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BRIEF REVIEW OF GHANA'S FOOD SYSTEMS TRANSFORMATION PATHWAYS

Felix A. Asante[1]

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1. Introduction

Global estimates show over half a billion people go hungry (FAO, 2020) and close to 2 billion people are either obese or overweight with another 2 billion of the world's population suffering from micronutrient deficiencies (Micha et al., 2020, Fresco et al., 2017). Inarguably, the world faces significant malnutrition problem (including micro- and macro-nutrient deficiencies, obesity, and diet related non-communicable diseases). This is evident in a recent analysis pointing out that effort in achieving the Global Nutrition Targets is likely to be missed. The observed malnutrition threat is accompanied by climate change, which is influencing food production and consumption trends, and thereby leading to undernutrition and affecting overall development. In addition, there are growing incomes, accelerated urbanization, and expanding middle classes which are also causing significant changes in consumer behaviour and nutritional choices, necessitating both public and private expenditures for better food market integration. As a result, there is a pressing need to examine our food systems to guarantee food and nutrition security and to advance sustainable development. It is likely that the COVID-19 impact may further exacerbates the worsening food insecurity and nutritional status of the most vulnerable groups including women, children and adolescents, refugees and displaced people, smallholders in rural areas, and the urban poor.

For the Sub-Sahara African region, the situation looks very scary and poses serious ramifications for sustainable development and public health. Rising inequality and income disparity have contributed to a proportion of 27.4% people living in extreme food insecurity in 2016 (FAO, 2017). Since 2014, there has been a growth in the number of people experiencing hunger from 47.9million to 256.1million in 2018 (FAO et al., 2020). At the same time, about 240 million people, particularly rural dwellers are malnourished (FAO, 2017), with 58.8% of the global stunted children living in Africa (FAO et al., 2020). Also, studies indicate a growing trend of NCDs and its dominance over all other causes of death in Africa by 2030 (GBD Obesity Collaborators, 2017; NCD Risk Factor Collaboration, 2016). Currently, experiencing a surge in obesity and other diet related NCDs while undernutrition and micronutrient deficiencies persist, Africa faces a new challenge of the coexistence of a double burden of malnutrition.

In Ghana for instance, about 33% of women of reproductive age are anemic which begins the vicious cycle of undernutrition in children, jeopardizing the achievement of the Zero Hunger Goal by 2030. Like other countries in the sub-region particularly West African economies, Ghana is grappling with multiple burdens of malnutrition. While food insecurity, and undernutrition (e.g. stunting, micronutrient deficiencies) persist, obesity and diet-related non-communicable diseases are rising rapidly. General nutrition situation and identification of the highest priority nutrition problems. Various estimates of nutritional status of Ghanaian children under aged 5 years show that 19% were stunted, 5% were wasted, and 11% were underweight (GSS et al., 2015). In 2018, the Multiple Indicator Cluster Survey (MICS) (GSS et al 2012) showed nearly similar rates of stunting (18%), wasting (7%) and underweight (13%), suggesting that stunting prevalence improved only marginally during the last 5-6 years, whereas child wasting and underweight worsened during the period. Other significant problems of undernutrition in Ghana include a high prevalence anemia in children 6-59 months (55%), adolescent girls (48%) and women of reproductive age (42%). From the foregoing, the high priority nutrition challenges in Ghana, include "stunting and wasting in children under 5 years of age; anemia in children 6-59 months of age, adolescent girls, and women of reproductive age; but also, overweight and obesity in school-age children and younger adolescents; and overweight and obesity in women of reproductive age (15-49 y of age). Report of the Demographic and Health Surveys show a significant rising trend in adult obesity – from 10% in 1993 to in 40% in 2015 (GSS et al., 2015). Also, the Ghanaian food environments (particularly in the urban areas) is currently characterized by cheap highly processed foods, with nutrient-dense foods such fruits and vegetables lacking in meals because it is unaffordable (Laar, 2021; Laar et al., 2020).

Addressing these issues to achieve the sustainable development goals (SDGs) requires using multifaceted strategies to combat the high and rising burden of malnutrition in all of its forms. Malnutrition is a multidimensional and cross-sectoral problem, necessitating the relevant and adequate participation of multiple players, stakeholders, and sectors in the food system. For instance, a nutritious food, along with adequate hygiene and healthcare, contribute to good nutrition. Decent employment, education and transportation and connectivity to functioning, resilient, sustainable food systems are important drivers to access to healthy foods (HLPE, 2017). Improved hygiene and healthcare can be necessitated by education, income, and transport, combined with quality health provision, access to clean water, and proper sanitation. Therefore, a food systems approach would be necessary to address these causes of malnutrition.

The concept of the "food system" includes all activities involved in the production, processing, marketing, consumption, and disposal of items derived from agriculture, forestry, or fisheries, as well as the inputs required, and the outputs produced at each of these processes (HLPE, 2017). Food systems also include the individuals and organizations that promote or obstruct systemic change as well as the sociopolitical, economic, and technological surroundings in which these actions occur (HLPE 2017). The associated drivers and supply chains of the food systems influence the food environments where people make dietary decisions.

To this end, this paper presents a review of Ghana’s Food System Transformation Pathways.

2. Description and analysis of the types and components of food systems in Ghana

2.1 Types of food systems

Experts have held that there are four major food systems that need to be considered in analyzing the food system in general, which are traditional, modern, traditional-to-modern, and modern-to-traditional systems (HLPE, 2017). Following the classification of food system by the High-Level Panel of Experts (HLPE, 2017), Reardon *et al.* (2019) regrouped them into traditional, transitional, and modern food systems.

2.1.1 Traditional food system

The traditional food system is dominated by smallholder farmers, who account for 70 percent of the approximated 5million farming population according to the Ministry of food and Agriculture (Peprah *et al.*, 2021). In 2018, the unemployment rate was 11.4 percent, with more than three-quarters of the unemployed aged 15–29 (IFAD, 2019). In this food system, 3.2 percent of the population lives below the 1.9 USD poverty level (WB, 2020). Regrettably, and quite surprisingly, most smallholder farmers are poor, and often struggle with hungry (Ritchie, 2021). Because farm sizes are less than 2 hectares, undertaking profitable farming is virtually impossible and food production is mainly consumed by the household. As a result, producers and consumers of food are essentially the same people. Farmers rear their own diary and meat livestock, and cultivate corn, wheat and vegetables for household consumption. Limited foods are only traded in the locality market with short supply chain and often cooked and consumed on the spot. Agricultural mechanization is virtually low, and people in this food system often rely on a second job (e.g. construction sector) to add to their household income. Sometimes, competition among smallholder farms tend to be high with very limited quality differentiation (Ruben *et al.*, 2021a).

2.1.2 Transitional food system

Transitional markets are the intermediate market between the traditional, non-formal markets (absence of contracts and 'spot market' money exchanges) and high-tech markets that have lengthy supply chains (intra-country and international), capital consolidation and concentration, and standards (the supermarketing model) (Reardon *et al.,* 2019). Thus, this type of food system has an increasing farm diversification, improved infrastructure, and a broader variety of tradable foods, longer food value chains to serve a larger urban society, with increased emphasis on food safety and public quality standards (Ruben *et al.,* 2021a). The configuration of the population of the Ghanaian economy indicates that the traditional food system is obviously going to coexist the transitional system over a period of time in its urban communities given the income level of the majority of the urban dwellers. Most street food sellers in Ghana sell prepared food that are primarily energy-dense (FAO, 2016b). Fruits vendors are very limited, and vegetables are sold occasionally. Whereas over a fourth of the sellers sell snacks made from home, only about 13% of venders sell pre-packaged meals and snack foods, as well as 25% of them sell industrial or homemade beverages. The traded products are usually based on proximity. Ghanaian schools are usually flooded with pre-package foods as compared to fruits.

2.1.3 Modern or high-tech food system

People who own farmland larger than 8.40 ha to produce large volumes of agricultural products; use patented variety crops (citrus fruits, vegetables); have well-organized supply chains; and use foreign knowledge by hiring international consultants and experts to produce high income are part of this food system. Simultaneously, it includes residents of large cities who can purchase high-quality processed foods in modern supermarkets and restaurants. The food system in this country is heavily reliant on imports. Imports include agri-chemicals, services, and equipment for growing food, while consumers' diets are heavily dependent on imported (semi) processed food from other countries. More industrialized farms, more processed foods and cold chains, and food sales through modern retail networks are all contributing to global food production. Food grown further away from cities is becoming more concentrated.

2.2 The Ghanaian food environment and consumer characteristics

2.2.1 Consumer behaviour

Starchy roots (cassava, yams), fruit (plantain), and cereals (mainly maize and rice) make up the majority of the Ghanaian diet. Starchy roots and grains still provide over 75% of dietary energy, and nutritional diversification is relatively minimal (FAO, 2009). There is also high fish intake, which accounts for more than 50% of the population’s animal protein intake as compared to the world average of 17%. Rice and bread (wheat) are associated with an urban diet, with per capita consumption of rice in urban areas accounting for about 76% of total rice consumption in the country. There has been also a mix result produced in terms of nutritious diets during the intense period COVID-19 pandemic, because a good nutritious diet encourages more vegetable and fruits consumption. Interestingly, the COVID-19 led to an increase in vegetable consumption and a decrease in fruit consumption as more than 90% of fruit for consumption is imported and the prices are higher than those practiced for vegetables. Cocoa products like chocolate, pebbles and cocoa powder are consumed by many Ghanaians. There has been also a growing pattern of change in diets in the Ghanaian urban communities; with unhealthy eating practices

gaining dominance and more prevalent among urban areas. Foods such as energy-dense and nutrient-poor foods, fried foods, sweet foods, sugar sweetened beverages were reported widespread consumption of unhealthy food/beverages. The lowest socio-economic groups in urban areas are more likely to consume unhealthy foods/beverages [Holdsworth *et al.,* 2020].

2.2.2 Consumer characteristics

Consumption of fast food is seen in a positive light as it displays higher social status. Significant NCD prevalence with 94.400 NCD deaths in 2016 and risk of premature death between 30 -70 years at 21% comparable to 22% for Africa (WHO, 2018). While consumers' spending power has increased drastically in the last 20 years, about 23% of the population was still living below the national poverty line by 2016, limiting the ability to purchase foods. Poverty is predominantly a rural problem, with 40% of the rural population living below the national poverty line (GH¢1,314) as compared to 8% of the urban population (GSS, 2019). Low nutrition literacy with few consumers reading nutrition labels when existent (especially on imported products). Among consumers who read labels, many are influenced by product price, time/convenience, and advertisements, rather than label/nutritional information, or ingredients (Azila-Gbettor *et al.*, 2013; Darkwa 2014; Hayford *et al.*, 2015; Booth *et al.,* 2021). Price is paramount when selecting food products, irrespective of quality and nutritional value (Azila-Gbettor *et al.*, 2013; Darkwa 2014; Hayford *et al.*, 2015; Booth *et al.,* 2021).

2.2.3 Food availability

Some Ghanaian households are still struggling with hunger with about 21% of them suffering from food insecurity. According to poverty and food insecurity are largely rural phenomenon, which mostly affects smallholder farm households as well as women, children and other vulnerable groups in the Ghanaian society. While the demand for food is increasing rapidly due to rapid population growth (2.3% per year from 2010 -2019)[12], the country is food self-sufficient in all the major staple crops except for rice, millet, and fruits and vegetables (Aryeetey & Ramos, 2022). From 2014 to 2017, staple crops such as roots and tubers (cassava, yam, and cocoyam) recorded an average annual growth of 5% in production levels resulting in surpluses (Aryeetey & Ramos, 2022). In northern Ghana, the market week usually lasts 3-6 days as compared to urban centres where markets typically operate every day. Also, there has been continuous growth in the presence of convenience stores, with a 36% share of total retail sales, and supermarkets with a 4% of total retail sales[3] particularly in the cities with most of them in located in Accra.

2.2.4 Food affordability

A nutrient adequate diet costs 126% of household food expenditure and is unaffordable for 27% of the population (FAO *et al.*, 2020). A healthy diet costs 283% of household food expenditure, which is unaffordable for 65% of the population (FAO *et al.,* 2020). Fluctuations in availability of food throughout the country affect affordability. Families are also vulnerable to global price spikes for imported foods such as rice. Food-based dietary guidelines for Ghana are under development (FAO *et al.,* 2020) by a multisectoral committee led by the Ministry of Food and Agriculture and the Ministry of Health, and are expected to be implemented in 2022 (Aryeetey & Ramos, 2022). Current labelling policy requires basic information (name of product and manufacturer, ingredient list, etc.) and detailed nutrition information is voluntary (except in instances where a nutrition or health claim is made (Laar *et al.,* 2018). There are no policies being implemented to support the availability of healthy foods and to limit the availability of unhealthy foods in communities and in-stores. Efforts to restrict marketing of breastmilk substitutes have been in place since 2000, with the passage of the Ghana Breastfeeding Promotion Regulations. Guidelines are

in place for advertisement of foods that were either locally manufactured/prepared or imported with specific requirements for Alcoholic Beverages and Energy Drinks (MoH, 2012b). The FDA requires that a product is registered before it can be advertised. During the registration they asses the safety, quality, labelling, and any claims made on the product. The advertisement script must then be approved by the FDA. The authority vets the scripts based on FDA's food advertisement guidelines (FDA, 2016). The Ghana National NCDs Policy seeks to restrict commercial promotion/marketing of unhealthy foods in children settings (eg. preschools, schools) (MoH, 2012a).

2.2.5 Food safety

Although Ghana is making effort to improving the food environment, yet food hygiene, food adulteration and contamination, and environmental sanitation like cleanliness of food outlets and household surroundings still pose a significant challenge. A related study found that contamination and adulteration levels of food were extremely high in Ghana's street food outlets, and that poor hygiene methods were frequently used, raising the danger of contracting foodborne infections (FAO, 2016). The Food and Drugs Authority (FDA) has the mandate to enforce policies, regulations, legislations relating to Food and Drugs. Food safety in Ghana shows substantial gaps and is lacking sufficient controls for both processed and unprocessed foods. Food safety research is highly concentrated in the urban areas and disproportionally focused on commercial food operations (especially street foods and microbiological safety) with limited information from other forms of food hazards (Ababio & Lovatt, 2014). Food safety can influence the food environment food safety regulations that can reduce toxin and other pathogen-borne contamination.

2.3 Food supply chains

In general, food supply has an important role in health, economic and social inclusion. Food supply chains can improve overall food nutritive contents by expanding accessibility to macronutrients and micronutrients, such as through biofortification, food fortification, or improved storage of perishable foods (such as fruits and vegetables) (Wang et al., 2022), or by lowering the amounts of compounds linked to diet-related non-communicable diseases (NCDs) in food formulation (HLPE, 2017). Food's nutritional value, on the other hand, might degrade as it moves through the food supply chain, hence influencing the food environment. This section looks into each stage of the food supply chain in details.

2.3.1 Input supply

In 2007, the government introduced subsidy and support programs on fertilizers and improved seeds, mechanization, and block farms targeting major crops including maize, rice, soybean, sorghum, tomato, and onions (Benin *et al.,* 2013).

2.3.2 Food production

The 5 main crops grown are Cassava (representing 45% of 2019's production and 15% of land planted in 2018), Yams (17%, 7%), Plantains (10%, 6%), Maize (6%, 15%) and Palm fruit (5%, 5%) (MoFA, 2019). Maize, rice, and soybeans' production are being promoted by the government and several development partners. Some farmers produce crops mainly for consumption and sale in local markets, namely millet, sorghum, beans, groundnuts, cassava, yam, cocoyam, sweet potatoes, plantain, bananas, and others. Domestic meat production of 168,291 metric tonnes in 2018, an increase of 17% since 2014

(MoFA, 2019). In terms of fish production, there has been a declining trend of 1.7% since 2014-2018. Domestic fish production stood at 367,868 metric tonnes in 2018, (MoFA, 2019). Agriculture production also started boosting up, as there was a sharp increase in land area under cultivation in the northeast, east central, and northwest regions of Ghana from 2015 to 2019 (3). Employing deliberate investment agenda can affect food availability and relative prices, for example by prioritizing a small number of staple cereals over legumes, indigenous grains, and other crops.

2.3.3 Storage and distribution

Ghana continues to face a challenge of storage facilities for its agricultural output. It is estimated 20% of the country's food output is lost during the post-harvest process, notably during distribution due to handling and poor logistics infrastructure. Current interventions include dissemination of new technologies of harvesting and processing, mass training programmes (Sugri *et al.,* 2021). A government owned company, the National Food Buffer Stock works with farmers to mop up excess produce. High cost of conventional storage solutions for smallholder farmers and high seasonal variability in food supply and prices make food expensive and perishable (5). Therefore, controlling this would mean that encourage or restrict domestic availability of affordable, nutrient-dense foods through export and import policies.

2.3.4 Processing and packaging

Value addition to agricultural produce meant for export has been a major problem to the trade sector of the country. For so many years, Ghana's tradable agricultural produce on the international market has been mainly primary raw produce. However, recent debates have focus attention on value addition to attract international competitive prices. Currently, efforts have been advanced on adding value to the country tree crops. Tree crops that are now being processed include cocoa (occupying 27% of cultivated land), oil palm (5%), cashew (2%), and coconut, rubber, citrus and mango (less than 1% each) (MoFA, 2019). At the same time, the government is working towards increasing cocoa processing to 50% of production, so that the country would no longer depend on the export of raw materials and capture more of the value (van Huellen, 2021). The agricultural sector provides raw materials for the industrial transformation being pursued by the government (MoFA, 2018). The main constraints to the processing sector are the low production and productivity, high cost, poor quality of local raw materials, and poor standards for processing and packaging (IFPRI, 2020a). It is therefore possible that the food environment is likely to be influenced by this sub-system by either increase availability of nutritious foods through fortification and limited processing (e.g. canning) or may reduce the nutrient content of foods through heavy processing (e.g. addition sugars, salt, saturated fatty acids).

2.3.5 Retail and marketing

The Ghanaian retailing market has been increasingly growing and it is expected to make up 70% of the GDP and 92% of the firms' environment (*see* Appiah *et al.,* 2020). The market is largely fragmented and informal with about 60% of food retail sector in Ghana consisting of open-air markets, street-side sellers, and shops. The retail sector provides a significant source of employment to most of the people and accounts for almost 90% of all registered firms (Adade & Ahiawodzi, 2012). The official wholesale and retail industry in Ghana is dominated by enterprises from India, Lebanon, and numerous European nations, but South African companies have been growing their market share thanks to bilateral trade promotion with Ghana[4]. The most processed goods found in retail shops include milled rice, processed fruits and vegetables, and frozen meats (Andam & Silver, 2016). At the peak of the COVID-19 pandemic, Ghana put in place restrictive measures including the closure of markets such as those in the Accra-Tema

metropolis to contain the spread of the virus. However, the closure of these markets–perhaps for non-adherence of COVID-19 social distancing protocols–led to a disruption in food supply chains (including fish) and markets (NDPC, 2020). To achieve food systems transformation requires a reduction of the availability of highly processed foods relative to whole, nutrient dense foods through food promotion.

2.4 Subnational and food system

Ghana consists of 16 regions which are further divided into 261 local districts. More broadly, the country's subnational can be classified into two parts, namely the north and the south.

The north is characterized by a very hot weather with dry winds (harmattan), and high plains. This region is suitable for staple crop production, especially rice, yam, and pulses and has markets organized 3-6 days per week. The rural northern population has a diet based on roots, tubers, and plantain. Agriculture is the primary source of livelihood and has been affected by unpredictable rainfall, which results in particularly high hunger and malnutrition (with identified iron and vitamin A deficits). More than 23% of children under 5 are stunning in the northern region. Poverty rate is high across the north, with the highest rate of 70.9% of population living below the national poverty line in the Upper West region (GSS, 2019). Again, access to financial services remains a challenge in the north, especially in the Upper East region where only 17% of the population has access to commercial banks (ibid).

Cooler than the north, the south has a warm and dry southeast coast, and hot and humid southwest. The region is composed mostly by a forested plateau with hilly ranges in the eastern border. The region produces fruits and cocoa, which is the main crop. The urban southern population's diet is based on rice, pasta, meat, and fish. Stunning in southern regions varies but is less than 20%, however overnutrition is emerging, especially in urban areas. Poverty rate is lower in the south, with the lowest rate of 2.5% of population living below the national poverty line in the Greater Accra region (ibid). Access to financial services is higher in the south, especially in Greater Accra region where 70% of the population has access to commercial banks (GSS, 2019).

2.5 Cross-Cutting Issues Relating to Gender-Inclusive strategies for food system transformation

The gender divide of the Ghanaian population shows that about 51% of the population are women in 2021 (GSS, 2021) with a Gender Inequality Index (GII) coefficient of 0.54 as in 2019, and 0.98 points in the gender gap index in the area of health and survival in 2021 (UNICEF, 2020). The total gender gap index for the country was 0.67 (UNICEF, 2020, WFP). In 2019, Ghana scored 64.6 out of 100 on the Gender Index of the Ibrahim Index of African Governance, and while this score has decreased by 7.4 points since 2010, the country was still ranked 10th out of 54 African countries (IIAG, 2019). The period also saw Ghana attained lower scores for laws on violence against women (25.0 out of 100) and political power and representation of women (54.1 out of 100). Nevertheless, there were some positive gains in the same period as the country achieved higher 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) (IIAG, 2019).

Women play a very important role in agriculture; however, they are often found to be less productive than men in the agricultural sector. Women perform diverse activities in the food system, from production and processing to retailing and consumption. They rear animals, engage in agribusinesses and food retailing, and make meals for their families, among other things (Malapit et al., 2020). In most instances, women

are found to be dominating smallholder agriculture (thus farming is done on a small parcel of land of less than 2 ha) whose contribution to overall agriculture performance has been highly significant (responsible for the bulk of food production). Yet, women are more likely to face hunger. In rural Ghana where smallholder farmers are largely found, it is argued that hunger is more prevalent among women than men[5]. They, for the most part, suffer barriers that hinder them from participating in food systems on equal and fair conditions (Ruben *et al.,* 2021). Women's empowerment is critical to achieving the goals of healthy, safe, and diverse diets (nutrient-dense food) that meet the nutritional needs of all household members; and inclusive food systems that involve smallholder farmers in the production of food and provide affordably priced foods to underprivileged segments of consumers (Ruben *et al.,* 2021).

In addition, young people are also within the marginalized group as employment opportunities continues to be a hurdle for a significant proportion of them. The rate of unemployment amongst people aged 15-24 years was 9.5% in 2020, which is twice as high as the total unemployment rate (4.7%)[6]. This proportion of young people who are unemployed has significantly increased as the latest Population and Housing Census shows that youth unemployment within this age group is estimated at 32.8%, more than twice the unemployment rate for the general population (13.4%) (GSS, 2021). The gender distribution shows a higher proportion for females than males both in general and age groups (*see* GSS, 2021:38). Even when they want to go into farming and other non-farming activities, they have limited access to land, financial capital and other resources and incentives to do (IFPRI, 2020b). With a Ghanaian population of more than half (57%) being under 24 years of age and the youth population (15-24 years) makes up 16% of the total population of Ghana (GSS *et al.,* 2015), it is likely for Ghana to experience an upsurge in its workforce in the near future when the agriculture sector can offer more sustaining opportunities with an improved livelihood to manage youth unemployment. Thus, a modernized agricultural sector with thriving private sector agribusinesses and incubation/innovation hubs can provide decent and rewarding careers in food systems for the youth (MoFA, 2019).

Freedom of speech is guaranteed by the 1992 Constitution and was further strengthened with the repeal of the Criminal Libel law in 2001. The Constitution of Ghana does not explicitly guarantee the right to adequate food; however, Ghana did become a State 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.

2.6 Drivers of food system environment

There are various factors that are affecting food systems all over the world, however, these determining factors can be broadly classified into parts: socioeconomic, environmental, political, and biophysical (FAO, 2018). These factors are intricately linked and, whether consciously or inadvertently, interplay to influence food-related actions, actors, and outcomes. They determine how food is produced, traded, and consumed as a whole. Informing and planning food system policy and the future of food systems will require a deeper knowledge of these forces and their interplay. In Ghana, these forces have been identified as follows;

2.6.1 Environment and climate

Agriculture is predominantly rain-fed and the climate is dominated by the inter tropical convergence zone and the hot, dry winds (harmattan) blowing from the Sahara. About 65% of land area is agricultural land (i.e. 20.7% of land area is arable) under permanent crops, and under permanent pastures[7] with hills on the easter boarder making agriculture more difficult in that area. Climate change is expected to result in

increased temperatures (up to 2.0°C by 2050 from 2018), intermittent floods, and dry spells with water stress (Ministry of Foreign Affairs of the Netherlands, 2019). More intense rainfall is expected to increase erosion, while the overall decrease in rainfall could result in decreased water flow (Ministry of Foreign Affairs of the Netherlands, 2019). The impact of increased temperatures on livestock production forced cattle herders to migrate from the north to the south. Sea level rise is projected to inundate low-lying coastal areas and increase the salinity of estuaries and aquifers. Unsustainable practices with impact on the environment include both legal and illegal surface mining ("galamsey"), and harmful use of pesticides, weedicides, and inorganic fertilizer (Mantey *et al.,* 2020).

2.6.2 Globalization and trade

Ghana's food demand gap is supported by import with one-fifth (20%) of its food being imported from other countries (NDPC, 2020). This section of the food market (food imports) represented a value of 5% of GDP in 2019 while exports accounted for 7% [8]. The two main imported food crops in 2019 were rice (11% of food imports) and wheat (7% of food imports), while the main export crops were cocoa and by-products (67% of food exports) and cashew nuts (10% of food exports) (ibid). Animal products also formed a major part of food imports, as frozen fish accounted for 9% of food imports in 2019 and poultry meat accounted for 8% (ibid). Imports were affected by the COVID-19 pandemic, which led to an enhanced preference for local food in the immediate and short term. In Ghana, a major hinderance to intraregional trade is transportation issues as there are excessive numbers of control points and informal payments leading to overall low levels of trade. Thus, many traders become discouraged by these artificial bureaucracies and frustrations, which results in restricted movement and trade across regions. Evidently, Ghana was ranked 118th out of 190 countries in the 2020 Ease of Doing Business Index and 13th in Sub-Saharan Africa (WB, 2020). In spite of this, it is the largest recipient of FDI in West Africa ($3 billion in 2019 mostly oriented towards gas and minerals (Unctad, 2019).

2.6.3 Income and growth

Ghana obtained lower middle-income status in 2010 when it recorded a gross national income per capita of $1,230, with incomes being unevenly distributed (Gini Index 43/100) – thus, showing a slight increase from 42.3 in 2012. Similarly, agriculture income contribution to GDP was 18.5% in 2019, which showed a declining path of 7% per year on average since 2016 (MoF, 2020), due to people moving from peasant agriculture to services, without passing through modern high-productivity agriculture (NDPC, 2020). There was also poor performance of the forestry/ logging (-1.7% growth) in 2019 (MoF, 2020). Also, agriculture provides employment for over 44% of the population mainly involved in production of crops, livestock, fishing or in processing and marketing of agricultural produce on a formal and informal basis (MoFA, 2018).

2.6.4 Demographic shift

The country has a population of 32.4 million as of 5/23/2022 and it is projected to increase to 50-60million by 2050 (World Population Review, 2022). The projected growth has been associated with a high fertility rate (3.89 births per woman) and efforts to minimize birth mortality. Due to the high fertility rate of Ghana, the country has more than half of its population (57%) who are under 24 years of age (NDPC, 2020). It is envisioned that the rising population growth is inevitably going to spur growth in the labour market as more young people turn up for jobs (new entrants), hence arriving at an increasing rate over the next 30 years (Adeniran *et al.,* 2020).

2.6.5 Leadership and governance

Ghana is a presidential republic with parliamentary system, an Executive President, a Parliamentary Legislature and a Judiciary (NDPC, 2020). Per its supreme law, Ghana has a four-year election cycle, with the most current one held in 2020. For several decades of democratic rule, the country has enjoyed a stable political environment with good security except in some isolated locations that experienced post-elections demonstrations in 2020 (WFP, 2020). All hotspot sites, including Chereponi, where trouble had flared the previous election years, were peaceful before the polls. Any violence or tension in the implementation locations had no effect on food distribution (WFP, 2020). Ghana practices a decentralized governance system with 6 Metropolitan, 111 municipal, and 143 district assemblies, along with complementary 16,000 sub-districts. The country has been a multi-party democratic state particularly since 1992 after returning to a constitutional rule with more than 20 registered political parties. After a long period of political unwillingness, Ghana has a strong, visible, political support for addressing food insecurity and improving the population's nutrition and food systems in recent times. Even at the core of national agenda, the country has placed strong emphasis on nutrition in its 40-year development plan.

2.6.6 Socio-cultural context

Ghana is made up of different people from diverse ethnic background with the major ethnic groups including the Akan (47.5%), Dagbani (17%), Ewe (14%), Ga-Adangbe (7%), Gurma (6%), Guan (4%), Gurunsi (2.5%), and Bissa (1%) (GSS, 2013). Aside the sociocultural dynamic of the local indigens, there is also about 4.3% of the population who are Caucasian and 2.4% is Asian.

2.6.7 Finance and capital

The Ghanaian agricultural sector is largely informal, lacking the documentation and registered collateral required for loans. The sector is also faced with several challenges among which they include limited insurance for farming; inadequate start-up capital; lack of credit for agriculture; absence of innovative financing mechanism for lending (MoFA, 2018). While 58% of the population had access to formal financial services in 2018 (Geiger *et al.,* 2019), only 20% of people in agriculture have access to credit.

2.6.8 Energy

With the objective of undertaking massive industrialization through the launch of One-District-One -Factory, growing its agricultural capacity and modernizing the sector as well as offering economic opportunity to its over 30 million people, Ghana continues to grapple with unstable and expensive supply of electric power, as well as large financial imbalance in its energy sector. Ghana has around 5,300 MW of installed generation capacity, but due to shifting hydrological conditions, insufficient fuel sources, and decrepit infrastructure, actual availability rarely reaches 2,400 MW. Its installed energy capacity is made up of hydro 35.9%; thermal 63.6%; and solar 0.5%[9]. There is also a projected need to procure an additional capacity of 225 MW by 2024 and an additional 200 MW by 2025 to preserve the security of supply[10]. The latest update as of April 5, 2022, shows that 84% of the Ghanaian population has access to electricity[11], which has been steadily increasing from 57% in 2012. According to the USAID, urban-rural energy accessibility differential is about 20% (i.e. rural areas -73% vs urban areas - 93%).

2.6.9 Science and technology

Ghana has 9 research and development centers under the Council for Scientific & Industrial Research (CSIR) that focus on agriculture related research, including the Animal Research Institute (ARI), the Crops Research Institute (CRI), the Soil Research Institute (SRI), the Oil Palm Research Institute (OPRI),

the Food Research Institute (FRI), the Forestry Research Institute of Ghana(FORIG), the Plant Genetic Resources Research Institute (PGRRI), the Savanna Agricultural Research Institute (SARI), and the Water Research Institute (WRI)[12]. The Science, Technology and Policy Research Institute (STEPRI) also does research on agriculture. Ghana spends less than 1% of agricultural GDP in agriculture R&D and innovation systems 9. Funding for research and technological development (R&D) in the agriculture sector is however still limited and often not well coordinated. R&D in food and nutrition security is mostly donor-driven, and thus donor tailored objectives dominate, with focus on maize, rice, and soybean.

3.0 Challenges in food system pathways in Ghana

The FSTP is bedevilled with a wide range of challenges that can be broadly grouped into five main areas. These are diet quality and nutrition security, consumption of unhealthy foods, environmental resilience, infrastructure capacity and discrepancies between regions. These are further detailed as follows;

3.1 Diet Quality and Nutrition Security

Ghana has made important strides to reduce food insecurity to 21%, although some Ghanaian households are still grappling with food insecurity which has been exacerbated by the COVID-19 pandemic (that is, share of food expenditure to total annual expenditure is about 43% among households (GSS, 2019). Yet only 48% of adult population have diets that adhere to the food-base dietary guidelines and net food supply is not enough to meet needs of a healthy diet, resulting in macro and micronutrient deficits e.g., protein, iron, zinc, B12. This is to say a healthy diet is unaffordable for a significant proportion of the people (65%), hence their inability to demand for nutrient-dense foods due to their low purchasing power, limited production which leads to price hikes and limited diversity of crops makes country dependent on imports of certain expensive crops. Thus, the average cost of healthy diets is 283% of a Ghanaian household food expenditure, higher than the averages of Africa (167%) and the world (95%), and this can be explained by the inability to match the production of rice, poultry and meat to consumption levels so relying on import demand to make up for the shortfalls, which tend to be too expensive for a large share of the population. The resultant outcome of the high cost of healthy diets is increased proportion of households' food expenditure dedicated to bread and cereals (19% of budget), and fish and sea foods (16% of budget). Even the limited output produced are often faced with poor storage and distribution handling and infrastructure, resulting in high amounts of food loss, as well as unpredictable rainfall in the northern region which causes nutrient-dense food availability fluctuations. By ensuring access to adequate, diverse diets, Ghana can improve quality of life, increase overall health, wellbeing, and productivity of its population, and reduce the dependency on imports of certain crops.

3.2 Consumption of Unhealthy Foods.

There has been a growing nutrition transition accompanied by changing dietary habits and food environments owing to increased urbanization in Africa (Holdsworth *et al.,* 2020). Indeed, Ghana has made progress in restricting marketing of breastmilk substitutes and is developing FBDG, yet its current food environment, fueled by high urbanization rate (57%) and ever-growing incomes of urban households, has contributed to the consumption of unhealthy foods. Fruits and vegetables, fish, eggs, dairy, nuts, and seeds have greater costs per unit of dietary energy than cereal grains and other starchy staples, vegetable oils, and raw sugar, which change over time and vary in space. Thus, poor food environment policies, high costs of a healthy diet and limited import control contribute to a high consumption of non-nutritious foods. The consumption of unhealthy foods has been found to be linked to malnutrition and Non-

Communicable Diseases (NCD) (Matos et al., 2021; Hawkes et al., 2013; 2020; Branca et al., 2019; Olatona et al., 2018; Kraemer, 2016; Li, 2014). In Ghana, both adult and child obesity are rising owing to increased consumption of unhealthy foods, with an overall adult overweight and obesity rate of 29% and an even higher prevalence in urban areas. Ofori-Asenso *et al.* (2016) also reported that obese/overweight adult people are about 43%, with diabetic adult patients being 45.6% in Ghana. The growing incidence of malnutrition among adult people has resulted in a significant NCD prevalence with 94.400 NCD deaths in 2016 and risk of premature death between 30-70 years at 21%. However, such growing trends of diseases in the Ghanaian society can be mitigated if effort is made to develop stronger food environment policies. In doing so, Ghana can stabilize or reduce its rates of overweight & obesity and achieve the ambition of 0% increase in the rate, which would result in stabilizing or decreasing the incidence of NCDs and a healthier and more nourished population.

3.3 Environmental resilience

Relatively, Ghana has slightly lower greenhouse gas (GHG) emissions from food and consumption than the African and world averages; however, emissions from agriculture are rising annually (USAID, 2016; EPA, 2019). Estimates from Ghana's Fourth National Greenhouse Gas Inventory Report indicate that greenhouse gas emissions increased by 67% between 1990 and 2016, while the country's economic expansion increased in tandem with rising demand for energy in industry, transportation, deforestation, and biomass consumption in homes (USAID, 2016; EPA, 2019). Ghana's total GHG emissions in 2016 were expected to be 42.2 million tonnes (Mt) CO2-equivalent, including Forestry and Other Land Use (FOLU). This was 7.1 percent higher than total emissions in 2012, and 66.4 percent higher than 1990 levels. Agriculture, Forest and Other Land Use (AFOLU) contributed 54.4% of the overall national emissions of 42.2 MtCO2e (EPA, 2019). The livestock industry rose by 177 percent between 1999 and 2010. Agriculture remains an important part of Ghana's economy, employing about half of the country's workforce. It has grown dramatically since 2007, although it is still primarily rain-fed and subsistence-based, with only basic technology (USAID, 2016). The prevailing threats makes Ghana and its agriculture sector vulnerable to global climate change and is not ready to combat climate change effects (Ministry of Foreign Affairs of the Netherlands, 2019). Heavy deforestation and illegal mining have been further contributing to climate change and biodiversity and habitat loss (Bennett-Lartey & Adu-Dapaah, 2015), with deforestation of primary forests increasing 60% between 2017 & 2018 (USAID, 2016). Therefore, some key steps that need to be taken in the wake of growing climate change include addressing illegal activities. Thus, tackling deforestation and illegal mining issues can help Ghana stagnate the impacts of climate change. This can further contribute to the protection of biodiversity both in forests and coastal areas and to the food security of populations living in areas with unpredictable climate while also reducing production uncertainty.

3.4 Infrastructure capacity

While Ghana has been improving overall production levels, supply chains suffer from lack of adequate infrastructure and long transit times. Discrepancies in prices due to low access to infrastructure and markets by smallholder farmers, with a farmgate and wholesale price gap of 169% (WFP, 2015). In a related study, farmers who do immediate post-harvest selling and are compelled to buy during the lean season lose an average of 29.3% of the value of their grain sales due to seasonal price changes (Baral & Hoffmann, 2018). According to some estimates, post-harvest losses account for at least 30% of farm productivity costing $700,000 each year (GBN, 2020). Rutten and Verma (2014) argued that losses from agricultural production and postharvest handling and storage stages are substantially smaller than the distribution stage. Post-harvest cereal losses could range from 50% to 70%. According to Ridolfi *et al.* (2018),

the post-harvest stage of the food system loses 20-30% of nutrient-dense (fruits, vegetables) and energy-dense (roots and tubers, grains, and legumes) items annually. Before being consumed, horticultural crops losses are about 20-35% of their worth (Ridolfi *et al.,* 2018), resulting in deficits in nutrient supply. These losses contribute to the agriculture environmental impact, which resulted in agriculture emissions growing 32% from 1990-2011 (USAID, 2016). With the glaring statistics of food losses, Ghana needs to improve infrastructure to improve productivity and decrease losses. By addressing the infrastructure capacity issue and improving the supply chains, Ghana can achieve the ambition of reducing both food loss and gap between farmgate price & wholesale price by 50% (from 2015) in 2025. This will enable a lower environmental impact and production costs.

3.5 Discrepancies among regions

There exist high discrepancies between northern rural areas and southern urban areas, with the north experiencing large inequalities in livelihoods. Rural northern Ghana has higher food insecurity and stunting rates, with average stunting rates exceeding 20% (GSS *et al.,* 2015; WFP/JAK, 2017). The northern Ghana is characterised by lower diet quality and supply of macro and micronutrients, with lower consumption of fruits and vegetables (LEAP, GSFP). The high cost of a healthy diet in the north is due to unpredictable rainfall patterns and low purchasing power owing to income inequalities (WFP, 2012). Ghana needs to increase the focus in the northern & rural regions to improve livelihoods and inequalities. To bridge the gap by further developing food systems in the northern regions, Ghana can achieve the ambition of less than 5% undernourishment rate by 2025. The food systems development results in more equitable livelihoods across the country, reduced income inequalities and healthier and nourished population.

4.0 Analysis of trade-offs and opportunities options in the various challenges for sustainable food systems transformation

Circumventing the existing trade-offs in food system performance means that concerted efforts are needed to achieve a new equilibrium between production and consumption of food in increasingly vulnerable agroecosystems (Terwisscha van Scheltinga et al., 2021). As healthy diets and sustainable food production are unreservedly possible, they require clear policy direction (Willett et al., 2019). The need to concurrently increase nutrition, inclusiveness, and environmental sustainability is one of the key reasons to argue for food system transformation rather than single-target initiatives (van Berkum & Ruben, 2021). Better connections between agricultural production and food value chains with diets, human health, livelihoods and agro-ecosystems requires stakeholder coordination and policy bargaining on harmonization of goals (Fanzo et al., 2021). The trade-offs that exist in the various challenges are further elaborated as follows:

Indeed, while increased local consumption of more nutritious foods would be good for health and well-being of citizens to achieve diet quality and nutrition security, it would leave less room for export and reduce income from trade. Thus, increased consumption of nutritious foods domestically reduces the quantity available for export to rack in the lucrative competitive world market price to increase revenue from export, hence affecting the income of the actors along the value chain. Besides, the increased Animal Sources Food (ASF) consumption may increase diet diversity but also increase emissions and negatively affect the environment. Grazing a sufficient number of animals on grassland can have beneficial consequences, such as retaining carbon in the soil and turning non-nutritive plants into animal protein. Regrettably, most meat is produced in intensive feedlots rather than pasture, at least in the United States.

70% of cultivated plants in the United States are used to feed these animals. Animals also need a lot of water for every pound of edible meat they produce. Antibiotics are used to help them survive in harsh circumstances, adding to the public health concern of antibiotic resistance. While manure disposal in this space is normally handled appropriately, it poses a threat to the quality of water. In addition, tropical forests are being burnt to make room for livestock production in developing countries. This action is considered as dangerous to the environment because carbon that has been trapped inside trees is emitted into the atmosphere, leading to global warming. This includes soil carbon, which would typically be safely deposited in the soil over time but is emitted during wildfires. While methane emissions are generally the focus of cattle's climate impact, land removal for cattle ranching has a higher impact. The global meat consumption for meat is expected to rise significantly in the future. There is a general notion that meat consumption is linked to a high-quality diet. Low-density grazing systems generate high-quality meat with minimal environmental impact, but they are unlikely to meet demand. Hence, if developing economies such as Ghana continue to experience population growth, income growth, higher educational levels and urbanization, then a significant reappraisal of what constitutes a healthy diet will be required. This is because these attributing factors often generate increasing demand for ASF (WHO, 2013; Zhang *et al.,* 2017). Aside that, there is also an opportunity for further policy direction to drive the country's effort in the fight against hunger while improving good health in the sense that existing policies amplify and encourage the production of bio-fortified crops, however, other salient interventions needed to improve affordability, availability and demand for more nutritious foods have been missing in these policies. Rethinking about the policy tools in the Ghana food climate to incorporate these key issues can help deepen the food policies to deliver the required result to safeguard against hunger and diet-related diseases.

Moreso, while increasing the price and reducing the availability of unhealthy foods would reduce negative health effects, the increase in prices and demand for more nutritious foods might make diets more expensive at an individual/household level which may compromise attempts to promote consumption of healthy food. Studies have found that rich individuals and households are usually primary consumers of nutritious food, which can be implied that nutritious foods are often more expensive and unaffordable (Drewnowski & Specter, 2004; Monsivais *et al.,* 2010; Jones *et al.,* 2014) to poor people whose primary objective is to optimise their consumption of foods so to be able sustain them through their daily activities (Headey & Alderman, 2019). Hence, poor people tend to buy more of energy-based foods such as staple foods like rice, plantain, maize, etc., and less of healthy foods. This is likely to make the production of nutritious foods less in quantities and hence create an excess demand which will drive up the price of nutritious foods. Therefore, demand for nutritious foods should be elastic to encourage more consumption of healthy diets. Besides, the existing policy places emphasis on labelling guidelines but excludes nutrition information which is also a vital aspect of health and nutrition. There also exists limited marketing restrictions as well as weak import restrictions that seek to control the influx of certain unhealthy food products. It is also worth noting that the current policies are only focused on mitigating, but not preventing NCDs. All these provide fertile grounds to shape policies.

Also, building environmental resilience to overcome the challenges in transforming food system pathways requires a trade-off where using environmentally friendly agriculture techniques may sometimes be less productive, which may result in lower yields and less attractive produce which tends to be less profitable. Thus, there is a trade-off of overly use of eco-friendly techniques in food production as they may be likely less effective result in a reduced yield and often change the shape of food produce which can influence the price and consequently generate less net returns as expected. Another trade-off that exists between environmental resilience and food security through deforestation. It is factual that preventing deforestation helps secure the green cover and reduce global warming, hence it increases environmental

resilience. However, doing so also inhibits and limits the growth of small landholdings and food supply. Thus, it restricts land for smallholders farming which leads to a reduction in food production in general and deprived rural and poor households of nutrient-rich foods such as vegetables and fruits. Efforts to preserve and reclaim Ghana lands and protect the ecosystem led the policy declaration of illegal mining that was erasing the green vegetation cover and destroying fertile lands for crop production, nonetheless, the full scale of benefit is yet to be witnessed as its implementation has been ineffective. In addition, there is a limited guidelines information of the effective use of fertilizer by farmers which may derail the gains from building environmental resilience.

There exists an opportunity cost in addressing the infrastructural capacity of food system. The reasons can be associated to the fact that reducing food loss may in the short run result in surpluses which may turn into food waste and lower prices for farmers. Often, calls have been made on the need to lower food losses in the presence of severe food insecurity, which tend to boost food surpluses and consequently cause food prices reduction because supply exceeds demand. However, the surpluses created usually results in increased food waste, perhaps limited storage facilities or buffers to absorb the excess supply of food. For instance, in 2013, Ghana lost 3,200 thousand metric tons of food worth $8.9 billion, with the figure likely to rise if food losses on Ghanaian farms are added. Distribution losses totalled 1.7 million tons, with retail and consumer losses totalling 578,000 and 946,000 metric tons, respectively[2]. Evidence show that wasted food is a contributor to climate change. According to the Washington State Recycling Association, over 96% of food waste are found in landfills, which further decompose and produce methane that affect climate change. Hence, there is the need to increase investment in infrastructure to control food loss and waste in ensuring food security. Nevertheless, there is also a trade-off when it comes to increasing public investment in infrastructure because it can reduce less investments in other critical issues. Despite current policies address the need to increase financing and investment, it is also much needed to focus attention on assessing how innovative risk assessments can help to resolve current shortages. Also, continuous enhancement and promotion of massive rural electrification investment can facilitate the adoption of cold facilities for storage among the rural farmers to avoid farmgate losses and waste to make enough profit from production and secure their livelihood as well as ensure food security in face of growing hunger in the country.

Regional disparity has been identified as another challenge that confronts the food system in Ghana, however, finding solution to this challenge faces a trade-off. Such trade-offs emerge in the following forms: greater attention on the Northern Ghana can lead to a declining result in other regions; increasing production in the north to boost food availability may lead to higher impacts of climate change and increasing deforestation; as well as increasing agro processing in rural areas, although provides jobs but it raises need for waste management infrastructure. These trade-offs can be explained by the fact that the Northern Ghana suffers from lower productivity and a difficult climate, resulting in low availability and affordability of foods, and hence causing higher levels of malnutrition and income inequalities compared to other regions. Therefore, efforts to address this disparity need a balanced mix to minimise the associated trade-offs. Inherent to the trade-off provides the opportunity for policy option that aim to provide social safety nets for people in the Northern Ghana who are in the lowest income bracket as government's programmes such Livelihood Eradication Against Poverty (LEAP) and Ghana School Feeding Programme (GSFP) insufficiently addressed the economic and nutrition condition of the north.

[2] https://www.modernghana.com/news/566607/2013-ghana-food-wastage-report.html

5.0 Recommended game-changing policies measures to address the challenges

There is a much growing need to transform Ghana's food system for a number of reasons that bother on food security, nutrition and improved livelihood for all. To achieve these objectives, emphasis is placed on the importance of resolving the associated challenges that are discussed in the preceding sections through sustainable result-driven policy measures. The following policy measures are the game changing solutions that can tackle underlying challenges in the food system transformation agenda.

There is a need to increase the productivity of staple crops by taking the required measures to strengthen markets and growing demand for more nutrient-rich foods. Pragmatic steps are needed to strengthen end-to-end planning for nutrition-sensitive production (including seeds, input subsidies, etc.), expand the district market network, strengthen strategies to address consumer behaviors (including food composition tables) and diversify school meals. Specifically, the Government of Ghana through its respective sector ministries must act:

The Ministry of Food and Agriculture (MoFA) needs to strengthen its sector plan, incorporate end-to-end planning for nutrition-sensitive production by selecting high-nutrient seed varieties, strengthening input subsidy for vegetables and fruits, and encouraging production of nutrient-rich indigenous foods and small livestock rearing. In collaboration, both MoFA & Ministry of Finance (MoF) need to investigate district markets' network expansion, as well as increase availability and affordability of nutrient rich-foods and market access through value-added agro-business. Also, it is important for the Ministry of Health (MoH) or its agency (Food and Drugs Authority) to consider strengthening strategies for better consumption by establishing food composition tables and Food-Based Dietary Guidelines (FBDG), and creating sensitization campaigns on nutrition, indigenous foods using understandable dialect. In addition, the Ministry of Gender, Children and Social Protection (MoGCSP) will have to potentially diversify meals for Ghana School Feeding Program.

The issue of consumption of unhealthy diets can be tackled through various ways: by improving the food environment using consumer-focused campaigns, marketing restrictions and updating labelling rules; giving production incentives such as input subsidies to producers of nutritious healthy food to encourage more production of nutritious foods to meet the growing demand size in order to reduce the reliance on import which is often made of unhealthy goods; and ensuring fair pricing of food inclusive taxation. More specifically, the Ministry of Health should strengthen its health sector plan, launch campaigns to promote the consumption of (indigenous) healthy foods and physical activity, including through (social media) campaigns for the youth, and make the benefits of a healthy diets more visible in order to improve the food environment. In addition, there is the need for both MoFA and MoF to explore innovative means of subsidizing inputs for nutrient rich foods based on exploiting findings from national dialogues and FBDG to promote good health and nutrition and ensure true pricing of food on the market. There is also a call on MoFA and MoH to consider exploring taxation/import tax (ban) of unhealthy foods as taxes influence price hikes, to consider defining and implementing clear marketing restrictions of unhealthy foods and drinks, and to update Ghana's General Labelling Rules with mandatory nutrition information and FBDG.

To ensure building an environmental resilience, it would be much more result-orienting if both the Ministry of Land and Natural Resources (MLNR) and the Ministry of Environment, Science, Technology and Innovation (MESTI) begin to empower communities to adopt sustainable and legal mining activities; strengthen community-based monitoring and engage the population to fight illegal logging; promote solar-powered irrigation and processing equipment; launch more agroforestry programs to help secure the

future of the forest and the environment at large; and promote neglected indigenous and nutritious food. Moreso, MNLR, MESTI and MOFA to explore scaling sensitization of sustainable resource management practices. The joint ministries need to provide local training and use early warning technological systems to develop and enhance understanding of soil, seasonal and climatic conditions. There is also a need for the three ministries to collaborate to promote production and sale of nutrient rich indigenous foods as well as ensure that food loss is mitigated by implementing a more circular food system (e.g., organic compose).

Moreover, it is important for Ministry of Trade and Industry (MoTI), MoF and MoFA to plan and stimulate demand and supply for infrastructure projects through analyzing costs, timelines, impacts and tradeoffs; selecting priority post-harvest management projects; facilitating new infrastructure PPPs, private sector investment and ease of doing business; re-allocating resources to invest in select and prioritized projects; and linking farmers to agro-processors. MoF needs to consider credit extension to build more infrastructure for the agricultural sector and other linking sectors to reduce post-harvest losses and serve as buffers for excess capacity of the market. MoFA to explore ways to better communicate best practices in the supply chain and create awareness on existing programs that decrease costs. MoTI to leverage existing skills and infrastructure to develop agro-business.

To bridge the gap between the north and the south of Ghana, MoFA should consider encouraging the use of irrigated agriculture and water storage; encouraging producers to produce more nutritious food and disseminating knowledge on nutrition. Also, MoFA needs to launch national agriculture insurance to protect against climate shocks as well provide better incentives to make agriculture attractive to youth and women by improving access to land, technology, finance, and training. In addition, MoTI and the Ministry of Transport (MoT) should look into improving agro-processing, supply chains and access to markets in the North while reducing trade barriers e.g. by providing incentives to processors to locate there. Again, it is important for MoGCSP to explore scaling up LEAP and GSFP in northern regions to make them more nutrition sensitive and accelerate the creation of jobs in other sectors.

ABOUT THE AUTHOR

Felix A. Asante, Professor, Institute of Statistical, Social & Economic Research (ISSER) and Pro Vice-Chancellor, Office of Research, Innovation and Development (ORID), University of Ghana.

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