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The Role of Biophysical and Technological Approaches Coupled with Political and Socio-Economic Factors in Transforming Ghana's Food Systems.

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Abstract: *Today, food security has been a dominant vocabulary in our terminologies and has now, more than ever also been a topical issue of concern worldwide. Thus the importance of food and its security can neither be underemphasized or divorced from a good quality and standard of living of humans. In Ghana, the adverse effects of undernutrition coupled with changes in our climate are evident on food productions and the patterns of consumption. This has raised calls for the urgent need to review the food systems within the country, essential to ensuring nutrition and food security as well as promoting sustainable development. The characteristics of Ghana's geography as marked by its climate, agro-ecological differences and differences in economies have all instigated this disparity between the northern and southern part of the country according to reports from the World Food Program in 2016. Additionally, given the changing diets and increased demands for food to meet the rising population within the country, both political and socio-economic factors coupled with the prevailing biophysical and technological considerations have been crucial to transforming the food systems within the country. These are essential considerations to further help bridge the gap in unequal access to safe and nutritious food between the northern and southern regions of the country. The Global food system framework is utilized in analyzing the underpinnings of biophysical and technological factors as well as political and socio-economic elements which influence Ghana's food system transition into a sustainable one, based on the HLPE's work in 2017. Technological and biophysical factors coupled with political and socioeconomic considerations are key to ensuring a transition in Ghana's food system into a sustainable one where every individual has access to safe, nutritious and healthy foods. Key biophysical issues identified within the food systems in Ghana include land scarcity due to insecure land tenure systems, food loss and food wastage due to the lack of storage facilities coupled with poor road infrastructures for the transport of foods resulting in post-harvest losses. Again, irregular rainfall patterns and water mismanagement have resulted in water shortages in the country's mostly rain-fed agricultural production which leads to reduced agricultural output. Socioeconomically, gender inequality and discrimination against women in access to land for agricultural purposes as well as changes in diet preferences into cheap and unhealthy foods have hampered the nation's food transition. Technologically, the lack of good road networks, storage facilities and the inability to improve the value chain and value addition in production negatively affects the transformation of the nation's food system. Politically, poor governance structures and the lack of implementation capacities have hampered the effective transition of the food systems.*

List of Abbreviations

GSFP - Ghana School Feeding Program

HLPE - High Level Panel of Experts

IDAF - Integrated Development of Artisanal Fisheries

UN-United Nations

UNDP-United Nations Development Program

UNCWFS-United Nations' Committee on World Food Security

UNFCCC- United Nations Framework Convention on Climate Change

UNFSS-United Nations Food Systems Summit

WFP-World Food Program

1. INTRODUCTION

"Rich or poor, young or old — every person in the world needs to eat. Safe and nutritious food provides not only life and health, but hope" (UNFSS, 2021) ... the words of Antonio Guterres, Secretary General of the United Nations during his statement of action at the United Nation's Food Systems Summit held in September, 2021. Nutritious and healthy foods have thus been an indispensable part of our human lives essential for the exhibition of proper human wellbeing and welfare. Today, food security has been a dominant vocabulary in our terminologies and has now, more than ever also been a topical issue of concern worldwide. Thus the importance of food and its security can neither be underemphasized or divorced from a good quality and standard of living of humans. Food security according to FAO *et al.,* (2021) has been rendered a contemporary issue following the increased reports of malnutrition with nearly 800 million people (10% of the world's population) lacking access to food. There has therefore been the need to improve our world's food systems to meet the increasing demands for safe, healthy and nutritious food. The food systems in the world, according to Springman (2018) has been a major determinant and driver of climatic variables such as temperature, rainfall and humidity, as well as fuelling changes in the uses of land, the depletion of freshwater resources, and pollution of aquatic and terrestrial ecosystems. These occurrences according to the authors are due to the excessive use nitrogen and phosphorus inputs to increase yields and production outputs to meet demands of the rising population, essential to addressing the Neo-Malthusian basis of food insecurity.

In Ghana, the adverse effects of undernutrition coupled with changes in our climate are evident on food productions and the patterns of consumption. This has raised calls for the urgent need to review the food systems within the country, essential to ensuring nutrition and food security as well as promoting sustainable development. Ghana, just like other countries within subSaharan Africa appears to be grappling with multiple burdens of malnutrition. With the persistence of food insecurity and undernutrition causing stunted growth, deficiencies in micronutrients, increasing obesity and diet-related non-communicable diseases, there has been the need to transform the nation's food systems (GBD Obesity Collaborators, 2017). There is therefore the need to marry improved food systems with environmentally sound practices in order to honour the supplies of both global and national food demands without exceeding the planetary boundaries. This has consequently necessitated clarion calls for a transition in our food systems, leaving more questions than answers in best ways to transform our food systems. The sole objective of this paper is thus to underscore the role of biophysical and technological approaches coupled with political and socio-economic factors in transforming Ghana's food systems.

1.1 Emerging Issues of Food Security; Ghana as a Case Study

Ghana is a country located in West African with a population of 31,927,243 as of October 28, 2021 based on figures coming from the Worldometer live reports. Ghana as a country within sub-Saharan Africa is prominent for its stability and democratic governance, and has made progressive strides and efforts to reduce poverty and hunger among the citizenry (WFP, 2016). It is however reported that there is a huge gap with unequal access to resources between the northern and southern parts of the country, and widening further between rural and urban areas of the country. This is evidenced in the persistence of hunger and malnutrition in the northern part of the Ghana including most rural and some peri-urban regions of the country. Generally, agriculture is rain-fed with the percentage of cultivated lands which are irrigated being less than 1% throughout the country. Furthermore, due to the occurrence of two rainy seasons within the southern part of Ghana, famers within the southern part are able to grow more crops as compared to their counterparts in the northern part of the country which experience a single rainy season (WFP, 2016). Just like the neighbouring Sahelian countries, these areas experience extreme weather events of increased temperatures and irregular rainfall patterns with prolonged dry days due to the changing climates. The characteristics of Ghana's geography as marked by its climate, agro-ecological differences and differences in economies have all instigated this disparity between the northern and southern part of the country according to reports from the World Food Program in 2016.

Few women in Ghana mostly engage themselves in farming activities, especially in the initial stages and phases due to strenuous activities of land clearing which are quite demanding in nature. The men

are however mostly involved in activities which require more strength to undertake such as land preparation (Marras *et al.*, 2021). The dietary pattern in the country has shifted over the years with an increasing demand for processed foods due to rising income levels and increase urbanization (Marras *et al.*, 2021). According to the authors, more than half of the total expenses for imported food within the country goes into seven major products. These products include rice, palm oil, raw sugar, poultry meat, wheat, processed tomatoes, and nonfillet frozen fish. There has been a relatively low rate of value addition within Ghana's agroindustry. 70% of the nation's agro-food businesses are mostly food processing at the household level or in small to medium sized plants. The medium and large scale industries have also focused on regional and international markets.

Given the changing diets and increased demands for food to meet the rising population within the country, both political and socio-economic factors coupled with the prevailing biophysical and technological considerations have been crucial to transforming the food systems within the country. These are essential considerations to further help bridge the gap in unequal access to safe and nutritious food between the northern and southern regions of the country.

2. CONCEPTUAL FRAMEWORK

The concept of Food Systems includes the entire scope of activities which are involved in the production, processing, marketing, consumption and disposal of goods which coming from agriculture, forestry or fisheries, the inputs required and the output generated at each of these stages (Laar *et al.*, 2021). These activities when enhanced, improve processes aimed at achieving food security and a sustainable food system by ensuring increased stability, availability, utilization and access (physical, social and economic) to safe, healthy and nutritious food by all people (FAO, 1996). A point worth mentioning is the fact that, with

Nyborg & Haug's work in 1995, *'Measuring Household Food Security,* the authors cite that the meaning assigned to the concept of Food Security has considerably been reformed in recent years, rendering it quite difficult in nature to be sufficiently addressed by development agents in projects.

Warnaar & Methorst (2017) describe the concept of food system transition as a holistic approach to enhancing the production activities and consumption within the food system where individuals consciously choose to eat healthier foods in a 'healthy' environment. On the concept of Food Sustainability, Ackers (2021) states that a sustainable food system is one which combines the factors of food production, distribution and consumption and is characterized by increased yields and output levels as well as improving environmental benefits. It can therefore be inferred from the given linkage above that a transition in our food systems is essential and required if a sustainable food system is to be achieved. On the contrary however, Bènè *et al.*, (2019) hold the opinion that there is no clear-cut definition attributed to the concept of sustainability, further adding that healthy foods are essentially sustainable.

2.1. Theoritical Framework

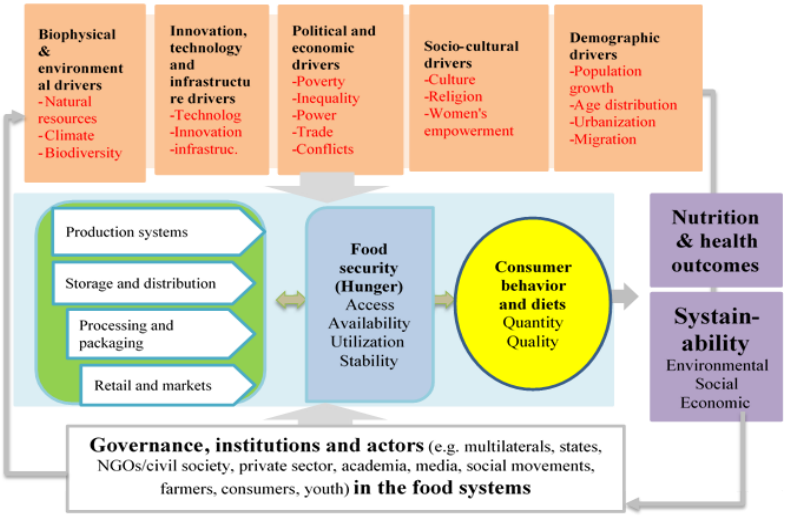

Figure1. *Global food systems (based on HLPE, 2017)*

The Global food system framework is utilized in analyzing the underpinnings of biophysical and technological factors as well as political and socio-economic elements which influence Ghana's food system transition into a sustainable one, based on the HLPE's work in 2017. As emphasized within the framework, Governance structures, Institutions and Actors influence changes in biophysical and environmental factors which include natural resources, biodiversity and climate issues. As affirmed by Vatn (2015) in his Environmental Governance System framework, these governmental institutions determine the economic use of the environment by defining the prevailing resource regimes and how the environment is utilized to produce goods and services. These also have a ripple effect and implication on the technological innovation and infrastructures coupled with political and socio-economic factors which all influence efforts aimed at transforming our food systems into a sustainable one. The High Level Panel of Experts (HLPE) on Food Security in the Global Food System framework thus outline these factors (biophysical, technological, political and socioeconomic) as being key to determining the systems of food production, storage and distribution, processing and packaging and the retail and market of these foods. These factors further determine the sustainability of our food systems by defining the access, availability, utilization, stability as well as the consumer behaviours and diets of individuals. This framework therefore highlights the underlying issues which influence Ghana's food systems into a sustainable one by predicting how farmers, consumers and more particularly state actors determine the biophysical, technological, political and socio-economic factors which go into food production and distribution and how these affect efforts aimed at transforming the nation's food systems.

3. Biophysical & Technological Approaches to Ensuring Food Security in Ghana

3.1. Biophysical Factors

Biophysically, land use and food production are inextricably linked and crucial to achieving sustainable food systems. With approximately 51 million km^2 of global lands used for agricultural purposes, 4 million km^2, 77% of these lands are used for livestock production with 1.1 million km^2 (23%) being used for crop production. These statistics indicate that land use plays a key role to ensuring food security whilst also being a determining factor of the ecological footprints in the food production system.

In Ghana, land has been a vital economic and a social asset that has been a source of both livelihood and social identity. However, with the face of climate crises today, there is an emerging problem of land scarcity within the country with a number of studies highlighting increased pressures in having access to lands for agricultural purposes particularly by the rural people and individuals living in peri-urban areas of the country (Bugri & Yeboah. 2017). According to the authors, the sizes of farms on average appear to be decreasing with an increase in land use changes mostly in densely populated areas, which further triggers competition for the use of the available spaces.

As cited by Quisumbing *et al.,* (1999), farmers' access to land on a long term basis serve as a motivating factor for these farmers to preserve the land while increasing their productions. Secure resource rights according to the authors could be powerful tools to ensure the attainment of this goal of securing lands for increased productivity. Furthermore, issues of land tenure insecurity, high cost of fertilizer input as well as the unavailability of various essential agricultural extension services for production have been major challenges facing most rural poor in their ability to produce food considering aside their difficulties in access to land. These tend to negatively affect food production within the country and subsequently a ripple effect on the nation's ability to meet demands. The Ministry of Food and Agriculture in Ghana recognizes the fact that insecurity in access to lands by women largely impedes the agricultural productivity of these women farmers. This occurrence according to the Ministry is further worsened by their limited access to financial services, their limited access to labour, lack of appropriate technologies, the skewed delivery of extension services, hefty workloads which result in time constrictions and the inability of these women to actively partake in decision making (Gender and Agricultural Development Strategy, 2001). A point worthy of mention as cited by Bugri & Yeboah (2017) is the fact that, 70% of the Ghanaian population are engaged in smallholder farming and these farmers depend on access to land to meet their basic needs. Thus the emergence of competition for these land resources is most likely to have significant effects on the livelihood of mostly the rural poor due to the weak governance structures as the ownership and use of these lands change. In my opinion, policy

interventions would be relevant to address the recent concerns of population growth and commercialization which alter the security of land tenure systems.

3.2 Technological Aspects

Springman *et al.,* (2018) assert that the negative impacts of food systems on the environment could grow from 50 to 90% between the years 2010 and 2050. This projection according to the authors could be due to changes in diets, food loss and wastage, inefficiencies in the use of water, increased use of nitrogen and phosphorus, as well as the emerging factor of population growth. Concerted efforts by Parties to the Paris Agreement to keep global temperatures well below 2 ºC whilst at the same time limiting this temperature to 1.5 ºC has been a major goal to achieve, leaving much to be desired. Results from the study "*Options for keeping the food system within environmental limits"* Springman *et al.,* (2018) have indicated that between the years 2010 and 2050, technological changes would be crucial to mitigating effects of food systems on the environment which is projected to rise by 50 – 90% due to the expected rise in population and individual income levels. These changes in technologies according to the authors are essential to abating and reducing the levels of emissions keeping them within the safe operating space which is not beyond the planetary boundaries for humanity. Considering the technological aspects in our food systems has thus been crucial to ensuring the sustainability of our food systems.

In Ghana, technological improvements are crucial to sustaining our food systems by increasing efficiency and improving water use in productions systems. In the view of Drechsel *et al.,* (2014) for instance, for improvement in water sources and the quality of water used for irrigational purposes, techniques such as 'drip irrigation' are useful in reducing the risk of contamination during production. Ansaa Asante (2012) further adds that the development of infrastructure such as waste water treatment plants, water pipes and standpipes to provide clean water on farmed lands are crucial to enhancing the production system on farms. A point worthy of mention is the fact that, contrary to the idea of improving the quality of water for safe and healthy food production, Yahaya *et al.,* (2015) argue that the practice of embracing these safe irrigation alternatives will most likely result in higher cost of vegetables and food prices. This, according to the authors would further render the processes of achieving equal access to food by all seem to be a mirage. In my personal opinion, it would not be appropriate to prioritize profits over the health of individuals. It is therefore crucial to strike a balance in production where the most efficient and cost effective technologies are adopted without incurring undue debts and losses and this would be relevant in the attainment of a win-win scenario.

Furthermore, in Ghana most villages engaged in the production of food crops are unable to transport their produce for sale within the urban areas due to the absence of infrastructures such as storage facilities and good road networks. This mostly results in the foods getting spoilt resulting in food wastage and consequently the inability of the citizens from utilizing these foods for the nourishment and their general wellbeing (Bugri & Yeboah, 2017). The authors further assert that the absence of direct support for agriculture reflects in low levels of public spending on agriculture coupled with the limited and mostly inefficient interventions for the promotion of value chain development and value addition for other commodities apart from cocoa.

Figure2. *Woven baskets for packing products that will be transported by road to consumers in various towns throughout the country. Credit: Marras et al., (2021).*

Furthermore, value addition and the development of value chain has been identified to be crucial to ensuring the full utilization of the food system in Ghana. As indicated by Diao *et al.,* (2019), there has been minimal efforts and interventions by the government of Ghana to ensure value addition of foods which are produced. The authors further add that the absence of a resilient public sector support has resulted in the unavailability of appropriate technologies, particularly improved seeds, frail rural infrastructure like poor roads and transport systems, absence of cold storage facilities and the lack of grading systems for quality control and its resultant limited promotion of export. Technological improvements would also champion the practice of climate smart agriculture through practices which would lower the ecological footprint of production activities on the environment coupled with reduction in livestock rearing known to contribute a significant amount of methane gas into the atmosphere (particularly with a shift to the consumption of more plant-based diet). There is therefore the need to invest more in technological infrastructures essential to ensure the transition of the nation's food system into a sustainable one where there is increased access to food by both the present and future generations.

4. SOCIO-ECONOMIC & POLITICAL FACTORS IN TRANSFORMING GHANA'S FOOD SYSTEMS

The Sustainable Development Goals 2 (Zero Hunger) and 13 (Climate Action) have been at the heart of Food Security and Environmental protection with the goal of eradicating malnutrition in all its forms, as envisioned in Agenda 2030 while enhancing the sustainability of our planet in efforts by the United Nations to ensure a better world. Integrating socio-economic and political analysis to understanding the global processes of food distribution have also been key to ensuring the sustainability of our food systems.

4.1. Socio-Economic Factors

Socio-economic factors of gender inequality, discrimination against women, the lack of jobs, diversification of rural livelihood and the shift to the consumption of less plant-based diets have all been major hurdles to cross meeting demands and ensuring food security within the country. In Ghana, the changing diets of individual consumers into the consumption of highly caloric foods has also been a major hindrance to the achievement of sustainable food systems in the country mostly due to the cheap prices of unhealthy foods coupled with the increasing income levels of individuals. A study undertaken by Devitt *et al.*, in 2011, showed that Ghana had a slightly greater consumption rate of calories estimated to be 2359.5 ± 63.6 kcal. There is therefore the need for change in diets to more plant based diets as advocated by Walter Willet *et al.*, (2019) in reports from the EAT-Lancet Commission calling for the consumption of more planetary healthy diets.

Another major socio-economic factor identified within the food production systems in Ghana is the involvement of women in agricultural activities. Statistical figures in the country indicate that women produce close to 70% of the nation's food crops and constitute almost half of the active labour force in the agricultural sector (Gender and Agricultural Development Strategy, 2001). The World Bank however spells out the ironic incident of relegating women through the systemic discrimination in accessing basic necessities to fully contribute to safeguarding the nation's food system despite the key role they play as principal agricultural workers. It is therefore crucial to involve women as well in agricultural activities while at the same time ensuring equal access to land resources for sustained food production as emphasized by Gender and Agricultural Development Strategy (2001).

On the health concerns regarding diets consumed in Ghana, reports from the Laar *et al.*, (2021) indicate that the status of food security and nutrition in most vulnerable populations is more likely to further worsen due to the health and socio-economic impacts of the COVID-19 pandemic. Additionally, the report makes an estimate that close to 690 million people suffered hunger in 2019, a rise by 10 million from the numbers in 2018, and by nearly 60 million within the last five years. The rise in prices of food coupled with its low affordability also connotes billions of people being unable to eat healthily or nutritious diets. The world today is witnessing a rise in the number of anaemic women; In Ghana, one out of every three women who is of childbearing age has an anaemic condition and this begins the vicious cycle of undernutrition in children, further thwarting efforts to achieve the United Nation's Zero Hunger Goal by 2030 (Laar *et al.*, 2021).

The Government of Ghana however was commended by the country director for IFAD, Salem Elsadani, during the Launch of National Dialogues on Food Systems for prioritising food and nutrition security

through the implementation of several integrated programmes over the last couple of years. Some of these implemented programs included the Planting and Rearing for Food and Jobs program which had the objective of increasing the productivity of farmers and overall income level of farmers; One-district-one-factory, with the aim of providing an opportunity to increase value addition and create jobs and the One-village-one dam project which was aimed at increasing all year production (IFAD, 2021). These projects have more room for improvement to serve the larger citizenry. Additionally, the Ghana School Feeding program (GSFP) was rolled out in September 2005 by the Government of Ghana as part of efforts to overcome undernutrition and malnutrition in children of school going age as indicated by Marras *et al.,* (2021). These have been steps and efforts taken to ensure that there is equal access to food by all people within the country.

Figure3. *Local farmers in Ghana working on a project to improve yields assisted by the UNDP/Food and Agriculture Organisation (FAO) Credit: FAO/Pietro Cenini)*

4.2. Political Factors

Findings from the work of Cadieux & Stocum in 2015 indicate that food insecurity mostly arises as a result of inequitable distribution of resources coupled with the uneven power relations in decision making. A thought-provoking incidence which occurred has been the recent boycott of the United Nation's Food Summit by Civil society activists and Researchers in academia alike, who later held their separate meeting. This boycott, in the view of Canfield *et al.,* was under the reason of registering their great displeasure with the entitlement of authority and top designations in the hands of corporate leadership who also push their interests and agenda to the forefront whilst prioritizing their profits margins. For a smooth and an allinclusive transition in our food systems into a sustainable one, it has thus been crucial to unravel the powers and interactions among actors in the food system, both globally and at country levels.

As a form of political support and empowerment, the government of Ghana should ensure equitable access to food by all through the protection of the land and production rights of smallholders whilst further reducing global food trade, as advocated by Clapp (2014). Wittman

(2011) further adds that the right of these local people to own and have control of their food systems such as ecological resources, methods of production, markets and food cultures are critical to ensuring access to sustainable foods by safeguarding the sovereignty of their food systems. In 2013, it was estimated in Ghana that the annual expenditure on food within the entire country totalled GHC24.2 billion, which accounted for close to 46% of the total annual expenditure (Marras *et al.,* 2021). Takyi-Mensah *et al.,* (2015) identify the high cost of farm inputs, reduced tariffs placed on imported meat rendering it cheaper compared to locally produced ones, the relatively high cost of borrowing, increased price of processed meat and the outbreak of disease as major constraints encountered by poultry farmers which hinders these farmers from increasing their productivity. Politically, issues of governance, corruption, ineffective implementation of policies as well as donor dependency have all crippled efforts at ensuring the sustainability of our food systems. There is

therefore the need to address the bottlenecks in the country's political systems to transform our food systems into a sustainable one.

5. Conclusion

Technological and biophysical factors coupled with political and socioeconomic considerations are key to ensuring a transition in Ghana's food system into a sustainable one where every individual has access to safe, nutritious and healthy foods. Key biophysical issues identified within the food systems in Ghana include land scarcity due to insecure land tenure systems, food loss and food wastage due to the lack of storage facilities coupled with poor road infrastructures for the transport of foods resulting in post-harvest losses. Again, irregular rainfall patterns and water mismanagement have resulted in water shortages in the country's mostly rain-fed agricultural production which leads to reduced agricultural output. Socioeconomically, gender inequality and discrimination against women in access to land for agricultural purposes as well as changes in diet preferences into cheap and unhealthy foods have hampered the nation's food transition. Technologically, the lack of good road networks, storage facilities and the inability to improve the value chain and value addition in production negatively affects the transformation of the nation's food system. Politically, poor governance structures and the lack of implementation capacities have hampered the effective transition of the food systems.

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