

Building Resilience and reducing Vulnerability to Climate Change: Implications for Food Security in Ghana

by Joseph A. Yaro, Department of Geography and Resource Development, University of Ghana



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1. Introduction

Food insecurity has been a long-existing developmental challenge for the continent of Africa. It has become further complicated because of its interwoven connectivity with social, economic, technological, political and environmental systems which serve as aggravating factors. With the growing incontestable effects of climate change the call for household, national, regional and global responses is becoming increasingly imperative. The impact of climate change is intrinsically interwoven with food security and this can be viewed from global to local levels considering the components of food systems. High and uncertain impacts from extreme climate events are a global phenomenon and can only be ameliorated to a limited extent by technological advance and enhanced resources and income (Burton et al. 1993).

Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO 1996). Food security has four main components: availability, accessibility, utilization, and food systems stability. These four dimensions have linkages with different impacts of climate change. Generally, a food system is considered vulnerable when one or more of these components is uncertain or insecure. Factors such as poverty, unavailability of employment, lack of education, increase in food prices, climate and environment conditions and poor access to market are identified to have a direct correlation with food security. These factors expand the vulnerability bracket beyond the social to include economic and environmental dimensions in explaining the implications of climate change on food security. To this extent, climate change is not the single most important cause of food insecurity but particularly important driver of food system performance at the farm end of production-related income (FAO 2008). Rather, food security is dependent more so on socio-economic conditions than on agro-climatic ones, and on access to food rather than the production (Yaro and Hesselberg 2010).

Food system performance today depends more on climate than it did 200 years ago; the possible impacts of climate change on food security have tended to be viewed with most concern in locations where rain-fed agriculture is still the primary source of food and income (FAO 2008). This view falls short in considering other factors which acts in combination with climate change, social and economic factors are important in determining food security of a region thus socio-economic factors are pertinent in addressing impact of climate change than tackling agro climatic factors. Changes in consumer taste and preference are a factor, which affects production and distribution of food globally.

Significant regional shifts in food production due to climate change will likely negatively affect developing countries in the tropics. The changing climate in Ghana for the different ecological zones has implications for the nature of agriculture and income earnings. These changes affect cropping systems, distribution, domestic food mix, and livelihood diversification and migration patterns.

The main question addressed by this paper is *'which aspects of food systems are most vulnerable to climate change and how will/does this affect the food security of households?* The answers provided examine the nature of vulnerability of food systems both to climate change

and other forces. The paper argues that solutions must emanate from a careful synthesis and integration of adaptation and mitigation strategies that go beyond mere agricultural production to the goals of sustainable development. Building resilience and reducing vulnerability to climate change embodies a strong advocacy for sustainable development. Brooks and Loevinsohn (2011) argue that an enhanced farmer capacity and access to information, in whatever way is essential to the development of more effective, local adapted responses to changed circumstances. The capacity to innovate is as central to adaptation to climate change as it always has been, since farmers are constantly adapting to changing circumstances. It is this underlying, quintessentially local capacity that underlies the diversity of agricultural systems and their constituents (Brooks et al. 2005).

2. Climate change, agriculture and food security

Agriculture is an important sector of the rural economy in developing countries, as it provides employment, income and food. A change in the production and distribution of food is critical to the food security. Impacts on both production and importation of food have critical impacts on the food security of people. Agriculture in the tropics is affected negatively by climate change based on most of the models produced for the future projections and pre-existing evidence. Darwin (2001) explains that general precipitation and temperature model results indicate that global warming shortens growing seasons in the Tropics and lengthens growing seasons at high latitudes. He further argued that in comparing with 1990 economic conditions, the model shows that these land resource changes reduce agricultural output in equatorial regions where many developing countries are located, this affect the food chain, affecting the quantities and types of food produced and the adequacy.

Climate change may affect agriculture and food security by altering the spatial and temporal distribution of rainfall and the availability of water, land, capital, biodiversity and terrestrial resources. It may heighten uncertainties throughout the food chain, from farm to fork and yield to trade dynamics, and ultimately impact on the global economy, food security and the ability to feed nine billion people by 2050 (Hanjra and Qureshi 2010). Similarly, IPCC (2007) Global climate models (GCMs) predict impact will range from slightly negative to moderately positive and that aggregate changes in world food production are likely to be small. However there is general agreement that climate change may lead to significant reductions in agricultural productivity in developing countries.

Climate change is not a homogenous global phenomenon in which its catastrophic effects will negatively affect the world. Indeed, consensus surrounding regional climate change variations conclude that temperate and polar climate regions will benefit from increase agricultural production, whereas tropical and subtropical climates are most likely to be negatively impact due to agricultural production losses (Devereux and Edwards 2004). The variability of sporadic rainfall can cause immense disruptions to the growing season in the tropics, and an increase in erratic weather events (e.g. flooding, dry spells) that further complicates primordially marginalized regions (Devereux and Edwards 2004). Reports have

concluded that increased dry spell seasons can cause significant destruction to Sahelian African regions.

Africa's vulnerability arises from a combination of physical and social processes and represents the interface between exposure to climatic threats interacting with other non-climatic threats, and the capacity of the threatened systems to cope with the threats. These threats could result in a geographic redistribution of vulnerability and a re-localization of responsibility for food security (FAO 2008). A moderate warming (increases of 1 to 3 °C in mean temperature) is expected to benefit crop and pasture yields in temperate regions, while in tropical and seasonally dry regions, it is likely to have negative impacts, particularly for cereal crops. Differential vulnerabilities exist on the scales of social, economic and environmental.

These spatial differentiations will lead to variations in climatic conditions per region. Adger (1999) argues that the impacts of extreme climate events are the principal climate phenomena which enhance vulnerability. The consensus of scientific opinion is that countries in temperate and Polar Regions will enjoy increased agricultural production, while countries in tropical and subtropical regions are likely to suffer agricultural losses (FAO 1996). The FAO projects that the impact of climate changes on global crop production will be slight up to 2030. After that year, however, widespread declines in the extent and potential productivity of cropland could occur, with some of the severest impacts likely to be felt in the currently food-insecure areas of sub-Saharan Africa, which has the least ability to adapt to climate change or to compensate through greater food imports (Fischer et al. 2005).

Food in poor regions in developing countries includes wild foods, which are particularly important to households. Wild foods are not only an important source of food but also a source of income for those with less access to land and other production requirements for engaging in normal agricultural and other non-farm activities. A depletion of these resources or a change in the geographic distribution of wild foods resulting from changing rainfall and temperatures could therefore have an impact on the availability of food and income. Changes in climatic conditions have led to significant declines in the provision of wild foods by a variety of ecosystems.

However, the level of food production is not a sufficient factor in ensuring food security, but rather the distribution and access to the food produced. For instance, in Ghana, food is left rotten due to inefficient distribution due to poor roads and poor market information. Geographical shortages of food within countries complicate the food security patterns even in the midst of bountiful harvest. This dilemma is historical as emphasized by Amartya Sen's seminal work in 1981. On the basis of accessibility, reduced yields may lead to loss of farm income, but this depends on market conditions. In furtherance, high market prices for food are usually a reflection of inadequate availability as persistently high prices force poor people to reduce consumption below the minimum required for a healthy and active life. Growing scarcities of water, land and fuel are likely to put increasing pressure on food prices, even without climate change.

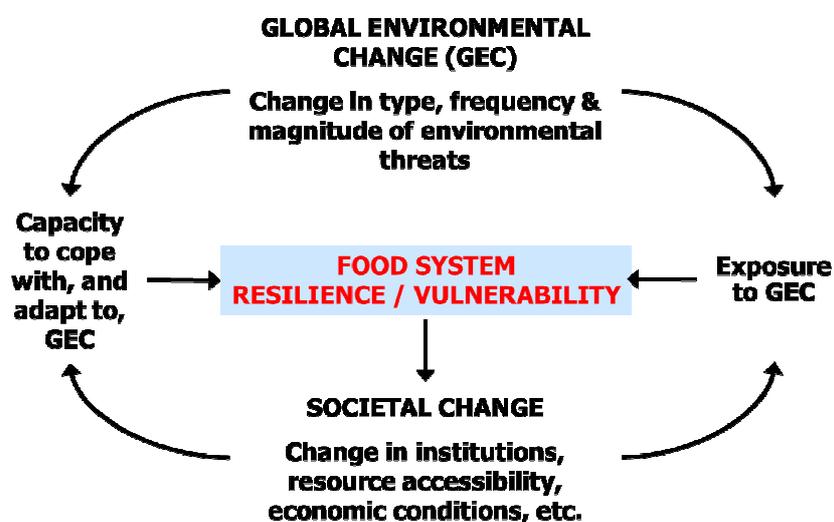
3. Household vulnerability to climate change and resultant food insecurity

To what extent does climate change impact the vulnerability of household capacities for food security, thus altering their socio-economic realities?

As Adger (1999) delineates, “vulnerability” can be defined as the level of human exposure to extreme weather activities like earthquakes, floods, and drought, which threatens their very existence, and means of livelihood through food production. The Food and Agricultural Organization (FAO 2008) states that agricultural production is immensely essential in two crucial ways: first, because it provides a means of survival through the production of food for consumption, and it employs 36 per cent of the world’s workforce and 40–50 per cent in agriculturally dependent Sub-Saharan countries. Hence, any minor deviations of food production patterns created from increase global warming could harm millions of people who solely rely on agricultural production for their means of economic livelihood. Food production has steadily decreased by 10 per cent in the last 20 years in the horn of Africa whilst acute famine has increased (Devereux and Edwards 2004). The subsequent effects of climate change on erratic weather exacerbates pre-existing humanitarian challenges, and poses new threats to the fragile agricultural system in which many rely upon for access to food production, thus instilling an instable environment of food insecurity.

Vulnerability must be measured in terms of its effect on food insecurity for the most marginalized communities. The heavy dependence of the rural poor in Ghana on agricultural cultivation connotes that food production losses induced by climate change, creates insurmountable challenges in combating food insecurity. Not only does it incapacitate the farmer’s abilities to access markets through fallen crop production, it also renders these households with limited access to alternative livelihoods. The economic imperative that food security holds in agriculturally based countries has immense influence towards production processes, commodity and trading pricing, and ultimately income levels. If domestic production falls short due to erratic weather patterns, it negatively affects the pricing of food thus subsequently limiting the individual’s purchasing power abilities in selling or buying goods (FAO 2008). High levels of penury also become an imperative means of measurements of one’s vulnerability as it directly correlates with an individual’s access to resources and coping mechanisms from extreme climate conditions (Adger 1999).

The vulnerability of the food system as a whole to climate change is the major determinant of household and national food security. The environmental and social vulnerability dimensions of the food system are shown in figure 1. The food systems approach has helped to identify the importance of considering multiple scales and levels in food security discussions (Ericksen 2008; GECAFS 2006). Food systems comprise a set of activities and outcomes ranging from production through to consumption, which involve both human and environmental dimensions. The different activities include: (i) producing food; (ii) processing food; (iii) packaging and distributing food; and (iv) retailing and consuming food. These activities are often referred to as the “food chain” (Ericksen and Ingram 2005). The vulnerability to environmental change is a function of exposure to an environmental hazard, which is mediated by social factors and institutions, which combine to determine the adaptive capacity and hence the overall vulnerability of the food system (Ingram and Brklacich 2002).



Source: Source: Erickson, P. 2008 (p.14)

Climate change has increased uncertainty and risk. Risk exists when there is uncertainty about the future outcomes of on-going processes or about the occurrence of future events. The more certain an outcome is the less risk there is, because certainty allows informed choices and preparation to deal with the impacts of hazardous processes or events.

As previously mentioned, a food system becomes vulnerable when one or more of the four components of food security – food availability, food accessibility, food utilization and food system stability is uncertain and insecure. Human vulnerability includes both the likelihood of exposure to stresses as well as the capacity to cope with such stresses.

Assessing the domestic impact of food insecurity at the household level gives a micro level indication of a family's ability to adapt to climate change impact. Income and asset are considered effective and efficient indicators of vulnerability than environmental indicator. These diverse aspects determining vulnerability can be conceptualized as a set of entitlements: it is the structure or architecture of these entitlements which underpins both security and vulnerability (Adger and Kelly 1998). The major indicators of vulnerability are poverty and resource dependency at the individual level, and inequality at the collective level. A household's food system comprises all the food chains it participates in to meet its consumption requirements and dietary preferences, and all the interactions and feedback loops that connect the different parts of these chains (FAO 2008). Climate extremes as well as social and economic change result in an evolving state of vulnerability with offsetting and interlocking social, economic and institutional facets (Adger 1999).

4. Spatial vulnerability to climate change in Ghana

Ghana's spatial vulnerability is dependent on the type of agro-ecological zone, level of economic activities and socio-cultural characteristics.

The coastal and interior savannahs are characterized by dry climate, increasing rainfall variability and hotter temperatures that result in decreased food output and incomes. The effect of sea erosion and tidal flooding is shoreline recession, increased flooding and salinization of surface and ground water. The feedback to the social dimension is poverty among those dependent on land and sea-based activities. The ability to adapt to these climate stresses is complicated by non-climate stressors such as unfavourable trade policies, low technology, social norms, degraded environment among others, that reduce the competitiveness of commercial farming and other industrial and service based activities. Food deficits resulting from these shortfalls in production are filled in from other regions imports. Hence, the ability to ensure household food security is highly dependent on capacity to import food, food prices, transport systems and distribution, local markets and eventually household purchasing power.

The purchasing power of farm households is low when farm production is affected by climate variability and hazards. This is due to the low level of useful diversification. For example, the level of profitable diversification in northern Ghana is low due to the general poverty of the area coupled with insufficient job opportunities created by state policies and globalisation. Decades of outmigration from northern Ghana explain the demographic deficit in terms of labour, skills and demand. Moreover, the declining natural resource base vis a vis degradation caused by both anthropogenic and environmental hazards reduces the viability of hunting and gathering. This is quite significant as these are two important sources of coping and a means of building assets. Over exploitation of these resources near settlements have increased transport costs and time involved in accessing these resources such as firewood, thatch, wild foods, and game. People capable of hiring trucks and using modern technology to harvest more wood or burn charcoal have taken over these resources far from settlements. Also, chain saw operators have invaded northern Ghana cutting very old trees protected over the decades for export as hard wood or for timber in the domestic construction industry.

The contribution of assets in the livelihood equation has dwindled in northern Ghana due to the falling number of livestock resulting from declining luxurious grazing areas and high cost of tertiary services. The privatisation of tertiary services has led to the suspension of free government programs in eliminating livestock diseases. Hence, many rural households have lost an important source of storing their wealth, which act as a source of investment and coping in times of climate and other stresses. Droughts have led to direct fall in livestock numbers for many families since the early 1980s. A new economic terrain characterised by a stagnating agrarian sector and a slowly growing service sector characterises most of northern Ghana.

Contrastingly, the coastal savannah has been influenced heavily by the globalisation of the Ghanaian economy. This hub of urbanisation is characterised by a growing informal sector where services and trade dominate. This zone receives many migrants escaping the stagnating agrarian economies of the north and other areas. New opportunities are created in this zone

mainly for the business class and the educated. Hence the benefits of the liberalisation policies have eluded the rural farmers and fisher folk. This group continues to struggle with dwindling fish stocks and high competition from foreign fish trawlers and fish imports. Farmers are losing their lands to peri-urban developments. The poor are facing a double exposure confronting nature and socio-economic change. Their ability to salvage infrastructure along the coast from rising sea levels and tidal flooding is reduced due to their poor asset base and low external assistance.

The forest ecological zones have more favourable climates than the rest of the country but may also suffer significant variations in rainfall and temperature that could affect food and tree crop outputs thereby reducing incomes from exports. Additionally, the exodus of vulnerable people from highly vulnerable regions to this zone creates pressure on environmental systems thereby complicating the sustainable management of natural resources.

The sensitivity of many export crops to temperatures make the livelihoods of small farmers precarious, as they try to eke out a living by engaging in outgrower schemes in agri-business chains. A significant number of farmers especially in the Eastern Region are involved in fruit farming. The timing of rains is very important for these crops. High sunshine exposure is directly correlated with ripening periods and the colouring of fruits. Winds have a destructive impact at the flowering stage, which can annihilate the entire investments of even huge commercial farms. The rise in plant diseases especially for cocoa when humidity changes enable infestation is likely to impact millions of small-scale farmers, which ultimately affect national export earnings.

Exacerbating these climate hazards are the social and economic conditions. Increasing poverty among disadvantaged food crop farmers due to neoliberal policies has reduced their resilience. The reduced prices of food crops on the international market followed by subsequent subsidies in exporting countries, has vastly destroyed the viability of small scale farming notwithstanding those who have commercial tree crops. Access to land due to land tenure inequalities reduces the possibility of taking advantage of emerging opportunities in non-traditional export crops or traditional export crops.

The influx of migrants has led to extensification of agriculture with both negative and positive effects; the negative effects being, the environmental destruction due to the increase of land clearing for agriculture and the use of chemicals. On a positive note, there is an increase in national outputs for both traditional and non-traditional export crops with some livelihood benefits for labourers and employees of marketing firms. A commercial orientation to agriculture makes indigenous local small-scale farmers loses lands to rich individuals who concentrate land. Social inequalities are at the root of asymmetric vulnerabilities.

Moreover, the poorly constructed infrastructure accounts for losses of food amidst food insecurity systems. Road networks are better developed in urban areas rather than rural locations, thus making the cost of production prohibitive and unattractive. The result is high food prices in local markets, which cannot compete with substitutes imported. Further, distant markets from the countries ports and food baskets mean higher prices for people living in these areas. Hence, in the lean season, the poor rural farmers tend to suffer from food security due to distribution and income factors. The urban poor are affected due to their inability to procure

incomes from diversified livelihoods to acquire food. The high number of rural-urban migrants in the major cities of Accra, Kumasi, Tema, Takoradi and now Tamale in the context of low employment opportunities and poor returns to small scale trading mean many urbanites are highly susceptible to food insecurity.

The vulnerability to climate change with regards to consequences for food security therefore relate to physical food production fluctuations, storage and distribution of imported foods, and the idiosyncratic capacities to procure food for households. The reliance of Ghanaian agriculture on rainfall rather than irrigated systems and the high number of poor people relying on this sector make the impacts of climate change a challenge.

5. Responding to climate change: Building resilience and reducing vulnerability

The integration of climate change adaptation and mitigation into an overall development agenda is paramount to addressing the impact of climate change on food security. The need for stakeholders' engagement in employing a holistic approach in addressing effect of climate change is critical for ensuring food security. It is necessary to strengthen the resilience of rural people and to help them cope with this additional threat to food security. Particularly in the agriculture sector, climate change adaptation can go hand-in-hand with mitigation. Strengthening resilience involves a conscious effort in adopting practices that protect vulnerable people for diversification of income sources, ensuring the existence of existing livelihood systems. Mitigation involves controlling greenhouse gases to stabilize climate change at an acceptable limit. Adaptation on the other hand refers to adjustments to the impact of climate change given existing levels of greenhouse gasses in the atmosphere.

Addressing vulnerability should be a household approach rather than a general approach because the ability to cope and adapt to climate change impact varies from one household to another and also among individuals.

Long-term policy responses require accurate information about the economic impacts of future climatic conditions. Despite recent advances in analysing the economic effects of global warming, information about climate change and food security in developing countries remains extremely limited. Specific details are lacking about the location, timing, magnitude, and probability with which food security issues might arise (Darwin 2001).

Future food security depends on investments decisions made today for tackling climate change, conserving water and energy resources, developing and adopting new seeds, renewed investments in irrigation, shoring up domestic food production, reforming international trade, and diversification of food production away from farming. Future food security requires governments and the public to deal forcefully with the issues critical in food production and food security, including population growth, widespread poverty and income disparity, climate change, water scarcity, land degradation and energy and food price inflation. Addressing these interlocking issues simultaneously is inevitable to prevent famine in poor nations (Hanjra and Qureshi 2010).

Moreover, there is a need for a diversification of livelihoods, there is no doubt that agricultural practices and livelihoods are being threaten by climate change activities. Thus far, there are limited alternatives to agricultural practices in which large portions of rural – low-income communities will be at heightened vulnerability and food insecure. Hence, the importance of policies that introduces livelihoods that do not rely heavily on natural resources nor negatively add any additional environmental harm. Increase water management and irrigation improvement and government funding for agricultural research that would aid farming techniques are all local initiatives that could offset some of the immediate effects of climate change.

According to (Beddington et al. 2011)humanitarian, environmental and global security concerns demand a global commitment to improve the lot of the large proportion of the human population that is currently food insecure. This requires that we build resilience to climate shocks and food price volatility, halt land degradation, and boost productive assets and infrastructure. Land tenure, mechanization; local knowledge and income are essential ingredients for building adaptive capacity for farmers. Some adaptation will involve shifting agricultural production from one location to another. This adaptation, too, would benefit from government policies that provide reliable, long run information that identifies suitable and unsuitable crop locations as climate changes (Darwin 2001).

Livelihood diversification is a key to reducing vulnerability of climate change affect; the ability of an individual to have income will determine the security when it comes to food accessibility. Consumer purchasing power becomes paramount, hence the need to ensure that people sources of income are diversified and sustained. Policies that stimulate economic growth and development thereby provide more alternatives to agriculture as a source of livelihood would benefit farmers transitioning to new professions (Darwin 2004). However, diversifying income sources may be a strategy for reducing dependency and vulnerability of individuals at the household level, but can also result; it is argued, in increased vulnerability (Berry 1993; Ellis 1998).

Reducing food system vulnerability is the ultimate concern of households, states and the world. This can be done in three ways: by increasing food production, by improving food distribution, and increasing economic access to food by individuals and households. However, *these measures should not exacerbate climate change or other aspects of environmental degradation.* Achieving these broad objectives involves contextual appropriate measures and strategies that build the resilience of people. There is the need to increase food production to reduce food system vulnerability especially through technological advances and the development of long-distance marketing chains. The right infrastructure and incentive structures for the food industry is critical for ensuring effective distribution at stable affordable prices. And finally access to employment in multiple sectors guarantees incomes and increases the purchasing power needed to procure food.

6. Policy areas for building resilience and reducing vulnerability

In order to achieve the goals stated above, the right policies are needed to enable strategies work at the household, national and global levels. The critical areas of policy development include the following:

- Research and Development
- Infrastructural development
- Innovation & Technology
- Trade policies
- Insurance
- Land tenure policies
- Social justice
- Poverty reduction
- Diversification of livelihoods – inter-sectoral linkages
- Water management
- Sustainable natural resource management
- Disaster preparedness and safety nets

These policies should seek to enhance both individual and national food security. The pursuance of merely idealistic ideals without an anthropocentric focus will take us back to naïve environmentalism. On the other hand a lapse to individualistic pursuance of wealth without regard for the common good stands the danger of frustrating sustainable development efforts. The policy areas listed above should be geared towards to achievement of sustainable development in which current generations' wellbeing is ensured while not compromising that of future generations. To achieve sustainable development a new thinking is needed whereby households become the focus of our general strategy rather than national level activities, which neglect the production unit within which, all the important decisions are taken. Building individual capacities certainly leads to household resilience, but these also need to be coordinated by households themselves.

7. Scale, Actors and Principles

Sustainable development is the goal of the global citizen whose actions at different places combine to define sustainable development outcomes. A sense of global comradely is necessary if humans are to accept responsibility for their actions, which are felt all over the world. Global citizens in turn influence decisions within households, regions, countries and international levels. Policies and actions are scale specific. There is the need for frameworks and agreements at the international level requiring multinational consensus based on the principle of shared responsibility. These shared values and their associated actions are needed

to provide the space within which nations and multinational organisations and companies operate. Then regional groupings must tune these agreements into realistic strategies that are context specific for their members. Nations then have the job translating these rules and strategies for the benefit of their citizens. In this regard, laws, rules and strategies are supposed to create the space for the household to operate efficiently and responsibly. Wrong incentives generated by these laws and strategies would frustrate household and individual efforts. Feedback mechanisms are important where individuals and household concerns and thoughts of laws, policies and strategies are expressed through community and local government mediations and eventually reach the international level. A dynamic process of rapid response systems is needed within malleable frameworks. Flexibility guided by global principles can allow national entities quickly change or amend policies to respond to emerging concerns.

These principles should necessarily include a shared responsibility, participation, and complementarity to allow for easy and appropriate consensus building. Humanism and human rights are important to avoid the mistakes of the past environmental conservation policies and of capitalist and socialist mistakes where the object have been 'things' rather than people. In this regard political contracts with the global citizens are important in ensuring accountability of the political elite. Efficiency and co-evolution are critical principles in preventing idealism, which destroys resources and waste time. Related to these is scientific and social realism, which puts a check on lofty thinking without reference to constraints.

Building resilience and reducing vulnerability to food security is not a simple task for one entity; but a process with broad-based participation, which enables households and individuals to function in their environments. Achieving food security in Ghana through resilience building should therefore pursue these wider systems in order to enable people access well adapted and properly functioning food systems.

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