Alma Mater Studiorum – Università di Bologna

DOTTORATO DI RICERCA IN

Scienze e Tecnologie Agrarie, Ambientali e Alimentari

Ciclo XXVI

Settore Concorsuale di afferenza: 07/A

Settore Scientifico disciplinare: **AGR/01**

TITOLO TESI

Assessing Food Security in Selected Mediterranean Countries

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Esame finale anno 2014

Acknowledgements

Apart from the efforts of myself, the success of any project depends largely on the encouragement and guidelines of many others. I take this opportunity to express my gratitude to the people who have been instrumental in the successful completion of this master

First and foremost, I would like to express my sincere gratitude my tutor and thesis coordinator, Prof. Giulio Malorgio, for the valuable guidance, advice and motivation. He has always stimulated to improve my work. He believed in my capacities giving me a large independency and persuaded me to continue my work and objectives.

I wish to thank my co-tutor and thesis advisor Dott. Luca Camanzi, who has motivated and supported me. You always been extremely patient and available for helping me during the research and to support me in the moment of difficulties. I cannot quantify how grateful I am for all the help you always gave me.

I would also like to thank Madame Martine Padilla who gave me the opportunity to conduct part of my research at the Ciheam Montpellier and she has been a great presence and help during the elaboration of this dissertation.

In addition, I would like to thanks my beloved parents, my sister and family, to which I dedicate this final dissertation for their moral support, their patience, strength, help and for being able to still stand me in all the occasions even when I was unreasonable.

This research wouldn't have been possible without the support of my good friends Laura, Cecilia and Geraldine, precious friends who always been there to tell me I was crazy, to give me motivation and courage to continue and also positive believers that always thought and repeated me I could make it. Thank you very much!!!

I want to thank Nacho which just for coincidence is a colleague and always helped me out when I was in need, but first of all is a great friend and accompanied me all these years with other extremely important people which I want to thank to be still part of my life: Luisa, Jorge and Anna.

Last but not least I wish to avail myself of this opportunity, express a sense of gratitude and love to my friends who accompanied me all these years and have always been supportive and a great and indispensable presence: Sarina, Elena, Cristina, Fabio, Elisa, my basketball team (the best one), Michele, Laura, Iaia, Sara, Eugenio, Manuela.

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Introduction

Food Security has become one of the most important issues in the international debate. Debate has become more and more important during the latest economic crises which have affected the entire world. After the prices crisis of 2008 the debate and the problem concerning the food security acquired relevance especially in the least developed countries. The same process happened in 2010-2011 (FAO,2011), as it was found price volatility in global food market had consequences on the household power purchase and affected especially the low-income countries and poorest households (Foresight, 2011; HLPE, 2011). Food security is also a challenge in the developed economies that in order to overcome market instability develop strategies that will guarantee food availability and affordability (Saravia-Matus,2012).

FAO Yearbook (2012) show that the Sub-Saharan Africa is the region most affected by chronic hunger (about one every three person) and that the highest numbers of undernourished are in South and East Asia. In fact, the undernourished part of the population depend directly on farming and agriculture and most often belong to rural areas of low-income countries and where access to food, resource, technology and innovation is a constrained (Saravia-Matus, 2012). Most of these people have problems of accessing usually, food is produced in rural areas, and urban dwellers are normally net food buyers, surprisingly The concepts of net food seller and net food buyer are quite distinct from whether the household is rural or urban. Nearly all urban dwellers are net food buyers; perhaps surprisingly, most rural dwellers, especially poor people are food buyers (purchaser) than producers (FAO,2011).

Actually the main cause for hunger is poverty, however it is a notion that has different dimension and it does not depend only on low-income, but it includes issues of deprivation and lack of access which can appear at many levels: education, food quality, nutrition, health, infrastructure, production resources, etc.

The food security issue is nowadays an important matter in the international debate, but any country has its own contest and should implement policies and strategies concerning their local structure, possibilities and needs.

In addition, Structural Adjustment Plans (SAPs), started at the beginning of the 1980s, have produced negative impacts especially in developing countries. SAPs were policies of development imposed by the International Monetary Fund (IMF) and the World Bank in order to restore a balanced budget, the trade balance, and the balance of payments. These policies resulted as a failure for many developing countries, worsening their economies. (Ciheam, 2008).

Moreover, several factors have caused significant distortions in market functioning resulting in difficulties or ineffective decisions in agricultural policies. These factors are instability on international markets, alternative uses of land in food and non-food production, population

growth and economic development in some emerging countries, and climate changes affecting agro-food and rural activities (Ciheam, 2008).

In terms of consequences, the global financial crisis and economic slowdown has now pushed food prices to lower levels. But at the same time, this financial crunch has also decreased the availability of capital for investment in agriculture which is urgently needed to increase productivity (Von Braun J., 2008).

Saravia-Matus et al. (2012) develop a helpful argumentation on economic issues of food security, highlighting similarities and diversities in low-income countries and in high-income countries. In the former case the main constraints are given by low agricultural productivity and insufficient local access to food, due to the availability and quality of the production factors, namely natural resources, capital and technology. In the latter case, food security concerns macroeconomic issues, such as commodity price volatility, international trade and market stability. The authors quote previous studies (Sen, 1981; Tomlinson, 2011; Smith et al., 2000) to recall that the emphasis in the economic literature dealing with food security has lately shifted from income earning and purchasing power, to food access, as the main constraint to food security. However they also acknowledge that "feeding the growing population with limited resources and in a sustainable manner is undoubtedly a challenge" that entails both technological, economic and institutional aspects, including agricultural productivity, market efficiency, social conditions, political governance and policy intervention.

Scarce productivity levels are a major constraint especially in most low-income countries, where it is hindered by poor yields and low cropping intensity FAO (2009). Water scarcity is also often a major problem, especially if irrigation systems are not efficient. Moreover, large output losses at farm level are often determined by inadequate rural structures, as well as the lack of harvest equipment and storage facilities. Further inefficiencies (such as higher costs and output losses) are then induced by long travel distances and/or poor roads and vehicles. Even in high-income countries, where farmers attain high productivity levels in the use of agricultural inputs, the efficiency and effectiveness of transport and retailing practices need to be improve in order to provide safer and healthier food and to reduce food waste (Saravia-Matus et al., 2012).

As far as the economic and institutional issues are concerned, it is important to underline that most (semi)subsistence farmers are only marginally integrated in the market systems and they are often not react to market trends (increasing or decreasing their production) due to resource constraints and the difficulties to obtain timely access to market information, credit and extension services (Evenson and Gollin, 2003; FAO, 2009).

Agricultural productivity – and therefore food supply - also depends on the adequate provision of education and health services for the rural population (Yúnez-Naude and Taylor, 2001; Appleton

and Balihuta, 1996), while civil conflicts and wars erode the livelihoods of both urban and rural populations.

Finally, volatility of international commodity prices has also lately become a concern for producers, traders, consumers and governments, due to the large span and unpredictability of price variations (FAO, 2011). According to many authors, commodity price variability has been boosted by two main factors, such as: *i)* the decline of global stock levels, decreased by 3.4% per year since 1995 and *ii)* the growing demand for non-food uses of agricultural products (mostly animal feeds and bio-fuels), that increases the competition on land and natural resources (FAO, 2009).

One of the main strategies is to invest in agriculture while food prices are high; this can ameliorate food security in the long term, the farmer's situation, improve production, increase their profit and make food more accessible by the most poor and vulnerable people (FAO, 2011).

Moreover, a combination of strategies such as increase in productivity, a greater policy design to predict price volatility and a general openness to trade will be more efficient than other to assure food security. Therefore, trade protection policies can have positive effects in price volatility and food security but if governments are not stable or policies are not predictable, domestic price volatility can increase due to domestic supply shocks (FAO, 2011).

All these issues are matters of high relevance for many Countries in the Mediterranean Basin, particularly those of the southern shore (i.e. Southern Mediterranean Countries – SMCs). In fact, the whole region is facing complex economic and social changes: on the one hand there is the necessity to satisfy the increasing and changing food demand of the growing population; on the other hand it is important to promote economic growth and adjust the agricultural production to food demand in a sustainable perspective. North and South Mediterranean Countries (SNMCs) present many common features but also significant disparities either in food demand, food supply and governments' policies.

The objective of the research is to analyze the different dimensions of food security and to show the different economic issues affecting food security conditions in the Mediterranean Countries. The aim is then to identify appropriate theoretical concepts and methodological tools to be used in the assessment of food security of a country (or region), with a particular emphasis on its economic dimension.

The study builds on a critical theoretical and conceptual review in order to propose a set of selected and refined indicators. The indicators will be then calculated with reference to the Mediterranean Countries over a twenty-year time-period, so as to provide empirical evidence of the development of their food security conditions.

The study develops in three methodological steps:

The first step is to focus on the economic issues linked to food security, through the analysis and elaboration of macro-economic data in order to give a contribution to the analysis of food security. The second step is to select and measure food security indicators through the Principal Components Analysis and the third step, based on the findings of the second one, is to assess food security in the Mediterranean Countries.

The study is divided in five main chapter, briefly described as follows.

The **First Chapter** introduces the subject considered. First of all the Economic and Agriculture Development theories are recalled in order to highlight the most important issues that contributed to the development of the food security concept.. Finally, a further interesting concept developed in the scientific literature along with food security has been explained in this section: the **vulnerability** concept. Vulnerability has been used as a reference notion to assess risk and instability. This concept has emerged more and more on the international agenda, in referred to risk exposure of countries and populations due to the recent economic crisis. Vulnerability doesn't have a common and official definition, however what it is of common agreement is that vulnerability doesn't cover only social fragilities but covers various aspects: income, age, gender, growth rates, economic, environment, inequalities, etc. This concept will be then discussed in the conclusions and some consideration will be taken into account.

In the **Second Chapter**, the global food supply and demand trends are outlined, in order to point out the complexity of the food security problem and its multidimensionality. The first part explains the multidimensionality of food security (availability, access, utilization) and the variables which affect it; the second part focuses on the analysis of food demand and supply with concern to the main variables affecting food security at a global level. Food demand is facing important modifications, particularly in developing regions, due to population growth and economic growth, thus boosting food demand and changing its structure. Food supply increase has slowed down while pressure on key resources (land, water, energy) is intensifying, and climate change is becoming a more and more a threaten, rising environmental concerns.

In the Third Chapter the analysis of the food security in a selection of countries in Mediterranean Region is carried out. The Mediterranean region is composed of countries with very different economic profiles: the Member States of the European Union (EU) are very different from countries in the Southern and Eastern Mediterranean (SEMCs). In this region, economic disparities are still much more marked than any signs of convergence (CIHEAM, 2008). In the third chapter we will overview the Mediterranean countries food security through the most important drivers (population, GDP, trade, economic development). The analysis will compare some of the Mediterranean countries taking into consideration the North African Countries (Libya is excluded for data missing) and some of the most populous northern and Mediterranean countries (Algeria, Egypt, France, Italy, Morocco, Spain, Tunisia).

The methodological approach followed in the study will be described in the **Fourth Chapter**. The research has followed three steps. After having analysed the food security issue throw an extensive literature review and discovered the complexity and multidimensionality of the food security issue, our methodological approach was carried out. First of all we decided to retain he FAO food security definition and three of its dimension: availability, access, utilization. The additional dimension of food security refers to vulnerability and its components: shock, exposure and resilience. Consequently we based the selection of our indicators by the application of the SMART criteria and in accordance with the objectives of the study (i.e. to assess economic issues of food security). Finally a refined set of indicators has been proposed and we have chosen to apply the Principal Component Analysis (PCA). The PCA is a data reduction methodology to simply data treatment when the number of variables (as in the case of food security)is very large. The description of complex interrelation between the original variable is made easier by looking at the extracted components. The aim is to identify which are the economic indicators which affect the most food security in the Mediterranean Area described in the following chapter.

Finally in the **Fifth Chapter** represent the part dedicated the measurements and the explanation of PCA results. The results are presented with reference to about hundred of countries and around 40 indicators of food security for all four dimension (availability, access, utilization, vulnerability). The Principal Component Analysis was the methodology applied in this section. We calculated the PCA using two different approach:

1) Indicators were divided in each representative food security dimension and the PCA was applied distinctively for each of dimension; 2) Indicators are putted all together and run in a unique PCA.

Consequently the results were discussed giving and overall food security condition in all the countries selected and in conclusion a specific discussion on the MCs was conducted.

MCs show and higher economic development compare to low-income countries, however the economic and social disparities of this area show vulnerability to food (in)security, due to: dependency on food imports, lack of infrastructure and agriculture investment, climate conditions and political stability and inefficiency.

1. Economic Development theory and food security

1.1 Agriculture and Economic Development

Over the year the Economic Development theories have changed. In the past, development has been considered as economic growth and capita-formation; emphasis was placed on economic efficiency.

Development was seen as 'economic progress' especially the two decades right after the independence of many third world countries. In the 1950s through the 1960s, economists dominated the development debates and saw industrialization and productivity as prerequisites for development. In order to ensure this there was the need to stimulate the fledgling industrial sector and to mobilize the traditional sector of the economy to the task of industrialization. However economic development, does not means only economic growth and assemble other aspects: self-sustaining growth; structural changes of production; technological, social and political innovation; and the improvement of the human condition (Adelman, 1961).

Moreover in relation to the economic crisis in 1973 and the concerns on the scarcity of natural resources. The development concept has improved combining different dimensions. As a result, in 1987, in the Brundtland Report (World Commission on Environment and Development) has been introduced a new concept of development: the sustainable development. *Sustainability* has three different dimension: social, economical and environmental and it is considered as the development that meets the needs of the present without compromising the future generations.

Authors (Sen) and institutions such as World Bank and UNDP highlighted the importance of the Human development as a dimension of development. In the Human Development Report (1993) was suggested to look at all the dimension of development as complementing each other.

In conclusion economic development lead to an improvement in the life of people and people with a better life also contributing to economic advancement.

Moreover the theories of Economic Development which brought to what is today the food security concept, will be highlighted in this section. Different authors and important issues emerged since the 16th/17th century until present will be considered.

1.1.1 Before the 60s

Centuries before the elaboration of the food security concept the most important task to growth and development was to augment production and capital.

From the 16th to the late 18th century, **the Mercantilism** dominated the economic discourse and policy.

Mercantilism is an economic doctrine based on the theory that a nation benefits by accumulating monetary reserves through a positive balance of trade, especially of finished goods.

The term "mercantilist" was coined by Smith to describe the system of political economy that sought to enrich the country by restraining imports and encouraging exports.

They had no systematic, comprehensive, consistent treatise, no leader, common method, or theory. Each "mercantilist" sought advantage for a specific, trade, merchant, joint-stock company or social group. "Protectionism" is often seen as a primary characteristic of Mercantilism.

The primary objective of Mercantilism was to increase the power of the nation state. One of the important aspects of national power or strength was wealth. The states that followed a policy of mercantilism tended to see trade, colonialism and conquest as the primary ways of increasing wealth. Mercantilists aimed to protect their business, they were promoting overseas trade between a country and its colonies by requiring colonies to trade only with the mother country.

The next paragraph by Landreth and Collander (*History of Economic Thought* ,2002, p.45) is summarizing the concept of the mercantilism:

"*The goal of economic activity, according to most mercantilists, was production – not consumption, as classical economics would later have it. For the mercantilists, the wealth of the nation was not defined in terms of the sum of individual wealth. They advocated increasing the nation's wealth by simultaneously encouraging production, increasing exports, and holding down domestic consumption. Thus, the wealth of the nation rested on the poverty of the many. Although the mercantilists laid great stress on production, a plentiful supply of goods within a country was considered undesirable. High levels of production along with low domestic consumption would permit increased exports, which would increase the nation's wealth and power. The mercantilists advocated low wages in order to give the domestic economy competitive advantages in international trade. Also, they believed that wages above a subsistence level would result in a reduced labor effort: higher wages would cause laborers to work fewer hours per year, and national output would fall. Thus, when the goal of economic activity is defined in terms of national output and not in terms of national consumption, poverty for the individual benefits the nation*".

Prior 1800, scarcity was way far to become an issue. Agriculture was at the centre of the Economic development.

Agriculture has been at the center of the economic debate. The first stream may be traced to the 18th century enlightenment when the French **Physiocrats** focused their theory on agriculture and land.

Physiocracy was a real ' school of thought ' , which developed in France in the eighteenth century The physiocrats, recognized in **Francois Quesnay** (1694-1774) their" mentor". Francois Quesnay's "*tableau economique*" (1758) organized a logical explanation of the conversion of land inputs to agricultural outputs and profit. The term physiocracy can be translated as ' power of nature ' ,

indicating a of their leading idea: the exclusive productivity of agriculture. The Physiocrats , believed that only the agricultural sector is able to generate surplus of production - " net product " - compared the other productive sectors which transform into wealth what has been created in agriculture : in this sense , they are " sterile " . In addition the intuition of the Physiocrats can also be justified by the observation that agriculture self-reproduction exist also without the intervention of human labour (Davanzani, 2007).

The Physiocrats saw the true wealth of a nation as determined by the surplus of agricultural production over and above that needed to support agriculture (by feeding farm labourers and so forth). They believed in the exclusive productivity of the land . The wealth is always and only from the "creation " of new goods and not by their "transformation". This means that only agriculture is productive.

Physiocrats objectives was to bring the head of the governments in the "general law of natural order". Once they were adopted, human behaviour would be harmonized with the law of nature (Neill, 1949).

The physiocratic system considered two economic sectors: agriculture and industry and three socio-economic productive classes (cultivators who rented land from the proprietary class) , proprietary and sterile (artisan and craftsman).

The classical political economy is represented by the tradition of economic thought between the publication of the Wealth of Nations by **Adam Smith** (1776) and the so-called marginal revolution of the seventies of the nineteenth century.

The classical economic thought develops from the first industrial revolution, characterized, in particular by the advent of factory organization and the growth of industrial production (textile industry in particular), urbanization (since 1850, the English urban population exceeded the rural population), and the birth of a new social subject – the proletariat.

Smith argues on economic development, theory based in the labour diversification. Labour is divided in social or technical: the first regards the separation of function among different social classes and the second relates to the tasks division in the production unit . With particular reference to the latter , Smith considers: i) the division of labour increases productivity and ii) it is " limited to the width of the market. Smith argues that the labour division increases productivity for three reasons: 1. increases the degree of specialization 2.allows a time saving ; 3. encourages innovations ' from the bottom-up ', bringing the workers to find more efficient methods of production and organizational systems.

The development process is , therefore , driven by the degree of division of labor , which in turn depends on the amplitude of the market. Smith observe that improvement in transport systems and urbanization, increase the demand endorsing the division of labour. From this, the following

effects: the degree of division of labour increases productivity , the costs of production is reduced, and consequently profits, investment, wages, demand augment. The mechanism is further amplified by the effect of high wages , according to which higher wages increases productivity, further squeezing costs and improving profits.

As we have seen , the notion of work production is present in the writings of the physiocrats, but is declined in a very different way by Smith. He rejects the principle of the exclusive productivity of agriculture, noting - in line with the historical context in which it is included (at the dawn of Britain

first industrial revolution) - where is mainly industrial activity to drive growth .(Davanzati, 2007)

However Smith could not ignore agricultural questions, many pages of the *Wealth of Nations* (1776) dealt with agricultural questions where he affirmed that it" is much more durable, and cannot be destroyed by [the] violent convulsions" of war and political instability (p. 427) including the differential capacity for specialization of agriculture versus industry and the arts of husbandry at the microeconomic level.

At the end of 1700 two were the authors which contributed to the setting of the economic development concept: **Malthus and Ricardo**. They focused their attention on some important issues which become a matter of concern also in food security.

Since 1798, **Malthus** in his "Essay on the principle of population" observed that sooner or later population will be checked by famine and disease, leading to what is known as a Malthusian catastrophe. Population is an important factor in the rising of food demand and in the changes on the food supply.

He theorized the population growth, considering that population without any kind of controls or constrictions, will continue to rise exponentially while the food supply will have a constraint. Population will growth until the food supply will not satisfy the bore subsistence. Unlikely from population food supply rise linearly and not exponentially. Population will growth exponentially until the point where the food supply will provide enough food for everybody. In case this equilibrium between population and supply will not exist, Famine and starvation will be experienced.

Ricardo was famously concerned with returns to land as a fixed factor "for the use of the original and indestructible powers of soil" , (1817,p. 44).

David Ricardo, since 1802, devoted himself to economic studies. In 1815 he wrote the *Essay on the influence of a low price of corn on the profits of stock* - more simply known as the *Essay on profits* whose objective was to demonstrate the inappropriateness of restrictions on imports of grain.

All studies carried out by Ricardo were motivated by a well-defined objective : discover the laws

underlying the process of income distribution. Ricardo is not interested in analyzing the income distribution in terms of value , but in terms of physical quantities . His purpose is to search the process of allotment of the total (quantity) off produced goods among the economic categories (wages, profits and rents) . A distribution process described in these terms - even if difficult by the analytical point of view - has the undoubted advantage of showing the actual conditions under which the income is allocated . The identification of the natural laws which are underneath the physical distribution of the product helps to find the strengths and weakness of the production process itself. In this way Ricardo gives importance to the actual availability and distribution of resources, taking out the role of the money as the driving input to the creation of income.

Ricardo defines the concept of rent as : "Rent is always the difference between the produce obtained by the employment of two equal quantities of capital and labour" (Ricardo, 1817, p. 59). He describes the mechanism of income distribution into three step: 1)When the fertile land is abundant , the product obtained is divided into two parts: wages, and the profit which measures the product surplus of agriculture.

2) The increasing of the wage availability will push the population to grow. But if the population increases also the demand for wage will increase. It will be necessary to cultivate new lands - less and less fertile - or lands located far away. It is possible to observe the unequal results of equal quantities of capital applied to different plots of land of equal size; or, in the case of unequal size, results calculated on the basis of equal areas. The two general causes of these unequal results — quite independent of capital — are: Fertility and The location of the land.

Ricardo defines his law of differential rent: "Whatever diminishes the inequality in the produce obtained on the same or on new land, tends to lower rent, and whatever increases that inequality, necessarily produces an opposite effect and tends to raise it"(Ricardo, 1817 p.83).

3) The decrease in profit that the agricultural sector is suffering will extend in all other sectors. The Rise of grain production described in the second phase is obtained by rising production costs. If the costs of production of grain increase the exchange value of the grain with the other products increases. Since wheat is the original input in the production of all commodities (agricultural or not) and because its price is increasing , the cost of production of all other goods will rise. The profit in the other sectors so begins to shrink because , notwithstanding the product finals, capital advances to non-agricultural sectors increase as these more anticipating the result of the major advances in agriculture. In conclusion he writes Ricardo:"Profits depend on high or low wages, wages on the price of necessaries, and the price of necessaries chiefly on the price of food"(Ricardo, 1815,p.492). The Ricardian theory of rent was not built with an end in itself ; Ricardo fact this theory could provide useful suggestions economic policy. (Davanzati, 2007)

Another contribution was made by **Engel** which argues on the consumers power purchase and their choices. Engel in his publication "Die Productions und Consumtionsverhältnisse des Königreichs Sachsen"(1857)analyses   income-expenditure data for Belgian working class households, and in the following statement he affirm what will become the Engel's Law (p.28): "the poorer a family, the greater the proportion of its total expenditure that must be devoted to the provision of food".

According to Engel's Law, household expenditures on food decline as incomes rise; and the income elasticity of demand for food is less than one and declines towards zero with income growth. Augmentation in income will bring to increase the demand for food containing fats, proteins and sugar (Southgate at al., 2011; Foresight,2011).

1.1.2   Changes in the Economic development Theory (After the 60s)

Issues related to food are connected with agriculture which has gone to cyclical movements over the past decades.

In the late 1960s and early 1970s it was generally expected that the agriculture productivity would not be able to keep pace with the continuous rising of the world population (Nijkamp, P. And Vindigni,G., 2002). The focus was on development patterns and processes of accumulation. The highest priority was to increase agricultural production: green revolution, agrarian reform, integrated rural development.

Another author argued about the problem of the population growth: **Hardin** (1968) with the theory called "the tragedy of the commons. Hardin explained that the population increasing and the constraints on the food shortages were imputable to the household choices to have more children, which were indirectly affecting the whole society, diminishing the per capita food supply for other people.

Consequently, The Club of Rome commissioned to a group of experts and natural scientists to investigate on the growing population and the economic development. The benchmark of the model is Malthusian. Expert such as **Meadows** et al. showed that that population, pollution and industrial output are growing exponentially and in absence of controlling measures of these trends, a collapse on the resources will be experienced. (Meadows et al. 1972)

This model by meadows et al.(1972)is omitting the markets, observing that markets do not exist for many natural resources (ex. Air we breathe).

In spite of this pessimistic views, during the mid 1970s the world agricultural productivity was rapidly augmenting, reducing the increasing gap between supply and demand (Nijkamp And Vindigni, 2002).

Classical Malthusian has neglected market and the simple human desire of man self-improvement, an aspect developed by some economist of the University of Chicago.

The ''progressive improvement in human society'' was developed by **D. Gale Johnson** and Nobel-laureate **Robert Fogel,** which have focused on the augmentation of food supply thank to the amelioration in agricultural practices such as technology innovation and crop rotation.

Concerning the supply, it can increase due to different reason, one of them is: investments. Investments causes more to be produced at any price given. A decline in input prices, lowers costs and increases supply. Moreover, production augment if there are improvement in the ways inputs are transformed into outputs.

In case of food supply, the productivity is influenced by the improvement of new agriculture technologies. This development is in line with the technological improvement which contributed to the overall economic growth.

However, on the other hand, new economic theory where emerging. In contemporary with the economic crisis of the 70s the term Degrowth has gained presence as a motto for social movements, a political slogan and a theoretical discourse. The origins of decroissance are often attributed to the Romanian economist Nicolas Georgescu-Roegen (1906-1994) and his book The Entropy Law and the Economic Process, published in 1973. In this book the author -also known as the father of bioeconomy- contested the logic behind the growth model by criticizing the fact that neoclassical economy does not take into account the physic and ecologic dimensions of production.

Consequently to economic crisis the degrowth theory and the **Meadows** et al.(1972) theory on the scarcity of resources a new approach to development was emerging: the sustainable development issue. In the Brutland Report (1987) this new concept was defined as "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". According to its general definition, *sustainability* has three different dimension: social, economic and environmental.

The French school of **Malassis** (Malassis 1996; Malassis and Padilla 1986; Malassis and Ghersi 1996) have analyses the food-system under different perspectives: social, economical and nutritional and it is considered as set of interdependent elements that works together to satisfy the food need of a population.(Fonte, 2002). We agree to call the food system, how men organize to obtain and consume food. Food systems apply to all activities that contribute to the supply function in a given society. The social distribution of food supply reflects the organization of societies . The history of food is a social history. These statements should be extensively explained.

In the Malassis in has identified three ages of the human food history, divided by two revolution: the agricultural revolution which is the invention of agriculture in the Neolithic, and the industrial

revolution, more typically located at the hinge of 18th and of the 19th centuries. The first age, 5000 to 8000 years before our era, is the pre-agricultural age based on food predation. Man, were depending on the plant and animal environment, either natural ecosystems, to achieve their self-sufficiency. This is the period of wild food.

The second, marks the transition from the pre-agricultural age to the agro-industrial age: the agriculture age. The major event of the agricultural age is the transition from raw to cooked food. Agricultural period is characterized by a few basic features that persist throughout this period .Man from being predators become producer. Consumption is organized within domestic units which are most often both area of production and consumption . This is the period of agriculture food. Self- consumption is highly prevalent. 70 to 80% of the population is agriculture and agriculture is the main source of wealth. Agriculture developed a sedentary lifestyle and created a new social structure based on farming (agriculture). At a certain stage of agriculture development allowed the creation of villages based on the labor division. Apparently equalitarian agrarian societies , were replaced with social inequality. The most powerful , rich and skilful understood that owning land was a symbol of domination and power. The agricultural period saw the farmers dominated by a minority of wealthy.

The third is the agro-industrial age. The industrial revolution of the eighteenth century changed the traditional agriculture food system, by a new one: the agribusiness. The industrial development was producing indirect and direct effects on agriculture and food. Indirect , because the industrial growth led to urban- industrial complexes and to the development of the food market economy, and to the commercialization of agriculture . The steam engine revolutionized transportation land and sea , which , with the use of cold (refrigerated transport) , made possible long-range transport of heavy and perishable products, and creation of large national and international markets.

Direct effects as the industry participated more in the production of foodstuffs. The industry replaces agriculture in processing agricultural products and domestic activities and in food production services(food ready to cook pre-cooked , cooked). This is the time of the triumph of the agro -industrial food.

Today, agriculture remains irreplaceable sector, but on agriculture basis an industrial superstructure is becoming more and more important. The share of food expenditure from industry , becomes more relevant than agriculture. The role of industry reflects in the production of goods and intermediates for the whole food chain activities.

In the past the economic growth has often been identified with GDP. Nowadays, growth and utility are not the objectives to the socio-economical welfare, other issues are taking place (social, economical and environmental).

In addition, as an example the sustainability concept, mentioned previously, has also been a core subject in the global political and economic debate from a long time. Among other important international institutions, such as IFPRI (2004) and the World Bank (2003), the United Nations explicitly addressed the subject during the Millennium Summit that took place in 2000, establishing sustainable development strategies and targets to be achieved by 2015 (Millennium Developments Goals - MDGs), that include *i)* eradicating extreme poverty and hunger, *ii) e*nsuring environmental sustainability, and *iii)* global partnership for development. The eight Millennium Development Goalss are: 1. Eradicate extreme poverty and hunger; 2. Achieve universal primary education; 3. Promote gender equality and empower women; 4. Reduce child mortality; 5. Improve maternal health; 6.Combat HIV/AIDS, malaria and other diseases; 7. Ensure environmental sustainability; 8. Develop a global partnership for development. The first target of the Millennium Development Goals (MDGs) is represented by the aim to eradicate extreme poverty and hunger. "Modern energy services help drive economic growth by improving productivity and enabling local income generation through improved agricultural development and non-farm employment" (UNDP, 2005).

In accordance with some of the MDGs objectives as contrasting poverty and chronic hunger **Amartya Sen**, in an interview for 'The New York Times' (2008), claimed that the world food crisis is the consequence of the growth in demand for food, rather than the decreasing of real world food production. Its approach is emphasize on the role of freedom, human rights and entitlement and he largely detaches from the traditional economics focused on utility and economic growth.

Sen highly contributed to the shifts on economic and development theories. He focused on the importance of incorporating into economic and social choices different aspects such as individual entitlements, functioning, capabilities, opportunities, capabilities, freedom and rights.

From this, it is important to observe that there are different variables conditions and global issues playing in the determination of food security. The multidimensionality of this concept reveal the complexity of its assessment.

Moreover, economic growth must be constantly nourished by the fruits of human development, such as higher qualified workers capable of technological and managerial innovations along with opportunities for their efficient use: more and better jobs, better conditions for new businesses to grow, and greater democracy at all levels of decision making.

1.2 Conceptual Framework of Food Security and Vulnerability

Important issue of the Economic Development became important to the determination of the food security concept, such as: the increase of the population and the constraints in food supplies theorized by Malthus, the correlation between food consumption and income level, the pressure on natural resources (Meadows, 1972), the land quality and the rent conceived by Ricardo.

Different authors argued (Sen 1981, Maxwell 1996, FAO 1996) on food security and introduced new elements to identify this concept.

In particular Sen has emphasized on the "access to food" (entitlement) issues, he claimed that the problem of food security concerns the demand side rather than the decreasing of food production. As studies have shown (FAO,1996; USDA 2011), there are enough food supply to guarantee the global food security. Consequently one of the most important issue regarding food security is the food supply distribution and the economical and physical access. In addition access issue will affect also the utilization dimension.

1.2.1 Food Security Definitions

Global Food Security has a more than 60 years history and a sequence of definitions and paradigms. After the historic Hot Spring Conference of Food and Agriculture in 1943, in which the concept of a "secure, adequate, and suitable supply of food for everyone" was accepted internationally, bilateral agencies of donor countries such as the USA or Canada, which were created in the 1950s, started to dispose their agricultural surplus commodities overseas. In the 1960s, when it was acknowledged that food aid may be a barrier of development for self-sufficiency, the concept of food for development was introduced and institutionalized. The creation of the World Food Program (WFP) in 1963 is one prominent example (Gross, R. et al. 2000). Food Security has become one of the most important issues in the international debate. Debate has become more and more important during the latest economic crises which have affected the entire world. After the prices crisis of 2008 the debate and the problem concerning the food security acquired relevance especially in the least developed countries.

The concept of food security as changed during the decades and the emerging of different debates and new challenges, Maxwell (1996) refers to food security as a "cornucopia of ideas".

The first official definition of "food security" was coined during the World Food Conference in 1974: "Availability at all times of adequate world supplies of basic food-stuffs..., to sustain a steady expansion of food consumption... and to offset fluctuations in production and prices" (UN, 1975)

The definition made in 1975 concerns basically the supply issues of food security. The focus shifted to the issue of "the access to food" which was codified and theorised by A. Sen in 1981 in his report *Poverty and Famines* and where he make reference as "food entitlement". FAO analysis focused on food access, leading to a definition based on the balance between the demand and supply side of the food security equation: "Ensuring that all people at all times have both physical and economic access to the basic food that they need" (FAO, 1983).

FAO Yearbook (2012) show that the Sub-Saharan Africa is the most affected by chronic hunger (about one every three person) and that the highest numbers are in South and East Asia. Most of these people have problems of accessing food rather than food availability, and the most food insecure are the ones living in rural areas; usually, food is produced in rural areas, where poor people are more food buyers (purchaser) than producers. In urban areas, food is little produced and people are normally net food buyers; in case food prices increase the poor will be directly affected. They will have less disposable income and they will face a reduction in food consumption, or they will lower the expenditures for others goods such as education and health, or change their diet buying cheaper unhealthy and not micronutrient-rich food.

Food is normally produced in rural areas, but high food prices will affect people's food security especially for the poorest famers. They are mostly food purchaser, they don't produce enough food for their families and when prices are high, instead of benefit and invest in agriculture – as an effect of high food prices for farmers – they might indebt themselves to buy food.

Consequently in a World Bank report in 1986 (Poverty and Hunger) food security concept started to highlight the individuals' dimension of the problem and was defined as: "access by all people at all times to enough for an active healthy life."

In this definition there are three new points that become fundamental: a level of analysis based on the individuals (micro), the transfer from the interest on "availability" to the aspect of "the access" to food and the concern about the health.

The report introduced the distinction between chronic food insecurity, associated with problems of continuing or structural poverty and low incomes, and transitory food insecurity, which involved periods of intensified pressure caused by natural disasters, economic collapse or conflict (FAO Policy Brief, 2006). "Food Security is access by all people at all times to enough food for active, healthy life."(world bank, 1986)

Focus on Household food Security. All Concepts on food security are directed to one concept of household food security: " ...Secure access at all times to sufficient food.." dealing with : 1. Sufficiency; calories needed from an active healthy life 2. Access to food, defined by entitlement to produce, Purchase or exchange food or receive it as a gift 3. Security, defined by the balance between vulnerability, risk and insurance 4. Time, where food insecurity can be chronic, transitory or cyclical (Maxwell & Frankenberger , (p.8), 1992).

Moreover at the FAO Summit in 1996 represent the last official definition of "food security": "...all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life." It prevails the attention for the individual dimension, for their preferences, the access to food, and health.

Indeed Maxwell D. (1996), proposed different definition on food security by experts and conferences, as a result of the complexity of the problem and its multi-dimension.

The most important mutation in the definition of food security is its new individual or household dimension and the new elements of access, sufficiency, security (or vulnerability) and sustainability (Maxwell, D. 1996).

This definition is again refined in The State of Food Insecurity 2001: 'Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.'(FAO, 2006)

Moreover, FAO assessed the issue of sustainable food security in occasion of the Biodiversity and Sustainable Diets Symposium (2010), focused on the impact of food consumption patterns on agriculture production, on the environment and on poverty alleviation. In that occasion the definition of "*sustainable diets*" was introduced as "… *those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations*". This new definition shows elements putting together the acceptation of "food security" and "sustainability". The same definition makes explicit reference to other important dimensions of sustainable diets, considering their environmental, economic and social impacts: "…*sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.*" (FAO, 2010)

Considering the interlinked nature of many world issues, for example the connection between poverty and malnutrition that is increased considerably in the 90s due to the increase of the world population, the growth of food demand connected with lifestyle and consumer changes; and also the creation of a new dichotomy between food and energy.

The position of each country on the food price crisis depends upon their own social-economic development level, the role of agriculture in their economic system and wage distribution, which is a determining factor in the impact of soaring food prices on the population analysis (Fanfani, 2008). However, the crisis can provide an incentive and opportunity for many developing countries to strengthen the contribution their farmers make to national economic growth and poverty reduction. As such, development opportunities can be realized for countries which export food (FAO, 2011; Foresight, 2011; FAO, IFAD, IMF et. al., 2011). Several factors are at play in the skyrocketing prices, reflecting both rising global demand and falling supplies of food grains.

The recent economic crisis and skyrocketing of food prices have animated the international debate and re-opened the debate on food security. World food prices started to increase considerably in 2007-2008, even though they started to drop in the second half of 2008 due to the economic crisis de recession and to a lower demand of food. The same process happened in 2010-2011 (FAO,2011). Population size will continue to increase from seven billion today up to nine

billion in 2050 pushing up the demand of food. Food supply will also face this increase while facing the competition of key resources (land, water, energy) and climate change is becoming a more and more a threaten. During this changes, globalisation is irreversible as climate change and food system will have to face new economic and political challenges (Foresight,2011).

1.2.2 Food Security Multidimensionality

Food Security as mentioned before is multidimensional concept. First of all food security has always been considered as a matter of food supply, in other words the ability of a country to provide enough food to meet the needs for its population (Ecker and Breisinger, 2012). The difficulty of measuring the actual food (in)security is that the food supply is only one of the issues involved. As mentioned by Sen (1981) enough food supply does not guarantee the freedom from food hunger. Therefore, as already mentioned, Sen focuses on the problem of the "access to food".

Different authors and expert have tried to explain the possible different dimension of food security (Campbell, 1981; Pangaribowo et al., 2013; FAO, 1996; Dupont, 2012), normally they have followed the official definition (FAO, 1996) which shows four different pillar.

In this section the four dimensions are explain. They are considered under the dissertation purposes, in other word focusing on the economic issues of food security.

Availability. For most of the human history life were short and unhealthy due also to insufficient supply available. In 18th century due to the amelioration on the agricultural production and the increase of productivity this trend has started change. However, the availability food does not ensure the access to it (sufficient, safe, an nutrition), which we will discuss later. The indicators of the supply side are normally calculated in Kcal/capita/person and the data serve as popular proxies for actual consumption at the national level. Two are the aspect which constitute the food availability dimension: production and exchange (Ingram,2011).

- Production, means the amount and type of food are available through local production in order to guarantee enough food security. It has as always been considered the first element to agricultural development and food security, way before the Industrial Revolution (mercantilist, physiocrats). Even nowadays in terms of food security and agriculture development the aim is to increase productivity and to have enough available food to guarantee a country self-sufficiency. However there might be commodities which are normally destined to food export (ex. Fruit and Vegetables in North African countries), and contribute to the economic development of the country but not to their internal self-sufficiency.

- Exchange represents the amount of food that can be obtained through barter, trade, purchase, or loans. In order to be potential competitive on the the exchange mechanism there are other important elements such as income levels and purchasing power, informal social arrangements for barter, local customs for giving and receiving gifts, migration, gender and age structure, markets, terms of trade, currency value, and subsidies

Access. This dimension shows that even a country could have enough food for its population, there might be physical or economical matters that obstacle the access to food. In this dimension could be considered all the socio-economical issues. As an example the access of an household to health structure could affect its food security. However in this contest the economical issues of access are (the one) taken into account. The economical indicators of accessibility aim to show the effects of the food prices, the economical growth and also the people power purchase of food. In addition, indicators which represent the physical access might not appear properly economical, however they show logistical problems of access which depends to the economical development of a country (Ex. Percentage of paved road, Road density, etc.). Three are the determinant of the food access: Affordability, Allocation and Distribution.

- Affordability is the purchasing power of households or communities relative to the price of food. It includes indicators such as: price level and its variations, the income and its wealth levels.
- Allocation means the governing mechanism that represent when and how the consumers can access food. As an example the governments implement policies to correct market failure and allocate food in emarginated and low-income area.
- Distribution represents the way how food consumption is made accessible. It includes aspects such as transportation and infrastructure (railroad and road density). It is the determinants of physical access to food.

Utilization. It measures the population ability to consume sufficient micronutrient intake and nutritional assumption (Pangaribowo et al., 2013). Anthropometric measurements are often used as proxies for assessing the eventual extent of malnutrition. The classical indicators in this respect have to do with the growth of children and body composition of adults. The most commonly used measurements are the body weight, height, age and sex of each individual (FAO, 1999). As an anthropometric measure we considered the percentage of stunted children (younger than five years old) which is an important indicator to household food security. Children are the ones most responsive to changes in living condition due to the high physiological nutrient requirement for

their growth and they are directly exposed to adverse health condition (IFPRI, 2012b). Moreover, this dimension includes indicators of nutritional health (Pangaribowo et al,2013), however as far as economical issues are concerned, these kind of indicators are not calculated to this specific subject. The three elements of food utilisation are nutritional value, Preferences (social value) and food safety (Ingram, 2011).

- Nutritional value are the calories and micronutrients which people should consume. Both under and over nutrition are considered. As an example it is characterized by the dietary diversity, hygiene practices, access to clean water, type of protein (animal or vegetable) and diseases that affect food absorption.
- The preferences includes all the individual choices on what kind of food consume and in respect to all to the practices related to cultural, religious and social values of the consumers.
- Food safety refers to the quality of food and to the danger of introduce into commerce food that could be a risk to the health. The main determinants of this are the procedures and standards and regulations (or lack of) for food production, processing, packaging and distribution.

Stability (Vulnerability and Shocks). Stability refers to the stability over time of the three dimension previously described: availability, access, utilization. It is actually a condition of the other three dimensions. The stability shows the possibility that the food security status may change over time. In this section Indicators of variability are considered, which show the changes of certain indicators, such as prices, production, supply, over time (FAO,2006).

Different authors gave their own interpretation to the food security dimensions. The Economist Intelligence Unit in 2012 have chosen three dimension of food security: 1) Affordability, measures the ability of consumers to purchase food, their vulnerability to price shocks and the presence of policies and strategies to face shocks.

2) Availability represents the sufficiency of the national food supply, the risk of supply disruption, national capacity to disseminate food and research effort to augment agriculture productivity.

3) Quality and Safety measures the variety and nutritional quality of average diets and the safety of food. (The EIU, 2012).

In one of the latest FAO report on Food Security multidimensionality (2013), stability has been described as vulnerability and shocks, in other words the extent and the exposure to risk. Keys indicators of this dimension are the risks and shock affecting directly food security, as wings in food and input prices.

The food security debate is always in evolution, and in a recent report of FAO (2013) show the multidimensionality of food security. FAO gives its own interpretation of the four dimension of food security and in the next table (Tab. 1) the new approach elaborate by FAO, is illustrated.

Table n. 1 - FAO Food Security Dimensions

FOOD SECURITY INDICATORS DIMENSION		
- Average dietary energy supply adequacy - Average value of food production - Share of dietary energy supply derived from cereals, roots and tubers - Average protein supply - Average supply of protein of animal origin	AVAILABILITY	STATIC and DYNAMIC DETERMINANTS
- Percentage of paved roads over total roads - Road density - Rail lines density	PHYSICAL ACCESS	
- Domestic food price index and	ECONOMIC ACCESS	
- Access to improved water sources - Access to improved sanitation facilities	UTILIZATION	
- Cereal import dependency ratio - Percentage of arable land equipped for irrigation - Value of food imports over total merchandise exports	VULNERABILITY	
- Political stability and absence of violence/terrorism - Domestic food price volatility - Per capita food production variability - Per capita food supply variability	SHOCKS	
- Prevalence of undernourishment - Share of food expenditure of the poor - Depth of the food deficit - Prevalence of food inadequacy	ACCESS	OUTCOMES
- Percentage of children under 5 years of age affected by wasting - Percentage of children under 5 years of age who are stunted - Percentage of children under 5 years of age who are underweight - Percentage of adults who are underweight - Prevalence of anaemia among pregnant women - Prevalence of anaemia among children under 5 years of age - Prevalence of vitamin A deficiency (forthcoming) - Prevalence of iodine deficiency (forthcoming)	UTILIZATION	

Source: Author elaboration from FAO Report (FAO, 2013)

Food security multidimensional and complexity makes difficult its assessment and measurement .

Many authors have tried to give their contribution (Maxwell, 1999; Clay 2002; Campbell 1991;Sen, 1981)

In addition in other reports (Pangaribowo et al., 2012; Lovendal et al., 2004; Diaz-Bonilla & Ron, 2010;Scaramozzino, 2006), authors in order to develop their work on Food Security, followed the four dimension used by FAO : access, availability, utilization, and stability.

However the complexity of this concept is part of the post-2015 development agenda that is being prepared together with broader measurement and new monitoring challenges of food security. FAO affirms that vulnerability to food (in)security is animating the food policy international debate, especially regarding the climate change issue.

In this analysis after having illustrated the different dimension of the food security dimensions we decided to put an highlight on the multidimensional concept of vulnerability and give our contribution to the matter in the followings paragraphs.

1.2.3   Food Security and Vulnerability

What is vulnerability?

Vulnerability is a concept emerged in the social sciences and when linked with economy or quantitative dimension it is difficult to measure and quantify.

Vulnerability is a subject of concern especially in the latest financial and food crises. An analysis on the literature on vulnerability shows that there is no consensus on this concept, in how to define it or measure it (Scaramozzino, 2006).

In the framework presented by Birkmann J. (2006), vulnerability concept has its origin in the 1970s as a response to the perception of disaster risk. And in the 1980s vulnerability has started to be used as the starting point to reduce risk and instability. Lately vulnerability has emerged more and more on the international agenda, especially with the recent economic crisis.

Sen's (1988) influential entitlement approach links vulnerability to inadequate access to assets, including intangible ones, such as social capital. However, access to assets offers no guarantee that the assets will be used in an effective fashion to reduce vulnerability.

In 1994 during the Barbados Conference on sustainable Development in Small Island Developing State, the need of developing vulnerability indices that could reflect the status of small developing islands, has been expressed. Consequently the UN General Assembly prepared a report on vulnerability and established a committee to prove that the vulnerability index could be a tool for identifying the least developed countries.

Vulnerability has been defined in relation with the least developed, which are basically low income countries with incapacity to economic growth.

To identify the LCDs the Committee for Development Planning beside the level of GDP, the index of human capital, introduced an economic vulnerability index.

Authors as Anderson emphasize that everyone is vulnerable at a certain degree, and it exist when some crisis may threaten and damage people health and life, or the property and resources on which health and life depend (Anderson,1995).

According to Birkmann, J. (2006) researchers and authors are facing a paradox because there are many studies and analysis to measure vulnerability but the real meaning is not clear and unique.

Alwang et al. in a paper concerning the vulnerability viewed from different disciplines explored the different meaning of this concept and the diverse methods to measure it. The authors in order to make vulnerability more understandable started to dived the concept into different aspect of risk as: 1)the risk itself, 2) how to manage it and 3) the impact of risk on welfare (outcomes). (Alwang et al. 2001) Risk is defined as interchangeable with uncertainty and it is represented by the probability of events which are characterized by their magnitude or frequency and duration. These risk's features will affect vulnerability (Alwang et.al 2001). Risk management could be ex-ante and ex-post.

First of all vulnerability presents different meanings concerning the dimension to which it refers: physical, social, economic and environmental. Among these definitions, two are the best-known: 1) the International Strategy for Disaster Reduction (UN/ISDR) has formulated the concept of vulnerability as the "The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards" (UN/ISDR, 2004); 2) the United National Development Programme (UNDP) has described it as "a human condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard". (UNDP, 2004: 11)

By contrast, the World Bank uses a risk-based approach for assessing household vulnerability (World Bank, 2005). The "Social Risk Management" framework of the Bank considers the sources of vulnerability and the ability of the community to manage the associated risk. The emphasis is largely on minimising risk exposure, although a major weakness in the approach is the absence of the consideration of those risks that stem from insufficient ownership or access to assets.

The FAO identifies currently vulnerable groups in terms of geographic location, and seeks to determine the causes of their vulnerability.

Romer Lovendal C. and al. (2004) refers to vulnerability as countries and people's exposure to risk and their resilience to this. Risk refers to phenomena, events, shocks and trends that could negatively affect the welfare of people and the governments' resilience or the people ability to implement strategies and policies to face the risk (prevention, coping and mitigation).

Furthermore, other authors highlight some components of vulnerability: Multi-dimensional, dynamic and scale dependent (individuals, region, household, region etc.) (Birkmann, J. 2006)

Brooks (2003) distinguishes between biophysical vulnerability and social vulnerability. Biophysical vulnerability depends on the gravity and frequency of hazard (natural hazard, climate change) and social vulnerability depends on the exposition of the humans to a certain hazard. The social vulnerability or socio-economic vulnerability will be the issue of interest. Therefore social vulnerability is in function of the extent of hazard and there are certain factors likely to determine the vulnerability of communities (poverty, inequality, access to resources, health etc).

In the bibliographic review presented by Birkmann, J. (2006), other authors express their interpretation of social vulnerability. They argue that it depends on different factors and characteristics of individuals, such as: initial well-being (nutritional status, physical and mental health), subsistence and adaptability, social and politic stability and institutions, self-protection and social protection.

The concept of vulnerability doesn't have a common and official definition, however what it is of common agreement is that vulnerability doesn't cover only social fragilities but covers various aspects: income, age, gender, growth rates, economic, environment, inequalities, etc.

Normally we heard speaking about vulnerability of poor household and countries. Recently, vulnerability acquired more and more interest in response to the concerns on the late crisis, instability episodes, conflicts and poverty in Africa and in least developed areas. Many authors refer to vulnerability at macro-level, but the debate has also moved to the households with researches on poverty and as a result of a large extent from macro vulnerability.

In the debate on price volatility and food security the economic vulnerability will be the aspect to be discussed and analysed.

Many researches reference to vulnerability as a risk or inability to cope with hostile environment or effects.

The following diagram (Fig. n.1), elaborated by researchers from the University of Malta, shows the components of the risk generated by external shocks.

Figure n. 1 - Definition of risk
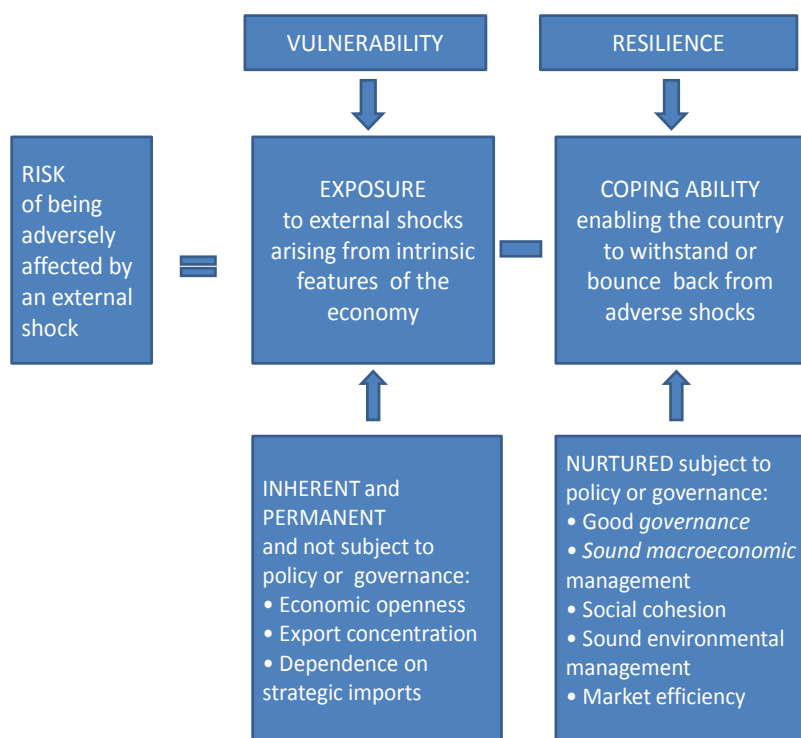
Source: Briguglio et al.(2006)

An interesting definition of vulnerability has been presented by the following two authors.

According to Combes J.L., and Guillaumont P. (2002) and Guillaumont P. (2009), economic vulnerability is defined as the risk of a country which its development is obstructed by natural or external shocks. These shocks have different origin: environmental (natural disaster, droughts, hurricanes, floods etc.), external shocks (trade shocks, commodity prices instability, international rate fluctuation etc.) and also shocks generated by political instability.

These two authors have been the ones to identify the components of vulnerability that could resume the different definition and determinants discussed by previous authors and researches.

Vulnerability is considered as a result of three determinants which includes also the previous definitions and analysis: shocks, exposure and resilience (Combes J.L., and Guillaumont P. 2002; Guillaumont, P.2009). In the following part the three components will be highlighted.

Size and frequency of shocks determines vulnerability; they have different nature, such as: environmental and "natural" (natural disasters, earthquakes, drought, floods etc.); external shocks (trade and exchange, world commodity price instability) and they can have origin from political instability and changes. The exposure to these shocks depends on the location and structure of the economy. The resilience concerns the capacity of countries to manage shocks and to cope with them. In this case it is important to make a distinction between "structural

vulnerability", which depends on different factors independent from current policies and "vulnerability deriving from policies" (Guillaumont, 2009).

The next diagram (Fig. n.2) shows an author elaboration of the vulnerability aspect and components.

Figure n. 2- Vulnerability concept and components
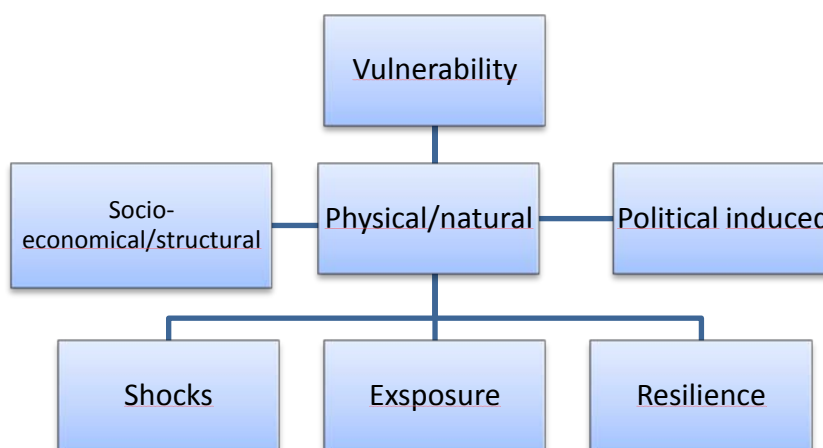
Source : Author's elaboration (Combes and Guillaumont, 2002; Guillaumont, 2009)

In the LDCs, normally the most vulnerable, both types of vulnerability structural and political can be found.

Combes and Guillaumont (2002) consider vulnerability of developing countries from the volatility of commodity prices, and in particular they argue about economic vulnerability, as the risk of being affected by unpredictable shocks.

According to this interpretation, the economic vulnerability of a country is influenced by its dependency from trade and therefore it is affected by international commodity price fluctuations and domestic price stability.

Vulnerability could be analysed at a macro and micro level. However, vulnerability affecting a whole country will be transmitted also to the individuals: farmers (particular the poor) facing with the price volatility shock, food buyers facing the lowering of their income for high prices, etc.

The capacity or incapacity of a country to cope with shocks and with the exposure to them reveals the level of vulnerability of a country and individuals.

This definition of vulnerability can be transmitted to the agro-food field, concerning the food price volatility shocks and the food security (or insecurity). High food prices shocks could affect food security of household (depending on the transmission of international food prices in the domestic market).

The economic vulnerability of a country depends on its dependency on trade; therefore the vulnerability if exporting or importing depends on the commodity price fluctuation and their

resilience. Similarly it is possible to make an analogy at a micro level on net food buyers and net food sellers, their vulnerability depends on their exposure to shocks and their capacity to cope (Combes and Guillaumont, 2002).

The multi–dimension of vulnerability makes possible the analysis between food price shocks and food security (recently defined at a household and individual level).

Directly or indirectly, in terms of price transmission in the domestic market, food price shocks can affect household food security in qualitative and quantitative terms, the gravity of price shocks depends on the level of vulnerability of the countries determined by their exposure and resilience to these shocks.

The magnitude of food price shocks and economic vulnerability could be observed through countries trade policy, and by pro capita GDP and the amount of GDP spent in food for the households. Data on households' vulnerability to high food prices are not always available; in addition various authors are trying to collect data by empirical studies.

Whilst definitions of vulnerability are plentiful, the real difficulty has been in finding a robust measurement of vulnerability that is consistent with the basic tenets of risk analysis. There are two main approaches to vulnerability measurement. The outcome approach measures vulnerability in terms of expected poverty (Ligon and Schecter, 2003). The utility-based approach measures vulnerability as the difference between the utility a household would derive from the consumption of a particular bundle with certainty and the expected utility of consumption (Ligon and Schecter, 2003).

As discussed before vulnerability is a multi-dimensional concept which hasn't found a global consensus among authors and experts. The aim is to conceptualize the concept of vulnerability to food security in order to facilitate its measurement. Therefore the difficulty of having a unique definition is that vulnerability implies the concept of risk and concerning the different disciplines to which the vulnerability and risk concept can be directed, it is inevitable the existence of multiple approaches.

 Similarly to food security, vulnerability has a multidimensional nature, entailing physical, social, economic and environmental issues. According to the emphasis given to one or more of these dimensions, various interpretations and definitions of vulnerability are provided.

Sen's (1981) influential entitlement approach links vulnerability to inadequate access to assets, including intangible ones, such as social capital. However, access to assets offers no guarantee that the assets will be used in an effective fashion to reduce vulnerability.

As far as vulnerability to food insecurity is concerned, Dilley and Boudreau, 2001 refer to a situation where: "*events that can cause harm*", "*susceptibility to a specific event*" and "*likelihood*

of an undesirable outcome, based on the potential occurrence of harmful events and levels of susceptibility to them among those likely to be exposed".

Dilley and Boudreau (2001) attempted to built a conceptual framework on vulnerability to food security.

The authors started to the necessity to answer to the question "vulnerable to what?". In the case of food security the answer would be " famine", "food insecurity" or "hunger". Dilley and Boudreau (2001) move a critic to the definition of vulnerability to food security as a relation to outcomes and tried to asses this concept considering the food –related crisis as any other event where condition may change and in order to prevent a negative outcomes it is important to identify previous events that might take to the outcomes itself.

In addition vulnerability to food security was identified as : "Events that can cause harm", "susceptibility to specific event" and "likelihood of an undesirable outcome, based on the potential occurrence of harmful events and levels of susceptibility to them among those likely to be exposed" (Dilley and Boudreau, 2001).

However   the discourse over vulnerability has taken different directions, on the on hands, authors refer this concept to disaster management where vulnerability is represented by the identification of the degree of damage that would affect populations and economic assets due to natural hazard events.

On the other hand , food security authors refers to vulnerability in relation with an outcome, measuring how people are getting to a state of famine or food insecurity. In 1981 Sen explained that the lack of availability of food supply was the first reason for famines and in addition he considered the problem to access to food as an explanation to understand famine under a social, politic and economic perspectives. From this moment authors started to summarize Sen's multi-dimensional idea as "vulnerability".

Chambers in 1989 expressed the vulnerability to food security as " and exposure to contingencies and stress, and difficulty in coping with them".

This definition conflates exogenous "risks" and shocks with a population's intrinsic lack of ability to cope with them. And whereas "vulnerability" in the disaster context is a dynamic, contingent concept reflecting a group's or other element's ability to withstand specific exogenous shocks or threats, the intrinsic aspect of vulnerability in Chambers' definition consists of a static state of categorical defencelessness.

Scaramozzino (2006) proposes a very interesting approach to vulnerability, stating that: "*(...) the analysis of food insecurity should be carried out in a dynamic context. It is essential not just to look at the current incidence of an inadequate nutritional outcome, but also to identify the individuals, households or the communities who are more at risk of suffering in the future. The main analytical concept that has been developed in order to address the issue of the future incidence of food*

insecurity is vulnerability analysis. (…) The vulnerability approach (…) looks at food insecurity ex ante, rather than examining it as an ex post outcome. (…) the analysis (…) can therefore fully consider the uncertainties associated with future food insecurity, such as the role of external shocks and the strategies that households, communities or public institutions can adopt in order to reduce the likelihood of negative outcomes"

In conclusion, we will adopt the approach proposed by Lovendal and Knowles (2006), who state that "*The terms 'vulnerability' and 'food insecurity' are often used interchangeably. This matters less when focusing on short-term unstable conditions. (…) However, over longer periods of time, people move in and out of food insecurity. Thus, while vulnerability refers to the ex-ante probability of falling or remaining below a specific threshold, food insecurity is the current or ex post measure relative to the threshold. (…) Vulnerability can be thought of as a continuum. The higher the probability of becoming food insecure, the more vulnerable one is*".

According to this definition, in order to obtain a measure of food (in)security and vulnerability a "cut off point" should be defined. However the same authors acknowledge that "*no standard exists that defines this threshold*". In order to overtake this obstacle, in this study we will focus on the structural (or chronic) dimension of food security and vulnerability, assessing their stability or change (improvement or deterioration) in the long run.

1.2.4 Food Security indicators review

As mentioned before there is not the best indicator, best measure or best analysis of and indicator (Habicht and Pelletier, 1990). Therefore the more the subject is complex the greater is the need for a range of indicators.

A single indicator cannot summarize the complexity of an issue such as food security, and a range of indicators has to be considered to explore all the dimensions of the matter. When analyzing the impact of different factors on food security, the impact assessment can then be performed on each single indicator in the set, or on the composite index of food security.

In this section we will explore some of the already existing indicators on food security

The Economist Intelligence Unit has created the **Global Food Security Index (GFSI).** This indicator assesses food security through three internationally designated dimensions: affordability, availability and utilization in this case called, quality and safety and selected indicators for each of the dimension. GFSI considers the nutritional quality and safety of food elements together with traditional supply and availability issues. These indicators (Tab.n.2) have the aim to analyze the risk to food security knowing that indicators should give information and produce an important base on understanding the risks to food(in)security but they have to be used carefully because

they simplify a complex issues and they cannot capture in total important cultural and political dimensions and risks. (Economist Intelligence Unit, 2012).

Consequently this indicators can be useful to serve as an early warning of potential shocks (price spikes) that might compromise a country's food security, or worsen already poor conditions.

Table n. 2 - Global Food Security Index

1. Affordability	2. Availability	3. Quality and safety
• Food consumption as a share of household expenditure • Proportion of population under the global poverty line • Gross domestic product per capita • Agricultural import tariffs • Presence of food safety net programs • Access to financing for farmers	• Sufficiency of supply • Average food supply in kcal/capita/day • Dependency on chronic food aid • Public expenditure on agricultural research • and development • Agricultural infrastructure • Existence of adequate crop storage facilities • Road infrastructure • Port infrastructure • Volatility of agricultural production • Political stability risk	• Diet diversification • Nutritional standards • National dietary guidelines • National nutrition plan or strategy • Nutrition monitoring and surveillance • Micronutrient availability • Dietary availability of vitamin A • Dietary availability of animal iron • Dietary availability of vegetal iron • Protein quality • Food safety • Agency to ensure the safety and health of food • Percent of population with access to potable water • Presence of formal grocery sector

Source : Economist Intelligence Unit 2012

FAO provides an **indicator of undernourishment (FAOIU)** for most of the countries and considers mean dietary energy supply as a proxy for food energy consumption. This indicator contain three main variables to be calculated : the mean quantity of calories available for human consumption, the inequality in access to those calories among the population, and the mean minimum amount of calories required by the population. The FAOIU seeks to estimate the proportion of the population which is at risk of insufficient consumption of calories. However this indicator presents some weak aspects: the calories availability is not a poor element to predict nutritional development, mortality and productivity (Pangaribowo et al., 2011)

Another well-know indicator of food security is **The Global Hunger Index (GHI)** which is calculated combining undernourishment(the share of population with insufficient calorie intake), child underweight (proportion of children younger than the age of five who are underweight), and child mortality(interaction of inadequate dietary intake and unhealthy environment). It provides information on the success and failures in the progress of hunger reduction and on the drivers of hunger.

However the GHI combines only provides a unique insight by combining three aspects of hunger. Some critics have been raised: the issue of double counting, aggregating sex and age specific minimum dietary requirements is critically debated as it might result in a large underestimation of undernutrition, and data on food availability are not fully reliable (FoodSecure, 2011).

In addition others indicators of food security are the **anthropometric indicators (AI)** which are specifically : stunting (low height-for-age), underweight (low weight-for-age), and wasting (low weight-for-height) measure nutritional outcomes at the individual level. The nutritional outcome is influenced by aspects beyond the availability of and accessibility to food, such as the interactions between food losses, intra-household food distribution, individual health and activity levels, and also environmental quality, few of which are captured in the indicators described in the previous sections. Svedberg (2001) pointed out the advantage of anthropometric indicators that they directly reflect the imbalances between energy intakes and expenditures. Even though anthropometric indicators measure nutritional outcomes, they do not cover specific nutrients that might be deficient. Nevertheless, it is argued that stunting might reflect long-term consequences of under-consumption of essential micronutrients such as vitamins and minerals (Pangaribowo et al. 2011) **Percentage of stunting** (height-for-age less than -2 standard deviations of the WHO Child Growth Standards median) among children aged 0-5 years.

Anthropometric data are derived from household survey and have the advantage of being disaggregated for group and region. However they have some problems of calculation, as technical errors and hard estimation of children age especially in developing countries, these measures are available from all countries however time series are not uniform since the data are not collected annually. However compared to other measures stunted children are reflecting long-term consequences of under consumption of essential micronutrients such as vitamins and minerals. Percentage of children aged <5 years stunted for age = (Number of children aged 0-5 years that fall below minus two standard deviations from the median height-for-age of the WHO Child Growth Standards / Total number of children aged 0-5 years that were measured) * 100.

National nutrition surveys and national nutrition surveillance systems are the preferred primary data sources for child nutrition indicators. Generally national surveys are recommended to be conducted about every 5 years. But this also depends on the nutritional status as well as on the change in the economical situation, the perceived change of nutritional status, and the

occurrence of human made crisis and natural disasters. (World Bank, World Development Indicators)

The Poverty and Hunger Index (PHI) is a multidimensional indicator of poverty and hunger linked with the MDGs indicators. The PHI is developed as one of the instruments in monitoring the achievement of MDGs. The proportion of the population living on less than a dollar per day, the poverty gap, the share of the poorest quintile in national income or consumption, the prevalence of children underweight, and the proportion of undernourished population calculated by the FAO are among the indicators used by Gentilini and Webb (2008). the MDG Project does not provide a coherent conceptual framework which explains how the MDG indicators are linked, nor does it establish a hierarchy of its target indicators. This presents some difficulty for the construction of the PHI and a convincing definition of its dimensions (Pangaribowo et al., 2011).

As mentioned previously FAO consider four dimension of food security and a range of indicators for each dimension has been selected. FAO considers the existing following indicators for each dimensions: Availability is considered as the amount of food that is available for a population at a certain time, related mostly with production and market availability. Accessibility which embrace's the Sen's thesis that food availability doesn't guarantee everyone free from hunger; this dimension includes indicators that hinder or facilitate the access to food. Utilization measure the ability of population to get sufficient intake and nutrition. Stability represent the stability of this three dimensions over time without risks, this dimension is considered by FAO as the vulnerability dimension, which shows that food security can change over time and it is a dynamic phenomena. FAO food security indicators have already been illustrated in Table n.1.

In FoodSecure report on **indicators of food and nutrition** have been selected referring to the time scale and geographical pattern of the subject. However subject as food and nutrition security are quite complex. In the reports the authors attempt to indentify the key factors and a conceptual framework of food and nutrition security, consequently these concept are made operational and in the end existing indicators are taken into account in order to analyze their weaknesses in methodology and dataset.

The complexity of the problem requires a greater range of indicators, food and nutrition security involve different disciplines, factors and dimensions , so set of indicators to capture all the dimensions is needed. Four are the dimension considered and for any dimension a set of indicators is studied: availability, accessibility, utilisation and stability.

Criteria of selection can be summarized as : identification of four dimension of Food and nutrition security, use of three type of indicators, status/outcome, process/interventions, and

determinants/risks; stabilization or the temporal scale (long-term vs short term); identification of the level at which the indicator can be measured.

IFPRI have developed an indicator to calculate food security distinguishing it in two dimension: Macro and micro level of food security. Macro-level food security is calculated by the share of food imports divided by total exports plus net remittance inflows (food imports / [total exports + net remittance inflows]). This indicator shows the capacity of a country to food imports through exports of goods. The macro-level indicator captures the ability of a country to finance food imports through exports of goods and services and the net remittances received. This indicator concerns food imports and it is calculated on the GDP%; however, this doesn't show the real percentage of imports, a more significant indicator could be the percentage of import on the total food availability. These could give information on the real importance of imports on the total food supplies.

Micro-level indicator is represented by the percentage of stunted children (younger than five years old). The percentage of stunted children (younger than five years old) is an important indicator to micro-level food security. Children are the ones most responsive to changes in living condition due to the high physiological nutrient requirement for their growth and they are directly exposed to adverse health condition (IFPRI, 2012).

Moreover, concerning this indicator showing micro (household) food insecurity vulnerability (stunting children) is appropriate, but it can be argued that it is not useful for prevent the food insecurity, the data are generated form ex-post analysis, and they are elaborated too late to construct measures to prevent food insecurity vulnerability.

In the USDA report (2011) has been calculated the food gap to food security. Two food gaps have been measured: 1) the nutritional food gap and it is measured through the gap between recommended caloric intake (2100 kcal) and food per capita availability; 2) the distribution food gap which is the gap between the per capita food needed to raise consumption of each income groups to the recommended caloric intake. In case a certain income group as a lower availability of food compare to the recommended intake, this difference represents the distribution gap (USDA, 2011).

In order to achieve the purposes and follow the focus of each study conducted on food security different indicators have been selected and authors gave their own contribution.

In our study we are taking into consideration the economic issue and after having reviewed other works and studies we selected our indicators that will be overviewed and discussed in the methodology section.

2. Drivers and Trends in Food Security

Many variables have a key role in a multidimensional concept as food security. In this section we will describe the most important variables and determinants which could affect directly or indirectly food security. Important variables in food demand and supply will be explained as follows.

2.2 Food Demand Side

Food demand is facing important modifications, particularly in developing regions, due to population growth, which is associated with per capita GDP increase, thus boosting food demand and changing its structure. Household expenditures on food decline as incomes rise; augmentation in income will bring to increase the demand for food containing more fats, proteins and sugar. However, in contrast with what said above, in urban areas low income households have access to processed food and urban lifestyles and exposure to food advertising will tempt people to increase consumptions of low quality food and of products rich of fat and sugar. This, might open to other problems related to food consumptions: health problems, obesity, cardio-vascular diseases, etc.

Next paragraphs represent an overview on the major variables affecting food demand.

2.2.1 Demographics trend

Population is an important factor in the rising of food demand and in the changes on the food supply. As mentioned , since 1798, Malthus started to theorize the population growth.

In the following figure (n.3) it is shown the Malthuisian model, where population growth until the point (t_l) (Malthusian trap) the food supply will provide enough food for everybody. Surpassed this point, starvation will be experienced and population will be constrained. Concerning Malthus, the system will be efficient only if people will have a minimal adequate diet, no more and no less

$$P(t)=P(o)e^{rt}$$

where

P(o) = initial population,

r = growth rate, sometimes also called Malthusian parameter,

t = time

Figure n. 3 - Malthus' population model
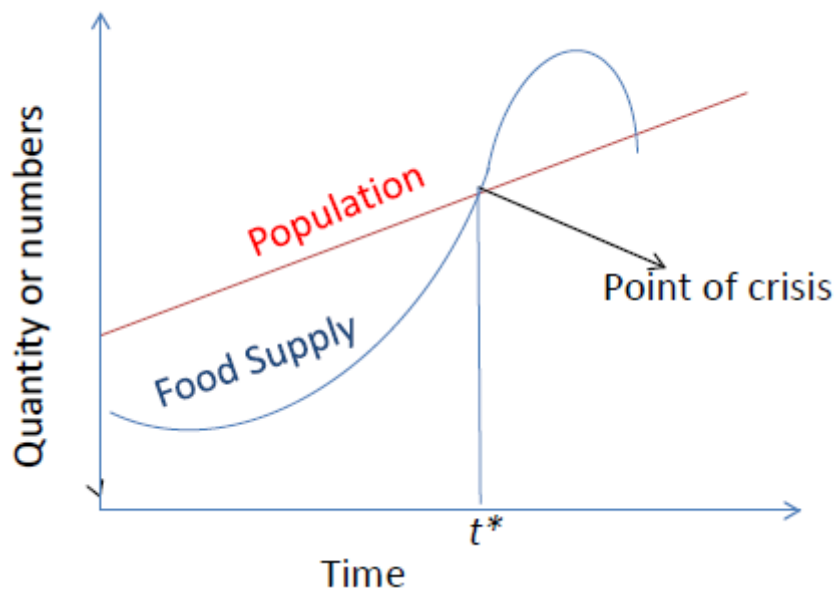
Source: Author's elaboration

Therefore in contrast with the Malthusian model, trends have showed that people's diets are improving even if population is growing. According to Malthus, this phenomena can happen only if per capita food consumption will diminish. However, the contrary had happened from the 1960 the world average calories augmented from about 1940 kcal/per capita/day up to the 2600kcal in 1990. Living standard, health and life expectancy got better which implying an exponential growth of population.

According to Malthus's model, better diets, improved health, and higher incomes ought to have caused a skyrocketing of human fertility. However, his principle of population has proved to be a poor guide to recent trends. In some places, most notably China, strict controls on family size, of the sort advocated by Meadows et al. (1972) and other modern Malthusians, have been applied. But many other parts of the world have experienced declines in fertility comparable to China's without resorting to coercive measures. The latter result can be explained only in terms of people, especially women, deciding that their individual interests are best served by having fewer children and also being able to act accordingly. (Southgate at al., 2011, Food Economy).

As we can see in the Figure n. 4, the number of people living in the world has increased considerably and this trend will continue in the future, by more than two billion people from today's levels, reaching 9.15 billion by 2050 as forecasted by FAO (FAO, 2012b). World population growth is pushing up the demand of food and if its supply is not increasing at the same rate, food prices are destined to soar. In addition the important aspect is not the pressure of world food

population growth on food demand, but the demographic growth of the countries that are in transition from their status of least developed countries (China, India, Brazil, etc) to developing or developed countries. For the concentration of the growing food demand in these areas, these countries generate a real pressure on world food security. FAO's latest estimate indicates there were 870 million undernourished in 2010/12. Although the proportion of population who are undernourished fell slightly with the rise in population (FAO, 2012b). It is important to highlight that a slowdown in the population growth rate is contrasted by a continuing fast growth in some countries. The majority of countries are precisely those showing inadequate food consumption and high levels of undernourishment and most of them are in sub-Saharan Africa. While the growth rate decline the population growth in this area is expected to fall from 2.8% in the past to a still high 1.9% per year in the period to 2050 while the rest of the world growth rate is estimated to decline from the past 1.6% to 0.55%. (FAO, 2012b). "The combination of low per capita food consumption and high population growth in several countries of sub-Saharan Africa can be a serious constraint to improving food security, especially where semi-arid agriculture is predominant and import capacity is limited (cit. FAO,2012b p. 2)".

Figure n. 4- World Demographic trend, (1970-2012).
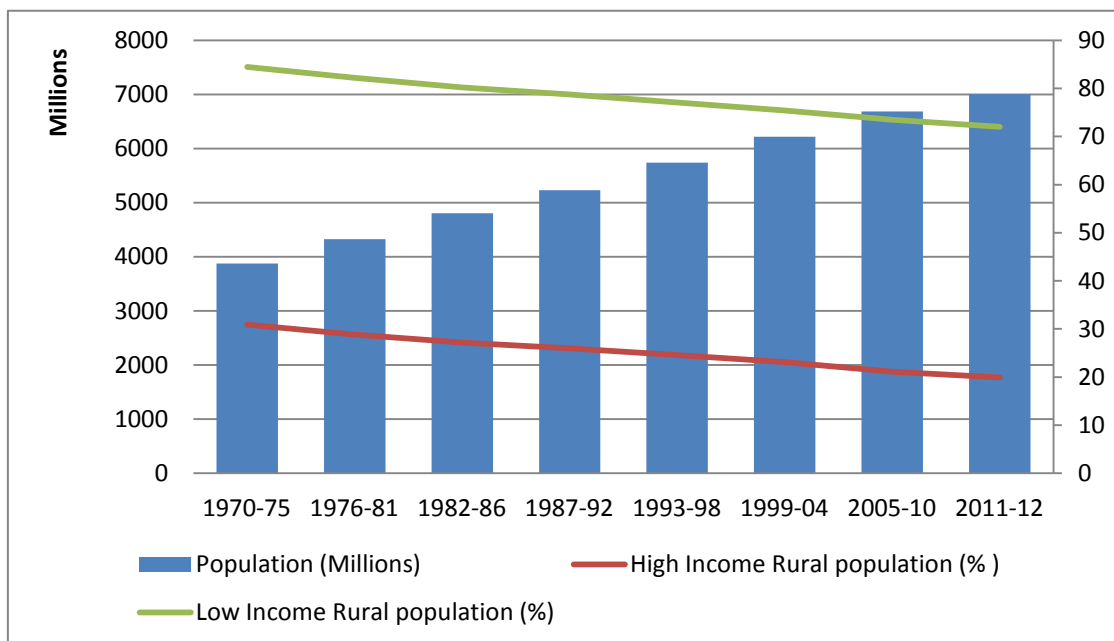
Source: authors' elaboration on World Bank data

Undernourished people are mainly located in rural areas of low-income countries (Fig.n.4) and access to food, resources and technology are the major constraints. On the contrary, the high income countries show a lower amount of rural population, but their food security is threatened by the volatility of food markets and the competition on limited resources (Saravia-Matus et al., 2012). In addition, world urban population represents the 60% of the total and will probably

increase by 3.1 billion between 2007 and 2050, passing from 3.3 billion to 6.4 billion. Cities are expected to absorb not only all the population growth expected over the next four decades but also some of the rural population growth, through rural-urban migration (UN, 2007). The urbanization process is affecting food demand due to the relevant differences in food consumption between urban and rural areas. (Fanfani, 2008).

2.2.2   Income, prices and food consumption

Data and analysis shows that living standards are improving and GDP per capita is increasing (Fig.5). However it is important to highlight that on the one hand, the high income countries sow and increasing trend in the GDP per capita over the years and on the other hand the GDP per capita of the low income countries it is seems to be static.

Figure n. 5- GDP per capita, PPP evolution in income groups (constant 2005 US$)
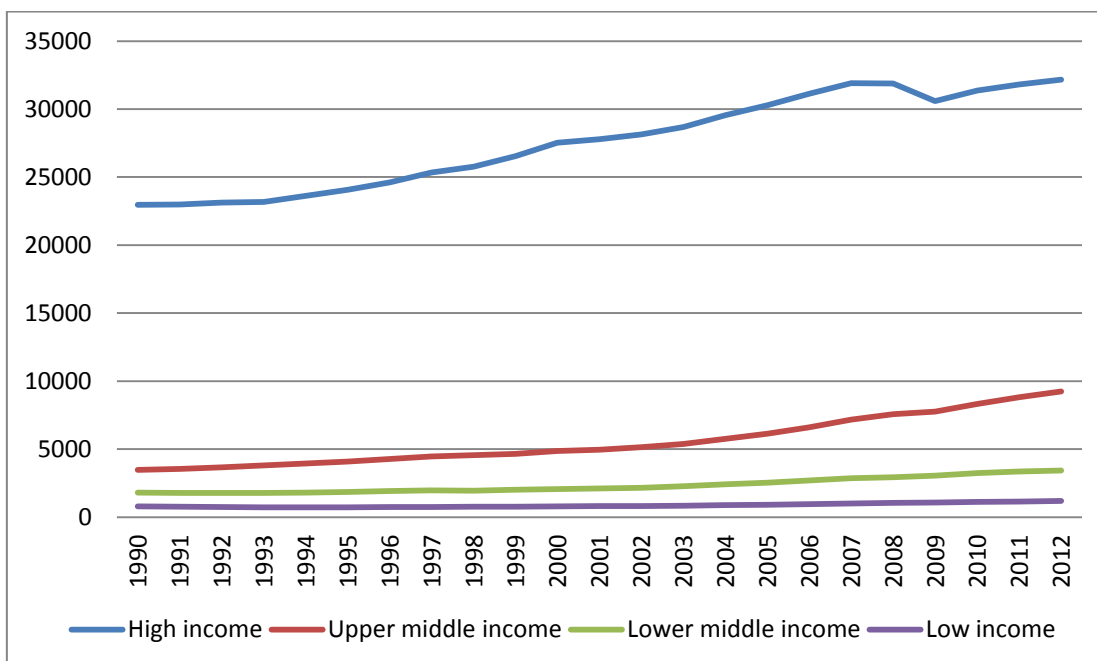
Source : World Bank data

FAO (2012b) have made some estimation on the GDP growth and the projection shows that GDP will continue to growth and that the developing countries are supposed to grow faster than the developed one. Concerns rise when the low-income country condition is arisen.

FAO affirms that there are at present least deveoped countries with per capita GDP under $1,000 and some of them might not improve their GDP in 2050 (FAO,2012b). Figure n.5 shows that their GDP growth has not improved so far, since 1990.

The next figure (n.6) show the repartition of the GDP, PPP per capita among countries using the World Bank classification in High Income countries, low income, $1,035 or less; lower middle

income, $1,036 - $4,085; upper middle income, $4,086 - $12,615; and high income,$12,616 or more[1].

Figure n. 6 - World GDP per capita, PPP in 2012 (constant 2005 US$)
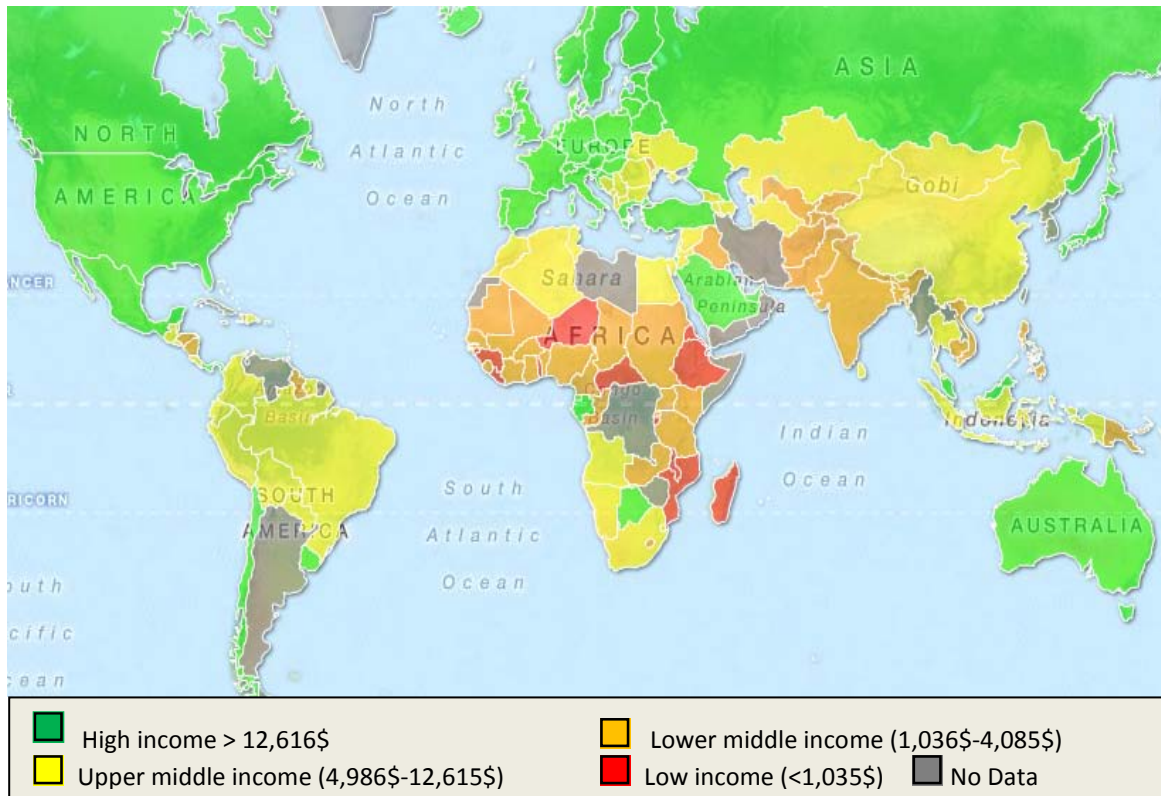
Source: World Bank Data base

The agriculture development and increasing in supply have generated a decreasing in food prices. This effects have consequences in diets, in household with higher GDP, purchase power is reallocated and food share expenditure is smaller in favour to other goods. The most common way to compare the economic development and average income between countries is to compare the GDP per capita, if possible at PPP so as to adjust the income to the cost of life.

Moreover, the GDP per capita does not take into account **income distribution**. The gap between the highest and lowest salaries are much bigger in some countries than in others. The GDP per capita being an average, it is important to know how far from this average most people really are, because just a small percentage of the population earns the biggest chunk. That is what the Gini coefficient tells us.

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[1] The World Bank's main criterion for classifying economies is gross national income (GNI) per capita. Based on its GNI per capita, every economy is classified as low income, middle income (subdivided into lower middle and upper middle), or high income. Income classifications are set each year on July 1. In this representation we used the same World Bank classification using the GDP, PPP per capita as indicator.

In addition, the PPP (purchasing power parity) takes into account differences in living costs among countries. As a general rule, food, housing, transport and other goods, are cheaper in the global south than in the industrialized north. As a consequence, comparisons using national income at purchasing power parity suggest that some aspects of economic inequality are less marked than if the comparison is made with market exchange rates of the currencies concerned.

As showed in the following figure that people with lower living standards will consume less food and their diets is normally based on cereals and other carbohydrates, however when living standards are improving (increase in GDP) people will privilege other services and change their diets consuming more food and vegetables and especially livestock products.

Figure n. 7- Relation between Living standards and Quantity of food consumed
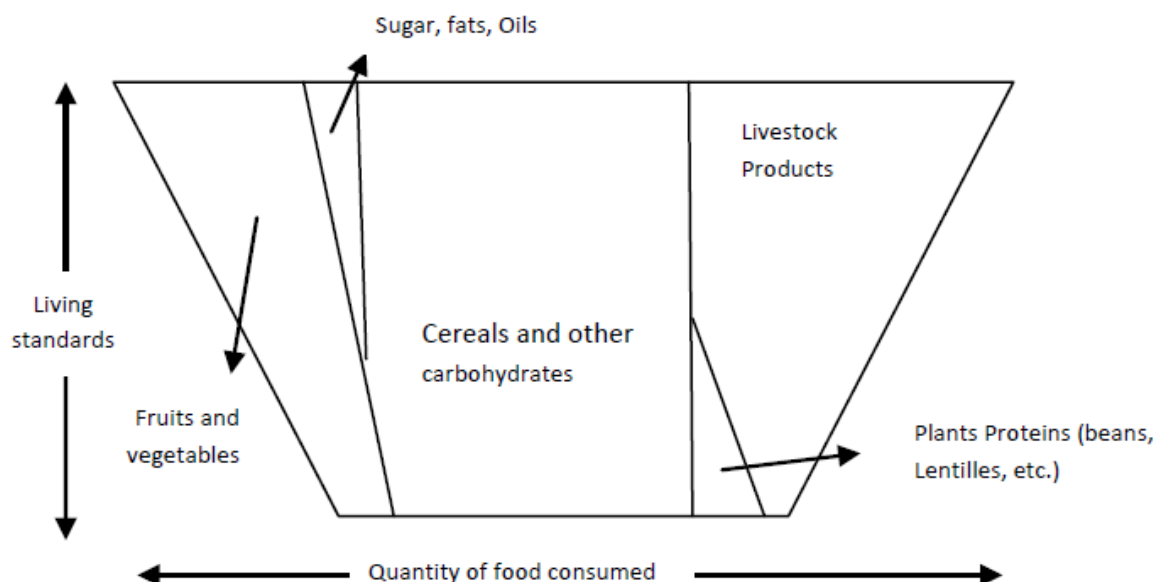
Source: Southgate et al. 2011

The relation between the increasing of GDP and food demand changes has been expressed by the Engel's Law which considers the sensitivity of food expenditure due to a rise or a decreasing of the income is expressed by the income elasticity of food demand. As people experiencing better living standards demand more food preparation and other services, the value of raw ingredients as a portion of total food expenditures diminishes.

The increase of food consumption which is caused by world population growth and by changes in daily diets that are linked to urbanization processes happening in China and India. For example the rising demand for meat, which is caused as the world income per capita increases, has exacerbated the pressure on grain and oil-seed prices since several kilograms of animal feed are required to produce each kilogram of meat (Sachs, J., 2008).

The recent trends in calories and diets are showing an decreasing in the number of under-nutrition.

In addition the rise of income in changing diets privileging the food safety. People are willing to pay more to have a better quality on food.

Urbanization is having consequences on the global food consumption changing the relation between income and food consumption. In contrast with what said above, in cities low income households have access to processed food and urban lifestyles and exposure to food advertising will tempt people to increase consumptions of food rich of fat and sugar. This, might open to other problems related to food consumptions:

Dietary changes are very significant for the future food system because, per calorie, some food items require considerably more resources (such as land, water, energy) to produce than others. However, predicting patterns of dietary change is complex because of the way pervasive cultural, social and religious influences interact with economic drivers.

Before entering in the discussion about prices volatility and its causes, the different definitions of price volatility will be highlighted.

What is price volatility? As affirmed by Von Braun and Tedesse (2012) prices changes are defined as trends, volatility and spikes and respectively: trend is the price movement over time, volatility are the continuous oscillation of prices from the mean, however the spikes are shocks on the price movements which could be higher or lower than the mean and they might cause economical and financial crisis.

Volatility can be predictable and unpredictable. Unpredictable volatility is normally defined by the term of shocks. This phenomenon has always been a characteristic of the agricultural markets due to the inelasticity of the demand and to the presence of supply variability. Markets are unable to face the variability of production (weather, cultivated area, yield variations etc.) and consumption (changes of incomes, prices and tastes): demand is inelastic and supply is variable (Gilbert and Morgan, 2010; Foresight, 2011). Moreover demand and supply are not able to respond in the short term, as an example farmers are not able to harvest what they have not produced, and concerning consumers, especially in poor countries, they won't change their diets or they have not lots of alternatives (Gilbert, C.L. and Morgan, C.W. 2010). In addition shocks in policy and income transition and change are important factors in the price variability.

Volatility presents different movements, more precisely: high and low frequency. High frequency volatility refers to shocks that last for a season or less (weather, disease, short term spikes etc..) and low frequency is a variability which could last longer than a season (Von Braun and Tadesse, 2012).

It is important to make another distinction regarding two dimensions of price volatility: the effects on producers and consumers. In theory when prices are high, producers are encouraged to invest in agriculture and to benefit from high prices. Farmers are mostly poor, and high prices could help to enforce their food security, however who has a higher surplus to sell his products will benefit from this situation and the poorest farmers will not receive the portion of the benefits. On the other hand, consumers, especially the households in the developing countries, which spend most of their income in food, will suffer from higher food prices, affecting negatively their nutrition, food security and welfare (FAO, 2011; Von Braun and Tadesse, 2012).

In 2007-2008 food prices rapidly increased, reaching their peaks in the second part of 2008, when they where three times higher than the ones in 2000s. From this price spike they started decreasing considerably due to the financial crisis, the recession and the lowering of the food demand. Taking a look to the historical volatility of prices we can assume that this is a cyclical phenomena; an example is the agriculture price spikes of the 1970s which many authors have estimated (in real terms) to have been higher than those in 2007-2008. In addition spikes in the 1980s and 1990s in Africa poor areas have provoked famine crisis. Consequently, the prices started to increase again in the 2010 (Von Braun and Tadesse, 2012).

Price volatility is different from the one of the previous years, the price transmission is more rapid and the price crisis involves all the market and the commodities (Von Braun and Tadesse, 2012) (Fig. n. 8).

Figure n. 8 - Evolution of food prices into the years, in nominal and real terms

Source: FAOSTAT

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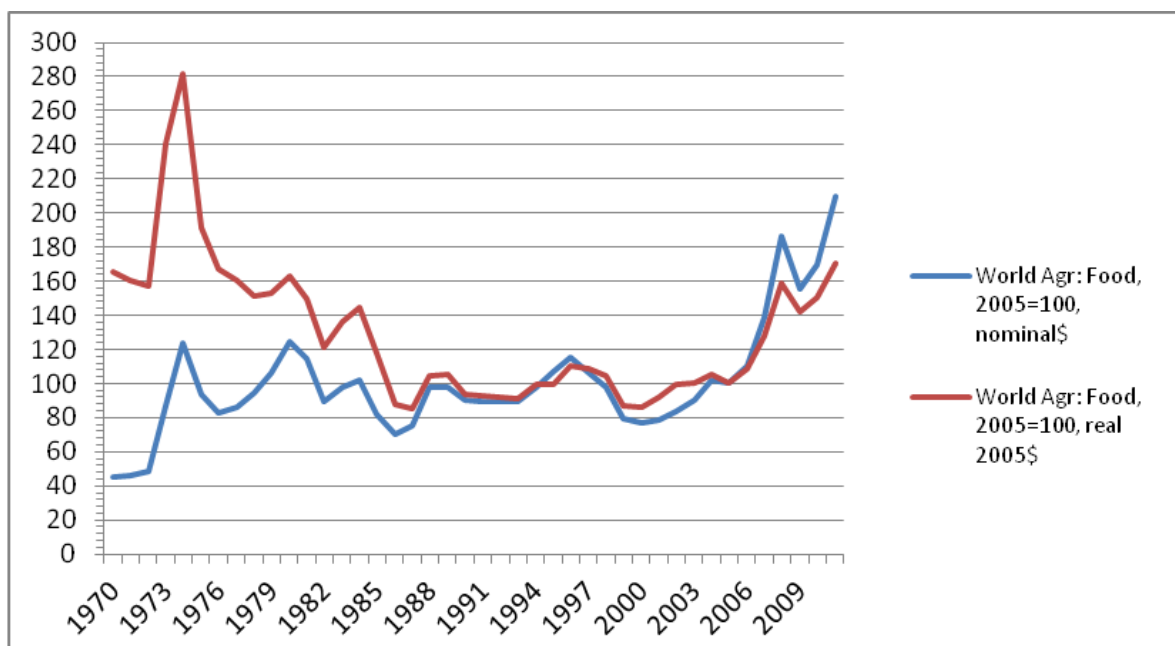
Many complex and different causes and factors are involved in the prices spikes and it is hard to control, prevent and estimate price volatility.

On the demand side the main factors that should be taken into consideration are: natural events such as draughts and floods, the decrease of stock level, demographic pressure, raw material use, financial speculation.

To analyze the factors involved in the rise of food prices we have to consider the adverse weather conditions that affected harvests in 2005 and 2006 generally in the main production areas such as Australia, France and Ukraine. The cereal and oil seeds stock reduction, and the increase in oil prices starting from 2002, led to higher production inputs and transport costs. Worldwide food stocks have decreased strongly in the last decades, due to the low level of productivity and increase of food demand. Strategic stocks are considered essential to limit price volatility in the global markets; although cost is still a mitigating factor (Banse, 2008). IFPRI recommends the creation of an emergency reserve of 300,000 tons of grain, located at strategic points in the developing world, which would be overseen by the United Nations World Food Program. However, currently emergency grain reserves are controlled nationally and there is still a lack of international coordination (Von IFPRI, 2008).

Other important causal factors can be found in the financial speculation and in the depreciation of the US dollar against many currencies, which has had a substantial impact, as it is the currency used in the majority of worldwide commercial trades. Thus, a weakening US dollar has led to a decline in the real purchasing power of raw material-exporting countries. Subsequently, exporters have raised prices to sustain purchasing power (Braun and Tadesse, 2012; Foresight, 2011; USDA, 2011).

On the supply side are involved some long-term underlying factors such as underinvestment in research and technology and in rural infrastructure, irrigation, as well as a growing pressure and scarcity of natural resources such as water and land (Rosegrant, 2008). Investments in agricultural R&D are necessary to keep long-term food prices at reasonable levels. But to avoid future price bubbles, action needs to be taken to improve market efficiency and food trade in crisis situations.

For example when food prices soared during the world food crisis in the 1970s, many Asian governments chose to invest substantial resources in irrigation and agricultural research, setting the stage for rapid growth in productivity that allowed millions of people to escape from poverty and hunger. Jacques Diouf, FAO Director-General said that a similar response is urgently needed today – particularly in sub-Saharan Africa.

A recent study (2008) by IFPRI shows that if investments in public agricultural research, which have stagnated since the mid-1990s , will double from US$5 billion to US$10 billion from 2008 to 2013, agricultural output could increase by 1.1% a year and about 282 millions of people would emerge from poverty by 2020. Probably if those investments were made previously and

agricultural productivity was increased, we would not have to face an increase of undernourished people from some 848 million in 2003 to 923 million in 2007, (FAO, 2008).

Fanfani (2008) highlighted key aspects that usually are not taken into consideration in the debate. He underlined the importance of the geographical difference between the global trade of commodities and the influence of agricultural production over the amount of goods commercialized worldwide. The majority of production does not enter into the international commercialization system, but instead is consumed in the producer country, so many of price soaring impacts are manifested inside national borders. For example only the 10% of world wheat production is commercialized internationally. Maize reaches about 10%, rice 6%, soy and sugar 30%.

So it is the analysis of the structural characteristics and changes in the agro-food systems of single country that allow a deeper understanding of the causes of rising prices and their effects. And in the measure where foods include more services and fewer raw materials, countries become sensitive to higher prices of services (ex. transports).

The European Union, followed by the US, has always been the first import area and it became, in the first years of the second millennium, also the main exporter. The dichotomy between importer and exporter countries is changing significantly; for example is important to note that developing countries had a positive balance on agricultural trade originally, but since the '70's that balance tents more and more towards negative values.

Following studies by Wageningen University & Research Centre, neither speculation had more than marginal effects on world food prices, so the main events affecting food price have been: the increasing demand in Asia as a result of income rising and changes in diet; bad policies and market performance; poor harvest and stocks reduction; high energy prices; some nation's policies applied in order to protect their own food supply; production limitation for food goods (Banse, M. et al. 2008).

Many authors and studies (FAO 2011; Foresight 2011; Minot 2011) suggest that food price volatility affects directly the food security of consumers and producers.

However it is difficult to calculate the impact of international food price volatility in the countries' domestic market, indeed neither consumers nor producers interact directly with world food prices. International food prices increase cyclically, but food consumption and production are affected by domestic prices.

Therefore, the impact of high food price on poverty and food security is determined by the transmission of world movements in the domestic markets.

Price transmission is affected by various factors: transport, countries level of self-sufficiency, exchange rate and domestic shocks (FAO, 2011).

Trade policies are the main factors of world food price transmission in the domestic market. Many countries, affected by the food crisis of 2006-2008, have implemented trade policy to cope with the crisis. The level of price transmission is normally determined by the degree of governments' controls on trade: on exports, controlling and limiting the high world prices in the domestic market and on imports, limiting the pass-through of very low world prices which could affect negatively the domestic market. However, not all governments have the capabilities and the stability to cope with the world food crisis, as an example, in many African countries, as Malawi, the absence of an efficient trade policy had negative impact on their domestic prices and food security (FAO,2011).

Agriculture is one of the mostly high restricted sectors in trade. However trade and stocks can optimally be used to reduce both the incidence and the impact of crisis.

2.3 Food supply side

Food supply increase has slowed down while pressure on key resources (land, water, energy) is intensifying, and climate change is becoming a more and more a threaten, rising environmental concerns. Agriculture has to implement a significant transformation in order to meet the related challenges of achieving food security and responding to pressure on resources and climate change. Projections based on population growth and food consumption patterns indicate that agricultural production will need to increase by at least 70 percent to meet demands by 2050. Most estimates also indicate that climate change and pressure on natural resources is likely to reduce agricultural productivity, production stability and incomes in some areas already have high levels of food insecurity.

Next paragraphs represent an overview on the major variables affecting food supply.

2.3.1 Technology and innovation

The continuous population growth is pushing up food demand and food supply has to be sufficient to guarantee global food security.

Agriculture production is the one of the sectors most affected by environmental conditions. Technology to implement all the input(factors of productions) to increase productivity is an important tool. The quantity that farmers produce depends on the price they pay for the inputs and those they receive for the output (market values).

 The objective is to augment productivity. Two are the way to increase food supply: one concern the exploitation of land and its use, called extensification and the second implies the implementation of other inputs such as, labor, machinery, fertilizer and pesticides, fuel, and

water (intensification). Each of these responses to demand growth has been an important feature of agricultural progress during the last century (Southgate at al. 2011).

Exstensification is used in many countries , even if increasing land productivity could be a costly option. To prepare a new field, a farmer must remove trees and other vegetation, improve drainage, and carry out related tasks. Whether or not this preparatory work is warranted depends on the returns coming his or her way. Especially if the additional output won from newly cleared land is modest, as would be the case where an agricultural frontier traverses low-quality land, extensification is rewarding for farmers only if food is becoming more scarce, as reflected in rising prices. But even with rising scarcity, expanding agricultural land use may be undesirable because of the adverse environmental impacts of habitat loss.

Due to its high cost exstensification stopped to be the main tool to augment food supply. The scientific improvements has been the protagonist of the development of **intensification** in different part of the developing countries and since the Green Revolution. Green Revolution has been one of the program to implement agriculture development and economic competitiveness in the developing countries.

Green Revolution has enhanced the use of new rice and wheat varieties (semi-dwarf) which are more exposed to sunlight and have facilitated the growth and production of cereals (new varieties were more productive). However these varieties were using more water resources and more fertilizers. In addition cost for fertilizer and new seeds were considerably high due to the fact that costs had to be paid months in advance compare to when the crops would have been harvested (higher demand for credit). Green Revolution have brought benefits to farmers who in many countries as in Asia have started to use the improved varieties, Since middle 1960s the area planted with semi-dwarf wheat varieties have been growing from a 30% up to about 70% in 1970. In addition Green Revolution also improved the situation of the landless people augmenting their productivity because it lowered food prices and increased labour demand.(Southgate, et al. 2011)

Beside the benefits that farmers have experienced, in the increasing of land productivity faced during Green Revolution and with the improvements of food supply, the growing food demand and the key resources competition is increasing and they can bring to environmental consequences and health problems, such as in area which are labour-scarce, additional mechanization will heighten agriculture's vulnerability to spikes in energy prices. Where land is the limiting factor of production, higher fertilizer prices will interfere with the application of conventional measures for raising yields, the mismanagement of irrigation systems often results in polluted aquifers and surface waters.

The strategy to these negative consequences is not by stopping agricultural intensification. Technological improvement, has to be encouraged, as Green Revolution had also positive outputs, new researches and spending in research and development should increase in order to

augment land productivity in a world with continuous population growth and food demand (Southgate et al.2011).

2.3.2   Competition for key resources and Environmental issues

Several critical resources (Land, Water and Energy) on which food production relies will come under increasing pressure in the future. Conversely, growth in the food demand and in food supply will itself exacerbate these pressures.

Land for food production.

Land per habitant is diminishing due to lack of not enough land conversed to food production. The demand to land for food production is increasing. As an example as exposed in the Foresight report crop yields grew by 115% between 1967 and 2007, and land have been extended by only 8%. Overall, the global agricultural area in use per person to produce food for a growing global population has declined (from 1.30 to 0.72 ha per person in the period 1967–2007) (Foresight,2011). However, there are marked regional contrasts: increased production in Asia since 1960 has been achieved almost exclusively without an increase in the area farmed, whereas in Africa cereal yields have remained static but more land has been brought into agriculture. Globally, expansion of agricultural land has been mostly at the expense of forests, savannah and natural grasslands (Foresight 2011).

As mentioned above, pressure on resources have increased and people express fears in the growing risks to food security due to the growing population. However the risk to food insecurity is not linked to the world capacity to produce food for two main reasons:

1) Enough food is produced worldwide to feed all the people in the world, However, nearly 1 billion people are suffering from chronic hunger today and one of the most significant is poor food distribution, 2) production constraints are and will continue to be important determinants of food security.

In the future ensuring food security for the growing population will become difficult due to few unused land and water resources and more limited yield growth potential compared to the past (FAO,2012b).

The following figure n.9 shows a decline in the amount of arable land in high and low income countries. Arable land per person has declined of about 50% from 1970 until present.

Figure n. 9- High and Low Income Arable Land (1970= 100)
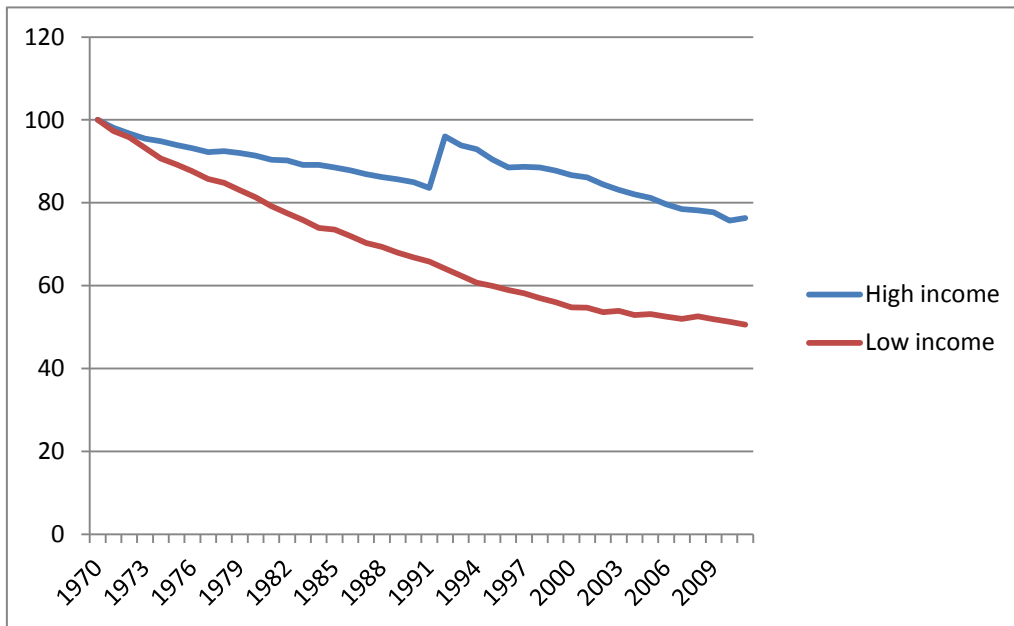
Source: World Bank database

Global energy demand

Petrol is a scarce energy source, so many oil-importing countries, following the oil crisis of the 1970s, started focusing their policies on renewable energy to address the main issues of the oil price unpredictability, the uncertainty of supplies and environmental problems linked to GHG emissions.

At that time, 90% of the energy consumption in the industrialized countries was based on petrol. Oil price increases had a deep impact on economic development.

Energy demand is projected to increase by 45% between 2006 and 2030 and could double between now and 2050 (Southgate etal.,2011). Energy prices are projected to rise and become more volatile, though precise projections are very difficult to make. Several parts of the food production is influenced by higher energy costs, as for example the production of nitrogen fertilisers are energy-intensive.

Energy costs matter even where rural population densities are higher and, as a consequence, agricultural development has involved little mechanization and instead has happened primarily thanks to gains in land productivity. Recent events in energy markets have had another effect on the food

economy, namely, the conversion of agricultural commodities into biofuels. Manufacturing ethanol in Brazil involves relatively modest tradeoffs, since much of the sugarcane used by the industry can be grown on grazing land with low stocking rates but in other parts of the world, biofuel development affect directly food supplies.(Southgate et al. 2011)

Global water demand

Agriculture is consuming about the 70% of the total global 'blue water' from rivers and aquifers available to humankind. Demand for water for agriculture could rise by over 30% between 2000 – 2030 and could double by 2050, depending on which future scenario is adopted, but will be affected by pressures from industry, domestic use, and the need to maintain environmental flows. Water resources are distributed differently in the world and there are some arid areas such as, Australia, Libya , Egypt and Punjab where their non renewable fossil aquifer have been stressed and have not the possibility to be replenished (FAO,2012b).

The augmentation of agriculture production in developing countries have stressed the water resources and enhanced an over extraction. In addition the absence of a proper system of irrigation is threatening the quality of water with consequences on land quality (ex. augmentation of salinity)and human health. In some developed countries too, lack of water regularly limits crop production (Australia).

Estimates suggest that exported foods account for around 16–26% of the total water used for food production worldwide, suggesting significant potential for more efficient global use of water via trade, if exporters are able to achieve higher water productivity than importers. In most cases, the major exporters (USA, Canada and the European Union) have highly productive rain-fed agriculture, while most importers rely on irrigation or low output rain-fed systems. Traded virtual water may also be helpful in raising farm incomes and in increasing the potential for exports. However, potential disadvantages to virtual water trade include a higher risk of environmental impact in exporting regions, and possible impacts on the food security of poor people in exporting countries where water is not managed to meet both local and export needs (Foresight,2011).

As shown in Figure n.10 most of the world irrigated agriculture is in developing countries, as we can see in Asia, North Africa and Latin America. Nearly one half of the irrigated area of the developing countries is in India and China. One third of the projected increase will likely be in these two countries (FAO,2012). There have been improvement also in the irrigated land in North Africa and it is estimated by FAO that four countries (Libya, Saudi Arabia, Yemen and Egypt) use volumes of water for irrigation larger than their annual renewable resources (FAO,2012b).
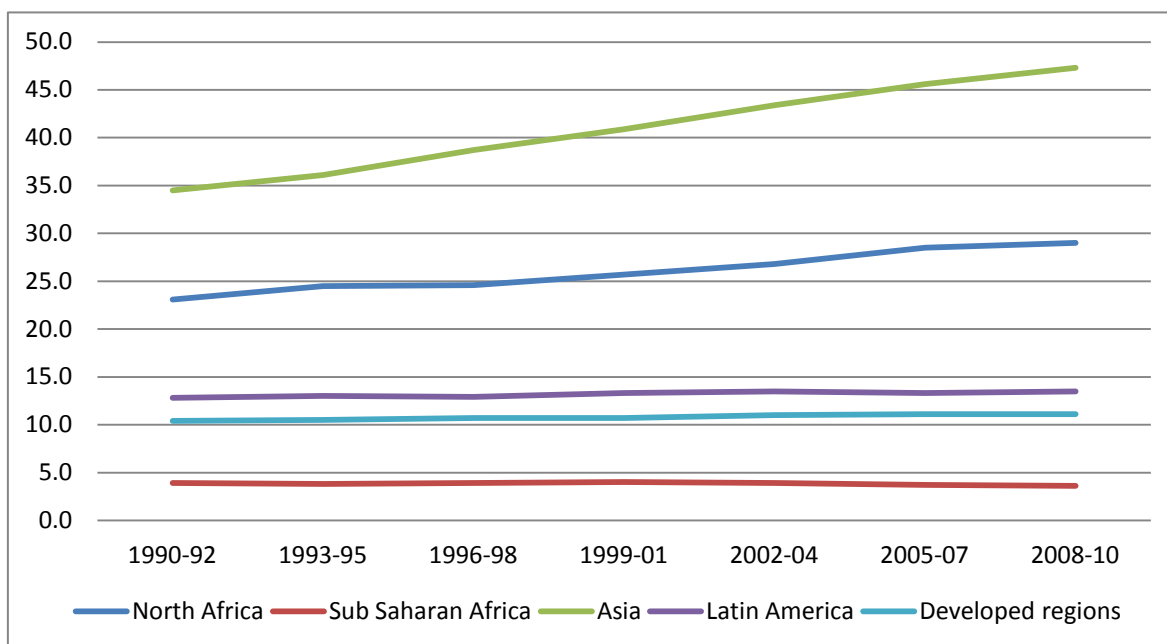
Source: World Bank database

An efficient use of water resources for irrigation is needed to avoid pressure on natural resources and maintain or increase agriculture production.

Environmental Issues: Climate Change and Biodiversity

Food demand is growing and has to be reached beside a situation of rising global temperatures, and changing patterns of precipitation. The changes in climate conditions will affect food production, the availability of water, fisheries and aquaculture yields, and the functioning of ecosystem worldwide. Extreme weather events will very likely become both more severe and more frequent, thereby increasing volatility in production and prices. Fisheries habitats will be affected by changes in hydrology, sea level and oceanic processes.

Agriculture is a major contributor to climate change, responsible for around 10–12% of greenhouse gas emissions. Emissions also occur beyond the farm gate, and indirectly through the effect of deforestation to increase the land available for agriculture. (Foresight, 2011)

In addition further conversion of rainforest to agricultural land should specifically be avoided as it will increase greenhouse gas emissions and accelerate the loss of biodiversity. Land will also be lost to urbanisation (recent rates have been 16 million ha per annum, often in highly productive areas). Agricultural land is also lost to erosion, desertification, salinisation and sea level rise.

 Moreover with the growing population, there will be more pressure for land to provide ecosystem and other services.

However forms of biofuels can play an important role in the mitigation of climate change, they may lead to a reduction in land available for agriculture. In addition, some biofuel production systems have: poor overall carbon efficiency; negative environmental consequences, particularly increased demand for tropical plant oils leading to deforestation; land competition and food security issues.

Policies for climate change mitigation will also have a very significant effect to achieve food security. Mitigation policies could have profound effects on where food is produced, the use of fertilisers, whether

land is brought into agriculture, and how land is managed.

2.4 International trade

The globalisation of markets has been one of the factors which is affecting food security in the world and it has been improved but the falling of the trade barriers and technological innovation reducing transaction costs and improving trade in high geographical distances. This trends are likely to increase the globalisation phenomena. Globalisation and the free trade market have brought the consumers to will cheap, safe and varied products and also developed and high dependency on poor countries.

The relative price of a country's exports compared to its imports can be improved through export restrictions. This goal can be achieved under a condition. The country which implements the measure has to possess an important powerful market exercising an influence on world prices. Supplying a significant share of the world market in a commodity, the country by restricting its exports provokes a stricture of the world supply and pushes up the world commodity price. It increases the relative price of exports compared to imports. Importers pay higher prices for the same goods while the exporting country benefit from a higher income. Terms-of-trade turn in favor of the latter. In other words, for each unit exported of commodity, the exporting country will be able to import and consequently its welfare increase. In practice, just few countries have enough market power on specific commodities.

The rest have generally a small fraction of world exports in a commodity. To achieve this goal a degree of collusion among these countries in the long-term is required. This mechanism is not evident or easy to set up. However, the effect on terms-of-trade can be cancelled whether importing-country reply by increasing their import tariffs. But it is not common, on the contrary, the most common policy responses have been to reduce or suspend import tariffs on staple food (Kim, 2010). Importing countries have to meet their domestic demand for food products.

As it is shown in Figure 11 despite the spikes of prices in 2008 the amount of imports of cereals remained constant and continued to increase over the years.

Figure n. 11- Import quantity (millions tonnes) and Cereal Price Index (1990-2011)
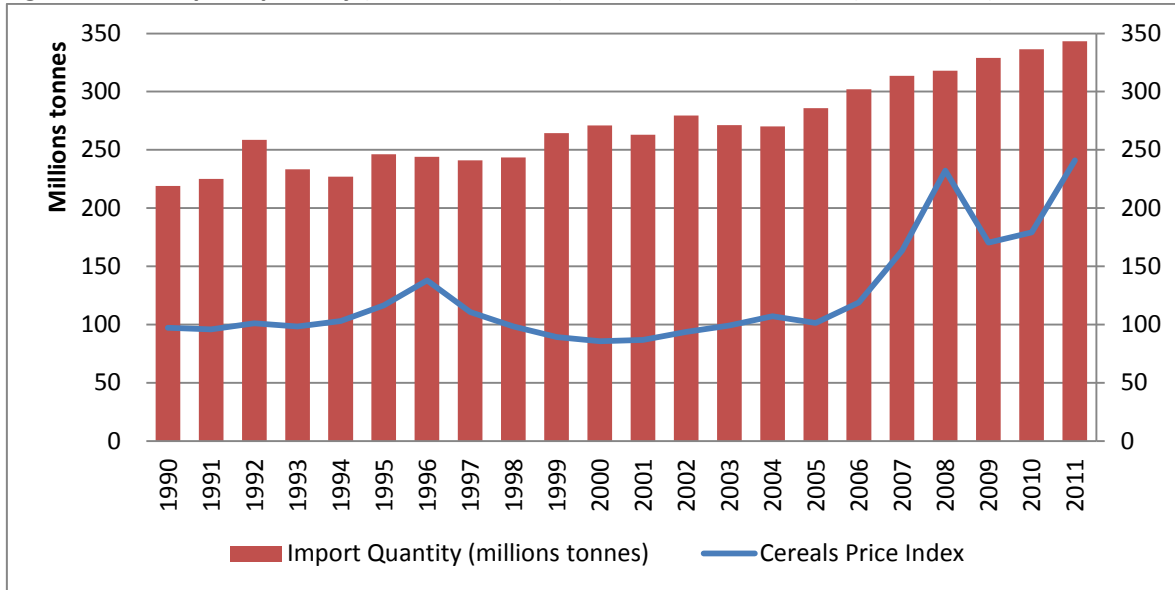
Source: FAOSTAT

High food prices have affected in particular all the countries which are dependent on food imports. Cereals are the basic food supply for excellence and most of the African countries especially North African are highly dependents on cereals imports. Shocks in the international market and on food prices will have consequences in the food security of these countries.

Figure n.12 show the most dependents countries on cereals imports.

Figure n. 12- Cereals Imports Ratio 2009 (%)

Low Cereals Importers < 30%
Medium Cereals Importers (30%-60%)
High Cereals Importers >60%
No Data
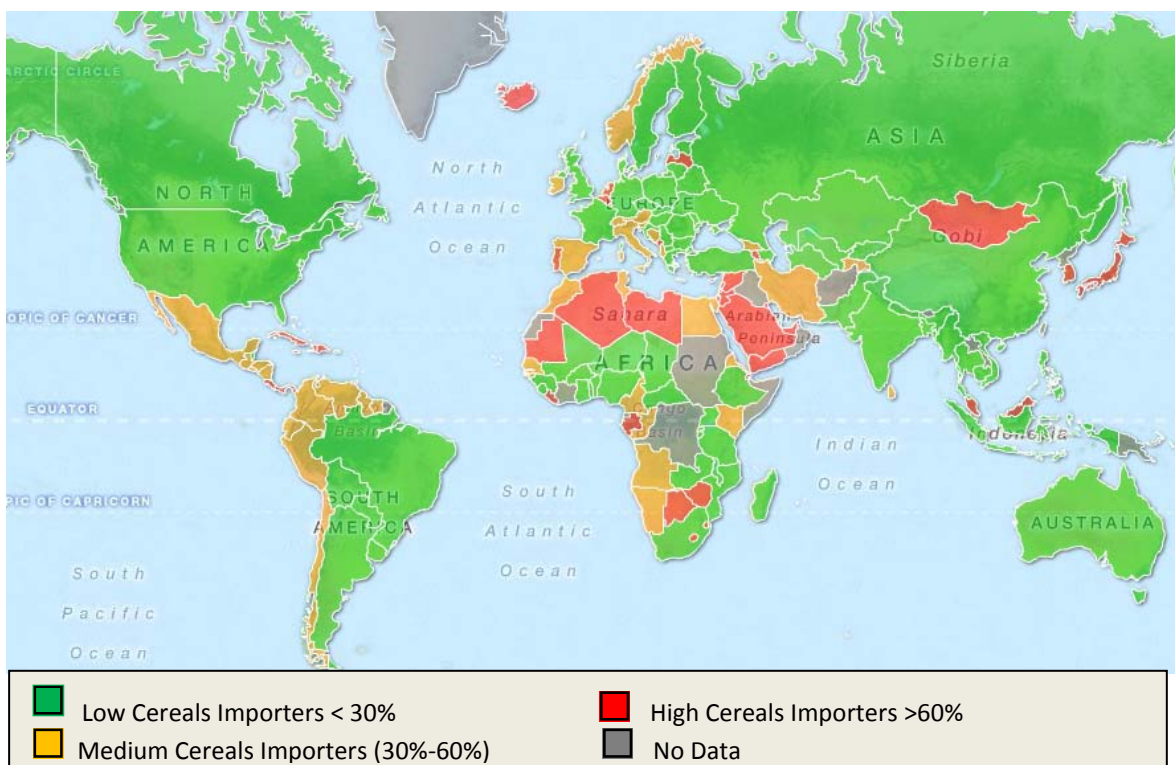
New food producers have emerged. In 2008, Brazil became the third largest world exporter of agricultural products after the United States and the European Union. In addition China and India improved their investments in agriculture production. Russia is already significant in global export markets, and it will increase its power due to the presence of a large underutilised agricultural land.

Production subsidies, trade restrictions and other market interventions already have a major effect on the global food security, and how they develop in the future will be crucial.

In recent decades there has been a decline in the level of some of the most distorting subsidies and a reduction in import tariffs, although substantial market distortions still exist.

Important issues include: the degree to which international trade agreements constrain subsidies of the food production sector in high-income countries and/or limit their application to environmental and rural development issues; the extent to which low-income countries receive 'special and differential treatment' in such agreements to protect vulnerable sectors and allow for agriculture-led economic growth; and the role that a growing range of public and private standards (for example, food safety, phytosanitary or veterinary health restrictions, and wider private standards promoting social and environmental sustainability) may act to facilitate or block the entry of poorer producers in global markets.

The extent to which governments act collectively or individually to face future challenges, particularly in shared resources, trade and volatility in agricultural markets and the political sensitivity of food put great pressures on governments to act in the national interest. But putting this first can have negative impacts on the wider system as seen in 2007–08, when pressures which resulted from food price spikes were amplified by temporary trade restrictions. (Foresight,2011).

3. Focus on Mediterranean countries

The main challenge for the food and agriculture sector, as mentioned previously, is to guarantee enough food, in quality and in quantity to conduct and healthy and active life (FAO,1996).

The Mediterranean region is composed of countries with very different economic profiles: the Member States of the European Union (EU) are very different from the countries in the southern and eastern Mediterranean (SEMCs), where realities are very mixed. In this region, economic disparities are still much more marked than any signs of convergence (CIHEAM, 2008). In this section as Mediterranean countries we will consider the Northern Mediterranean countries (NMCs) or The European Mediterranean Countries (northern Shore): Albania, France, Italy, Greece, Portugal, Spain, and The Southern Mediterranean Countries (SMCs) (southern Shore): Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia and Turkey.

Other geographical distinctions might appear during this section as: North Africa countries (Algeria, Egypt, Morocco, Tunisia) or Arab Mediterranean countries (Algeria, Egypt, Jordan, Lebanon, Morocco, Syria, Tunisia). Libya was arbitrarily excluded due to the lack of numerous data.

The food and agricultural systems in the Mediterranean region are facing different and complex economic and social changes. On one hand there is the necessity to satisfy the growing food demand, and on the other hand to contribute to growth process sustainability and to increase the competence level in agricultural environmental performance. In addition, there are two relatively complex factors such as price volatility and the growing interest in agro-food products safety and nutritional aspects.

In this context a coordinated action of food policies to activate effective actions series become important

The Mediterranean basin presents many disparities. The Mediterranean area (neighboring countries), in 1999 represented the 8.4% (over 500 millions) of the world population. By 2025 up to 60% of the Mediterranean population will live in the developing countries (the poorest), generating and high South-North migration flow. North-South Mediterranean region beside the demographic imbalance show disparities on the Human Development Index (HDI). HDI includes three aspect of the human-being: average wealth (GDP per capita in PPP), life expectancy at birth, and level of education. HDI present a low rating of HDI compare to northern countries, even though there are improving to fulfill the gap.

Thus, illiteracy is close to 50% in Egypt and Morocco, 50% of the population has no direct access to drinking water in Turkey, more than 30% of homes are without sanitation in Lebanon, Syria and Morocco. The infant mortality rate is between 20 to 50 per 1000 in the Maghreb and the Middle

East against less than 8 per 1000 in the northern Mediterranean countries. The gap in life expectancy at birth is 12 years between Italy and Tunisia (IFPRI, 2004).

The disparities are also explained through the level of GDP in the North Mediterranean countries (NMCs) (five times higher in 2004) and labour productivity. The five European countries of the Mediterranean now provide 85% of GDP and 73% of agricultural GDP in the region, 81% of total trade, 93% of agricultural exports and 74% of agricultural imports. In addition, the agricultural trade balance is + 1.8% for the North-Mediterranean and present very large deficit (- 64%) in the south (IFPRI, 2004).

Southern Mediterranean Countries (SMCs) have entered into a process of economic and policy transition, and they have implemented policies and stabilization plans to control macroeconomic issues, reduce their disparities and improve their growth.

Contemporary with the latest price spike of 2010, started the Arab awakening which have seen involved also some of the SMC and first of all Tunisia. The reasons of these uprisings are imputable to lack of democracy, freedom and justice, and, in addition, the deterioration of food security as a result of the international high food prices.

Food security become a serious challenge, for various reasons: high food prices, dependency of these countries to food imports, the rising food demand due to population growth and problems to access water resources (IFPRI, 2012b).

In order to assure food security the implementation of strategies and policies is important. They have to focus on: improving data access, improving economic growth (more a country is economical vulnerable the more will be exposed to shocks), better distribution for the expenses in the public sector. The SMC adopt different strategies to protect their countries, but this doesn't mean their efficiency. Therefore the SMC present a double inefficiency: 1) the states' inefficiency which have trouble to stabilise the systems and 2) the markets inefficiency which present high instability and volatility (worsened by speculative behaviour in the public and private sectors) (Lerin et al. 2009).

In this perspective it is important to notice that North and South Mediterranean Countries (SNMCs) present many common features but also significant disparities either in food demand (food consumption patterns, food safety and nutritional conditions), food supply (agricultural production conditions, climate, integration into international markets,) and governments' policies.

In this section we will overview the Mediterranean countries food security through the most important drivers (population, GDP, trade, economic development). The analysis will compared some of the Mediterranean countries taking into consideration the North African Countries (Libya

is excluded for data missing) and some of the most populous northern and southern Mediterranean countries.

3.1 Demographic and Economic trends

3.1.1 Demographic dynamics

Population and its incessant growth push on the food demand and vulnerability to food insecurity risk. Concerning the demographic dimension, Mediterranean Countries are the example of the global trends of population growth. As a result, on the one hand the SMCs are experiencing a continuous growth and on the other hand, in the NMCs the growth rate is contracting. Figure n.13, shows the trend of the Mediterranean countries population which have been increasing over the years. Egypt and Turkey population have registered an higher growth rate from the 90s compare to the others MCs.

Figure n. 13 - NMCs and SMCs Demographic trend in Millions (1970- 2012)
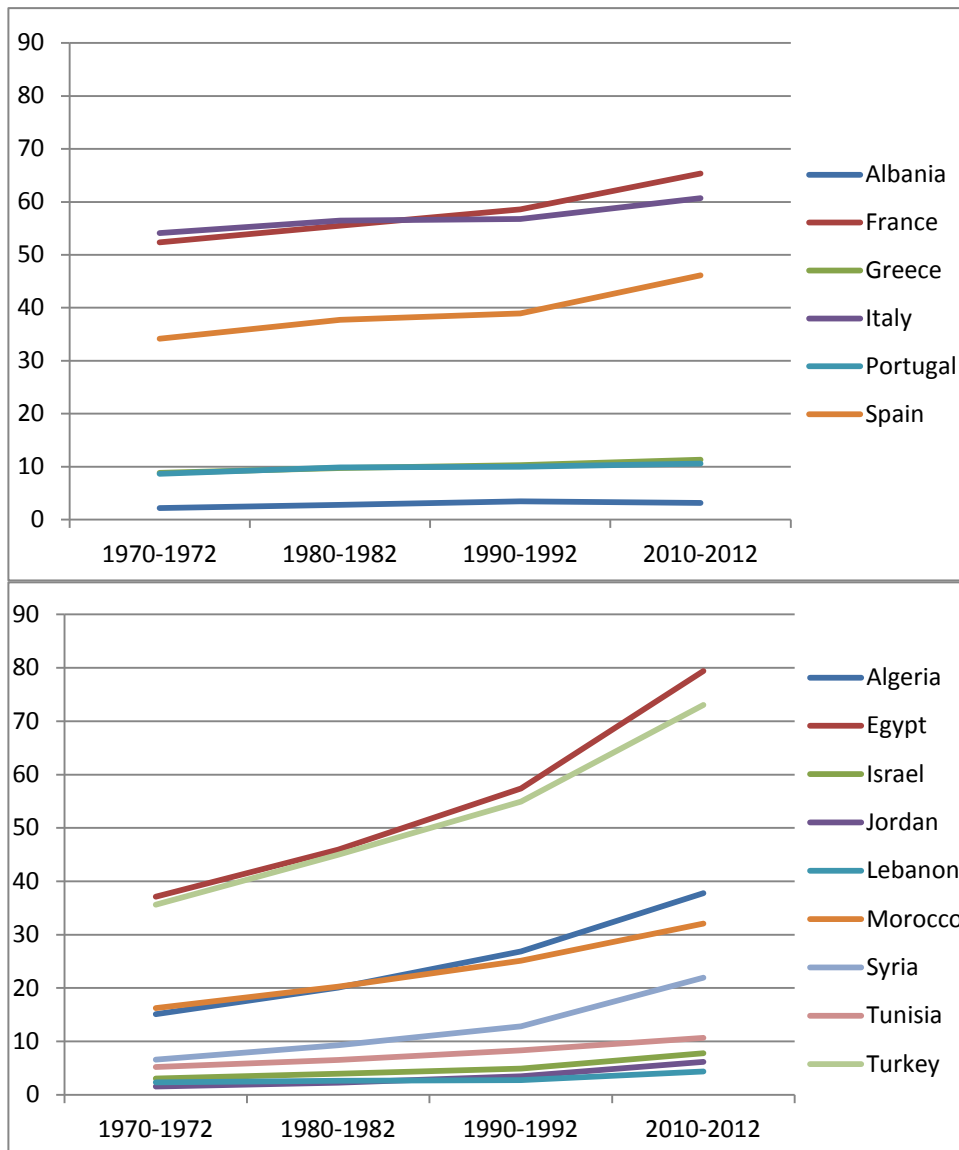
Source: WorldBank database

In NMCs the population rate growth is diminishing as all the developped country. SMCs are imporving ttheir economic development and they present a rate growth higher than the northern countries even if in the year is diminishing. Table n.3 show the evolution of the population growth rate since 1970. NMCs very low level of growth rate, Greece and Portugal have experience a negative growth rate, respectively -0.01% and -0.33% in 2010-12. However SMCs have higher population growth rate than NMCs, even only for Jordan (2.20) and Syria (2.10) the level was above 2% in 2010.12. The population patterns in SMCs are getting similar to NMCs.

Table n. 3- Population growth rate (%) (1970-2012)

	Population Growth rate (%)			
Northen Mediterranean	**1970-72**	**1980-82**	**1990-92**	**2010-12**
Albania	2.57	2.33	0.41	0.12
France	0.80	0.50	0.42	0.51
Greece	0.44	0.83	0.91	-0.01
Italy	0.52	0.13	0.07	0.40
Portugal	-0.49	0.85	-0.12	-0.33
Spain	1.04	0.66	0.24	0.22
Southern Mediterranean	**1970-72**	**1980-82**	**1990-92**	**2010-12**
Algeria	2.74	3.17	2.46	1.87
Egypt	2.21	2.23	1.86	1.67
Israel	3.00	2.09	4.19	1.83
Jordan	4.28	3.90	6.67	2.20
Lebanon	2.37	0.38	1.76	1.37
Morocco	2.19	2.37	1.82	1.30
Syria	3.40	3.51	2.90	2.10
Tunisia	1.70	2.65	2.15	1.06
Turkey	2.37	2.31	1.68	1.27

Source: WorldBank database.

The urbanization process is fastening in all developing countries, changing the food demand and affecting the diet composition, as for the low and middle-income countries which are facing problems related to food insecurity and high levels of obesity (Popkin, 1999).

As far as the Mediterranean area is concerned, urban population is rapidly increasing and the rurality is in decline (Fig. n.14). The population composition is diffenrent in the two shore. The NMCs have started before to register high level of urban development. In France, nowadays, about 86% of the population lives in cities. SMCs are becoming more urban (Fig. n.14), since the 90s , Algeria's urban population (52% in 1990) has reached the 73% in 2010-12. Egypt on the contrary presents still an high rural population (about 56%) which hasn't mutated over the last twenty years.

Figure n. 14- Urban Population (% of total) (1990-92;2010-12)
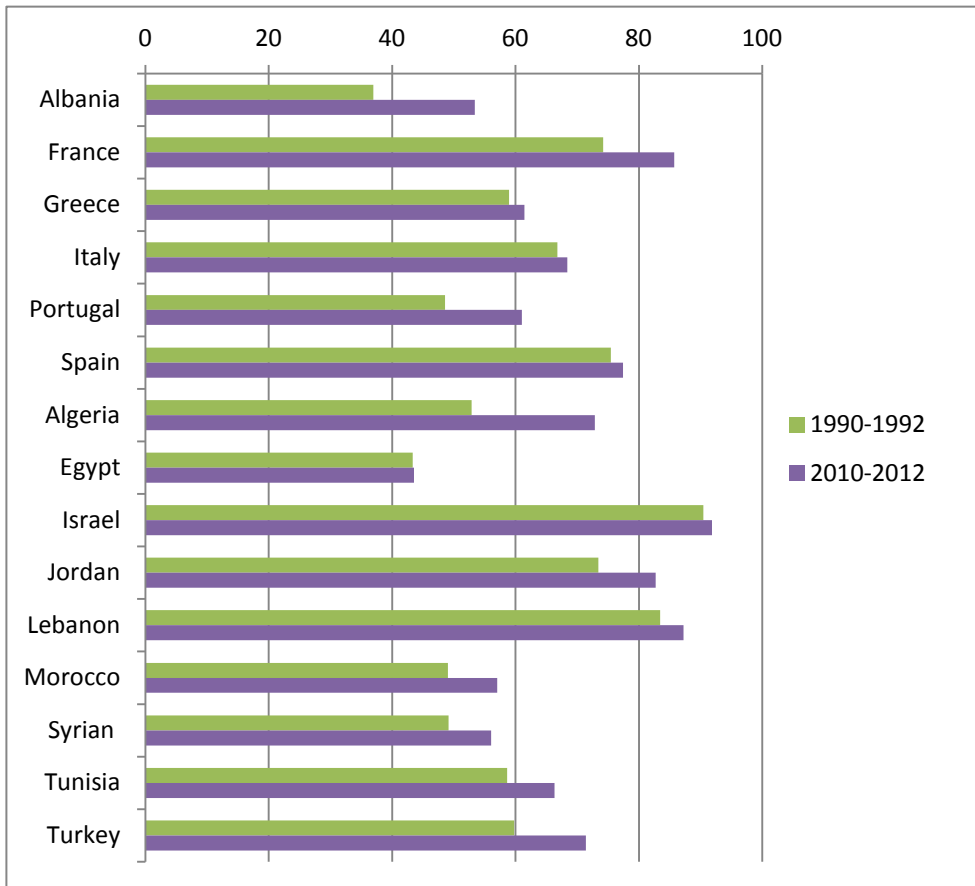
Source: World Bank database

However the demographic challenges in both Mediterranean areas will be different. On the one hand, the North society will face the diminishing of the fecundity, exsperiencing an increase of unemployement ,of ageing and non-working population in a jeopardized economic. On the other hand, in the South, population will continue to grow, as a consequence the number of cities, the urban and peri-urban population will increase (CIHEAM,2008).

This demographic trends could generate problems of food security. In urban areas people are food net buyers and the constraint to food security is the income level. In developing countries, in urban areas there are a lot of poor which have not access to enough cash to guarantee enough food.

3.1.2   Income and prices

Since the end of the 20th century the globalization process has increased and emerging powers became protagonists on the economic development scene. The Mediterranean countries were not active participant to this process. As mentioned before, this area present different economic background, NMCs are very different form SMCs and economic disparities are still an important issue in this area and affect the economic development of this area, in particular in the Southern

Mediterranean area. The GDP per capita have continued to grow since the 1990s. The two maps below show the GDP per capita, PPP in the Mediterranean region in 1990 and 2012. The division of income level is the one used by the world bank which divided the countries in High income (> 12,616$), Upper middle income (4,986$-12,615$),Lower middle income (1,036$-4,085$) and Low income (<1,035$).

 If we compare the two maps below (Fig.15), regarding the level of GDP per capita in the MCs we notice that despite the NMCs which are economically developed, some of the SMCs (Egypt, Morocco, Jordan, Syria) have improved their income per capita and passed from a state of lower middle income countries to upper middle income countries, Turkey was upgraded to high income level, even in 2009 its GDP was 11754$ and was part of the upper middle income countries.

Figure n. 15 GDP per capita, PPP (constant 2005 international \$) (1990;2012)
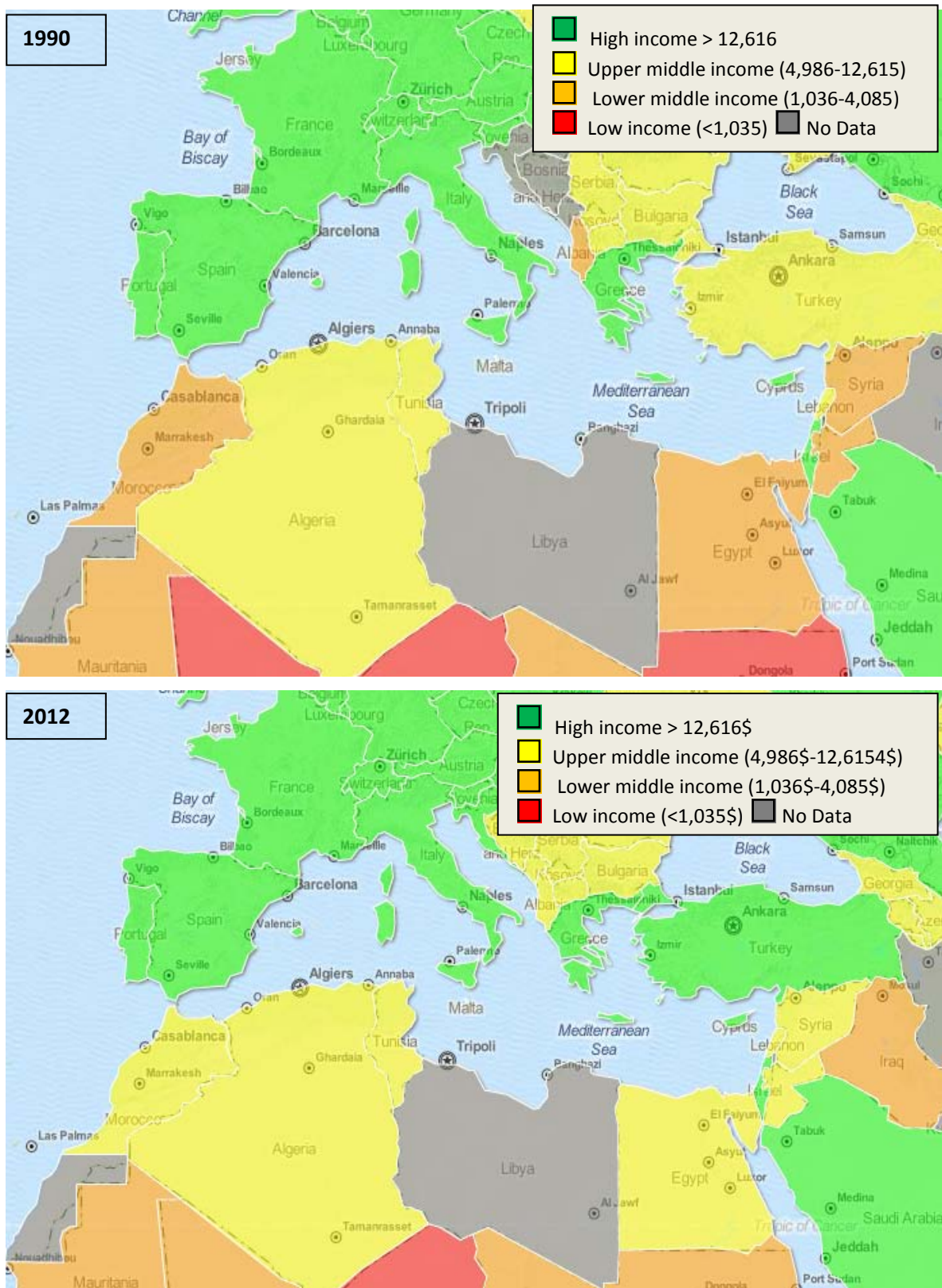
Source:World Bank database

The income level does express many features of the development of a country. Moreover, as the demographic trend is in evolution, the urban population is increased, there is another factor

affecting food security: the income. Beside the prices soared to sky-high, households might still posses enough financial resources to buy food and preserve their food security.

 The magnitude of a food crisis could be measures by the amount of GDP spent in food for the households (as showed above) and the GDP pro capita. The GDP in NMCs is not even comparable to SMCs, It registers high level. However in SMCs GDP per capita has an increasing trend, even from this data we can notice and amelioration in the economic condition of the countries.

Moreover, in SMC, problems of food security and vulnerability to price spikes depens on the difference of income's distribution: the richeast 10% earn the 30% of the GDP and the poorest 10% only the 3% of GDP. These numbers show that a decline in purchaising power might increase vulnerability of the poorest population and affect their food security (USDA, 2011).

These data (Figure n. 15) don't give any information about the distribution of the income which is one of the most reason why there might be problems of food insecurity in the SMCs countries. An indicator which gives some indication on the equality of income distribution is the GINI Index.

Another important issues of the Economic development of ca countries is represented by the price level. Between 2006 and 2008 prices of various commodities started to increase considerably, in some case even 180%, as for cereals, and in 2009 the prices of dairy products fell up to 40 %. Consequently, after a period where price were getting lower, they started rising in 2010.

The following Figure (n.16) shows the international movements and spikes of food prices indices of different food commodities.

Figure n. 16- Annual real food price indices (2002-2004=100)
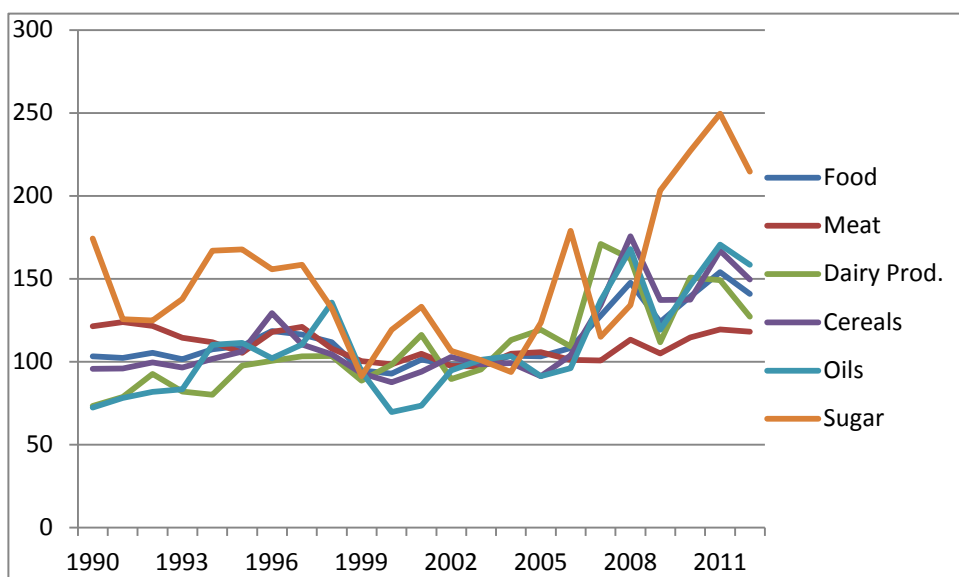
Source: FAOSTAT

Prices volatility could have effect on food security, especially to the poor households , constraining their access to enough cash to buy food.

Many studies on price transmission (Dawe, 2008; FAO 2011; Ianchovichina et E. Al. 2012; Lerin et al., 2009; Loening, J. L., 2011) have found that most of countries, during the international food prices increasing, have experiences high domestic prices. Authors are trying to study the degree of influence of high international food prices on domestic markets through empirical studies.

The aim of the empirical studies is to assess the degree of risks coming from international high food prices and volatility.

According to Ianchovichina et E. Al. in a working paper published (commissioned) by the Word Bank (2012) The Middle East and North Africa (MENA) countries, price transmission, differ from other developing countries for the high use of subsidies and governments' control. Indeed, governments use production subsidies, import protection and build up food reserves in order to regulate food consumption, trade and production.

High food prices had effect on all the Mediterranean countries. However, in SMC, high food prices are a major concern for these countries, which are high importers of cereals and in particular of wheat. Thus, the amount of imports is likely to increase for growth population and climate change (draughts and water scarcity).

In addition South Mediterranean countries are affected by malnutrition suggesting that households are vulnerable to price shocks. However households' food security is influenced by prices spikes in the presence of price transmission in the domestic market.

 Domestic prices can be affected not only by international prices movements but by a number of countries specific factors. Among these factors: food prices policies, such as price controls and subsides, trade and production policies, domestic supply chain issues, food stock management, infrastructures weather patterns and exchange rate etc . For these reason is hard to see in which extent international food prices could influence domestic prices. The level of pass-through to domestic price depends to different factors that can be identified only in specific analysis, country by country, regarding their own characteristics including exchange rate and food subsidies policies. All countries are affected by price shocks but with different magnitude and exposure (USDA, 2011).

The Middle east and North African countries present a different domestic transmission compare to the other developing countries. In most Arab countries the food inflation has remained positive also when international food inflation was negative, including SMC (Ianchovichina et E. Al.2012).

The majority of South Mediterranean countries will spend high percentage of GDP on food subsidies. subsidies take fiscal resources that could be used for investments and infrastructures, and generate problems of macroeconomic management.

Subsidies are used to protect countries from international prices shocks and fluctuations, however if international prices rise also subsidies have to be higher to keep domestic price at the same level. This could cause negative effects on countries dependent on imports and with limited fiscal space.

The empirical study on MENA countries – which includes also SMC- have experienced in increase in the food Consumer price index (CPI) (ex. Morocco 8%, Egypt 21%), subsidies remain at the same level or decreased except for Egypt which augmented subsidies level (Ianchovichina et E. Al.2012).

The CPI trend is increasing in all countries, however Egypt followed by Syria, Turkey and Tunisia register the highest level (Figure n.17).

Figure n. 17-Food Consumer price index (CPI) 1990-2010. (2000=100)
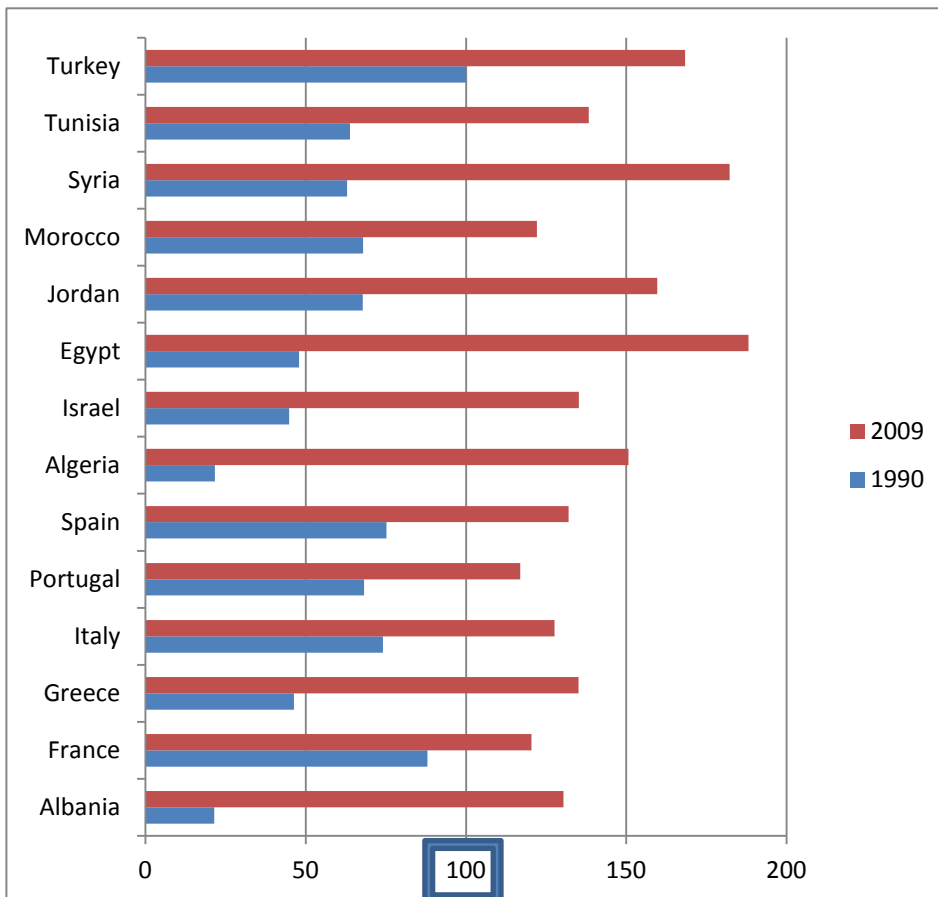
Source: International Labour Organization (ILO) database.

There is a high literature on empirical studies on the transmission of international food price shocks (Dawe, 2008; Lerin et al. 2009; Minot,2011) however concerning the SMCs it is difficult to obtain data.

With food prices spikes, concerns on meeting the nutritional needs have been raised. In SMC Governments implemented policies in order to preserve their countries from effects of the price

increases. However these policies are costly and discourage countries' investment in agriculture (USDA, 2011;FAO, 2011).

3.2 Food demand and supply Consumption

3.2.1 Dietary composition and Food Expenditure

Compare to the other developing countries South Mediterranean countries are the most food secure. The Mediterranean region covers average consumption of calories- FAO declared that the world has the capacity of producing enough food to provide every person with more than 2 700 calories per day a level which is normally sufficient to ensure that all have access to adequate food- due to their high GDP and governments' food safety programs (USDA, 2011).

Belghazi (2013) provides evidence of these features. In particular he highlights that total available food supply has grown considerably over the past 20 years, reaching more than sufficient food availability (2,900 to 3,300 calories per person per day) in Egypt. In Figure n. 18, the data show an increase of the Kcal average per person consumed per day in all of these countries since 1990. All MCs seems to have enough Kcal/capu/day to garantee food security. Compare to northen countries in SMCs Kcal per person have augmented considerably, although the kcal available have always been over the avarage proposed by the FAO.

Figure n. 18- Daily kcal per capita (Kcal/capita/day) (1990; 2009)
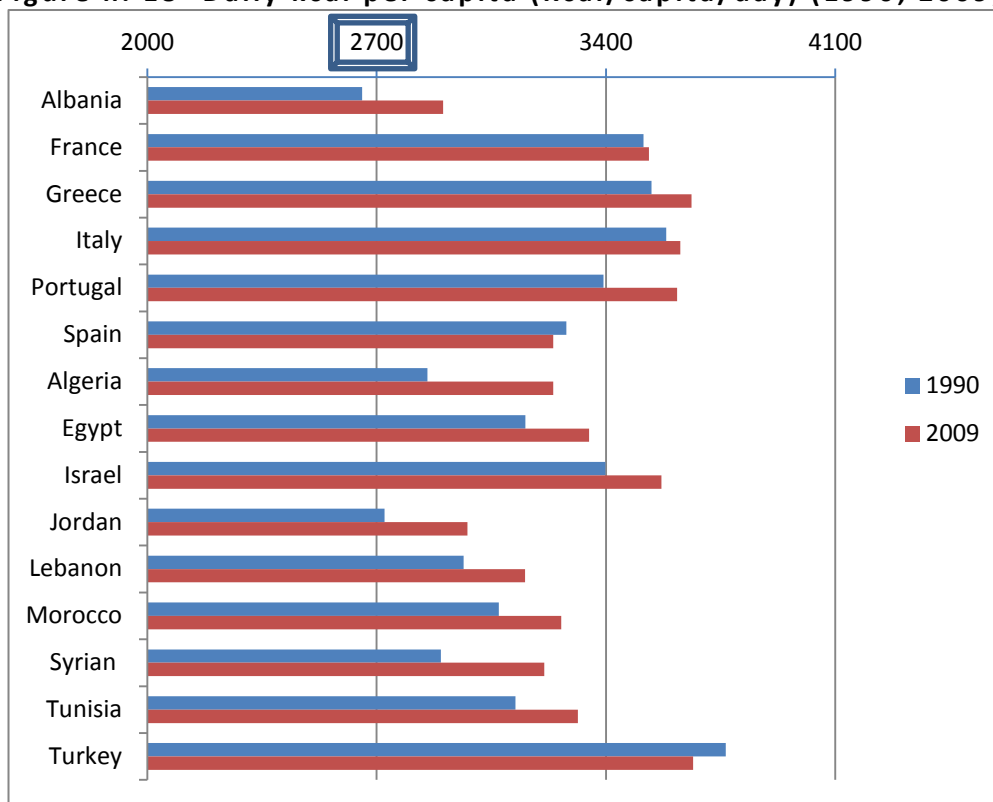
Source: FAOSTAT

The improvment in the food supply available could be the consequece of governement's food programs and agriculture investments. Indeed,Tunisia, Algeria and Morocco are promoting access to credit for farmers, subsidies for fertilizer and seed varieties. In addition, Tunisia is implementing programs for seed distribution and aid to farmers with poor harvest were improved by the governements.(USDA, 2011)

However, the diet is mainly vegetarian (10% or fewer calories are of animal origin in all countries), cereals being the basic ingredient. Aside from fruit and vegetables, almost all the agricultural products consumed in the SMCs went through agro-industrial processing, particularly dairy products (Belghazi, 2013). As shown in the Table n.4, cereals (3429 in 2009) are the first element of the diet composition in SMCs followed by sugar , vegetable and fruits. On the contrary, in NMCs cereals occupy as well the first place in the diet composition, but in a reduced amount (about 1002 kcal/capita/day in 2009). These countries have a more diversified diet and cosume higher quantity of meat, vegetable oils and milk.

Table n. 4 - Dietary Composition in Mediterranean Countries (Kcal/capita/day) (1990; 2009)

	North Med		South Med	
	1990	*2009*	*1990*	*2009*
Total Kcal/capita/day	3106	3304	3327	3429.
Cereals	1059	1002	1611	1580
Meat	333	359	120	165
Milk	288	338	139	173
Sugar %Sweeteners	277	282	331	330
Vegetable Oils	494	532	348	405
Vegetables+Fruits	236	259	226	249

Source: FAOSTAT

An other task concerning food security is the nutritional aspect. Beside the fact that these coutries dispose of an high level of kcal per capita per day, it has to be underlined that countries such as Algeria and Tunisia have increased the consumption of fat, respectively up to 56% and 25%. These level of intake and the increasing percentage of fat consumption suggest the possibility of these countries of facing diseases linked to the overconsumption (ex.obesity) (USDA,2011) The developed and least developed countries converging objective is promoting public goods through agricultural potential preservation. In addition agricultural policy has the ethical commitment to ensure the world population access to food trough the use of sustainable production processes and technologies and to improve quality and nutritional properties of food at a global level.

However SMCs remain exsposed to food insecurity risks. Different studies show that there aren't changes in food security in these countries but they are vulnerable to some factors which could alter the situation, such as: economical and political instability, increasing number of internally displaced people and of refugees form neighbors countries (ex.Libia), possible inefficiencies in production, commercial and economic activities, unpredictable weather and limited resources (infrastructures, water and arable land)(Ianchovichina et E. Al.2012).

Furthermore in order to see the In NMCs , consumer expenses are directed mostly to other goods and services. The amount of the food expenditure is around the 14% . During financial crisis, their food security won't be affected because they can always redirect their expenses to food products. On the contrary, SMCs still concentrate their expenses on food, as we can observe in Table n.5 Morocco, Egypt and Algeria dedicate more than the 40% of their expenses to food, they are definitely more vulnerable in a case of financial and food crisis. Turkey and Israel have accelerated the economic development process and they are reaching the average percentage of NMCs. Israel GDP per capita have the same level of SMCs which implies that cosumers expenditure are concentrated in other goods.

Table n. 5- Share of per capita Food Expenditure (%) (2012)

	Food Expenditure (%)
NMCs	
France	13.2
Greece	16.5
Italy	14.2
Portugal	16.5
Spain	14
SMCs	
Algeria	43.7
Egypt	42.7
Israel	15.9
Jordan	32.2
Morocco	40.5
Tunisia	35.5
Turkey	22.2

Source: ERS-USDA

Martine Padilla in MediTerra 2010 (Ciheam, 2010) affirms that Southern Mediterranean Countries Governments are applying interventions on Food policy by introducing measures to preserve food security and also nutrition, food safety and health. Morocco has adopted a programme to improve the living standards to the most needy which includes schemes involving work in the public interest (food in return for work) and direct food transfers. Algeria has opted for income

aid, adopting and launching the "social safety net" scheme in 1991. In Egypt the idea of social action plan has been put forward but has not yet been put into effect, however in 2006 governments launched a warning against bird flu in order to preserve food safety and recently In Tunisia a dietary and nutritional monitoring system has been in operation since 2006, with the collaboration of European partners, provides the basis for monitoring the evolution of nutritional problems as well as the impact of strategies pursued so they can be adjusted when necessary (CHIEAM, 2010).

SMCs have improved productivity and measures to ensure food security, however while food security is quite reassured in the quantity aspect, food quality remain a challenge. Therefore, policies do not target the food commodity which contribute the most to the caloric intake; indeed, without a proper regulation it is possible to risk food insecurity for nutritional disequilibrium. Agricultural policies and subsidisation policies in SMC have been targeting food security for decades, but they were not focusing on the quality issue. Moreover, certain agriculture products (refine cereals, white flour, and sugar) were under subsidisation policies to ensure food security in terms of quantity, but to detriment of nutritional and quality issues (CHIEAM, 2008).

Countries food security perspective is favourable, if they will increase their availability of food augmenting the commercial imports and the domestic production. In addition, the region is deeply dependent on food imports which are estimated to grow up to the 46% of the total food supply in the 2021. This level will remain high if the SMC will increase export earnings and capital inflows (USDA,2011).

3.2.2 Food Production and Trade

Agriculture continues to play a key role and to occupy an essential place in the societies and economies of the Mediterranean. It is precisely because agriculture is a strategic sector that the forms of trade liberalization that are underway must be closely monitored, bearing in mind that the agricultural trade situation in the Mediterranean is now extremely critical. A whole series of questions are thus arising on the future of agriculture in the Mediterranean countries, which are becoming increasingly dependent on the changes in the global agro-food system, and on the ways and means of strengthening Euro-Mediterranean co-operation through agro-food policy. (Mediterra, 2008)

Regarding trade liberalization is this: what could be the balance between the commitment to enhance the competitiveness of export production and to development policies, and measures to protect domestic production in order to meet domestic demand more effectively? The Mediterranean area is a mosaic of trade relations. Since the 1995, in Barcelona, the Euro-

Mediterranean Partnership played a key role in the negotiation for the creation of a free-trade area by 2010.

The policies of the 80 such as tariff protection, the absence of competitive pressures, pricing policies, lack of taxation, but also the inadequacy of research have hindered technological competitiveness (Taoumi Larbi 2008). Furthermore, as regards the changes in food and nutrition models in the southern Mediterranean countries, as in most developing countries, the effect of the changes in diet is much greater when government policy is geared to keeping price levels aligned with international markets and the distribution chain is expanding with reduced profit margins. The standardization of the dietary pattern and the homogenization of food consumption is most evident in countries that are more exposed to the market internationalization process. In fact, in the new globalization context, Mediterranean agricultural products are exposed to increasing competition, and the consumption of traditional products is decreasing in the urban environment as the result of changing needs; furthermore, product supplies conform to the international market (CIHEAM, 2008).

As previously mentioned South Mediterranean countries are exposed (vulnerable) to food price and quantity risk due to their dependency on food imports and fiscal balances (USDA, 2011)

Belghazi (2013) also underlines that the EU is the most important origin and destination of SMCs' imports and exports. The main commodities imported are cereals, in particular by Israel, Jordan, Lebanon and Algeria. Apart from Libya, policies are oriented to protect the national agricultural sector by means of import tariffs and subsidies to domestic producers. During the last decade, these countries average productivity per agricultural worker rose significantly (from 2.3 thousand US dollars per year to 3 thousand US dollars, at constant 2000 prices) even though agricultural productivity is still highly sensitive to climate fluctuations (except Egypt), in particular rainfall, which can vary greatly from year to year.

The Mediterranean zone is one of the EU's leading fruit and vegetable suppliers, and preferential trade agreements between EU and Mediterranean countries have a positive impact on fruit and vegetable exports from Mediterranean countries to the EU (Martí-Selva and Álvarez-Coque, 2007) leading to an increase in the Mediterranean countries 'share of the European market over time. In spite of these factors, difficulties in accessing the European market persist for these countries.

In the SMCs countries, where the production system is fragile and natural resources are scarce, liberalization can lead to serious distortions between domestic and foreign markets and also to a decline in natural resources such as land and water, with the result that small traditional firms are marginalized (Femise, 2003).

Natural resources in Mediterranean countries are widely stressed. Population growth, urbanization, development progress as well as climate change impacts will continue to affect the natural resources as land and water. In the Mediterranean basin, the effects of climate change on

water resources are related both to an increase in evaporation volumes and a change in the water soil content. Mediterranean countries are experience a continuous decline in the arable land per person (Figure n. 19). This is an indicator, for the increasing demand for agricultural products facing finite natural resources such as land and water.

SMCs should apply interventions to assure the maintenance of agricultural production capacity, such as: subsidies to improve soil fertility and water resources and in agricultural research and infrastructures. In NCMs as a result of the decline of the rural population and the increase of the urban population, the amount of arable land has decreased, except for France. Due to these processes, also the SMCs present decline in the arable land, Egypt, Israel, Jordan and Lebanon have the smallest amount of land availability.

Figure n. 19 Arable land (hectares per person)in MCs
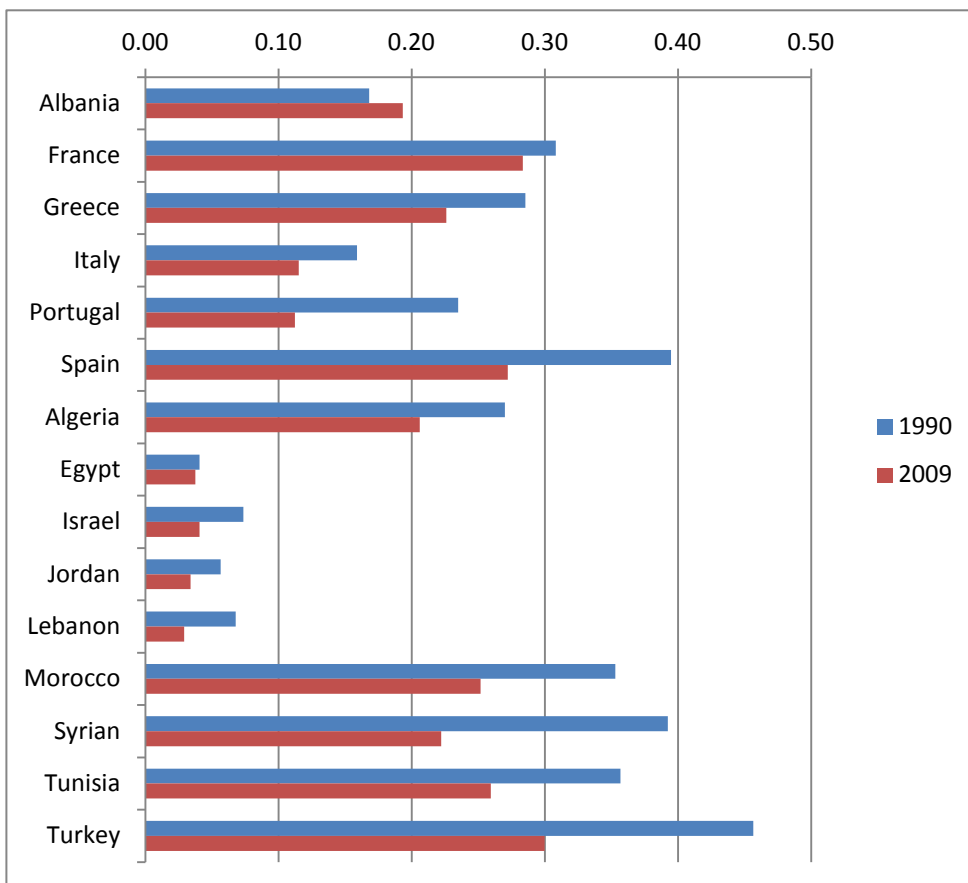
Source: FAOSTAT

Moreover as mentioned before, SMCs are highly dependent on food import and they are less economically developed and vulnerable in case of international shocks (prices spikes, food and financial crisis). Ianchovichina et al. (2012) working paper analyses respectively the imports and consumptions shares of MENA countries and net imports to domestic food consumption to see

the countries' dependency on imports to satisfy the domestic demand for certain food products, and to show the level of exposure to international price shocks.

SMCs have always been cereals importers countries and this data it is important to show their dependency on imports and develop new strategy to invert the tendency. However this data gives information on the quantity of the imports, but not the reasons. Many of this countries are affected by climate conditions, such as drought, and importation can augment year by year also depending on the weather. At the same time some countries such as Morocco and Tunisia are augmenting their meat production and the imports can augment to animal feed and not only to human use. These are aspects that should be considered.

All SMCs are dependent to cereals imports even if in the historic trend (Figure n.20) we can notice a slight decrease in this dependency. Countries as Algeria, Morocco and Tunisia have registered a high percentage of cereals imports 2000 compare to 1990 and 2009(respectively 83%, 56% and 70%), this might be connected to constraints in cereals production such as the climate conditions. Portugal (87%) is the highest importer of cereals in NMCs, However all SMCs (except Turkey) have an average rate of cereals imports superior the 40% up to 100% (Israel, Jordan and Lebanon).

Figure n. 20 - Cereal Import dependency ratio (%)
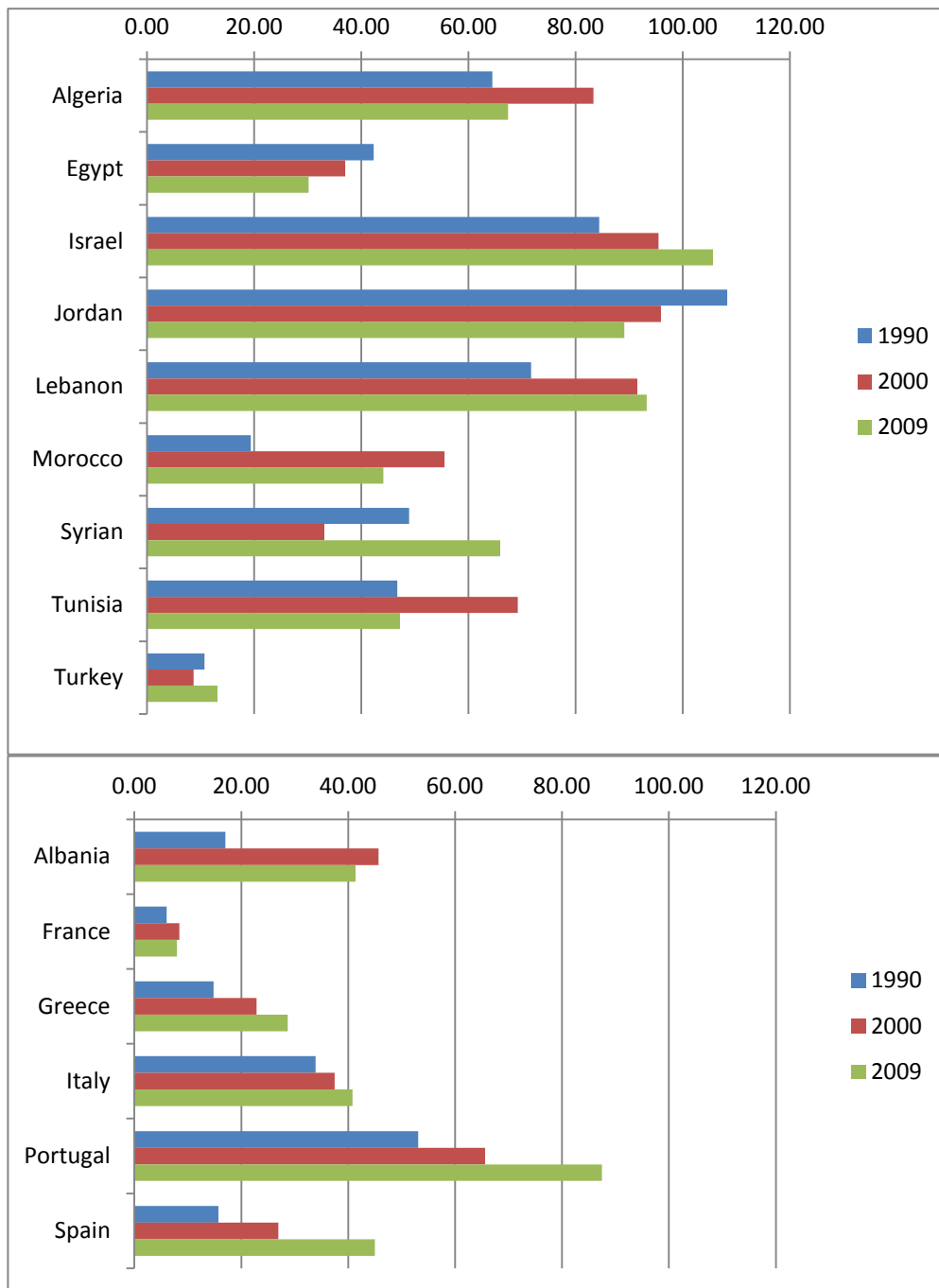
Source: FAOSTAT

These trends in SMCs' agro-food systems threaten their food security condition during time, unless specific economic strategies and policy measures are adopted. In order to be effective, such actions must be grounded on an appropriate knowledge base on the issues at stake. Unfortunately, this is quite a difficult goal to be attained, mostly because of the multi-dimensional nature and the complexity of the food security concept. This is also why in the economic literature different approaches and assessment methods are provided, but there is no general consensus on their application and interpretation.

3.2.3   Domestic Policies

The Agricultural policies, often, are to try to prevent market failure through mechanisms of correction and containment of the effects due to low equilibrium in pricing or asymmetric information, generated by inefficient allocation of resources and unequal distribution of income along the food chain.

The South Mediterranean countries are trying to improve their policies to reduce their economic and political vulnerability.

The important task for these countries is to implement and design efficient strategies and policies to react to shocks, and as says Guillaumont, (2009) to improve their resilience.

In order to react to economic and political vulnerability worsened by high food prices and generating food security problems SMC have to focus on different tasks: global food and agriculture outlooks and option for policy including climate change issues; globalisation, trade and market inclusion; natural resources policies; risks and emergencies; governance and policy processes; development strategies; poverty; nutrition and social protection; diet, health and food safety.

The agricultural policy guidelines implemented in the southern Mediterranean countries
can be summarised in three major categories:

> modernisation of production facilities and improvement of agricultural performance and rural infrastructures, particularly in the field of irrigation;

> food safety and the preservation of consumer purchasing power;

> enhancement of the competitiveness of the agro-food export market, where there is a comparative advantage, by devoting greater attention to quality.

The reforms undertaken by the various countries are mainly characterised by a process of State withdrawal and liberalisation of private initiative. With the resulting acceleration of economies and markets these countries are now opening up more to the outside world. The development strategies adopted are structured around the following tasks:

> solving structural problems and optimising the use of production factors;

> resolving irrigation issues – caused by drought and irregular rainfall – in order to improve the performance of agriculture;

> strengthening support services to agriculture such as research, dissemination and training;

International high food prices and transmission to domestic market makes countries exposed to shocks, the magnitude of the exposure depends on their vulnerability (importing countries, high price transmission, low-income countries, policy instability, etc.).

Countries with a higher local production such as Morocco and Egypt will be less vulnerable to international food price spikes, but they will face quantity risk such as climate change and water scarcity.

In case of international price spikes, the dependency on food supply imports can stress the national and household budgets, depending on the level of subsidies and the pass-through from international to domestic prices.

Franz Heidhues, Hezron Nyangito, Martine Padilla, Gérard Ghersi and Jean-Charles, Le Vallée (IFPRI,2006) have elaborated a scheme to resume the food security efficiency of strategies, policies and programs in SMC.

Table n. 6 - Grade of policy and strategies in the SMC

Policy category	Grading	Remarks
Macroeconomic policies	Intermediate	- Well identified problems and clearly defined objectives - Formulation of policies and programs and implementation deficient - Involvement of stakeholders minimal
International trade	Intermediate to good	- Policies and programs with well defined objectives generally implemented as scheduled - Little participation by stakeholders
Public sector reforms	Intermediate	- Objectives clear and consistent, but implementation of policies and programs met heavy resistance - Much remains to be done
Poverty reduction strategies	Intermediate	- Efforts made also involving stakeholders; policies and programs less clear - Feedback of lessons learned lacking
Production support	Good	- High on the priority list of most countries; action taken also in response to external pressure
Governance	Poor	-Problems and objectives recognized, but policies and programs half- hearted and capacity to implement inadequate.
Human capital formation	Poor to intermediate	- Objectives and policies and programs partly inconsistent - Constraints in capacity to implement within time frame set
Poor Natural resource management	Very poor	- Objectives and policies and programs partly inconsistent Constraints in capacity to implement within time frame set - Little attention given to the issue - Policies and programs not well defined - Stakeholders participation minimal and implementation deficient

Source: IFPRI 2006.

However, in order to face the new millennium challenges some of the southern Mediterranean countries have adopted new forms of intervention concerning environmental sustainability, land conservation, rural development and improvement of the food model in order to protect public health: In Algeria, rural development policies are part of a broader project, the "Sustainable Rural Development Strategy 2004-2014", which proposes a series of development activities, assessing

the financial aspects for the various partners and considering their impact on job creation (Ministère de l'Agriculture et du Développement Rural (MADR), 2004).

In Morocco, the "Green Plan", a modernisation programme, has been underway since 2008. It aims to make agriculture the main engine of economic growth in the country, with advantages in terms of GDP growth, job creation, exports and poverty reduction. Its principle objectives are to modernise agriculture, boost productivity, increase value added and introduce support measures for small producers (Toumi, 2008).

In Tunisia, the 11th Plan for economic and social development (2007-2011) defines the main objectives of Tunisian agriculture. These include the sustainable management of natural resources, efforts to seek solutions to environmental issues, measures to support exports, and support for family farmers through rural development projects.

The Mediterranean region, in particular the SMCS faces a number of development and food security challenges. It is crucial for this countries to implement strategies to improve and guarantee food security. Most of SMCs are still highly dependent on the cereal imports and relies on the international market. Achieving food security and economic development is closely linked, and it is important to implement policies for all the countries in order to improve infrastructure and the access to water resources and in addition make progress in the political and economical stability of these countries.

4. Methodology

The **objective** of the research is to give a contribution to the assessment of food security with a special focus on the MCs. Food security, as previously discussed is a multidimensional and complex issue and there is no a consensus on its assessment.

In order to achieve these purposes, the research has been developed in three steps.

At this point, consequently to the discussion on the complexity and multidimensionality of the food security issues and as it was explained in the first chapter, food security does not present a scientific consensus on its assessment. Different authors (Ecker and Breisinger, 2012; Ingram,2011; Timmer, 2000) and international organizations (IFPRI, World Bank, IFAD etc.) have retained the FAO definition of food security and three of its dimensions (access, availability, utilization). FAO in a recent publication have shown more than four dimension of food security (Tab.n.1), meaning that the debate on food security is in a continuous evolution. We have chosen not to consider stability because it has to be present in each dimension, in other word, food security has to be guarantee at long term. However, the additional dimension of food security refers to vulnerability and its components: shock, exposure and resilience. Vulnerability is an important issue for food security and FAO consider it as a Food Security Dimension.

After the analysis of the different dimension of food security, In this research four dimension have been retained: access, availability, utilization and vulnerability.

The following figure(n.21) represents the dimensions of food security. In our study we considered four dimension of food security availability, accessibility, utilization and vulnerability each of this dimensions includes indicators that describe determinants of food security and indicators aimed at capturing outcomes of food insecurity. The fourth dimension (stability) also considered by FAO and by the Economist Intelligence Unit is not taken into account in the following table , to the proposes of our study

Figure n. 21 Food Security Dimensions
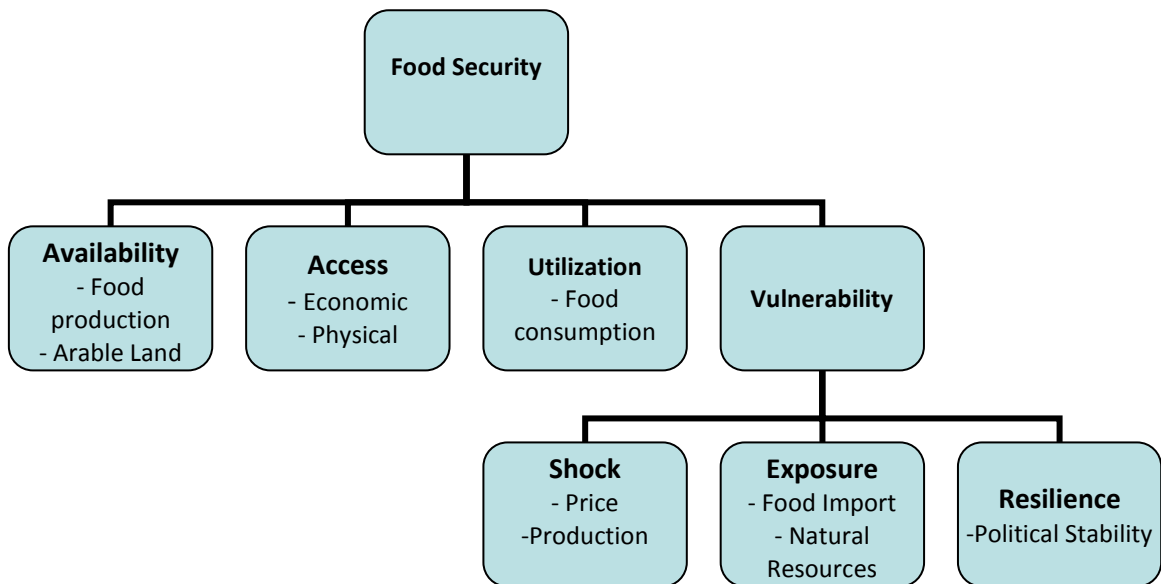
Source: Author's elaboration

2) As a second step, a qualitative evaluation of the existing food security measurement indicators are conducted, based on the application of relevant selection criteria(Ex SMART) and in accordance with the objectives of the study (i.e. to assess economic issues of food security), so that a refined set of indicators has been proposed. Following this methodology were selected some economic indicators significant to the assessment of food security such as: the price level, the income level, the Import dependency Ratio, The arable land (per person), the dietary share of the major food commodity (cereals, fruit, meat, milk, sugar, and vegetable), food commodities (cereals, fruit, meat, milk, sugar, and vegetables) per capita production, etc.

3) Finally, in order to reduce the number of variables which are determinant to food security, a Principal Component Analysis was applied. As an example, Napoli, M. in 2011 used the same methodology and the four food security dimensions (availability, access, utilization and stability) , however the indicators were divided in each respective dimension and ran in four different PCA. Ernest Reig in 2012 depicted the features of food security across the world with a special focus on the challenged faces by Arab and Sub-Saharan Africa countries, the indicators were selected and ran in the PCA all together considering also the four dimension of food security: availability, access, stability and utilization.

In our research the PCA was calculated selecting two years 1990 and 2009, in order to analyze the differences between this two periods. In conclusion the results of the PCA were discussed with a particular focus on the Mediterranean Region. The PCA will be applied and discussed than in the Fifth Chapter.

The methodology of the dissertation is explained in the next section.

4.1 Indicators and criteria of selection

What is an indicator ?

Hammond et al. (1995, p. 1) describe an indicator as ''something that provides a clue to a matter of larger significance or makes perceptible a trend or phenomenon that is not immediately detectable.(…) Thus an indicator's significance extends beyond what is actually measured to a larger phenomenon of interest''.

Indicator is quantitative or qualitative factor or variable that provides a valid and reliable way to measure achievement, assess or reflect changes connected to an activity, project or program. The quantitative indicators reveal the size of efforts, measure quantities or amounts, qualitative indicators may reveal more about their effects, people's judgments or perception about a subject and they are often most helpful in determining what is working and what can be improved.

Indicators represent information that can tell us that a change we are interested in is happening, they help to verify if a progress has been made, but they cannot tell why and how the change occurs. Indicators only indicate they do not explain a change.

Indicators are an essential component of any effective M&E (monitoring and evaluation) system. For example, at the national level, indicators provide technical experts and decision-makers with the data required to effectively manage a country's response to certain issues.

In development, it is often difficult to make objective and exact observations of the complex development changes we are addressing. Instead, we frequently rely on observations that approximate intended changes. We use indicators that are commonly understood to be closely related, e.g. share of social expenditures in a government budget as "proxy" for poverty orientation of national policies, or proportion of parliamentarians who are female as "proxy" for empowerment of women in national decision-making processes.

"The choice of indicators, their measurements, analyses, and the need for other data can be very different for inferences from research, for making public policy, or for planning or evaluating programs. There is no best indicator, best measure of an indicator, or best analysis of an indicator in a generic sense. The definition of "best" depends ultimately on what is most appropriate for the decision that must be made." (Habicht and Pelletier 1990).

The selection of the different indicators depends on the context we want to apply them. Indicators are used in any kind of contexts such as, sustainable development, food security, policy, economy etc.

Depending on the context taken into account and the subject studied, several methodologies for indicators selection have been used. In the context of sustainable development (UNDP) and evaluation of projects, the "SMART" is the most common to be adopted. However, there are

other type of indicators selection that have been used by organizations (UNICEF, UNAIDS, EU) and authors (Watson et al. 2010; Bossel 1999).

International Organization (UNDP, UNICEF , IISD) have developed their framework to select indicators, according to different purposes. Unicef and EU consider an indicator good if it is **"SMART".**

- *Specific* : also referred to as "validity", An indicators is specific when it is not bias by other factors but measure what it asserts to measure.

- *Measurable*: It can mean both qualitative and quantitative and the indicator has to be precisely defined

- *Achievable:* indicator requires data that can be collected and measured (feasible).

 -*Relevant:* the information provided by the indicator has to be important to the objectives or to the projects. It has to capture the essence of the desired result

- *Time-bound:* When will this objective be accomplished? A specified and reasonable time frame should be incorporated into the objective statement.

 UNDP uses the same method of evaluation for indicators. However SMART can also mean: Specific, Measurable, Attainable (results has to be realistic), Relevant and Trackable(data sources has to be known and available and dat should be available at a reasonable cost and effort).

Concerning the objective of the programs or of the evaluation there are additional criteria related to SMART. Other attributes could be: reliable(results should be the same no matter who is collecting the data or when) ,comparable (indicators can allow comparison over time and among locations), contextually appropriate (the measurement used must be culturally/socially /politically acceptable to the population or country concerned), cost-effective(cost of Data has to be affordable) , sensitive.

In addition , concerning the sustainable development issue **Bossel (1999**) has pictured a number of requirements for finding indicators:

• Indicators of sustainable development are needed to guide policies and decisions at all levels of society: village, town, city, county, state, region, nation, continent and world.

• These indicators must represent all important concerns: An ad hoc collection of indicators that just seem relevant is not adequate. A more systematic approach must look at the interaction of systems and their environment.

• The number of indicators should be as small as possible. That is, the indicator set must be comprehensive and compact, covering all relevant aspects.

• The process of finding an indicator set must be participatory to ensure that the set encompasses the visions and values of the community or region for which it is developed.

• Indicators must be clearly defined, reproducible, unambiguous, understandable and practical. They must reflect the interests and views of different stakeholders.

• From a look at these indicators, it must be possible to deduce the viability and sustainability of current developments, and to compare with alternative development paths.

• A framework, a process and criteria for finding an adequate set of indicators of sustainable development are needed.(Bossel H., 1999)

In addition Watson et al.(2010) have also produced a set of indicators on sustainable consumption and production, as follow: relevant; it should be best the indicator to answer the question; understandable; graphically representable; readily interpretable; Relevant in most countries not only in few; monitorable; Reliable and consistent, Representative.

Most of the criteria showed previously contain , even if differently assembled, the requirements that refer to the SMART methodology.

Other organization as UNAIDS has developed its own methodology to consider and indicator as a good one. Indicator should meet the following five standards:

1.The indicator is needed and useful.

2.The indicator has technical merit.

3.The indicator is fully defined.

4.It is feasible to measure the indicator.

5.The indicator has been field-tested or used operationally.

In addition, where indicators are presented as part of a set, this set should meet a sixth standard: The overall set is coherent and balanced. (An Introduction to Indicators, UNAIDS (2010).

Criteria of indicators selections are multiple, the most the subject is multi-dimensional as food security and vulnerability in our case the methodology is not unique.

However the indicators concerning subject as food security and vulnerability will also consider some of these requirements, however these subjects are multidimensional and their evaluation and measurement is complex and doesn't present a unique criteria.

 Indicators are not always the best methodology for collecting information for evaluation. For example, they can be very resource-intensive, requiring more time, money and staff to implement than alternatives. Also, they are not well-suited for collecting information in highly complex environments, where multiple factors (e.g. political, economic, social and cultural) and multiple populations are involved; in these situations, indicators are unlikely to answer key questions about why a program is or is not working and what might work better. (An Introduction to Indicators, UNAIDS (2010)).

4.2 Selected Food Security Indicators

In relation to the definition of food security and the explanation of its dimensions, indicators linked to economical issues have been selected for each dimension. In this section the set of indicator that we have selected and calculated will be explained.

4.2.1 Availability

Providing enough food to enough food is a necessary condition to ensure people to have access to food. This dimensions refers to those variables that express the availability of land, food supply, production and Self-sufficiency.

Arable land (hectares per person)

"Arable land central to agriculture and rural development, and are intrinsically linked to global challenges of food insecurity and poverty, climate change adaptation and mitigation, as well as degradation and depletion of natural resources that affect the livelihoods of millions of rural people across the world. In many industrialized countries, agricultural land is subject to zoning regulations. In the context of zoning, agricultural land refers to plots that may be used for agricultural activities, regardless of the physical type or quality of land". (World Bank database/metadata).

It includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded (World Bank database).

Per capita food Production kg/capita/ per year.

Long-term trends in per capita food production provide an indication of the contribution of the sector to food supplies in the regions (FAOSTAT). This data does not give information only on the food production but also to the other components of the agriculture market. It is an important indicator to show the potentiality of the agriculture market, in order to see if the production is rising or in which product the market is investing. This indicator have been calculate on the Food Commodity Balance Sheet (FAOSTAT) selecting the production of major commodities(cereals, Fruits,. Meat, Milk, Sugar, Vegetable Oils and Vegetables) and divided by the population.

Cereal yield (kg per hectare)

Cereal yield, measured as kilograms per hectare of harvested land, includes wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. Production data on cereals relate

to crops harvested for dry grain only. Cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing are excluded. The FAO allocates production data to the calendar year in which the bulk of the harvest took place. The cultivation of cereals varies widely in different countries and depends partly upon the development of the economy. Production depends on the nature of the soil, the amount of rainfall, irrigation, quality of seeds, and the techniques applied to promote growth (World Bank database/metadata).

Self Sufficiency Ratio

The self-sufficiency ratio (SSR) is defined as: SSR = production*100/(production + imports − exports). The SSR can be calculated for individual commodities, groups of commodities of similar nutritional values and, after appropriate conversion of the commodity equations, also for the aggregate of all commodities. In the context of food security, the SSR is often taken to indicate the extent to which a country relies on its own production resources, i.e. the higher the ratio the greater the self-sufficiency. While the SSR can be the appropriate tool when assessing the supply situation for individual commodities, a certain degree of caution should be observed when looking at the overall food situation. In the case, however, where a large part of a country's production of one commodity, e.g. other cereals, is exported, the SSR may be very high but the country may still have to rely heavily on imports of food commodities to feed the population. The self-sufficiency rate (as defined above) cannot be the complement to 100 of the import dependency rate, or vice-versa. (FAOSTAT)

4.2.2   Access

The access to food is normally differentiated by economical access and physical access to food. Economical access is determined by food income and food prices and physical access by the presence of infrastructure to access food as roads, ports, railways and food storage facilities. However in this case different are the indicators that can be selected. In this study we had to exclude some valuable indicators due to the lack of data to run in the Principal Components Analysis. As an example the Gini Index which measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. Thus a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality. Another useful indicators of food access is the share of food expenditure on the total, which gives information on how much of the households income is destined to food consumption and which part of population is more vulnerable to food insecurity in case of food crisis.   Due to this difficulties we selected other indicators of economical

access, as the GDP per capita, food prices, rural population and indicators as improved water sources and road density as indicators of physical access.

% of Rural Population (on total)

Rural population refers to people living in rural areas as defined by national statistical offices. It is calculated as the difference between total population and urban population. Aggregation of urban and rural population may not add up to total population because of different country coverage. In terms of food security, undernourished people are mainly located in rural areas of low-income countries. In this areas access to food, resource, technology and infrastructure are the major limit.

Domestic price level index

Domestic food price level is an important indicator for global monitoring of food security because it compares the relative price of food across countries and over time. The Domestic Food Price Level Index is calculated by dividing the Food Purchasing Power Parity (FPPP) by the General PPP, thus providing an index of the price of food in the country relative to the price of the generic consumption basket. (FAOSTAT/World Bank)

GDP per capita, PPP (constant 2005 international $).

Value based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2005 international dollars.

In SMCs the GDP per capita has and increasing trend, however even form this data we can notice and amelioration in the economic condition of the countries. These data doesn't give any information about the distribution of the income which is one of the most reasons why there are problems of food insecurity in the SMCs countries (USDA, 2011).

Road Density (km of road per 100 square km of land area).

This indicator provides information on the possibility of physical access to markets. Road density is the ratio of the length of the country's total road network to the country's land area. The road network includes all roads in the country: motorways, highways, main or national roads, secondary or regional roads, and other urban and rural roads. Regional aggregates are computed

as weighted average using surface area as weight. Because of the low coverage, missing values were interpolated using linear trend between two points or extrapolated backward and forward using the closest point. Note that regional aggregates were calculated only if countries for which data were available represented more than 70% of the total area of the region they belong to. (World Bank)

Access to Improved Water Sources (% of population)

Access to an improved water source refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public standpipe, borehole, protected well or spring, and rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 liters a person a day from a source within one kilometre of the dwelling.

4.2.3 Utilization

Utilization includes two distinct type of indicators: the food consumption with indicators concerning adequate food intake and food quality, and anthropometric indicators. In order to consider the economic issue of this dimension we considered indicators of food intake and the share of dietary diversity. However we had to exclude the stunted children, and anthropometric measure of micro-level food security, due the lack of data available. Children are the ones most responsive to changes in living condition due to the high physiological nutrient requirement for their growth and they are directly exposed to adverse health condition (IFPRI, 2012b).

Share of Dietary Energy Supply (cereal, milk, meat , vegetable oils, sugars, vegetables and fruit) it measure the percentage of the energy supply (kcal/caput/day) provided by each group of food commodity on the total Dietary Energy Supply (DES) (kcal/caput/day) calculated from the corresponding countries in the FAOSTAT Food Balance Sheets. This indicator gives the portion of the supply quantity available per habitant. This indicator it is also called Indicator of apparent consumption, It does show the Kcal/caput/day available but not the actual consumption.
Mediterranean countries have an high availability on Kcal/caput/day, however it would be important to show the real consumption, to have a more precise on the food security in this countries and their dietary composition.

Total Food Supply (Kcal/cap/Day). Total food supply or dietary energy consumption per person refers to the amount of food, expressed in kilocalories (kcal) per day, available for each individual in the total population during the reference period. Caloric content is derived by applying the appropriate food composition factors to the quantities of the commodities. Per person supplies are derived from the total amount of food available for human consumption by dividing total calories by total population actually partaking of the food supplies during the reference period. However, per person figures represent only the average supply available for the population as a whole and do not necessarily indicate what is actually consumed by individuals. The actual food consumption may be lower than the quantity shown as food availability depending on the magnitude of wastage and losses of food in the household, e.g. during storage, in preparation and cooking, as plate-waste or quantities fed to domestic animals and pets, thrown or given away (FAOSTAT).

4.2.4 Vulnerability

Vulnerability is considered as the risks to shocks and the capability to react to them (resilience). This food security dimensions is represented by three determinants: shocks, exposure to them and resilience and the indicators selected concerning food security are representative of these determinants. As shocks we consider all those indicators of variability and instability as production variability and income variability, however another important indicators of shocks is the price volatility which has been excluded due to lack of data. Dependency on food imports and agriculture irrigated land are indicators of exposure and in conclusion political stability is considered as an indicators of resilience. Other indicators such as the technological and innovation investment and government expenses on research and development could have been useful to calculate resilience but they haven't been taken into account due to the lack of data.

Agricultural irrigated land (percentage).
Agricultural irrigated land refers to agricultural areas purposely provided with water; including land irrigated by controlled flooding. Different countries, especially in the poor areas of low-income countries, still have deficiencies in infrastructures improvement and agriculture modernization. These are aspects that can improve food productivity and food security in these countries.

Per capita food supply variability. It corresponds to the total food supply in kcal/person/day as estimated by the FAO Statistic Division. The variability is obtained as the standard deviation over 10 years of the deviation from the trend of per capita food supply observed during the period

1990 to 2009. This indicator of vulnerability represent the dimension of shock concerning the shock, and it measure how a country is exposed to the variability of food supply.

GDP per capita, PPP (constant 2005 international $) variability.

The variability is obtained as the standard deviation over 5 years of the deviation from the trend of per capita food supply observed during the period 1990 to 2009. This indicator of vulnerability represent the dimension of shock concerning the shock, and it measure how a country is exposed to the variability of the income. In addition GDP variability can expose the countries to problem of facing economic crisis and expose them to risk of food security in particular those countries which measure an high percentage of share of expenditure in food.

Per capita food Production Variability kg/capita/ per year.

This indicator have been calculate on the Food Commodity Balance Sheet (FAOSTAT) selecting the production of major commodities (cereals, fruits, meat, milk, sugar, vegetable oils and vegetables) and divided by the population. The variability is obtained as the standard deviation over 5 years of the deviation from the trend of per capita food supply observed during the period 1990 to 2009. his indicator of vulnerability represent the dimension of shock concerning the shock, and it measure how a country is exposed to the variability of food production. The MCs, especially the SMCs, are highly exposed to climate change and production does measure and high level of variability, which can expose the countries to risk of food security due to shock on food production.

Index of Political Stability and Absence of Violence. Index - values vary from approximately -2.5 (weak stability) to 2.5 (strong stability). Political stability and absence of violence measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism The WGI compile and summarize information from 30 existing data sources that report the views and experiences of citizens, entrepreneurs, and experts in the public, private and NGO sectors from around the world, on the quality of various aspects of governance.

The Worldwide Governance Indicators (WGI) are drawn on four different types of source data: 1) Surveys of households and firms; 2) Commercial business information providers; 3) Non-governmental organizations; 4) Public sector organizations. The indicator reflects the statistical compilation of responses given by a large number of enterprise, citizen and expert survey respondents in industrial and developing countries, as reported by a number of survey institutes, think tanks, non-governmental organizations, and international organizations (World Bank). Due to the nature of these indicators, and the different sources of data utilized and the method used,

indicator measurement is difficult. The latest riots and problems happening in the SMCs are not included in this time series.

Value of food imports over total merchandise exports (%)

Value of food (excl. fish) imports over total merchandise exports. Simple sum of the value of food imports and total merchandise exports by regions / sub-regions and then the sum of food imports divided by sum of total merchandise exports and multiply by hundred. It measure the

Food Import/GDP_PPP (constant 2005 international $)

The total value of food Import on the total GDP, PPP which measure the total value of Gross domestic Product that is spent for food import. It show the exposure of a country to food import on the total GDP.

Food Export/ Food Import

Value of the total food Export divided by the value of the total import. It is an indicator which show the competitiveness of a countries in the international and it show if it is vulnerable to food imports.

Import Dependency Ratio (cereal, fruits, milk, meat, vegetables oils, sugars, vegetables) (percentage)

Sum of the various components of the indicator: imports, exports and production by regions/sub-regions and application for each commodity of the formula : commodity import/(commodity production + import-export). The complement of this ratio to 100 would represent that part of the domestic food supply that has been produced in the country itself. However, there is a caveat to be kept in mind: these ratios hold only if imports are mainly used for domestic utilization and are not re-exported (FAOSTAT) SMCs have always been importers countries and these data are important to show their dependency on imports and develop new strategy to invert the tendency, and make them less vulnerable. However these data give information on the quantity of the imports, but not the reasons. Many of these countries are affected by the climate conditions, such as droughts, and importations can augment or decrease year by year also depending on the weather condition.

SMCs have always been cereals importers countries and this data it is important to show their dependency on imports and develop new strategy to invert the tendency. However this data gives information on the quantity of the imports, but not the reasons. Many of these countries are affected by the climate conditions, such as drought, and importation can augment year by year also depending on the weather. At the same time some countries such as Morocco and Tunisia

are augmenting their meat production and the imports can augment to animal feed and not only to human use. These are aspect that should be considered.

The following tables (Tab. n.7 and n.8) summarize the Indicators selected in the four dimensions of food security considered.

Table n. 7 Selected Indicators

Availability	Access	Utilization
- **Per capita food Production kg/capita/per year** - **Arable Land (Hectare per person)** - **Self Sufficiency Ratio** - **Cereal yields (Kg per hectare)**	- **% of Rural Population (on total)** - **Road density (per 100 Km²of land area)** - **Food Price Level index** - **GDP , PPP per capita (constant 2005 US$)**	- **Total Food Supply (Kcal/Capita/Day)** - **Share of Food supply per commodity per kcal/capita/year**

Source: Author's elaboration

Table n. 8- Selected Vulnerability Indicators

Vulnerability
-Per capita food production variability (shock) **-Percentage of arable land equipped for irrigation (exposure)** **- Value of food imports over total merchandise exports (exposure)** **- Import Dependency Ratio (IDR) (exposure)** **- Per capita food supply variability (shock)** **- Index of Political Stability and Absence of Violence (resilience)**

Source: Author's elaboration

Consequently, after having selected our indicators and verified the availability of data, we selected 93 countries from all the five continents that we divided in five areas: Asia, Developed Countries (DCs), Mediterranean Countries (MCs or MED in graphics), South America (SA) and Sub-Saharan Africa (SSA). The countries with not access to agriculture data or small island were excluded. In Appendix 1 we reported the complete list of the selected countries. To built our data base we chose three years 1990, 2000, 2009. The reason why we haven't considered previous years such as 1980 to give a longer laps of time, is due to the lack of data, this is the same reason why we weren't able to select years further 2009. In order to follow the purposes of our study, explaining the MCs food security, we analysed the PCA results on the selected countries

(presented in the following chapter). The original data used to run the PCA and referring only to MCs selected are reported in Appendix 3.

In conclusions we applied the Principal Component Analysis on the database created.

4.3 Principal Component Analysis (PCA) description

As mentioned previously different indicator and variables are affecting food security. Due to the high number and the different nature of the variables implied, food security measurement is complex. As result, we applied a data reduction methods to simplify the analysis. In this case the Principal components analysis (PCA) has been chosen. It is useful when you have obtained data on a number of variables (possibly a large number of variables), and believe that there is some redundancy in those variables. In this case, redundancy means that some of the variables are correlated with one another, possibly because they are measuring the same construct. Principal component analysis is appropriate when you have obtained measures on a number of observed variables and wish to develop a smaller number of artificial variables (called principal components) that will account for most of the variance in the observed variables.

This method is one of the simplest and most robust ways to reduce variables. It is also one of the oldest, it was proposed by Karl Pearson (1901) and developed by Harold Hotelling in 1933. To this, PCA it is also also known as the Karhunen, Loeve transformation, the Hotelling transformation, the method of empirical orthogonal functions, and singular value decomposition.

The principal component analysis (PCA) intends to describe the relationship between several quantitative variables. This statistical method help to analyze simultaneously a large number of variables . We work from an array of quantitative data with n rows (one row per individual or"Observation") and p columns (p quantitative variables).

The PCA aims to summarize the information carried by a large number of quantitative variables using (a smaller number) of synthetic variables (quantitative) called main factors the PCA. The main factors are in fact linear combinations of the starting variables , which have two major advantages:

- The main factors are uncorrelated: they form an orthogonal basis (new standard) of all the most important variables from the departure ;

- The first two or three factors generally used to extract the most information contained in the data (the importance of the axes is decreasing) , where it took several variables initially

In PCA, the extractions of Principal component (PC) can be made using either original multivariate datasets or using the covariance or the correlation matrix if the original dataset is not available. In deriving PC, the correlation matrix is commonly used when different variables in the dataset are measured using different

units or if different variables have different variances. Using the correlation matrix is equivalent to standardizing the variables to zero mean and unit standard deviation.

The principle of PCA is to replace the initial p variables by new variables (which are the main factors). The original dataset is written down as this initial matrix

$$X = \begin{matrix} X_1 \\ X_2 \\ \vdots \\ X_p \end{matrix} = \begin{matrix} X_{11} & X_1 & \dots & X_{1p} \\ X_{21} & X_{22} & \dots & X_{2p} \\ \dots & \dots & \ddots & \vdots \\ X_{p1} & X_{p2} & \dots & X_{pp} \end{matrix}$$
with $i= 1,2,\dots p$ and $j=1,2,\dots p$

Where

- columns represents p observations

- row represents p variables considerate in the analysis

Below is the general form for the formula to compute scores on the first component extracted (created) in a principal component analysis

$$C = XA' = \begin{cases} C_1 \ \alpha_{11}(X_1) \ + \ \alpha_{12}(X_2) + \dots \alpha_{1p}(X_p) \\ C_2 \ \alpha_{21}(X_1) \ + \ \alpha_{22}(X_2) + \ \dots \ \alpha_{1p}(X_p) \\ \dots \\ C_p \ \alpha_{p1}(X_p) \ + \ \alpha_{p2}(X_2) + \dots \alpha_{pp}(X_p) \end{cases}$$

Where

p = variables

C=the subject's score on principal component (the component extracted)

α_{1p}=the regression coefficient for observed variable p, as used in creating principal component p

X_p=the subject's score on observed variable p

There are two other properties in the PCA model definition:

1) the components scores are uncorrelated among each other:

$Corr(\,C_i, C_j) = 0$

2) the size of the coefficients is constraints across components otherwise the variances of the principal components would depend on the coefficients sizes as well while the aim is that they are determined byt the different weight of the original variables.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in the variables that might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis may be useful with your data. If the value is less than 0.50, the results of the factor analysis probably won't be very useful. Bartlett's test of sphericity tests the hypothesis that your correlation matrix is an identity matrix, which would indicate that your variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with your data

In principal component analysis, the number of components extracted is equal to the number of variables being analyzed. Usually the first component usually explain the largest amount of the total variance. Although only the first few components will be the ones retained for interpretation.

In order to retain the number of meaningful components to be retains there are different methods:

1) The eigenvalue-one criterion. An eigenvalue represents the amount of variance that is accounted for by a given component. In PCA, one of the most commonly used criteria for solving the number-of-components problem is the eigenvalue-one criterion, also known as the Kaiser criterion (Kaiser, 1960). With this approach, you retain and interpret any component with an eigenvalue greater than 1.00. The rationale for this criterion is straightforward. Each observed variable contributes one unit of variance to the total variance in the data set. Any component that displays an eigenvalue greater than 1.00 is accounting for a greater amount of variance than had been contributed by one variable. Such a component is therefore accounting for a meaningful amount of variance, and is worthy of being retained.

2) The Scree Plot. Plotting the eigenvalues against the corresponding PC produces a scree plot that illustrates the rate of change in the magnitude of the eigenvalues for the PC. The rate of decline tends to be fast first then levels off. The elbow, or the point at which the curve bends, is considered to indicate the maximum number of PC to extract. One less PC than the number at the elbow might be appropriate if you are concerned about getting an overly defined solution. The components that appear before the break are assumed to be meaningful and are retained for rotation; those appearing after the break are assumed to be unimportant and are not retained.

3)Proportion of variance accounted for. A third criterion in solving the number of factors problem involves retaining a component if it accounts for a specified proportion (or percentage) of variance in the data set. For example, you may decide to retain any component that accounts for at least 5% or 10% of the total variance.

Consequently in case in order to obtain a reduced number of value in each columns and in case we want to review the correlation between variables and components, the rotation methods is the one used for this propose. Therefore in case more the one component has been retained the rotation method is the one that makes the interpretation of results easier. There are different time of rotation, one of the most popular is the VARIMAX which tends to maximize the variance of a column of a the factor pattern matrix (Mazzocchi, 2008).

5. Measurement and Results

5.1 PCA results

Consequently to the selection of the food security indicators, in order to assess food security, the Principal Component Analysis has been applied. The database used for the PCA is composed by 40 indicators of food security, 94 countries and three years of reference 1990, 2000, and 2009. Two are the methods used: 1) indicators have been divided into four groups for each of the food security dimensions: availability, access, utilization and vulnerability; 2) the whole set of indicator have been putted together and used for a new PCA. The latter method represent the objective of our study: select the most important indicators that play a key role in the assessment of food security.

5.1.1 In "Blocks"

In this section the 40 indicators representative of each dimension of food security have been divided in four groups (availability, access, utilization, vulnerability) and four different PCA have been run for 93 countries. We want to see how much is the variance explained by the components extracted in this section. And see which indicators are playing a key role in the two phases.

Availability

This dimension includes all the indicators referring to food production and land availability. As mentioned before as far as availability is concerned the indicators of food production, self-sufficiency and arable land are representative of this dimension.

The Kaiser-Meyer-Olkin measure of sampling adequacy tests whether the partial correlations among variables are small. Bartlett's test of sphericity tests whether the correlation matrix is an identity matrix, which would indicate that the factor model is inappropriate. The KMO measures the sampling adequacy which should be greater than 0.5 for a satisfactory PCA to proceed. Looking at the table (n.9) below, the KMO measure is 0.612. Large values for the KMO measure indicate that a PCA of the variables is a good idea. Another indicator of the strength of the relationship among variables is Bartlett's test of sphericity as mention in the section concerning the PCA explanation. Bartlett's test of sphericity is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated. The observed significance level is .0000. It is small enough to reject the hypothesis. It is concluded that the strength of the relationship among variables is strong. So it is a good idea to proceed with the analysis.

In the following results discussed in this section, the KMO measure a Sampling adequacy greater than 0.6 and in the Bartlett test the significance level is small to reject the hypothesis and continue the PCA analysis (Tab.9).

Table n. 9 - KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.614
Bartlett's Test of Sphericity	Approx. Chi-Square	2640.977
	df	91
	Sig.	.000

The total Variance Explain is composedby:

- Component: The PCA generates the same number of component of the initial variables, in this case we used 14 variables so we have 14 components

- Initial Eigenvalues: the Eigenvalues are the variances of the principal components.

- Total: contains the eigenvalues. The first component will always account for the most variance (and hence have the highest eigenvalue).

- % of Variance - This column contains the percent of variance explaines by each principal component.

- Cumulative % - This column contains the cumulative percentage of variance explained. This means that the first 5 PC measures the 80% of the total variace

- Extraction Sums of Squared Loadings - Reproduce the values given on the same row on the left side of the table. The components retained are the one with the Eigenvalue that measure greater than 1 (> 1).

The following Table(n. 11) show the Total variance Explained PCA. The PCA has generated the same number of components as the initial variables and only the one with the eigenvalue >1 are retained. In this case five are the component exstracted and the total variance explained is about 80%. The first and second component explain together about the 47%.

Compon ent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulativ e %	Total	% of Variance	Cumulati ve %	Total	% of Variance	Cumulativ e %
1	4.574	32.671	32.671	4.574	32.671	32.671	3.593	25.665	25.665
2	2.083	14.882	47.553	2.083	14.882	47.553	2.322	16.584	42.249
3	1.823	13.019	60.572	1.823	13.019	60.572	1.909	13.632	55.882
4	1.675	11.963	72.535	1.675	11.963	72.535	1.773	12.665	68.546
5	1.086	7.758	80.292	1.086	7.758	80.292	1.644	11.746	80.292
6	.820	5.854	86.146						
7	.481	3.439	89.585						
8	.398	2.846	92.431						
9	.302	2.160	94.591						
10	.261	1.865	96.456						
11	.208	1.488	97.944						
12	.138	.983	98.927						
13	.098	.700	99.627						
14	.052	.373	100.000						

Extraction Method: Principal Component Analysis.

The Scree plot (Fig. 22) below shows a "change" or the "elbow point" at the level of the second and the third component. The elbow rule, in case the elbow point is identifiable, suggests which are the PC to be retained, in this case we can affirm that the first component is the one to be retained.

Figure n. 22 Principal Components Selection
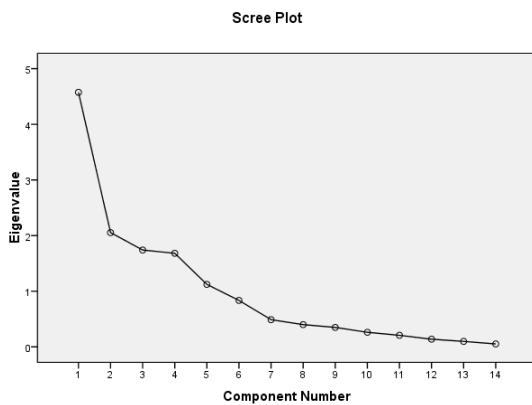
The component Matrix shows 5 principal components. Regarding what it has been stated in the scree plot analysis the first two component is the one selected. The Component matrix shows that the first component has an high correlation for the indicator of production, basically, we can find most of the availability indicators. In the PC1 there is an high correlation of Self-sufficiency and

Production of Cereals, Meat, Milk and Sugar. It presents also a moderate correlation of the Arable Land(0.534) and Cereals yields (.527) (Table n.11).

Table n. 11 - Component Matrix

	Component				
	1	2	3	4	5
Cereals yields	.527	.403			-.466
Arable Land	.534	-.556			.465
Self-Suff._CEREALS	.621	-.597			
Self-Suff _MEAT	.771				
Self-Suff _MILK	.765				
Self_suff F_SUGAR	.425		.413	-.515	-.453
Self-Suff _OILS			.582	.587	
Self-Suff _VEG+FRUIT			.632		
Production_CEREALS	.772				
Production_MEAT	.884				
Production_MILK	.641	.499			
Production_SUGAR	.674				
Production_OILS			.566	.700	
Production_VEG+FRUITS		.509	.560		

Extraction Method: Principal Component Analysis.

The results of this PCA show that most of the indicators of availability are significant and explain the PC1. Production, land and self-sufficiency are all important and positively correlated to PC1, PC1 could be called "food availability" itself.

Access

The PCA is run with the indicators of access. Among these: the Rural Population, the domestic price level and the infrastructure such as the road density and the access to improved water resources. KMO shows and high adequacy (.888) of the dataset to continue the PCA (Tab.12).

Table n. 12 - KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.808
Bartlett's Test of Sphericity	Approx. Chi-Square	725.127
	Df	10
	Sig.	.000

This PCA present an easy interpretation because the first component extracted explain the 66% of the total variance and it is the only one retained (Tab.13).

Table n. 13- Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**3.323**	**66.459**	**66.459**	**3.323**	**66.459**	**66.459**
2	.733	14.658	81.117			
3	.445	8.890	90.007			
4	.303	6.065	96.072			
5	.196	3.928	100.000			

In addition the Component Matrix shows one only PC extracted which include all the indicators of Access. All indicators are positively correlated except for the percentage of the rural population (-.857) and the domestic food price level (Tab.14).

Table n. 14– Component Matrix[a]

	Component
	1
Rural Population (%)	-.857
GDP per capita, PPP	.885
Domestic Price Level	-.800
Road Density	.644
Improved water source	.867
Extraction Method: Principal Component Analysis. a. 1 components extracted.	

The results of the PCA show the importance of all the indicators selected. PC1 shows the role of all the economic development. On the one hand, in a country where GDP per capita increase also the infrastructure improve such as the road density and the improved water sources. And on the other hand, when the economic development increase the rural population decrease and prices in a developed economy have a lower impact.

Utilization

The KMO show also an high adequacy (.754)(Tab.15). However it is necessary a little premise to this dimension. Utilization has always been considered as the dimension of health, micronutrients, quantity of food consumed. One of the indicator we normally analysed is the percentage of the stunted children, even as mentioned before it had to be excluded from the analysis due to lack of data. Indeed, as indicators of Utilization we considered the consumption of the major food commodity expressed in Kcal per capita/day. However these data are not precise because the food supply data, to which we have access, show the apparent consumption of food and not the actual one.

Table n. 15- **KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.754
Bartlett's Test of Sphericity	Approx. Chi-Square	670.212
	df	21
	Sig.	.000

The component retained for this PCA are the first two which explain about the 64% of the total variance. The PC1 explains itself the 47% fo the total variance (Tab.16).

Table n. 16 - **Total Variance Explained**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.312	47.307	47.307	3.312	47.307	47.307	2.946	42.080	42.080
2	1.166	16.663	63.971	1.166	16.663	63.971	1.532	21.891	63.971
3	.811	11.584	75.555						
4	.570	8.140	83.695						
5	.505	7.208	90.903						
6	.385	5.501	96.405						
7	.252	3.595	100.000						

Extraction Method: Principal Component Analysis.

The scree plot (Fig. 23) show the "elbow point" at the PC2 this show that the component to be retained is the first one. However there is a 16 % of the total variance explained by the PC2. In addition it is important to notice that around the 37% of the variance remains unexplained.

Figure n. 23- Principal Components Selection
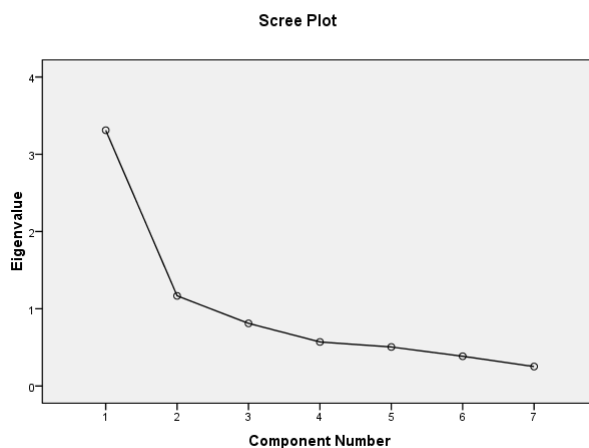
The PC1 is represented by a high positive correlation of dietary share of meat, sugar and milk, however cereals are negatively correlated (Tab.17).

Table n. 17- Component Matrix[a]

	Component	
	1	2
Dietary Share_CEREALS	-.798	
Dietary Share_MILK	.795	
Total Food Supply (kcal/caput/day)	.788	
Dietary Share_MEAT	.756	
Dietary Share_SUGAR	.716	
Dietary Share_OILS	.524	
Dietary Share_VEGETABLE+FRUITS		.865

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

PC1 summarize the food consumption in total and the dietary diversity, characterized by the consumption of meat, sugar, milk and vegetable oils, as a result the basic staple food represented by cereals is negative correlated, in other words when if the consumption of cereals decrease, the diet diversification augment in consuming more meat, milk sugar and vegetables oils. This tendency goes along with the improvement of economic development as the Bennet's Law explicated: as the GDP per capita augment, the source of calories changes and people improve the quality of their diet, and its diversification.

Vulnerability

Vulnerability is considered as another dimension which, as previously discussed include three sub-dimension coming from its definition: shock, exposure, resilience. In this case and also concerning the availability of the data we selected the vulnerability indicators for each of its dimensions, such as: 1) Shock: variability of price level, per capita food production variability , per capita food supply variability, GDP per capita variability; a) Exposure: percentage of arable land equipped for irrigation, value of food imports over total merchandise exports, and import dependency ratio;3) Resilience: Index of political stability and absence of violence. The KMO show adequacy to continue with the PCA (Tab.18).

Table n. 18- KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.745
Bartlett's Test of Sphericity	Approx. Chi-Square	870.486
	df	91
	Sig.	.000

In this part of the analysis among the 14 component extracted, four PCs are retained. The first two PCs explain most of the variance. However the four PCs extracted explain only the 55% of the

total variance which means that other factors has to be considered to explain the total variance(Tab.19).

Table n. 19- **Total Variance Explained**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.290	23.498	23.498	3.290	23.498	23.498	2.819	20.137	20.137
2	2.178	15.555	39.053	2.178	15.555	39.053	1.970	14.068	34.205
3	1.224	8.745	47.798	1.224	8.745	47.798	1.656	11.826	46.031
4	1.061	7.582	55.380	1.061	7.582	55.380	1.309	9.349	55.380
5	.987	7.052	62.432						
6	.913	6.524	68.956						
7	.881	6.294	75.250						
8	.773	5.523	80.773						
9	.664	4.744	85.517						
10	.518	3.701	89.218						
11	.453	3.234	92.452						
12	.420	3.000	95.452						
13	.345	2.462	97.914						
14	.292	2.086	100.000						

Extraction Method: Principal Component Analysis.

The Scree plot (Fig. 24) suggest that two are the principal components to be retained.

Figure n. 24- Principal Components Selection
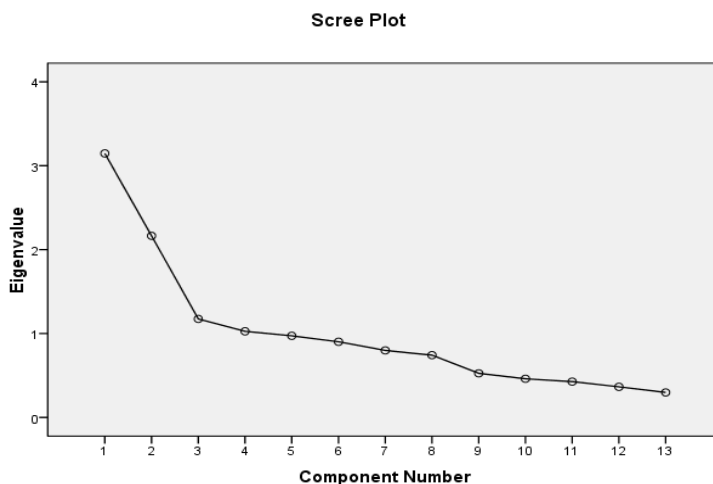
The PC1 is represented by the indicators of import variability and political stability and the PC2 show an high correlation of the cereals production variability, of food export and the political stability and a moderate negative correlation of import ratio of milk and cereals (Tab. 20).

	Component			
	1	2	3	4
IRRIGATED LAND			-.758	
GDP_PPP Variability	.588	.531		
Food Import/Total Export				.440
Food Import/GDP_PPP			.433	
Food Export/ Food Import		.442		
Food Supply Variability				
Import Ratio_CEREALS	.631	-.476		
Import Ratio_MEAT	.768			
Import Ratio_MILK	.418	-.452		-.565
Import Ratio_SUGAR	.517			
Import Ratio_OILS	.595			
Import VEGETABLE_fruits	.793			
PROD Variability_CEREALS		.664		
POLITICAL_STABILITY	.504	.667		

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

In order to be able to better read the results concerning PC1 and PC2 we decided to use a rotation method (VARIMAX), in order to reduce the numbers of correlation present in the columns. PC1 indicators are all positively correlated: import of meant and vegetable, variability of cereals production and GDP per capita and political stability. PC2 presents the positive correlation of the cereals and milk import and a negative correlation of the cereals production variability (Tab. 21).

Table n. 21- **Rotated Component Matrix**[a]

	Component			
	1	2	3	4
IRRIGATEDLAND				.814
Variability_GDP_PPP	.793			
IMPORT/EXPORT			.552	
IMPORT/GDP.PPP			.667	
%FOODEXPORT/IMPORT			-.423	
Food_SUpply Variability				-.493
IMPORTCEREALS		.669		
IMPORTMEAT	.584	.466		
IMPORTMILK		.815		
IMPORTSUGAR			.515	
IMPORTOILS			.474	
IMPORTVEGETABLE_fruits	.783			
ST.DEV_PROD_CEREALS	.420	-.561		
POLITICAL_STABILITY	.815			

Extraction Method: Principal Component Analysis.

 Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

5.1.2 "In one Block"

In order to achieve the objective of our study and assess food security with all its components we ran another PCA. In this second phase of the PCA we decided to run the variable in a unique block. The dataset utilized is the same used in the previous phase, composed by 40 indicators, 93 countries and three years as a timeline:1990,2000,2009.

The indicators of each food security dimension analysed in the first phase are putted together and run in one PCA. The KMO measures the sampling adequacy which should be greater than 0.5 for a satisfactory PCA to proceed. Looking at the table below, the KMO measure is 0.777. Bartlett's test of sphericity is used to test show that the significance level is .0000 which means that the strength of the relationship among variables is strong (Tab.22).

Table n. 22-KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.777
Bartlett's Test of Sphericity	Approx. Chi-Square	8958.562
	df	780
	Sig.	.000

In this PCA the initial variables were 40 and 40 components are generated. However looking at the value of the Eigenvalue greater than 1, only 10 PCs are retained for the analysis. The ten PCs explains about the 74% of the variance. PC1 itself explain the 27.75% and PC2 the 16% (Tab. n.23).

Table n. 23- Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.102	27.755	27.755	11.102	27.755	27.755	8.710	21.776	21.776
2	4.762	11.905	39.661	4.762	11.905	39.661	3.662	9.155	30.931
3	2.775	6.937	46.597	2.775	6.937	46.597	3.348	8.370	39.301
4	2.347	5.866	52.464	2.347	5.866	52.464	2.715	6.787	46.088
5	2.119	5.297	57.760	2.119	5.297	57.760	2.608	6.521	52.609
6	1.760	4.401	62.161	1.760	4.401	62.161	2.196	5.490	58.098
7	1.533	3.832	65.993	1.533	3.832	65.993	2.059	5.147	63.245
8	1.270	3.175	69.168	1.270	3.175	69.168	1.776	4.440	67.685
9	1.145	2.863	72.030	1.145	2.863	72.030	1.642	4.104	71.789
10	1.023	2.557	74.587	1.023	2.557	74.587	1.119	2.798	74.587
11	.932	2.331	76.918						
12	.848	2.119	79.037						
13	.791	1.977	81.013						
14	.752	1.880	82.893						
15	.680	1.701	84.594						
16	.638	1.596	86.190						
17	.561	1.403	87.593						
18	.485	1.214	88.807						
19	.450	1.125	89.931						
20	.425	1.063	90.994						
21	.395	.987	91.981						
22	.355	.887	92.867						
23	.314	.785	93.653						
24	.301	.751	94.404						
25	.284	.710	95.114						
26	.271	.678	95.792						
27	.236	.590	96.381						
28	.223	.558	96.939						
29	.181	.453	97.392						
30	.163	.407	97.799						
31	.161	.402	98.201						
32	.126	.316	98.517						
33	.115	.288	98.805						
34	.101	.252	99.057						
35	.094	.236	99.293						
36	.072	.181	99.474						
37	.070	.176	99.650						
38	.065	.163	99.813						
39	.061	.152	99.965						
40	.014	.035	100.000						

Oberserving the scree plot (Fig. 25), in order to better understand how many component to be selected, the elbow point is observable at the level of the PC3 which suggest to consider the first two components, evn though together they explain around the 40% of the total variance.

Figure n. 25- Principal Components Selection
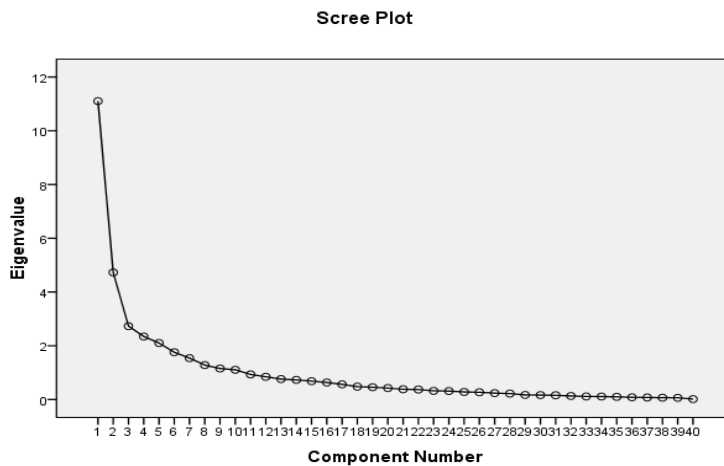
The Component matrix shows a number of the indicartors highly correlated to the PC1. The indicators which explain the PC1 are representative for all the four dimension. The first factor depends positively on the following indicators: the income, the consumption of meat, milk and sugar, the production of meat, the cereal yields and the political stability. On the contrary the factor depends also negatively on other indicators: the rural population, the domestic price leve and the consumption of cereals. The PC2 is explained by positively correlated indicators such as the cereals, milk and meat import dependency ratio, and negatively correllated with the arable land, the cereals self-sufficiency, the cereals production and its variability (Tab.24).

Table n. 24– **Component Matrix[a]**

	Component									
	1	2	3	4	5	6	7	8	9	10
Rural Population (%)	-.825									
IRRIGATED LAND			.410							
Cereal yiealds	.753									
GDP per capita, PPP	.881									
GDP_PPP Variability	.770									
Domestic price Level	-.727									
Arable Land		-.696								
Road Density	.606									
Improved water source	.781									
Food IMPORT/ Total EXPORT										
Food Export/Food Import										
Food Import /GDP.PPP							.518			
Total Food Supply	.795									
Food Supply Variability										.840
Dietary Share_CEREALS	-.675							.409		
Dietary Share_MEAT	.744									
Dietary Share_MILK	.724									
Dietary Share_SUGAR	.671									
Dietary Share_OILS										
%VEGETABLE+FRUITS			.491					-.560		
Import Ratio_CEREALS		.770								
Import Ratio_MEAT	.434	.501								
Import Ratio_MILK		.486		.493						
Import Ratio_SUGAR		.462	-.479		-.447					
Import Ratio_OILS										
Import VEGETABLE_fruits	.686		-.422							
Self-Suff._CEREALS		-.797								
Self-Suff _MEAT	.473					.441				
Self-Suff _MILK	.540			-.518						
Self_suff _SUGAR					.700					
Self-Suff _OILS				.765		.422				
Self-Suff _VEG+FRUIT			.670							
Production_CEREALS	.623	-.562								
Production_MEAT	.814									
Production_MILK	.572					.424				
Production_SUGAR	.573				.535					
Production_OILS				.715		.411				
Production_VEG+FRUITS			.726							
PROD_CEREALS Variability	.407	-.524								
POLITICAL_STABILITY	.727									

Extraction Method: Principal Component Analysis.

a. 10 components extracted.

In order to facilitate the interpretation of the results we decided to rotate the Component Matrix. To reduce the number of value in each columns and in case we want to review the correlation between variables and components, the rotation methods is the one used for this propose. There are different type of rotation, one of the most popular is the VARIMAX which tends to maximize the variance of a column of a the factor pattern matrix.

The first factor groups show positive correlation of the income and its variability, the consumption of milk, meat and sugar, the cereal yields. On the contrary indicators such as the rural population, the level of price and the consumption of cereals are negatively correlated to the PC1.

The second factor is represented by indicators positively correlated of arable land, cereals self-sufficiency, cereals production and its variability; cereals import dependency is negatively correlated to PC1.

Table n. 25- Rotated Component Matrix[a]

	Component		
	1	2	3
Rural Population (%)	-.846		
IRRIGATED LAND			
Cereal yiealds	.618		
GDP per capita, PPP	.833		
GDP_PPP Variability	.798		
Domestic price Level	-.729		
Arable Land		.686	
Road Density	.425		
Improved water source	.775		
Food Import/ Total Export			
Food Export/Food Import			
Food Import /GDP.PPP			
Total Food Supply	.757		
Food Supply Variability			
Dietary Share_CEREALS	-.595		
Dietary Share_MEAT	.712		
Dietary Share_MILK	.762		
Dietary Share_SUGAR	.721		
Dietary Share_OILS	.437		
%VEGETABLE+FRUITS			
Import Ratio_CEREALS		-.708	
Import Ratio_MEAT	.406		
Import Ratio_MILK			
Import Ratio_SUGAR			
Import Ratio_OILS			
Import VEGETABLE_fruits	.551		
Self-Suff._CEREALS		.836	
Self-Suff _MEAT			.835
Self-Suff _MILK			.783
Self_suff F_SUGAR			
Self-Suff _OILS			
Self-Suff _VEG+FRUIT			
Production_CEREALS	.407	.788	
Production_MEAT	.512		.755
Production_MILK			.727
Production_SUGAR	.401		
Production_OILS			
Production_VEG+FRUITS			
PROD_CEREALS Variability		.740	
POLITICAL_STABILITY	.680		

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Due to these results we can attempt a name for each of these retained components. PC1 could be named after "economic development" and PC2 after "basic food supply". If we consider the

developed countries, we can easily notice the GDP rising with the amount of the consumption of milk, meat and sugar (Engel's Law, Bennett's Law). In a developing economy when the GDP increases also technology and innovation tend to improve and as a result we can observe the positive correlation to PC1 of indicators of infrastructure as access improved water sources and the level of road density. Political stability is positive correlated to the PC1 and it represents an important issues for the economic development. This background is coherent with the fact that indicators, which might express development problems and a reduction of wellbeing, are negatively correlated to PC1 such as the level of prices, the cereal consumption and the rural population percentage. In all societies cereals are the most food supply consumed, but as far as the wellbeing increase the rural population and cereals decrease.

The PC2 refers to society which are cereals producers, therefore the relation is positive for variables of cereals self-sufficiency and production and it is negative for the cereal import variables. PC2 level might increase in those countries which are cereal producers and can provide to their own self-sufficiency, and decrease in those countries that are dependents on cereals imports.

Before showing the PCA score in the Mediterranean we decided to observe where the MCs are positioned compared to the other countries. The years taken into consideration are the 1990 and 2009. Results of PCA have be grouped in five geographic areas: Asia, Developed Countries (DC), Mediterranean Countries (MED), Sub-Saharan Africa (SSA) and South America (SA) (Fig.n.26). Figure n. 26 and 27 are showing respectively the food security situation in all the countries used in the PCA.

Figure 26 show the food security in all the countries selected in the 1990. This graphic allows to see the differences from 1990 to 2009.

MCs (MED in the Figure n.26,27,28,29 and 30) includes also countries that are part of the Developed Countries such as Albania, France, Greece Spain, Italy and Israel. Concerning the Economic Development (PC1) some of the MCs have a negative level and show a lower economic development than the Developed Countries. As expected they seems more developed than the SSA, SA and Asia.

Concerning the Basic food supply (PC2) it is more difficult to find a precise pattern of each area, the PC2 depends more on the singular characteristic of the country, the amount of cereal produced, the dependency to the import , the available arable land and the cereal self-sufficiency. Some of countries such as SSA and MED (MCs) might be affected my climate conditions, which can have a high influence on the import dependency ratio. However MED together with some of the SSA, ASIA and SA have negative level of PC2.

Figure n. 26- PCA Results In 1990 (ASIA, MED, DC, SSA, SA)
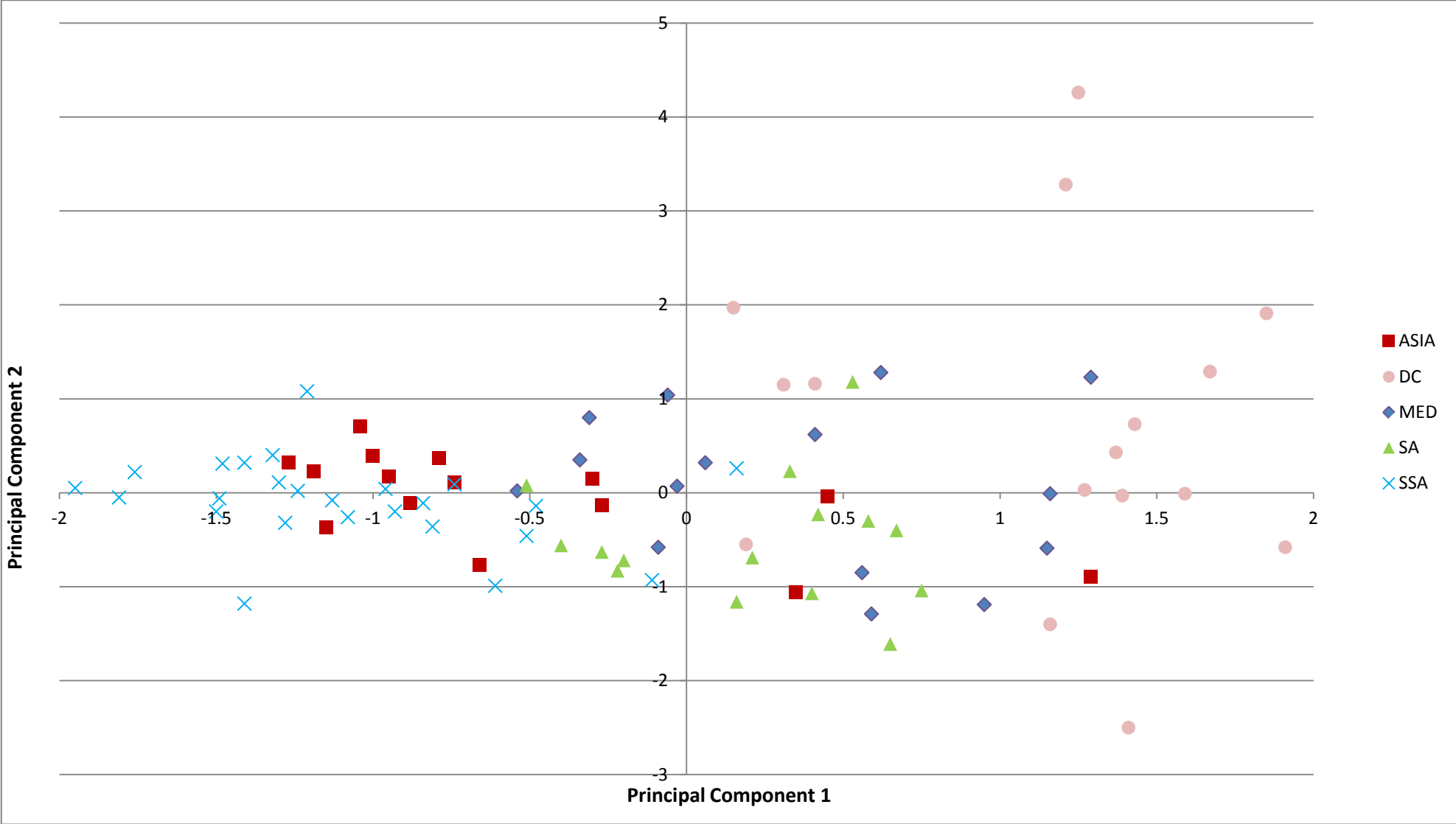
Figure 27 shows a slgiht amelioration of the economic development in all the countries since 1990. As in 1990, DCs measure a positive level of the PC1 together with the SA countries. Since 1990, Some of the SA countries went from a negative economic development to a positive one in 2009. Most of the SSA and ASIA countries measure a negative level of the economic development, even if their level of economic development has improved since 1990. As espected some of the SSA countries present the lowest level of the economic development. However the MCs (MED) show an high diversity concerning the economic development, five of MED countries have a negative economic development, and the rest show are positive level, this is the results of a geographical area whichis composed by three different continents (Africa, Asia and Europe) which present many economical, social and cultural disparities.

As far as basic food supply are concened it si more difficult to find a common trend for each geographical area, also some of the DCs presents a negative level which means they might have little arable land available and they are dependents on cereals imports. An high percentage of the SA countries have a negative level of basic food supply meaning their dependency to cereal import, a low self-sufficiency and little arable land.

ASIA and SSA countries show the basic food supply level close to zero or negative, some of these countries are depend on food import or they are close to be. The SSA countries showing a very low economic development might not be dependent to cereal import also because they might not have the finacial resources to import enough food. Very few DCs have a negative level of PC2.

Figure n. 27- PCA Results In 2009 (ASIA, MED, DC, SSA, SA)
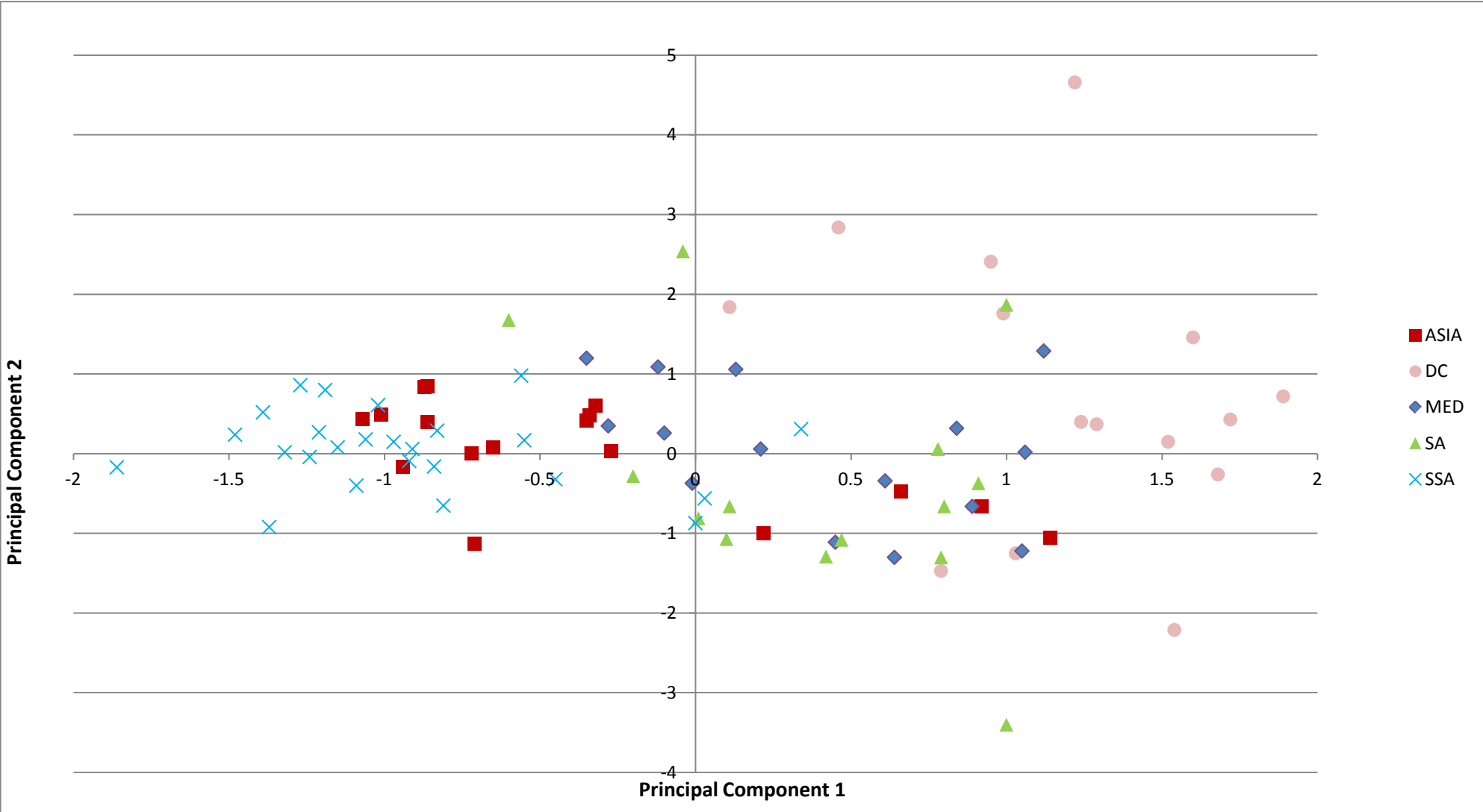
In order to interpret the results we divided in two Figure 27 and zoomed on the food security assessment of each countries looking where the MCs (MED) are positioned compare to the others. Figure 28 show the countries with a positive level of economic development represented in quadrant 1 and 4 (Q1 and Q4).

As exspected, all DCs have positive level of economic development and Switzerland register the highest level (2.04) followed by Finland, Sweden, Norway and USA. The majority of SA countries and MCs (MED) have a positive level in the economic development. Only two SSA country shows a positive level of PC1: South Africa and Angola (measuring 0).

Concerning the basic food supply (PC2) it is difficult to describe a trend for each geographic area which depends on the countries' specific characteristics, such as the land exstention and productivity and off course the climate conditions. However the majority of DCs have a positive level of PC2 and Australia registered the highest measure followed by Hungary, Canada and Argentina. These countries, on the one hand they tend to have an high economic development meaning a less consumption of cereals, higher consumption of meat, milk and sugar, developed infrastructures high land productivity and in particular an elevated GDP per capita. And on the other hand, concerning the basic food supply, production of cereals is high as the self-sufficiency and the availability of arable land and they are not dependent on cereals imports.

In addition there are countries, economically developed, which present a negative level of basic food supply, as an example countries such as Costa Rica (egistering the highest negative level of PC2), and Netherlands may not have enough availability of arable land, or produce little cereals and rely on cereals imports.

Figure n. 28- Zoom on PCA 2009 results (Q1 and Q4)
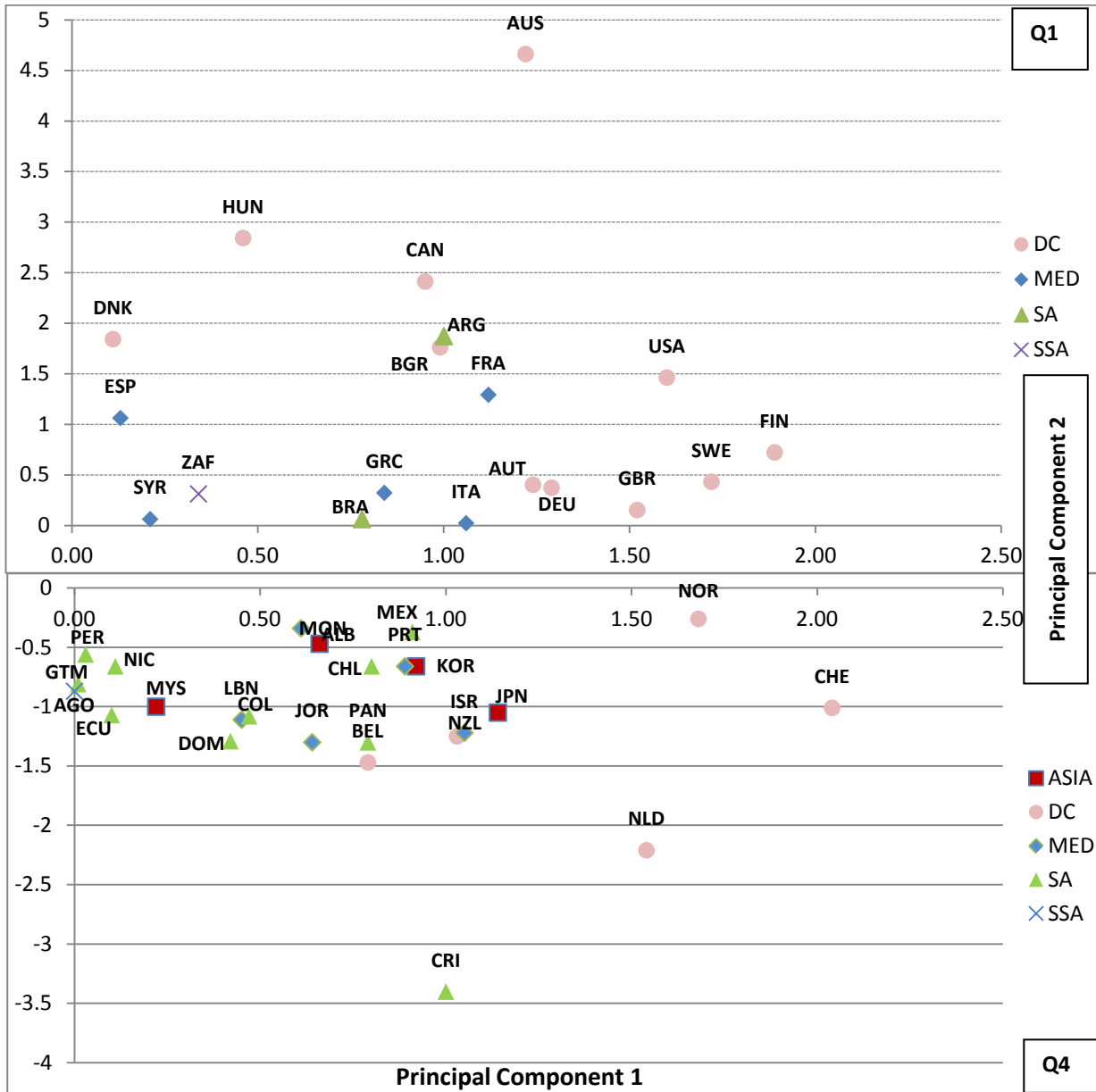
Source: Author's Elaboration

In Figure n. 29 are represented the countries with a negative level of economic development represented in quadrant 2 and 3 (Q2 and Q3). As espected, none of DCs show a negative value of PC1. In Q2 and Q3 there is a majority of SSA and Asian countries which show all a negative economic development; Burundi followed by Congo and Chad measure the lowest level. Yemen presents the highest problem of food insecurity among all countries. As showed previous in the Q4 (Fig.28) CostaRica has the highest negative level of PC2, however Yemen has both high value of negative economic development and negative basic food supply, this means difficulty on finances, infrastructures and food production, as a result it shows a vulnerability to garentee food security. Other countries present the same problem of both negati principal components value, meaning a probability to be food insecure:Burundi, Congo, Kenya, and cote d'Ivoire Sudan.

Figure n. 29- Zoom on PCA 2009 results (Q2 and Q3)
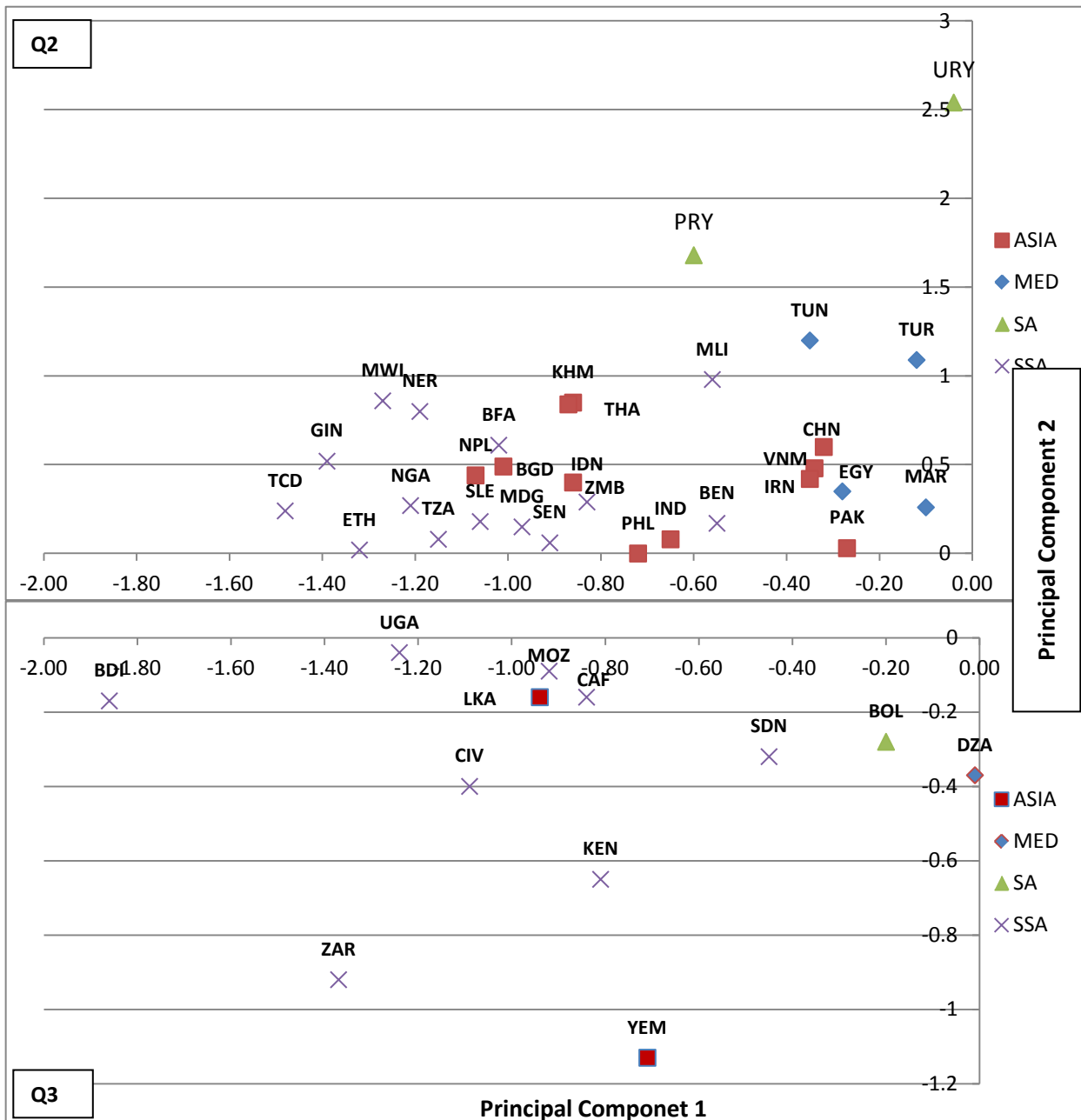
Source: Author's elaboration

Most of the countries show a trend in the economic development, Asia and SSA are negatively developed and DC and SA countries on the contrary show positive levels. However this the same statement does not work for the MCs (MED) countries. The countries representing this region are from three different continents (Europe, Asia, and Africa). As result, African countries show negative level of economic development and European are part of the DCs and show a positive level.

In addition concerning the PC2 any country has its own characteristics due to the available land, the cereals production, the climate conditions and the dependency on imports. Climate and also production policy and land quality play a key role in the definition of the basic food supply.

In the next section we will load our results on a chosen specific area: The Mediterranean Region.

5.1.3 Results in the Mediterranean Countries

The final step of this analysis is to calculate the scoring of each country in any of the two principal component that have been extracted. The two PC have been calculated for each of the 93 countries. However in this part we will illustrate and discuss the score of the PC1 and PC2 in the Mediterranean Area for some selected countries.

The next Table n.25 shows the score of the two principal components.

Table n. 25 Scores According to Principal Component 1 and 2.

		PC1	PC2	PC1	PC2	PC1	PC2
		1900		*2000*		*2009*	
Albania	ALB	-0.03	0.07	0.45	-0.61	0.61	-0.34
Algeria	DZA	-0.09	-0.58	-0.05	-0.62	-0.01	-0.37
Egypt	EGY	-0.54	0.02	-0.43	0.11	-0.28	0.35
France	FRA	1.29	1.23	1.33	1.23	1.12	1.29
Greece	GRC	0.41	0.62	0.98	0.29	0.84	0.32
Israel	ISR	0.95	-1.19	1.38	-1.32	1.05	-1.22
Italy	ITA	1.16	-0.01	1.15	-0.05	1.06	0.02
Jordan	JOR	0.59	-1.29	0.69	-1.49	0.64	-1.3
Lebanon	LBN	0.56	-0.85	0.29	-1.02	0.45	-1.11
Morocco	MAR	-0.34	0.35	-0.12	-0.12	-0.1	0.26
Portugal	PRT	1.15	-0.59	1.22	-0.66	0.89	-0.66
Spain	ESP	0.62	1.28	1.26	0.6	0.13	1.06
Syria	SYR	0.06	0.32	0.37	0.07	0.21	0.06
Tunisia	TUN	-0.31	0.8	0.34	-0.24	-0.35	1.2
Turkey	TUR	-0.06	1.04	0.01	0.78	-0.12	1.09

As expected, it show that the NMCs are better positioned than SMCs in the "Economic Development". Most of the countries have increased their development since 1990, however the food and economic crisis and the spike of prices level in 2008 had consequences on all the world countries. In Figure n. 30, it is possible to observe that all NMCs had worsened their economic development since 2000 especially Spain that in 2009 had measure an economic development which is lower than some of the SMCs (Algeria, Lebanon and Syria). Egypt is the country which experience the lower economic development even though it improved over the years. Tunisia had experience a rise in the wellbeing in 2000 but in 2009 it returned to experience negative level of development. In addition Tunisia Turkey and Morocco are the ones less economic

developed among the Mediterranean countries. Albania shows the lowest level of economic development in the NMCs even it present an amelioration in 2009

As far as the PC2 is concerned (basic food supply) we can observe that all SMCs show level of dependency to cereals imports. In the graphic if we refer to the year 2000 most of the SMCs were register an exposure to cereal imports and low level of production, except for Turkey. Countries such as Tunisia show a high change in the PC2 level form the 2000 to 2009, were it become less vulnerable.

Lebanon, Jordan, Israel and Algeria are the countries with the lowest level of PC2, this could mean that they are highly vulnerable to cereals imports. The other SMCs register positive level but near the 0 level (Syria, Egypt, Morocco). As far as NMCs are concerned their level of PC2 is different among countries compared to the PC1, countries such as Portugal and Albania show dependency to cereals imports and less productivity and arable land. However due to the lower economic development SMCs are less capable and more vulnerable to shocks than NMCs.

The outcomes of the PCA referring to the economic development (PC1) and the basic food supply (PC2) in MCs are represented graphically in Figure n.30.

Figure n. 30- **Principal component Score in Mediterranean Countries**

1990 =starting point   2000= middle point   2009 = label and last point
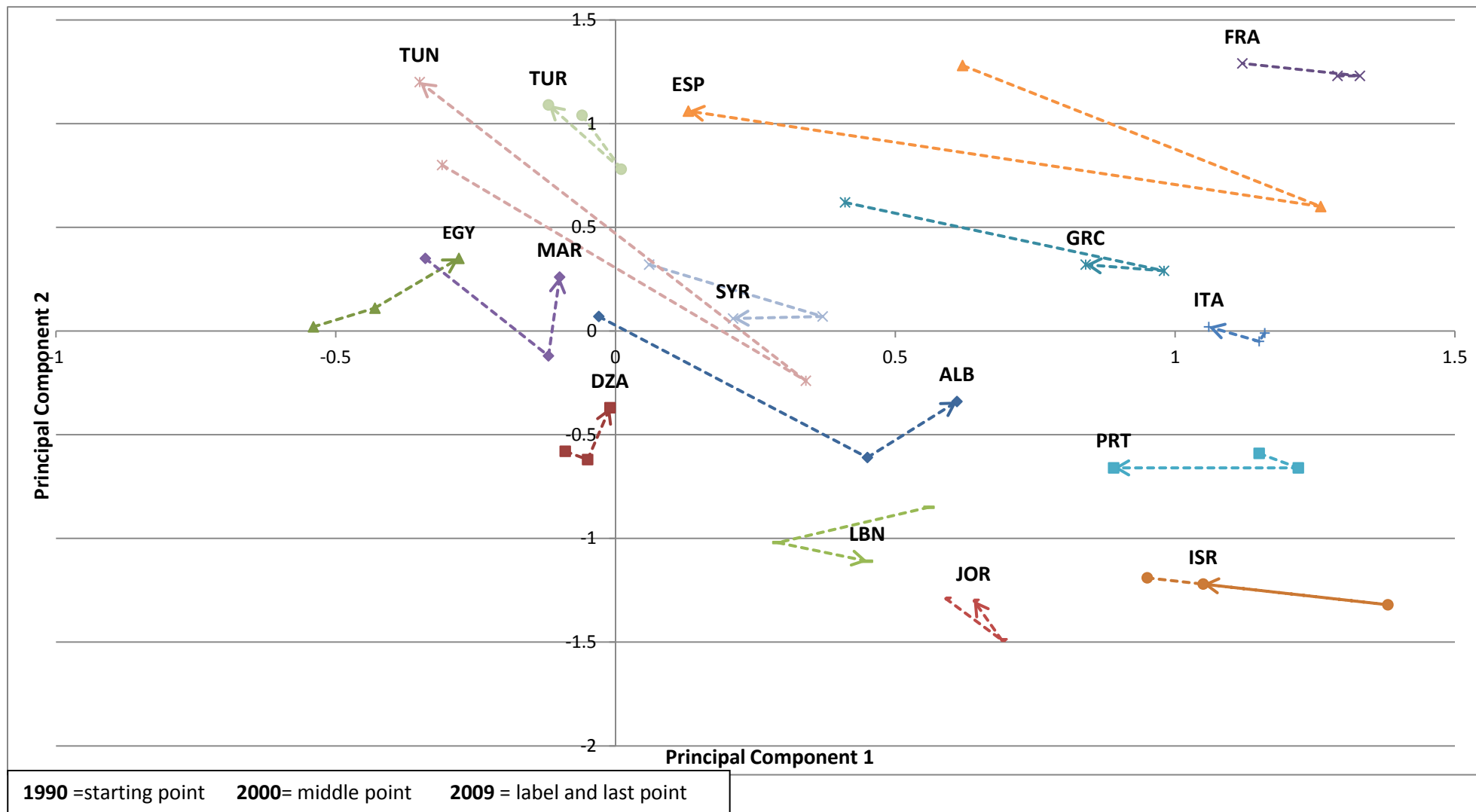
Albania

Albania presents the lowest level of the Economic Development (PC1) among the NMCs. Albania PC1 started from a negative level (-0,03) improving until 0.61 in 2009. As far as access is concerned, compare to the other NMCs, Albania's rural population (48%) is the highest and the GDP per capita (PPP) is the second lowest (4315 $) after Portugal (3288$). In addition Albania presents a diminishing of the of infrastructures such as the road density and the access to improved water source in 2009 (respectively from 97% to 95% and from 64 to 62%). Moreover Albania has augmented its meat production (15 kg in 1990 to 28 in 2009), the import dependency (7% in 1990 to 36% in 2009) and the consumption (from 4% to 8%). Albania is also the biggest consumer (17%) and producer of milk in the Mediterranean area rising its production from 150kg in 1990 and doubling the production in 2009 up to 331.62 Kg/cap. Basic food supply level worsened and became negative since 1990. Albania is the second lowest after Portugal and it seems to be vulnerable to the cereals imports, it raised the imports since 1990 from 17% to 41%.

Algeria

Algeria presents a negative level of economic development. In 1990 the PC1 registered a negative level(- 0,09) that slightly improved until 2009 (-0,01). Algeria's rural population decreased since 1990 (48%) reaching the 30% in 2009. It counts the third highest GDP per capita level in SMCs and has lowered the variability of it from 169$ in 1990 to 62$ in 2009. Infrastructures are not very developed the road density measures only 4.70 Km per 100km² the lowest amount in the Mediterranean Region. The land productivity (cereals yields) show a rising over the years form 687 kg/ha to 1653 kg/ha. This might show some external reason to this instability such has climate condition. Algeria's dietary pattern remains quite similar over the years: cereals are the most consumed food (54%) and meat never got over the 3%. Domestic prices are stable for all the countries in the Mediterranean area even in Algeria the level decreased from 1.85 in 1990 to 1.68 in 2009. Moreover Algeria seems to be quite vulnerable concerning the political stability level which always been negative even if it improved measuring -1.86 1990 up to -1.22 in 2009.

As far as the PC2 is concerned as mentioned before cereals are the first staple food to be consumed in Algeria. The PC2 level has always been negative which means that Algeria might be vulnerable and dependent to cereals imports and variability of production. The production of cereals doesn't seem constant in 1990 production was 61 kg per person, diminishing to 29 kg/cap in 2000 and rising until 144 kg in 2009. In addition cereal self-sufficiency ratio is quite low measuring a 21% in 1990, 10% in 2000 and 44% in 2009. Import ratio of cereals reach the highest point in 2000 (83%) and still measured an high percentage in 2009 (67%).

Egypt

Egypt is the lowest developed country in SMCs with a level of-0.54 in 1990 which improved until -0.28 in 2009. Egypt population is mostly rural and its level remained constant (56%).Egypt is the highest consumer of cereals in the Mediterranean area (65%) which can be an indicators of a low dietary diversification, therefore consumption of meat, milk, vegetable oils have not improved in this country.

It is also vulnerable on the political stability side, which seemed to start an improvement process in 2000 (- 0.01) but its level decreased in 2009 (- 0.62). This could cause the jeopardizing of food security policies. In addition, it is vulnerable to the GDP per capita variability which measured around 108 $ in 1990 and rise up to 339 $ in 2009.

As far as PC2 is concerned Egypt register a positive level which improved over the years. Therefore Egypt is the second less dependent on cereals import of SMCs (from 42% in 1990 to 305 in 2009). It also register a cereals self-sufficiency over the 50% (65% in 2009). Beside the fact that arable land availability is quite low (0.04 Ha/cap) Egypt produces 272 Kg of cereals in 2009, amount that remained quite constant over the years.

France

France represent the most economically developed country of MCs even its level decreased since 1990 and measuring 1.12 in 2009. France population is mostly urban registering only the 15% in 2009. The GDP per capita is the highest (29168$)of the Mediterranean area and its variability have got more stable since 2000 (1007$ in 2000 and 488$ in 2009). France produce around 374 kg/cap of milk which makes it the biggest producer among MCs. It presents the lowest consumption of cereals(26%) after Spain, the highest level of meat consumption (12.30%) and sugars (11%) of NMCs. Compare to SMCs dietary diversity is greater which is also a sign of economic development as explained by the Engel's law. France infrastructures are well developed, the road density is the largest in MCs (189 km per 100sq). Furthermore is the country most dependent on fruit and vegetable import (52%). In addition it shows a positive level of political stability (0.47in 2009) even it decreased since the 90s(0.82).

Regarding the Basic food supply, France does have the largest amount of arable land per person in NMCs (0.28 Ha/cap). Moreover it produces about 1081kg/capita of cereals making it the less vulnerable to imports (7%) and self-sufficiency ratio measured the 174% in 2009.

Greece

Greece economic development highly improved since 1990, even there is a decrease from 2000 to 2009. Greece, second only to Portugal, has the highest percentage of rural population (38%) in the NMCs. Food consumption concerns cereals (28%), meat (12%), milk(9%) and vegetable oils (6%). The GDP per capita is quite elevated (25302$) however from the 1990 the variability of the income increased from about 438.28 $ in 1990 to 829 $ in 2009, which might imply an higher exposure to shocks. Moreover Greece has experienced to be more vulnerable concerning the political stability from 2000 (0.71) it became negative(-0.22 in 2009).

The Basic food supply of Greece show a lower level than 1990 but still positive (0.32 in 2009). The availability of arable land has decreased from 0.29 ha/cap in 1990 to 0.23 in 2009.Greece shows a good level of cereal self-sufficiency (89 %) and import dependency ratio rise from 14% in 1990 to about 30% in 2009.

Israel

Israel has the lowest level of rural population (only 8%) among the MCs and it is the most economically developed of the SMCs even the level of its development decreased since 2000 from 1.38 to 1.05 in 2009. GDP per capita is the highest of the SMCs 25250$. Consumption of cereals is the 30%, 11% of meat, 7% of milk, 11% of vegetables oils and 7% of sugar. Israel concentrate its production on meat which has increased from 50 kg/cap in 1990 to 89 kg/cap in 2009. Another commodity produced in large amount is the milk even the production has decreased from 1990 (211 kg/cap) to 2009 (175 kg/cap). This economic development is obstacle by an high vulnerability to political instability which measure -1.62 in 2009.

Concerning the basic food supply Israel registers one of the lowest level -1.22.Israel has very few arable land available (about 0.04 Ha/cap), its production of cereals has lowered considerably over the years (from 85 kg/cap in 1990 to 34 kg/cap in 2009). Data show a few cereal self-sufficiency available for the country (7%) meaning a very high level of cereals imports about the 105%.

Italy

Italy presents a high level of economic development together with country such as France, Greece, Portugal and Spain, even if, since 2000 the economic development decreased. The actual rural population is the 30% and it show as well a good level of GDP per capita (26729$). Italian infrastructure as road density and improved water source are well developed (162% and 100%). Consumption of cereal is 30% of the total and it is the highest consumers of vegetable oil in the MCs (19%). Italy seems to be dependent on meat imports for the 34% , in addition also the vegetable and fruit imports have augmented since 1990 (from 6% to 16% in 2009). Italy presents

as well as France a positive level of political stability even it worsened since 2000 (from 0.85 to 0.34).

Concerning the basic food supply Italy has the lowest level after Portugal and Albania. The land availability per person, 0.12 ha/cap, is quite low compare to France, Greece and Spain, as well as cereal production which count around 280kg/cap. Moreover Italy is cereal self-sufficient for the 67% and dependent on import for the 41% which compare to Greece and France is quite elevated.

Jordan

Jordan is the second most developed in SMCs. Rural population is on the 17% of the total; the GDP per capita measure 5245$ with and important variability (329$ in 2009). Despite its positive level of development, the infrastructures as the road density are the lowest among MCs (9%). The food consumption in Jordan is concentrated on cereals for the 44% , meat(6%), milk(5%), the highest level of sugar (14%) and vegetable oils (13%). Jordan is also dependent on meat imports for the 43% and vegetable for the 26%. Concerning political stability it increased its vulnerability since 200 (from -0.01 to -0.36 in 2009).

Concerning the basic food supply Jordan show a negative level and it is the lowest of the MCs (-1.3 in 2009). The availability of land (0.04 ha/cap) is the lowest together with Lebanon, it is also the third most depend on cereal imports and the cereals production is almost null (10kg/cap) which make this country highly vulnerable in case of international shocks.

Lebanon

Lebanon economic and basic food conditions are quite similar to Jordan. The level of its economic development is positive , the rural population was the 12% in 2009, the second lowest in MCs. The income per capita(11739) is the third highest in SMCs after Israel and Turkey, even if, it shows an important variability which increased since 2000 (from 136$ to 806$). Diet diversity is represented by the 30% of cereals, 5 % of milk and 9% of meat, and the consumption of vegetable oils lowered significantly from 13 % in 1990 to 1% in 2009. Lebanon political stability is very low, and it decreased notably from -0.53 in 2000 to -1.58 in 2009.

As far as the basic food supply are concerned Lebanon counts a negative level (-1.11). Arable land availability is very low (0.03 ha/cap) and it is the second country, after Israel, most vulnerable to cereal imports counting 72% in 1990 up to 93% in 2009. Cereals production is quite low (45 kg/cap), it is the third less productive country in MCs.

Morocco

Morocco shows a negative level of economic development, is the third country less develops among MCs. It present a high percentage of rural population (43%); the GDP per capita (4167$) is the lowest in MCs and it is even lower than Egypt. The variability of the income per capita increased from 62$ in 2000 to 213$ in 2009, this is a sign of vulnerability to shocks for Morocco. Morocco diet is based on cereals (57%), the consumption of milk(2%) is the lowest in the MCs, meat covers only the 4% and there has been an increasing in the sugars consumption (12% in 2009). Infrastructures ad road density are little developed , only 13 km/100km² and improved water source presents the lowest percentage in MCs (81%). Morocco has improved the production of milk (from 40 kg/cap in 1990 to 60 kg/cap in 2009), as well as production of meat (from 19 kg/cap to 30kg/cap). It is not dependents on vegetable and meat also because it present a low consumption of this food supply. However the political stability is negative(- 0.41) and as it happened in other MCs it lowered since 2000.

 Concerning the basic food supply Morocco show positive level in 1990 and 2009, and negative in 2000. This could depend on the fact that Morocco is dependent on cereals imports, in 1990 it registered the 20% , in 2000 the 55% and in 2009 the 44%. This phenomenon is linked to an high variability in the production of cereals, which measured 58 kg/cap in 1990, up to 103 kg/cap in 2000 and 75 kg/cap in 2009. Morocco is one of the most vulnerable countries to cereals production shocks. In absence of shocks, Morocco is capable of producing high amount of cereals (224 kg/cap in 2009). The influence of climate is usually the reason to these shocks.

Portugal

Portugal shows a positive level of economic development as all the NMCs even it worsened since 2000. Portugal present still a 40% of rural population and GDP per capita is quite elevated 21375$ even it hasn't improved much since 2000. It used to registered a high variability in the income that got more stable from 1088$ in 2000 to 307$ in 2009. Dietary consumption is composed by cereals for the 30%, meat (11%), milk (7%), vegetable oils (11%) and sugar. Infrastructure are the worst in the NMCs and they highly degraded since 1990 (from 73 km/100km² to 23 km/100km²). Portugal is both dependent on meat imports (30%) and vegetable and fruits imports (25%). As it happened the political stability has lowered since 2000 but the level remains positive (0.76 in 2009).

Portugal present the lowest level of basic food supply in the NMCs. It show a high dependency in cereals imports (about 90%), the highest in NMCs. Arable land decreased notably since 1990 (from 0.23 ha/cap to 0.11 ha/cap) and so did the production of cereals from 134 kg/cap in 1990 to 94 kg/cap in 2009.

Spain

Spain used to have a high level of economic development that improved from 1990 to 2000 reaching its highest level. However in 2009 there was a substantial crash on Spanish economic development which decreased from 1.26 in 2000 to 0.6 in 2009. Spain has 22% of rural population and the GDP per capita measured 27082$ in 2009. Infrastructures present a high level (132 km/100km²). Dietary share presents the lowest amount of cereals(23%) in MCs, followed by meat(12%), milk (7%), sugar (8%) and vegetable oil (10%) of which it used to be the highest consumer until 2000 (20%). Political stability decreased reaching a negative level from 0.61 in 200 to -0.47 in 2009.

Regarding the basic food supply Spain arable land is about 0.26 ha/cap. It is cereal import depend for the 44%, cereals production have lowered from 600kg/cap in 2000 to 380 kg/cap in 2009, and it presents an important variability on the production (58 kg/cap in 2000 and 75 kg/cap in 2009).

Syria

Syria economic development lowered since 2000 but still presents a positive level (0.21). Rural population is the 44% of the total and the income per capita measured 4167$. Syria road density is quite low 36 km/100km²and improve water source is 89%. Dietary share is composed for the 44% by cereals, followed by meat(4%), milk (7%), Sugars (9%) and vegetable oils(16%). Syria is not dependents on meat imports, and the production is low(21 kg/cap). Moreover political stability is worsening and the level it is negative, -0.49 in 2009.

As far as basic food supply are concerned, Syria shows a positive level and stable level since 2000 (0.06), even if in 1990 the level was higher. Arable land is 0.22 ha/cap in 2009 and decreased since 1990(0.39 ha/cap) it does produce a large amount of cereals (224 kg/cap in 2009), even if it is also dependent on cereals imports for the 65%

Tunisia

Tunisia registered a positive level of economic development in 2000 (- 0.34) which became negative in 2009 (- 34). Tunisia counts about 34 % of rural population and the GDP per capita is 8333.68 with an important variability that increased from 108$ in 1990 to 426$ in 2009. Infrastructure are little developed, road density measure only 12 km/100km². The dietary consumption presents a prevalence of cereals up to 51%, followed by sugar (11%), vegetable oils (12%), meat and milk are consumed in very little amount (about 3%). However the production of milk increased from 53 kg/cap in 1990 to 103 kg/cap in 2009. Tunisia is one of the lowest

countries dependent to meat and vegetable imports. Political stability is positive, even if, as all countries, it decreased from 0.28 in 2000 to 0.06 in 2009

Basic food supply in Tunisia has a similar path as in Morocco, in both countries the level was positive in 1990 and 2009 and became negative in 2000. Beside the decrease of the arable land over the years, this might be imputable to a high dependency to cereals import which measured the 70% in 2000 and decreased up to 47% in 2009. Furthermore Tunisia cereals production is higher in 2009 (247 kg/cap) than in 2000 (115 kg/cap) and the production variability plays an important role (73 kg/cap in 2000 and 44kg/cap in 2009).

Turkey

Turkey economic development was slightly positive in 2000 and returned negative in 2009. Since 1990 the rural population decreased from 40% to 30% in 2009 and the GDP per capita increased up to 11754$ and GDP variability augmented from 264$ in 2000 to 409$ in 2009. Infrastructures are quite developed compare to the others SMCs measuring 46 km/100km². Turkey diet consumption is 47% based on cereals, , 7% of milk, 8% of sugars, 14% of vegetable oils, and a very little percentage of meat (2.70%). Turkey is the lowest importer of meat in MCs (0.10%). It is the largest producer of sugars in SMCs and second only to France among MCs, it also have an high production of milk (176 kg/cap). Turkey political stability worsened in 2009 even if it always registered a negative level (from -0.84 in 2000 to -1.03 in 2009).

Basic food supply is the second highest after France. Turkey has the largest amount of arable land available per person (0.30 ha/cap) in MCs. In addition it produces a high amount of cereals and it is the second producer among MCs, since 1990 it has been also highly self sufficient in cereals, up to 103% in 2009.

Summary of Results

NMCs result to have all a higher economic development compare to SMCs. Israel makes and exception on the level on the economic Development which is very close to the NMCs standards. Jordan and Lebanon also show high level of economic development. Concerning food consumption in MCs is normally based on cereals, on the one hand NMCs consume less cereals (around 30%) in favour of more meat, milk, fruit and vegetables, on the other hand SMCs register an high consumption of cereals (40/50 %), and sugar(around 12/15%). Infrastructure are normally better developed and the GDP income is definitely larger in NMCs, only Israel reaches the same levels of NMCs. Jordan, Lebanon and Israel have a very low level of basic food supply. All the three countries have very little arable land available (about 0.03 Ha/cap) and they also are dependent on cereals imports (around 90% and 100%). Among the SMCs all countries have high level of

cereals imports, such as Algeria (69% in 2009), Syria (65%), Tunisia (47%) and Morocco (44%), only Turkey has the lowest level of import dependency ratio.

Tunisia and Spain experienced the highest constraints in the economic development from 2000 to 2009, Spain registered a lower cereals yields rent from 3609 kg/ha in 2000 to 2938 kg/ha in 2009 and also the GDP per capita increased at a lower growth rate compare to 1990. Tunisia beside having reduced to negative its economic development in 2009, improved the basic food supply level. Concerning the PC2 also Morocco presented the same tendency, this show the vulnerability of this countries to food imports and where food security is affected by constraints in the cereals production in which climate conditions plays a key role.

6. Conclusions

The aim of this research project is to analyze the different dimension of food security and to show the different economic issues which represent the most important aspects affecting the food security in the Mediterranean Countries. The objective is then to the identify appropriate theoretical concepts and methodological tools to be used in the assessment of food security of a country (or region), with a particular emphasis on its economic dimension.

Food Security has always been a challenging matter. Authors such as Malthus in 1978 theorized the problem of the food supply in relation with the increasing of the population , or Engel (1821) which correlated the income level to the share of food expenditure. The term "food security" was established in the '70s, during the 1974 World Food Conference, and it was related to the ongoing food availability. Food security reflects the nature of the food problem experienced by poor people, however since the '70 the concept has evolved, developed and modified. After the early '80s, the definition of food security became more and more a problem of access to food, theorized by Sen A. as "food entitlement". Different authors (Maxwell, 1996; Chambers, 1989; Sen, 1981) gave their contribution to define food security, however FAO's definition of 1996 have gotten the major consensus.

The food security issue was emphasized when it became one of the Millennium Development Goals (MDG) task in 2000 during the Millennium Summit: "The target of reducing extreme poverty rates by half by 2015".

In addition following the financial crisis and prices spikes of 2008, the debate and the problem concerning the food security acquired relevance. Debate has more and more affected the entire world, not only the least developed countries but also the emerging economies.

Developed Countries have more financials availability and political stability to face food and financial crisis, however the economies in transition, the emerging economies and in particular the least developed countries still present inefficiency in the policy-making process and in the economic stability. These countries show vulnerability to became food insecure due to an high exposition to shocks and a lower resilience to them.

Based on the analysis conducted we gave a contribution to the assessment of food security with a particular focus on the Mediterranean region.

The first step was to review all theories and authors which contributed to the assessment of food security. From this first phase emerged the complexity of the subject and the absence of a unique definition. In this study we referred to the FAO's food security definition ": "...all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life." (FAO,1996).

Along with the food security concept, many authors (Combes and Guillaumont, 2002; Dilley and Boudreau, 2001; Romer Lovendal et al. 2004; Scaramozzino, 2006)have been induced to make reference to the concept of vulnerability which does not have an official and unique definition yet. In this research vulnerability to food security has been considered as exposure to risk and resilience to them (Romer Lovendal et al. 2004) and characterized by three dimensions: shock, exposure, resilience (Combes and Guillamont, 2002).

Food security has been analysed through a multidimensional approach by considering four of its dimension of food security: availability, access, utilization and vulnerability.

After a global framework on food security the Mediterranean region and in particular 15 countries, became the focus of our study: Albania, France, Italy, Greece, Portugal, Spain, Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia and Turkey. North and South Mediterranean Countries (SNMCs) present many common features but also significant disparities either in food demand (food consumption patterns, food safety and nutritional conditions), food supply (agricultural production conditions, climate, integration into international markets,) and governments' policies.

The social and economic development, and a much more stable policy system in NMCs contribute to their capacity to react (resilience) to food crisis or shocks (political, economical).

However SMCs have entered into a process of economic and policy transition, and they have implemented policies and stabilization plans to control macroeconomic issues, reduce their disparities and improve their growth. Beside these transitions, food security has always been a serious challenge, for various reasons: high food prices, dependency of these countries to food imports, the rising of food demand due to population growth and problems to access water resources (IFPRI, 2012b). As far as availability is concerned, average food supply is found to be adequate and slightly improving in most countries (even though the supply adequacy indicator considered doesn't provide information on different income groups). Food availability has increased for fruit, vegetables and (to a lesser extent) for milk. The former two commodities are normally destined to food export, and contribute to the economic development of the country, but not to their internal self-sufficiency.

Food supply availability is also hampered by natural resource constraints, such as the scarcity of arable land equipped with irrigation. This means that agricultural production is highly affected by water precipitation and climate instability (droughts). This is a major vulnerability factor that can expose the country to shocks as high prices and large percentage of food imports and ultimately lead to food insecurity. Domestic production variability can also induce countries to augment their import to guarantee their domestic food security. All MCs import cereals, in particular SMCs are highly dependent on cereals imports (in 2009 Jordan imported the 90 %, Lebanon 93%), shocks in

production and in food prices can generate a vulnerability to food (in)security. According to the data available on economic access, NMCs have and higher GDP per capita (from the lowest amount in Greece 20921$ up to 29823$ in France in 2012)compare to SMCs. Income per capita is improving also in SMCs, at a lower rate, Turkey(13737$ in 2012) and Lebanon(12591$) show the highest level in SMCs, after Israel which present a level of economic development close to NMCs. Morocco and Syria remain the SMC countries with the lowest GDP per capita (4573$ and 4684$ in 2012), followed by Egypt, Jordan , Algeria and Tunisia. Physical access to food markets did not improve substantially over the time in any of the countries considered. The SMCs road density remain very low, Algeria and Jordan show respectively only 4.70 and 8.82 km of road per 100 km²of land area, compared to the NMCs which register road density up to 161 km of road density per 100 km²of land area in Italy, 132 in Spain and 190 in France.

As far as utilization is considered cereals are the main staple food consumed, however in NMCs (North Mediterranean Countries) diet is more differentiated and consumption of meat, milk, sugar, fruit and vegetable is increasing. On the contrary SMCs base their diet on cereals consumption with a slight augment in the consumption of milk, sugar and vegetable oils.

As far as vulnerability is concerned, SMCs seems to be less resilient to shocks compare to the NMCs. NMCs have on their side a major economic development and a systems of regulations and political stability which allow to prevent shocks such as price volatility or constraints in food production.

SMCs present economies in transition where the political identity is in continuous evolution and unconsolidated policy on prices and production might create riots and instability. In addition climate conditions make this countries exposed to shocks in production and to food imports.

Consequently, based on the conceptual review conducted, we proposed and calculated a refined set of indicators to assess structural trends observed in food security and vulnerability conditions. Due to the high number of factors and variables playing a key role in the determination of food security , we concentrate on the economic issues involved in food security and created a dataset of 93 countries, from each Continent, considered 40 indicators in total and collected the date for three different years 1990, 2000 and 2009. At this point the PCA methodology was applied in order to reduce the number of variable and facilitated the assessment. In our study we chose to adopt a two-step methodology: 1) Indicators of each dimensions were grouped and PCA was ran for each dimension. These methods confirmed the significance of the dimensions and of the indicators selected to assess food security.

2) The same dataset was considered and all the indicators were ran in a unique PCA in order to reduce the number of indicators and give a global assessment of food security.

Two were the PCs retained which explain together about the 40% of the total variance, meaning that other factors play a role in the assessment of food security. In these results food security is determinate by two Principal Components : the economic development (PC1) and the basic food supply (PC2). Economic development is explained by indicators of: 1) availability such as cereals yields; 2) access as food prices ,rural population, per capita GDP and infrastructure (Road density and improved water sources); 3) utilization as the food consumption and 4) vulnerability as the GDP per capita variability and the political stability. Moreover basic food supply is explained by indicators of cereal production, self-sufficiency and arable land (availability) and indicators of variability such as cereals production variability and cereal imports.

PCA results show the food security situation in the 93 countries selected. As expected the developed countries (DCs) are the most food secure showing high economic development and positive level of basic food supply compare to the other geographical areas. Moreover, most of South American countries show a positive level of economic development and a negative one in basic food supply. Sub-Saharan Africa countries show the lowest economic development together with the majority of Asian countries.

Our results show that in DCs there is not a risk to food insecurity. As a result, food security in high-income countries have more financial sources, technology and strategies to guarantee food security. These countries main concerns are the sustainability, the long-term availability and affordability of food. Their challenge on food security is to meet the rising demand for food through environmentally, socially and economically sustainable processes. On the contrary, low income countries as in Sub-Saharan Africa and in most of Asia face problems of undernourishment and chronic hunger. The lack of infrastructures, of improvements in technology threaten their food security. In these countries there is enough room to improve productivity instead of expanding the arable land, but lack of infrastructure and arid and marginal environments are a great obstacle .

Overall, the results obtained show moderate and gradually improving both vulnerability and food security conditions in the targeted countries. However critical aspects emerge from a closer examination of the various food security features and vulnerability aspects due to country-specific issues.

However the MCs food security doesn't show an homogeneous trend. The Mediterranean Area is represented by developed, North African and East-Asian countries which explain in part the disparities. As a results, the NMCs are, also part of the DCs, the most food secure, only Portugal and Albania are more exposed (vulnerable) to cereals import. On the one hand, the MCs compared to countries experiencing high level of food insecurity such as the Asia and Sub-Saharan Africa countries (SSA) do not show extreme poverty or and high incidence of infectious

diseases (ex. malaria, tuberculosis, HIV/AIDS) and emergency situations such as natural disaster or conflicts (Padilla et al. 2005). On the other hand, in particular the SMCs show weaknesses in the economic development and in the basic food supply. SMCs show a higher level of vulnerability to food insecurity, they tend to be dependent on cereals imports, to experience a higher political instability and to be affected by climate conditions. However, some of these countries, such as Lebanon and Israel, which are high cereals importers, seems to be less exposed to problems of food security and more resilient, thanks to their financial sources. As far as the basic food supply is concerned, some MCs (Morocco, Tunisia, Spain) experienced high oscillations over the years, showing their vulnerability to food imports and that food security is affected by constraints in the cereals production in which climate conditions plays a key role. Their vulnerability is also exacerbated by the farmers constricted to leave their agriculture holdings, the reforms implemented in favour of the liberalization of the land market in countries (Tunisia, Morocco and Egypt) where the peasant agriculture have always been the centre of agriculture sector. (Habib Ayeb, 2012).

In addition, the political instability increased from the 2008 financial and food crisis worsened until the uprisings of the 2011 called "the Arab Spring".

In order to react to economic and political vulnerability worsened by high food prices and generating food security problems SMC have to focus on different tasks: global food and agriculture outlooks and option for policy including climate change issues; globalization, trade and market inclusion; natural resources policies; risks and emergencies; governance and policy processes; development strategies; poverty; nutrition and social protection; diet, health and food safety.

As we argued, SMC are different to the other developing countries for their human development, and they are vulnerable to shocks in particular for their dependency on cereals imports and their internal instabilities. In conclusion the important task for these countries is to implement and design efficient strategies and policies to react to shocks, to improve their resilience.

The SMCs adopt different strategies to protect their countries, but this doesn't mean their efficiency. Therefore the SMCs present a double inefficiency: 1) the states' inefficiency which have trouble to stabilize the systems and 2) the markets inefficiency which present high instability and volatility (worsened by speculative behavior in the public and private sectors).

MCs experience somehow vulnerability to food insecurity and a shared and common agricultural policy for Mediterranean countries is therefore of fundamental importance and must address the following issues.

As far as availability is concerned MCs have enough adequate food supply, however production is threaten by climate condition and arable land is diminishing, so it is important, the development

of compensation and mitigation policies in natural resources management to guarantee farmers' incomes and accompany the trade liberalization process.

Access remain an important challenge to SMCs especially concerning the improvement of infrastructure and technology. Technology enhancement is one of the key issue to stabilize productivity and boost efficiency so as to achieve general food security objectives, both in its access and availability dimensions. Other useful strategies relate to the creation and enforcement of public-private partnerships, producer associations and cooperatives aimed at supporting professional training and improving access to inputs and services (i.e. mainly credit and insurance, certification) for small and medium producers.

Moreover Access to food must be complemented with access to health services, education, salubrious environments, and safe water sources, amongst other resources, in order to achieve nutrition security.

MCs presents still issue on the food quality and utilization ,strategies to promote access to quality-assured and balanced food have to be implemented. Public intervention should strengthen control systems and implement strategies to rationalize the consumption of certain strategic products through pricing and taxation policies. In addition the identification of joint action in the Mediterranean region has to be enhanced in order to improve information and awareness of the connection between diet and health and to promote the nutritional and environmental aspects of Mediterranean agricultural production in connection with the Mediterranean dietary model.

The improvement of management and monitoring policies for food safety in order to ensure food of sufficient diversity and safety to promote good health should be pursued.

Furthermore MCs are still vulnerable to food security and exposed to food imports and to shock in food production and prices, in order to improve their resilience to guarantee food security, efficiency in the food chains should be pursued by supporting networks of economic agents at various stages, from production to export, and introducing regulations which enhance market information and transparency and international trade opportunities. These measures may help producers to correctly perceive and react to market signals and benefit from opportunities or avoid threats arising from domestic and international markets.

Another way to improve their resilience is to support and promote the development of contractual and concentrated forms of agricultural supply with greater involvement of farmers through producer organizations with a view to enhancing bargaining power, achieving greater price stability and ensuring that value added is distributed more equitably throughout the

production chain. Agricultural market reform can improve the food security of poor consumers by improving the private production, distribution, and processing of the type of foods they consume. Action to share and strengthen policies for improving quality and differentiating Mediterranean agricultural products in order to identify and enhance the Mediterranean food product chain, in which, through measures to improve organic farming and expand geographical indications, tradition and origin can play a key role in creating value added and protecting typical traditional products on the international market.

 Measures to encourage greater interest in rural development policies, which can improve the potential of a rural system by integrating various local economic activities. Rural development policy could be the tool applied to common and converging operational approaches to enhance the image of the Mediterranean and of typical local products and at the same time protect the agricultural ecosystem and the landscape.

The Agricultural policies, often, are to try to prevent market failure through mechanisms of correction and containment of the effects due to low equilibrium in pricing or asymmetric information, generated by inefficient allocation of resources and unequal distribution of income along the food chain. The South Mediterranean countries should try to improve their policies to reduce their economic and political vulnerability.

Through this study we were able to understand that food security remains a challenging matters not only for the least developed countries. Other elements emerged: the vulnerability dimension play a key role in the determination of food security; economies in transition as SMCs are exposed to food (in)security vulnerability; economic development and governments' policies and strategies play a key role; specific country characteristics are fundamental to design strategies to guarantee food security; access to data are determinant.

Food security remains a complex and multidimensional problem where further studies must be developed. This Macro-economic analysis allowed us to draw a common path in the definition of food security and state the importance of the economic development and of the basic food supply. However to have a better picture of the situation of a country other factors are involved. Food security is also connected to social, cultural and political background, the government's policies are crucial to guarantee the food security of a country. In addition there are other limits to this kind of research: unfortunately macro-economic data are not always precise and accessible. Some important indicators weren't included in the analysis due to lack of data. One important indicators to analyze food security also in developed countries and to study the population group more vulnerable is the income distribution and the share of food expenditure on the total expenditure. Thus, even though the Southern Mediterranean Region doesn't present startling food security concerns as other developing countries do (e.g. in the sub-Saharan region),

income distribution in SMCs is rather imbalanced and there are purchasing power inequalities heightening their vulnerability.

Moreover the methodology used was necessary to reduce the number of variables involved in the food security. The PCA objective is to reduce the dimensionality of a data set consisting of a large number of interrelated variables, while retaining as much as possible of the variation present in the data set. This is achieved by transforming to a new set of variables, the principal components (PCs), which are uncorrelated. In addition PCA is a static process, and this assumption will somewhat deteriorate the monitoring results for dynamic processes such food security. In order to assure food security the implementation of strategies and policies is important. They have to focus on: improving data access to be able to understand the evolution of the phenomena over time studying the shocks (production, climate, economic crisis), the reforms, the policy system and the social background; increasing economic growth (more a country is economical vulnerable the more will be exposed to shocks), and allowing a better distribution for the expenses in the public sector.

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Appendix 1 – Selected Countries ' List

Label	Asia Country	Label	Developed Countries Country	Label	Mediterreanean Countries Country	Label	South America Country	Label	Sub-Saharan Africa Country
BGD	Bangladesh	AUS	Australia	ALB	Albania	ARG	Argentina	AGO	Angola
KHM	Cambodia	AUT	Austria	DZA	Algeria	BOL	Bolivia	BEN	Benin
CHN	China	BEL	Belgium	EGY	Egypt	BRA	Brazil	BFA	Burkina Faso
IND	India	BGR	Bulgaria	FRA	France	CHL	Chile	BDI	Burundi
IDN	Indonesia	CAN	Canada	GRC	Greece	COL	Colombia	CAF	Central African Republic
IRN	Iran	DNK	Denmark	ISR	Israel	CRI	Costa Rica	TCD	Chad
JPN	Japan	FIN	Finland	JOR	Jordan	DOM	Dominican Republic	ZAR	Congo, Dem Rep
KOR	Korea,Rep	DEU	Germany	LBN	Lebanon	ECU	Ecuador	CIV	Côte d Ivoire
MYS	Malaysia	HUN	Hungary	MAR	Morocco	GTM	Guatemala	ETH	Ethiopia
MON	Mongolia	NLD	Netherlands	PRT	Portugal	MEX	Mexico	GIN	Guinea
NPL	Nepal	NZL	New Zealand	ESP	Spain	NIC	Nicaragua	KEN	Kenya
PAK	Pakistan	NOR	Norway	SYR	Syria	PAN	Panama	MDG	Madagascar
PHL	Philippines	SWE	Sweden	TUN	Tunisia	PRY	Paraguay	MWI	Malawi
LKA	Sri Lanka	CHE	Switzerland	TUR	Turkey	URY	Uruguay	MLI	Mali
THA	Thailand	GBR	United Kingdom	ITA	Italy	VEN	Venezuela	MOZ	Mozambique
VNM	Viet Nam	USA	United States of America					NER	Niger
YEM	Yemen							NGA	Nigeria
								PER	Peru
								SEN	Senegal
								SLE	Sierra Leone
								ZAF	South Africa
								SDN	Sudan
								TZA	Tanzania
								UGA	Uganda
								ZMB	Zambia

Appendix n. 2 – Mediterranean Countries Database

	Rural population (% of total population)			% of arable irrigated land			Cereal yield (kg per hectare)			GDP per capita, PPP (constant 2005 international $)			Standard Deviation/Variabiltiy GDP per capita, PPP (constant 2005 international $)		
	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009
Country															
Albania	63.57	58.26	48.78	73.06	59.86	55.83	2794.39	3175.08	4315.32	3731.69	4461.05	7525.78	175.79	391.57	568.27
Algeria	47.92	39.21	29.04	6.17	7.54	7.61	687.67	883.27	1653.94	5861.82	5730.07	7138.56	169.71	131.02	61.99
Egypt	56.52	57.20	56.69	115.94	116.55	126.56	5702.94	7280.08	7158.35	3266.44	4235.99	5570.64	108.36	197.13	339.12
France	25.94	23.11	15.51	10.95	14.50	14.17	6082.61	7239.65	7455.41	24211.74	28209.89	29168.37	992.35	1007.00	488.29
Greece	41.16	40.26	38.96	39.01	53.55	60.96	3035.85	3899.77	4106.51	17325.03	20316.73	25302.04	432.10	841.68	730.05
Israel	9.64	8.80	8.24	60.06	61.60	74.01	3485.97	2443.28	3181.55	17863.46	23212.92	25250.15	463.28	745.36	829.45
Italy	33.27	32.78	31.91	42.81	47.50	57.02	3944.93	4993.94	5086.90	23730.90	27717.07	26729.15	1016.56	737.68	795.90
Jordan	27.77	20.19	17.79	35.20	39.74	47.26	1220.00	1726.28	1244.07	3291.53	3588.79	5245.63	438.47	45.53	329.90
Lebanon	16.88	14.00	12.98	46.99	69.23	73.17	1878.26	2414.95	2618.89	6257.49	9979.67	11739.54	1540.07	136.33	806.78
Morocco	51.61	46.67	43.67	14.45	17.25	18.53	1120.02	366.61	1919.27	2698.70	2923.98	4167.55	91.51	62.26	213.90
Portugal	52.09	45.60	40.08	37.46	43.76	45.35	1877.68	2780.68	3288.68	16177.37	21154.91	21375.69	1261.53	1088.26	307.23
Spain	24.65	23.74	22.83	22.18	29.28	29.17	2484.51	3609.80	2938.61	19776.66	25147.12	27082.32	1160.40	1305.78	562.94
Syria	51.07	48.05	44.71	14.19	29.02	26.51	749.99	1148.65	1707.72	2937.36	3667.88	4466.08	123.54	85.83	87.93
Tunisia	42.05	36.57	34.10	12.89	14.29	16.62	1144.60	977.12	1880.02	4467.54	6053.52	8333.68	108.90	307.63	426.09
Turkey	40.80	35.26	30.24	16.52	21.73	24.43	2214.16	2311.05	2783.14	8108.60	9898.15	11754.23	319.15	264.82	409.26

Country	Domestic Food Price Level Index			Arable land (hectares per person)			Road density (km of road per 100 sq. km of land area)			Improved water source (% of population with access)			Standard Deviation Production (kg/caput/year)			Political Stability and Absence of Violence/Terrorism		
	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009
Albania	1.62	1.76	1.64	0.17	0.17	0.19	64.17	62.61	62.61	96.90	97.00	95.10	23.35	14.07	18.82	-0.43	-0.65	-0.05
Algeria	1.85	1.84	1.68	0.27	0.24	0.21	3.71	4.37	4.70	93.90	89.40	83.70	20.62	50.61	33.14	-1.86	-1.50	-1.22
Egypt	2.03	1.96	1.72	0.04	0.04	0.04	9.22	9.22	10.03	92.90	96.10	99.00	20.57	11.57	8.68	-0.58	-0.01	-0.62
France	1.07	1.07	1.06	0.31	0.30	0.28	161.26	162.79	189.60	100.00	100.00	100.00	38.20	33.15	63.19	0.82	0.75	0.47
Greece	2.19	1.44	1.14	0.29	0.25	0.23	87.96	88.26	88.61	96.20	98.90	99.80	48.11	16.91	21.71	0.45	0.71	-0.22
Israel	1.25	1.17	1.26	0.07	0.05	0.04	59.81	74.53	83.00	100.00	100.00	100.00	10.67	9.32	5.74	-1.24	-1.05	-1.62
Italy	1.22	1.19	1.20	0.16	0.15	0.12	158.72	159.18	161.84	100.00	100.00	100.00	11.46	6.99	27.44	1.04	0.85	0.34
Jordan	1.11	1.21	1.31	0.06	0.04	0.03	8.29	8.16	8.82	96.70	96.70	96.30	10.88	6.24	3.86	-0.15	-0.09	-0.36
Lebanon	1.18	1.26	1.49	0.07	0.04	0.03	60.96	69.33	66.70	100.00	100.00	100.00	4.39	3.29	3.31	-0.76	-0.53	-1.58
Morocco	1.52	1.59	1.58	0.35	0.31	0.25	13.33	12.90	13.04	73.00	78.00	81.90	58.56	103.97	75.47	-0.29	-0.17	-0.41
Portugal	1.25	1.18	1.06	0.23	0.16	0.11	71.10	74.61	23.45	96.10	97.90	99.40	15.33	4.37	15.65	1.22	1.34	0.76
Spain	1.16	1.10	1.11	0.39	0.33	0.27	131.39	131.49	132.00	100.00	100.00	100.00	61.80	58.40	82.86	0.16	0.61	-0.47
Syria	1.54	1.39	1.47	0.39	0.28	0.22	17.94	20.43	36.81	85.70	87.50	89.50	102.48	75.51	71.29	-0.41	-0.25	-0.49
Tunisia	1.59	1.67	1.65	0.36	0.30	0.26	12.24	11.61	11.84	81.50	89.40	95.30	74.09	73.75	44.03	0.16	0.28	0.06
Turkey	1.36	1.41	1.85	0.46	0.38	0.30	46.89	50.55	46.28	85.40	92.90	99.30	55.12	25.28	47.40	-1.27	-0.84	-1.03

Country	Food import/total merchindise export(%)			Food Export (%) on food Imports)			Import/GDP, PPP (constant 2005 international $)			Total Food supply (kcal/capita/day)			Standard Deviation Variability Food supply (kcal/capita/day)		
	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1900	2000	2009
Albania	21.57	70.89	48.58	60.24	1.92	3.19	0.69	1.25	2.23	2656	2842	2903	80.76	161.30	28.51
Algeria	15.19	10.27	12.11	1.17	0.83	1.79	1.37	1.25	2.11	2855	2922	3239	86.31	48.28	72.13
Egypt	96.76	42.85	32.50	8.02	11.29	50.41	1.36	0.98	1.75	3154	3318	3349	43.03	72.84	54.11
France	6.82	4.77	7.05	155.64	140.46	113.32	1.07	0.91	1.81	3515	3608	3531	51.76	31.64	48.67
Greece	28.19	19.29	28.43	80.01	72.63	59.91	1.29	1.02	2.04	3539	3608	3661	87.41	46.83	11.61
Israel	7.72	4.67	5.68	104.77	51.37	55.37	1.12	1.00	1.44	3398	3539	3569	78.52	54.93	39.94
Italy	9.21	5.73	6.94	52.29	78.69	82.93	1.17	0.87	1.76	3584	3720	3627	72.30	88.02	35.34
Jordan	59.65	35.59	30.02	15.44	24.32	45.64	6.08	3.93	6.17	2724	2687	2977	46.28	50.62	99.89
Lebanon	106.99	119.66	44.06	16.33	11.28	18.36	3.27	2.65	3.70	2965	3056	3153	118.67	31.11	19.15
Morocco	12.14	17.30	20.66	111.16	46.76	54.59	0.77	1.51	2.19	3073	3056	3264	109.36	84.71	50.53
Portugal	10.34	10.77	14.38	21.94	26.42	38.65	1.05	1.21	2.80	3393	3534	3617	237.90	54.25	36.51
Spain	8.90	5.94	8.34	131.77	167.08	140.60	14.31	2.04	21.55	3279	3375	3239	87.16	40.05	46.22
Syria	15.42	13.83	26.45	81.15	65.08	76.53	1.16	1.08	2.09	2896	3103	3212	88.23	101.78	61.67
Tunisia	13.64	9.16	8.59	49.95	69.79	86.93	13.57	0.92	23.74	3124	3236	3314	117.49	96.49	34.80
Turkey	10.58	4.92	4.54	168.39	209.73	193.34	3.76	0.22	5.32	3766	3636	3666	152.48	47.81	43.33

| Share of dietary Supply(kcal/capita/day) per commodity | | | | | | | | | | | | | | | | | |
| CEREALS | | | MEAT | | | MILK | | | SUGAR | | | VEGTABLES OILS | | | VEGTABLES +FRUITS | | |
Country	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009
Albania	59.68	46.94	37.58	4.07	5.63	8.06	9.98	16.85	17.09	7.00	7.11	7.17	7.45	6.26	5.65	2.03	7.32	10.68
Algeria	56.95	57.36	54.65	2.80	2.94	2.62	5.57	5.72	6.92	9.84	9.65	9.45	13.70	12.77	9.08	1.54	5.13	8.24
Egypt	66.17	64.07	64.83	2.25	2.68	3.17	1.49	2.11	2.69	9.89	8.86	6.96	5.58	3.80	16.28	2.85	8.32	9.20
France	23.44	24.31	25.66	15.28	15.05	12.32	11.27	10.67	9.88	9.87	10.42	10.99	11.38	11.67	7.93	2.59	4.71	4.67
Greece	30.04	28.88	28.52	7.88	8.92	8.03	9.75	10.56	11.75	8.67	8.81	8.52	18.00	15.60	6.17	4.07	10.42	8.52
Israel	36.23	30.71	32.47	7.53	10.00	10.98	7.68	7.04	7.06	12.27	14.33	6.89	13.15	15.80	10.45	3.41	9.04	9.02
Italy	31.81	31.24	30.91	11.08	10.94	10.95	7.98	8.25	7.50	8.12	7.96	8.24	17.44	17.39	18.72	2.82	7.98	7.83
Jordan	52.06	46.67	44.94	4.96	5.58	5.91	4.52	4.88	5.48	14.90	15.04	14.31	10.06	13.21	13.26	1.95	4.73	4.50
Lebanon	35.08	34.20	32.22	5.36	7.07	8.59	3.41	4.91	5.23	11.23	10.41	12.97	12.58	13.71	0.93	5.56	11.19	8.34
Morocco	63.65	61.78	57.23	2.73	2.91	3.74	1.40	1.37	1.84	9.83	11.98	12.38	8.40	8.87	8.37	2.28	4.81	6.16
Portugal	29.03	28.72	29.86	8.64	11.12	11.14	6.10	7.61	7.22	7.75	8.60	6.58	14.41	11.40	11.41	3.15	7.44	7.77
Spain	23.06	21.87	23.77	11.71	13.72	12.10	7.01	7.59	6.79	8.23	9.48	7.53	18.66	20.09	10.20	4.03	7.14	6.27
Syria	51.62	43.41	44.86	3.73	4.22	3.95	5.94	5.64	6.66	11.88	13.44	8.87	10.84	16.60	16.16	2.35	5.70	6.23
Tunisia	55.12	51.36	51.57	2.85	3.62	3.29	3.65	5.04	4.80	8.67	8.65	10.59	15.62	14.09	11.95	3.01	7.08	7.39
Turkey	51.14	48.62	47.68	2.55	2.59	2.70	6.11	5.47	6.19	8.36	8.14	8.43	10.91	12.79	13.53	3.56	8.28	8.24

Country	Import dependency ratio																	
	CEREALS			MEAT			MILK			SUGAR			VEGETABLES OILS			VEGETABLE+FRUITS		
	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009
Albania	17.01	45.68	41.35	7.68	28.35	36.01	4.50	1.55	2.61	75.46	103.29	83.22	96.65	93.20	96.04	0.00	16.24	9.78
Algeria	64.48	83.32	67.39	3.68	3.12	11.66	54.35	54.76	54.49	99.93	99.93	103.54	73.78	89.04	143.38	4.28	0.97	8.17
Egypt	42.32	36.99	30.14	14.26	13.02	7.47	11.41	8.10	8.09	45.65	20.29	22.05	102.60	90.99	49.66	0.13	0.48	0.53
France	6.03	8.42	7.96	18.33	20.27	28.67	9.28	18.19	17.65	31.77	31.80	27.63	74.16	71.51	72.66	25.67	38.81	51.99
Greece	14.79	22.85	28.69	33.37	77.92	53.40	30.80	40.61	51.35	5.05	27.46	65.87	20.59	20.34	46.89	3.50	6.41	10.19
Israel	84.39	95.51	105.63	11.04	13.49	10.88	3.66	8.41	6.05	109.25	93.29	106.94	46.16	46.56	111.91	5.47	9.26	15.11
Italy	33.89	37.44	40.81	22.77	29.75	33.70	34.54	36.01	44.78	18.05	27.51	68.89	54.37	74.66	58.31	6.34	11.98	16.07
Jordan	108.33	95.94	89.12	37.72	21.05	42.58	60.29	48.55	66.15	145.45	102.43	102.81	89.33	157.36	37.29	15.79	12.29	26.60
Lebanon	71.67	91.53	93.29	21.20	16.08	26.30	55.09	59.54	53.58	98.81	81.68	109.50	84.59	92.28	67.67	8.82	8.81	12.44
Morocco	19.37	55.53	44.11	0.90	0.50	1.40	12.66	8.59	11.57	32.63	52.32	75.76	60.64	72.46	96.50	0.06	0.92	2.88
Portugal	53.09	65.63	87.44	13.49	24.03	30.66	3.84	21.83	33.20	111.23	99.61	200.94	25.52	52.76	14.71	6.10	18.01	25.05
Spain	15.73	26.91	44.97	6.71	7.26	12.17	14.02	27.61	36.43	24.01	33.96	75.03	17.73	35.06	131.38	3.13	7.81	17.12
Syria	48.92	33.09	65.90	0.88	0.01	1.55	3.58	7.00	7.67	91.07	63.34	121.98	42.99	53.43	41.50	0.51	2.74	9.45
Tunisia	46.72	69.20	47.25	9.01	1.74	2.83	29.57	8.05	11.24	97.79	99.06	89.11	78.04	91.55	135.38	0.31	1.77	1.95
Turkey	10.73	8.71	13.13	0.97	0.15	0.10	1.17	1.03	1.82	39.85	0.95	1.42	58.43	51.17	54.10	0.49	0.59	1.05

Country	Self-Sufficiency ratio																	
	CEREALS			MEAT			MILK			SUGAR			VEG			VEGETABLES OILS		
	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009
Albania	88.43	58.37	58.69	92.33	75.66	64.02	95.50	98.71	97.39	24.54	4.98	4.57	116.1	84.72	91.61	28.09	5.81	4.48
Algeria	21.08	10.33	44.33	96.32	96.91	88.38	36.27	45.26	45.57	0.07	0.12	0.27	95.34	99.38	91.99	11.52	8.91	19.21
Egypt	61.41	69.08	65.81	83.35	87.05	92.67	84.96	91.77	94.09	57.67	70.03	91.99	102	101.41	105.77	13.58	17.47	28.10
France	209.43	192.66	174.14	101.23	108.16	99.61	121.02	121.21	127.57	225.19	219.74	132.05	85.59	79.89	65.47	78.26	78.13	74.39
Greece	100.30	86.59	89.05	69.27	46.94	50.14	72.05	64.84	59.58	94.20	103.51	34.20	129.3	123.66	118.51	81.12	129.01	85.71
Israel	16.45	5.14	7.65	91.32	87.67	90.46	96.86	92.14	95.54	0.84	0.61	0.57	182.1	120.04	122.56	60.10	60.47	35.97
Italy	82.72	85.07	67.09	81.15	77.90	76.21	67.77	69.98	68.78	94.71	100.87	41.92	113.6	117.48	115.86	50.28	62.01	35.32
Jordan	10.40	3.53	3.00	63.18	79.98	77.71	43.36	55.83	54.14	0.11	0.05	0.12	162	137.25	154.42	22.00	39.09	14.97
Lebanon	12.08	12.91	16.03	76.38	85.42	76.24	42.25	40.69	47.43	4.51	26.98	2.62	101.5	105.95	116.72	18.49	17.45	21.19
Morocco	75.97	21.09	69.69	99.11	100.75	100.15	87.35	94.83	92.59	65.38	48.73	33.93	117.8	115.96	113.84	51.81	29.14	29.90
Portugal	41.09	35.54	22.67	88.29	78.18	76.62	101.07	93.69	85.28	2.71	17.64	3.98	99.58	95.01	99.71	92.92	84.04	75.89
Spain	91.98	95.01	56.42	95.62	107.21	119.85	92.78	83.79	70.23	92.85	84.08	60.93	123	140.30	154.41	135.20	112.50	90.01
Syria	75.13	67.01	60.38	99.24	99.99	98.64	96.60	93.65	95.06	8.25	16.09	11.41	105.8	111.24	98.00	61.37	64.48	71.29
Tunisia	53.53	30.53	60.79	91.61	98.73	98.06	70.45	93.57	92.92	10.81	2.80	2.03	103.1	105.76	105.22	95.51	61.00	103.27
Turkey	100.81	103.20	103.03	99.83	100.27	106.77	98.97	99.19	99.12	99.12	143.65	124.61	108.2	109.55	114.30	65.95	74.19	64.37

Country	Production																	
	CEREALS			MEAT			MILK			SUGAR			VEGETABLES+FRUITS			VEGETABLES OILS		
	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009	1990	2000	2009
Albania	259.56	171.20	200.21	15.70	20.36	28.64	150.14	286.84	331.62	5.05	1.23	2.15	162.69	230.41	162.69	114.02	0.71	0.68
Algeria	61.99	29.46	144.39	16.62	17.79	16.52	37.23	47.70	61.65	0.02	0.03	0.09	96.93	126.24	96.93	59.77	1.38	2.46
Egypt	212.43	273.79	272.47	12.95	19.93	24.59	40.57	57.10	73.08	18.23	23.29	24.11	246.09	334.45	246.09	164.12	2.15	2.41
France	942.83	1077.96	1081.69	98.33	106.75	84.61	458.95	422.53	374.29	87.82	92.08	85.83	335.12	293.70	335.12	130.65	22.10	39.79
Greece	436.23	450.80	421.20	52.04	41.59	39.14	176.35	184.30	181.44	33.62	41.71	13.75	767.51	775.26	767.51	382.90	55.46	40.97
Israel	85.10	29.08	34.34	50.14	79.32	89.08	211.44	193.55	175.99	0.59	0.49	0.40	695.57	456.34	695.57	265.84	20.54	10.92
Italy	299.38	355.65	280.63	69.65	71.67	69.49	210.79	233.56	189.36	31.64	35.76	14.65	550.94	606.03	550.94	249.75	21.19	20.23
Jordan	40.70	11.91	10.30	20.19	29.07	32.43	30.41	42.64	54.01	0.05	0.02	0.05	334.70	235.67	334.70	254.13	6.72	3.64
Lebanon	28.62	37.96	45.31	28.87	53.64	51.30	48.09	64.32	71.19	1.98	10.91	1.41	735.47	537.06	735.47	297.08	4.34	5.47
Morocco	254.30	69.23	224.96	18.79	21.09	30.48	38.98	43.68	60.39	20.37	18.32	14.32	203.70	203.72	203.70	123.49	4.84	6.45
Portugal	137.73	152.64	94.42	56.69	71.18	73.66	166.82	208.85	192.61	0.76	6.36	1.18	458.14	414.64	458.14	218.07	23.95	33.59
Spain	478.02	603.04	380.21	89.23	121.95	115.72	170.98	172.30	160.60	27.49	32.23	17.50	666.28	703.12	666.28	300.37	52.90	52.01
Syria	249.02	214.57	225.31	17.63	21.43	21.46	106.92	102.20	114.56	2.93	6.76	3.61	244.02	223.82	244.02	134.48	17.00	16.19
Tunisia	202.94	115.86	247.61	17.96	26.36	25.27	52.23	96.30	103.59	3.06	0.81	0.74	275.57	321.93	275.57	189.81	13.68	20.47
Turkey	557.92	508.63	467.71	21.50	22.11	27.19	178.12	155.03	176.05	32.73	44.78	40.25	501.77	561.41	501.77	335.05	16.88	17.37

Appendix 3- Correlation Matrix of PCA

Availability Correlation Matrix

		CEREAL	ARABLAND	SELFSUFF_CEREALS	SELFSUFF_MEAT	SELFSUFF_MILK	SELFSUFF_SUGAR	SELFSUFF_OILS	SELFSUFF_VEG+FRUIT	PRODCEREALS	PRODMEAT	PRRODMILK	PRODSUGAR	PRODOILS	PRODVEG+FRUITS
Correlation	CEREAL	1.000	-.197	.112	.327	.365	.128	.007	-.101	.348	.565	.468	.343	.129	.194
	ARABLAND	-.197	1.000	.637	.250	.310	.209	.090	-.109	.613	.326	.125	.373	-.006	-.097
	SELFSUFF_CEREALS	.112	.637	1.000	.315	.329	.371	.200	-.210	.733	.303	.094	.383	-.005	-.146
	SELFSUFF_MEAT	.327	.250	.315	1.000	.733	.224	-.008	-.038	.435	.767	.502	.386	.029	-.034
	SELFSUFF_MILK	.365	.310	.329	.733	1.000	.129	-.129	-.024	.408	.693	.630	.334	-.136	.089
	SELFSUFF_SUGAR	.128	.209	.371	.224	.129	1.000	.054	.153	.226	.163	-.006	.787	-.032	.049
	SELFSUFF_OILS	.007	.090	.200	-.008	-.129	.054	1.000	.038	.066	.045	-.072	.051	.714	-.007
	SELFSUFF_VEG+FRUIT	-.101	-.109	-.210	-.038	-.024	.153	.038	1.000	-.224	-.065	-.025	.135	-.003	.594
	PRODCEREALS	.348	.613	.733	.435	.408	.226	.066	-.224	1.000	.603	.290	.454	.051	-.003
	PRODMEAT	.565	.326	.303	.767	.693	.163	.045	-.065	.603	1.000	.775	.473	.101	.165
	PRRODMILK	.468	.125	.094	.502	.630	-.006	-.072	-.025	.290	.775	1.000	.196	-.014	.155
	PRODSUGAR	.343	.373	.383	.386	.334	.787	.051	.135	.454	.473	.196	1.000	.051	.162
	PRODOILS	.129	-.006	-.005	.029	-.136	-.032	.714	-.003	.051	.101	-.014	.051	1.000	.014
	PRODVEG+FRUITS	.194	-.097	-.146	-.034	.089	.049	-.007	.594	-.003	.165	.155	.162	.014	1.000
Sig. (1-tailed)	CEREAL		.000	.032	.000	.000	.017	.455	.047	.000	.000	.000	.000	.016	.001
	ARABLAND	.000		.000	.000	.000	.000	.068	.035	.000	.000	.019	.000	.458	.054
	SELFSUFF_CEREALS	.032	.000		.000	.000	.000	.000	.000	.000	.000	.059	.000	.469	.008
	SELFSUFF_MEAT	.000	.000	.000		.000	.000	.450	.266	.000	.000	.000	.000	.317	.286
	SELFSUFF_MILK	.000	.000	.000	.000		.016	.016	.347	.000	.000	.000	.000	.012	.070
	SELFSUFF_SUGAR	.017	.000	.000	.000	.016		.184	.006	.000	.003	.461	.000	.301	.208
	SELFSUFF_OILS	.455	.068	.000	.450	.016	.184		.265	.138	.230	.115	.200	.000	.457
	SELFSUFF_VEG+FRUIT	.047	.035	.000	.266	.347	.006	.265		.000	.139	.340	.012	.479	.000
	PRODCEREALS	.000	.000	.000	.000	.000	.000	.138	.000		.000	.000	.000	.200	.482
	PRODMEAT	.000	.000	.000	.000	.000	.003	.230	.139	.000		.000	.000	.047	.003
	PRRODMILK	.000	.019	.059	.000	.000	.461	.115	.340	.000	.000		.001	.406	.005
	PRODSUGAR	.000	.000	.000	.000	.000	.000	.200	.012	.000	.000	.001		.201	.003
	PRODOILS	.016	.458	.469	.317	.012	.301	.000	.479	.200	.047	.406	.201		.405
	PRODVEG+FRUITS	.001	.054	.008	.286	.070	.208	.457	.000	.482	.003	.005	.003	.405	

Access Correlation Matrix

		%RURALPOP	GDP_PPP	DOMESTICPRIC ELEVEL	ROADS	WATER
Correlation	%RURALPOP	1.000	-.713	.587	-.348	-.767
	GDP_PPP	-.713	1.000	-.625	.573	.664
	DOMESTICPRICELEVEL	.587	-.625	1.000	-.408	-.623
	ROADS	-.348	.573	-.408	1.000	.420
	WATER	-.767	.664	-.623	.420	1.000
Sig. (1-tailed)	%RURALPOP		.000	.000	.000	.000
	GDP_PPP	.000		.000	.000	.000
	DOMESTICPRICELEVEL	.000	.000		.000	.000
	ROADS	.000	.000	.000		.000
	WATER	.000	.000	.000	.000	

Utilizatio Correlation Matrix

		TOTALFOODSUPPLYTOT	%CEREALS	%MEAT	%MILK	%SUGAR	%OILS	%VEGETABLE+FRUITS
Correlation	TOTALFOODSUPPLYTOT	1.000	-.466	.518	.572	.478	.413	.182
	%CEREALS	-.466	1.000	-.566	-.534	-.447	-.397	-.383
	%MEAT	.518	-.566	1.000	.590	.452	.180	-.002
	%MILK	.572	-.534	.590	1.000	.534	.251	.010
	%SUGAR	.478	-.447	.452	.534	1.000	.270	.060
	%OILS	.413	-.397	.180	.251	.270	1.000	.156
	%VEGETABLE+FRUITS	.182	-.383	-.002	.010	.060	.156	1.000
Sig. (1-tailed)	TOTALFOODSUPPLYTOT		.000	.000	.000	.000	.000	.001
	%CEREALS	.000		.000	.000	.000	.000	.000
	%MEAT	.000	.000		.000	.000	.001	.484
	%MILK	.000	.000	.000		.000	.000	.434
	%SUGAR	.000	.000	.000	.000		.000	.159
	%OILS	.000	.000	.001	.000	.000		.005
	%VEGETABLE+FRUITS	.001	.000	.484	.434	.159	.005	

Vulnerability Correlation Matrix

		IRRIGATEDLAND	ST DEV_PPP_2009	IMPORT/EXPORT	IMPORT/GDP.PPP	%FOODEXPORT/IMPORT	Standard_DEV_FoodSUpply	IMPORTCEREALS	IMPORTMEAT	IMPORTMILK	IMPORTSUGAR	IMPORTOILS	IMPORTVEGETABLE_fruits	ST.DEV_PROD_CEREALS	POLITICAL_STABILITY
Correlation	IRRIGATEDLAND	1.000	.074	-.035	-.036	-.043	-.107	.237	.105	-.039	.103	.079	-.107	-.201	-.022
	ST DEV_PPP_2009	.074	1.000	-.159	.058	.046	-.105	.153	.402	-.028	.105	.184	.527	.227	.600
	IMPORT/EXPORT	-.035	-.159	1.000	.087	-.105	.001	.045	-.031	.007	.076	-.017	-.111	-.108	-.201
	IMPORT/GDP.PPP	-.036	.058	.087	1.000	-.092	-.080	.244	.181	.188	.234	.274	.145	.026	.021
	%FOODEXPORT/IMPORT	-.043	.046	-.105	-.092	1.000	.002	-.167	-.121	-.105	-.203	-.177	-.036	.224	.131
	Standard_DEV_FoodSUpply	-.107	-.105	.001	-.080	.002	1.000	-.138	-.205	-.009	-.025	-.177	-.211	.013	-.051
	IMPORTCEREALS	.237	.153	.045	.244	-.167	-.138	1.000	.411	.414	.388	.351	.344	-.298	-.003
	IMPORTMEAT	.105	.402	-.031	.181	-.121	-.205	.411	1.000	.356	.332	.287	.570	-.001	.307
	IMPORTMILK	-.039	-.028	.007	.188	-.105	-.009	.414	.356	1.000	.232	.139	.261	-.236	-.109
	IMPORTSUGAR	.103	.105	.076	.234	-.203	-.025	.388	.332	.232	1.000	.247	.237	.031	.106
	IMPORTOILS	.079	.184	-.017	.274	-.177	-.177	.351	.287	.139	.247	1.000	.405	-.073	.220
	IMPORTVEGETABLE_fruits	-.107	.527	-.111	.145	-.036	-.211	.344	.570	.261	.237	.405	1.000	.111	.521
	ST.DEV_PROD_CEREALS	-.201	.227	-.108	.026	.224	.013	-.298	-.001	-.236	.031	-.073	.111	1.000	.307
	POLITICAL_STABILITY	-.022	.600	-.201	.021	.131	-.051	-.003	.307	-.109	.106	.220	.521	.307	1.000
Sig. (1-tailed)	IRRIGATEDLAND		.111	.283	.276	.240	.039	.000	.043	.260	.045	.096	.039	.000	.359
	ST DEV_PPP_2009	.111		.004	.169	.225	.042	.006	.000	.325	.042	.001	.000	.000	.000
	IMPORT/EXPORT	.283	.004		.076	.043	.491	.229	.304	.455	.104	.392	.034	.037	.000
	IMPORT/GDP.PPP	.276	.169	.076		.065	.095	.000	.001	.001	.000	.000	.008	.337	.364
	%FOODEXPORT/IMPORT	.240	.225	.043	.065		.488	.003	.023	.042	.000	.002	.276	.000	.015
	Standard_DEV_FoodSUpply	.039	.042	.491	.095	.488		.011	.000	.443	.340	.002	.000	.416	.203
	IMPORTCEREALS	.000	.006	.229	.000	.003	.011		.000	.000	.000	.000	.000	.000	.480
	IMPORTMEAT	.043	.000	.304	.001	.023	.000	.000		.000	.000	.000	.000	.494	.000
	IMPORTMILK	.260	.325	.455	.001	.042	.443	.000	.000		.000	.011	.000	.000	.037
	IMPORTSUGAR	.045	.042	.104	.000	.000	.340	.000	.000	.000		.000	.000	.308	.040
	IMPORTOILS	.096	.001	.392	.000	.002	.002	.000	.000	.011	.000		.000	.115	.000
	IMPORTVEGETABLE_fruits	.039	.000	.034	.008	.276	.000	.000	.000	.000	.000	.000		.034	.000
	ST.DEV_PROD_CEREALS	.000	.000	.037	.337	.000	.416	.000	.494	.000	.308	.115	.034		.000
	POLITICAL_STABILITY	.359	.000	.000	.364	.015	.203	.480	.000	.037	.040	.000	.000	.000	

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Correlation Matrix Of ALL INDICATORS	%RURALPOP	IrrigatedLand	CEREAL Yields	GDP_PPP	VAR_GDP	Price level	ARABLAND	Roads Density	Water Access	Food_IMP/Tot_EXP	%FoodExp/FoodImp	IMPORT/GDP.PPP	Tot_Food_Supply	VAR_FoodSUpply	%CEREALS	%MEAT	%MILK	%SUGAR	%OILS	%Veg+Fruits	IMP_CEREALS
Corr. %RURALPOP	1.000	-.143	-.556	-.716	-.662	.586	-.131	-.351	-.767	.192	-.221	-.101	-.709	.217	.586	-.666	-.566	-.710	-.438	-.141	-.326
IrrigatedLand	-.143	1.000	.346	.049	.072	-.116	-.339	.031	.358	-.036	-.040	-.039	.196	-.124	.145	.026	.057	.169	.033	.212	.228
CEREAL Yields	-.556	.346	1.000	.732	.602	-.529	-.195	.681	.646	-.185	.045	-.025	.657	-.273	-.405	.488	.442	.434	.194	.123	.147
GDP_PPP	-.716	.049	.732	1.000	.811	-.620	.161	.574	.663	-.198	.028	.074	.774	-.248	-.636	.614	.638	.508	.354	.106	.150
VAR_GDP	-.662	.072	.602	.811	1.000	-.556	.123	.492	.624	-.157	.053	.062	.668	-.108	-.566	.567	.565	.456	.357	.140	.155
Price Level	.586	-.116	-.529	-.620	-.556	1.000	-.102	-.408	-.620	.190	-.156	-.057	-.570	.129	.371	-.561	-.538	-.607	-.187	-.049	-.161
ARABLAND	-.131	-.339	-.195	.161	.123	-.102	1.000	-.182	-.007	-.084	.260	-.066	.088	.058	-.156	.272	.184	.059	.053	-.119	-.355
Roads Density	-.351	.031	.681	.574	.492	-.408	-.182	1.000	.420	-.104	-.044	.148	.511	-.201	-.405	.280	.402	.264	.184	.064	.300
Water Access	-.767	.358	.646	.663	.624	-.620	-.007	.420	1.000	-.230	.143	.080	.776	-.218	-.451	.519	.557	.656	.366	.270	.219
Food_IMP/Tot_EXP	.192	-.036	-.185	-.198	-.157	.190	-.084	-.104	-.230	1.000	-.105	.085	-.217	.001	.131	-.225	-.171	-.220	.020	-.044	.044
%FoodExp/FoodImp	-.221	-.040	.045	.028	.053	-.156	.260	-.044	.143	-.105	1.000	-.092	.071	.007	-.147	.316	.112	.207	.017	-.018	-.166
IMPORT/GDP.PPP	-.101	-.039	-.025	.074	.062	-.057	-.066	.148	.080	.085	-.092	1.000	.155	-.087	-.048	-.040	.010	-.023	.175	.025	.244
Tot_Food_Supply	-.709	.196	.657	.774	.668	-.570	.088	.511	.776	-.217	.071	.155	1.000	-.152	-.450	.510	.554	.463	.417	.199	.161
VAR_FoodSUpply	.217	-.124	-.273	-.248	-.108	.129	.058	-.201	-.218	.001	.007	-.087	-.152	1.000	.204	-.135	-.152	-.207	.003	-.067	-.156
%CEREALS	.586	.145	-.405	-.636	-.566	.371	-.156	-.405	-.451	.131	-.147	-.048	-.450	.204	1.000	-.561	-.518	-.426	-.383	-.405	-.217
%MEAT	-.666	.026	.488	.614	.567	-.561	.272	.280	.519	-.225	.316	-.040	.510	-.135	-.561	1.000	.587	.446	.175	.007	.004
%MILK	-.566	.057	.442	.638	.565	-.538	.184	.402	.557	-.171	.112	.010	.554	-.152	-.518	.587	1.000	.527	.243	.028	.112
%SUGAR	-.710	.169	.434	.508	.456	-.607	.059	.264	.656	-.220	.207	-.023	.463	-.207	-.426	.446	.527	1.000	.257	.075	.310
%OILS	-.438	.033	.194	.354	.357	-.187	.053	.184	.366	.020	.017	.175	.417	.003	-.383	.175	.243	.257	1.000	.160	.265
%Veg+Fruits	-.141	.212	.123	.106	.140	-.049	-.119	.064	.270	-.044	-.018	.025	.199	-.067	-.405	.007	.028	.075	.160	1.000	.167
IMP_CEREALS	-.326	.228	.147	.150	.155	-.161	-.355	.300	.219	.044	-.166	.244	.161	-.156	-.217	.004	.112	.310	.265	.167	1.000
IMP_MEAT	-.371	.100	.444	.472	.400	-.267	-.151	.484	.307	-.031	-.119	.180	.385	-.222	-.373	.194	.281	.170	.235	.070	.414
IMP.MILK	.035	-.044	.076	-.020	-.021	.008	-.251	.279	.011	.004	-.106	.184	-.013	-.024	.022	-.153	-.269	-.043	.110	.038	.413
IMP_SUGAR	-.130	.093	.038	.149	.103	-.044	-.066	.099	.058	.076	-.202	.232	.201	-.030	-.023	.018	.029	-.064	.109	-.066	.385
IMP_OILS	-.221	.083	.278	.230	.186	-.270	-.139	.349	.198	-.018	-.180	.275	.221	-.163	-.007	.091	.207	.158	.039	-.072	.356
IMP_VEG+Fruits	-.471	-.106	.636	.686	.537	-.457	-.013	.733	.402	-.113	-.037	.144	.464	-.212	-.456	.408	.519	.370	.163	-.059	.348
SELFSUFF_CEREALS	-.098	-.265	.121	.198	.182	-.179	.635	.012	.136	-.167	.349	-.170	.149	-.012	-.117	.341	.219	.027	-.052	-.142	-.677
SelfSuff_MEAT	-.251	-.104	.303	.243	.127	-.248	.261	.314	.190	-.087	.266	.012	.169	-.063	-.210	.289	.242	.254	-.064	-.055	-.028
Self_suff_MILK	-.324	-.009	.339	.380	.265	-.288	.326	.206	.242	-.083	.199	-.072	.290	-.132	-.298	.380	.435	.272	-.022	-.022	-.144
Self_Suff_SUGAR	-.055	-.147	.141	.063	.076	-.208	.204	.158	.120	-.099	.225	-.097	-.029	-.049	-.155	.116	.058	.230	.000	.038	-.154
Self_Suff_OILS	-.126	-.128	.016	-.019	.052	-.054	.088	-.050	.107	-.069	.376	-.051	.022	-.006	-.070	.179	-.022	.143	.026	-.050	-.031
Self_Suff_VEG+Fruit	.000	.233	-.087	-.196	-.134	-.009	-.111	-.074	.033	-.002	.123	.022	-.085	-.005	.021	-.093	-.024	.193	.073	.099	.213
ProdCEREALS	-.399	-.163	.352	.535	.443	-.398	.616	.212	.387	-.161	.203	-.048	.488	-.047	-.333	.469	.400	.272	.131	-.054	-.403
ProdMEAT	-.610	.041	.556	.627	.467	-.512	.334	.422	.488	-.167	.310	.030	.528	-.161	-.533	.687	.495	.471	.147	.032	.052
ProdMILK	-.387	.206	.452	.464	.284	-.327	.127	.247	.341	-.105	.182	-.006	.365	-.173	-.371	.417	.388	.366	.093	.062	.020
ProdSUGAR	-.407	-.093	.352	.395	.337	-.426	.373	.351	.394	-.146	.220	-.051	.301	-.141	-.364	.352	.357	.523	.196	.038	.015
ProdOILS	-.178	-.044	.137	.134	.150	-.133	-.008	.110	.193	-.071	.144	.040	.157	-.055	-.121	.147	.059	.188	.117	-.054	.155
ProdVEG+FRUITS	-.341	.423	.206	.184	.252	-.256	-.096	.167	.439	-.065	.122	.158	.434	-.051	-.311	.175	.220	.283	.309	.566	.237
Var_prod_CEREALS	-.313	-.206	.058	.285	.224	-.245	.597	.034	.266	-.108	.230	.026	.326	.018	-.188	.318	.299	.210	.147	-.087	-.293
Political_Stability	-.541	-.016	.557	.680	.605	-.556	.213	.397	.494	-.199	.132	.027	.563	-.032	-.394	.616	.464	.385	.175	-.103	.006

Correlation Matrix Of ALL INDICATORS	IMP_MEAT	IMP.MILK	IMP_SUGAR	IMP_OILS	IMP_VEG+Fruits	SELFSUFF_CEREALS	SelfSuff_MEAT	Self_suff_MILK	Self_Suff_SUGAR	Self_Suff_OILS	Self_Suff_VEG+FRUIT	ProdCEREALS	ProdMEAT	ProdMILK	ProdSUGAR	ProdOILS	ProdVEG+FRUITS	Var_prod_CEREALS	Political_Stability
CORR. %RURALPOP	-.371	.035	-.130	-.221	-.471	-.098	-.251	-.324	-.055	-.126	.000	-.399	-.610	-.387	-.407	-.178	-.341	-.313	-.541
IrrigatedLand	.100	-.044	.093	.083	-.106	-.265	-.104	-.009	-.147	-.128	.233	-.163	.041	.206	-.093	-.044	.423	-.206	-.016
CEREAL Yields	.444	.076	.038	.278	.636	.121	.303	.339	.141	.016	-.087	.352	.556	.452	.352	.137	.206	.058	.557
GDP_PPP	.472	-.020	.149	.230	.686	.198	.243	.380	.063	-.019	-.196	.535	.627	.464	.395	.134	.184	.285	.680
VAR_GDP	.400	-.021	.103	.186	.537	.182	.127	.265	.076	.052	-.134	.443	.467	.284	.337	.150	.252	.224	.605
Price Level	-.267	.008	-.044	-.270	-.457	-.179	-.248	-.288	-.208	-.054	-.009	-.398	-.512	-.327	-.426	-.133	-.256	-.245	-.556
ARABLAND	-.151	-.251	-.066	-.139	-.013	.635	.261	.326	.204	.088	-.111	.616	.334	.127	.373	-.008	-.096	.597	.213
Roads Density	.484	.279	.099	.349	.733	.012	.314	.206	.158	-.050	-.074	.212	.422	.247	.351	.110	.167	.034	.397
Water Access	.307	.011	.058	.198	.402	.136	.190	.242	.120	.107	.033	.387	.488	.341	.394	.193	.439	.266	.494
Food_IMP/Tot_EXP	-.031	.004	.076	-.018	-.113	-.167	-.087	-.083	-.099	-.069	-.002	-.161	-.167	-.105	-.146	-.071	-.065	-.108	-.199
%FoodExp/FoodImp	-.119	-.106	-.202	-.180	-.037	.349	.266	.199	.225	.376	.123	.203	.310	.182	.220	.144	.122	.230	.132
IMPORT/GDP.PPP	.180	.184	.232	.275	.144	-.170	.012	-.072	-.097	-.051	.022	-.048	.030	-.006	-.051	.040	.158	.026	.027
Tot_Food_Supply	.385	-.013	.201	.221	.464	.149	.169	.290	-.029	.022	-.085	.488	.528	.365	.301	.157	.434	.326	.563
VAR_FoodSUpply	-.222	-.024	-.030	-.163	-.212	-.012	-.063	-.132	-.049	-.006	-.005	-.047	-.161	-.173	-.141	-.055	-.051	.018	-.032
%CEREALS	-.373	.022	-.023	-.007	-.456	-.117	-.210	-.298	-.155	-.070	.021	-.333	-.533	-.371	-.364	-.121	-.311	-.188	-.394
%MEAT	.194	-.153	.018	.091	.408	.341	.289	.380	.116	.179	-.093	.469	.687	.417	.352	.147	.175	.318	.616
%MILK	.281	-.269	.029	.207	.519	.219	.242	.435	.058	-.022	-.024	.400	.495	.388	.357	.059	.220	.299	.464
%SUGAR	.170	-.043	-.064	.158	.370	.027	.254	.272	.230	.143	.193	.272	.471	.366	.523	.188	.283	.210	.385
%OILS	.235	.110	.109	.039	.163	-.052	-.064	-.022	.000	.026	.073	.131	.147	.093	.196	.117	.309	.147	.175
%Veg+Fruits	.070	.038	-.066	-.072	-.059	-.142	-.055	-.022	.038	-.050	.099	-.054	.032	.062	.038	-.054	.566	-.087	-.103
IMP_CEREALS	.414	.413	.385	.356	.348	-.677	-.028	-.144	-.154	-.031	.213	-.403	.052	.020	.015	.155	.237	-.293	.006
IMP_MEAT	1.000	.358	.329	.292	.574	-.167	-.018	.024	-.102	-.071	-.116	.098	.234	.156	.106	.098	.107	-.014	.312
IMP.MILK	.358	1.000	.233	.141	.261	-.276	-.056	-.518	.002	.189	-.073	-.191	-.091	-.148	-.015	.316	-.109	-.233	-.097
IMP_SUGAR	.329	.233	1.000	.248	.239	-.294	-.051	-.059	-.635	-.044	-.169	-.074	.073	.143	-.383	.171	-.054	.024	.111
IMP_OILS	.292	.141	.248	1.000	.404	-.152	.154	.176	-.018	-.265	-.110	-.038	.181	.155	.121	-.093	-.056	-.074	.219
IMP_VEG+Fruits	.574	.261	.239	.404	1.000	.037	.387	.289	.067	.021	-.159	.292	.513	.340	.340	.227	-.077	.113	.526
SELFSUFF_CEREALS	-.167	-.276	-.294	-.152	.037	1.000	.328	.343	.369	.199	-.214	.734	.310	.093	.382	-.007	-.149	.575	.277
SelfSuff_MEAT	-.018	-.056	-.051	.154	.387	.328	1.000	.711	.236	.002	-.014	.444	.755	.463	.394	.036	-.016	.309	.288
Self_suff_MILK	.024	-.518	-.059	.176	.289	.343	.711	1.000	.141	-.122	.004	.411	.676	.599	.344	-.135	.112	.311	.401
Self_Suff_SUGAR	-.102	.002	-.635	-.018	.067	.369	.236	.141	1.000	.051	.149	.225	.166	-.009	.786	-.036	.051	-.001	.127
Self_Suff_OILS	-.071	.189	-.044	-.265	.021	.199	.002	-.122	.051	1.000	.033	.068	.055	-.065	.050	.714	-.010	.096	.025
Self_Suff_VEG+FRUIT	-.116	-.073	-.169	-.110	-.159	-.214	-.014	.004	.149	.033	1.000	-.223	-.047	-.001	.136	-.007	.594	-.132	-.079
ProdCEREALS	.098	-.191	-.074	-.038	.292	.734	.444	.411	.225	.068	-.223	1.000	.609	.282	.453	.052	-.003	.731	.472
ProdMEAT	.234	-.091	.073	.181	.513	.310	.755	.676	.166	.055	-.047	.609	1.000	.760	.477	.108	.186	.388	.576
ProdMILK	.156	-.148	.143	.155	.340	.093	.463	.599	-.009	-.065	-.001	.282	.760	1.000	.191	-.009	.179	.172	.416
ProdSUGAR	.106	-.015	-.383	.121	.340	.382	.394	.344	.786	.050	.136	.453	.477	.191	1.000	.049	.165	.229	.333
ProdOILS	.098	.316	.171	-.093	.227	-.007	.036	-.135	-.036	.714	-.007	.052	.108	-.009	.049	1.000	.012	.027	.125
ProdVEG+FRUITS	.107	-.109	-.054	-.056	-.077	-.149	-.016	.112	.051	-.010	.594	-.003	.186	.179	.165	.012	1.000	.006	.131
Var_prod_CEREALS	-.014	-.233	.024	-.074	.113	.575	.309	.311	-.001	.096	-.132	.731	.388	.172	.229	.027	.006	1.000	.305
Political_Stability	.312	-.097	.111	.219	.526	.277	.288	.401	.127	.025	-.079	.472	.576	.416	.333	.125	.131	.305	1.000