

Opinion

# Conceptual triple E model for sustainable food security: A solution-based framework for hunger and malnutrition in Nigeria

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## Abstract

Food insecurity, hunger, and malnutrition have been a global challenge, particularly among low- and middle-income countries, including Nigeria. Despite international donors' interventions, the number of food insecure households, hunger, and malnutrition keep increasing, though exacerbated by the security challenges in Nigeria. Nigeria ranked 107<sup>th</sup> out of 113 countries on the Global Food Security Index (GFSI), and the level of hunger in Nigeria remains considerably serious, as Nigeria also ranks 109<sup>th</sup> out of 125 countries in the 2023 Global Hunger Index (GHI). Owing to these challenges, the Nigerian government has instituted policies and programmes to boost food production, yet the issue of food insecurity persists due to poor implementation. Failure of policies and programmes is principally due to the so-called NO-STEP syndrome-no sincerity or transparency in the execution of policies. Furthermore, there have not been structures that could provide a basis for the formulation of the policies and also evaluate the strengths and weaknesses of their implementation. Therefore, this study outlines a conceptual "Triple E (Evaluation, Education, and Empowerment) framework". The goal is to strengthen rural agricultural activities for adequate food production, a sure pathway to achieving food security and hunger reduction. Furthermore, considering the increasing number of malnourished children in Nigeria, the Triple E also entails a novel initiative, SIT-250/4/1 (survey, identify, and treat 250 thousand malnourished under five children, every quarter per year), and if adopted by the Federal Government of Nigeria, it could help reduce significantly, in the shortest possible time, the number of malnourished children in Nigeria.

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## INTRODUCTION

Food security exists when all people, at all times, have physical, social, financial, and economic access to sufficient, safe, and nutritious food that meets the consumer's dietary needs and food preferences for an active and healthy life. However, the world population is on the rise and is expected to reach about 10 billion by the year 2050, making the goal of food security for all ever more difficult to achieve and maintain. This level of population increase would require raising overall food production by at least 70% (Daszkiewicz, 2022; FAO, 2009).

Unlike the concept of food security, which has evolved for decades, the concept of nutrition security could be considered an emerging concept that builds on food security. It means the availability and affordability not just of food per se but of foods that promote individual wellbeing, prevent diseases, and treat diseases (Mozaffarian et al. 2021). Although there has not been a definitive definition of nutrition security, the present study defines it as when all people at all times have access to foods

containing the required nutrients that are sufficient to meet an individual's nutrient requirements.

Hence, part of the hunger crisis and its associated health and social consequences like malnutrition, diseases, and insecurity could be addressed if the global community put more effort into food production. The hunger crisis is a serious global problem, though the causes vary from country to country, especially in countries worst hit by military or security challenges (WFP, 2022). Countries like Afghanistan, Ethiopia, and Yemen are currently experiencing serious and alarming levels of hunger (30.6, 26.2, and 39.9 percent, respectively), while Somalia and South Sudan are provisionally categorized as alarming (35.0-49.9%) (GHI, 2023). Nigeria also has a level of hunger that is serious, 28.3%, and ranks 109<sup>th</sup> out of the 125 countries (GHI, 2023). The global hunger index score is categorized as low ( $\leq 9.9$ ), moderate (10.0-19.9), serious (20.0-34.9), alarming (35.0-49.9), and extremely alarming ( $\geq 50.0$ ).

According to the Global Food Security Index (GFSI) report for 2022, Nigeria ranked 113<sup>th</sup> among 113 countries in terms of food affordability, 108<sup>th</sup> in terms of availability, 57<sup>th</sup> in terms of

sustainability and adaptation, and 79<sup>th</sup> in quality and safety (Otekunrin et al. 2023). Nigeria's overall score of 42/100 was ranked 107<sup>th</sup> out of 113 globally and 25<sup>th</sup> out of 28 sub-Saharan African (SSA) countries (Otekunrin et al. 2023). In some sense, many countries are not food secure, including some of the developed countries. In the USA, for instance, more than 10% of households were food insecure prior to the COVID-19 pandemic (Coleman-Jensen et al. 2022; Parekh et al. 2021), and the number of food insecure households in the USA increased to about 38% (March 2020) during the pandemic (Kakaei et al. 2022).

From a global perspective, before the advent of the pandemic, about 820 million people had been suffering from hunger and starvation (Kakaei et al. 2022), and about 282 million people in Africa are undernourished (Mohajan, 2022), of which 220 million are from sub-Saharan Africa (Obada et al. 2021). This is because African countries have yet to frankly give food production a top priority and recognize the need to reduce food insecurity, hunger, and malnutrition. Certainly, George Kent was right that ending hunger would be a disaster for some people, as hunger is not a problem but an asset to those at the top end of the social ladder (Kent, 2008). Ending the hunger crisis in Nigeria requires aggressive and undiluted government commitment, and the government must at all times retain a strong political will to harness the full potential of Nigerians, especially those in rural communities.

In the past, agriculture was the chief economic mainstay of Nigeria, as emphasis was placed on food production. Over 50% of Nigeria's gross national product was attributed to agriculture, and over 80% of her foreign exchange earnings come from the export of the food produced in Nigeria (Fogg, 1965). This was because agriculture was given due priority, and policies to boost food production were initiated and optimally implemented. However, many policies formulated and implemented after the oil discovery in Nigeria have had little or no impact.

The issue of food insecurity in Nigeria is getting worse as population growth far exceeds growth in food production (Hlophe-Ginindza and Mpandeli, 2020) despite government claims of virtuous policy implementation. In fact, shortfalls in food production may continue to worsen due to rising costs of farm tools, less credit access to farmers, increasing costs of fertilizers, rural-urban migration, causing a decrease in the number of farmers (Romanus et al. 2020), and, above all, corrupt policy implementation (Abdulwaliyu et al. 2023). Thus, there is a need to rapidly initiate or adopt an approach that would guarantee adequate food production and other efforts that are needed to avert or reduce hunger and malnutrition in Nigeria. Averting hunger and malnutrition (under-nutrition) goes beyond having just plenty of food in regional, national, or international domains. It is also about providing equal and just distribution of people's entitlements to social, economic, and agro-ecological support, owing to the fact that food insecurity and consequently hunger and malnutrition are products of multiple factors in social, economic, political, and ecological systems (Alaimo et al. 2020).

Although malnutrition remains a significant public health challenge globally, affecting millions of people, it is more of a devastating challenge in Africa, including Nigeria. The challenge of not having enough to eat became significantly worse during the COVID-19 lockdown measures, and many more households could not meet their nutritional needs (Iheme et al. 2020). In Nigeria, the prevalence of malnutrition is high, despite several interventions aimed at promoting healthy diets and reducing food insecurity (Ogunleke et al. 2023). In fact, Nigeria faces the

biggest burden of undernutrition in Africa, with the largest population of malnourished children under the age of five (Omotesho et al. 2019), with some 2,300 children dying daily in Nigeria as a direct or indirect result of malnutrition (Emeagi and Apugo, 2022). Reports from the 2018 Nigeria Demographic and Health Survey (NDHS) revealed stunting prevalence among children up to five years as 37% (with 17% severely stunted), 29% underweight or severely underweight, and 9% were either wasted or severely wasted (Amusa et al. 2023). Generally, about 12 million and 3 million under-five children in Nigeria are stunted and wasted, respectively, while 23.5 million are anemic (Vanguard, 2023). UNICEF (2023) posits that about 25 million Nigerians are currently at risk of food insecurity.

One of the recent initiatives of the federal government of Nigeria is the anchor borrower's program, launched with the goal of boosting food production and reducing food importation. However, the program has been thwarted by poor implementation, monitoring, and evaluation. This failure may be due to a lack of a standard model that should gauge the strengths and weaknesses of any food program or policy in Nigeria. Therefore, we conceptualized the Triple E model, or AOAB (Abdulwaliyu, Okoduwa, Arekemase, and Batari) Triple E model, and suggest that it be adopted for a more food-secure Nigeria. The model may offer the government and key players in the agriculture sector the opportunity to know the number of farmers in rural communities, and the challenges or problems faced by the smallholder farmers, as well as to understand the knowledge gap of the local farmers, to identify the number of malnourished children (especially wasting), and to better determine how the government could assist farmers and caregivers to improve their food production and the nutritional status of children and other vulnerable people.

## A BRIEF OVERVIEW OF RECENT STUDIES ON HUNGER, FOOD INSECURITY, AND THE BURDEN OF MALNUTRITION IN NIGERIA

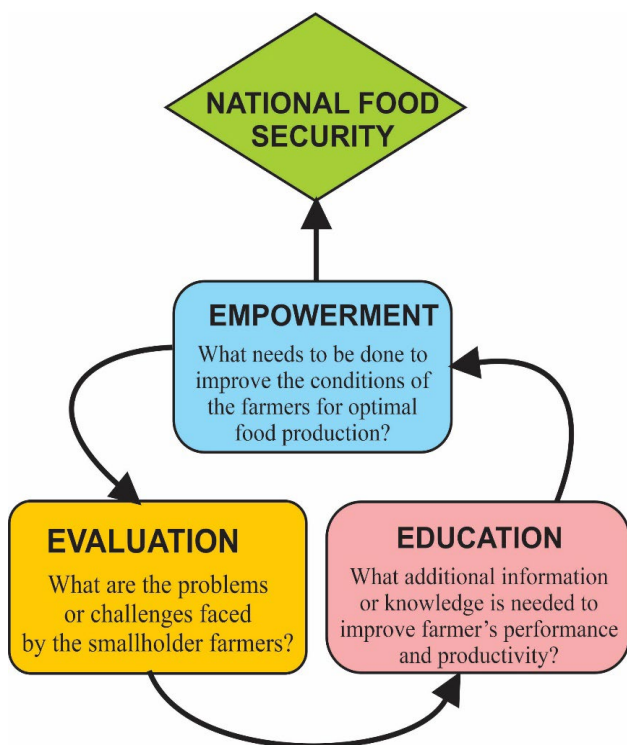
In Nigeria, several studies have shown that most households remain food insecure and the prevalence of food insecurity has continued to increase (Adekoya et al. 2023). Assessment of the prevalence of household food insecurity and its associated factors in Ibadan, Nigeria, revealed an overall prevalence of 81%, with higher food insecurity in urban slums compared to rural areas (93.2% versus 68.3%) (Oderinde et al. 2023). This suggests that households with under-5 children in urban slums are more likely to have food insecurity compared to those in rural areas, owing to several reasons such as limited access to land, low income levels, high food prices, unemployment, inadequate infrastructure, and limited social support, among several others (Oderinde et al. 2023). In a study of 280 farmers Emelife et al. (2023) showed that there is looming food insecurity in the south-east region of Nigeria and therefore recommended proactive policy responses in support of farmers. Analysis of data to ascertain the level of food insecurity among 451 households in rural northern Nigeria showed that more than 50% of the households are food insecure (Oyedira and Olajid, 2023). Evidence of food insecurity among farming households in Ikere Local Government Area of Ekiti State, Nigeria, using the Household Food Insecurity Access Scale (HFIAS) approach, showed that 83.7% of the households were food insecure at varying levels (Ajao et al. 2023). The prevalence of food insecurity among 3519 pregnant women aged 15–49 years studied by Ujah et al. (2023) found that nearly 75%

reporting moderate to severe food insecurity.

Hunger and malnutrition, though having many causes are an immediate consequence of severe food insecurity. A recent study found the prevalence of stunting, underweight, and wasting to be 47.4%, 32.7%, and 22.6%, respectively, among 2350 under-fives from three local governments in Niger State, Nigeria (Olabimpe and Adeola, 2023). In Northwest and Northeast Nigeria, it was projected that about 6 million children under the age of five may suffer from acute malnutrition between May 2022 and April 2023. This includes 1,623,130 Severe Acute Malnutrition (SAM) cases and 4,308,404 Moderate Acute Malnutrition (MAM) cases. Furthermore, about 511,890 pregnant and lactating women will likely be acutely malnourished and would thus need nutrition interventions (IPC, 2022).

### TRIPLE E FRAMEWORK

The Triple E framework entails problem identification among the smallholder farmers in the rural communities of Nigeria and providing solutions to the problems. It has three components: Evaluation, Education, and Empowerment (Figure 1). The goal of the triple E is to strengthen rural agricultural activities, ensure adequate and healthy food production, and enhance food and nutrition security, particularly among rural dwellers. This could be achieved via the assessment and analysis of the problems associated with food production in a targeted community or population, capacity strengthening via farmer’s education, and support for farmers with farming tools.



**Figure 1.** Conceptual Triple E Model, or AOAB (Abdulwaliyu, Okoduwa, Arekemase, and Batari) Triple E Model of Food Production for Sustainable Food and Nutrition Security

#### EVALUATION

Depending on the subject matter, there are different definitions of evaluation, but in this context, we define evaluation as “the systematic collection and analysis of data to enable the researcher to identify key challenges, problems, and needs of the farmers in

order to improve their effectiveness for optimal food production.” The objective of the farm evaluation is to assess the productivity of the farm and also to assess the different factors present in the farm system that could affect food production. The evaluation phase answers the questions: who, where, and what? Who are the farmers, where do they live, and what are their challenges?

### WHAT TO EVALUATE

- The number of farmers and farms: Unlike developed countries, Nigeria has no statistics on the number of farmers and farms. The USA, for instance, has around 2,019,000 and 2,012,050 farms as reported for the years 2020 and 2021, respectively (USDA, 2022). Having statistics on the number of farms, farmers, and acres in every state in Nigeria would give the government a budgetary idea for any agriculture interventions and may also help provide information on the status of agriculture or food production in a region, state, or country as a whole. It may also help mitigate the issue of non-farmers in Nigeria benefiting directly from any interventions meant for farmers.
- The size of arable lands and to what extent they have been utilized or underutilized: arable lands are lands that could be used for growing crops. Unfortunately, these lands are lost to degradation through anthropogenic activities, urban development, climate change, etc. Preserving and maintaining the amount of arable land is essential for food security (Chen et al. 2019), especially for the future.
- The amount of food produced and the amount of food needed to be produced to meet the food requirements of the growing population.
- Assessment of local or indigenous knowledge of the smallholder farmers in the rural communities: this may enable the government to design strategies that could improve local food production, the livelihood of the farmers, and nutritional outcomes for individuals living in the rural communities, especially women and children.
- Assessment of social, economic, and political factors associated with food production in rural communities in Nigeria. In this context, social factors are problems faced by farmers that have negative implications or consequences for food production and thus need to be addressed. For social challenges to be recognized as problems, the farmers living in a specific geographical region or community have to first of all recognize them collectively as problems and put forth the problem(s) before the government or policymakers. Unfortunately, the rural farmers in Nigeria have little or no power to do so. The most convenient avenue to do so (table their collective problems) is through their representatives, because the representatives are the epitome of a functional democracy. They should be able to understand and influence the problems (especially those that have social and economic implications) of the farmers in their constituency.
- Assessment of the quality of the soil upon which the food is grown: healthy soils are the basis for adequate and healthy food production, hence food security. It has been observed in Nigeria that crop production, yield, and nutritional value have significantly declined due to poor soil quality (Ndubuisi and Kelechi, 2021). Therefore, assessment of soil quality and protecting the soil’s biological, physical, and chemical integrity are of great importance in ensuring food security (Zhu, 2009).
- Assessment of national household food security and nutritional status, especially among rural dwellers: periodic assessment of household food and nutrition insecurity should be taken into serious consideration for proper nutrition policy formulation (Tamiru and Belachew, 2017). To reduce the number of malnourished children in Nigeria, the government should adopt a novel SIT-250/4/1 approach. This novel initiative, also known as the One Million Initiatives could help reduce the number of malnourished children in Nigeria in a short time frame. The idea is to conduct a periodic survey to identify and treat 250 thousand malnourished children four times (every quarter) in a

year (SIT-250/4/1). And by extension, it may also necessitate identifying specific determinants of malnutrition, because to reduce malnutrition considerably, one must understand its causes (Ogunnaike et al. 2020). Treatment of malnourished children has been the sole responsibility of non-governmental organizations, particularly UNICEF, which provides over 75-80% of the global demand for ready-to-use therapeutic food (RUTF) suitable to treat malnourished children (UNICEF, 2023). Therefore, to reduce malnutrition drastically, the government must also shoulder the responsibility of tackling early childhood malnutrition.

## TARGET GROUP

Smallholder farmers should be the focal group. In the past, smallholder farmers in Nigeria generated around 98% of the country's export crops (Fogg, 1965). Smallholder farmers are not only the backbone of food security, but they are also central to achieving food security in Nigeria and the world at large. The Food and Agricultural Organization and the World Health Organization have recognized that smallholder farmers are the key frontline players towards achieving sustainable food and nutrition security, and strengthening the rural agriculture system is the key pathway to sustainable food security (Dioula et al. 2013). Therefore, giving the necessary support to smallholder farmers could improve their production capacities, which may have positive impacts on nutrition and food security at local, regional, and national levels (Louhichi et al. 2020). If due attention is not paid to rural farmers, then in a few years, the government may have no choice but to subsidize foods purchased by Nigerians. Because at that time, only those at the top end of the social ladder, would have the opportunity to import foods or produce locally and would sell them for any price. The government must learn from the mistakes of the West, where foods are heavily subsidized. A study by Nordin and Nordin (2017) acknowledged that, in most parts of the world, governments are now spending billions of dollars to subsidize food. And because many of these so-called foods are lacking in some nutrients, governments are also forced to spend billions of dollars to subsidize nutritional treatments via fortification, supplementation, and medical interventions (Nordin and Nordin, 2017).

## EDUCATION

The farmers' education may be strictly based on the outcomes of the problems or challenges identified during the evaluation phase of the Triple E framework. Furthermore, practical demonstrations of the best farming practices or agricultural activities that could improve food yield and the quality of the food produced should be considered. Education is important to improving agriculture productivity; hence, the need to initiate policy interventions that will enable the use of education to increase farmers' performance and productivity is paramount (Eric et al. 2014). Also, there is an urgent need to educate farmers in the rural communities of Nigeria on climate change adaptation (Anabaraonye et al. 2019).

By extension, there is a need to educate people on dietary diversity, especially given the fact that humans rely strongly on fewer foods, particularly rice, maize, and wheat, as sources of energy. Whereas there are about 30,000 edible plants discovered so far, only around 23% have been tapped for edible purposes. Relying on fewer edible plants, and considering the ever-growing population, efforts to curb issues of food insecurity, hunger, and malnutrition may be futile ((Nordin and Nordin, 2017).

## EMPOWERMENT

Empowerment in agriculture plays an important role in improving food production and nutrition security (Mwololo et al. 2022). The

evaluation phase of the Triple E model is the key determinant of the farmer's empowerment. After the evaluation of the farmers' needs and the education of the farmers, what else needs to be done by the farmers to improve food production in rural communities? What best agricultural interventions can improve local or indigenous practices in the most cost-effective ways? Rural farmers have sound collective experience and practical solutions (based on their own indigenous knowledge) to produce food within their capacity. Hence, if given all the necessary support that they need, a more equitable and sustainable agriculture may be achieved.

Some of the challenges and/or needs of the farmers are persistent, while others are dynamic. The dynamic challenges may need to be evaluated periodically, as different problems posed to farmers at different times and locations may require different solutions. The persistent problems or challenges, on the other hand, are the needs or challenges faced by the farmers and have lasted for more than a decade or decades. Some of these problems that have lingered for so long are insecurity, poor policy implementation, low-yielding crops, and poor breeding practices. Hence, the farmers in the rural communities of Nigeria may need to be empowered or provided with the following:

- Adequate Security: adequate security is a necessary tool for adequate food production, and no nation can be food secure amidst insecurity, especially in rural communities (Abdulwaliyu et al. 2023).
- Non-corrupt policies and programs that will make farming more profitable: good policies are important factors for food sovereignty and can substantially influence consumer demands (Sabaté et al. 2016). One study observed that a one percent increase in farmers' access to agricultural finance is associated with an increase in food production by 0.002 to 0.006%; more agro-funding at low rates would also motivate the farmers (Osabohien et al. 2020). Despite the recognized impact of agro-financing on food production, the government should reduce or desist from giving loans to non-farmers. In fact, in Nigeria non-farmers benefit more from monies or loans meant for farmers, which is why desired results are not usually achieved. If government support for farmers were material-based (mini-mechanical farm equipment, seed, etc), much of this problem might be avoided. It is worthy to note that, no matter how good a policy is and the amount of money involved, it will be fruitless amidst the NO-STEP (no sincerity, transparency in execution of policy) syndrome. This syndrome is the major reason, or perhaps the only reason, why Nigeria and other African countries are progressing very slowly. If the government does not improve, calls for development in the agricultural sector (and other sectors) would amount to little, and food security would certainly not be achieved.
- Higher-yielding crop varieties: it has been observed that an increase in crop yields significantly lowers hunger rates (Ngoune and Shelton, 2020).
- Better livestock breeding practices

Food distribution or subsidy have always been major approaches to improve the welfare of food-insecure households (Shittu et al. 2018), especially for people from rural communities, but sustainability is always a problem. Hence, giving the food-insecure household the necessary tools, knowledge, and skills to enable them to produce adequate food on a sustainable basis is a superior option. It is worthy to note that many African countries, including Nigeria, continue to battle with hunger and undernourishment despite receiving food from international organizations (Wudil et al. 2022). Thus, it is necessary for African leaders to take a measurable, aggressive approach to solving the hunger crisis rather than relying on foreign aid.

Adopting the Triple E framework would serve as a catalyst for the social, economic, and human development of rural communities and would help meet the goals of poverty reduction, zero hunger, and malnutrition reduction. The short-term advantage of adopting the Triple E framework would involve a lower cost of

farming and higher profits, while at the same time offering consumers the opportunity to pay lower food prices. The long-term advantage is stable and sustainable rural, regional, and national economies. The framework should be a continuous process, even if the desired results are achieved at one point in time. The Government of Nigeria could institute an independent National Centre for (or Institute of) Food and Nutrition Security that should be responsible for the implementation of agriculture and/or food and nutrition policy.

Inflated or artificial reporting to the public on such policies might then be reduced. Any program aimed at increasing food production in Nigeria needs to be evaluated and supported by a decrease in food inflation and reliance on imports, a rise in food exports, enhanced food and nutrition security, and a decrease in poverty within rural areas. Also, the centre or institute should be responsible for gathering and maintaining statistics on the number of farmers, farms, and acreages, both arable and under cultivation. Furthermore, the centre or institute should periodically evaluate how much food is produced, how much is imported and exported, and how much is required to feed the growing population of Nigeria.

The Triple E framework could be regarded as a problem identification and problem-solving framework. It could assist the government in identifying the true nature of the underlying problems responsible for low food production. All phases of the framework are critical steps towards ensuring and achieving food and nutrition security. For Nigeria to be food secure, food production must be adequate (more than the population demands and/or requirements) on a sustainable basis (Abdulwaliyu et al. 2023).

## CONCLUSIONS

In the past, food production in Nigeria was the chief source of revenue for the government, owing largely to the initiation of noble policies and the good implementation of those policies. But its pre-eminence was undermined by the discovery of oil. Since

then, the policies formulated to boost food production in Nigeria have had little or no impact on food production, a key pathway for nutrition and food security. The reason for this is often the corrupt or poor implementation of government policies. The creation by the government of an independent centre or institute to implement policies for achieving food and nutrition security could help overcome these constraints.

Furthermore, the government has no reliable model for the assessment, oversight, and execution of its policies. Therefore, the present study outlines the Triple E framework, which encompasses problem identification and providing solutions to the problems. By extension, the framework would enable the government and other important and interested stakeholders to know the challenges (social, economic, political, or natural) faced by the farmers in rural communities and what needs to be done to improve the conditions of the farmers or to overcome these challenges. Additionally, increasing food production is an obligatory step towards ending or reducing hunger (food deprivation) and malnutrition in Nigeria. The framework, if adopted, would help the government and other stakeholders formulate policies that may have positive impacts on the livelihood of rural farmers. And also, any food policy, if implemented with all degrees of fairness, would help to achieve poverty reduction (SDG 1), zero hunger (SDG 2), and good health and wellbeing (SDG 3).

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## CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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