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ECONOMY OF THE GLOBAL FOOD SYSTEMS

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BACKGROUND:

This project studies the framework of the global food system. As an interdependent system, it is influenced by major businesses, elements and crisis that add pressure to sustainability and nutrition. We study the path followed and the current situation of it to provide knowledge of the future perspective.

METHODOLOGY:

The project is a research study involving explanation, visualization, comparison and analysis of fundamentals that entails global reflection.

During all the project, we rely on the most official sources we can find in order to access to the most accurate information. Research sources come fundamentally from organizations (United Nations, World Bank, United States Department of Agriculture, etc...), universities (Oxford, Calgary...), academic research sources and other contrasted information sources.

The time horizon considers the twenty and twenty-first century.

OBJECTIVES:

- Analyze the global food system focusing on the main structures and influencers.
- Understand the global perspective and the interdependency of its framework.
- Consider the numerous crisis that could affect food systems.
- Provide knowledge of the present and future sustainability options for food systems.

ABSTRACT:

We analyze the economic fundamentals of the food system with a holistic approach. Population growth increases as well as demand of food, so the food system is challenged. Food price volatility, conflicts and crisis jeopardize nutrition and health.

Currently, most of the food products consumed are controlled by 10 companies and agriculture is perceived by them as an interesting business. We question ourselves about the future and the sustainability of the food system. This paper shares guidance to understand the nature of the problem and the interdependency of factors.

Keywords: economy, global, food system, nutrition, price, agriculture, value chain, companies, consumption, fertilizer, sustainable.

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1. INTRODUCTION

People ask themselves about their diet and about the reasons behind their food consumption patterns. In this project we focus on the major patterns that shape our diet. Absolutely all the food we consume is involved in what is called the “food system”. We will start defining what a food system is and reflecting on the main companies that operate in it. Food producers end up connecting with consumers through a complex structure that we will try to understand, the value chain. In the value chain, it all begins with agriculture. The production of agriculture exploded with the Green Revolution and currently, multinational companies manage a major part of the agriculture business, calling it agribusiness.

Nutrition is a fundamental part of the food system. In the recent history, the financial crisis hit the system and caused a price increase. We will try to understand the repercussions of the crisis in nutrition and examine another particular case of price increase.

Currently, there are many trends taking part in the food system. These trends are influenced by many features that the world will have to face as well as by policies. We discover the main trends that will shape the future of food systems.

In the first part of the project, we introduce a historical perspective and a summary of the current global nutrition situation in the world. Later on, we present the main concept we are going to study, the framework of the food system. We evaluate the main features of the food systems, considering its global approach. There exist many kinds of food systems: local food systems, organic food systems and many more types. They depend on many causes, but we consider as if the world would have one for the project.

In the second part, we focus on how the food and beverage industry emerged and how companies build its vast empires of brands through mergers and acquisitions, as well as their influence over population and response to sustainability. Subsequently, we examine the elements of the value chain that connect input companies to consumers and the process they follow to build this important part of the food system. The Economic, demographic, innovative and management scenarios are evaluated.

In the third part, we study the impact of the Green Revolution and Agribusiness. Since it started with grain thousands of years ago, it has developed throughout the years. Agriculture has always constituted a fundamental part of food systems and in the second half of the last century, it has entered in a new era with the use of modern technology and genetics.

After the Second World War, the world suffered droughts and technology helped population to overcome the situation. They referred to that era as the Green Revolution. In the Green Revolution we study the situation that originated it, the technology that was

adopted and how it helped to increase production. We emphasize in the main innovative, political, economic and environmental repercussions around the world.

More recently, as the business of agriculture evolved, it turned the situation into the inclusion of multinational companies in the business. Hence agriculture has developed in what is called agribusiness or the second green revolution. In agribusiness, we present the financialization and the current situation of it. The challenge of the prices for commodities and the trends which are now being developed as well as other repercussions, paying special attention to the price peak of fertilizers.

In the fourth part, we put into perspective the financial crisis of 2007. The crisis threw millions of people below the hunger threshold as the food prices increased dramatically. We study how the increase took place, what resources were affected the most and how hard could it hit certain people, as well as the confluence of major factors. Unfortunately, the financial crisis was not the only one that hit food systems in the past years. It turns out that in 2010-2012 another series of crisis in the food system occurred, but the financial was not directly involved. In 2010, climate played the most important role. We try to figure out the relationship between food price index and a singular outcome in the food system. Even though the food price index reached to maximum levels, it did not have a big impact in people just because of the type of food that suffered the increase in price.

It seems interesting to figure out how an increase in food price could affect consumption and we analyze the way to measure it, paying special attention to the case of cereal and the shift of food patterns that took place. After food consumption patterns are turned down to a lower nutritional level, they make impact in nutrition and health.

In fifth and final part, the goal is not to present a solid conclusion but to present understanding of the nature of the most probable situations that agriculture and food systems entail in the future, facing into the twenty-first century. We present the most important trends and challenges for the upcoming years that are affecting and will affect food systems. We study the demographic expansion that will happen in the current century which compromises food production, especially in the case of Africa. Subsequently, we focus on the global economic growth, prices and investments happening in the food system. Another important aspects for food sustainability are the climate change, natural disasters and the conflicts on earth that we will have to face. As the food systems are run by people, we examine the future policies that will help food sustainability and the debate coming from the nutrition private finance studies which determine opinion from people and would favor private interest. In the last point, we analyze the finance of food systems based on the sustainable development goals.

Finally we will mention the main challenges that food systems will take in the following years and we extract the conclusion based on the most important points.

2. GLOBAL NUTRITION AND FOOD SYSTEMS

Agricultural production has multiplied by 3 between 1960 and 2015, enhanced by green revolution technologies and an expansion in the use of water, land and other natural resources favoring agricultural purposes. This has been accompanied by a process of globalization and industrialization of food and agriculture. This expanding food production and economic growth has created a heavy cost to natural environment. For instance, the fossil fuels emit huge quantities of greenhouse gases, which are responsible for climate change and global warming. The incidence of natural disasters has increased fivefold since the 1970s.

Throughout the years, there has been a lot of progress in reducing hunger and poverty and improving food security and nutrition. Major productivity and technological advances have contributed to more efficient use of the resources and to a leap towards food safety.

Approximately, 795 million people suffer from hunger and more than 2 billion have some deficiency in micronutrients or have over nourishment. 653 million people will still be undernourished in 2030. The current rate of progress will not eradicate hunger even by 2050. This evolution of food systems has responded in a change of dietary preferences and overconsumption patterns which have been reflected on overweight and obesity around the world.

All this negative issues are accelerating in intensity and pace. Agriculture is an important part of the problem, although the full implications are difficult to predict. Global food security is in jeopardy due to pressures on natural resources and climate change, which are threatening the sustainability of food systems (FAO, 2017).

Food systems are conceptual frameworks (Figure 1) which entail five main categories of drivers: biophysical and environmental; innovation, technology and infrastructure; political and economic; socio-cultural; and demographic drivers. The amount of impact of each driver will depend on the kind of food system. These drivers lead to the three core constituent elements of food systems; food supply chains, food environment and consumer behavior. These elements, influenced by the drivers, will define nutrition, shape diets and determine economic and social outcomes (HLPE, 2017).

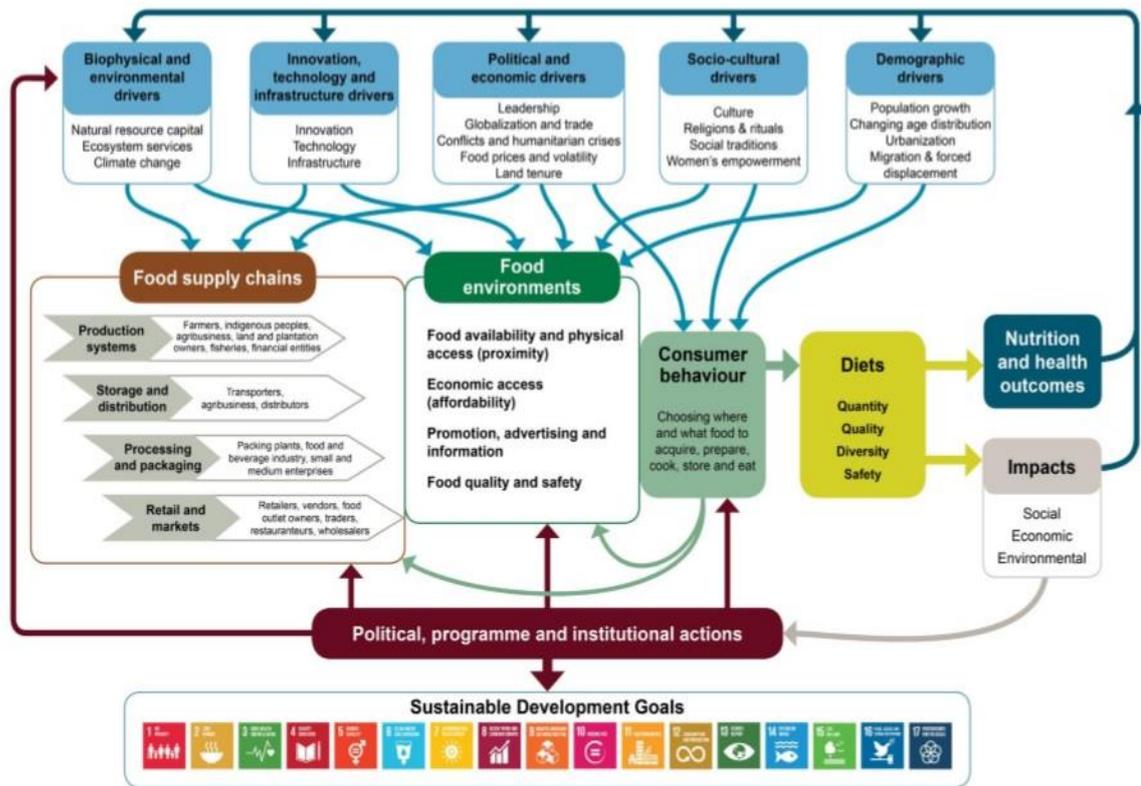
As food systems are even more concentrated on fewer hands, this raises another area: policy. Policy making is exposed as a core issue. The policy debate will take place and if we can engage all stakeholders of the private sector, producers and consumer organizations in improving dialogue, recognizing that inclusive governance is key for promoting better decisions, that would definitely be helpful to improve conditions.

Food systems are becoming more capital-intensive and vertically integrated. This is happening because of food distribution and input provisioning. Small producers are the first to lose due to an increasing seek of employment outside of agriculture. This creates migratory flows from male members expected to work in rural households leading to a more intensive feminine workflow in many places. This raises further questions on policy

coherence, such as if the global regulatory structures protect producers and customers against an increasing monopoly power.

The historical transformation of socio-economic systems have been always characterized by the exit of labor from agriculture and the subsequent decline in contribution of agriculture to gross domestic product. The same process appears to take place in low and middle-income countries. As demography increases the demand for agricultural products, urbanization requires food to be easily transported and stored. Hence the food processing has become a key part in the transformation of food systems (FAO, 2017).

Figure 1: Conceptual framework of food systems.



Source: HLPE, 2017

3. FOOD AND BEVERAGE INDUSTRY

The food and beverage industry emerged after the population became more urban in 1920. By moving to urban territories, companies adapted all their resources to the new market and new strategies surged in order to satisfy demand. Food companies started to process, transform, store and transport food and a new kind of value chain was introduced to the food system.

History tells that in the US Great depression of 1929, about a fifth of food was produced at home. Nowadays, less than 2% of the food is produced at home. Retail has been introduced in consumers' lifestyle and they buy food from a wide range of foodservice locations.

Urbanization made people increase their income and subsequently reduce the percentage of money they spend on food. In 1930 over 20 percent of their income was spent on food and in 2004 less than 10 percent. Currently, it turns out that only 5 percent of the Gross Domestic Product (GDP), belongs to food expenditures.

Food products and brands emerged at the beginning of the last century, so many of them are more than 100 years old. Consumers received many of them as their favorites and that preference was followed by later generations.

It is very common to buy products from Coca-Cola, Pepsi, Nestlé, Quaker, Kellogg's and many other brands¹ in the food system. It may sound ridiculous, but there are 10 companies that have control over the most quantity of food that consumers buy in the grocery store (Figure 2). They are mostly American and all make more than 20 billion US dollars on food sales. Products that were produced by smaller companies like Odwalla, Stonyfield Farms or even Twinings -a tea company for more than 300 years- have now become another brand of the big ten companies (CED, 2017).

Mergers and acquisitions are everyday operations in companies that have the control of the food we eat. Four firms alone control 40 % or more of the market. With these amount of power they can increase prices, influence with their policy and even reduce their rate of innovation. Impacts on environment and human health are some of the large variety of issues related to these companies.

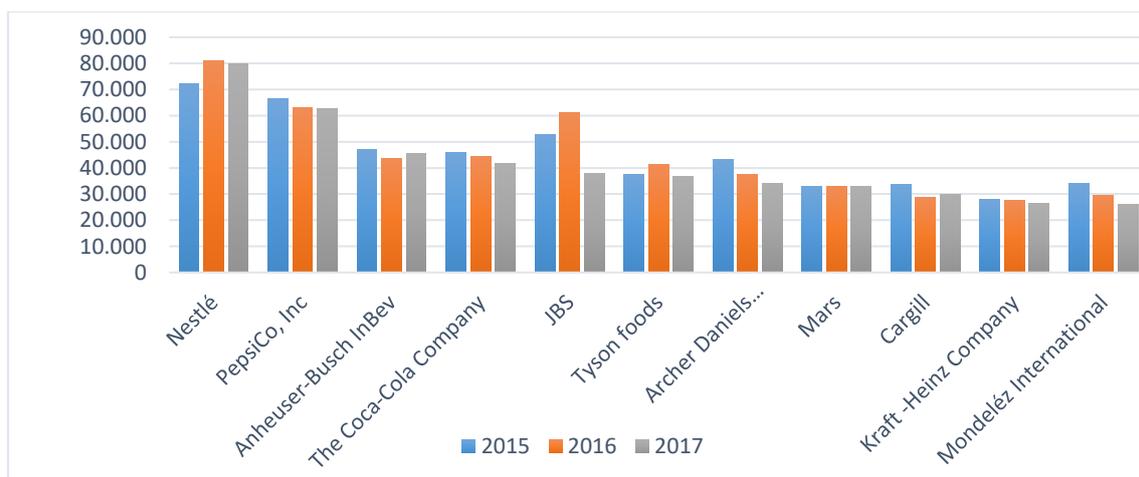
The USDA (United States Department of Agriculture) developed a National Organic Standard in order to differ from state or regional standards, and predicted to accelerate consolidation in the sector. The first draft was released in 1997 and in 2002 set the final implementation.

¹ Pictures of the main brands in the business shown in annexes.

Since 2012 another amount of acquisitions have been done: Coca-Cola acquired a minor stake in Aloe Gloe; Kellogg's acquired Pure Organic and the biggest one was announced by Danone with the acquisition of WhiteWave for \$12,5 billion (Howard, Philip H., 2016).

There is no doubt about the power and influence of these companies over resources and population due to their huge dimension. In order to figure out their response on sustainability, there are organizations who try to measure their influence and their commitment to achieve a better world and evaluate their disposal. Oxfam is an international confederation of 20 organizations which works with partners and local communities in more than 90 countries, claiming to use the power of people against poverty. Oxfam released a campaign called "behind the brands" to evaluate the companies' policy in order to improve social and environmental responsibility and they evaluate rankings based on the most important things for the world to achieve (OXFAM, 2013).

Figure 2: Food Sales from the biggest Food and beverage companies (US \$ million)



Source: BNP media, 2018

3.1 THE VALUE CHAIN OF FOOD SYSTEMS

Food systems are complex structures, in which food producers end up connecting with consumers through a value chain, starting in the farm and ending in their dining rooms.

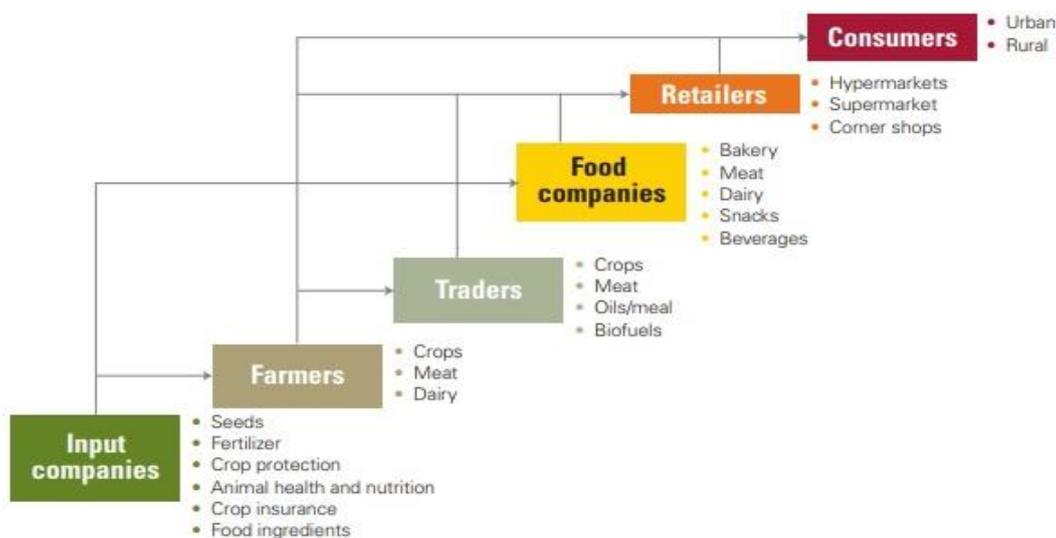
Value chains connect input companies to consumers in an industry of US 5 trillion dollars. Their goal is to provide access to food and, more recently, even fuel. The industry represents 10 percent of the money from consumers expenditures. Although in recent years food supply chains have grown remarkably due to productivity, in many parts of the planet, feeding the population remains a fundamental problem.

Innovation through the value chain aims to have great economic, social and environmental repercussion. The increasing opportunities of investing in the value chain, are considered as a strategic option for financial investors. Since 2004, investments in food and agriculture have tripled and by 2013 they were estimated in \$100 billion. During many years, food and agribusiness have obtained the higher total returns to shareholders (TRS) compared to other sectors with an average of 17 percent annually in 2004-2013. For example, energy averaged 13 percent and information technology 10% (McKinsey, 2015).

Demographic factors, as increase of population and economic growth of the people moving to urban areas, created a higher demand for food and biofuels. In the US there are more than 320 million consumers in the food system. Apart from this, there are also drivers affecting the demand side, as consumers consider important the social and environmental dimensions of the value chain. On the supply side, people is concerned about the decrease of levels of yield gain, climate change, water scarcities and droughts.

As we see in the figure, the value chain is constituted by input companies, farmers, traders, food companies and retailers. There are a great diversity of members in all the sector including subsistence farmers, generic manufacturers and high tech companies among others. These companies could range from small and medium-sized enterprises (SME) to multinational companies. The profit pool of these companies involved in the value chain is estimated to be around \$600 billion (KMPG, 2013).

Figure 3: The agriculture and food value chain.



Source: KPMG Value Chain Diagram, 2013

In order to understand the process of the value chain (Figure 3), we can define the following steps:

1. **Farm production:** Farmers produce commodities for consumption with minimal processing such as fresh vegetables, or provide inputs into processed products such as wheat that could easily be turned into bread.
2. **Primary Processing:** in the first stage beyond the farm, the food industry includes meat processing, oilseed crushing and refining, sugar refining, dairy processing and grain milling. Companies work in rural areas and could transform and store.
3. **Secondary Processing:** In the second stage, the food industry utilizes raw or partially processed commodities to create final consumer food, such as orange juice, frozen pizza and ice cream. They ensure supply during all the year by storing between harvests periods.
4. **Food Retailing:** Food products are distributed throughout the country to feed the consumers. In this stage, Wholesalers and distributors match up supply with demand.
5. **Consumers:** Food products are supplied to the food retail industry or wholesalers for distribution to consumers. Supermarkets, drugstores and other stores are ready to sell to customers for consumption at home. Other institutions sell food in the food away from home market, like restaurants or cafeterias.

Food supply chains have increased as well as the physical distance from facilities. The consumption of processed, prepared and packaged food has increased in all areas with exception of isolated rural communities. Most of farm commodities are produced only seasonally. The food value chain must consider infrastructure to transport and store food. During the last years, the coordination along the value chain has increased as retailer and consumer demands have become more specific. Companies may contact with farm producers to specify the features demanded for particular markets. For instance, organic products require specific production practices, so they can be guaranteed for proper consumption (CED, 2017).

Investing in food and agribusiness entails a deep understanding of crops, geographies and value chains and many of the most relevant opportunities are in unfamiliar territories to some investors. The profitability of the investment depends on the crop, but also in the performance of the different parts of the value chain.

When companies are involved in the value chains, they tend to be more effective and have the ability in finding an agreement in many issues like the health qualification of the food they are making, transparency, communication, viability of the farms and specially in setting the prices and many other important commitments. That would add value to the products they are selling to the customers and a good management of the value chain can make the difference and bring the market to the next level.

The USDA (United States Department of agriculture) shares guidance in order to improve the quality of relationships between the different parts inside the value chain. The main one is to keep the “triple bottom line” (economic, social and environmental outcomes) consistent with the criteria of the value chain. In reference to collaborators, it is important to stand in balance and avoid abuse of power from the economically more powerful one, and accept constructive criticism. The food value chain must be flexible and should make business decisions, adjustments and capture market opportunities as quickly as possible. Finally it must keep its structure, dimension, nimbleness and be close enough to buyers and suppliers (USDA, 2014).

4. FROM THE GREEN REVOLUTION TO AGRIBUSINESS FINANCIALIZATION

4.1 THE GREEN REVOLUTION

After the Second World War, agricultural production in India was scarce between 1947 and 1965. Droughts affected in the 1960s and the population was threatened by famine, which was only alleviated by food grain shipments from the United States. Fortunately, by the end of 1960s, salvation seemed to be possible when strains were produced with inbred resistance to the worst pests.

The Green Revolution started in 1930 but it began most markedly in the period between 1960 and 1970. It set a new dimension of agricultural production in developing countries. In 1968, the administrator of the U.S. Agency for International Development (USAID), William S. Gaud, used for the first time the term “Green Revolution” while referring to the increasing technology that agriculture adopted in the recent years.

"These and other developments in the field of agriculture contain the makings of a new revolution. It is not a violent Red Revolution like that of the Soviets, nor is it a White Revolution like that of the Shah of Iran. I call it the Green Revolution." – William S. Gaud.

A new agricultural technology started to appear in form of seeds of high-yielding varieties (HYV), inorganic fertilizers, assured irrigation and pesticides. It constituted a new technology set to transform agriculture in developing countries. The most relevant improvements were coming from genetics, fertilizers and farm machinery: (H.K. Jain, 2010)

- The discoveries in the early century of the Liebig’s theory on the use of inorganic fertilizers to replenish nutrients that were previously removed from the soils by crop plants.
- Mendel’s Laws of inheritance, provided the basis for scientific plant breeding.
- The synthesis of DDT, by Paul Muller, that led to the emergence of a wide range of organic pesticides for crop protection.
- The growing strength of the industrial revolution like the invention of tractors and other useful farm machines.

Gaud mentioned the record yields of wheat in Pakistan, Turkey and India and of rice in Philippines as part of the Green revolution, but the most successful part turned out to be in the second half of the century when both productivity and production in rice, wheat and food staples made impact (H.K. Jain, 2010).

HYVs were products resulted from traditional plant breeding methods, thus hybrids were produced by pollinating unrelated parents in by cross. HYVs of rice, wheat and maize were successful in the areas of tropical wetlands like India, China, Indonesia, Pakistan or Bangladesh (Fitzgerald-Moore and Parai, 2009).

The Rockefeller foundation and the Ford foundation took part on it in a very remarkable way. In 1950, The Rockefeller foundation in cooperation with the government of Mexico organized the Maize and Wheat Improvement Program resulting in two international Agricultural Research Centers, IRRI in Philippines and CIMMYT in Mexico. These two centers became important in designing fertilizers, high-yielding varieties of wheat, rice and influencing the rest of developing countries (H.K. Jain, 2010).

HYVs seeds brought a great increase in their production with two and almost three crops a year. Between 1965 and 1980, the production of wheat and rice in developing countries increased 75%, and the introduction spread rapidly. By the middle 1980s, 50% of the wheat and 60% of the rice were sown by HYVs strains in developing countries.

One of the big differences when it comes to HYVs is the use of water. In HYV farming, water is a necessity while in traditional farming it was used more as a protective measure. HYV requires concentrations of water for longer periods of time. In the 1950s the irrigated area was 21 million hectares and in 1980 it was 39 million hectares. The government built dams in order to make possible the new systems and farmers drilled tubes (Fitzgerald-Moore and Parai, 2009).

In the Green Revolution, genetically grown monocultures are grown and the use of pesticides is huge. As crops production increased, pesticide uses did the same. In the middle 1950s, 2.000 tons of pesticides were used annually, compared to the 1980s when more than 80.000 tons were used.

The HYVs methods were new to traditional farmers and most of them could not afford a big expenditure. In order to create more production, farmers obtained loans to buy farming machinery, such as tractors, mechanical threshers and electric pumps. Loans were also used to buy seeds, fertilizers and water credits for canal use and power for the pumps of the tube wells.

The economic and political evolution of the Green Revolution was difficult to evaluate, but meant to change the structure of social and political relationships as it caused conflicts in obtaining the scarce sources. In addition, it brought income disparities. There were only selective farmers who could get high financial standing to buy technology. For small farmers, the technology was considered too expensive and they were not able to take advantage of it, and often they could not afford to maintain the same yield as the bigger ones.

The Green revolution was the most important and the biggest innovation in agriculture and it took place in only twenty years. Technological advances were the key for this revolution and they showed a new way of feeding the demand of food due to growing population. On the other hand, there were relevant causes that were questioned:

The Biorevolution as an appropriate way of solving the problem or a less use of technology that would favor the preservation of genetic diversity and the ecological impacts in water, soil and damage caused by pesticides and herbicides.

As prices and trade affect farmers and their production, the sustainability of the revolution was always questioned. For example: in India input prices grew faster than production prices in a certain period of time and in Philippines the productivity of rice decreased 40% in over a period of twenty years (Fitzgerald-Moore and Parai, 2009).

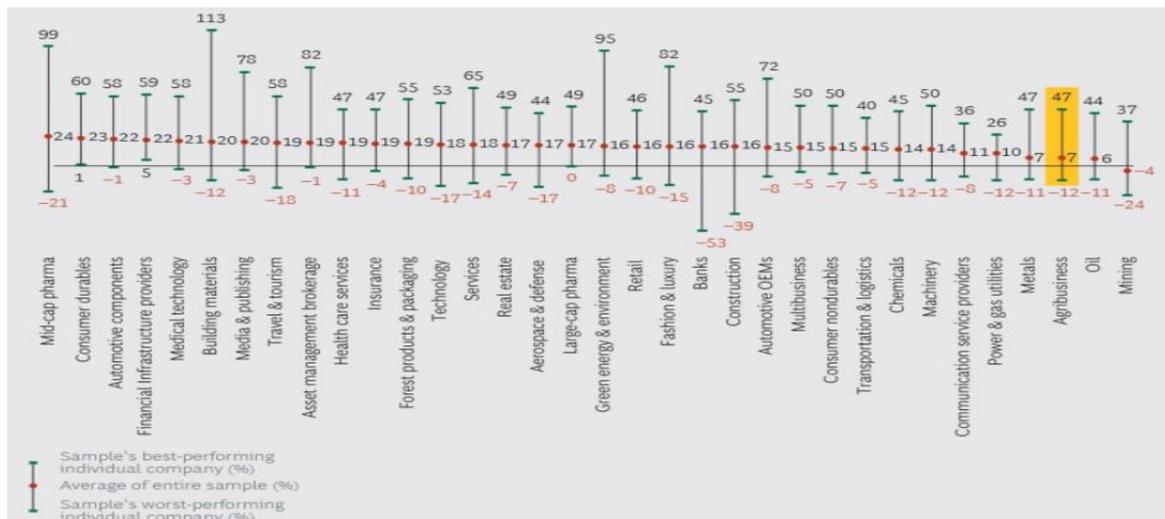
4.2 AGRIBUSINESS FINANCIALIZATION

There has been many entities and institutions with particular interest in what is called “financialization” of the global food system. In the recent years, banks, investment funds, pension funds and hedge funds have invested a lot in the business. Institutional investors invest money of a large portfolio of clients to buy financial assets (bonds, options, shares, future contracts, etc.) and other like real estate. These investors include commercial banks, pension funds, mutual funds, insurance companies and grants from foundations and universities. In the case of pension funds, they have invested the most quantity in agricultural lands and in production, processing and distribution of food, so by 2016, the main percentage (20%) of institutional investments were financed by these funds (Echánove Huacuja, Flavia, 2017).

In the case of TIAA-CREF, one of the most important U.S. pension funds with \$869 billion in 2016, announced a new \$3 billion agriculture investment in North America, South America and Australia. They had already invested \$2 billion in 2012, so they were making it small but following growth patterns. Farmland in United States is growing and is worth more than \$3 trillion (Maxwell & Locke Ritter, 2016).

During the recent years, agribusiness has faced a challenging situation for value creation. From 2012 to 2016, the top 40 global agribusiness companies, generated a total average shareholder return (TSR is the annual percentage return to owners, which comes from capital gains plus dividends) of 7% annually (Figure 4), lower than almost all the industrial groups in that period with the exception of oil (6%) and mining (4%). In comparison with the 2007-2011 period, the annual percentage return to owners (shareholder return) was the opposite when agribusiness industry was higher than any other industry. Agribusiness companies like Cargill, Tyson Foods and JBS among others have had to face the situation.

Figure 4: Agribusiness shareholder return (2012-2016). (percentage)



Source: Boston Consulting Group, 2017

Most of agribusinesses suggest that prices for commodities have been crucial impeding value creation. In the United States, corn price has fallen more than 50% since 2012 and many farmers of cotton and soybeans have seen costs exceed all production costs. Pressure on farmer's economics has reduced margins for farm inputs, such as equipment and seeds. The producers of fertilizer have been hit the hardest. These companies have seen fertilizer prices drive negative return to owners from capital gains plus dividends.

The commodity crisis has promoted several investments in innovation, which have had impact in more yield enhancing products and services. Farmers are shifting their investments towards technological extremes, adopting cutting-edge technologies, such as biologics and low-cost solutions, such as lime application.

Currently, there are favorable conditions for crop in the United States that result in strong yields and big amounts of stock and the same is happening in Brazil with the highest record production in 2017 (BCG, 2017).

As we know, agribusiness is evolving from a more local and regional business to expanded corporations, public and state agencies. If we analyze the current perspective and the future we would be able to figure out some trends which are being developed right now include:

- Consumer trends in the demand for food change are constantly changing and activism with regard to labelling has increased. Trends of food safety and responsible food have emerged. Diets have changed to a more animal-protein based diet during the last decade.
- Technological development and skilled personnel enhances productivity and competitive advantage. This ensures competitiveness and food security by decreasing prices and making them affordable. More trade agreements are

established and more protectionism measures are taken in the United States and in many European countries.

- Agricultural food regulation is increasing and is helpful for the protection of consumers and environment, as well as for the use of water and land as natural resources and even the sun and wind as renewable energy (BCG, 2017).
- Business intelligence has grown with big-data in order to strive for greater efficiency. Companies need to improve their communication with clients, consumers, stakeholders and others to offer greater value. The increasing use of granular data (for example: data for every ten meter square of a field), and analytical capability to integrate many sources of information, with the goal of becoming more efficient and lowering the cost. As data is captured by different members of the value chain, managing it would require strategic partnerships and acquisitions. Deere & Company has signed strategic partnerships with input firms. In 2013, Agricultural giant Monsanto acquired The Climate Corporation for \$930 million and many other moves took place around agriculture giants (McKinsey & Company, 2015).

Something is happening in agricultural business, which is changing it for several reasons. The traditional model requires a new view from leaders in agribusiness as they are meeting a growing demand of food. Agribusiness should understand that creating value for the farmers means creating value for shareholders, they should become more effective by creating competitive advantage. Principles of economic, social and sustainability must be accomplished as well as food security goals (Purchase John, 2017).

4.2.1 The fertilizer market. A singular case of price peak.

A wide range of factors are involved in the price crisis, especially when it comes to volatility on commodity markets. One of the important attributions of market drivers to agribusiness is fertilizers. In the price spike of 2008, India, which was the largest global importer of phosphorous fertilizers, had a major contribution to the situation. India doubled its import of phosphorous fertilizers in 2008 when prices doubled and in addition to the protective trade measures established by fertilizer suppliers, it led to a 19% drop in global phosphate fertilizer export. Taking into account that Indian fertilizer subsidies led to farmers not adjusting their demand to the new situation, it all concluded that these three factors have jointly caused the spike (Frontiers in Nutrition, 2017).

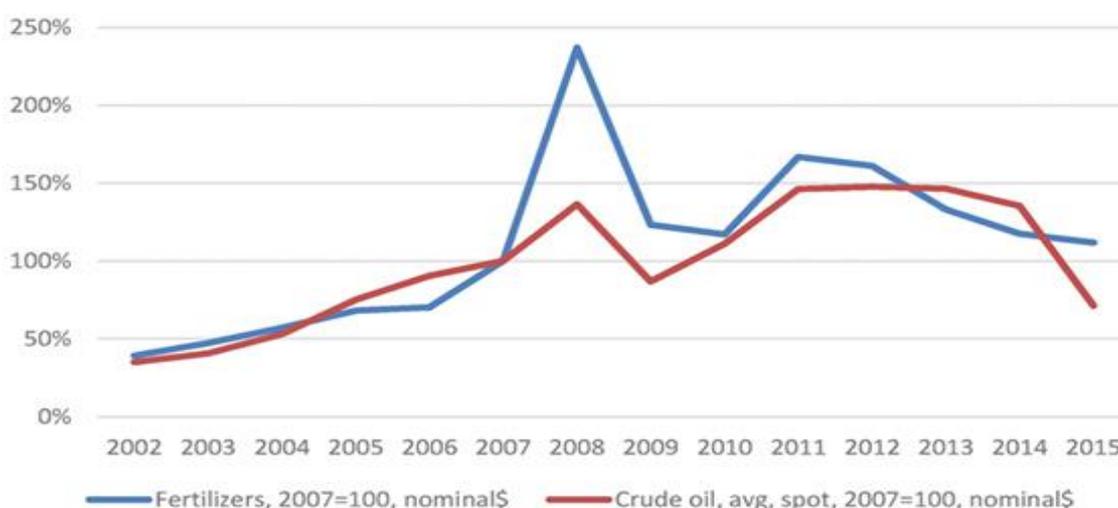
If we want to consider the main drivers relevant to the price peak we should consider the following ones assuming to have jointly produced the effect, although the relative contribution of them is likely to be very different:

The value of the US dollar over the period 2003-2008 depreciated against the Chinese yuan (13%), Indian rupee (18%), Russian Ruble (23%), Canadian dollar (34%) and Brazilian real (48%). This led to a rising demand in some of these countries, as the imports became substantially cheaper.

Transportation costs increased due to a previous increase in fuel prices and the high demand of freight services is considered another big contributor to the 2008 fertilizer price spike. The average Phosphate Rock (PR) import price increased from \$80 to \$220 in 2008, so the share of transport cost in the import price fell from almost 40% to 25%.

Oil prices were deemed to have contributed the most to this price spike in relation to phosphorus fertilizer. The response to oil prices was disproportionate. The relative increase in oil prices in 2008 compared to 2007 (Figure 5) was about 35% and the increase in fertilizer prices in the same period was about 135% (World Bank, 2016).

Figure 5: Global fertilizer and oil prices in percent relative to 2007. (US dollars, nominal).



Source: *Global Economic Monitor (GEM) Commodities, World Bank, 2007*

Fertilizer demand for biofuels production in the US, Brazil and Europe are often mentioned to be factors. It turns out that, in these countries, from 2007 to 2008 there was a 33% increase in the area under energy crops. The total 2008 global production increase in biofuels was far lower, only about 5%.

The prices of commodities doubled in 2007 and 2008. That led to increasing profits for farmers stimulated by the higher demand. Food price increase appeared to be a moderate factor of impact on fertilizer price because farmers in many exporting countries had high price levels for their production and only India had a dramatic increase in imported fertilizer and the food price peak is much less pronounced than the fertilizer peak. Raw material costs in 2007-2008 increased a lot. Phosphate Rock (PR) prices almost tripled, and are named among the main factors contributing to fertilizer price increase.

Another factor for this influence in the prices is the low inventories of 2008. They had very limited capability of adjustment to a fertilizer surging demand and claimed to have

influenced the market. Unfortunately, there is no information on global scale and there are only estimations.

The concentration of market power in a few major countries and companies is certain, but this fact is not considered a trigger of the 2008 price peak. The protective reaction of fertilizer supplying countries is based on the anticipation of a high export price. National authorities protect domestic consumption by reducing the quantity of exports. By reducing the supply, they increase international prices to a new level (Frontiers in Nutrition, 2017).

The international buyers of fertilizer, subsidize their domestic use, and this is supposed as one of the reasons why farmers are slow reducing fertilizer consumption in response to a price increase. This component remains discussed as a possibility.

The great market distortion observed in 2008 entailed great profits for fertilizer producers who had outstanding profits that year. That common interest from the big companies in profit maximization may not exclude the possibility of their cooperation in order to support growing prices. For some big companies, like Mosaic, gross margin tripled in 2007-2008, growing from 10% to 30%.

Fertilizers are fundamental inputs for agriculture and food security, so conflicts on prices must be avoided as they could generate heavy impacts, especially if they remain for a long time. Policies must secure stability for all the members involved (Khabarov and Obersteiner, 2017).

5. FINANCIAL CRISIS IMPACT ON FOOD SYSTEMS

The financial crisis started in 2007 in the US with the subprime mortgage crisis but soon spread to Europe and developing countries. It is considered by many economists the worst financial crisis since the Great Depression of the 1930s.

Developing countries had a slower economic growth due to a decline in foreign capital, exports, remittances and depreciating exchange rates. Government budgets in developing countries were also in risk as they could not face expenditures for social protection and services. Households reduced the food consumption in both quality and quantity due to higher food prices which turned out into hunger and malnutrition.

5.1 FOOD PRICES

The Food and Agriculture Organization estimates 75 million people were thrown below the hunger threshold due to high price increases in 2007 on foods and more than 40 million in 2008. In addition to the previous undernourished people, the number reached 1 billion in 2008, just before improving to 925 million in 2010 (FAO, 2009).

When crisis appears, the most vulnerable population to increasing food prices are the people who spend a large amount of their income in buying food, or the ones that buy more food than the quantity they sell. These groups are predominantly the small farmers and urban poor people who spend between 50 and 80% of their income on food. In most developing countries, a middle-class family could spend from US \$6 to \$10 per capita per day which means 35 to 65% of expenditures and in most of these countries, more than 80%, people live with less than \$10 per capita per day.

Higher food prices would not benefit all farmers but a minority of them because less than 20% produce enough surplus to be categorized as net sellers. They would sell crops even when their harvest is not enough for their own consumption. They would sell for a low price during harvest time and buy at a higher price during lean season just because they need cash to maintain themselves.

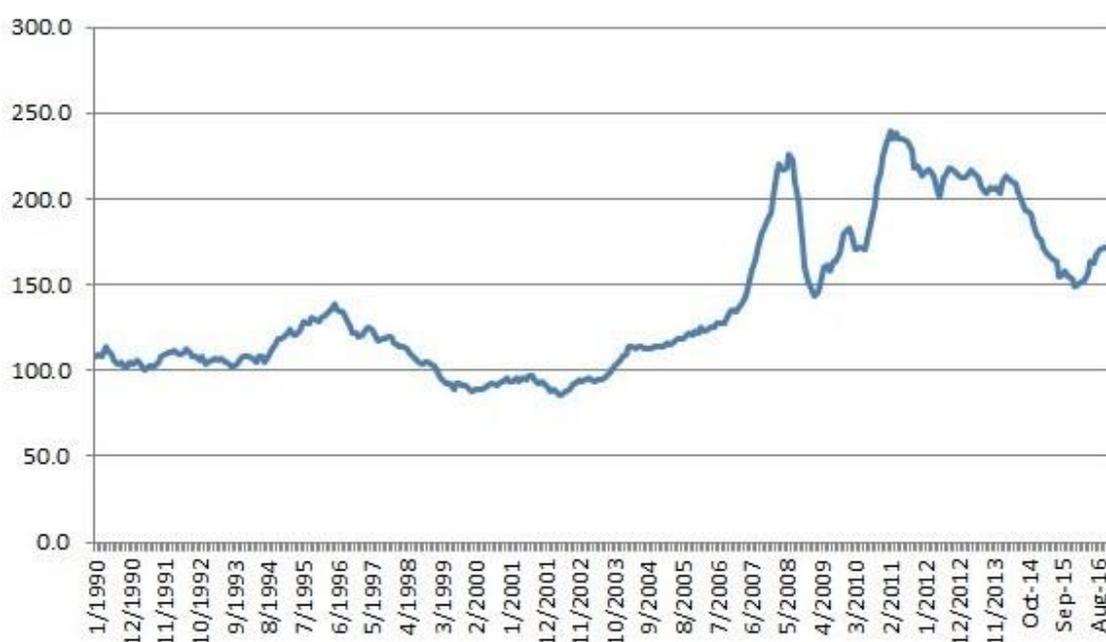
Since 2005, food and fuel prices were increasing and kept growing until 2008. Between June and December 2008, The FAO food and cereal price indices decline about one third. That was considered a positive aspect of the global financial crisis (FAO, 2009). Many things contributed to lower those prices, such as a stronger situation of the dollar, lower transport costs, a slower growth of the demand and minor export restrictions. Yet food prices were still high and remained high during 2009. For example, cereal price in January 2009 was 80% above the level of 2005 (The Journal of Nutrition, 2010).

According to FAO, the food price index doubled between 2007 and 2008 (Figure 6) due to a confluence of many factors: high oil prices demand were not able to covered by

production, biofuel ethanol (as a substitute of oil) increased due to higher demand and food exports bans met low food reserves to exacerbate even more the raise of prices.

Unfortunately, the price peak of 2008 has not been the only price peak of food. It turns out that in 2010-2012 another price peak occurred, but the financial crisis was not directly involved. In 2010, climate played an important role. Excessive heat caused crop failures in Russia and increased wheat prices, meanwhile in China, an unprecedented drought took place that obliged the country to start large-scale imports. Some sources even appoint to “the Arab Spring” and to biofuels as triggers of the spike (World Resources Institute, 2013).

Figure 6: Food Price Index (1990-2016).



Source: FAO, 2017; Data: Nominal Food Price 2002-2004=100

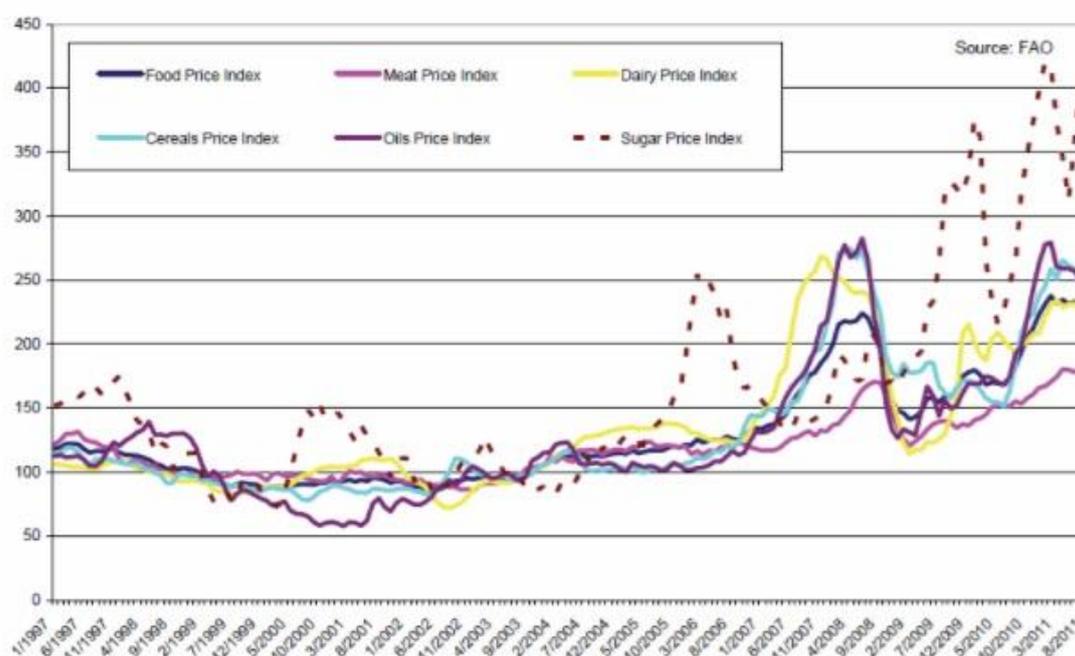
The impact of the crisis in 2010-2012 was considered different than the 2007-2008. The rise has been led by oils and sugar, and harvests were able to maintain the price of rice, which is a major staple for more than 60% of population in developing countries. In addition to the fall of price staples in these countries (something that had not happened in 2007-2008), the outcome was that the impact in poverty has been more limited (Ali and Eidelman, 2011).

5.2 FOOD PRICES INFLUENCE ON FOOD CONSUMPTION

Food indicators have to reflect the food and nutritional status and be sensitive to shocks like economic crises. If indicators are good enough, they can give preventive measures, avoid damage and the need for high cost of therapeutic feeding. The World Food Programme (WFP) uses proxy measures. The main one is based on the increase of the food basket cost. The WFP calculates changes of costs of food baskets in 35 countries, which are based on a weighted average of price changes, using energy contributions to the food basket as weights. It turns out that households with multiple energy sources would be less affected by price increases than others with just a single source because of they can substitute to a cheaper food unless all the commodities are affected by the price increases. On average, the cost of the food basket in the latest quarter of 2008 was 36% higher than in the same quarter of 2007 in the regions of West and Central Africa, East and Southern Africa, Asia and Latin America.

An example for this is the case of cereal. Cereal prices grew from 2000 and reached its peak in 2008 (Figure 7). According to the FAO cereal price index more than tripled its price. It led to a reduction in the quantity and quality of food in the most vulnerable households which spend the largest amount of income on food. These vulnerable people switched to cheaper food that is less nutritious and when those nutritional needs are not satisfied, people become more likely to contract any kind of illness. The rise of prices created a shift of patterns in food consumption due to a great price volatility within food items.

Figure 7: FAO Monthly Food Price Indices.



Source: FAO, 2012; Data: 2002-2004= 100

5.3 IMPACT IN NUTRITION

The Millennium Development Goals, established in 2000, in the United Nations Millennium Declaration, eight international development goals to apply for 2015. The first goal had the purpose of reducing underweight by 50%. The fourth goal called for a decrease in mortality in children under 5 years by two-thirds between 1990 and 2015.

Over 10 million children die every year before turning five years old. A third of these deaths are in relation to undernutrition. Statistics mentioned that 80% of them live in Africa or Asia and for children chronic malnutrition in the first two year is associated to irreversible consequences (Thompson, Brian).

The Global Hunger Index (GHI) is a report published once a year that gives a qualification to countries in order to classify the level of undernourishment (Figure 8). The indicators are: Child death rate, proportion of population undernourished; prevalence of wasting in children; and the prevalence of stunted growth in children. The score is between 0-100. The higher the score is the higher the levels of hunger are in the country. A score above 20 is considered “serious” and above 35 is “alarming”. The warfare situation in many countries in Central Africa will not allow help from aid organizations (Pauli, Marcel, 2017).

Figure 8: Global Hunger Index (2017).

Afghanistan	34.8
Central African Republic	46.1
Chad	44.3
East Timor	34.3
Haiti	36.9
Madagascar	35.4
Niger	33.7
Sierra Leone	35.0
Yemen	35.0
Zambia	39.0

Source: Welthungerhilfe, FAO, Concern Worldwide, 2017

In order to adjust to higher food prices, households would reduce consumption in both diversity and energy intake. The consumption of expensive food items is reduced as well as the frequency and the size of the meals. Adults –especially women- would give priority to children’s food consumption than to their own and that speaks by itself about the magnitude of the situation.

When it comes to micronutrient deficiencies because of higher food prices, households tend to reduce the most expensive animal source foods (milk, eggs and meat), vegetables,

fruit and nutrient food. Subsequently, if they are not able to afford a smaller diet, they may reduce basic foods such as sugar, oil and staples, so the intake of micronutrients is reduced before energy intake is reduced. This downgrade in micronutrients leads to health issues and may increase susceptibility to infections and deficiencies.

The next phase is more severe and it takes place when households reduce either the size or the number of meals. In this case, they would suffer deficiencies in energy and macronutrients and underweight would appear, which could turn out severe and involve acute malnutrition.

Many studies have been done in order to address the macronutrient deficiencies (The Journal of Nutrition, 2010): In Bangladesh, between 1992 and 2000 while rice prices increased, its consumption remained constant, but child underweight increased. The explanation was that this was accompanied by a lower non rice food consumption. It turned into an increasing chronic energy deficiency among other causes. Subsequently, they concluded that the status was related to dietary diversity and dietary quality.

The most affected people by a low nutrient diet are those with the highest requirements like young children, pregnant woman and patients with chronic illnesses such as tuberculosis and HIV/ AIDS. Poor people are the most affected by higher prices because they are net buyers of food who are already consuming a poor diet and they do not have enough resources to face increased prices.

The overall impact of the financial and economic crisis has been severe and caused increasing poverty and unemployment. Considering the nutrition perspective, it aggravates hunger and malnutrition and the number of malnourished women and children increases. It causes civil unrest and more conflicts like hunger riots.

In order to cope with increased food prices and evaluate potential improvements for the future, we can take several conclusions and ideas even from the childhood which represent an opportunity for shaping the future health of the next generation.

We could say that short-term price raises have long-term effects and we should use instruments to stabilize food prices and make food more affordable for people as well as provide social protection to the most vulnerable population.

Investing in nutrition involves high costs but its repercussions of not targeting this issue could entail the high cost of hunger for people. The public institutions should not disregard this issue, as there are plenty of solutions. In order to apply interventions, including market and nonmarket, paying attention to the contextual factor would be crucial for making decisions. Modalities could involve cash transfer programs with vouchers, food assistance or a combination of both. In the future, more surveillance systems should be considered to improve vulnerabilities and food security for people (The Journal of Nutrition, 2010).

6. THE FUTURE OF FOOD SYSTEMS

“I believe that in 30 years or so we will no longer need to kill any animals and that all meat will either be clean or plant-based, taste the same and also be much healthier for everyone” - Richard Branson, founder of the Virgin group.

We all ask ourselves how nutrition will be in the future and how food systems will innovate in order to improve the current situation. It turns out that the Food and Agriculture Organization of the United Nations has elaborated a quadrennial review of their strategic framework for 2018-2021. This point lays out the main trends and challenges for these upcoming decades and includes extra analysis from multiple resources.

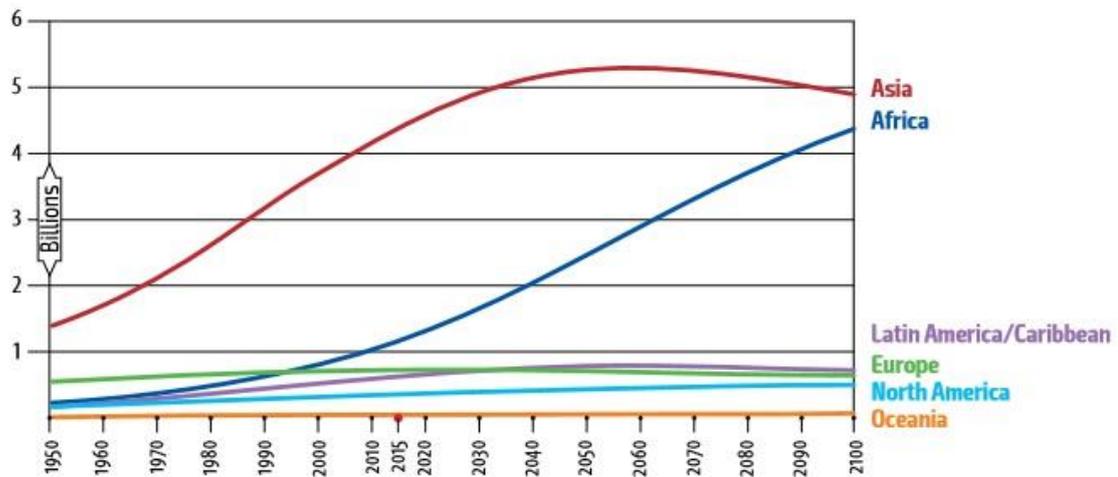
In order to address the issue, there are trends to succeed in eradicating hunger and poverty, while making agriculture and food systems more sustainable. There are many trends but the most important ones are these, which involve high interdependence between:

6.1. The huge demographic expansion that will happen along the century.

The world's population is expected to keep growing to 10 billion by 2050. This means the agricultural demand will rise 50 percent compared to 2013. It is expected an 11 billion population by the end of the century. There are considerable differences between high, middle and low-income countries. High-income countries would reach their maximum population by 2040. Low and middle-income countries would have a slow decline in growth over the medium and longer term. There are huge differences in growth rates within low-income countries as Asia, the most populous continent would reach its population peak in the 2050-2060 period (Figure 9). The only region of the world where population is set to continue to expand is Africa. Although the continent's growth rate will not continue to accelerate, the population is expected to increase and will not reach its higher peak this century. It is expected to reach more than 2,2 billion by 2050 and even more than 4 billion by 2100 (FAO,2017)

Farmers are approximately one-sixth of the population and they produce the equivalent food of 3.800 calories per person per day which is considered well above the minimum requirements to feed the population (Graeme Hugo, 2011).

Figure 9: Population growth until 2100, by region. (billions of people)



Source: United Nations, 2015

The question is whether we can achieve the required production increases even as pressures are already scarce on land and water resources, and the climate change negative impact is intensifying. There exists a consensus view that current systems are capable of producing enough food, but it will involve major transformations to produce it in a sustainable manner (FAO, 2017).

Demand of cereals is projected to increase from 1921,3 million tons in the late 1990s to 3046,5 million tons in 2025. Transformations will require improved seed varieties, better agricultural practices and other measures favoring sustainable agriculture, as well as actions in order to take care about climatic change and pollution (Graeme Hugo, 2011).

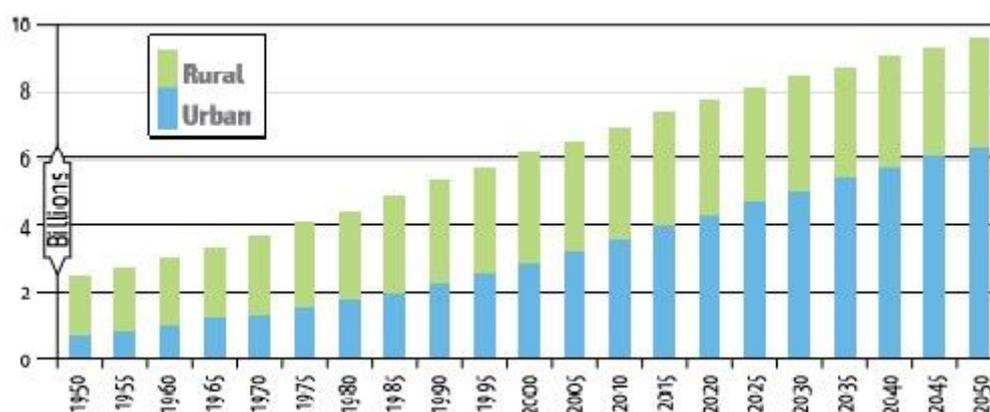
The growth in income in countries, specifically in low and middle income countries would create a transition towards an increasing demand of meat, fruits and vegetables requiring shifts in outputs and adding pressure to natural resources.

Agricultural investments and innovations are increasing productivity but the low growth of yields have turned into rates that are low for comfortable production. There is a significant proportion of food losses and reducing them would lessen the need for higher quantity of production. It is estimated that one-third of the total food produced is wasted.

The acceleration in productivity is harmed by the degradation of natural resources and the transboundary diseases of plants and animals even becoming resistant to antimicrobials. This propose further questions: Will the food be good enough for human consumption even in low-income areas where population growth is higher? Can economies and agricultural sectors be transformed to provide better employment and income opportunities?

For many decades, the world's population was rural predominantly. Thirty-five years ago 60 percent of all people lived in rural areas. Since then, this urban-rural balance has taken a remarkable change. Nowadays (Figure 10), more than a half of the global population is urban, exactly, 54 percent. In 2050, more than two-thirds of the world's population will live in urban areas. Changes in agriculture, technology and job opportunities have helped urbanization (FAO, 2017).

Figure 10: Growth in urban and rural population to 2050 (billions of people).



Source: United Nations, 2015

In 2050, the global urbanization could lead to a net extra addition of 2,4 billion to urban areas, more than the total global population increase of 2,2 billion. This means that rural population may see a net reduction of 200 million and it is caused by higher mortality rates in rural areas and shorter life expectancies.

Urbanization has a direct influence over food consumption, and is also high in low-income countries, especially in Latin America. Urban income tends to increase the demand of processed foods as well as animal-source food, vegetables and fruits involving a dietary transition. Higher urban income increase the opportunity costs of preparing food and favor products with a large amount of labor. This creates a change in the nutrient content of diets becoming higher in sugar, salt and fat. This shift in consumption means a shift in employment in the food system, causing fewer people working in agriculture and more in food processing, retail and vending.

Aging will also accelerate in rural population and tends to start earlier in rural areas. It has major implications for labor force and agricultural production, as older people may have disadvantages because of discrimination against older in accessing credit and other income resources (FAO, 2017).

6.2 Global economic growth, investment and food prices.

The world's global economy grew from 2,6 percent a year to almost double in size between 1990 and 2014. Over that period, gross domestic product (GDP) grew by 5,1 percent annually driven by low and middle-income countries. In the same period, China grew at double, by more than 10 percent a year.

The GDP increases taken by economic systems have variations as they depend on a wide range of factors: market, technology, resources, population, climate change, policy, etc.

Projections on economic growth for 2050 projected by AT2050 (Alexandratos and Bruinsma, 2012), calculate that GDP per capita would increase between 2005-7 and 2050 from \$7.600 to \$13.800, which means an annual growth rate of 1,4 percent. The income gap will continue to widen from \$25.500 to almost \$40.000 (absolute terms).

This would affect values of agricultural demand for low and middle-income countries, where reactions to customer's income are expected to be stronger than in high-income countries. The rise of the middle class as a result of the increase of income in emerging countries will change demand to a higher consumption of meat, dairy products and more intensive food items which will entail repercussions for natural resources.

Investments have increased over the last 25 years. The growth has increased in high-income countries that averaged less than 2 percent a year between 1991 and 2014. Those levels fall almost 15 percent in these countries due to the 2008-09 financial crisis. By 2014, those levels recovered to the previous level of \$9 trillion (constant prices of 2005). Investments are growing and in the special case of Asia, the levels have increased dramatically as China grew at some point at an annual rate of 15 percent. In 2014 China assumed more than 85 percent of the investment in the region.

Food prices have fallen back to levels that were reached in the 1980s. They still remain above the low levels of the 1990s and 2000s. Two peaks have occurred, one in 2008 and the other in 2011. FAO and the Organisation for Economic Co-operation and Development (OECD) present a mixed frame of medium-term developments in food commodity prices for 2025; Meat and cereals are projected to decline in real terms with the exception of coarse grains, but prices for dairy products will tend to rise in the next 10 years. In general, prices will remain higher than in the decade before the peak of 2007-2008 because of the crisis (FAO, 2017).

There is a trend to lower prices in agricultural commodities but there is a lot of uncertainty. Agricultural prices weakened in 2017 and the projections situate them stable for 2018 and 2019. Low prices of energy helped reduce grain and oilseeds costs, so their production has been relatively intensive and also reduced incentives to production of biofuel, which grew 15% annually during the past 10 years and is expected to grow only 3 % in the next three years. (World Bank, 2018)

Food price volatility received remarkable attention in 2007-2008 food price inflation crisis. In the last 50 years, it reached the highest level of fluctuation in the 1970s. Since

2000, fluctuations have been above the level of previous decades, when levels were below the linear trend line and current levels of volatility are approaching those observed in the 1970s.

Food prices depend massively on how production manages constraints and climate change. Climate change could jeopardize the expansion of agriculture and that would be reflected on high prices.

6.3 Climate change

The Kyoto Protocol of 2005, established the commitment of 182 countries to reduce the greenhouse gas emissions, but those have increased at a global level. 70 % of them are originated from only 6 members: United States, China, The European Union, India, Japan and Russia (IIISD, 2015).

Climate change impacts are expected to be more severe on middle and low-income countries, where more percentage of people depend on agriculture and are vulnerable to food insecurity. In 2015, world leaders addressed this issue under the United Nations Framework Convention on Climate Change (UNFCCC) and negotiated the Paris Agreement on climate change, recognizing the priority of ending hunger and taking control of food production systems on facing the adverse effects on climate change. The Paris agreement recognizes the special circumstances of developing countries, especially the ones that are particularly vulnerable to climate change adverse effects (UNFCCC, 2015).

In the last 50 years, greenhouse gas (GHG) emissions have doubled, and will keep increasing. Without efforts to adapt to climate change, food insecurity will increase substantially. The impact will not relate just on food supply, but in quality, access, utilization, stability and diseases. Less rainfall will make water less available compromising hygiene and favoring spread of pathogens.

Climate change affects food-insecure regions, affecting crop, livestock and fish stocks. The overall increase in demand of agriculture and farming practices will lead to a more fiercely competition for natural resources, increasing greenhouse gas emissions, deforestation and land degradation.

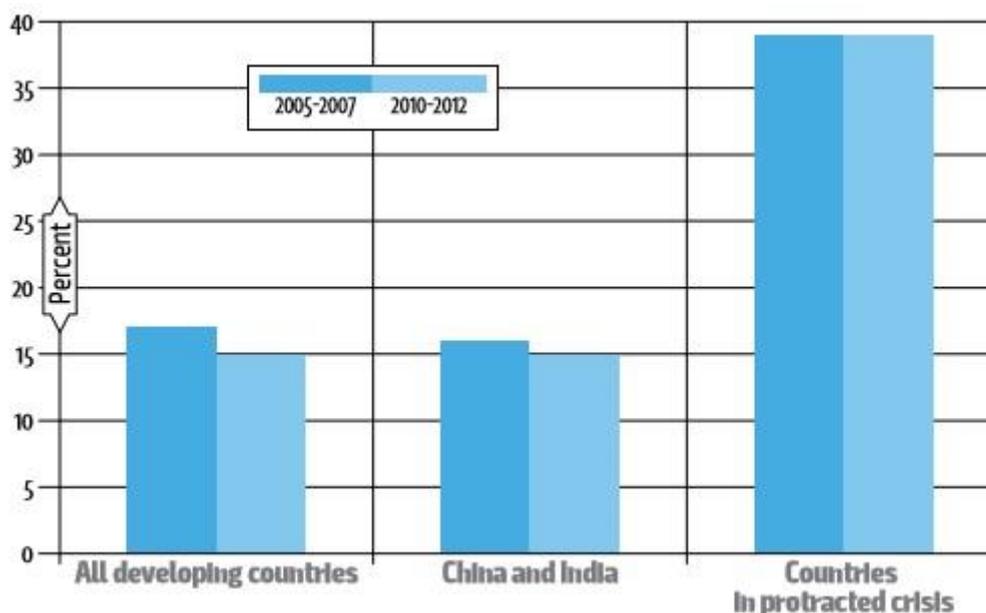
The Inter-governmental Panel on Climate Change (IPCC), is confident that agronomic adaptation by smallholders can improve yields up to 15-18 percent and consider it crucial. Measures for climate change adaption need to be applied not only to food production, but to all parts of the supply chain as there are not sufficient research on how food processing affects climate change. Packaging, transport, storage and trade should be considered (FAO, 2017).

6.4 Conflicts, crises and natural disasters

While the growth of global population may provoke an increasing number of violent conflicts, this was inverted between 1995 and 2003. Nevertheless, conflicts have increased since middle 2000s. The Global Peace Index Report (IEP, 2016) exposed that the world became less peaceful in 2015 confirming the trend of decline. The report shows a global inequality in peace, in which the most peaceful countries continue to do so and the least peaceful getting even more violent. It turns out that countries with the highest levels of hunger are the ones with the higher levels of conflicts, especially civil conflicts.

Crisis and conflicts are increasing in both number and intensity. They can be reduced or amplified by climate related natural disasters. Natural disasters and conflicts are considered major disrupters in food security and cause migration of people. They tend to reduce food availability and make more difficult the access to health care. On average, it exists a proportion of undernourished people living in low-income countries with a protracted crisis (Figure 11) which is between 2,5 and 3 times higher than in other low-income places.

Figure 11: Prevalence of undernourishment and protracted crisis 2005-2007 and 2010-2012. (percentage)



Source: FAO, 2017

These conflicts affect agricultural production in rural areas. Vulnerable people lose access to resources for many reasons: physical destruction, disrupt of transportation systems, damages to farm assets, etc. Between 1970 and 1997, agricultural losses for low-income countries on a conflict averaged \$4,3 billion per year (FAO, 2017).

6.5 Political decisions for food and nutrition security.

The importance of governance on food systems is reflected in the 2030 Agenda for Sustainable Development, which constitutes a new chapter for international governance and cooperation towards a sustainable development goal. It is framed by the Rome Declaration on Nutrition. This agenda goes beyond the traditional objective of dividing countries in “developed” and “developing” to propose a new system in which sustainable development is presented as a universal challenge for all countries, so the decade is considered an opportunity for consolidating nutrition actions and facilitating policy decisions across the areas.

As a part of the 2030 Agenda for Sustainable Development, on September 25, 2015, countries committed to a set of goals, known as the Sustainable Development Goals (SDG17), which settle a new vision for the upcoming years.

The objectives of this agenda are transformative. The first goal consists in the elimination of all forms of exclusion and inequality everywhere and the ending of poverty, malnutrition and hunger (Figure 12). The most remarkable ones are based on protecting the planet and ensure prosperity for all, as well as the need of access to universal health care and the strong attention to gender issues.

The 2030 Agenda for Sustainable Development, adopted by the international community in September 2015, shares the proper guidance for international governance, with development objectives and commitment. This is considered a universal challenge and a responsibility for all countries around the world, which will require changes in consumption and production.

It provides a vision on how the objectives can be combined to create new sustainable development paths. The second Sustainable Development Goal (SDG 2) focuses on ending hunger, improving nutrition, achieving food security and promoting sustainable agriculture by 2030. This 2030 Agenda has many other SDGs, like SDG 13 for eradication of poverty and climate change and SDG 14 and 15 for sustainable use of marine and terrestrial ecosystems.

The United Nations Development Programme (UNDP) set a project for the 2030 Agenda. The project called ‘Enabling responsive, coherent and inclusive support to the implementation of the 2030 Agenda for Sustainable Development’ or also called ‘MAPS project’ started in 2016 and will run until 2020 and shares guidance about support and coordination of the activities for the partners (UNDP, 2017)

Figure 12: the Sustainable Development Goals.



Source: United Nations, 2017, quoted in FAO 2017

The agenda contains a big legal instrument, such as The Paris Agreement on climate change, which commits nations to keep the raise of global temperature under 2°C.

It entails different new approaches to international cooperation and mutual accountability and shares a vision of facilitating access to markets, technology and policy support to the least develop countries. It also pronounces towards enabling support and collaboration between the private sector and non-state entities.

6.6 Industry- sponsored science

In the past years, many countries and governments decided to reduce their support on health research. Public research has been dismissed from governments as well as from international research organizations.

The gap has been covered by private companies and that has generated a lot of controversy. For instance, privatization of agricultural research has focused on commodities which give investors enough business to secure the biggest return on investment. That means there are healthy crop varieties with high nutritional benefits that have been rejected from diets.

The privatization of the studies that influence our diets have implications for the validity as they finance them and tend to produce outcomes that favor their interests in a big magnitude. In order to redefine the power of research, people must be informed by more

public institutions and large-scale data which would help scientific integrity in pursuit of the public interest and their health benefit. (Food Ethics Council, 2018)

According to the World Health Organization, The sixty-fifth World Health Assembly committed to the WHA65.6 resolution in 2012. It establishes a plan for infant and young child nutrition. The goal is to create an environment for food and nutrition policies and to establish a dialogue with national and international parties and create partnerships and alliances to promote nutrition actions to safeguard against future conflicts (World Health Organization, 2017).

6.7 Development finance

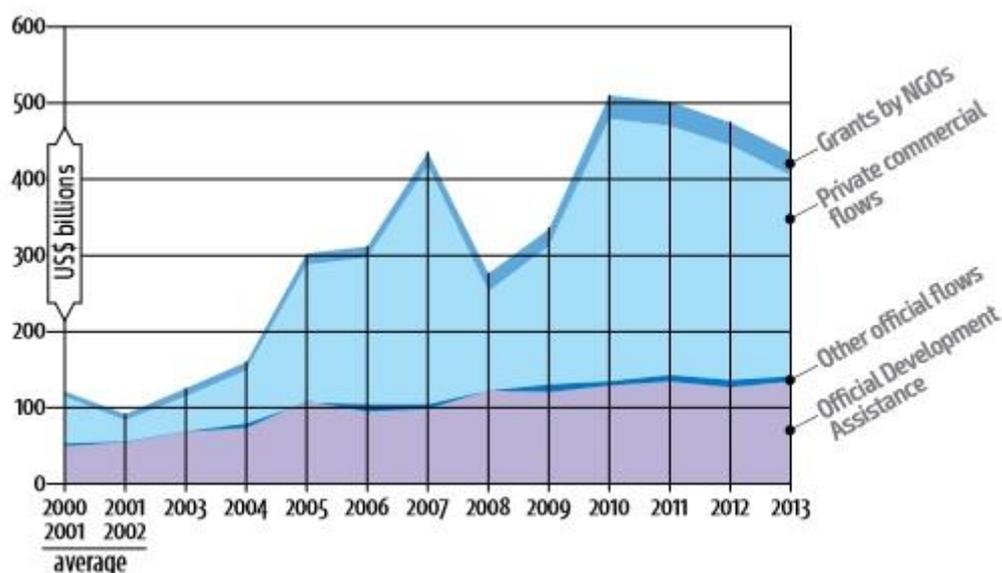
One of the most effective ways to create economic growth and reduce poverty is investing in food and agriculture, especially in countries with low development. It is important for ending hunger and malnutrition as well as for stabilizing markets, so prices are affordable for most of consumers. Food and agricultural investments are also important for rural incomes and livelihoods as they may have capability of addressing climate change, facilitating transition to sustainable agriculture and conserving natural resources.

A new concept is being developed in the recent years called “Nutrition Economics”. The merge of nutrition and health economics aims to address the issue of nutrition on health and economic aspects. It focuses on recommendations for daily nutrition and put them in a cost effectiveness frame. There is not an specific method to evaluate this, apart from policy measures.

The ISPOR (The International Society for Pharmacoeconomics and Outcomes Research) is starting a Nutrition Economics Special Interest Group (SIG) for the economic evaluation in costs of disease-related malnutrition (DRM), which entails individuals, society and health care system as a whole focus. In Europe, 33 million patients suffer from DRM, at an estimated cost of \$170 billion, more than double of the money spent in obesity. Investing in nutrition economics is an emerging scientific area developing to give recommendations based on economic evaluations. (Freijer Karen, 2014)

The 2030 Agenda for Sustainable Development has settled a comprehensive investment scenario. The Official Development Assistance (ODA), which level reached \$132 billion in 2015 (Figure 13), will continue to be an important source for low-income countries in achieving the Sustainable Development Goal. There has been great financial increases for low-income countries from members of the Development Assistance Committee of the organization for the Economic Co-operation and Development (OECD-DAC), remittances, and financing from emerging countries, such as Brazil, China and India. In the future ODA and domestic resource will remain important but will not be enough to finance SDGs as FAO, IFAD and WFP estimate a requirement of about \$145 billion in additional investment to achieve zero hunger by 2030.

Figure 13: financial flows to low-income countries, 2000-2013 (US \$ billions).



Source OECD, 2015

Note: These flows refer to net financial flows originated from OECD-DAC member countries and include FDI, private commercial flows, export credits, bonds and other commercial investments in developing countries.

In the past decade, more funding options have become available from many resources, such as development banks, private sectors, non-governmental organizations and specialized funds. This reflects the importance of the private bank, especially in middle-income countries that have increased their finance through Foreign Direct Investment (FDI), bonds, syndicated banks and private philanthropy from foundations and NGOs.

The United Nations estimates the incremental investments in sustainable development to be made in low-income countries at about \$1.1 trillion in the coming decades (Figure 14) in order to end hunger, provide clean energy and make food systems sustainable. Including that estimate, the incremental investment for low-income countries requires \$1,5 trillion a year, which is approximately 2 percent of the GDP, which would not be a great cost (FAO, 2017).

Figure 14: Annual incremental investments needed in energy, agriculture and food security for sustainable development (US\$ billions).

	Alms and assumptions	Incremental investment needs 2000-2050	Of which, in developing countries
Climate change mitigation: Energy supply	Stabilize greenhouse gas concentrations to limit warming to <2°C (with at least 50 per cent probability)	1 000	600
Climate change mitigation: Energy end-use efficiency	Significant end-use efficiency increase and greenhouse gas stabilization to < 2°C	800	480
Climate change adaptation (mostly in agriculture)	Minimum investments in securing livelihoods, assuming successful mitigation	105	105
Agriculture and food security	Increasing agricultural yields to ensure global food security without further expanding agricultural land	265	265
Total		2 172	1 452

Note: in constant 2010 US\$

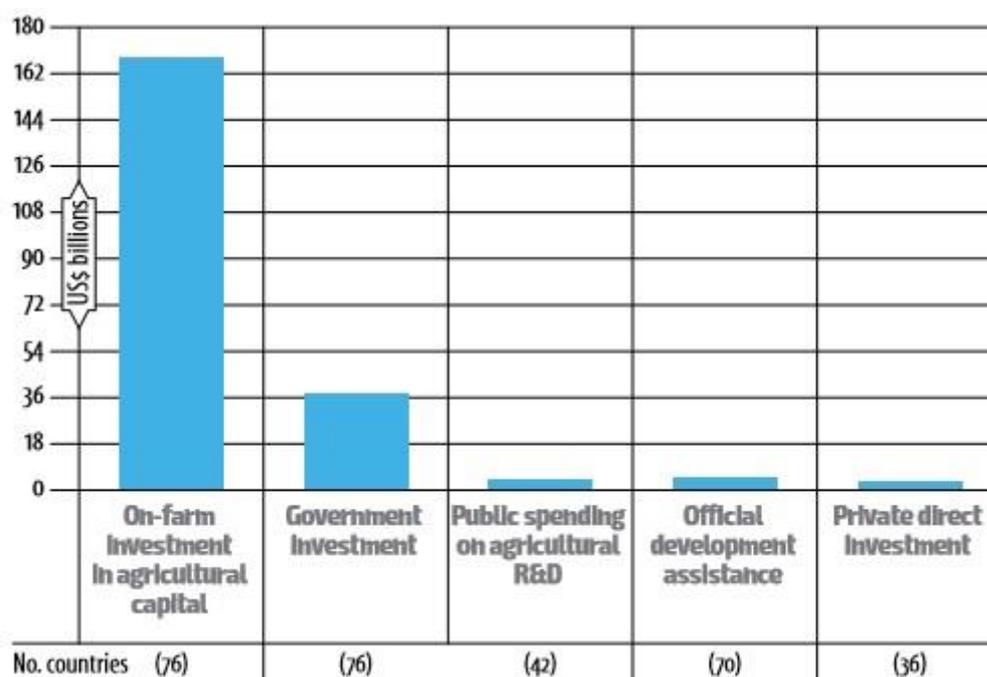
Source: Adapted from United Nations, 2012. Data for agriculture and food security are from FAO, IFAD and WFP, 2015.

Investment should come from a mix of domestic and external funding and of public and private resources, with public funding and policies acting as instigators more than covering investment costs. It is not desirable that all the finance would come from external finance or public.

In agriculture, most of the investments tend to be made by the private sector, concretely, by farmers. Public investments (Figure 15) represent a significant quantity in low-income countries. In the world, there are over 570 million farms, and more than 90 percent are family farms, but in low-income countries almost all of them are very small, so they face barriers in order to adopt sustainable practices.

The governments should support those smallholders by investing in rural infrastructure and resources that would be fundamental in favor of pro-poor investment. Recently, there has been an emergence of partnerships between the public sector, private sector and communities to promote agriculture, rural development, reduction of poverty, food security and improved nutrition (FAO,2017).

Figure 15: Investment in agriculture in middle and low-income countries by source, annual average. (US \$ billions).



Note: the number of countries covered is shown in parentheses

Source: FAO, 2012

The problem with agricultural investments is that they are considered high-risk investments due to susceptibility of production to climatic hazards. It is especially risky in low-income countries because infrastructure, cold storage and transportation are not developed enough.

Private investments in agriculture will be influenced mainly by agricultural and food prices policy. Governments provide incentives to agribusinesses in order to increase agricultural production. The existing production involves subsidies in inputs, such as fertilizers and fossil fuels. The OECD spent \$211 billion in 2015 in agricultural production support. Countries who do not belong to the OECD, spent \$352 billion in that year (FAO, 2017).

Currently, new ways of financing investment are emerging. The government catalyst role is starting to pay-off, and private investors are mobilizing in order to achieve sustainable development of agriculture and food systems (FAO, 2017). For instance, the role of private investors in microfinancing linked with environmental support, improves the sustainability of water use and local environment (Bizikova, Livia, 2016).

ODA has declined in importance, but other sources have emerged, and present an opportunity to fill financing gaps. In the last years, numerous funding partners have appeared, like the Green Climate Fund, established in 2010 under the United Nations Framework Convention on Climate Change to support investments in middle and low-income countries and help sustainable agriculture that promotes transformative change. It can also be helpful to address the funding gap by showing the viability of climate-smart agriculture.

Other sources include development banks which finance middle-income countries, such as the Asian Infrastructure Development Bank, operated by China, and the New Development Bank, operated by the BRICS.

The Committee on World Food Security, in 2014, endorsed 10 Principles for Responsible Investment in Agriculture and Food Systems. This was the first time that a broad range of stakeholders committed to a set of principles to agricultural investment and to all the value chain. Those principles are globally applicable and include actions to address a wide range of economic, social and environmental issues.

Challenges on the future of nutrition

These trends present some challenges to food and agriculture, such as:

- Reduction of inequalities and eradication of extreme poverty, ensuring that vulnerable people who escape poverty do not fall back into it.

The cooperation between countries in addressing inequalities in levels of income, levels of assets and opportunities. Pro-poor growth strategies must be settled to ensure the growth of the weakest in market integration and investment in agriculture.

Pro-poor growth should be established beyond agriculture, involving rural and urban areas, supporting job creation and a wider diversification of income. Social protection will help the challenge of ending hunger.

- Interdependency of all countries and a reevaluation of food systems for meeting future challenges.

These international frameworks for action will be challenging in achieving policy coherence due to their interdependence. They recognize the need to integrate different actions to achieve linked goals and that new technical demands and policy-makers would take place at all levels, as well as new demands on institutional arrangements and a new range of coordination of governance.

Food systems must be accompanied by responsible investments which should be vertically coordinated, offering standardized food and formal employment opportunities.

Food systems should be efficient and aware of the environment and biodiversity impacts. They need innovative systems that protect and enhance natural resources while increasing productivity, such as climate-smart agriculture and conservation agriculture (FAO, 2017).

There are interesting theories from the consumer perspective. It turns out that eating healthier food would be a benefit for sustainability, helping farmland and environment. Increased consumption of healthier foods would provoke farmers to increase production of those foods instead of commodity crops. This shift in consumption would turn into an increase in production of healthier soil and water. If American population would eat the recommended quantity of vegetables, production of healthy foods would increase by 88%. This, would bring environmental benefits such as the replacement of soybean and corn acres for vegetable and fruit acres, hence reduce the environmental damage caused by monoculture farming. There is also evidence that reducing the consumption of meat would lower global warming (UCSUSA, 2013).

7. CONCLUSION

After finishing working on the project “Economy of the Global Food Systems, we will describe the main conclusions about the development of food systems.

Food systems are complex structures based on a wide range of variables resulting from sources that could affect diets and nutrition. History has been hard treating food systems in developing countries and developed ones have established efficient systems capable of feed the population taking advantage of technology and innovation.

Every new situation in a food system affects different depending on the country and on the situation. Climate change or conflicts would affect more in the less advantages countries as well as diseases and other major causes. Hunger is not the only problem in these kind of countries, undernourishment is also remarkable in countries with scarcely nutritional diets. Those diets are mainly affected by crops and by the value of the food item we are considering. Price volatility in the last decade has increased and high prices peaks have been severe, impacting differently on every singular product.

Food companies are increasing in size and power and most of the brands we consume are concentrated in a few hands. During de decade, mergers and acquisitions have been constant, devaluating minor brands just because the power of the bigger ones is huge and minor ones cannot compete and stablish reasonable relations with members of the value chain.

Agribusiness has changed over the last twenty years becoming a multinational business that gives stakeholders a high return on their investments. Farmers are becoming less because they cannot compete with the bigger companies and they are located far from urban areas were food demand has increased due to high rates of urbanization. During recent years, volatility of prices in agriculture has been high and the most quantity of investments in agriculture are done by private companies.

Looking ahead, the sustainable development goals remain the main policy for the next years as they would influence the food system in many ways. The goals of the 2030 agenda will require enormous transformations in food systems if they intend to be accomplished. Hunger and undernourishment remain as the main goals to fight against but the commitment of the public institutions has always been questioned.

More recently, public institutions and private interests have been joining forces in order to stablish new ways of finding outcomes for reduction of poverty and improved nutrition. This forces may be questioned as the private entities may have interest in favoring nutritional products that give them higher rates of profitability to their businesses instead of the more nutritional foods for the population.

The situation remains difficult for the food system but the problems are very well identified and the commitment to them will tell if results are good enough for the world.

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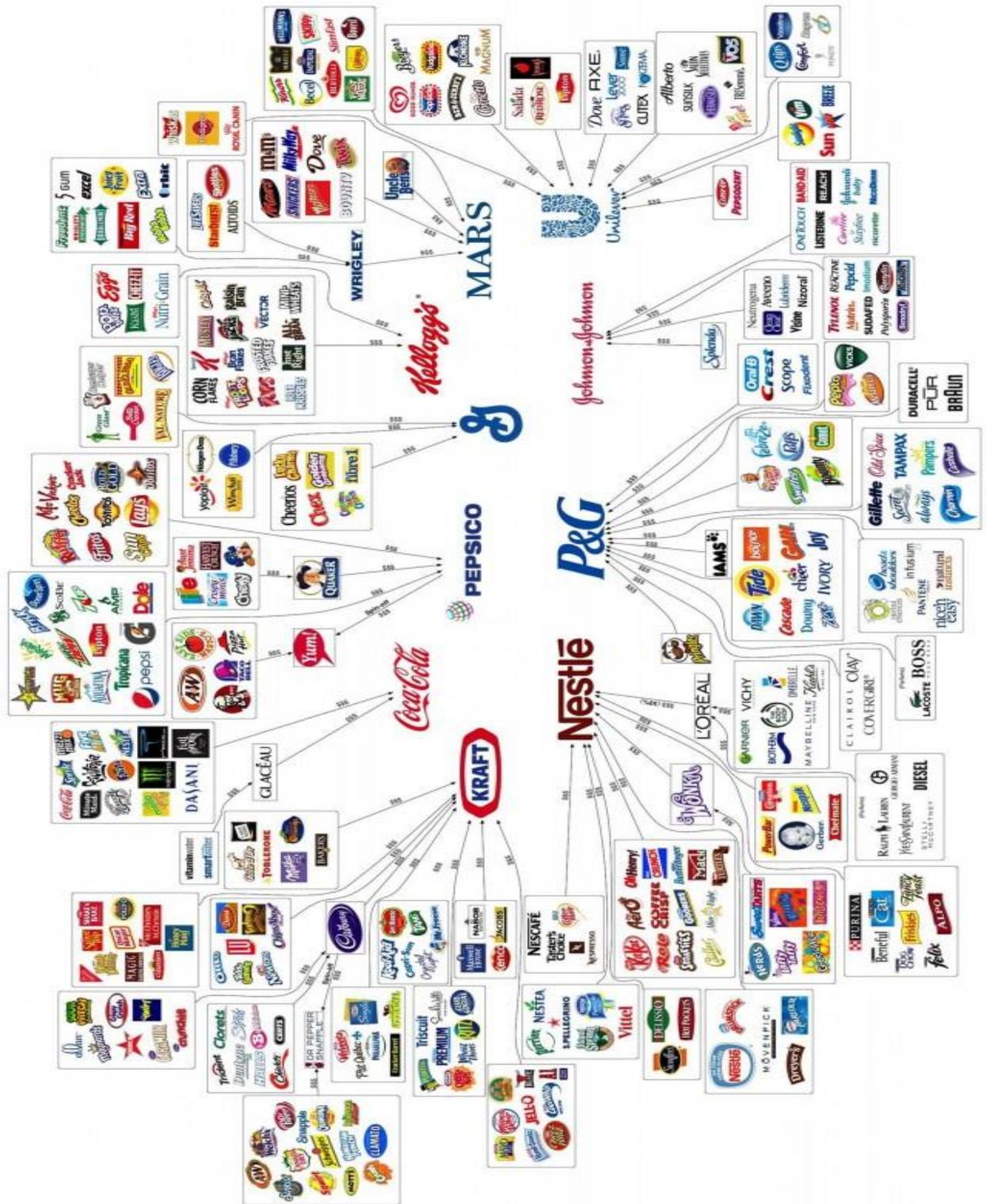
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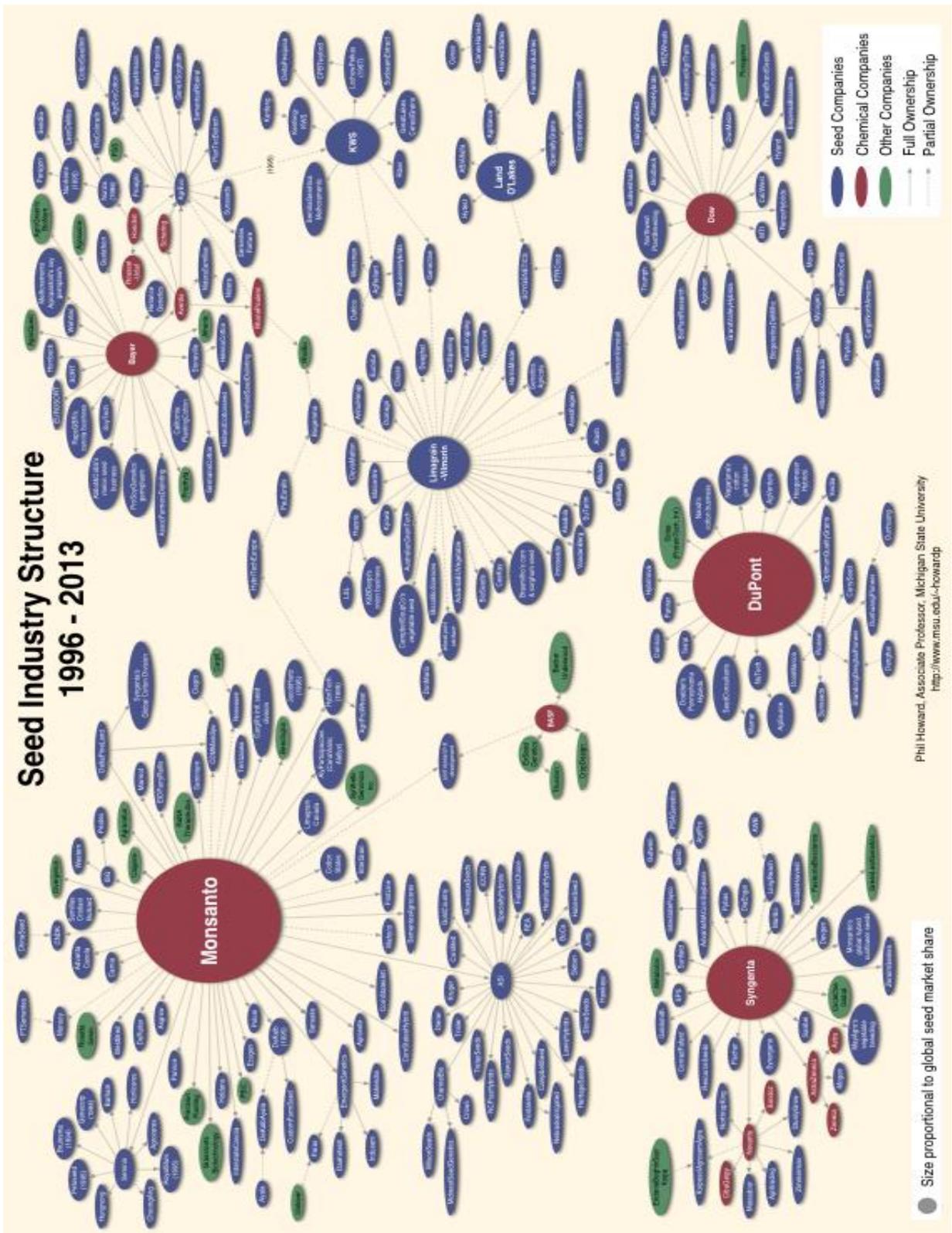
9. ANNEXES

ANNEX 1: Organic processing industry structure 2016



Source: Howard, Philip H. 2016.

ANNEX 2: Seed industry structure 1996-2013



Source: Howard, Philip H. 2016.

