

## INNOVATION IN THE FOOD SECTOR: MODELING THE FUTURE OF FOOD SECURITY

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### Abstract

From an historic perspective, the human need for food determined the emergence of one of the oldest markets on the globe, that had evolved for hundreds of years and whose evolutionary experience has radically shaped the sector from the hunter-gatherer period to the big manufacturing food industry of today. At a first glance, the development and progress registered over the years should characterize a modern sector, built on sustainable resources and infrastructures that can assure a long-term safety and security in the food sector. Despite these premises, the food sector today is further distinguished by food insecurity and food safety issues, aspects that have exceeded problems like hunger or food hygiene. This may be considered a paradox of our days, as there is still about 1 billion of the globe's population that has nothing to eat, while all regions worldwide are in danger of overweight and obesity epidemics. Thus, the current study aims to highlight the main struggle in this domain, by identifying the current food and nutritional policies and the action plans that the specific organizations in the field have put in place in order to address these problems. In this context, the market's accountability is ensuring a sufficient quantity of high-quality food, with an optimal nutritional intake and a fair regional distribution so that it can be accessible to as many people as possible. In this sense, hypothetical scenarios have been designed in order to be able to analyse possible solutions and topics that can be consider for improving the global policies.

### Keywords

Food safety, food security, quality management systems, organic food, GMO, food market, food policies.

### JEL Classification:

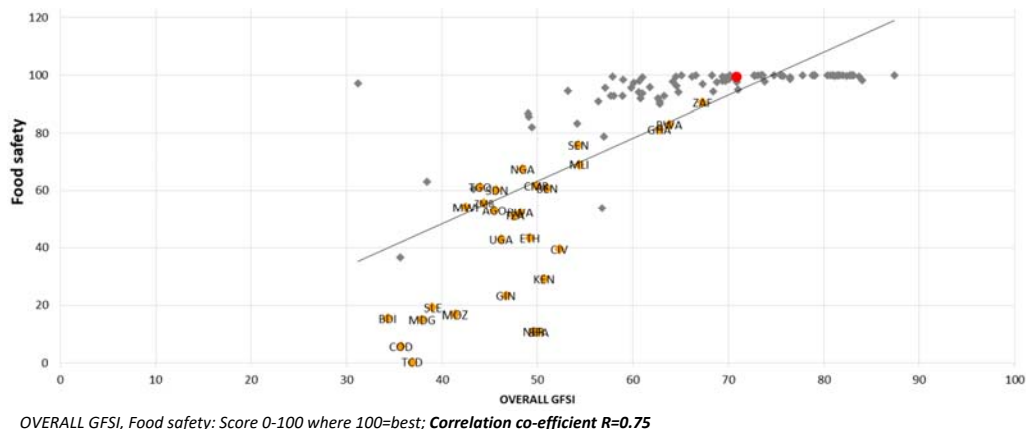
Q13, Q18, L15, L66, M11

## **Introduction**

Food security remains one of the major global challenge that the world has to face both now and in the future (Chen et al., 2019) by trying to find answers to the question “how to feed the world in 2050”(van Dijk et al., 2020). Historically there are some regions in the world where food security have been a bigger concern than food safety considering the small percentage of 7-9% of the world’s arable land and 20% of the world’s population (FAO, 2020; Jen, 2017). This is justified by the fact that in 2018 in Asia there were still 1 billion people suffering moderate or severe food insecurity out of the total of 2 billion people having this problem worldwide (FAO, 2020). Considering that this segment of the population don’t have regular access to sufficient and nutritious food there is a high risk of malnutrition and health problems in their case. Moreover, the decrease recorded in agricultural cultivated land and in fresh water resources made countries like China to increase the imports of food over the next years (Yu and Han, 2020). Even if the Chinese government recorded an important progress in improving food safety standards in recent years, because of the shared responsibility in control of food safety between different national and local authorities (Jen, 2017), their traditions, food heritage and cultural dimensions (Vranceanu and Iorgulescu, 2016), the progress seems to be rather slow. The importance of food safety was proven one more time by the coronavirus pandemic that started in China, one of the reasons why all the concerns and legislation should work towards reducing potential foodborne illness. The interest for innovation in the food sector can be proved also by the large number and the upward trend in scientific papers written on food security and food safety, most of them being published by researchers from USA, China and UK (Hu et al., 2019). Food safety is a science centred activity and providing guidance for authorities and companies to take appropriate food safety decisions is mandatory (FAO, 2019a). The aim of this paper is to better understand the development and progress registered in the food sector by interpreting current global performance in terms of food security and food safety. Moreover, by understanding the existing patterns and by referring them to the pillar structure of modern food systems a consumer preference-based model has been outlined, offering an overview of the strong correlation between food safety and food security from the consumer’s perspective. The model includes also nutrition, poverty, trade, health and market development as key factors in shaping the consumer’s behaviour and needs. Considering the globalization of the food industry, the evolution from local to global markets, shipping products over longer distances and all the established regulations, a global perspective over the food system is needed (Nayak and Waterson, 2019; Popp et al., 2018).

### **1. The state of food safety and food security at a global level**

Food safety and food security represent two interdependent notions, which are main concerns for many global organizations that are active in the field of agriculture, food market and nutrition. According to the general director of the Food and Agriculture Organization, food security cannot exist without food safety, which represents the base for healthy diets and lives (FAO, 2019a). This is proved by the strong correlation between food safety and food security index ( $R=0.75$ ) in the case of Sub-Saharan Africa countries (marked with yellow in Fig. no.1) which have the lowest values for food safety and also serious problems in terms of food security.



OVERALL GFSI, Food safety: Score 0-100 where 100=best; Correlation co-efficient  $R=0.75$

**Fig. no. 1 The correlation between Food safety and the Global Food Security Index in the case of Sub-Saharan Africa countries**

Source: EIU, 2019. The Economist Intelligence Unit: Global Food Security Index.  
<https://foodsecurityindex.eiu.com/>

Food safety evolved one with the increased number of people involved in this process in different stage of development, better performing processing technologies, modern production practices and improved standards applied around the world (Nayak and Waterson, 2019). Shipping food over longer distances needed a development of the preservation sector, robust governance and harmonized regulations and standard, the food safety responsibility being shared from production to consumption in the entire supply chain (FAO, 2019a). It is clear that food safety has a major impact on food security, and this can be further improve through international harmonized food standards. Nowadays, when the population is more exposed to different food hazards and authorities responsible with inspections, especially for imported food, have no direct control over the production process, thus certification mechanism and appropriate communication between competent authorities is essential (FAO, 2019a). There are many factors that influence food security, which is a complicated issue considering the systematic challenges, the level of uncertainty and complexity of the problems that emerge worldwide. This can explain why since 2014 there was an increase in absolute and relative terms of undernourished people in Africa, Oceania and Western Asia (FAO, 2019b; Lenaerts, Collard and Demont, 2019). Climate change is one of the most important challenge for food security, leading to a decrease in agriculture productivity and these could lead to a risk in food security also for some developed countries that now are on the top of GFSI index (Chen et al., 2019). Thus extreme weather events, increasing level of CO<sub>2</sub>, temperature change negatively affects the global crop production needing more resilient and sustainable methods to be used in agriculture (Lenaerts, Collard and Demont, 2019). In spite of all the improvements in terms of an increase global access to food, there is still a significant proportion of the population in low-income countries suffering from food insecurity (Hossain, Mullally and Asadullah, 2019). At the same time globalisation has led to a higher variety of food, changes in dietary preferences and more complex distribution methods needed and longer supply chains put more pressure on food safety.

One essential step in improve food security worldwide is by measuring its performance, and taking appropriate actions where these are needed. Important progress has been recorded with different composite indexes that integrates multidimensional indicators used for performance monitoring in this field, most of them created by FAO. For food security, one of the most recent one is the Global Food Security Index (GFSI) developed by The Economist Intelligence Unit and used to provide a benchmark for the way in which 113 countries ensure access to

food in terms of affordability, availability, quality and safety (EIU, 2019). Based on this index in 2019 the highest number of countries included on the first positions in this ranking are from Europe while the worse situation remains in countries from Sub-Saharan Africa, as it can be seen in the following figure.

Top Ten, 2019				Bottom Ten, 2019					
Rank	Data	Score	Δ	Rank	Data	Score	Δ		
1	Singapore	—	87,4	0,0	113	Venezuela	—	31,2	+0,2
2	Ireland	—	84,0	+0,6	112	Burundi	—	34,3	+1,0
3	United States	—	83,7	+0,6	111	Yemen	—	35,6	-0,7
4	Switzerland	—	83,1	0,0	110	Congo (Dem. Rep.)	—	35,7	+2,4
=5	Finland	—	82,9	0,0	109	Chad	—	36,9	+2,0
=5	Norway	—	82,9	+0,5	108	Madagascar	—	37,9	+0,6
7	Sweden	—	82,7	+0,2	107	Syria	—	38,4	+1,3
8	Canada	—	82,4	+0,7	106	Sierra Leone	—	39,0	-0,6
9	Netherlands	—	82,0	+0,5	105	Mozambique	—	41,4	+0,5
10	Austria	—	81,7	+0,3	104	Malawi	—	42,5	+2,7

**Fig. no. 2 Best and worst performers in Food security in 2019**

Source: *The Economist Intelligence Unit, 2019. Global Food Security Index.*

<https://foodsecurityindex.eiu.com/>

At a global level it can be seen that important progress was recorded over the past decades in terms of food security, but unfortunately the food price crises from 2008-2009 proved how fragile is the current situation (Chen et al., 2019; Nayak and Waterson, 2019). These can be also a reason why food security remains an important concern worldwide. Moreover, Lenaerts, Collard and Demont (2019) indicated that the progress in cereal productivity is approximately 1% annual growth which is not sufficient for the future increase in demand, thus an improvement of the food system is required in terms of improved productivity through new technologies development, dietary change and food waste reduction. There are several attempts to respond to this challenge and to identify future solutions. One of them is scenario planning, being a good mean to deal with uncertainty and complex issues, which can be used in strategic planning and to guide policy makers (van Dijk et al., 2020). Often, this method suppose finding answers to questions like “What will happen?” or “How can we reach a target?” (van Dijk et al., 2020).

## 2. Scenario planning: agricultural potential in shaping global food policies

One of the major concerns of global organizations like World Health Organization or Food and Agriculture Organization is to implement a comprehensive strategy which can include in an effective manner both preventive and corrective actions that are focused on both food safety and food security issues.

In this sense, organizations are trying to collaborate with governments and corporations in order to develop and improve food policies, by better understanding the modern vision of the food sector driven by consumers’ needs, environmental necessities and industry’s potential resources, aspects that should be harmonized taking also into consideration local particularities that exists in several countries or regions.

Nevertheless, taking into consideration the complexity of modern food systems, this represents a difficult task. According to the High Level Panel of Experts on Food Security and Nutrition, a food system gathers all the elements (environment, people, inputs, processes, infrastructures, institutions etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes (HLPE, 2017).

Thus, when talking about food policies and innovation in this sector, the starting point should represent understanding the actual system, its main structure and constituents that are playing an important role in shaping the current food market. Regarding an actual food system, beside nutrition and health outcomes, different studies identify three main pillars that represent entrance and exit points for the act of nutrition (Walls et al, 2019):

1. food supply chains;
2. food environments;
3. consumer behaviour and needs.

If we take as an example some of the latest food policies or market developments that have been issued since the beginning of 2020 in different countries or regions, across the globe, it can be observed that the vast majority involve economic and financial aspects like price regulations or import duties. These actions are directed more towards the regulation of the food supply chain or the defining of different food environments (economic, political, socio-cultural etc.). However, the consumer will be influenced by these actions, but the results are not exactly driven towards the consumer's needs.

Regulation of prices for certain goods can have a positive impact for regions that are characterized by poverty, but from a consumers' point of view the need of food is strongly linked to resolving safety, security and nutritional issues in order to be able to create the necessary premises for a for a general positive state of health.

Consumer behaviour and needs represent the decision-making matrix that determines the type of food acquired for consumption in order to allocate the optimal amount of nutrients within the household, while using diversified and constantly available natural resources that will not affect their health, neither the health of the environment.

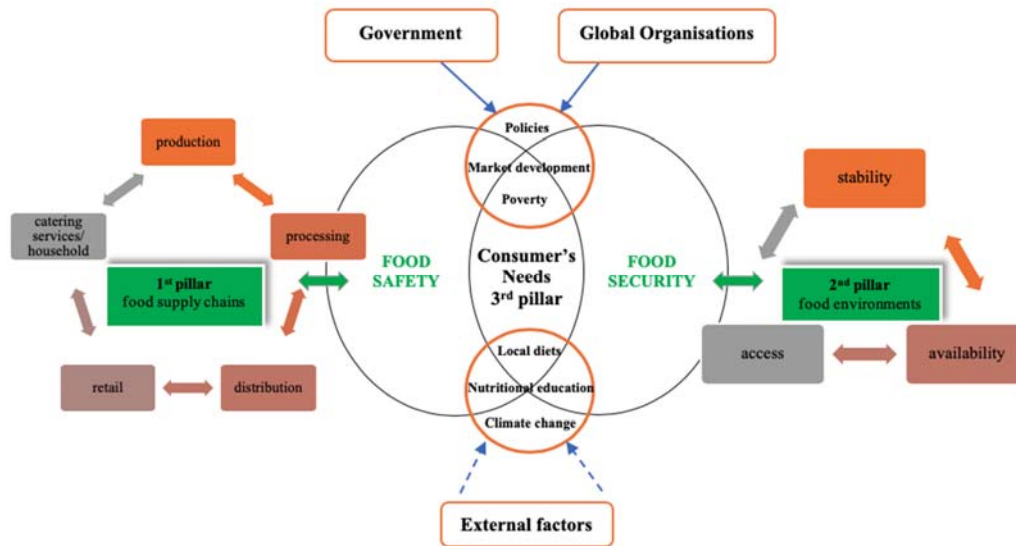
Thus, shaping global food policies by consumer's need should represent one of the main concerns of food and agricultural organizations, as when nutrition, safety and security of the act of feeding are in balance, the food market will follow and so will the economy.

There is a general practice that in poor countries food policies aim to resolve food security issues over food safety or a healthy nutrition (Pelletier et al., 1995), this being usually politically prioritized. On the other hand, in more developed countries, food safety is prioritized over a healthy nutrition, as overproduction and imports determine a large volume of resources that enter the food chain, where it can be subject to different type of hazards.

When trying to understand a certain pattern in the food sector, outlining a consumer preference-based model can provide highly valuable information on how different policies can be shaped in order to optimize the act of feeding as a quality requirement.

In this sense, the following model was designed in order to highlight the strong correlation between food safety and food security from the consumer's perspective. The model also pictures the role of nutrition, poverty, trade, health and market development in shaping the consumer's behaviour and needs. The expected output is understanding what are the main determinants that can contribute to upset the balance of a normal food system

As it can be observed in Figure no. 3, **food safety** is highly influenced by the first pillar and all stages in the food supply chain, where different types of hazard can occur and influence the results of the act of nutrition. Logistic phases can play a very important role in maintaining food's sanogenetic characteristics and avoidance of contamination. Starting with the production phase, processing methods or distribution stages and even the retail of food products can influence the quality of final product that reaches the table of the consumer.



**Fig. no. 3 Modeling food safety and food security issues by consumer's needs**

*Source: author research*

Moreover, contamination risks can appear even in the consuming phase, regardless the output form (restaurant or other food services or households). Biological, chemical, physical and human hazards can start at an incipient stage of the production phase, by failing to comply the animal and plant health requirements or by not respecting animal welfare. Further down the production and processing phase, hormones, chemical residues or bacteria can be found in food products, reaching values that can put in risk human health. Overall hygiene plays a very important role, starting from the production phase throughout all processing, distribution, retailing and consumption phases. For example, animal products can represent a safety threat if they are not proper refrigerated in the supermarket or at home.

Nevertheless, human error or fraud can also determine safety issues. Here we can add as an example improper labelling of food products, like not mentioning on the label specific ingredients that can cause allergies or on the other hand adding a specific superior ingredient that is replaced with a lower quality one.

Thus, food policies must be directed toward controlling all food chain phases in order to prevent faulty handling, storing or preparing of food products that can determine infection or other type of food diseases and help in maintaining a balanced nutritional level that ensures a healthy diet.

**Food security** is directly influenced by three main determinants – stability, access and availability. In other words, all people, at all times (stability) should have the necessary social and economic resources (access) in order to benefit from safe, nutritional and sufficient food (availability) for maintaining a healthy diet.

But nowadays, the food sector is characterized by three main security issues: malnutrition, food lost and waste combined with the general trend of population growth. Also, the security aspects are directly influenced by the demographic conditions, economic conditions, environmental conditions and natural resources as well as social and cultural conditions.

Also, security issues differ from a region to another. Developed countries are facing food lost and waste in the general context of an unhealthy diets, that involve a higher intake in calories but lower intake in nutrients, causing obesity and other related diseases. On the other hand, the countries from the third world are facing with the lack of food availability, this causing a

poorer nutritional content and a reduced calorie intake, that determine malnutrition and associated diseases.

Thus, food safety and food security represent important objectives for the global food policy makers, taking into consideration that solving these issues can determine positive outcomes on human health by introducing nutritional education and healthy diets as daily habits.

Nevertheless, from a political and economic point of view, one of the biggest challenges for governments will be to find solutions that can integrate healthy nutrition practices and resources into the food security and food safety policies. This means that healthy nutrition related subjects should be more promoted on political agendas.

### **Conclusions**

Without innovation in the food sector, food safety and food security goals cannot be achieved. Moreover, the future challenges will be more difficult to address as all actions must take into consideration sustainability principles too. Climate change, extreme weather events, increasing levels of CO<sub>2</sub> or temperature change will still raise questions regarding of how resilient the actual agricultural methods are and how long can they still be use before causing effects and repercussions that can no longer be corrected.

Talking about the future, food availability will always have a representative impact on the development of human society and will remain essential for the evolution to modern era of the third world countries. And better than availability, governments of countries that are facing difficulties and problems regarding malnutrition and foodborne illness, from Africa, Asia, Oceania or South America must also integrate in their food policies concepts like affordability, quality and safety.

Furthermore, supply chains must adapt and also understand that eliminating hunger does not represent the only condition for solving their problems. Retailers must ensure healthy, nutritionally dense and safe food products regardless of the regions or market where they operate. Food systems will need to integrate and use in a sustainable way all available resources (land, energy, water, money, waste management, transport, science and technology) in order to eliminate legislative variations across countries and unify requirements from one commodity to another.

Thus, consumer's needs must always represent the starting point in when building or expanding food policies, legal frameworks or food systems. Organizations must finely define the differences that occur in consumer's behaviour by region and the main determinates that cause these differences, like the income level, diets, local conditions and government infrastructures.

Taking into consideration that in the near future the food market will need to assure the necessary resources to feed over 9 billion people (King et al, 2017), it is understandable that all efforts must substantially increase and be directed to safe and sustainable food production, incorporating in the food chain both big producing companies and smallholders.

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