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The U.S. Government's Global Food Security Strategy and the Effectiveness of Agriculture-Led Growth Through the Perspectives of Climate Change and Sustainability

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THE U.S. GOVERNMENT'S GLOBAL FOOD SECURITY STRATEGY AND THE EFFECTIVENESS OF AGRICULTURE-LED GROWTH THROUGH THE PERSPECTIVES OF CLIMATE CHANGE AND SUSTAINABILITY

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Abstract

The United States Agency for International Development's (USAID) Global Food Security Strategy Fiscal Year 2022-2026 addresses food security in developing countries. The U.S. Global Food Security Strategy set forth by USAID lays forth a strategy for increasing food security in twelve targeted low-income and developing nations. How well the USAID policy does this with consideration of climate change, sustainability, and socio-economic well-being is crucial to examine given the fact that climate change impacts and predictions are now affecting food systems at all stages, from growth through production. The following discussion combines elements of a policy brief and research paper to provide analysis and critiques of this policy. This paper will argue that one of the policy's primary objectives, inclusive and sustainable agriculture-led economic growth, is a generalized approach that may not lead to success in all of the target countries. This is in part due to the role agriculture plays in contributing to climate change. Rather than agriculture-led growth, the policy should instead work to address food insecurity through customized solutions for each target country or region and avoid promoting a single strategy. Additionally, the policy could be improved by incorporating alternative food sources to aid in expanding the availability of food and help shift away from a sole focus on agricultural production. With these two policy alternatives, the U.S. Global Food Security Strategy will be better positioned to succeed in mitigating food insecurity globally.

Introduction

The United States Agency for International Development's (USAID) Global Food Security Strategy Fiscal Year 2022-2026 addresses food security in developing countries. The issue of food security is of major concern and negatively impacts not only the physical health of individuals in a region, but also other areas of socioeconomic development. How well the USAID policy does this with consideration of climate change, sustainability, and socio-economic well-being is crucial to examine given the fact that climate change impacts and predictions are now affecting food systems at all stages, from growth through production (Loboguerrero et. al., 2019; Porter et. al., 2014).

The following discussion combines elements of a policy brief and research paper to provide analysis and critiques of this policy followed by suggested alternatives which would better position the Global Food Security Strategy for success in mitigating food insecurity in the targeted developing countries. In order to ground this analysis and provide additional context for points made in this research, case studies from a number of countries and regions will be presented including Colombia, Honduras, Ethiopia, Malawi, Nepal, and Tanzania. The literature reviews and interviews which form the foundation of the research for this paper help to provide contextual information about how policies are written, and how the U.S. Global Food Security Strategy sits on the world stage based on the positionality of the United States on the world stage. This policy touches upon issues of international aid, sustainable development, and climate change, making the context surrounding it important to note when interpreting the written policy. Therefore, the following sections will discuss the background and context surrounding this policy, before presenting a research-based discussion of how the policy could be improved upon in order to succeed in sustainably mitigating food insecurity in the targeted countries.

Problem Identification

Food insecurity is defined by the Food and Agriculture Organization of the United Nations (FAO) as when an individual or a household lacks "regular access to enough safe and nutritious food for normal growth and development and an active and healthy life." (FAO, n.d.). In addition to this broader definition, the FAO categorizes food insecurity as mild, moderate, or severe (FAO, n.d.). Similarly, the United States Department of Agriculture (USDA) defines food insecurity using tiers of limited access to food, ranging from high food security and marginal food security, to low food security and very low food security (USDA - ERS, 2022). This is a shift from pre-2006 definitions from the USDA which only included categories of food security, food insecurity without hunger, and food insecurity with hunger (USDA - ERS, 2022).

While food insecurity exists even in the wealthiest nations, one of the primary issues when looking at food insecurity on a global scale is the disproportionate prevalence of food insecurity in developing countries versus developed countries (U.S. Government Global Food Security Strategy, USAID, n.d.)[1]. Research conducted in 2014 by the USDA found that 27% of the world's population was food insecure, with roughly half of the populations in low-income countries experiencing food insecurity while only 10% of the population in developed countries was found to experience food insecurity (Smith & Meade, 2019).

The U.S. Global Food Security Strategy Fiscal Year 2022-2026[2] set forth by USAID lays forth a strategy for increasing food security in 12 targeted low-income and developing nations. It is addressed by and from the perspective of the United States Government (USAID, n.d.). The policy discusses solutions which are mainly driven by its core objectives, but the policy could be

[1] Citation for: United States Agency for International Development. United States Government Global Food Security Strategy Fiscal Year 2022-2026. (n.d.). Hereafter referenced using abbreviated citation: USAID, n.d.

[2] Hereafter referred to by abbreviation: U.S. GFSS

improved upon by incorporating new solutions which would position the strategy to do a better job of accounting for climate change and sustainability in each of the 12 targeted nations. The policy should work to address food insecurity through customized solutions for each target country or region, rather than a single strategy to be applied to all cases. Another solution to improve the policy may be the incorporation of alternative food sources to aid in expanding the availability of food sources and help shift away from a sole focus on agricultural production. For the purposes of the following research paper, before discussing alternative policy suggestions an analysis of this policy must be done alongside an examination of the background and context under which it exists.

Background[3]

The following section provides background information on the causes of food insecurity, the main pillars which define food insecurity, the political and historical context, and the role that sustainability plays in discussing and mitigating food insecurity. Throughout the remainder of the policy analysis this information will serve as a helpful framework to discuss the policy and adjacent topics.

What Causes Food Insecurity?

The question of what causes food security does not have a simple answer, nor is there one answer which fits all cases of food insecurity. There are, however, patterns of causes and effects which have historically led to food insecurity. Similarly, food security is inextricably linked to poverty, which in itself has a web of complex causes and manners of existing. In addition to lack

[3] Portions of the following "Background" section are based on works submitted by this author in CLIM-5035-01 taught by Stella Hassan and CLIM-5020-01 taught by Mohamed Behnassi.

of livelihoods, other causes of food insecurity may include extreme climate events, unstable government, war and conflict, unsustainable agricultural practices, lack of technology, and rapid population growth (Pawlak & Kołodziejczak, 2020).

The impacts of climate change are significant contributors to increasing hunger and malnutrition due to increased frequency and intensity of climate events such as droughts, floods, and storms (Kumar et. al., 2018). These events often bring damage to agricultural crops, destruction to infrastructure, or otherwise negatively impact livelihoods resulting in an inability to purchase or access food (Kumar et. al., 2018). Already, for example, climate change impacts in East Africa over the past several years have led to a decline in agricultural production by shortening growing seasons, increasing stress on water supply, and rising temperatures which leads to fewer and smaller plant organs with shorter production seasons (Adhikari et. al., 2015; Niang et. al., 2014; Prasad et. al., 2008; Stone, 2001).

Unsustainable agricultural practices, such as overuse or incorrect use of pesticides and fertilizers, monocropping/continuous farming, and other causes of soil nutrient depletion can lead to decreased crop yield and even a decrease in the nutritional quality of crops (Adhikari et. al., 2015: 112; Sanchez et. al., 1997: 1-46; Tripathi et. al., 2022: 1). An example of this can be found in the Terai region of Nepal, where soil nutrient depletion due to erosion and improper use of chemical fertilizers has led to a decline in soil fertility, reducing crop yield (Tripathi et. al., 2022: 1). An overall reduction in crop yield can lead to decreased food security, including reduced supply and lowered nutritional values of food (Bindraban et. al., 2012: 478-488; Tripathi et. al., 2022: 1). Cases such as that of the Terai region of Nepal make it evident that if agriculture is to be a primary solution to food insecurity, then healthy soils are necessary for sustained success (Tripathi et. al., 2022).

Instability in government, war, and conflicts have historically often led to disruptions in food security. A case of this can be found in Venezuela, where political instability, inflation, and economic downturn has contributed to a severe decline in food security (Herrera-Cuenca et al., 2021). Previously, Venezuela produced 70% of the food needed to sustain its population through crop and livestock agriculture, with the remaining 30% being imported (Herrera-Cuenca et al., 2021: 1). In recent years, however, unhelpful government policies put domestic food producers at a market disadvantage; around the same time, oil prices fell and the Venezuelan economy fell into decline which led to a lack of access to food (Herrera-Cuenca et al., 2021: 1-2). As well as governmental instability, routine transitions of power can also result in damage to the longevity of food and nutrition security policies, particularly when there is a change of party in power (Escobar-Alegria et. al., 2021). Policies which require long-term implementation in order to succeed may become unsustainable if new parties in power disagree with aspects of the policy (Escobar-Alegria et. al., 2021).

Pillars of Food Security

The U.S. Government Global Food Security Strategy defines food security and nutrition as one combined term, with the definition “access to - and availability, utilization, and stability of - sufficient food to meet caloric and nutritional needs for an active and healthy life” (USAID, n.d.). This definition presents the now commonly accepted four dimensions, or pillars, of food security, as defined by the FAO (FAO, IFAD and WFP, 2013). These four dimensions of food security were identified by the FAO in “The State of Food Insecurity in the World” report published in 2013 as “food availability, economic and physical access to food, food utilization and stability” (FAO, IFAD and WFP. 2013). Establishing these dimensions in 2013 served as a tool for measuring and monitoring food security status and progress alongside agendas such as

the Millennium Development Goals (MDG) (FAO, IFAD and WFP. 2013). In the most recent publication by the FAO, these four dimensions continue to be utilized to define and measure food insecurity:

> [Food availability is defined as] Whether or not food is actually or potentially physically present, including aspects of production, food reserves, markets and transportation, and wild foods.
>
> [Food access is defined as] If food is actually or potentially physically present…whether or not households and individuals have sufficient physical and economic access to that food.
>
> [Food utilization is defined as] If food is available and households have adequate access to it….whether or not households are maximizing the consumption of adequate nutrition and energy. Sufficient energy and nutrient intake by individuals is the result of good care and feeding practices, food preparation, dietary diversity and intra-household distribution of food, and access to clean water, sanitation and healthcare. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals.
>
> [Food stability is defined as] If the dimensions of availability, access and utilization are sufficiently met, stability is the condition in which the whole system is stable, thus ensuring that households are food secure at all times. Stability issues can refer to short-term instability (which can lead to acute food insecurity) or medium- to long-term instability (which can lead to chronic food insecurity). Climatic, economic, social and political factors can all be a source of instability.
> (The FAO, IFAD, UNICEF, WFP & WHO, 2022: 202-203)

It is recognized that in order to achieve food security, the four dimensions (or pillars) of food security must be met (Committee on World Food Security, 2014). This is not only apparent in reports and literature published by the FAO and other organizations, but also in policies aimed at increasing food security including the U.S. Government Global Food Security Strategy. Presently, some scholars and organizations are proposing that additional dimensions be added and accepted as key pillars to food security (Aborisade and Bach, 2014; Clapp et. al., 2021;

Guiné et. al., 2021; The FAO, IFAD, UNICEF, WFP & WHO, 2022 in the World, 2022). Among these proposed additions are pillars of climate change, agency and sustainability (Clapp et. al., 2021; Guiné et. al., 2021; The FAO, IFAD, UNICEF, WFP & WHO, 2022 in the World, 2022).

In their argument to add climate change as an additional dimension to food security, Guiné et. al. argue that gaps in the concept of food security as defined by the four main pillars exist in relation to sustainability and other variables related to climate change impacts (Guiné et. al., 2021). Additionally, they note the possibility that some approaches used to combat undernutrition may have the potential to contribute to climate change, which is one reason that climate change should be considered amongst the pillars of food security (Guiné et. al., 2021). In another scholarly article published in 2021, Clapp et. al. argue that there should be six, rather than four, main dimensions to food security, stating that agency and sustainability should be added to the already-recognized four pillars. Similarly, The FAO, IFAD, UNICEF, WFP & WHO, 2022 in the World 2022 publication by the FAO acknowledges that agency and sustainability are two additional dimensions of food security which have been proposed by the High Level Panel of Experts (HLPE) of the Committee on World Food Security (CFS) (The FAO, IFAD, UNICEF, WFP & WHO, 2022 in the World, 2022).

Sustainability/Increased Production

As the world population grows, the demand for food increases. The global population has been expected to reach between 9.2 and 9.7 billion by 2050 and the demand for food is expected to increase by between 59% - 98% according to projections made in 2013 by Valin et. al. (Elferink, 2016; Fukase et. al., 2017; Pawlak & Kołodziejczak, 2020: 2; Silva, 2018; Valin et. al., 2013: 1). In order to accommodate such an increase in food demand, it is clear that the amount of food available must increase. Thus far, the majority of policy makers, governments, and other

entities have concluded that an increase in food availability means an increase in agricultural production. Despite this being the most commonly proposed solution, increased agricultural production could become more challenging for developing countries than for developed countries (Pawlak & Kołodziejczak, 2020). In their 2020 article assessing the role of agriculture in food production, Pawlak and Kołodziejczak argue that agricultural production may need to increase by 60-70% by 2050 in order to feed the projected global population (Pawlak & Kołodziejczak, 2020: 2; Silva, 2018). And yet, developing countries where much of the world's population growth and food insecurity takes place may not have the capacity to produce food at higher rates. This is due to technology and knowledge barriers, poverty, conflict and war, natural disasters, climate change, and other potential factors (Pawlak & Kołodziejczak, 2020).

Impacts of climate change, which are increasingly leading to drought, flood and storm conditions in tropical regions, are a significant barrier to increasing agricultural production in developing countries (Trenberth, 2005; Parker et. al., 2019). Having some of these contributing factors in common, however, does not mean that tropical, developing nations are homogenous countries with the same needs; rather, developing countries are highly diverse in their situations and needs in relation to food insecurity and different approaches to policies are needed in order to combat food insecurity in different types of food-insecure countries (Pawlak & Kołodziejczak, 2020).

Policies/History

Challenges with food security is a global issue which many policy makers, scholars, NGOs, and governments have all worked to address through a variety of approaches. The effectiveness of these approaches can be varied and difficult to assess, particularly when examining the long term sustainability of food security solutions. The United States has created

and implemented several policies addressing food insecurity beyond its borders and in low-income, underdeveloped countries (Food for Peace and Foreign Policy., n.d.; Feed the Future Newsletter, 2011; Office of Food for Peace, n.d.). In 1954, the Food for Peace Act was put into place to provide food supplies globally by utilizing U.S. agricultural surplus (Office of Food for Peace, n.d.; Food for Peace and Foreign Policy., n.d). This program is still in existence, with the most recent report having come out of the USAID office in 2018 (Office of Food for Peace, n.d.). Later, in 2010, following the 2009 G8 summit in Italy the United States Agency for International Development (USAID) launched the Feed the Future initiative aimed at combating food insecurity in a number of developing countries (Feed the Future Newsletter, 2011). Following its initial release, multi-year strategy plans were released for individual countries which the initiative aimed to address, spanning from 2011-2015. These countries included Honduras, Guatemala, Haiti, Zambia, Uganda, Tanzania, Senegal, Rwanda, Nepal, Mozambique, Mali, Malawi, Liberia, Kenya, Ghana, Ethiopia, Cambodia and Bangladesh. This list has evolved over the course of the Feed the Future program which is still being implemented in 2023.

Most recently, Feed the Future is presented in the United States Government Global Food Security Strategy, which has now been published in two iterations for fiscal year 2017-2021 and fiscal year 2022-2026. The Feed the Future Program and the U.S. Global Food Security Strategy are derived from one another, and for the purpose of this policy briefing, will be referenced by referring to the U.S. GFSS as the written policy, and to the Feed the Future program as the program itself. The U.S. GFSS policy is a presentation of the implementation of the Feed the Future initiative and details its progress and implementation across the twelve countries the program currently operates in: Bangladesh, Ethiopia, Ghana, Guatemala, Honduras, Kenya, Mali, Nepal, Niger, Nigeria, Senegal, and Uganda (USAID, n.d.). The executive summary for the

policy states that it is “an integrated whole-of-government approach that aims to end global hunger, poverty, and malnutrition through the Feed the Future initiative”, which also works towards implementing the Sustainable Development Goals (SDGs) and the 2030 Agenda (*Global Food Security Strategy “Refresh” (GFSS-R)*, n.d.). The policy begins by discussing the up to date progress, successes, and failures of the Feed the Future initiative, then laying out the proposed strategy for the new iteration of the initiative from 2022-2026 (USAID, n.d.). The three main objectives of the policy are presented:

- Inclusive and sustainable agriculture-led economic growth
- Strengthened resilience among people and systems
- A well-nourished population, especially among women and children

  (USAID, n.d., p.23-24).

In addition to the above objectives, aspects such as working with marginalized and/or vulnerable populations, the climate change crisis, and the United Nations Sustainable Development Goals (SDGs) make up other focal points of the policy (USAID, n.d.). As the most currently significant U.S. policy addressing global food security, the U.S. Government Global Food Security Strategy Fiscal Year 2022-2026 calls for a thorough examination and potential critiques. While sustainability is cited as a primary objective of the policy, there may be important aspects of global sustainability being overlooked in the initiative. Similarly, future impacts of climate change may render some aspects of the Feed the Future initiative insufficient in the coming years, making it crucial that upcoming iterations of the policy center climate change predictions and adaptation solutions. While increasing agricultural production to combat food insecurity is a useful strategy, alternative food sources which can aid in achieving food security through more sustainable means should not be overlooked. Additionally, countries

struggling with high rates of food insecurity should be examined individually and customized solutions should be provided in the U.S. GFSS policy, rather than a one-size-fits-all approach. In the following discussions the Feed the Future initiative and its corresponding policy, the U.S. Government Global Food Security Strategy Fiscal Year 2022-2026, will be analyzed through the lens of these proposed alternative policy strategies.

Context[4]

The following section provides contextual information surrounding politics and history, academic and scientific perspectives, climate change issues in the tropics, and a comparison to issues of food insecurity within the United States. Examining the context of the U.S. GFSS in these areas will help to ground the forthcoming policy analysis, critiques, and suggestions.

Political and Historical Context

The primary political and historical context in this policy is the positionality of the United States as a highly developed top global economy with a history of exploitation of less developed countries with smaller economies. In order to effectively discuss the U.S. Government Global Food Security Strategy, it is necessary to examine the way the United States has historically set the stage with how it executes international policies. The relationship between U.S. food and agricultural policies and foreign food economies are important contextual elements alongside the history of U.S. international aid policies.

Specifically, U.S. food aid policies have come with criticisms of damaging corporate interests and politicized aid. Although historically U.S. in-kind food aid has been used simply as

[4] Portions of the following "Context" section are based on works submitted by this author in CLIM-5020-01 taught by Mohamed Behnassi.

a way to dispose of surplus agricultural food supply, over time this has declined as surpluses have become less common. However, in more recent years corporate grain and shipping interests have lobbied in government and to represent NGOs who distribute food aid in order to continue to utilize it as a disposal mechanism for production surpluses. This is an example of prioritization of corporate interests over effective aid because in many cases it has been shown that in-kind food aid is generally less effective than cash-based aid programs (Jeong & Trako, 2022). In fact, following the Doha Round negotiations in 2003/2004 by the World Trade Organization, there was pressure put on the United States to shift away from in-kind food aid transfers. In-kind food aid is often less efficient for a variety of reasons. In-kind food aid is more time consuming to send and can often take weeks or months to arrive from the United States to its destination. It also may be sold in markets as opposed to given as a donation, meaning that it can flood local markets and distort prices leading to local residents being unable to afford it. Lastly, it becomes more challenging and less likely that local food preferences and traditions will be taken into consideration, leading to potential issues with the distribution of culturally inappropriate foods. Currently, the U.S. Government Global Food Security Strategy begun in 2022 implements a combination of in-kind, cash, and technical-based food aid, a shift away from previous aid policies based on entirely in-kind food aid (USAID, n.d.). (Clapp & Fuchs, 2009).

There are instances throughout history in which United States policy has ultimately limited the growth of food economies in developing countries, for example via agricultural subsidies such as with corn production in Mexico (Kelly, 2019). The U.S. Farm Bill is an example which showcases the impact of U.S. corn subsidies on the Mexican corn industry, including farming and the corn sale market. The introduction of corn subsidies in the U.S. Farm Bill has caused significant changes to the Mexican corn industry (Kelly, 2019; Relinger, 2010).

The beginning of this can be linked to the signing of the North American Free Trade Agreement, or NAFTA, in 1994 (Relinger, 2010). Because NAFTA allowed U.S. grown corn to be sold freely in Mexico, domestically grown Mexican corn saw major price drops (Relinger, 2010). This created a trickle-down effect where small, rural Mexican growers were forced to stop farming and move into more urban areas of Mexico after falling into poverty, resulting in a large migration towards cities which took a toll on rural communities (Relinger, 2010). Examples such as this one provide a lesson that the United States must exercise caution when creating policies which may affect the economic wellbeing of developing countries. In the U.S. GFSS, there is a section which discusses how the policy will work to increase exports of American goods (USAID, n.d.). When implemented, American exports and any in-kind donations should be thoroughly vetted by policymakers and involved parties for potential negative impacts on the market economies of the destination countries.

Academic and Scientific Context

The discussion regarding food insecurity amongst the academic community creates additional context through which to examine food insecurity policies. While the academic discussion is often not centered around policy itself, as researchers conduct studies on food insecurity, sustainable food production, land management and related topics, recommendations are made which become useful to policymakers.

Much of the current discussion around global food insecurity is centered on agricultural productivity and its correlations with climate change (Baldos & Hertel, 2014). In their 2014 article discussing this, Baldos and Hertel note that increases in agricultural productivity over the past few decades have contributed to a global increase in food availability (Baldos & Hertel, 2014). However, they also note that there are now concerns that these increases in agricultural

productivity are causing crop yields to reach their biophysical limits, particularly for grains such as maize, rice, and wheat which are staple foods in many developing areas of the world (Alston et. al., 2009: 1209-1210; Baldos & Hertel, 2014: 555; USAID, n.d.). In the study, Baldos and Hertel conclude that the impacts of climate change on nutritional outcomes of crop growth is uncertain, but the key to improving food security outcomes is increasing productivity growth in agriculture (Baldos & Hertel, 2014). In the U.S. GFSS it is acknowledged that increasing agricultural productivity will help to address food insecurity, but that this must be done with increased output rather than increased land use (Jayne & Sanchez, 2021; USAID, n.d.).

In a 2019 study conducted by Smith et. al., a variety of land management practices are examined to determine which are best suited to combat food security while mitigating climate change and land degradation (Smith et al., 2019). Smith et. al. address increased land productivity and note that it is a useful strategy to reduce greenhouse gas emissions by increasing productivity on existing agricultural lands rather than expanding land area use (Burney et. al., 2010; Smith et al., 2020). However, this is only the case if it is done sustainably. Smith et. al. report that if increasing land productivity were to be achieved by using agrochemical inputs, then it could be detrimental to environmental sustainability and mitigation of greenhouse gas emissions (Pretty et. al., 2018: 441-446; Smith et al., 2020: 1537). Both Smith et. al. and Baldos and Hertel approach reducing food insecurity from a perspective which prioritizes addressing undernutrition, and Smith et. al. in particular focus on achieving this through proper land management (Baldos & Hertel, 2014; Smith et. al., 2020). The U.S. GFSS shows some similarities in its approach, particularly with a focus on increased land productivity through the policy's Feed the Future initiative (USAID, n.d.).

It should also be considered that increases in agricultural productivity may put strain on limited water resources, particularly in areas where water accessibility is already an issue (World Bank, 2016). This potential problem correlated with increases in agricultural productivity is discussed in the U.S. GFSS (USAID, n.d.; World Bank, 2016). A study by Ayinde et. al. similarly examines agricultural production in the context of climate change in Nigeria, one of the nations targeted in the U.S. Government Global Food Security Strategy (Ayinde et. al., 2010). Ayinde et. al. conclude that irrigation systems are the best way to keep water use sustainable in agricultural production (Ayinde et. al., 2010). Despite this, the U.S. GFSS states that irrigation systems are frequently inefficient in areas with food insecurity due to old or leaky irrigation pipes, and improving irrigation systems is a target area in the policy (USAID, n.d.).

In a 2020 study, Molotoks et. al. discuss the impacts of climate change, population, and land use on global food security. Molotoks et. al. make clear in their arguments that population growth, and the increased food demands it creates, is a main driver of food security globally (Molotoks et al., 2021). The study also notes that countries with declining populations have the lowest food insecurity rates, while the opposite is true for countries projected to experience rapid population growth (Molotoks et al., 2021). For example, the countries with the highest expected population growth are India, Nigeria, Democratic Republic of Congo, Pakistan, Ethiopia, Tanzania, and the United States (Molotoks et al., 2021: 2; United Nations, 2019). In these countries, it is expected that resources for agricultural technology will become more limited as more food is needed and it becomes harder to produce the food sustainably (Molotoks et al., 2021: 2). Despite this fact, the U.S. GFSS only targets food insecurity in one of these nine countries (Ethiopia) and does not discuss population growth as a factor likely to impact food security.

The approach of the U.S. GFSS to address global food security shares some overlap with recent academic findings on the causes, impacts, and potential solutions to food security and its climate risks. However, there are also areas in this policy which are out of alignment with the current literature and may fail to consider key points of the root causes of and most practical solutions to global food insecurity.

Climate Change Impact Context: The Tropics

The impacts of climate change are one of the most significant contextual factors surrounding the U.S. Government Global Food Security Strategy. The impacts of climate change are already being seen and felt across the globe, with many impacts being felt intensely in tropical and subtropical regions (Ometto et. al., 2022). Every one of the 12 countries *(Guatemala, Honduras, Senegal, Mali, Ghana, Niger, Nigeria, Ethiopia, Kenya, Uganda, Nepal, Bangladesh)* in which the Feed the Future program operates is in the tropics or subtropics and is already experiencing impacts of climate change. This is briefly acknowledged in the U.S. Government Global Food Security Strategy, as the policy notes that climate change impacts posed an increased risk to food insecurity while providing some discussion on mitigating these risks (USAID, n.d.).

Of the 420 million hectares of land deforested between 1990 and 2020, over 90% was in tropical regions. On top of this, 45% of forested areas on earth are in the tropics, and they are crucial to climate change mitigation, including hosting high biodiversity, serving as natural carbon sinks, and other ecosystem services. The loss of associated ecosystem services in these areas can be disastrous, having compounding effects on the regional and global climate and impacting local livelihoods - including degradation of important food sources. These impacts include general warming and heatwaves, increased droughts, and higher frequency of forest fires,

all of which increase tree mortality and limit the overall ability of the forest to regenerate over time. (Ometto et. al., 2022: 2371).

Another crucial ecosystem player which suffers climate change impacts in tropical regions are coral reefs. Not only do the coral reefs themselves provide valuable ecosystem services and high biodiversity, but they also serve a societal importance, including by providing food sources, for many coastal - and particularly small island nation - communities (Gattuso et. al., 2014: 97). Coral reefs are affected by rising ocean temperatures and ocean acidification, and these occurrences together with the impacts of non-climate drivers mean that approximately one-third of the world's coral reefs are projected to suffer long-term degradation (Gattuso et. al., 2014: 99). Degradation of tropical forests, coral reefs, and other important ecosystems mean that livelihoods of coastal and tropical communities can be harmed, leading to direct and indirect impacts on food security. Decreased livelihood can indirectly lead to food insecurity by limiting the ability to afford food for purchase, and degraded forest and ocean habitats can directly limit food supplies by eliminating sources of food such as wild plants and fish.

The disruption of ecosystems caused by climate change can lead to changes in weather patterns which put food security at risk. For example, droughts and floods are damaging to the agriculture industry across any sector with the impact of droughts on crop production having the potential to be highly detrimental (Adhikari et. al., 2015; Pachauri and Reisinger 2007). In recent years, for example, droughts and flooding events have been prevalent across East Africa, putting the rainfed agriculture systems in danger of failing (Adhikari et. al., 2015). Changes in rainfall patterns, heightened El Niño Southern Oscillation (ENSO) events, and other climate change-related variabilities have caused varying degrees of food insecurity in over 40% of the African population (Cordell et. al., 2009; Dai, 2011; Droogers, 2004; Makame et. al., 2015: 131).

It is widely shown and accepted that the cause of increased droughts and flooding in recent years, across the globe as well as in East Africa, is human-induced climate change (Seneviratne et. al., 2021). In 2009, Nelson et. al. predicted that there would be a 7-10% reduction in maize yield across sub-Saharan Africa by the year 2050 (Adhikari et. al., 2015: 116; Nelson et. al., 2009). With even a slight drought, crops are vulnerable to damage and yield reduction, making drought one of the biggest threats to agriculture in East Africa (Adhikari et. al., 2015; Guan et. al., 2010). A specific example of this can be found in the Zanzibar Archipelago within East Africa, where the island regions of Unguja and Pemba have been highly impacted by rainfall-induced crop failures and food insecurities over the past several years (Makame et. al., 2015).

In a similar example, climate change impacts are having varied effects on food security across Latin America (Banerjee et. al., 2021). In many Latin American and Caribbean countries, household incomes and therefore food security are often dependent on the agriculture sector (Banerjee et. al., 2021). In Latin America, agricultural production is closely linked to livelihoods via international trade markets (Banerjee et. al., 2021). For instance, the Banerjee et. al. study based on five important crops in Latin America (beans, maize, rice, soybean, and wheat) found that various impacts of climate change across the region led to lower yields, which then resulted in a trade deficit in some Latin American countries; this translated to lower incomes and increased vulnerability to food insecurity (Banerjee et. al., 2021: 5; Prager et. al., 2020). The adjacent sector of animal and livestock agriculture is similarly important economically, as well as in terms of food supply, for many Latin American countries including Argentina, Brazil, and Colombia (Banerjee et. al., 2021: 6). And while according to Banerjee et. al. there is limited research about the impacts of climate change on livestock, it is true that rising temperatures can

increase stress on livestock and have the potential to affect their productivity and therefore their ability to contribute to food supply and livelihoods across the region (Banerjee et. al., 2021: 6; Hristov et al. 2017).

Comparison to Food Security in a Developed Country

It is worth discussing the fact that while the U.S. Government Global Food Security Strategy is a policy meant to address food insecurity and provide food aid to several targeted low-income, developing countries with high rates of food insecurity, the United States itself has widespread food insecurity. Nationally, 10.2% of households in the United States were food insecure in 2021 (Food Security and Nutrition Assistance, USDA ERA, 2022). However, zooming in on a particular city or state within the U.S. can provide a different picture of food insecurity. In responses to a survey study conducted by the Greater Boston Food Bank in 2022, 33% of the state's population reported being food insecure, with 20% of households reporting "very low food security" (Ruggiero et. al., 2023: 3). This is despite the fact that Massachusetts is the second wealthiest state in one of the wealthiest countries in the world (Chamber of Commerce, 2023).

The approach that the U.S. takes to tackling food insecurity domestically, in many ways, differs from the approach it takes to tackling food security internationally. In part, this may be due to food insecurity in the United States being an issue of poverty rather than of food scarcity. The U.S. famously produces an abundance of food and regularly has crop surpluses which have contributed to in-kind food donation globally (Clapp & Fuchs, 2009). Therefore it can be inferred that food insecurity in the United States is not a food supply issue, but a poverty issue. This may be why the U.S. domestic food security policy, the Supplemental Nutrition Assistance Program (SNAP), focuses on addressing food security using cash vouchers. The domestic policy

takes a more immediate, short-term approach than its international, globally-focused counterpart by utilizing food purchasing vouchers distributed monthly to citizens (Center on Budget and Policy Priorities, n.d.). Continuing to utilize the state of Massachusetts as an example, the state's SNAP program was utilized by 15% of the state population in 2022, and includes additional benefits for fresh fruits and vegetables via a statewide extension of the program called the Healthy Incentives Program (HIP) (Center on Budget and Policy Priorities, 2023: 1; Mass.gov, n.d.). While the state of Massachusetts is a small and specific example of the American government's approach to domestic food security, it provides a useful picture of how the United States has generally selected cash/voucher assistance as the preferred way to address food insecurity. It is unclear, then, why U.S. policy has shown reluctance to provide cash assistance when addressing food insecurity internationally, historically choosing and even presently leaning towards in-kind food donations (Clapp & Fuchs, 2009; USAID, n.d.).

Methods

The methods used to produce this policy brief were policy analysis through literature review and interviews. Both methods of research were used in order to provide information and enhance the analysis of the capstone project. Policy analysis through literature review served as the primary method of the project, including document analysis, reviews of previous policies and/or policy iterations, and a thorough literature search. A literature review was conducted using internet search engines, SIT Library resources, and directly relevant "gray" literature. Many different sources were included in the research and are cited both in-text and in the attached *Reference* section.

The literature review research method served as a tool to enhance my understanding of background information and the context surrounding the U.S. GFSS. In the background section of this policy brief, the literature review was focused on the causes of food insecurity, how food security is defined, and how food security is related to sustainable development. By conducting this targeted literature review, I was able to create a framework through which I could come up with the policy alternatives I later propose. This background was necessary in order to gain an understanding of the root causes of food insecurity, given that the policy analyzed in this research is working towards creating solutions for food insecurity. Additionally, the relationship between food security and sustainable development is central to this policy brief, as I use climate change and concepts of global sustainable development as the lenses through which I address the U.S. GFSS.

In the context section of this policy brief, literature review was a tool to gather information about historical and academic contexts, the context of climate change in tropical regions, and a comparison of food security in the United States. The history of U.S. international food security policies was essential to inform the way in which I analyze the U.S. GFSS. Similarly, the context of academic and scientific literature was an important method to provide information about how academic analysis has treated food security policy in the past, and where it has pointed out successes and failures. This literature review was a core strategy for informing the proposed policy suggestion and alternatives presented later in the research. It was also important to gather data on how climate change and agriculture are impacted in tropical regions, given that all of the 12 countries addressed in the U.S. GFSS are located in either the tropics or subtropics. In order to propose sustainable policy alternatives which impact countries in these regions, it is crucial to understand what sustainability needs to look like in order to mitigate

climate change impacts. And while the 12 countries addressed in the U.S. GFSS should not be homogenized, their similar climates and tropical weather patterns allow for a small margin of reasonable generalization in this area. Lastly, drawing a comparison between the status of food security in the United States, the country whose governmental agency is responsible for this policy, helps to ground the policy's context by providing information about what occurs in its country of origin.

Interviews served as a secondary method of data collection for this policy brief. Interviews included four unstructured interviews with participants who brought relevant experience. Given the topics of food security, international policy between the U.S. and tropical developing countries, and agriculture which are prevalent throughout this policy brief research, I sought interviewees who brought relevant experience in these areas in order to provide insight into the aspects of these topics I was not able to cover through literature review alone. Amongst these are first-hand, on-the-ground experiences with food production in multiple tropical, developing-country settings, including Malawi and Guatemala. Through these one-on-one interview sessions, I was able to source data which a literature review alone would not provide.

At the outset of this research, the goal was to seek five to eight interviews[5]. In total, four interviews were conducted. At the outset of this research, the interviews were planned to be semi-structured and include a list of predetermined questions for all participants. However, based on the individual identities of the interviewees and their respective areas of experience and expertise, it was better suited and of more value to the research to conduct unstructured interviews with questions tailored to each individual interviewee. Each interviewee was asked

[5] Several potential interviewees were contacted who declined to be interviewed for a variety of reasons, including summer travel plans, lack of available time, and preference. Some potential interviewees also agreed to be interviewed and then became unresponsive as the interview neared, leaving limited time for the researcher to find replacement interviewees; this led to a result of fewer interviewees than initially expected.

between 4-7 questions based on what time permitted. Questions asked to each interviewee are included below in the description of each interview. Some interviewees were asked the same questions in some cases, but not all cases. Additional follow-up questions were also asked in order to prompt more detailed or specific responses on some topics.

All interviews were conducted virtually using either Zoom or Microsoft Teams as a platform, with both audio and video settings turned on. Each participant signed and returned the Participant Informed Consent Form prior to conducting the interview, and was offered the chance to ask any questions about the Participant Informed Consent Form ahead of the interview. Interviews lasted between 30 minutes and one hour depending on the participant. This timeframe also included a few minutes of greeting and colloquial conversation at the beginning and end of each interview, including introductions in the cases where the researcher and interviewee did not have a prior relationship.

The total number of individual participants interviewed for the research was four. These participants are referred to in this study as *Interviewee #1, Interviewee #2, Interviewee #3,* and *Interviewee #4.* The following section details the role and expertise of each interview participant and the core questions they were asked during their interview, excluding unplanned follow-up questions (see chart below).

One primary limitation of the research process for this policy brief was the short duration of the period of time available to spend on research. A year-long research process for a literature review may have yielded more information which could have led to additional policy recommendations and critiques. Additionally, more interviews would have made for stronger research, particularly if interviewees could have been targeted based on the proposed alternative policy strategies.

The author and researcher of this research paper recognizes their positionality in the following ways: as an American citizen, with likely higher wealth and/or socio-economic standing than many of the individuals whose needs this policy addresses; as an individual with a formal primary and continuing education; as an individual who does not have lived experience with food insecurity. Additionally, the researcher recognizes that conversations regarding international policies have the potential to be politically driven, and the stigma which can be present surrounding food insecurity and poverty in the United States and abroad. Lastly, the researcher recognizes the terminology and classification of countries as "developed" or "developing" and issues with these classifications, including their contribution to creating stigmas and biases. The position of the U.S. Government on issues of climate change and sustainability, including the reality that the government and its stakeholders may be obstructing engagement of the topic or misleading the public, has also been noted.

Interview Summary

Participant	Expertise	Interview Questions
Interviewee #1	NGO Executive Director; working on sustainable food systems and sustainable agriculture globally	1. Can you start by telling me a bit about the work you do with sustainable agriculture, and specifically in relation to smallholder farmers? 2. What would you say are the most important considerations when increasing agricultural production? What cautionary advice about this would you give policymakers if you could? 3. What are we risking, as a society, if we use synthetic fertilizers, pesticides, and herbicides irresponsibly (or at all)? 4. Can you share any examples of your experience that include work with indigenous methods of land stewardship? What

		does that concept mean to you, and why does it matter? 5. What is the relationship between sustainable agricultural practices and the livelihoods of smallholder farmers? Which comes first? Are there cases when we need to choose between the two - are they ever mutually exclusive? 6. What do you see as the potential impact of our positionality as Americans when working with smallholder farmers in developing countries or regions of the world? 7. What responsibility do corporations sourcing from smallholder farmers in low income/developing regions have towards actively supporting livelihoods?
Interviewee #2	Academic; Expertise in sustainable agriculture	1. Can you start by telling me a bit about the work you do with sustainable agriculture? 2. What is the relationship between sustainable agricultural practices/sustainable food systems and the livelihoods of smallholder farmers? Which comes first? Are there cases when we need to choose between the two; ie. are they ever mutually exclusive? 3. What is the situation in Malawi (or other places you've worked in) with food security and farming households/communities - is food security an issue? 4. Are smallholder farmers in Malawi generally subsistence farming or is there often involvement in local/national markets? 5. Do you have examples of your experience that include work with indigenous methods of land stewardship? What does that concept mean to you, and why does it matter? 6. Where do you see climate change come into play in food production? How do you engage with this in your work? 7. What is your opinion on U.S. responsibility to help w food

		security in Malawi?
Interviewee #3	Farmer, Educator; Working towards sustainable food systems and improving food security in Malawi	1. Can you start by telling me a bit about the work you do? 2. How sustainable is agriculture as practiced in Malawi? How is sustainable food production, processing, and storage conducted? 3. Do you see a correlation between sustainable agricultural practices and food security? What about unsustainable agricultural practices and food insecurity? 4. In your view, has progress been made to address food insecurity since you began working on agricultural topics? 5. In food insecure areas in Malawi, how often to people turn to "alternative" food sources (ie. plants which aren't usually eaten, vegetarian proteins, insect proteins, flowers)? 6. Should the U.S. government address food security in other countries? 7. Given your experience, what are some factors that determine the rise or fall of food security? Which of these factors do you see as the most worrisome?
Interviewee #4	Academic; Expertise in Sustainable Development in Latin America and Africa	1. Can you start by telling me a bit about the work you do with sustainable development in LatAm and Africa? 2. What is your opinion on the tendency of the U.S. to address issues (like food security) in developing nations with a homogenous, one-size-fits-all approach? 3. In your opinion, how can the U.S. do its part to work towards sustainable development in developing countries and regions? What should the U.S. gov't avoid when attempting to do this? 4. Does the private sector need to be involved for progress to be made?

Suggested Policy Alternatives

The first paragraph in the executive summary of the U.S. Government Global Food Security Strategy (U.S. GFSS) states that the policy "brings the full strength of the USG [U.S. Government] to bear on ending hunger by drawing from the expertise of agencies across the government" (USAID, n.d.). In order to accomplish this, the policy identifies three main objectives which it aims to reach through the Feed the Future program. These primary objectives are useful frameworks and may serve to help reduce poverty and food insecurity in some developing regions, and yet they are also representative of some of the policy's flaws. In particular, the first main objective which focuses on agriculture:

> **Objective 1: Inclusive and sustainable agriculture-led economic growth**: Foster growth in the agricultural sector that increases access and availability to nutritious food and creates sustainable entrepreneurship opportunities.
> (USAID, U.S. Global Food Security Strategy Summary, n.d:1)

Additionally, the development hypothesis which the U.S. GFSS presents on this objective is as follows:

> ● If **inclusive food and agriculture systems that are productive and profitable are strengthened**, especially for small-scale producers and micro, small, and medium enterprises (MSMEs), and support availability and access to safe and nutritious foods; and
> ● If there is **strengthened and expanded access to markets and trade**, market participation is increased, and there is greater movement, availability, and affordability of agricultural inputs, goods, services, and safe, nutritious foods; and
> ● If **employment and entrepreneurship is increased**, especially for the landless, extreme poor, women, youth, and marginalized or underrepresented groups; and
> ● If **sustainable productivity is increased** while promoting nature-positive impacts on natural resources and the environment;
>
> Then **inclusive and sustainable agriculture-led economic growth** will be achieved, through a strengthened agriculture sector that will spill over to other sectors, benefiting

> from increased incomes, skills, and capacities that will contribute to the resilience of households and communities.
> (USAID, n.d.: 28)

There are several key elements which this policy objective fails to account for, some of which will be addressed in the following section through the lens of climate change mitigation and sustainability. Firstly, the objective implies that increasing agriculture-led economic growth is a solution for all of the twelve countries which it is addressing, despite the fact that they are scattered across the world with large differences in agricultural context (Interviewee #1, June, 2023). The policy would be improved if it were to take into consideration the needs of each country individually and recommend the most sustainable and effective pathways for promoting economic growth in local food systems. This is particularly important when considering that while climate change impacts are occurring across the globe, every region and community is impacted differently. Second, more sustainable food production methods should be implemented alongside agricultural production in some countries, such as alternative foods. Alternative foods may include edible insects, wild edible plants, or alternative preparations of cultivated plants. In particular, edible insects could provide economic growth if cultivated, in addition to their potential to contribute to the food supply and common diet in some areas. Therefore alternative foods should be considered, where appropriate, as a pathway towards increasing food supply and as a potential for economic growth. In the following section, these two strategy recommendations will be proposed; first by discussing the differences between the target countries (and similar countries where Feed the Future programs have operated in the past), and second by arguing the case for incorporating alternative food sources into the U.S. GFSS as a strategy for addressing food insecurity in some target countries (*Countries,* Feed the Future, 2020).

Context-Driven Policies to Replace One-Size-Fits-All

If the U.S. Government's Global Food Security Strategy is to succeed in all of the countries in which the Feed the Future program operates, it needs to develop customized strategies for individual locations, either by country or region. This has been done to an extent in past iterations of the Feed the Future Program, but the most recently available country-specific strategic plan for, for example, Honduras, was published in 2011, and the most recent for Guatemala was published in 2018 (Feed the Future, n.d.). Following the first iteration of the U.S. GFSS (fiscal year 2017-2021), the Feed the Future Program has taken a one-size-fits-all approach with the second iteration of the U.S. GFSS (fiscal year 2022-2026). This is not the most efficient or useful approach, and the policy would be improved if individualized, national or regional context-driven additions were made in order to address each area's own needs.

In general, the over-homogenization of low-income, developing nations should be avoided in order to achieve successful, positive outcomes in sustainable development. In particular, generalizing the needs of populations whose livelihoods are focused on agriculture is unlikely to yield positive results due to both societal and ecological differences. Even within one country or one region, context can vary from city to city or village to village and the causes of and solutions to food insecurity can be different (Interviewee #2, June, 2023). While the following discussion arguing for customized food security strategies focuses on national and regional (within one continent) customization, it should be noted that there may be instances where populations experiencing high levels of food insecurity would be better served by policies focused on regional (within one country) or city-specific strategies.

The first primary objective of the U.S. Global Food Security Strategy, "Inclusive and sustainable agriculture-led economic growth", suggests that increasing agricultural production

should be a primary solution to increasing food security across all twelve of the policy's target countries (USAID, n.d.). However, due to climate change impacts and extreme weather patterns in some of these countries, the expansion of agriculture may not be the most efficient or sustainable way to improve food insecurity, and in fact may not even be possible to achieve. One example of this can be found in Honduras, one of the two Latin American countries that the Feed the Future program operates in. In Honduras, 45% of the population lives in rural areas, with the majority of rural households relying on subsistence farming for their food security (Dodd et. al., 2020; Jansen et. al., 2006; World Bank, n.d. *as cited in Dodd et. al., 2020).* And yet, nearly 60% of its population lives in poverty, one in four children are stunted, and 72% of households rely on agriculture for their food (Sanders et. al., 2019: 5; World Bank 2015; World Food Program USA, 2023). According to the FAO, approximately 25% of the population of Honduras are experiencing "high levels of acute food security" during the 2023 lean season which runs from June through August (FAO, 2023). On top of this, the 2023 June-August period has been projected to experience lower than average rainfall paired with higher than average temperatures, which will result in negative impacts on crop yields (FAO, 2023).

In the U.S. GFSS, the policy acknowledges that climate change impacts present "one of the greatest risks to achieving agriculture-led economic growth" (USAID, n.d.). The policy then states the importance of promoting adaptation strategies and climate change mitigation approaches in its target countries in order to help increase food security (USAID, n.d.). This is an example of an overly generalized approach using agriculture to mitigate food insecurity. Mitigation and adaptation strategies centered around agriculture may be far more likely to be successful in some of the policy's target countries than in others. An example of this is seen in the case study of Honduras. Honduras is prone to many climate change impacts, including

tropical storms, drought conditions, floods, hurricanes, landslides, and unpredictable rainfall patterns (Dodd et. al., 2020; Sanders et. al., 2019). During the period between 1996-2015, it was found that Honduras was more heavily affected by extreme weather events than any other country in the world (Kreft et. al., 2017; Sanders et. al., 2019: 4). These climate change-driven extreme weather events lead to unpredictable crop yield, which has had (and continues to have) high potential to increase instances of food insecurity in the country (Dodd et. al., 2020: 1). It has been found that staple crops in Honduras, including maize, will likely have higher reduction in yield due to climate change impacts than crops in most other areas of the world are likely to have (Sanders et. al., 2019: 2). Outside of climate change-driven impacts, there are other contextual factors in Honduras which make agricultural growth and success challenging - these include lack of infrastructure in government, urbanization, population growth, and lack of structured land ownership or land planning (Sanders et. al., 2019; Interviewee #4, July, 2023).

It should be noted that Honduras itself is non-homogenous and contains variation in topography across the country, including both highland areas and coastal regions (Sanders et. al., 2019). This means that when planning for food security increases and climate adaptations, any policy which addresses Honduras should take into consideration the different contexts of these regions and note that each may require different approaches in order to increase food security successfully. However, for the purposes of this policy analysis the case study of Honduras as an example country is focused on the overall agricultural situation in Honduras. Given the collective results of climate change impacts and other factors, it can be concluded that Honduras may not be the best candidate country for an agricultural growth-based approach to mitigating food insecurity. In fact, Honduras may be better suited to a different approach entirely, whether it is

integrating alternative food sources, focusing on growing other economic sectors to increase diversity of income, or another strategy which centers local context.

Another region where agriculture-led economic growth may not be the most sustainable or successful strategy to mitigate food insecurity is sub-Saharan Africa. Target countries in the U.S. GFSS which fall into this region are Senegal, Mali, Ghana, Nigeria, Niger, Uganda, Ethiopia, and Kenya (USAID, n.d.). This is an example of how the U.S. GFSS could be modified to provide customized solutions on a larger scale - regional rather than national - while still working to avoid a one-size-fits-all global approach. As a region, sub-Saharan Africa has been subject to a wide array of climate change impacts which, in similarity to Honduras, have brought about significant challenges in the agriculture sector (Adhikari et. al., 2015). Two of these challenges are drought conditions and water scarcity, which make crop growth and irrigation difficult (Adhikari et. al., 2015). In fact, water availability in semi-arid regions of sub-Saharan Africa is known to be the factor which most negatively impacts agricultural success (Adhikari et. al., 2015: 112; Barron et. al., 2003). This means that the region can be particularly impacted by periods of droughts or unpredictability in rainfall patterns. Additionally, a history of continuous farming and incorrect fertilizer application has resulted in highly depleted soils in the region, further contributing to agricultural challenges (Adhikari et. al., 2015: 112; Sanchez et. al., 1997).

Within sub-Saharan Africa, sub-regions can be examined individually for agricultural context and challenges, such as East Africa. Between Ethiopia, Kenya, and Uganda alone, land varies from temperate highlands to coastal lowlands with still more variances in between (Adhikari et. al., 2015). There is also a large variation in agricultural practices, from agro-pastoral to large commercial and smallholder, meaning that food production and availability may look different in various places throughout the region (Adhikari et. al., 2015: 111). Despite

this, the causes of agricultural and food production challenges remain fairly consistent across the region, including extreme climatological events and water scarcity (Adhikari et. al., 2015). However, it is the differences in context which lead to the need for different solutions - for example, the temperate highlands regions may be more able to support increased agricultural growth, as the U.S. GFSS promotes, while coastal regions may have more depleted soils and require a non-agriculture based solution to increasing food security. And while the U.S. GFSS does acknowledge the strain that climate change impacts put on land as one of the greatest risks to achieving their objective of agriculture-led economic growth, they continue to advocate for pushing the sector to grow through mitigations such as climate-smart agriculture practices, regardless of the type of land or agriculture being addressed (USAID, n.d.).

Ethiopia is one of the target countries of the U.S. GFSS, and is highly impacted by climate change (World Bank Climate Change Knowledge Portal, n.d.). This means that its climate mitigation and adaptation strategies would be best focused on addressing lack of water including potential strategies such as planting drought-tolerant crops, collecting rainwater for storage, or implementing efficient drip irrigation systems to conserve water. While these practices may or may not be suited to all regions of Ethiopia experiencing drought, for the purposes of this policy analysis, the primary concern is not necessarily *which* are the best solutions, but that the solutions must be researched and decided upon by policymakers and tailored to fit specific needs. In order to do this, consultation with in-country experts and the governments of Ethiopia and other countries affected by this policy should be amongst the primary methods of research and decision making. This is the best way for the U.S. GFSS to be successful in its objectives.

In interviews conducted for this analysis, three out of the four interviewees were asked a question about whether the U.S. should be involved in helping to mitigate food insecurity and promote sustainable development in developing countries, and what should be considered in their approach. In response, all three interviewees stated that the U.S. has a responsibility to be involved (Interviewee #2, June, 2023; Interviewee #3, July, 2023; Interviewee #4, July, 2023). In response to what the U.S. should consider when implementing such policies, Interviewee #4 replied, "The [thing to] avoid at all costs is [to] not recognize the importance of understanding the context of what you're working in, not taking an overly simplistic approach to things" (Interviewee #4, July, 7, 2023). Taking an overly simplistic approach is, in fact, precisely what the U.S. GFSS is doing when it addresses food insecurity in target countries as a blanket problem with a one-size-fits-all solution, rather than focusing on context and proposing customized food security strategies accordingly.

It is also worth noting, when discussing the nature of the U.S. GFSS and its approach of a blanket-solution policy to address food insecurity in 12 developing countries, why the USAID, an agency of the U.S. government, may be interested in promoting agriculture-led economic growth in the first place. Especially considering that, as has been discussed, there are several existing factors in the 12 target countries which point towards agricultural growth being unsustainable and possibly ineffective to mitigate food insecurity. In the U.S. GFSS, the policy takes a section to discuss how the strategy will be of benefit to the American economy and the American population. The policy describes how its strategy focused on agriculture-led economic growth in food insecure countries would result in increased demand for U.S. exports, help expand markets for U.S. farmers and agri-businesses, increase opportunity for private sector investment in agricultural and food systems by helping to increase productivity and incomes, and

would help Americans to launch startup companies whose products target customers in the areas where Feed the Future operates (USAID, n.d.). This is a rather long list of benefits to the American economy, considering the policy's stated mission which is grounded in reducing poverty, hunger, and malnutrition in target countries (USAID, n.d.).

One possible reason for the U.S. GFSS to include a focus on how this policy can benefit Americans may be that American policies, especially those drafted at the federal level, are meant to appeal to audiences which include American lawmakers and citizens. Since USAID receives its funding from the budgets decided on by the U.S. Congress, it can be reasoned that appealing to members of congress, and doing so by articulating benefits to American taxpayers, is likely a goal of USAID policymakers (How to Work with USAID, n.d.). Therefore, while the mission of the U.S. GFSS is not to focus on how it can benefit the United States, it remains true that in order to succeed the policy must be acceptable to the American audience.

In order to amend the U.S. GFSS and effectively promote strategies which prioritize in-country context, the following text should be added to the policy: *The U.S. Global Food Security Strategy will target 12 countries with high levels of food insecurity and draft individualized strategies for each country or region according to the contextual factors unique to each area's situation. Factors to be considered include characteristics of the land and soil, risk factors related to climate change (such as rising sea level if in a coastal area), cultural norms and preferences, and government structure, among other relevant considerations.*

Alternative Foods To Replace Agricultural Expansion to Promote Sustainability

The U.S. Global Food Security Strategy focuses heavily on agricultural growth as the method by which to combat food security. As the first of the three primary objectives of the

policy, the push for expansion in the agriculture sector is prevalent throughout the strategy (USAID, n.d.). Agricultural expansion is cited as being four times as effective a way to reduce extreme poverty in developing countries than growth in any other sector (Ligon and Sadoulet, 2018; USAID, n.d.). According to the U.S. GFSS, the results of this growth in food security through increased agricultural production can be seen both directly and indirectly, in rising demands for locally grown foods and other goods, job creation, and through low food prices, making food more affordable to benefit low-income groups (USAID, n.d.). The policy also discusses that productivity increase in the agriculture sector impacts multiple areas, such as increased crop yields, resource-use conservation, increased efficiency in markets, less loss of product post-harvest, and value addition (USAID, n.d.).

Alongside the policy's objective focused on agriculture are sub-objectives, one of which is, "An ambitious approach to climate change" (USAID, n.d.). As the strategy discusses its plans to address climate change through the Feed the Future initiative, focusing both on short and long-term impacts, it also details some of the causes and effects of climate change. According to the policy, approximately 75% of greenhouse gas emissions from land-use change are the result of the expansion of agriculture in developing countries, and frequently lead to deforestation and/or the loss of other ecosystems, many of which are also carbon-rich (USAID, n.d.: 15). The acknowledgement that agricultural expansion is a major cause of greenhouse gas emissions in the developing world is seemingly at odds with the first objective of the policy, which is agricultural expansion in the developing world. And while the policy does go on to discuss implementations such as expanding the use of sustainable farm practices, regenerative agriculture, and sustainable grazing, it fails to consider that there may be alternative pathways to increase food security which do not involve the expansion of agricultural lands and production.

As the U.S. GFSS strategizes working towards increased agricultural production, the focus of that growth is on increased productivity and profitability for farmers (USAID, n.d.). The strategy does not specify whether the agricultural production which it aims to increase refers to specific food crops, animal and livestock agriculture, or crops with mainly economic rather than food value (coffee, cacao, palm oil, etc.). However, initial iterations of the Feed the Future program were focused on the production of staple, yet nutrient-poor, crops such as wheat, rice, and maize (USAID, n.d.). The current U.S. GFSS recognizes this as a shortcoming of the Feed the Future program, though does not specify increasing the production of other, more nutritious crops such as beans or vegetables. Senegal is an example of a country where agriculture-led growth has been promoted by the Feed the Future initiative, where the program worked to increase rice production by 123% from 2012 - 2018 through loans-based programs (USAID, n.d.: 4). While this benefitted local communities by meeting the demand for rice, this approach may be missing the need for more nutritious sources of food. It has been shown that a diet lacking in variety and nutrient diversity is less likely to be conducive to improved nutritional status and a healthy level of food security as defined by the FAO (Arimond, 2004: 2579–2585; FAO, n.d.; Jones, 2017: 769). Therefore, increasing the agricultural production of staple crops or animal products may not be as effective at reducing food insecurity and increasing nutritional status as diversifying diets through alternative, nutritionally dense, and sustainable methods.

In particular, animal agriculture results in high levels of greenhouse gas emissions and requires incredibly large amounts of crop and land input. It is estimated that livestock consumes one third of the total cereal grains produced globally, an amount which could instead be used to feed three billion humans (van Huis, 2015: 1; FAO, 2002; Eisler et. al., 2014). It is also estimated that livestock uses 68% of the world's available agricultural land which is more than twice the

amount of land dedicated to crops (van Huis, 2015: 1; *FAOSTAT consulted 2015, as cited in van Huis, 2015*). Large growth in this sector may exacerbate the effects of climate change due to emissions (Smith et. al., 2007). In a study published by Xu et. al. in 2021, it was estimated that 57% of worldwide GHG emissions from human food consumption and production were from animal-based food, and 29% from plant-based foods (Xu et. al., 2021: 724). In a 2007 IPCC report, it was found that the animal agriculture sector was growing particularly fast in developing regions, and would lead to increases in manure and therefore greenhouse gas emissions (Smith et. al., 2007). Additionally, it was found that in Latin America, The Caribbean, and Central Asia (along with countries in Eastern Europe and the OECD Pacific), CH_4 (methane) from enteric fermentation in animal agriculture was the largest source of greenhouse gas (GHG) emissions (Smith et. al., 2007: 503; US-EPA, 2006).

Despite its contribution to climate change, the animal agriculture sector continues to grow, and this growth continues to be a component of the U.S. GFSS (USAID, n.d.). According to a 2019 report by the World Research Institute, the demand for animal-based foods is expected to increase along with population growth in the coming years, and as of 2019 was on track to increase 70% by 2050 (Liceaga et. al., 2022: 21-22; World Resources Institute, 2018). While the U.S. GFSS acknowledges that livestock agriculture contributes to climate change, it argues that its expansion in fertile areas can contribute to sustainable food production by protecting fragile forests, wetlands, grasslands, and ecosystem services (USAID, n.d.).

The expansion of agricultural production as the primary strategy for increasing food security is likely not conducive to mitigating climate change or promoting sustainable development, and presents a contradiction to the primary objectives and goals presented by the U.S. GFSS. It should be noted that there are so-called “climate-smart” or regenerative

agricultural practices which can be employed to help improve the sustainability of agriculture. However, in order for these to be successful and contribute to a sustainable form of agricultural expansion, they should be done according to the particular context in a growing area, preferably down to the local or sub-national level (World Bank, 2021). It is also true that sustainable or climate-smart agricultural practices which work well in temperate climates, like in much of the U.S., may become more challenging in the tropics or be too expensive for smallholder farmers, such as composting and organic farming (Interviewee #1, June, 2023).

Given the evidence that agricultural production, and in particular animal-based agriculture, is a major contributor to GHG emissions, it is clear that there is a need for alternative food sources to meet increasing demand while avoiding high levels of GHG emissions. Alternative food sources with lower associated GHG emissions and high nutritional value are a sustainable, accessible way to meet increasing food demand and decrease food insecurity. Alternative food sources include foods such as edible insects, wild edible plants, or unconventional uses of alternative parts of cultivated plants (Liceaga et. al., 2022; Mariutti et. al., 2021; Walsh, 2009). Increases in the production of these foods, if implemented thoughtfully, could be an effective approach for the U.S. GFSS to sustainably reduce food insecurity in some developing areas of the world targeted by the policy.

One of the major benefits of alternative food sources is that they can be produced or gathered locally, contributing to the local economy in new ways (Mariutti et. al., 2021). A good example of this is edible insects. The incorporation of edible insects into the food system would be best accomplished through farming insects; this is because gathering wild insects in large amounts over time could create adverse ecosystem effects including population collapse or possible loss of animal food sources (Mariutti et. al., 2021: 14; Yen, 2009). This could help to

create an additional industry and local jobs and income, along with opportunities for market involvement.

Edible insects are a high-protein and low-environmental impact alternative to meat (van Huis, 2015). Their feed to protein conversion rate is 1.7 per 1kg, versus that of cattle which is 10 per 1 kg (Mariutti et. al., 2021: 13). Already, a large variety of edible insects are consumed across the globe, the majority being in tropical countries in Latin America, Asia, and Africa (Costa et. al., 2020; Garofalo et. al., 2019; FAO/WUR, 2013; van Huis, 2015; Liceaga et. al., 2022; Interviewee #3, July, 2023). As the countries targeted by the U.S. GFSS are all within these regions, the concept of edible insects as a food source may be more openly accepted. Although, edible insects may not be the best option for alternative food sources where eating insects is not a widely accepted cultural norm and may even have a taboo attached to it. This is an example as to why no solutions, including edible insects as an alternative food source, should be proposed as the best course of action for all countries targeted by the U.S. GFSS. Instead, edible insects, along with other categories of alternative food sources described in this research paper, should be applied as part of customized, country or region-specific policies only where they make contextual, cultural, and logistical sense. This includes some (yet not all) of the 12 countries targeted in the current U.S. GFSS, where incorporating more edible insects into the common diet could be useful in order to provide more nutrition and reduce food insecurity.

Already, the edible insect market is growing and market projections have shown that the edible insect market could reach a value of US$8 billion by 2030 (Glob. Mark. Insights, 2020 *as cited by Liceaga et. al., 2022*; Liceaga et. al., 2022: 20). In their 2022 publication, Liceaga et. al. compile a list of benefits of edible insects into the following three categories: *Nutritional benefits* (high protein, essential amino acids, fiber content, mono- and polyunsaturated fats, vitamins,

minerals), *Bioactive properties* (antioxidant, anti obesogenic, antihypertensive, anti-inflammatory, antimicrobial, immunomodulatory), and *Sustainability* (low impacts on land and natural resources, high feed efficiency conversion, low greenhouse gas emissions) (Liceaga et. al., 2022: 21, *Figure 1*).

In a 2021 article, Doi et. al. highlight and discuss the benefits of incorporating edible insects into the global food system through a production and food safety standpoint. Food safety is a particularly important perspective to consider given that the U.S. GFSS target countries are located in the tropics and subtropics and food safety in hotter temperatures can present challenges. In their study they concluded that while edible insects have a high production rate, the risk of transmission of zoonotic diseases is low (Doi et. al., 2021: 850). Another reason that edible insects are a sustainable food source in comparison to traditional livestock is the fact that farming insects is a smaller-scale operation and requires much smaller staff than traditional livestock raising, limiting the opportunity for transmission of disease pathogens (Doi et. al., 2021: 851). This has the potential to allow for more participants in the edible insect market, and could lead to increases in income for more people. Additionally, as the world sees harmful events such as the COVID-19 pandemic, global temperatures rise, and extreme weather events increase, smaller farming operations may become more conducive to worker health than large, open-field crop or livestock agriculture operations. Overall, Doi et. al. point out many advantages of edible insects as a food source which would be useful considerations for the U.S. GFSS to implement as it works to increase food availability (Doi et. al., 2021).

Other than as a direct food source for humans, edible insects could also serve as a more sustainable method of feeding livestock or farmed fish in existing animal agriculture and aquaculture environments (van Huis, 2015). While currently, most eaten insects are collected

from the wild, in order for them to serve as a viable source of feed for livestock and farmed fish, the insects would likely need to be farmed (van Huis, 2015). This type of farming is high efficiency by being less water, land, feed, and energy intensive than producing regular crop or fishmeal-based feeds, and could be a productive use of resources in the Feed the Future program (Costa et. al., 2020; Doi et. al., 2021; Mariutti et. al., 2021; van Huis, 2015). This could be a useful solution to implement in the U.S. GFSS, particularly in countries which already have a large economic or cultural dependence on livestock agriculture and in which increasing the efficiency and profitability of livestock agriculture could contribute to poverty reduction and, by extension, food security.

A useful example of using edible insects as a food source can be found with indigenous communities in Colombia[6], where there are at least 69 reported species of edible insects commonly eaten by various ethnic groups in the Amazon and Caribbean regions (Gasca-Álvarez and Costa-Neto, 2022: 1). Colombia has a relatively common tradition of eating insects (Gasca-Álvarez and Costa-Neto, 2022). Commonly consumed insects in the country include varieties of ants and wasps (Pérez-Grisales and Uribe Soto, 2022: 2). Many of the insects consumed in some regions of Colombia are, in fact, crop pests, and is therefore a useful practice for ensuring crop health sustainably while lessening the need for insecticides (Pérez-Grisales and Uribe Soto, 2022: 5; Ruddle, 1973). And while this method of gathering wild insects is a sustainable practice in itself, there is also room in Colombia (and other nations like it) to incorporate edible insect farming into their food economy as a sustainable alternative to increasing agricultural or livestock production to combat food insecurity, which affects 77% of indigenous households in Colombia (Amaya-Castellanos et. al., 2022: 2; Instituto Colombiano de

[6] Colombia is not one of the 12 target countries of the U.S. GFSS, but serves as a useful example of what is already in practice elsewhere in the world, and taking place under similar enough circumstances that it could feasibly be applied to some of the 12 target countries.

Bienestar Familiar, 2015). This example of edible insects already being integrated into diets as a common, culturally accepted, and sustainable food source can serve as a model for countries targeted in the U.S. GFSS with similar rates of food insecurity and which could benefit from the incorporation of nutritious edible insects into the common diet.

All of the above benefits to incorporating edible insects as a dietary component have the potential to achieve the goal which the U.S. GFSS is working towards - increasing food security. The nutritional value, high-efficiency production potential, low greenhouse gas emissions, and low land impact all indicate that incorporating edible insects into the food systems of nations struggling with high rates of food insecurity as an alternative source of protein and other nutrients would be a promising way to increase nutritional health and therefore food security. It is also an option for alternative foods which is easily accessible and could be implemented with minimal knowledge, training, or equipment. And while a promising and highly sustainable option, edible insects are not the only alternative food source which could help to replace the expansion of agriculture and accomplish the goals of the U.S. GFSS.

Another alternative group of food sources which the U.S. GFSS overlooks, yet could be a viable and useful tool to reduce undernutrition and food insecurity, are wild edible plants (WEPs). Wild edible plants are defined as plant species which are not cultivated or domesticated, but can be found and harvested in their natural environment and consumed as food (Beluhan and Ranogajec, 2010; Lulekal et. al., 2011: 1). WEPs can be a wealth of nutrients, are often found in abundance, are highly sustainable, and therefore can be powerful tools for improving food security and nutrition, particularly in developing countries (Mariutti et. al., 2021). Consuming WEPs as a food source has been reported in many countries, and yet has been overlooked in many food and conservation programs (Borelli et. al., 2020). There is an opportunity, then, for

the U.S. GFSS to dedicate some of their resources to focusing on what's locally available by increasing the knowledge and use of wild edible plants as alternative food and nutrition sources alongside the cultivation of edible insects.

A useful case study to examine the use of alternative, wild food sources in times of food insecurity already in practice is throughout East Africa in Malawi and Zanzibar, Tanzania[7]. In an interview discussing this topic, Interviewee #3 (who is a lifelong resident of Malawi and works on sustainable food systems through the teaching of climate-smart agriculture practices) discussed Malawians' use of insects and wild food plants during times of low food security. This occurs particularly commonly during the harvest period when farmers are waiting for their crops to be ready for eating, from January - March (Interviewee #3, July, 2023). In Malawi, Interviewee #3 stated, flying termites and locusts are the most common insects which are gathered for food. They also noted in the interview, however, that collecting wild foods in Malawi is often foregone because it carries a cultural stigma with a relationship to the cultural stigma surrounding poverty (Interviewee #3, July, 2023). This is an important aspect for the U.S. GFSS to consider, because although these wild foods may be providing useful nutrition and helping to boost food security, their lack of cultural acceptance could hinder efforts to make them into a larger part of the common diets. The U.S. GFSS, therefore, should work with local communities to determine whether alternative food sources such as edible insects or wild edible plants are a culturally appropriate strategy to help increase food security.

In the case of Zanzibar, Tanzania, on the island of Pemba in particular there is a history of famine (Walsh, 2009). In a 2009 article, Walsh discusses the history of famines on Pemba Island, including the famine of 1971-1972. During this time, many Pembans turned to alternative food

[7] Malawi and Tanzania are not amongst the 12 target countries of the current U.S. GFSS, but are amongst the 21 countries where Feed the Future programs have operated, and regionally similar nations where the use of WEPs has already been occurring, making them valuable examples for the purpose of this study.

sources including WEPs in order to have enough to eat (Walsh, 2009). In many cases the wild edible plants are two wild yams varieties - the bitter yam and the wild yam - are foraged in Pemba during times of famine, even though the bitter yam has been reported to cause vomiting or even death if not properly prepared, and the wild yam is reported to be similarly poisonous unless thoroughly and properly treating prior to consumption (Walsh, 2009: 11; *Verdcourt and Trump 1969: 193 as cited in Walsh, 2009; Maundu et al. 1999: 118 as cited in Walsh, 2009*).

In addition to wild edible plants there are also instances of residents in Pemba turning to another category of alternative foods. Cultivated plants which are not usually eaten, for instance the consumption of immature coconuts or unripe mangoes, are also utilized as a food source in times of food insecurity (Walsh, 2009). Similarly, the leaves of cultivated yam, pea, and pumpkin plants (among others) are known to be consumed during times of famine (Walsh, 2009). There are also reports of saving the peels of cassava tubers to be used as food when these would normally, in non-famine times, be thrown away - an example of alternative preparation and uses of common foods to increase food supply (Walsh, 2009). These wild edible plants and alternative plant uses as food for famine times on Pemba Island is a clear example of how food security can be improved through the sourcing of local species and more use of available plants for food. The use of alternative parts of cultivated plants could be a promising strategy for the U.S. GFSS to employ in order to help increase the volume of food supply, and particularly in areas which already have successful agriculture. This could easily take the place of agricultural expansion and contribute to the U.S. GFSS objective of agriculture-led economic growth by increasing productivity of food without increasing the number of plants or crops grown.

It should be noted that while often referred to as alternative food sources, wild edible plants and edible insects are common and considered normal by some populations throughout the

world, including many indigenous populations (Mariutti et. al., 2021). It has also been found that traditional diets of indigenous groups around the world play a significant role in maintaining food security, nutrition, ecosystems and biodiversity, and tradition (Sidiq et. al., 2022). As shown in the example case study of Colombia, the U.S. GFSS could turn to indigenous communities in the target areas where the Feed the Future program operates and help to build and promote the continuation of indigenous food sources and food systems. This may lead to opportunities for locally available and sustainable food options such as edible insects, wild edible plants, and alternative uses of cultivated plants, and assist in integrating these into the common diets in order to reduce food insecurity and increase food access and availability.

In order to amend the U.S. GFSS and expand the availability of and access to food, the following objective should be added to the policy to replace objective #1, inclusive and sustainable agriculture-led growth: *Inclusive and sustainable growth of the food production sector, differentiated by local context: possible areas of growth may include alternatively available foods such as insect proteins, wild edible plants, or in some cases, climate-smart agricultural growth. Each country or region's individualized strategy should determine the best option for expanding growth in the food production sector.*

Conclusion

This paper's exploration of the U.S. Government's Global Food Security Strategy through the intersection of a policy brief and a research paper serves to discuss the issue of growing global food insecurity, at a time when this challenge is becoming more and more difficult to solve due to a changing climate and increasingly prevalent social and economic inequities. In particular, the backdrop of climate change and the need for immediate, efficient,

and sustainable adaptation solutions across the globe makes the issue of food insecurity a key concern on the world stage. And yet, policies such as this one present solutions which do not sufficiently prioritize climate change mitigation strategies or sustainable adaptation solutions.

Climate change projections should be closely monitored by policy makers and used as a framework for drafting policies, particularly ones such as the U.S. GFSS which addresses land use as a focal point of the policy. In the current era of a rapidly changing climate, any policy which does not put sustainability at the forefront of its operations is not only unlikely to succeed in the long term, but may also become more damaging than helpful to the current state of the situation which it is trying to address. In the case of the U.S. GFSS, it is the problem of global food insecurity which cannot be solved without sustainable solutions and a focus on climate change mitigation and adaptation strategies.

Similarly, social and economic context and nuances must be considered when drafting policy, and this is of particular importance when it is a policy such as the U.S. GFSS, drafted from the perspective of the United States and discussing strategies which will impact populations in smaller, lower income, and developing countries. The U.S. is a country which regularly has food surpluses and therefore must be highly considerate of its positionality when creating programs for countries which regularly experience high rates of food insecurity and scarcity (Clapp & Fuchs, 2009). The best way to ensure that policies are written with consideration of the populations whom they are impacting is to draft them in collaboration with governments, local experts, and individuals with lived experience in the settings which the policy is to address. If these perspectives are included when creating policies, then these policies will be better positioned for successful implementation.

The policy modifications suggested in this paper, introducing area-specific food insecurity mitigation strategies and incorporating the use of alternative food sources in food insecure areas where it would be compatible, are two alternative pathways that the U.S. Government's Global Food Security Strategy could take in order to be successful. After conducting the research to produce this policy analysis, it is the author's conclusion that incorporating alternative food sources into the common diets of food insecure populations as an alternative to promoting agricultural growth is the most promising pathway for this policy to effectively mitigate food insecurity while prioritizing climate change, sustainability, and local context. Edible insects, wild edible plants, and the consumption of alternative parts of cultivated plants are solutions to food insecurity which are already being put to use by many communities in many regions across the globe. Expanding upon these practices in areas where they are already being utilized would serve as a sustainable, cost-effective, and culturally considerate way to increase the availability of food and access to food - two of the key pillars of food security as defined by the FAO (FAO, IFAD and WFP. 2013).

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