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Redefining Global Food Security: Do we really have a Global Food Crisis?

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Abstract

With the Climate change effects becoming more and more undoubted in the world populations, the reality of food production trends taking a negative curve is clear. This bring up the questions of whether the farmers will be able to produce food for the sustenance of the world population or not? The rate of developing food shortage coping mechanisms in this regard is slower that the ravaging negative climate change effects of drought and floods on farm performance. This commentary has the aim of requesting a fresh discussion around the fundamentals of what is food, what is a food security and what is nutritional security? It is possible that the humanity has a perception that needs refocusing. This is a perception that some people may choose out of non-food safety issues not to eat certain foods while other however healthily eat such food. It therefore becomes hard to technically accept that food is in short supply for those the opt not to eat that which is edible.

Keywords: Climate change, Food production, Food shortage, Food security, Nutritional security.

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Contents

Contribution of this paper to the literature
This paper provides an alternative outlook on the current state of food security across the globe. Through review of literature and other published works, this paper brings to light the options to increase food security in the world.

1. Introduction

Climate change effects worldwide are leading to drought in some places and indeed floods in other. Some places now have some long cropping seasons while indeed in other places the seasons have become shorter. The overall impact of these changes is the changes in food production in the farms. A lot of farmers are indeed not able to meet the usual food demands of the increasing consumer population. In this commentary, we seek to catalyze a fresh global discussion on what is food shortage, what is food and many definitions concerning food security. Our view is that such a discussion can lead to establishing globally accepted food cuisines and a re-evaluation of what people should call food or rather new food. This re-evaluation is expected to redefine food shortage and stimulate innovation around enhancing food security globally, offering new food to other territories instead of relying on pre-set old boundaries of conceptualizing food.

2. What is Food Security?

Food security is a concept that has numerous definitions and opinions. The most common definition is the one from the 1996 World Food Summit that stated: Food Security, at the individual, household, national, regional and global levels is achieved when all people at all times, have physical and economical access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. In Europe what is described as food security is known as food safety in the United States [1]. In the European context food security is the regulation and control of food safety chains to monitor food toxicity, hygiene and traceability.

Kyeyune and Turner [2] defined food security as accessibility to food at all times despite production and prices fluctuations. However, the different definitions encompass the various aspects of food from availability, access, production and cost. Based on the definitions above, food security was dissected to have 4 major components that are food availability, access, utilization and stability [3].

Food availability is best described as the amount of food present at any given time via food production channels. The availability of food is, therefore, usually closely linked to agricultural output. Food access on the other hand zones in more on the ability of a household to obtain said food given obstacles like road access and cost [4]. Food utilization is the process of preparing and consuming food. This includes the amount of food consumed and the proportions. Stability typically refers to circumstances surrounding the accessibility of food which may include violence and price variations [5]. The concept of food security, therefore, should be analyzed on a broader sense as low-income countries have, in addition to growing and purchasing food, resorted to consuming wild fruits, vegetables and crops. Plants that are recognized traditionally and accepted within the respective societies [6]. Therefore, the notion of largely connecting food to that which only cultivated by some people introduces fundamental errors going forward in the food security discourse.

3. What is Food Insecurity?

The description of food security is incomplete without mentioning food insecurity. Food insecurity is described as the insufficient access to or possession of food. Food insecurity hangs heavily on the failure to obtain sustainable amounts of nutritious and safe food on a regular basis [6, 7]. The state of food insecurity is often attributed to climate change, however, economic instability and regional conflict in war torn zones also contribute largely. The consequences of which are usually linked to the development of malnutrition and increased mortality rates [8]. High food demand and food production shortfalls results in food scarcity which in turn will give a rise to food insecurity [9]. It should be noted that all the countries flagged by FAO as having adverse food crises are also experiencing some form of violent conflict Food insecurity [10] and when linked to climate change is usually characterized by low agricultural output due to droughts, diseases, or floods [11]. However, people may still experience food insecurity despite adequate agricultural output. This is because, though food may be available individuals may not have the resources and means to access it, cases that affect both third and first world countries [6]. Food insecurity has in some cases been merged with the concept of hunger, making the words food security and hunger interchangeable [1].

The general global increase of food prices and subsequent challenges of accessing food have resulted in some governments in Sub-Saharan African countries incorporating traditional knowledge systems, strategies and policies in order to improve the situation of food insecurity. Many of these attempts target the provision of affordable food and increasing access to food [12].

Although food security and insecurity depend on the access to food, one is forced to question whether food access really the point of question. The understanding of what food is within communities is questionable and brings doubt to the idea of food security with respect to access. Therefore, can one say food security or insecurity is entirely dependent on the accessibility of food given cultural differences play a significant role in what is socially accepted as food?

4. What is Nutritional Security?

In addition to food security, nutritional security takes into consideration care, health and hygiene practices [1]. Therefore, the Food and Agriculture Organization defines nutrition security as "a situation that exits when secure access to an appropriately nutritious diet is coupled with a sanitary environment, adequate health services and care, in order to ensure a healthy and active life for all household members." Although food security and nutritional security are often described as co-dependent and somewhat similar in definition, it should be noted that nutritional security is not always a reflection of food security. Nutritional security is highly dependent on food security, however, knowledge of how to implement and utilize available food resources is crucial as nutrition dependent

health complications may arise [13]. Nutritional security, like food security encompasses the idea of the availability in sufficient amounts of nutrients that promote positive growth and development [14].

Several underutilized foods are known to have good nutritional value but are not mass produced globally and locally neither are they often incorporated into diets such as *Tylosema esculentum* (marama bean) [15]. Marama bean, an indigenous plant found in Botswana, Namibia and South Africa is an edible nutritious legume. It is a highly nutritious with high contents of proteins (29-39%) and lipids (32-42%) among other nutrients and antioxidative compounds [16]. Nevertheless, despite the high nutritional value of Marama bean, it is not consumed much beyond Botswana, Namibia and South Africa. Bambara groundnut (*Vigna subterranea* (L.) *Verdc.*), for example is a nutritious pulse grown in several African countries like Namibia. Despite it not being grown for the global market, it has minimum agricultural input requirements and high nutritional compositions [17]. The functionality of bambara groundnut alludes to the possibility of using underutilized or minor crops and foods in nutritional security.

Such crops become a solution especially to low income families without regular affordable access to nutritious food. These crops usually require less financial input and in local regions are usually developed to withstand pests and diseases. Apart from providing nutritious alternatives and production ease, these minor crops offer other purposes such as fodder, a livestock need not often readily available in the agricultural sector [18, 19]. Nutritional security, therefore, requires attentive consideration in itself as more often than not it affects low income families and communities.

5. What is Edible?

Edible is from the Latin word that means "to eat". Anything that can be safely consumed is called edible. It is important to define the term edible as there are many cultural and social connotations that may result in alternative definitions. However, that definition is very limiting due to the term "safe to eat". Over the past decades, the number of food allergies cases have increased for both adults and children (by 18%) with the most cases being reported with milk, egg and peanut sensitivities. Milk and eggs both being major components of most diets [20, 21]. Food allergy is a life-threatening costly condition that reduces the food options of an individual. The term "safe to eat", therefore, is distorted in that respect.

Entomophagy, the consumption of insects, is commonly practiced in developing countries and is therefore, nutritious alternatives. Some of the most commonly eaten insects like locusts (*Locusta migratoria*), grasshoppers (*Zonocerus variegatus*) and crickets (*Acheta domesticus*) have high protein contents. The protein content of the meal worm for example is 24.6 g/100g [22, 23]. Table 1 presents nutrition content of edible insects.

Table-1. Comparative amounts of protein in different foods including insects.

Food	Protein (g per 100g)
Wasps, bees, ants	13-77
True bugs	42-74
Beatles	23-66
Dragonflies	46-65
Crickets	23-65
Mopane caterpillar	48-61
Termites	32-38
Mackerel	16-28
Beef	19-24
Chicken	23
Pork	20
Eggs	12

Source: (Adapted from UN report 2013) [24].

6. What is Food Palatability?

Palatable is any food that is acceptable or satisfactory to an individual. It is a perception-based notion. This acceptability is largely determined by our sensory system. Our sensory systems are designed to help us detect palatable foods and avoid what they perceive to be non-palatable [25]. Therefore, palatability can be said to be subjective as one individual may find a food palatable and the next may not. Palatability is also controlled by the absorption, intake, selection and digestion of food [26].

The term palatable refers to the favorable taste a food has that triggers more intake of the food. It may also refer to how one favors the food in question, however, the first definition is usually accepted as an appropriate definition [27]. Palatability is also linked to food pleasantness leading to an increased consumption and may influence favor of choice. Thereby, possibly prompting intake of new foods [28]. Despite this, it is difficult to measure palatability as it is subjective. The influence of it with respect to food consumption may be considered insignificant as a result.

7. Is it Possible to Broaden the Food Base?

Yes, the food base can be grown as people's cultures, traditions and locations strongly dictate what food base is based in that region. For example, in the 1800s, immigrants from Italy into the United States introduced foods such as spaghetti and pesto and these got integrated into the US cuisine. However, many different edible plants and animals although nutritious remain underutilized mostly due to ignorance on their existence and cultural beliefs. Legumes such as Marama bean and Bambara groundnut (sometimes referred to as orphan legumes) are consumed in some African countries within certain tribal groups with the benefits of minimal input and great nutrient value, however, these crops remain largely underutilized [15, 17]. It can be argued that growing the food base, although possible, might be a daunting task for example introducing pork to the Middle Eastern people into their diet is considered impossible as they believe that it is religiously "unholy" [28].

Fish foods also offer a health alternative to nutritional security. Different types of seafood are typically rich in vitamin D and other minerals such as calcium, iodine, magnesium, selenium and zinc. In many tropical and coastal countries, they are a readily available and affordable source of food [29]. However, like all food sources now, fish are at risk of becoming scarce as a food source due to climate change and other factors such as overfishing. These factors raise challenges for areas largely dependent on the seafood as a source of food and nutritional security and income. Therefore, the effects will impact the economy, migration patterns and population stability [30]. Given the potential of many different foods to provide all essential nutrients and be cheaply cultivated or sourced, it is possible to grow the food base if other crops, fruits and animal sources are explored [30]. Given the potential of many different foods to provide all essential nutrients and be cheaply cultivated or sourced, it is possible to grow the food base if other crops, fruits and animal sources are explored.

8. Is it Possible to Minimize Food Spoilage?

Food spoilage is considered as any sensory change in food that the consumer perceives it to be unacceptable and happens metabolically [31]. Spoilage in most food is caused by a high percentage of water and oxygen most especially in the fresh foods [32]. Canning is one of the methods in which food spoilage can be avoided when done correctly. It prevents growth of undesirable of microbes, destroys enzymes, and removes oxygen by helping form a high vacuum in the jars [31, 32]. Improper storage and handling of food have also been linked to lead to spoilage due to failure to prevent contamination.

Given the known causes of food spoilage and considering the amount of food discarded each year (estimated to be 40% of all produced food) avoiding food spoilage is of paramount importance and also possible [33, 34]. Prevention of spoilage due to microbial activity may be achieved by practicing food preservation techniques like refrigeration, chemical preservatives and drying. Improper storage of food may accelerate aging of preservative agents. Following storage instructions may, therefore, be a solution to avoiding spoilage [35-37]. It is also vital to explore developments in food technology to prevent food spoilage like the use of *Cymbopogon citratus* oil commonly known as lemongrass oil in English [38]. The conventional food preservation strategies such as the use of refrigerators, heating and the addition of antimicrobial compounds have been reported to contribute to the loss of taste and flavor in the foods. This is replaced using organic agents such as lactic and acetic acid [32].

9. Is it Possible to Avoid Food Wastage?

Food wastage is a very big problem worldwide as it has been reported that about a third of all the food produced globally is wasted [39] as can be seen on the diagram that follows. Globally, an estimated 1.3 billion tons of food per year are never consumed with wastage beginning from agricultural production to domestic use in households. On average developed countries have a higher degree of food wasted than developing countries [33].

Food wastage unlike food spoilage, is the discarding of food that is still fit for human consumption. As over production and excessive supply result in some produce not being sold in retail markets and subsequently wasted, efforts have been made by some countries to minimize the amount of food wasted. In 2016 France became the first country to ban discarding food considered no longer suitable for sale in favor of donating it to those in need [40, 41]. However, food wastage can be attributed to wasteful habits, therefore, in order to address the problems of and associated with food wastage a couple of actions may be taken. Social approaches to reducing wastage include feeding those in need of food and also feeding animals. While introducing fines as punishments for wasting may also be effective. As some food is lost due to spoiling it is essential for consumers to buy food they need only and to also take note of the storing and packaging requirements in order to prolong shelf life [31, 41, 42].

Food wastage can be avoided by not over buying, planning ahead, checking the sell-by date as people tend to waste food because they believe it has gone bad. Retailers can help the consumers buy the right amounts of food and help them with proper storage conditions [43]. Food wastage can also be avoided and reduced by raising the awareness on the impact of food wastage on food security. Less food wastage would lead to more efficient land use and better water resource management with positive impacts on climate change and livelihoods (Figure 1).

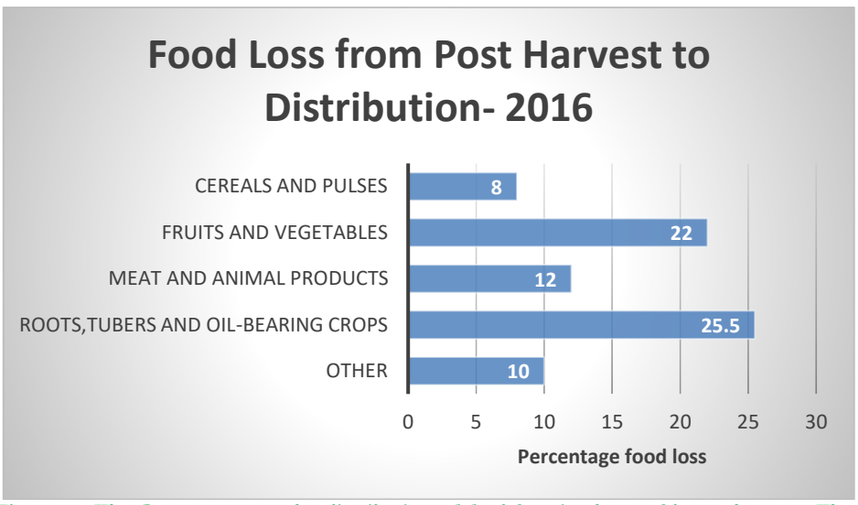

Figure-1. The figure presents the distribution of food lost in the world post-harvest. The figure presents overall percentages of fruits and vegetables, different meats, dairy and cereals.
Source: Adopted from Food and Agriculture Organization Food Loss Index [44].

10. Can Food be Recycled?

The idea of recycling is to maximize the use of any given item with overall intention to save the environment, minimize costs and improve resource utilization. With respect to food production, most food is recycled as

production stage with the intent (in most cases) to use it as fodder. Recycled food may also be used as fertilizer though it can be difficult to sort when in large quantities risking inclusion of food packaging [33, 42]. Food waste may also be used to clean water by biodegradation and bioabsorption as in the case of dye removal in water. It is, therefore, possible and advisable to recycle food [45].

There have been reports of food being recycled from manufacturing and processing industries and this food being used as feed [46]. Recycling of left-over food helps in the management of food waste, as it can be utilized in aerobic and anaerobic biotechnological processes [46]. In most cases the major fraction of food waste, however, may not be qualitatively good enough in terms of hygienic issues to reuse it as food. Therefore, the hydrolysis of organic materials and recycling of them as secondary raw materials in processes for materials and chemicals productions seems the only resource efficient way to deal with it.

11. Is it Possible to Develop a Catalogue of Global Cuisines?

Yes, it is possible, with the integration and sharing of different food catalogues around the globe. In the last century there has been an increase in interrelationships between cultures and countries thereby allowing for exchange of cultural systems including food and food habits [47]. Tourists eager to try different cuisines are attributed to the introduction to different cuisines. An increased number of tourists are travelling seeking to try out different foods in what is now known as culinary tourism. Diversity, palatability and unique presentation encourage information exchange of ideas and recipes and all variations available while visiting [48].

Restaurants that serve foreign cuisines also encourage cultural flow of global foods [47]. Therefore, given these facts, it is possible to develop a global cuisine with the incorporation of different cultures, lesser known or underutilized foods and improved food preparation techniques that prevent or limit food spoilage and wastage. Although with such a catalogue a debate would arise on which foods to include as one that would include all the foods consumed globally will be impossible to construct.

In addition, some foods might not be considered a good fit for the catalogue as they would have not passed the food safety agents tests for them to be considered non risky for consumption. For example, in Europe you have the European Food Safety Authority that provides scientific advice on foods that they say helps protect the consumer animals and the environment from food-related risks.

12. Are Some Foods Superior to Others?

Superiority is being dominant or better than the next object or individual. Therefore, to say some foods are better than others is a question of preferences hence an answer to this question will not have any objectivity tied to it. Some nutritionists have said some foods are superior compared to others due to them having a higher percentage of essential minerals as compared to other foods [49]. Soybeans for example are legumes considered superior based on their high protein content which ranges between 34.96% – 36.07% (or higher) [50]. The term superfoods may also be coined to describe nutritious foods with other health benefits like disease prevention. Other foods may have phenolic compounds and antioxidants that improve general health [51]. In Western Europe, Hungary in particular, they had been reports of "inferior" foods being shipped into the country. One such case is when the Hungarian authorities found a certain brand of pizza having less cheese than the same pizza from the same brand being sold in Germany and Austria.

Inferior food can be synonymous with inferior good. With an inferior good being a good whose demand goes down when the income of a population goes down hence foods such as noodles and canned foods are said to be inferior foods as they are normally consumed by people from low income households.

The superiority of food can be determined by nutritional value and health benefits. Foods with high nutritional value are considered superior based on their ability to provide essential nutrients in sufficient amounts. The idea of superiority of foods can also be considered subjective as it can be judged according to flavor and taste resulting in favor of particular foods. This will lead to some foods being eaten more than others depending on an individuals' preference [52].

13. What is the Role of Culture and Religion in Defining what is Food to a Society/ to the World Population?

There is a saying that goes, "You are what you eat" we can see how culture largely influences what we consume as when we are consume some certain kind of traditional food we are grouped to belong to a certain culture. Food then plays an important role in defining the cultural identity of a group of people [53]. Religion and Food are also connected which adds meaning and significance to our lives. Attempts to address and rectify malnutrition challenges based on food security have been, in some cases, noted to be hindered by culture and beliefs related to edible foods [3]. The UN documented cases in which nutritious and edible foods were rejected based on cultural aspects not considered [24]. Over the turn of the 21st century it has been found that American fast demand has declined while Asian demand has increased due to its diversity and uniqueness [54].

For example, Muslims fast during Ramadan and during this fasting month they eat and drink before dawn and after sunset. Also, the Jews follow a strict diet rule which they refer to as a kosher diet [53]. Many followers of Buddhism, Hinduism, and Jainism are vegetarian this is in part due to them following a doctrine that teaches non-injury or nonviolence. Therefore, abstinence from eating meat in these traditions stems from the desire to avoid harming other living creatures. In this regard we can understand that food conveys religious sentiments of the people, making them unique and having their own identity. The following Table 2 shows this interrelatedness.

Culture and religion play a huge role with respect to food intake. Culturally or religiously acceptable foods contribute to the discord relating to the definition of edible. Within the Hindu religion, it is thought disreputable or to some extent punishable by religious law to consume beef as cattle are a symbol of a deity. Then, within the confines of the term "safe to eat", the definition is distorted given that beef is consumed by many other cultural groups all over the world. Pork is another such example widely shunned by individuals who practice the Islamic religion and some Christian groups. It is important then to try and conjure an accommodating definition of what is edible with regards to and the contributions to food security.

Table-2. Various religious sects and their food preferences.

Type or religion	Practice or restriction	Rationale
Buddhism	Refrain from meat while vegetarian diet is preferred. Moderation in all foods. Fasting required of monks.	Natural foods of earth are considered most pure. Monks avoid all solid food after noon.
Eastern Orthodox Christianity	Restrictions on meat and fish. Fasting selectively	Observance of Holy Days includes fasting and restrictions to increase spiritual progress
Hinduism	Beef prohibited. All other meat and fish restricted or avoided. Alcohol avoided. Numerous fasting days.	Cow is sacred and cannot be eaten, but products of the "sacred" cow are pure and desirable. Fasting promotes spiritual growth.
Islam	Pork and certain birds prohibited. Alcohol prohibited. Coffee/tea/stimulants avoided. Fasting from all food and drink during specific periods.	Eating is for good health. Failure to eat correctly minimizes spiritual awareness. Fasting has a cleansing effect of evil elements.
Judaism	Pork and shellfish prohibited. Meat and dairy at same meal prohibited. Leavened food restricted. Fasting practiced	Land animals that do not have cloven hooves and that do not chew their cud are considered as unclean (e.g. hare, pig, camel).
Mormonism	Alcohol and beverages containing caffeine prohibited. Moderation in all foods. Fasting practiced.	Caffeine is addictive and leads to poor physical and emotional health. Fasting is the discipline of self-control and honoring God.
Protestants	Few restrictions to food or fasting observations. Moderation in eating, drinking and exercise is promoted.	God made all animal and natural products for humans' enjoyment. Gluttony and drunkenness are sins to be controlled.
Rastafarian	Meat and fish restricted. Vegetarian diets only, with salts, preservatives and condiments prohibited. Herbal drinks permitted; alcohol, coffee and soft drinks prohibited. Marijuana used extensively for religious and medicinal purposes	Pigs and shellfish are scavengers and are unclean. Foods grown with chemicals are unnatural and prohibited. Biblical texts support use of herbs (marijuana and other herbs)
Roman Catholicism	Meat restricted on certain days. Fasting practiced	Restrictions are consistent with specified days of the church year.
Seventh-day Adventist	Pork prohibited and meat and fish avoided. Vegetarian diet is encouraged. Alcohol, coffee and tea prohibited	Diet satisfies practice to "honor and glorify God"

Source: Adapted from FAQS Religion and Dietary Practices [55].

14. Discussion

When talking of a world food crisis it is important to redefine terms such as edible and palatable only then can we confidently talk of having a food crisis. Food is termed edible if it is safe to eat while some foods may not be edible in some regions of the word, such as most grasses that are eaten in most parts of Africa are not known as food or consumed in Western countries. Another example is the Marama bean which was mentioned earlier in the report. Therefore, growing the food base in these areas that have reported a large population of its people not having sufficient food would be one way to tackle the food crisis. On the other hand, this may not be accepted by some people because most of the foods that are eaten by the local population in Africa have not undergone any scientific tests therefore some individuals may not deem them edible or safe to eat.

Food wastage which has been extensively defined can be avoided by taking critic steps along the production to consumption pipeline. Wastage should be minimized during the production, farmers have their produce wasted due to it not meeting consumer standards on a yearly basis and most of the food is lost in this way. This could be avoided by farmers only breeding/growing the consumer appealing or marketable foods. Another way to curb the food wastage problem would be to give the excess food in households and supermarkets to the less privileged before the food spoils and make use of preservation techniques such as refrigeration. Although reducing food waste by giving the surplus food to the underprivileged looks like a simple solution some sections of the population feel this is not the way to go. Their arguments lie in the belief that this is a morally distressing and problematic solution to food wastage, as it provides and illusion of solving hunger while in the actual fact it is not addressing the underlying problem of poverty.

15. Way Forward

Despite all the information presented above, the questions raised surrounding food security do not present a clear picture of the state of food resources in many communities. Food security though largely dependent on climatic conditions and consequentially the economic status of the country, does not put much consideration into underutilized plants and animals as well as unknown edible plants and crops. The basis of food security, therefore, ignorantly lies on recognized available foods. In conclusion, it is important to acknowledge the differences in definitions of the terms presented in this paper, however, the original definitions though insightful are largely limiting. Many questions are raised therefore by unifying the limitations of the definitions. There is need, thus, to re-evaluate the definition of food security and given the many possibilities present on the different types of foods globally available.

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