliver sustainable and healthy diets for all Ghanaians. Section 2 reviews the current agricultural

policies and identifies gaps along the agricultural supply chain. Section 3 analyzes the critical environmental challenges threatening Ghana's food systems. Section 4 outlines and analyzes the national and sub-national contexts in relation to diets, food security, nutrient adequacy, food safety and nutrition outcomes. Section 5 presents a landscaping and diagnostic analysis on gender and equity in food systems. Section 6 concludes the report with a summary of key findings and policy recommendations to transform Ghana's food systems and enable the delivery of sustainable and healthy diets for all.

2. Policy opportunities along the agricultural supply chain

The agricultural supply chain can be defined as “a system encompassing all the activities, organizations, actors, technology, information, resources and services involved in producing agri-food products for consumer markets” (OECD and FAO, 2016). Therefore anything (upstream or downstream) that influences food production and the delivery to the final consumer (“farm to fork”) is a component of the agricultural supply chain. This refers to both unprocessed as well as processed food products. It involves agricultural inputs, production, aggregation, warehousing, packaging, transportation, processing, research and development, market information, extension services and regulation, (OECD and FAO, 2016; Tsolakis et al., 2014). This definition needs to be positioned within the context of sustainability, where the environment and matters of social inclusion take priority in the pursuit of economic goals.

2.1 Characteristics of the agricultural supply chain

A closer look at the agricultural supply chain shows that it is heterogeneous with numerous actors and stakeholders who have different interests and possess varying degrees of power and influence. This means that regular assessments of the agricultural supply chain are necessary given the context of rapid changes in food demand, climate change and environmental sustainability considerations. These assessments will help to end hunger, achieve food and nutrition security, as well as reduce poverty and marginalization.

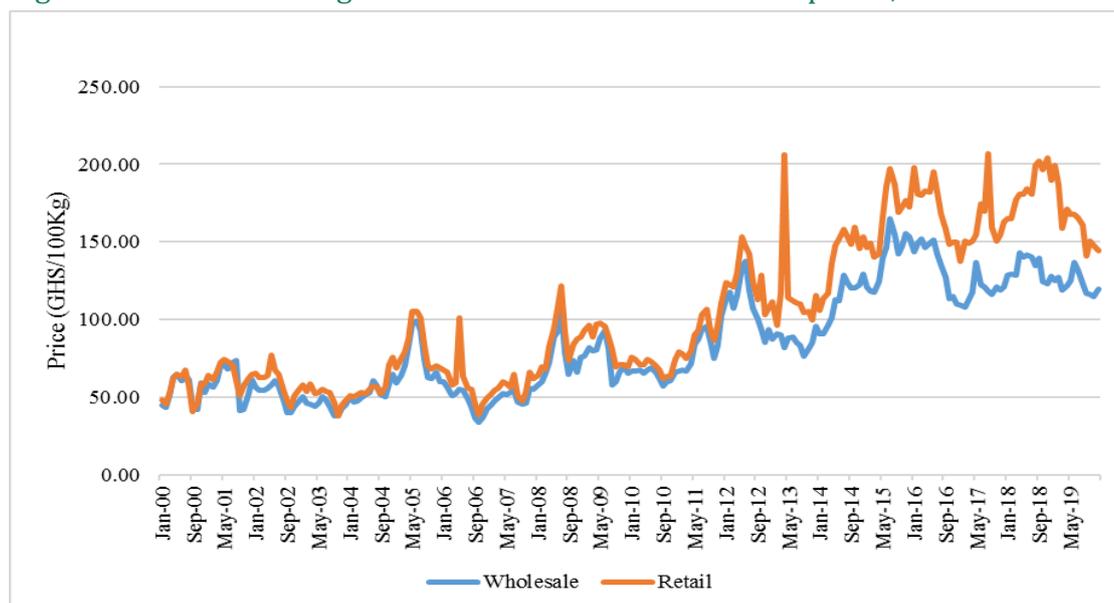
Food production in Ghana is seasonal, partly because of the high dependence on rainfall for farming. Moreover, about 20-50 percent (Affognon et al., 2015; Rutten and Verma, 2015) of food produced by farmers, especially fresh produce, is spoiled and damaged on farms because of lack of adequate storage, cooling facilities, packaging, appropriate modes of transportation and access to markets. Due to the reasons described above as well as a lack of resources and avenues for farmers to sell their products at fair prices, farmers are particularly vulnerable and susceptible to exploitation by larger supermarket chains and retailers (market queens and middlemen). For instance, when bumper harvests occur, prices collapse, and farmers lose out. Thus, farmers tend to be the most disadvantaged and vulnerable along the supply chain.

Discussions about the agricultural supply chain are mostly dominated by output market considerations, that is, production of food and its distribution to the consumer. However, the availability and accessibility of inputs such as improved seeds, machinery and implements, agrochemicals like fertilizers, herbicides and pesticides are fundamental in any discussion around agricultural supply chains. The high cost of these inputs - especially machinery - and the seemingly oligopolistic control of the market for seeds and agrochemicals is a burden for farmers. Clearly, the agricultural input supply chain is just as important as the agricultural output supply chain in policy design considerations for sustainable transformation of food systems.

2.2 Challenges facing the agricultural supply chain

Access to timely and accurate market information is critical to the success of any agricultural supply chain. When actors along the chain have access to information such as production volumes, prices, stock levels, intermediary and retail prices, they become informed on how to act and what to negotiate within the supply chain. However, there is a lack of or inadequate access to timely market information for all actors. Producers (farmers) therefore do not know what the overall supply and demand numbers are. As such, they are likely to sell their products to middlemen and other actors along the supply chain who have better information on these indicators and can adjust prices accordingly. For example, since 2008, the real wholesale price of maize in Ghana has declined, while the real retail price of maize has not experienced a corresponding decline (Figure 1). This indicates that the benefits of reduced prices are not fully transmitted to consumers, and farmers do not benefit from the improved margins on the retail side (MoFA and IFPRI, 2020).

Figure 1: National average maize wholesale and retail real prices, 2000 to 2019



Source: Computed based on data from MoFA-SRID; Food CPI-adjusted (2015=100) from FAOSTAT

Another challenge of the agricultural supply chain is its informal nature, which results in adverse consequences such as the lack of formal contracts and traceability, food losses, poor food quality and safety. For instance, traceability is critical to ensuring the quality and safety of products as well as their origin. Food products need to be traceable to facilitate the recall of damaged and contaminated products, including animal-sourced products. The majority of products, especially fresh products, are not traceable in Ghana. This is worsened by the large number of markets which are open-air markets, not well organized and whose sanitary conditions compromise food safety and increase the risk of food losses. The lack of proper contracts among different actors in the supply chain can lead to food supply disruptions. Farmers/producers can exploit distributors when there is product scarcity and the opposite can happen when products are in abundance. The inefficiencies created by these disruptions increase the logistical requirements for food distribution, reduction of post-production losses and ultimately the cost of food to the consumer. The lack of further processing and handling of products, scarcity of cooling vans to transport fruits and vegetables, as well as fresh meat and meat products heighten the risk to food safety, and food and nutrition security. This cocktail of the interlinked effects of the agricultural supply chain's informal nature coupled with the growing frequency and risk of disease spread across species, demands critical attention from policy makers on strengthening the formalization of Ghana's agricultural system.

Unfair trading practices at both domestic and international levels are another challenge facing agricultural supply chain actors in Ghana. Importation of certain agricultural products that enjoy subsidies from their countries of origin into the Ghanaian market crowds out local production. The argument can be made that increased competition benefits the consumer, but unfair competition is not only detrimental to the local industry, it also poses national and strategic risks in the long run. One example is the stringent phytosanitary conditions and other administrative bottlenecks that discourage local smallholder producers from exporting, given their limited capacity. On the domestic front, the power of market women and middlemen to determine product prices remains a major challenge. Due to the lack of resources for production, storage and even ready markets, farmers take high-interest loans from microfinance institutions, aggregators, transporters, market women and middlemen under unfavorable conditions. At the same time, farmers are made to pay for inputs at relatively high prices.

Lack of financial investment and inadequate public expenditure lie at the heart of most of the challenges facing the agricultural supply chain in Ghana. The agricultural sector requires high financial investments to promote an efficient supply chain. Investment is needed to improve seeds and inputs, develop a good road network and for the processing and marketing of products. However, these investments are beyond the reach of the government, necessitating the active participation of the private sector and large-scale investors. Besides financial resources, the private sector can bring in its experience and competitive advantage in innovation and efficiency. African governments are currently expected to invest at least 10 percent of their annual national budgets in the agricultural sector and grow the sector by 6 percent annually in line with the Malabo Declaration and commitments related to agriculture, poverty reduction, elimination of hunger, climate change resilience and intra-Africa trade. Governments have also committed to facilitate private sector investment in agri-businesses and agro-industries. Over the years, the government of Ghana has failed to meet these benchmarks, although the country overall remains on track to meet the Malabo commitments (AUDA-NEPAD, 2020; Benin and Tiburcio, 2019). Financial institutions should be willing to support the agricultural sector with long-term loan facilities because of its potential for high returns.

2.3 Opportunities in the agricultural supply chain

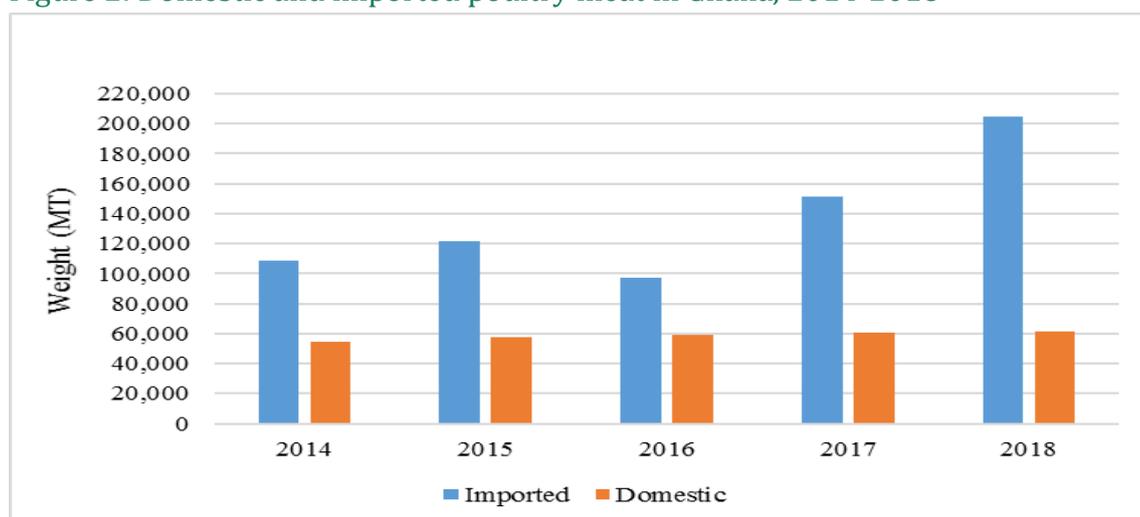
Factors such as the growing complexity of consumer demands and the increasing consideration for sustainable food systems do not just contribute to challenges, they also create opportunities for a variety of actors such as those in the private sector, to venture into the various sub-sectors of the agricultural supply chain.

Environmental conditions in Ghana are naturally suitable for agricultural production. The tropical climate is advantageous for the production and raising of most crops and animals. Natural inputs for agricultural production are available but their supply can be inconsistent. Due to the overreliance on rain-fed agriculture (MoFA, 2019; MoFA, 2018), production is highly seasonal. However, if demand is guaranteed, farmers can invest in irrigation systems, improved seeds and fertilizers, appropriate technology, as well as increase land acreages to meet consumer demand.

Given the availability of raw materials and the high import bills the country incurs on agricultural commodities such as rice, poultry and processed foods, there is room for import and product substitution as most of these commodities, especially semi-processed foods, can be manufactured locally. This would not only provide value-addition revenues, but it would also generate important employment opportunities and reduce foreign exchange pressures. Furthermore, the growth of Ghana's middle class and rising urbanization, means that the market for processed yet healthy foods has room for expansion. These circumstances point to the potential for higher returns on investment in the agricultural sector.

The agricultural sector has seen improvements in the application of technology, but relatively speaking, the many aspects of the sector remain rudimentary (GSS, 2020b). The use of machinery and agrochemicals is limited. The Ministry of Food and Agriculture’s (MoFA) mechanization service centres (AMSEC) established in 2007 to provide farmers with timely mechanization services have improved overall access to farm machinery by smallholders. The AMSECs were stocked with planters, tractors, boom sprayers, ploughs and other implements. The initial number of AMSECs established in 2007 was 17 with an additional 72 centres rolled out in different parts of Ghana between 2009 and 2011 (Malabo Montpellier Panel, 2018; Diao et al., 2014). However, the penetration and range of machinery and implements remain limited (GSS, 2020b). Ghana has one of the lowest rates of fertilizer use in comparison to recommended levels (Tetteh, et al., 2017) while less than 4 percent of cultivated land is irrigated (MoFA, 2019). Significant opportunities exist for investment in the agricultural sector. With respect to livestock, poultry presents high opportunities for growth as its imports are high. Between 2014 and 2018, an average of 136,781.01MT of mostly frozen chicken valued at about GHS 449,341,740.66 (US\$114,054,838.92) was imported into Ghana annually. Domestic poultry meat production is less than 50 percent of imported poultry meat (Figure 2) (MoFA, 2019). This contributes to the extreme pressure on the country’s primary trade balance position but provides an important opportunity for import substitution through improved farming and production systems to reduce costs. Agri-businesses can potentially introduce technological innovations into the supply chain to add value to the raw materials..

Figure 2: Domestic and imported poultry meat in Ghana, 2014-2018



Source: Data from MoFA-Facts and figures, 2018

The agricultural sector has some of the highest returns on investment, but this comes with associated risks. The sector’s numerous challenges also provide opportunities for innovative solutions. For example, investment in machinery, improved seeds and breeds, transportation (e.g., cooling vans), packaging and marketing, and private warehouses offer opportunities for high returns.

2.4 Policy gaps

Over the past decade, the government has consistently highlighted the importance of not just focusing on improving production but also improving access to markets and market linkages as a much more sustainable way of promoting production, increasing food security and reducing poverty among farmers. The Food and Agriculture Sector Development Policy (FASDEP) II and the Planting for Food and Jobs (PFJ) program attest to these commitments (MoFA, 2007; MoFA, 2017). These two policies were formulated 10 years apart but have a similar focus. The repetition of the phrase “...improving access to markets and market linkages...” in different policy documents is not only evidence of their

importance to the national development agenda, but also points to the success or the lack of it, in policy execution. Nonetheless, some other major programs and projects have been implemented by the government in partnership with private sector and development partners over the years to drive the development of the agricultural supply chain. These include the Ghana Agricultural Development and Value Chain Enhancement (ADVANCE 1 and 2), Ghana Commercial Agriculture Project (GCAP) and the Ghana Agricultural Sector Investment Programme (GASIP):

- i. The ADVANCE project (2009-2020)¹ was a private-sector led initiative that aimed to help scale up agricultural investment by establishing linkages between farmers and agribusiness or up-takers. The project encouraged the development of competitive value chains for rice, maize and soybeans through technology adoption by farmers and market linkages. Project participants, especially smallholder farmers, were provided with access to markets, finance, inputs, equipment and information (ACDI-VOCA, n.d).
- ii. GASIP (2015-2021)² has three main components, including value chain development, rural value chain infrastructure, and knowledge management, policy support and coordination. The first two components focus directly on improving linkages among actors in the supply chain. Component 1 focuses primarily on developing strong market linkages that will help ensure farmers are able to meet the demands of consumers and industry in terms of both volume and quality. Component 2 focuses on developing the agricultural infrastructure of rural communities to enhance their agricultural activities through the provision of machineries such as tractors, planters, millers and harvesters to farmers, and more agriculture-linked public infrastructure such as feeder roads, warehouses and small-scale irrigation schemes (MoFA-GASIP, n.d). Implementation of the various program components improves the capacity of actors to actively participate in the agricultural supply chain.
- iii. Finally, GCAP (2013-2020)³ focused on financial investments in different aspects of the supply chain. GCAP engaged in largescale projects like the rehabilitation and modernization of irrigation schemes including the Kpong Left Bank Irrigation Project (KLBIP), Kpong irrigation scheme (KIS) and Tono irrigation scheme (TIS). The project also promoted public-private partnerships (PPPs) and provided counterpart funding for small commercial farmers looking to scale up within the project catchment area. GCAP also facilitated market linkages between agri-businesses (investors), smallholders and nucleus farmers (MoFA-GCAP, n.d).

The government's drive to establish institutions and agricultural support centres such as the Agricultural Mechanization Services Enterprise Centres (AMSECs), the Ghana Commodity Exchange (GCX), Buffer stock company, EXIM Bank Ghana and the Development Bank of Ghana (soon to start operations), are sustainable ways of ensuring dedicated effort is given to the strengthening of agricultural supply chains. Other projects like Youth in Agriculture and the Out-grower Value Chain Fund (OVCF) also provide incentives for young people to get into agriculture.

One of the shortfalls of some of the programs and activities discussed in this section is the limited scope in terms of geographical coverage and duration of the programs. Most of the interventions are time-bound and their continuity is a challenge once the projects end. As such, the long-term benefits of the programs are not fully realized.

What is missing among the different agricultural policy documents is a harmonized agricultural supply chain policy framework, within which all these programs are executed. Such a framework would align investments and interventions from the private sector and development partners with the government's agenda for sustainable, inclusive and efficient agricultural supply chains. However, the current Planting for Food and Jobs (PFJ) program is a strong guide for the development of a robust agricultural supply chain in Ghana. The components of the PFJ - centered on seed access and

1 <https://storymaps.arcgis.com/stories/05e19f0abd2c42ccbfd3ea39317c7c4>

2 <https://mofa.gov.gh/site/programmes/gasip>

3 <https://mofa.gov.gh/site/projects/ghana-commercial-agriculture-project-gcap>

development, fertilizer access, fertilizer systems development, extension services, marketing and E-agriculture - cover significant segments of the agricultural supply chain. However, several policy gaps have been identified which are elaborated here:

Market transparency. This goes beyond production and the provision of price information to key actors in agricultural supply chains. Changing consumption patterns point to an increasing interest in environmentally friendly production systems, animal welfare, organic foods and issues around child labor. Ghana's current agricultural sector policies do not provide explicit guidelines and remedial measures for dealing with these aspects. Market information needs to be easily and readily accessible to all relevant actors to avoid disadvantaging smallholder farmers and small firms which may lack the capacity to compete with big firms in gathering relevant market information. The Ghana Commodity Exchange (GCX) provides weekly price updates to its producers and buyers. However, this information is limited to just the commodities (maize, rice, sesame, sorghum and soya bean) that are traded on the exchange and currently, few smallholders have access to these services.

Lack of cohesion and coordination of activities along the supply chain. Various policy documents identify the key actors and challenges in agricultural supply chains. However, interventions to tackle the challenges are mostly done in isolation. The 2020 Agricultural Census report identified the lack of coordination along the supply chain as one of its bottlenecks. The need to better link all segments of the supply chain is paramount for its optimal functioning.

Price and trade policies/guidelines. In the context of fair trade, current agricultural policy documents do not outline how actors in agricultural supply chains can practically enforce their rights if they face unfair trade competition practices from their market rivals. For example, small firms which can get crowded out of the market following drastic price reductions by big companies have limited avenues for redress. Farmers likewise are not protected from bigger companies which coerce them into contractual agreements that are detrimental to their agricultural activities. Moreover, the growing phenomenon of international supermarket chains which are sourcing their products from outside Ghana, including fruits and vegetables.

A missing health and nutrition-sensitive agenda. Current agricultural policies do not reward or promote the production and consumption of healthy diets in the supply chain. Actors in the chain are not incentivized to produce healthier and diverse diets such as fruits and vegetables and fewer ultra-processed foods. A sustainable agricultural supply chain should increase the availability and accessibility of healthy diets.

Ethical issues. Issues such as animal welfare, child exploitation, forced labor, environmental pollution, food alteration and food waste are some of the concerns shaping global discussions on agricultural supply chains. Given the many challenges confronting the agricultural sector in Ghana, agricultural policies do not specifically address some of these critical concerns although other governmental policies address them in general terms.

A concept of the agricultural supply chain of the future. Current agricultural policy documents are focused on short- and medium-term outlooks of the food system. However, the rapid changes taking place in global food systems call for discussions around long-term structural changes to Ghana's current agricultural supply chains. As a growing economy, some of the key concerns that need addressing and which should animate policy discussions, include: (a) the continued dependence on smallholder farmers for food crop and animal production; (b) the future of open-air and wet markets; (c) the ideal employment numbers in agricultural supply chains; (d) the levels of technological advancement and innovation that should be permitted or introduced into agricultural supply chains.

3. Addressing the Environment and Climate Change Nexus

Prospects for future economic growth and development of sustainable food systems in Ghana are under serious threat from climate change and environmental degradation including deforestation and other forms of land degradation. The coastal ecosystem also faces several challenges such as coastal erosion and flooding, overexploitation of natural resources as well as marine and coastal pollution. These developments threaten socioeconomic development by reducing the availability or access to water, food, and energy. These adverse impacts are expected to be worsened by climate change.

Climate change is expected to have substantial impacts on Ghana, as it will potentially alter seasonal climate cycles, temperatures and rainfall patterns. Significant climate change trends have already been registered, seen in the progressive increase in mean temperatures and the decrease in mean annual rainfall in all regions. Temperatures have increased by about 0.2 °C per decade, with a more rapid increase seen in the northern regions. Agriculture will be the sector most seriously impacted by climate change with economic losses concentrated in the Northern, Brong Ahafo and Ashanti Regions. The discussion in this section begins with the degradation of ecosystems and then proceeds to climate change.

These challenges can be addressed by policies promoting climate adaptation and mitigation as well as limiting or reversing ecosystem degradation. Ghana has ratified the Paris Agreement and has developed several policies and strategies to address the challenges of climate change. To help develop sustainable food systems in the face of climate change, the government is promoting climate-smart agriculture (CSA). However, Ghanaian smallholder farmers face numerous challenges in adopting CSA practices. Key among them are access to information, access to credit and access to affordable insurance services. To promote the diffusion of CSA, there is a need to strengthen research and extension systems, build infrastructure and innovation ecosystems, and address gender disparities.

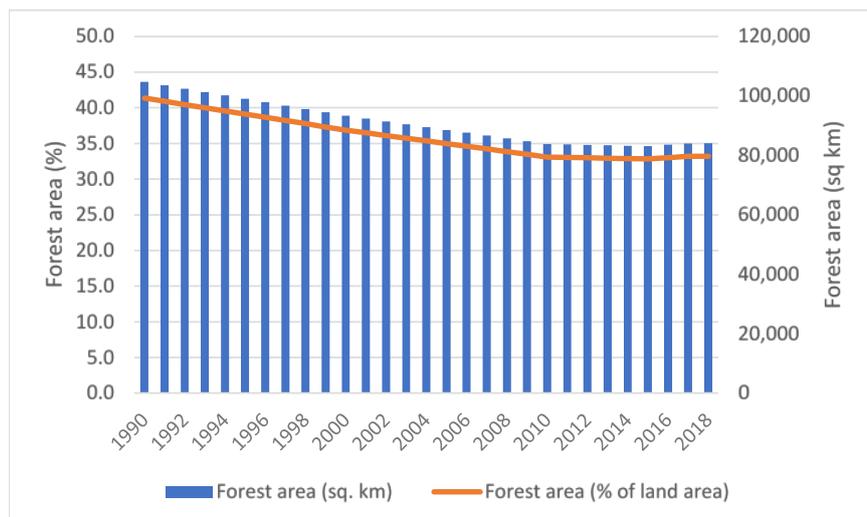
3.1 Degradation of ecosystems

The main forms of environmental degradation in Ghana are the degradation of terrestrial ecosystems, freshwater ecosystems, and coastal and marine ecosystems. The key drivers of terrestrial ecosystem degradation are anthropogenic changes in land use, such as agricultural expansion, livestock grazing, fuelwood harvesting and mining (especially illegal mining referred to as galamsey). Ghana's freshwater ecosystems are also at risk from anthropogenic land-use change, over-extraction of water, and increased pollution and sedimentation in water bodies. Coastal and ocean systems are experiencing pressure from pollution (especially plastic pollution), migration, salinization, habitat degradation, biodiversity losses, and resource over-exploitation.

Deforestation

Ghana is endowed with diverse forest resources that cover 25 percent of its land and span three main agro-ecological zones: High Forest Zone (HFZ); Transitional Zone (TZ); and the Savannah Zone (SZ). The SZ mainly occurs in the northern part of the country, the TZ is in the middle belt, while the HFZ is in the lower section of the country. Since the 1980s the TZ has expanded southwards due to gradual drying in the sub-region, drought events (e.g., El Niño) and the onset of climate change (Owusu and Waylen, 2009). In 1900, Ghana had over 8 million hectares (ha) of tropical high forests, but from the 1950s to 2000, it lost 2.7 million ha which is more than 60 percent, of its primary forests (FAO, 2010). Figure 3 shows that between 1990 and 2018, the forest area as a proportion of the total land area declined from 43.6 percent to about 35 percent, a decline of 8.6 percentage points.

Fig. 2. Ghana: Forest area, 1990-2018



Source: World Bank, *World Development Indicators*.

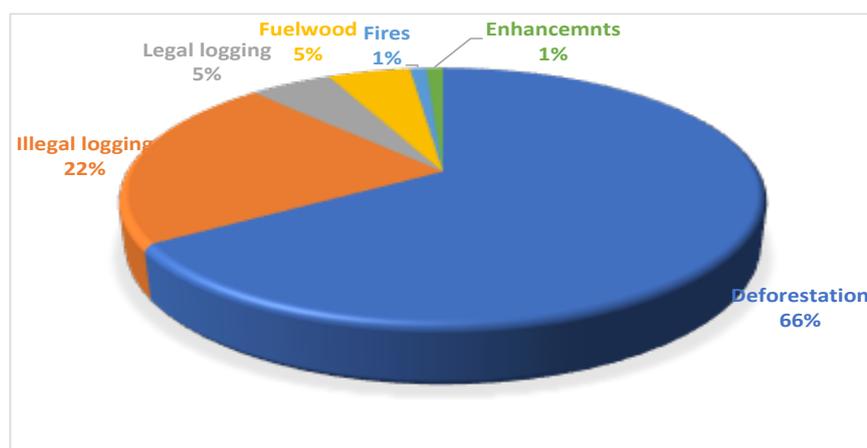
An FAO assessment of the forest resources indicated 44 percent of forest reserves are under active production, 20 percent are in poor condition and designated for plantation development, 9 percent are in poor condition and in convalescence to promote natural regeneration, and 27 percent are under-recognized conservation or community management. In 2018 alone, Ghana lost nearly 190,000 ha, resulting in increased CO₂ emissions per ha and increasing losses in biomass per ha (World Bank, 2020).

The main source of forest degradation is illegal logging, although legal logging, wildfires and fuelwood harvesting also play a role. Agricultural expansion is largely driven by food crop and tree crop expansion, while logging includes both legal and illegal activities. Fuelwood harvesting, charcoal production, wildfires, infrastructure development, and mining (legally and illegally for gold, minerals and sand) are also key drivers of deforestation (MLNR, 2017).

Figure 4 shows that deforestation – defined by the Government of Ghana as human-induced forest loss – was the largest contributor to greenhouse gas (GHG) emissions over the period 2001 to 2015, accounting for 66 percent of total emissions. This was followed by illegal logging with 22 percent, legal logging and fuelwood harvesting with 5 percent each, and Enhancements with 1 percent.

The indirect causes of deforestation and land degradation include a high population growth rate, increasing demand for food crops, biomass energy and construction material and the growing global demand for timber, cocoa and chocolate, and other cash crops such as palm oil.

Fig. 3. Ghana: Main drivers of forest sector emissions, 2001-2015



Source: MLNR, 2017.

Land degradation

The United Nations Conference to Combat Desertification (UNCCD) defines land degradation as “a reduction or loss, in arid, semi-arid, and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or processes, or combinations of processes, including (those) arising from human activities and habitation patterns such as soil erosion, deterioration of the physical, chemical and biological or economic properties of the soil, and long-term loss of natural vegetation” (UNCCD, 2012).

Land degradation affects Ghana’s crop and pasture lands, forests, natural habitats, urban areas and water bodies. It ultimately constrains socioeconomic development by reducing the availability or access to water, food and energy. Further, it contributes to resource-based conflict. The main types of land degradation in Ghana include soil erosion, declining soil fertility, deterioration of rangelands and deforestation (MESTI, 2011).

The proximate causes of land degradation are complex and include demographic, economic, and policy influences such as high population growth, and land tenure issues; increasing local demand for agricultural and wood products; limited technology use in farming systems (e.g., persistent reliance on rainfed and slash and burn agriculture); a reliance on fuelwood and charcoal for household energy needs in both rural and urban areas; and lack of enforcement of relevant regulations.

The drivers of land degradation can be classified into two main types: biophysical and anthropogenic. The biophysical factors are naturally occurring vulnerabilities due to soil composition, topography and climate. The anthropogenic factors include agro-silvi-pastoral practices such as slash and burn agriculture, reduced fallow periods, improper soil management and livestock overgrazing.

Land degradation in Ghana has increased over the past few decades. Nearly 70 percent of Ghana is estimated to be subject to “severe to very severe” erosion (Asiamah, 1987). Soil erosion rates are high in the Upper West, Northern, Brong Ahafo and Upper East Regions. Soil erosion by wind or water stems from inappropriate agricultural, forestry and infrastructure practices. In areas with more degraded lands, surface runoff and hence soil erosion is widespread and concentrated. Erosion is the greatest threat to Ghana’s drylands in the SZ where land degradation is qualified as “desertification.” The marked increase in agriculture has led to changes in land use across the country, resulting in two major negative trends in land use and productivity. One is the conversion of forests to croplands and shrubs. And second is a decline in productivity (MESTI, 2017a).

Other factors such as internal migration and galamsey gold mining have contributed to and amplified land degradation in Ghana. Migrants seeking to escape land degradation at home may also be fuelling land degradation in their new destinations. Population growth and rapid urbanization are associated with increased land degradation, which tends to be greater in districts where population growth is strongest. For example, the Greater Accra Region, which experiences the greatest influx of migrants, has the highest soil erosion rate in the country at 15.6 tons/ha/year. Galamsey has also been a significant contributor to land degradation. Waterways are particularly vulnerable because land disturbances increase the likelihood of erosion and sediment loading in streams (Rajaei et al., 2015).

Coastal and marine ecosystems

Ghana has 550 km of coastline, a 20,900 km² continental shelf, and 218,100 km² of exclusive economic zone, the fifth largest in West Africa (MESTI, 2017b). Ghana’s coastal zone represents around 6 percent of the country’s land area. Several areas along the coast have been designated as wetlands of international importance (i.e. Ramsar sites). These wetlands are rich in biodiversity because they serve as nursery grounds for many marine fish and crustacean species, harbor important bird life, both resident and migratory, and serve as nesting grounds for various globally endangered marine turtle species such as leatherback, hawksbill and green turtles.

The coastal ecosystem faces several challenges, including coastal erosion and flooding, overexploitation of natural resources, marine and coastal pollution, illegal sand mining, loss of biodiversity and ecosystem services, severe weather, and rapid urbanization and unsustainable land uses. These challenges degrade the coast, endanger ecosystems, put human livelihoods and well-being at risk, undermine economic potential, and increase vulnerability to natural disasters. Uncontrolled urban and peri-urban development, including building in waterways, has also contributed to the flooding of coastal communities with severe consequences for livelihoods and food systems.

It is estimated that Ghana loses about 2.7 million m² of its shoreline every year, with 80 percent of the shoreline actively eroding (Appeaning Addo et al., 2008). Coastal erosion and flooding are particularly serious in and near Accra where sea level rise has increased erosion intensity. About 1.8 million people living in the coastal zone are at risk of exposure to coastal flooding and soil erosion. This exposure is projected to increase by 67 percent by 2050 (USAID, 2014). Climate change is expected to exacerbate this situation with rising sea levels expected.

Marine pollution is increasingly becoming a serious problem in Ghana, especially due to the high economic dependence on coastal industries such as fisheries and tourism. Marine pollution is mainly due to poor management of solid, liquid, mining, and industrial waste. Accra, the capital city, generates nearly 900,000 metric tons of solid waste per year, with a generation rate of approximately 0.5 kg/person/day (Samwine, 2017). The city does not have the infrastructural capacity to manage this waste and it is estimated that only 75 percent of all waste generated is collected daily. The rest is dumped into open spaces, surface drains, and water bodies, much of which flows into the Korle Lagoon which has a direct outlet to the Gulf of Guinea. The lagoon is also surrounded by a digital waste dumpsite in Agbogbloshie, resulting in significantly high accumulations of heavy metals in the adjacent soils.

Conversion of mangroves to other land uses, notably agriculture, salt ponds, and roads, as well as the use of mangrove wood for construction material has accelerated their rate of destruction. Preservation and restoration of these natural features in Ghana's coastline is necessary to help manage erosion, reduce the risk of flooding in coastal communities, as well as enrich and enhance the productivity of fisheries.

Ghana's fishing industry contributes significantly to the country's food security, nutrition, employment, household income, and foreign exchange earnings. Small-scale canoe fishing is critical to millions of individuals, families, and communities. There are indications that Ghana's capture fishing sector is in decline. Fish consumption per capita has declined steadily over the past decade and was down by 20 percent to 21 kg in 2016 (World Bank, 2020). Between 1996 and 2016, landings of small pelagic species (anchovies, chub mackerel, and sardinellas) decreased 86 percent, from 138,955 to 19,608 MT (MoFAD, 2018). This negative trend is a classic sign of the "tragedy of commons" which results in resource overexploitation. Direct causes include fleet overcapacity, illegal fishing, and climate change. The proximate causes include lack of job opportunities in other sectors, coupled with an open-access regime, where the right to harvest fish is open to all.

3.2 Climate change impacts and flow-on effects to the food system

Climate change is expected to have substantial impacts on Ghana, with the potential to alter seasonal climate patterns, temperature, and rainfall. There have already been significant historical changes in climatic patterns. For example, temperature and precipitation data over the 1960-2000 period show a progressive increase in mean temperatures and a decrease in mean annual rainfall in all regions. Temperatures, for instance, have increased by about 0.2 °C per decade, with a more rapid increase in the northern regions (MESTI, 2013). Different climate change impacts have been projected under various future scenarios. In a low warming scenario, a countrywide warming of 1 °C is projected by the 2030s and 2040s. In a high-warming scenario, temperature increases of 1.3 °C and 1.8 °C are projected for the 2030s and the 2040s, respectively. The models forecast a pronounced increase in heat extremes

in southern Ghana. Mean annual temperatures are projected to increase most rapidly in the northern inland regions, by 1.0 to 3.0 °C by the 2060s, and 1.5 to 5.2 °C by the 2090s (World Bank, 2017b). Despite larger uncertainty, climate models tend to indicate an increase in extreme wet event conditions in the northern regions of Ghana, while total annual rainfall is projected to decline by 1.1 percent by 2020, and 20.5 percent by 2080. The Ashanti and Brong Ahafo Regions are expected to experience extreme droughts, while the northern regions will experience an increase in extreme wet events (World Bank, 2017b).

Climate change will also bring indirect effects such as changes in vector-borne diseases of both crops and livestock. The changing weather patterns may severely affect economic growth, with adverse implications for household incomes, poverty, health and livelihoods (MESTI, 2017b). By 2030, it is estimated that 400,000 additional people will live below the poverty line due to climate change (World Bank, 2017b). And by 2050, the reduction in GDP per capita is estimated to be in the range of 6.5 percent (low warming scenario) to 11.4 percent (high warming scenario). In the most extreme case, the decrease in GDP per capita could be as high as 35.5 percent (low scenario) to 46.2 percent (high scenario) (Baarsch et al., 2020).

Agriculture will be the sector most seriously impacted with economic losses concentrated in the Northern, Brong Ahafo, and Ashanti Regions. Agricultural value-added in these regions will decline by around 17 percent, likely leading to an increase in poverty incidence and migratory outflows. This will also adversely impact food systems and threaten food security. Economic modelling shows that climate change is expected to lead to higher food prices, in turn reducing the food production and incomes of smallholder farmers with increasing food imports (Asafu-Adjaye, 2014).

Given that about 64 percent of Ghana's electricity supply relies on hydropower, the energy sector will be hard hit by climate change as the heat and dry extremes could further accentuate the vulnerability of electricity production and the distribution system. Flooding events and storms could also affect electricity distribution and transmission. On the demand side, increasing temperatures will also increase electricity demand for cooling, placing additional pressures on capacity. The services sector will also be affected as erosion, waterlogging, and flooding may curtail transportation and trade activities. Additionally, access to clean drinking water, sewage and sanitation services, and the associated health risks, may reduce the ability of the economically active population to engage in productive activities. Negative climate impacts will accelerate rural-urban migration, resulting in the growth of informal settlements. This will lead to impacts on health, poverty, and social stability.

3.3 Policies and strategies

The Government of Ghana (GoG) has developed a number of policies and strategies to address climate change. It ratified the Paris Agreement in September 2016, and the associated Nationally Determined Contributions (NDCs), which are anchored in the 40-year long-term development plan, the National Climate Change Policy, as well as the Low Carbon Development Strategy. Other policies and strategies include the National Energy Policy, National LPG Promotion Policy, Strategic National Energy Plan and National Gas Master Plan, Renewable Energy Act, Energy Efficiency Regulation, Environmental Fiscal Reforms, Forest and Wildfire Policy and the National REDD+ Strategy. Ghana also has a Plan of Action on Disaster Risk Reduction and Climate Change Adaptation, which orients the approach of the national agenda in terms of disaster response, disaster prevention and risk reduction.

Ghana's terrestrial and marine ecosystems can be managed sustainably by devising and applying nature-based solutions (NBS). The European Commission defines NBS as actions to "address a variety of environmental, social and economic challenges in sustainable ways. They are actions that are inspired by, supported by or copied from nature" (EC, 2015). The International Union for the Conservation of Nature defines a NBS as "the potential power of nature and the solutions it can provide to global challenges in fields such as climate change, food security, social and economic development" (IUCN, 2012). Examples of NBS include climate change mitigation and adaptation measures such

as afforestation, agroforestry, conservation agriculture, and integrated watershed and catchment management.

Several concerns have been raised about food systems ranging from environmental, equity and trade, to dietary and health issues. In the area of the environment, the concern is about the environmental impact (i.e., 'food print') of the production and distribution of food commodities. A number of scientists have expressed the view that the 'modern' food system is both an agent and victim of "environmental harms" (e.g., see Garnett and Dodfray, 2012, p6). That is, the environmental resources underpinning the food system are being depleted and damaged in ways that threaten food production in the long run. Much of this damage is also being caused by the food system itself.

4. Delivering nutritious and healthy diets

Over the past three decades the rates of obesity and other diet-related non-communicable diseases (NCDs) have been on the rise globally (Collaboration NRE, 2016; GBD Obesity Collaborators, 2017), including in Ghana (Ghana Statistical Service, 2015). With over 40 percent of Ghanaian adults being overweight or obese (Ghana Statistical Service, 2015; Ofori-Asenso, Agyeman, Laar and Boateng, 2016), coupled with chronic food insecurity and undernutrition (FAO, IFAD, UNICEF, WFP and WHO, 2020; Fanzo et al., 2018), Ghana is experiencing a significant double-burden of malnutrition. In Ghana, malnutrition - in all its forms - is largely driven by proximal factors such as inadequate access to nutritious, and safe diets, but also distal drivers including exposure to unhealthy food environments, and therefore poor-quality diets. In addition, and as pointed out above, Ghana is experiencing rapid urbanization with a growing middle class, with widespread availability of obesogenic diets, that is diets high in fat and sugar (Amevinya, Quarpong, Laar, 2020; Green et al., 2020) - consistent with an advanced stage of a nutrition transition. High blood pressure, elevated fasting plasma glucose, dietary risks factors of NCDs, and a high body mass index are among the top 10 risk factors that combined lead to the highest mortality and disability figures in the country. (MOH, 2012). Urgent action is needed, as Ghana responds to multiple combined public health challenges.

Ensuring that every Ghanaian realizes his or her right to access to safe, and nutritious food is a challenging, yet achievable task that requires inputs from all sectors. It is currently well established that the determinants of good nutrition cut across multiple sectors, including health, agriculture, finance, trade, education, etc. Good nutrition results from a healthy and nutritious diet, but also proper hygiene and good healthcare. Access to healthy diets is highly dependent on decent employment, access to education, and transport and connections to a thriving, resilient, sustainable food system. Proper hygiene and health care likewise rely on income, education, and transport, along with provision of safe drinking water and adequate sanitation. This, therefore, reinforces the need for a food system approach.

It has long been recognized that food environments (a critical component of the food system) are critical determinants of safe and nutritious food. Food environments have been conceptualized to include the physical, economic, policy, and socio-cultural surroundings, as well as opportunities, and conditions that influence people's food consumption patterns (Swinburn et al., 2013). Others divide food environments into personal environments (food accessibility, food affordability, convenience, and desirability); and external environments (food availability, prices, vendor, and product properties and marketing and regulation) (Turner et al., 2018). In this regard, the food environment can be an entry point for interventions that aim to ensure access to safe and nutritious foods. These entry points may include the physical spaces where food is bought, the built environment that allows consumers to access these spaces, personal determinants of food choices (e.g., income, education, values, skills). But there are also political, social and cultural nudges that can be deployed (HLPE, 2017). Outlined and analysed below are the national and sub-national contexts in Ghana in relation to diets,

food security, nutrient adequacy, food safety, and nutrition outcomes. Also discussed are local policy contexts; priority areas for ensuring access to safe, and nutritious food for all Ghanaians.

4.1 Overview of the current state of diets, nutrition and health outcomes in Ghana

Over the years, the Ghanaian diet has largely relied on starchy roots (cassava, yams), fruit (mostly plantain), cereals (maize, rice) and to a lesser extent, animal source foods (ASFs). Starchy roots and cereals still supply about three-quarters of the dietary energy; diversity of the diet remains low (GSS, 2015). The adult Ghanaian diet has a main energy-dense component served with either a soup or a stew (Laar and Aryeetey, 2014). In many settings, the sources ASF are stews and soups, which are prepared with fish (mostly), and sometimes beef, poultry, pork, chevon, snails or crabs, as available. Since ASFs have a high nutrient density, the quantity and quality of soups or stews – depending on its ASF content - are indicative of dietary quality. This dietary pattern, where most calories are derived from starchy carbohydrates and limited ASF, is a problem nationally, but more pronounced in some regions. Recently, Marivoet et al., (2020) developed nutrient adequacy maps to identify the major challenges behind Ghana's insufficient or unbalanced dietary intake. The maps show food production and consumption data converted into corresponding calorie and nutrient amounts - comparing them with the nutrition requirements of each region's population. Their data corroborate earlier findings that the northern part of the country is disproportionately affected.

4.2 Food (in)security

In recent decades, Ghana has made significant progress toward addressing its food insecurity challenges. Ghana was the first African country to meet the Millennium Development Goal (MDG) 1 of halving poverty and hunger. Indeed, poverty and hunger decreased by 75 percent between 1990 and 2004. The number of malnourished Ghanaians also fell from 7 million in the early 1990s to less than 1 million in 2015. Importantly though, food insecurity at the household level or among vulnerable groups persists, despite overall national reductions in undernourishment. There are staggering inter-regional disparities in household food insecurity, ranging from 1 to 34 percent (worst affected are the northern parts of the country, and rural communities' across the country). The last nationwide comprehensive food security and vulnerability analysis estimated that about 5 percent (1.2 million people) of Ghana's population were food insecure with about two million people vulnerable to becoming food insecure at the time of the survey. The Ghana Zero Hunger Strategic Review bemoaned a high Hunger Index – translating into annual cost associated with child undernutrition to be GH¢ 4.6 billion (~USD750,000). These dynamics suggest the need for more targeted interventions that address vulnerabilities that are not evident in nationally aggregated data. The key food security challenges in Ghana have been mapped and include sub-optimal staple food production, huge losses in agricultural produce, weak food commodity value chains, seasonal variability in food availability and prices, and inadequate access to sufficient nutritious food at the household level, but also inequitable distribution/ market constraints, food waste, food loss, and nutrient loss. Indeed, the work of Marivoet et al., (2020) reveals nutrient surplus in some areas, deficit in others, and self-sufficiency in others.

4.3 Nutrient adequacy

Currently, Ghana fares decently well with respect to macronutrient (including protein) intake: households on average consume at least 82 percent of the recommended intake. In contrast, micronutrient deficiencies are alarmingly high. Marivoet et al., (2020) showed that apart from kilocalories, protein, and folate, for which production adequacies are substantially high, Ghana is not producing enough micronutrients. Production adequacies amount to only 41 percent for calcium, 63 percent for iron and 83 percent for zinc. In addition to insufficient national food production, the country appears to suffer from high nutrient loss, resulting in either from post-harvest losses or waste,

or food exports. For such nutrients as vitamin A, which is typically found in fruits, vegetables, and oils, some have suggested that low nutrition literacy may explain why household intake is deficient (Marivoet et al., 2020). In fact, the 2014 Ghana DHS reported that Ghanaian households consume fruits or vegetables only three times per week (GSS, 2015) Other drivers worth noting include access, availability, affordability, and nutrition literacy challenges.

4.4 Food safety

Ensuring food safety among others entails protecting the food system from microbial, chemical and physical hazards. When food safety systems are well developed, they contribute to improved public health, nutrition, enhance access to food trade, reduction of poverty, increased food security and the protection of the environment. Global and local interests in food safety have been heightened by both potential and actual food incidents. To address these concerns, national and international strategies have been put in place to provide the requisite information, standards and regulations. The Government of Ghana is increasingly showing support and commitment to address food safety concerns and improve the food safety situation in the country. In Ghana, there are several concerns and gaps that currently exist in this regard. There are food safety issues with regard to food production, handling, packaging, processing and transportation (King et al., 2000; Mensah et al., 2000; Ababio and Lovatt, 2015). There are also food system actors within the food value chain, whose activities are largely uncoordinated.

Indeed, a recent situational analysis of Ghana's food safety situation reveals major challenges that exist along the food value chain (farm to fork). These challenges – as per the National Food Safety Policy of 2019 relate to food production (including chemical and microbial contamination of foods; poor harvesting and drying systems for grains resulting in the production and accumulation of fungal toxins; poor handling and packaging of fresh produce at the farm level and local markets), the food value chain, imports and exports; training in food safety; public and consumer education; laboratories and surveillance, biosafety issues, and environmental pollution and food safety. Current efforts toward promoting food safety cover these areas. A review on food safety and food hygiene research in Ghana, however, reported that food safety research was highly concentrated in the capital city of the country and disproportionately focused on commercial food operations specifically street foods and microbiological safety with limited information from institutional catering and other forms of food hazards (Ababio and Lovatt, 2015). The Dietary Transitions in Ghana Cities Project (Rampalli, Pradeilles, Tandoh, 2019) identified food safety as an important factor to consider in promoting healthy eating in urban Ghana, including food hygiene, food adulteration and contamination and environmental sanitation, i.e. cleanliness of food outlets/home surroundings. A 2016 review commissioned by the Food and Agriculture Organization of the United Nations (FAO), found that contamination and adulteration levels of food were very high in street food outlets in Ghana, while poor hygiene practices were often adopted, increasing the risk of developing foodborne diseases (Marras S, AgBendeck, 2016).

Several efforts by institutions to contribute to ensuring that the foods consumed by Ghanaians are safe and of good quality exist. In 2019, the Government of Ghana developed the National Food Safety Policy to harmonize and coalesce these efforts. The Ministry of Health (MOH) in collaboration with relevant Ministries, Departments, Agencies (including the Ministry of Food and Agriculture, Ministry of Trade and Industries, Ministry of Environment, Science and Technology and Innovations, Ministry of Local Government and Rural Development, Ministry of Education, National Development Planning Commission) and other partners contributed to the development of the Policy. The ultimate aim of the Policy is to establish and maintain an integrated farm to fork food safety system that ensures consumer health and public safety (MOH, 2019). The adoption and implementation of this National Food Safety Policy is expected to reduce the incidence of food-borne diseases in the country. The National Food Safety Policy will also provide a basis for the establishment of National Food Safety objectives, requirements and guidance for application to specific sectors of the food chain, that is, from

farm to fork. Through the adoption and promulgation of this Policy, the Government of Ghana reaffirms its commitment to fulfilling the constitutional obligation of ensuring safer and better nutrition for its population.

Early - in 2012, the Ministry of Health introduced the Public Health Act (PHA) to ensure the prevention of disease and the promotion of good health before products reach human and animal consumption (MOH, 2012). This legislation is comprehensive and includes specific regulations on disease control, healthcare provision, food and drink quality and distribution, tobacco control, institutional responsibility, and sanitation. It also outlines the legal framework to which all stakeholders in the food system must adhere. These regulations were brought about to ensure access to safe and nutritious food for Ghana's population and to challenge undernutrition and obesity through access to quality food. The Food and Drugs Authority is mandated to conduct the enforcement, registration, and quality control of food and feed standards for domestic and imported goods in Ghana. The clear regulations found in the PHA, together with enforcement from the FDA, have increased overall food quality in Ghana. In 2019, over 2,896 products were tested, of which 78 percent passed the strict regulations; this constituted an increase of 2.9 percent from 2018 (FDA, 2020)

Furthermore, the Ministry of Health led in the development of a national policy to combat non-communicable diseases (NCDs) resulting from inadequate diets, including heart disease, obesity and cancer. Launched in 2012, and revised in 2021, Ghana's National NCD Policy outlines actionable declarations to minimize salt, fat, trans fats, and added sugars in processed foods, including in food available in supermarkets and restaurants.^{46,47} The NCD policy is also supported by stringent legislation (Public Health Act of 2012), that helps identify the accuracy of declared nutritional content thereby regulating declarations made about food that are aimed at protecting food safety and consumer health. The existing legal framework checks the claims of origin, ingredients and the date of processing and manufacturing for products (Public Health Act of 2012),

4.5 Nutrition and health outcomes

For decades undernutrition among children and adults has been the major public health challenge. Adult underweight or a body mass index (BMI) under 18.5 kg/m² is indicative of chronic energy deficiency. If it occurs among women of reproductive age, it increases the risk of intrauterine growth restriction and low birth weight, which are risk factors for neonatal morbidity and stunting. In Ghana, 9 percent of women are underweight, with most living in rural areas or in the northern sector of the country. With a current prevalence of undernourishment at 6.5 percent (which is below the world average of 8.9 percent)- Ghana has made tremendous progress in reducing this burden. The proportion of stunted children in Ghana has seen a steady decrease from 35 percent in 2003 to 19 percent in 2014; while wasting in children has seen a similar decrease from 8 percent in 2003 to 5 percent in 2014; and underweight from 18 percent in 2003 to 11 percent in 2014. Anemia affects about 66 percent of Ghanaian children and 42 percent of women aged 15 – 49 (GSS, 2015). Micronutrient malnutrition remains a major public health problem in Ghana. Vitamin A, Iodine and Iron deficiencies are prevalent, especially among children and women of child-bearing age. As the various undernutrition-related indicators are trending down – due to sustained response from various sectors, data from the Ghana DHS conducted in 1993, 1998, 2003, 2008, and 2014 show a significant increase in overweight, and obesity among Ghanaian women aged 15-49, with an increase from 10 percent in 1993 to a staggering 40 percent in 2014 (GSS, 2015; GSS, 1993) A systematic review in 2016 reported that 43 percent of Ghanaian adults were either overweight or obese (Ofori-Asenso et al., 2016). The percentage of deaths resulting from NCDs (including obesity) is estimated to be 44 percent in Ghana, while the risk of premature death from select NCDs is 15 percent (MOH, 2012).

4.6 Existing policy and programmatic innovations

Since Independence in 1957 the Government of Ghana has demonstrated its commitment to addressing malnutrition challenges (particularly food insecurity and undernutrition). Ghana is a signatory to several international declarations endorsing the right of its citizens to adequate food and nutrition security. Local efforts to address food insecurity and undernutrition include the development of various legislations, regulations, policies, strategies, and programs. Gharthey(2010), broadly organized Ghana's nutrition policies that have been adopted and implemented since independence into six eras – beginning from “food demonstration and nutrition education” (1957 –1966) to “consolidation of strategies for addressing micronutrient deficiencies, exclusive breastfeeding and community-based growth monitoring” (2000 –2008). Laar et al., (2017) describe the seventh era - beginning in 2010. This era is largely characterized by efforts to scale up proven interventions for undernutrition—as part of the Scaling up Nutrition (SUN) Movement, and some nascent efforts to combat rising rates of overweight, obesity, and other diet-related NCDs.

As outlined above, Ghana has, in the last two decades, through concerted policy and programmatic efforts, made major strides in poverty reduction, economic growth, and a reduction in the prevalence of adverse nutrition outcomes. However, there remains significant challenges especially with respect to policy action to transform its food systems. Having traditionally focused its efforts and resources on infectious/communicable diseases, there has been a huge inertia to refocusing and reprioritizing Ghana's health and food systems' needs (Laar et al., 2020; Laar et al., 2019). In recognition of the increasing burden of NCDs over the past decade, the first national NCDs policy and accompanying strategy was published in 2012. The national policy and accompanying strategy highlight interventions such as regulating advertisement of unhealthy foods and non-alcoholic beverages particularly to children; limiting the level of trans fats and salt in industrially processed food, as well as food-related health taxes for implementation (Fanzo et al., 2018; MOH, 2012)

A recent food security policy review revealed that agriculture-related food security policies are mainly dealing with production, distribution, and exchange of food; while nutritional value and food safety, for instance, are main concerns of the health and nutrition policies (Linderhof, 2019). The authors recommended the integration of food security elements into all policies.

A recent compilation of “Policy Innovations for Food Systems Transformation in Africa” by the Malabo Montpellier Panel (2021) recognized Ghana's effective coordination mechanism through the National Development Planning Commission (NDPC), and sub-national program delivery through relevant sectors. Thus, governmental institutions at the forefront of Ghana's march for food systems transformation include the NDPC (coordination), and the Ministry of Food and Agriculture (MoFA) – which amongst others, aims to modernize Ghana's agricultural sector to improve food security, create employment opportunities, and reduce poverty. Taking all of the current arrangements into account, Ghana can be said to have a vibrant and dynamic institutional framework that can lead its food systems transformation.

As regards, long-term policy direction, Ghana has developed multiple strategic plans and policies across sectors that demonstrate stringent commitment to improving the complex food system. The draft Long-Term National Development Plan (LTNDP) (2018-2057) is the Government of Ghana's flagship national policy that looks to transform Ghana into a nation “beyond aid”, and into one that is industrialized, inclusive, sustainable, politically stable, and globally influential – thereby accelerating economic development, poverty reduction and improving living conditions for Ghanaians. The latest LTNDP outlines the government's contributions necessary to improve food security and agriculture growth. The Food and Agriculture Strategy for Development (FASDEP II) is the agriculture policy currently being implemented to combat food insecurity and improve rural development in Ghana. The Medium-Term Agriculture Sector Investment Plans (METASIP) I, II, and III are complementary plans introduced to support FASDEP in funding the implementation of Ghana's agricultural priorities and achieving sustained agricultural GDP growth.

4.7 Policy options for transforming Ghana's food environments and systems

As part of a complex food system, policy efforts to improve food environments need to be tackled at multiple levels, engaging multiple actors across diverse sectors that account for the co-existence of multiple forms of malnutrition, i.e. with 'multiple duty actions (Hawkes, 2020; Laar, 2021). Evidence shows that food environment policies (e.g. policies on food composition, food marketing, food labeling, food retail, and food provisioning as well as fiscal policies) when delivered as a cluster of interventions are impactful (Taillie et al., 2020). Policies to create healthy food environments and sustainable healthy diets, such as those that aim to improve the nutritional quality of food; restrict unhealthy food marketing; encourage healthier food provisioning practices, improve food retailing spaces and activities; and promote effective food labeling regulations, as well as progressive fiscal policies (taxes and subsidies), are being advocated to prevent diet-related NCDs. Presenting evidence from a realist review focused on Ghana and Kenya, Booth et al., (2021) argue that, if governments implement comprehensive policy measures that serve to limit the availability of unhealthy food products while intervening to avail healthy ones to consumers; the production, processing, promotion of unhealthy diets will be reduced; leading to reduced availability, attractiveness and consumption of unhealthy foods. To this end, presented below are suggested policy options and interventions that have the potential to improve "diet quality; nutrient supply; undernutrition, overweight/obesity, food safety; as well as the food environment.

Diet quality: Potential interventions

- Diversify and provide healthier meals as part of school feeding programs, by removing any unhealthy foods and creating an overall healthier food environment
- Establish food composition tables, food-based dietary guidelines, and subsequent nutrient profiling of foods and beverages, which can facilitate better labeling⁴
- Increase knowledge on nutrition by informing consumers on appropriate combinations of available food (e.g., through nutrition sensitization campaigns, educational programs)

Nutrient supply: Potential interventions

- Expand the focus beyond food security based on energy needs to include household access to macro and micronutrients (especially in rural areas)
- Encourage producers and processors to increase production of nutrient-rich foods for the domestic market
- Develop alternative animal and vegetal sources of proteins that can be produced domestically
- Improve the population's nutrition literacy – through food-based dietary guidelines (FBDGs) and other interventions so that food producers and consumers recognize the need to limit intake of nutrients of concern, and promote consumption of nutrients as protein, fiber, vitamins A, C & E, calcium, iron, potassium and magnesium, folate and zinc
- Peruse strategies to improve the traditional (local) food system rather than replace it

Undernourishment: Potential interventions

- Increase productivity and total production and improve food distribution
- Improve food distribution to vulnerable groups to enhance food and nutrition security status of poor and disadvantaged groups

Overweight & Obesity: Potential interventions

Run targeted campaigns for individuals and households focusing on both overweight/obesity and undernutrition, promoting healthy diets and physical activity for urban and peri-urban populations

- Make the benefits of affordable healthy food visible and reveal the costs of damage to the environment and human health
- Ensure true pricing of food so that affordable and healthy food is accessible to all

Food safety: Potential interventions

- Implement and update regulatory framework on food safety and ensure dissemination and implementation
- Raise consciousness of the public health impacts of aflatoxins
- Introduce and promote interventions and support smallholders to profitably produce organic foods
- Strengthen the use of organic certification
- Strengthen the Healthy Street Food Incentives (HSFI) and implement the WHO Global Strategy for Diet, Physical Activity and Health
- Better collaboration with Environmental Health Officers to develop and maintain a database of street food and motivating street food vendors to register in a public database
- Legislation on mandatory nutrition labeling of food including street vended food
- Stimulate the demand for fruits and vegetables
- Develop a resource-efficient food monitoring and inspection system

Food environment: Potential interventions

- Implement policies that make unhealthy foods less affordable and less attractive while making healthy foods attractive and affordable, such as food-related health taxes
- Pass legislation to regulate the advertisements of foods and drinks high in nutrients of concern such as sugar, salt, saturated fatty acids etc)
- Create a food labeling policy to support nutrition advocacy
- Provide sufficient funds for nationally relevant research on nutrition and NCDs

5. Gender and Equity in GHANA'S Food Systems

Although the Constitution of Ghana does not explicitly guarantee the right to adequate food, Ghana is party to the International Covenant on Economic, Social and Cultural Rights (ICESCR), which recognizes the right to adequate food. The Optional Protocol (OP-ICESCR) was signed in 2009 but has not been ratified yet. The country has supported the global and African regional concern for inclusivity expressed by the SDGs and the Agenda 2063. Over the last three decades, gender mainstreaming and the case for women empowerment, youth engagement, and other marginalized groups have been emphasized with a lens that builds more equity within and across the entire food system.

5.1. Status of gender and equity in the food systems

The CAADP M&E report on gender and equity in food systems

The commitment of member states of the African Union to gender equality in Africa is not in doubt (AU, 2004). Several activities, including the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods, which set forth new goals for a more targeted approach to achieve the agricultural vision for the continent (AU, 2014), have highlighted the importance of female and youth empowerment for shared prosperity and improved livelihoods.

In 2018, African countries produced the first-ever Comprehensive Africa Agriculture Development Programme (CAADP) Biennial Review (BR) report along with the Africa Agriculture Transformation Scorecard. The commitments were set forth to achieve shared prosperity and improved livelihoods through inclusive agricultural growth. The commitments lay a foundation for policy and program implementation, with some (albeit not explicit) attention to gender. Among the seven commitments, realizing those to end hunger, reduce poverty, boost intra-African trade, and increase resilience to climate and other risks will not be possible to achieve without taking gender into account. The data systems that provide information on gender gaps in processes and outcomes are currently being developed by the countries. The 2019 report recorded that Ghana was on track with respect to “...a resolve to ensure that the agricultural growth and transformation process is inclusive and contributes at least 50 percent to the overall poverty reduction target, through measures to ensure robust agricultural GDP growth, inclusive public-private partnerships in priority value chains, and engagement of the youth and women”. “increase the proportion of rural women that are empowered in agriculture to 20 percent by 2025” (AU, 2020). The lack of data continues to be a challenge in reporting progress on the indicators as they relate to women and youth engagement in agricultural value chains. African Union Member States, including Ghana, need to invest more to strengthen data collection, analysis and interpretation to be able to report against these indicators.

Roles, perceptions, and experiences of national stakeholders on gender and equity in food systems

The importance of ensuring gender balance and equity within Ghana’s food system has been expressed in diverse ways by both governmental and non-governmental organizations. In the lead for championing the cause is the Ministry of Gender, Children and Social Protection (MOGCSP). The mandate of the ministry includes equitable livelihoods, population growth and migration, diet nutrition and health outcomes, gender and youth and human rights. The ministry is represented during the formulation of any policies and programs as they relate to equitable livelihoods, pushing for more access to finance and skills training for women. Hence, the ministry is connected to almost all other sectoral ministries albeit into varying degrees, including the Ministry of Finance to ensure regular flow of financial support; the Ministry of Food and Agriculture to ensure effective roll-out of MoFA’s Gender and Agriculture Development Strategy (GADS II); and the Ministry of Employment and Labour Relations, Education and Local Government and Rural Development, to ensure policy implementation and support for capacity building in mainstreaming gender in all project design and execution.

Most research institutes in Ghana are grouped under the Council for Scientific and Industrial Research of the Ministry of Environment Science Technology and Innovation (MESTI). Their mandate of ensuring effective formulation and implementation of policies on innovation, science and technology, including agriculture, food processing and innovations allows them to align with academia. The Food Research Institute champions food safety, health and nutrition engages with women groups and civil society to carry out awareness campaigns and education as part of its social responsibility. In universities, several agricultural and socio-economic research projects investigate situations of

women, men and youth in relation to food systems (farming, input delivery, marketing and trade, and association) and occasionally join in sensitization and awareness campaigns. Departments such as Family and Consumer Sciences, Agricultural Economics and Agribusiness and Food and Nutrition are key examples.

With a keen interest in supply chain development, food environments and investments, some companies in Ghana use their corporate social responsibility activities to undertake empowerment projects that promote nutrition and healthy diets among pregnant and lactating women, and schoolchildren. Nestle Ghana Limited is well-known for its decade-long media campaign on nutrition tips. Through business advertising, companies such as Unilever Ghana, Promisidor Ghana and other food companies identify with families, especially women and children to promote healthy diets using their processed products - margarine, tomatoes, pasta cooking oils and salt. There are also firms such as Green Gro Limited that produce and promote organic inputs among male and female farmers.

In addition, non-governmental organizations advocate for equitable livelihoods and lobby government and the private sector for safer and more responsible production and consumption. In Ghana, the Association of Ghana Industries (AGI), Private Enterprise Federation (PEF), General Agricultural Workers Union (GAWU, among others, initiate or join in media and public awareness campaigns to improve food environments, diets, nutrition and health outcomes and well as the overall supply chain subsystem. They participate in public policy making on food, agriculture, fisheries and nutrition and support enforcement of regulations, which safeguard family life.

5.2. Public policies, regulations and strategy development

Ghana's food and agriculture and nutrition policies that form the basis of investment plans and government annual budget releases to support implementation, monitoring and evaluation is well aligned with African continental priorities. Based on the recent Malabo commitments, the Biennial Reports indicators are tracked and efforts to address deficiencies are identified during monthly meetings by the Agricultural Sector Working Group (ASWG) and METASIP Monitoring committees. The Gender and Agricultural Development Strategy (GADS) is the guiding framework for ensuring inclusivity and empowerment of women and youth in all flagship and development projects by government and non-governmental organizations that operate in the agricultural sector.

How the policy environment has created incentives for equitable livelihood is shown in the following: Over 51 percent of Ghana's population are women with a Gender Inequality Index (GII) coefficient of 0.54 as of 2017 (WFP, 2018). A 64.6 score (out of 100) was assigned on the Gender Index of the Ibrahim Index of African Governance (IIAG) in 2019; while this score has decreased by 7.4 points since 2010, Ghana is still ranked 10th out of 54 African countries. The scores for laws on violence against women have been estimated at 25.0 (out of 100) and political power & representation of women at 54.1 (out of 100). The scores for socioeconomic opportunity (75.0 out of 100), access to public services (83.9 out of 100), and equal civil liberties (85.0 out of 100) are higher. In terms of BMI, 40 percent of women (49 percent urban vs. 28 percent rural) and 16 percent of men (23 percent urban vs. 8 percent rural) are considered overweight or obese. In terms of income, the Gini coefficient based on incomes across the food system is estimated at 0.43. That women play a very important role in agriculture is not in doubt, however, they are often found to be less productive than men. This has been attributed to limited decision-making powers of women with respect to access and control of resources and income as well as participation in leadership groups and overwork. The women empowerment in agriculture index (WEIA) was 0.71 in 2014 (Zereyesus et al., 2014). The gap between farmgate and wholesale price was estimated at 169 in 2019, making rural women who are at the forefront of rural trade worse-off than urban women and men. The proportion of men and women engaged in agriculture with access to macro and microcredit financial services is 20 percent; while women's access is more restrictive although the expansion of access to microfinance savings and credit in the last few decades by women is not in doubt.

Unemployment amongst young people aged 15-24 years was 8.72 percent, which is almost twice as high as the total unemployment rate. About 57 percent of Ghanaians are under 24 years of age and the youth population (15-24 years) makes up 19 percent of the total population of Ghana. A modernized agricultural sector with thriving private sector agribusinesses and incubation/innovation hubs is the opportunity to provide decent and rewarding careers in food systems for the youth.

5.3. Opportunities and Challenges for Transformative Policies

Transformative policies ensuring gender equality and equity

Policies ensuring gender equality and equity in food systems transformation are expressed in a number of documents by the Ministry of Food and Agriculture, Ministry of Fisheries and Aquaculture Development, Ministry of Health, Ministry of Trade and Industry and Ministry of Local Government and Rural Development. Gender mainstreaming programs facilitated by the Ministry of Gender, Children and Social Protection have ensured that there are gender desks or directorates in each of the ministries. The MoFA has a directorate of Women in Agricultural Development (WIAD), whose mandate it is to formulate and implement strategies that empower women and men at the household level to adopt technologies for sustainable production, consumption and trade at the local level. The gender desks at each district assembly of the Ministry of Local Government and Rural Development ensure that women and youth are not excluded from the benefits of community-level projects and programmes related to food, nutrition, health and sanitation at home and market levels.

Opportunities of the transformative policies ensuring gender and equity

Households and firms at the community level manage resources, which are shown to be limited. Hence, the government's policy and flagship programs, infrastructure and capacity-building projects support household/private sector activities of procurement, operations, processing, marketing and sale and after-sale services. Important infrastructure that creates opportunities for women, youth and other vulnerable groups include rural and urban roads, rail and transport, irrigation centres, mechanization centres, community skills development and technical vocational education and training (TVET) centres/institutes, community warehouses, local market centres, microfinance and small loans centres (MFSLC) and agricultural/health extension services. While the transport system facilitates movement of both inputs and harvested produce to and from markets and farms, irrigation system makes all year round water available for production of vegetables and rice (in particular). Mechanization centres, especially when sited at places closer to the farmers' fields make access to machines for field work and post-harvest processes easier to women who are the dominant group in these processes. In Ghana, tractors, harvesters and grain shellers are very important labor-saving devices that reduce the drudgery faced by women and older persons in particular. Young people are inexperienced and need skills upgrade now and again, hence community TVET centres are handy. When harvested produce can be stored for a while in community warehouses before processing (paddy rice) or marketing (all durable crops, especially grains) farmers will gain from better prices later. The importance of MFSLC lies with improving savings culture, building credit history and easing accessibility to credit and financial literacy, especially by women and youth start-ups. More technical and managerial information on field, post-harvest and quality diets and health management are usually supplied by extension officers at the community level.

Apart from government infrastructure, private sector investments in plant and equipment, as well as trade delivery systems, is expanding, in response to government policy and flagship programs such as Planting for Food and Jobs (PFJ) and One District One Factory (1D1F). Factories have been rehabilitated and established to employ young people and women in banana production for export, horticultural crops production, processing and exports among others. The nucleus out-grower and contract farming system is supporting youth and rural women, while input dealership shops, mechanization centres, greenhouses and agri-tech service providers are employing trained youth and

women. Due to subsidies on improved seeds, fertilizer and machinery hire, some women and youth can engage in sustainable agricultural intensification. In terms of information for food production nutrition and health, extension agents hired by local government departments (Agriculture, Environmental and Health Services and Ghana Health Service) ensure free services to households and community-based associations/organizations.

Challenges women and youth face with transformative policies

Despite the efforts to create an enabling environment for households and firms to respond, barriers remain including unfavorable policies, economic barriers (interest rates, inflation, exchange rate, tariffs and taxes and incomes), socio-cultural traditions and norms, technological dynamics, environmental changes and legal frameworks. As discussed above, the result is the production of sub-standard foods, consumption of unhealthy food, diet adequacy and diversity issues, discrepancies between regions, inadequate infrastructure capacity and low environmental resilience. Poor food environments are leading to increased consumption of unhealthy foods, resulting in higher non-communicable disease (NCD) prevalence; the most affected are the poor and vulnerable, especially women and youth who lack the means to seek quality health care. Women and youth are the part of the population with the highest nutrient deficiencies, limited control over land and work mainly in the informal sectors.

6. CONCLUSION

Overall, Ghana has made significant progress in the development of agricultural policies that are based on broad stakeholder engagement and evidence-based policy positions. The issues surrounding agricultural supply chains have been captured in different policy documents with different levels of emphasis on different actors in the chain. However, a specific policy document to streamline agricultural supply chains in Ghana is not currently available.

Greater efforts should therefore be targeted to the development of sustainable agricultural supply chains to ensure activities along the chain are done in environmentally friendly and socially inclusive ways while at the same time, being economically viable. These goals are hinged on widespread technology adoption and innovation along the agricultural supply chain. These approaches are also more suited to attracting more green investment and financing.

Some specific recommendations for developing sustainable agricultural supply chain policies include:

- i) Promotion of public-private partnerships (PPPs) to attract more financial resources and technological innovations. Investing in post-harvest management (e.g., building warehouses, supplying cold vans) and medium-sized industries will boost the profit margins for actors within the chain.
- ii) Development of legislation to address the ethical issues in the agricultural supply chain. This will create a stable and safe environment for example, for actors who seek to engage in the adoption of biotechnologies.

As the agricultural supply chain develops, there will be consolidation along the chain, both horizontally and vertically. Policy must ensure that smallholder farmers and small firms are protected to avoid exclusion and marginalization of vulnerable groups. Farmers should be treated fairly and they should get an equitable share of the final prices paid by consumers.

Risk management along the chain must be comprehensively assessed. Production, transportation, processing and marketing-related risks should be clearly spelled-out and guidelines provided for mitigating them. For example, agricultural insurance and long-term financial services should be integral to any support services provided to actors in the chain.

Consumers should be educated, encouraged and nudged to demand more healthy diets. Government should consistently revise its standards and regulations to drive food industries and marketing companies towards healthy diets. Industries that use clean energy can benefit from “green” tax rebates.

The success of a sustainable agricultural supply chain relies on all actors within the chain, but the ultimate responsibility lies with the government to commit to the development and implementation of appropriate policies. Institutional and individual accountability in ensuring the right things are done is key to the smooth functioning of the chain.

Climate change adaptation and mitigation are crucial for Ghana to develop a sustainable agricultural supply chain. The country faces a number of challenges and opportunities in implementing its adaptation and mitigation strategies. First, the budgetary support by the government to fund climate change activities remains low. Funding is mainly donor-driven and project-based. The funding issue is particularly significant as Ghana’s Nationally Determined Contributions (NDCs) propose investment needs of US\$22.6 billion (US\$9.8 billion for mitigation and US\$12.8 billion for adaptation). Ghana intends to mobilize one-quarter of this amount domestically and obtain the rest from international sources (UNFCCC, 2015). However, the Government of Ghana (GoG) currently faces domestic resource mobilization challenges. The tax-to-GDP ratio is around 13 percent, well below the Sub-Saharan African average of 15 percent. The majority of workers in the informal sector (which accounts for 80 percent of the workforce) do not pay taxes. There is therefore a need to leverage digital technologies to enhance tax collection and compliance.

Second, Ghana lacks accurate weather and climate data, which are essential for the prevention of losses in terms of life, livelihoods and assets, as well as for the sustainable design of climate-sensitive economic activities and infrastructure. The country needs to invest in capacity building and technology in this area with the help of its development partners.

To help develop sustainable food systems in the face of climate change, the GoG should promote climate-smart agriculture. Climate-smart agriculture (CSA) leverages technological innovations to increase productivity and profitability on farms, and to build farmers’ resilience. Examples include the use of new crop varieties that tolerate heat, soil salinity and resist floods and drought. Conservation agriculture, crop diversification, and integrated pest management are also CSA practices that help to improve soil and water quality. CSA practices such as precision agriculture and push-pull technology help to optimize the use of farm inputs, improving farm productivity and lowering costs. However, Ghanaian smallholder farmers face numerous challenges in adopting climate-smart agriculture. Key among them are access to information, access to credit and access to affordable insurance services. To promote the diffusion of CSA, there is a need to strengthen research and extension systems, build infrastructure and innovation ecosystems, as well as address gender disparities. There is also a need to increase the involvement of the private sector, university and research institutions in technology generation, extension adoption, as well as dissemination of agricultural knowledge. Rising incomes, growing urbanization and the emergence of supermarkets offer opportunities for smallholder farmers to diversify their production towards high-value commodities such as fruits, vegetables, meat, eggs and fish. However, to facilitate this process, smallholder farmers will need to be provided with affordable credit, as well as access to quality farm inputs such as seeds and fertilizer. Climate risk management can be improved through crop insurance and early warning systems. This will encourage farmers to adopt innovative technologies such as CSA and protect themselves from the high risks of crop failure.

Third, like most African countries, Ghana has considerable supplies of renewable energy resources that offer an opportunity to leapfrog to low-carbon energy. This would contribute to future reductions in greenhouse gas emissions, support economic growth, reduce poverty, improve people’s lives, and contribute to transformation of food systems. However, although prices of renewable energy technologies keep falling, the high setup costs discourage adoption by small businesses and farm households. Moreover, foreign investors are not keen to invest in the associated infrastructure due to the weak policy and regulatory environment, corruption and the complex and uncertain land

tenure system. To attract the investment required to exploit Africa's renewable energy resources, the government should develop a stable regulatory and policy environment as well as establish competitive pricing to promote mini-grids and standalone systems. There is also a need for strategies and policies (e.g., financing mechanisms) to boost women's participation in the renewable energy value chain.

Ghana needs to rapidly develop and implement policies that will help limit the degradation of its ecosystems. Initiatives such as reducing Emissions from Deforestation and Forest Degradation (REDD+) hold good prospects for Ghana to accelerate nature-based solutions (NBS) to reduce greenhouse gas emissions and address socio-economic development challenges. However, to date, financial transfers through REDD+ to Ghana have been limited. This is partly to do with poor forest governance characterized by poor institutional capacity and performance and insecure or weak land and forest tenure by local communities. There is therefore an urgent need for land tenure reforms to enable indigenous and local communities to claim property rights in forest land in order to benefit from REDD+ payments. Increased participation in the REDD+ initiative will help Ghana to advance toward its NDCs under the Paris Agreement by using blue carbon markets.

There are also options for the sustainable use and management of coastal and marine ecosystems which form Ghana's blue economy for sustainable and inclusive growth. This can be done through policies to regulate and monitor fishing, improve waste management and reduce plastic pollution. The increasing volumes of waste dumped in the ocean harm fish production and other marine organisms. Ghana can also maximize the benefits of its blue economy by collaborating with other African countries to address the issues of piracy, armed robbery, and illegal, unregulated, and unreported fishing which threaten the sustainable use of blue economy resources.

Developing sustainable food systems is likely to improve environmental outcomes. A policy option for reducing the impact of food production on the environment is to promote sustainable intensification of agriculture (Montpellier Panel, 2013). Encouraging higher productivity on a smaller area of land can prevent the additional greenhouse gas emissions that would result from expanding the agricultural area. However, emissions per unit of output can still increase, partly due to the growing dependence on fossil fuels that agricultural intensification may entail (WWF, 2016). Therefore, this higher production per hectare should be done using CSA practices such as application of smarter crop rotation methods, or by using precision agriculture to better match the application of inputs (such as water and chemical fertilizers) to local soils and temperature conditions.

Another policy option to achieve sustainable intensification along the food chain is to target reduction of food losses and waste (FLW). This would help achieve food security and improve food chain efficiencies (FAO, 2011). Reducing food wastage would ease the pressure on agroecological systems to meet the growing food demand, thus improving food system sustainability and ensuring food security and nutrition. Food loss and wastage amount to significant squandering of resources including water, land, energy, labor, and capital while also contributing to climate change (FAO, 2015). According to FAO (2012), minimizing FLW can also reduce water demand. Reducing waste across the entire food chain would improve input use efficiency by increasing the amount of available food per given level of inputs (Ingram, 2011).

Besides agricultural production, there are other activities in the food supplychain that also have an environmental impact. These include storage, transport, processing and retail which consume considerable energy, thereby contributing to greenhouse gas emissions. Energy-saving, the recycling of food waste as biogas or using less packaging material are examples of options for reducing the environmental harm of these activities. New technologies to save energy or create biodegradable packaging materials can be enforced using environmental and other legislation as well as by regulation and/or through economic incentives such as taxes and subsidies.

Another environmental concern about the modern food system is that it relies on extractive (mainly mono-crop) agriculture with intensification leading to environmental degradation processes such as biodiversity loss, soil erosion and pollution. Some scholars argue (e.g., see Eakin et al., 2016; Gliessman, 2014) that there is a need to focus on humans as an essential part of agro-ecosystems and to consider natural capital as essential for sustaining agricultural production. It would also be necessary to ensure that agriculture is compatible with other ecological processes and services. This will require a shift from the current focus on only production to a systemwide view of food production. Innovative policies such as targeted subsidies and tax incentives as well as penalties and fines are required to address issues such as water depletion, soil degradation, agrobiodiversity loss and overexploitation of marine resources.

Finally, to maximize positive environmental outcomes, there is a need to make farming an attractive and viable livelihood option for educated young people. There is also a need to promote inclusive and resource-efficient food supply chains. This will require strong political will and dedicated leadership at all levels including the public sector, private sector, academia, the media and civil society.

As part of a complex food system, policy efforts to improve food environments need to be tackled at multiple levels, engaging different actors across diverse sectors that account for the co-existence of multiple forms of malnutrition, i.e., policies with ‘multiple-duty’ actions.^{28,29} Evidence shows that food environment policies (e.g., policies on food composition, food marketing, food labeling, food retail, and food provisioning as well as fiscal policies) when delivered as a cluster of interventions are impactful.³⁰ Policies to create healthy food environments and sustainable healthy diets, such as those that aim to improve the nutritional quality of food, restrict unhealthy food marketing, encourage healthier food provisioning practices, improve food retailing spaces and activities, and promote effective food labeling regulations, as well as progressive fiscal policies (taxes and subsidies), are being advocated to prevent diet-related NCDs. Based on a review of evidence focused on Ghana and Kenya, Booth et al.(2021) argue that government implementation of comprehensive policy measures that serve to limit the availability of unhealthy food products, while intervening to make healthy ones available to consumers, will reduce the production, processing and promotion of unhealthy diets and also lead to reduced availability, attractiveness and consumption of unhealthy foods.

Diet quality: Potential interventions

- Diversify and provide healthier meals as part of school feeding programs, by removing any unhealthy foods and creating an overall healthier food environment
- Establish food composition tables, food-based dietary guidelines (FBDGs), and subsequent nutrient profiling of foods and beverages, which can facilitate better labeling
- Increase knowledge on nutrition by informing consumers on appropriate combinations of available foods (e.g., through nutrition sensitization campaigns, educational programs)

Nutrient supply: Potential interventions

- Expand the focus beyond food security based on energy needs to include household access to macro and micronutrients, especially in rural areas
- Encourage producers and processors to increase production of nutrient-rich foods for the domestic market
- Develop alternative animal and vegetal sources of proteins that can be produced domestically
- Improve the population's nutrition literacy, through FBDGs and other interventions so that food producers and consumers recognize the need to limit intake of nutrients of concern, and promote consumption of nutrients such as protein, fibre, vitamins A, C & E, calcium, iron, potassium, magnesium, folate, and zinc
- Propose strategies to improve the traditional (local) food system rather than replace it

Undernourishment: Potential interventions

- Increase productivity and total production while also improving food distribution
- Improve food distribution to vulnerable groups to enhance the food and nutrition security status of poor and disadvantaged groups

Overweight and obesity: Potential interventions

- Run targeted campaigns for individuals and households focusing on both overweight/ obesity and undernutrition. Such campaigns should also promote healthy diets and physical activity for urban and peri-urban populations
- Make the benefits of affordable healthy food visible and reveal the costs of damage to the environment and human health
- Ensure the true pricing of foods so that affordable and healthy food is accessible to all

Food safety: Potential interventions

- Implement and update regulatory frameworks on food safety and also ensure dissemination and implementation
- Raise awareness of the public health impacts of aflatoxins
- Strengthen the use of organic certification
- Strengthen the Healthy Street Food Incentives (HSFI) and implement the WHO Global Strategy for Diet, Physical Activity and Health
- Improve collaboration with Environmental Health Officers to develop and maintain a database of street foods and encourage street food vendors to register in a public database
- Legislation on mandatory nutrition labeling of food including that sold by street vendors
- Boost the demand for fruits and vegetables
- Develop a resource-efficient food monitoring and inspection system

Food environment: Potential interventions

- Implement policies that make unhealthy foods less affordable and less attractive while making healthy foods attractive and affordable, such as a sugar tax
- Pass legislation to regulate the advertisement of foods and drinks with nutrients of concern
- Create a food labeling policy to support nutrition advocacy
- Provide sufficient funds for nationally relevant research on nutrition and NCDs
- Enact legislation on mandatory nutrition labeling of food, including street foods

When considering income and gender equity, the right level of ambition to realize food systems transformation is being pursued given the policy targets set out in the SDGs, CAADP and national policies for food, agriculture, nutrition and health. Resolving the most pressing issues in Ghana's food systems (consumption of adequate, diverse and healthy diets, infrastructure capacity and low environmental resilience) in all its regions (north-south), results in trade-offs that need to be considered. For example, increasing yields via intensified use of inorganic fertilizers and pesticides and heavy-duty machines will impact the environment negatively. Similarly, due to limited financial resources, improving infrastructure capacity in terms of roads and technology may have implications on the budgetary amounts available for health and nutrition campaigns and awareness programs.

Addressing these trade-offs as well as the north-south divide in income generation and the attendant migration will be key. Overall, improving the attractiveness of foods and dietary diversity has led to the importation of packaged foods and taken a toll on the country's balance of payments.

In order to create more synergies between the different dimensions of policy issues, several systems are used. To resolve tradeoffs between the different components (and ambitions) within the food system, there are strategies to strengthen the supply chain/marketing, water, energy, sanitation, environment and financial subsystems, including more recently the digitalization subsystem. Government flagship projects are the lead interventions to address food system challenges. To ensure better access for women and youth to different elements of the supply chain, more input dealer shops located closer to farming communities are needed, as are improved marketing systems and storage options at the community level such as warehouses and well-functioning market centres. Improving water systems through large and small-scale irrigation and effective water-user associations will build upon what exists. Completing dams under the 1V1D project will help close the gap between the North and South in terms of productivity and year-round production which is limited by the difficult climate. Improving the energy systems will result in continuous access to affordable fuel and electricity to power machines for both field production, post-harvest handling and food processing and distribution. Enhancement of sanitation systems will lead to better waste management for recycling and use in the food systems, as well as work towards sustainability and attainment of a circular economy. Agroforestry and the several climate-smart agricultural practices being promoted through community-based groups, individuals and firms is the way to go to reduce greenhouse gas emissions and strengthen climate change mitigation and adaptation. Improvements in the financial system would reduce interest rates and make credit more affordable and accessible to women and youth as well as enhance investments in food system activities. The potential barriers are mainly related to weak enforcement of laws, poor monitoring and evaluation, corruption and low accountability at all levels of government and the slow and inadequate release of funds for procurement and remuneration of capacity building facilitators.

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