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Analysis of Food Consumption in Europe Via Time Series Clustering

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Index

Abstract

The purpose of the following graduation thesis is to investigate the evolution of food consumption in the European countries. Due to its importance in satisfying basic needs, several authors have studied food consumption. In the empirical analysis will be described the food consumption patterns in the European countries and the major differences occurred in the period between 1961 and 2009. The statistical technique, that has been used, is the Cluster Analysis of Time Series, with the measure of the Dynamic Time Warping (DTW). Finally, some common diets were individuated in order to express food consumption habits in five European macro-regions.

Italian

Lo scopo della seguente tesi di laurea è di analizzare l'evoluzione dei consumi alimentari nei paesi Europei. Questo tema è stato trattato da vari autori, a causa dal fatto che il consumo di generi alimentari è fondamentale nella nostra vita. Nell'analisi empirica verrà descritta la struttura dei consumi alimentari in Europa e le differenze più importanti che si sono verificate dal 1961 al 2009. È stata utilizzata la tecnica statistica della Cluster Analysis nelle serie storiche, avvalendosi della misura del Dynamic Time Warping (DTW) allo scopo di evidenziare le analogie tra le varie evoluzioni nei paesi europei.

Infine sono state individuate delle alcune diete comuni che rappresentano le abitudini alimentari di cinque macro regioni europee.

Introduction

The twentieth century has represented one of the most important periods of the humankind, although anguished by two World Wars in the first half, the second part of the century has been the theatre of an astonishing rebirth, which brought to unprecedented generalized socio-economic and wealthy levels. The industrial revolution boost, temporarily cancelled by the global conflicts, burst in the second half of the last century, taking the humankind to levels of growth and welfare never seen before, this is true especially for Western countries. Such great economic changes that took place in this period profoundly alter not only the economies of Western countries but many aspects of their social life.

The growth of incomes occurred since the second half of the twentieth century, has allowed people to improve their lifestyles and therefore their consumption. The combination of technological progress and industrialization along with the lack of war conflicts and famines has turned the society from a subsistence model into a model driven by consumer preferences and tastes.

Given that, one of the major changes in the way of life regards food consumption, it can be said that if once it used to satisfy basic necessities, nowadays people eat also for hedonistic and healthy reasons.

In the last thirty years, the evolution of food consumption in European countries has been analysed by several authors and some general conclusions can be derived from those works. Some of focused on the general picture (Blandford, 1984; Gil, Gracia and Peréz y Peréz, 1995; Hermann Röder 1995; Gracia and Albisu, 2001; Fanfani 2009), others analysed more specific regions (Cornia, 1994; Elsener and Hartmann, 1998; Gracia and Albisu, 1999; Pingali, 2006; Mauracher and Valentini 2006) and finally other studies were conducted on the evolution of the food categories (Grigg, 1995, 1996, 1997, 1999, 2003; Schneider 2002).

The central aim of this graduation thesis is to analyse how food consumption patterns have changed since post-war period in Europe through the elaboration of FAO data via cluster analysis.

Precisely, the considered data are referred to a period that goes from 1961 to 2009 and express the daily calorie consumption per capita. Through the statistical tool represented by the Cluster Analysis of Time Series, it has been possible to analyse the trend followed by the thirteen food categories in each of the 39 European nations. Thanks to the cluster analysis it will be possible to group the states that have followed a similar evolutionary path, in order to identify the major trends of each category.

Besides the previous study, a cross section analysis has been made in order to cluster the countries that show similar diets considering the three different years.

This graduation thesis will present the following structure: in the first chapter will be described the food consumption determinants, preceded by a brief historical analysis of food consumption until 1961; in the second chapter are illustrated the food category considered in this work, along with a quick presentation of the methodology which has been used; the third chapter comprehends the description regarding the historical evolution of the thirteen categories; finally, the last chapter shows how similar diets are distributed throughout Europe.

Foreward

It is important to define some useful geographical terms later on used to referring to a group of countries. Europe is frequently divided in four macro regions, Northern, Western, Southern and Eastern Europe, but there is not a common definition. These areas will be named as follows, without the pretention to confer any undisputable definition. For Northern Europe: Ireland, United Kingdom, Iceland, Denmark, Norway, Sweden and Finland. The latter three countries are also usually called Scandinavian countries. The Western Europe includes: France, Luxembourg, Belgium, Netherlands, Germany, Switzerland and Austria. The Southern European countries are: Portugal, Spain, Italy, Greece and Malta. Eastern European countries correspond to the Soviet Bloc states: Russia Federation, Estonia, Latvia, Lithuania, Belarus, Poland, Czech Republic, Slovakia, Ukraine, Moldova, Hungary, Romania, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Albania, the FYROM and Bulgaria. From now on I will strictly refer to these definitions.

1 Analysis of Food Consumption Theory

Food consumption in the European countries can be summed up in four major points: (1) the proportion of expenditure allocated to food is decreasing and has reached very low levels; (2) the achievement of a certain calorie threshold, beyond which people do not increase their food consumption; (3) a shift in food consumption structure; (4) changes in consumption patterns, which correspond to an increase in the relative quantity of food consumed away from home. The first point is not surprising, since it is a generalized phenomenon of the macro-economic growth in Europe. The second point it is the result of what happens in the richest countries, where quality is preferred to quantity, since people want to eat better as their food expenditure diminishes. The third point is generally characterised by the so-called nutrition transition and although there are several differences among countries which are influenced by distinctive aspects and also by their cultural and historical evolution. Similarly, the last point is also common to all countries, even though its intensity presents variations among countries and labour circumstances (Gracia & Albisu, 2001).

1.1 Changes in Food Consumption Models

According to Malassis the evolution of food consumption passes through the following three models: a traditional model, an agro-industrial model and, finally, a 'satiety' model. In the traditional model, the importance of food consumption acquires a remarkable level in households expenditures and it is still characterised by high levels of personal consumption which are typical of rural households. The development of the industrial transformation and the internationalization of markets brings to high consumption levels in caloric terms and mass consumption

of standard products increases along with their included services. The traditional meal structure changes and people also start to consume meals away from home, instead of just eating at home. The internationalizing processes of economies are starting to produce their effects in terms of an increasing availability of food goods, moreover, these are less affected by the seasonality. The 'satiety' consumption model, defined by Malassis, corresponds to an extreme version of the agro-industrial model. It is characterised by the saturation of caloric consumptions and the growing importance given to health and hedonistic properties of food. This is connected to a tendency of differentiation in consumptions, whereas the household expenditure for food is decreasing in relative terms. The saturation process, that happened in all developed countries, has brought to a loss in terms of importance of the income as explicative variable of food consumption. Moreover, it has brought to substitution effects and higher competitiveness among food goods. Recent nutritional trends modify the 'satiety model' due to several overlapping factors which bring to a more fragmented and differentiated food-market. Food-quality and food-safety have become the main elements in the evolution of consumptions. Specifically, the research of quality has developed among the consumers an interest in typical goods, that has created many market niches. The demand of quality products recalls to the concept of food safety, which is a fundamental requirement especially after the food diseases occurred in the 1980s and 1990s. In the last years, an increasing attention has been paid to nutrition and health and this explains why the nutritional and healthy features have been used to sell products.

The influence of international processes has contributed to the deseasonalization of food consumptions, but, on the other hand, has brought to a major awareness and attention at the sustainability of production among consumers (Fanfani, 2009).

1.2 1800-1960: History of food consumption before the nutritional transition

Statistics rarely exist before the late-nineteenth century although historians have produced estimates. Before 1800 the only quantitative data upon food consumption were the few surviving documents that listed food purchases for institutions, such prisons and orphanages, that are not necessarily representative of the population. It has, however, been argued that the consumption of livestock products, declined in the sixteenth century and was not restored until the mid-nineteenth century. It is often thought that a primary characteristic of food consumption before the nutritional transition was the frequent occurrence of famine. Yet, by the early-nineteenth century the frequency of famine had greatly diminished and after the end of the Napoleonic Wars (1815) serious famine was almost rare.

Most of the scholars agreed that an effective guide to the nutritional status of a country is the total calories available *per capita* per day and most studies figured out that in the nearly-nineteenth century those values increased all over European countries. However malnutrition (deficiency diseases such as scurvy and pellagra) and undernutrition were widespread until the half of the twentieth century and from then on there was an increase of the average weight of population.

Even if there is a rather limited evidence on the composition of the diet in the early-nineteenth century, starchy staples (generally cereals and potatoes) accounted the majority of total calories. The reason of their importance was that cereals and pulses were the cheapest sources for calories and proteins. In pre-industrial Europe the consumption of bread and, to a lesser extent, potatoes provided 65–75% of the calorie intake, and also accounted for much of the protein. The percentage remained remarkably high until the middle of the nineteenth century and since then the ratio had, more or less suddenly, fallen in all countries (Grigg, 1996).

In the twentieth century, when total available supplies reached about 2800–3000 calories and undernutrition was no longer a problem, the consumption of nearly all food categories continued to increase with the exceptions of cereals,

potatoes and pulses. Indeed, the increasing in income were spent upon preferred foods that provide energy and protein but with a pleasant taste.

Moreover the starchy staples saw a further shift from the consumption of inferior to superior cereals in the nineteenth century; for example nowadays wheat replaced rye that was formerly the leading bread flour in Northern and Central Europe in the nineteenth century. This shift to wheat also occurred to detriment of chestnuts, maize and oats (Grigg, 1995).

So great was the dominance of starchy staples, that in the late-eighteenth century livestock products provided a very few contribution to total calorific and proteins intake per day. Indeed livestock products -meat, milk, cheese, eggs, butter and fish- rarely made up more than 15% of the calories intake in the pre-industrial diet. Simultaneously with the decline of starchy staples, the livestock products consumption had steadily increased in the nineteenth century supplying the protein per day intake.

Sugar is another food category that represented a luxury good in the pre-industrial era, but its consumption grew in the later-nineteenth century with the spread of hot beverages, such as tea and coffee, and also for its use in patisserie. Moreover in the last century the cost fell due to the process of industrialization and calorie intake from sugar increased in all countries (Grigg, 1997).

Also the consumption of oils and fats, although essential for cooking, had a marginal role in the pre-industrial diet, since they were not used in elevated quantities. The great increase in consumption began in parallel with the purchase of livestock and the appearance of new oilseeds in the later-nineteenth century.

Fruit and vegetables seem to have played a little role in the pre-industrial diet, with the exception of the Mediterranean region, although their consumptions may have been possibly underestimated in the past.

1.2.1 Causes of changes in the diet

The industrial revolution gave a prompt to the increasing of the socio-economic level: the economic and social changes that took place during the later nineteenth and the early-twentieth centuries involved also the “traditional”, until that moment, diets.

First of all, the growing productivity of agriculture increased the output of food and promoted population growth. Moreover as the transportation network improved with the construction of railways, much of the continent was freed by the dependence on local harvests and could access to a large variety of foods. Then the growing capacity to move quite cheaply foods through long distances allowed the reduction of the real cost of transport. Furthermore new technological preservative systems, such as the refrigeration that was introduced into ships and railways or the system of bottling foods, contributed to bring costs down and preserved perishable commodities.

Then, the growth and export of manufactured goods made nations and consumers rich enough to import goods from all over the world at prices, sometimes, below those of home grown produce.

Afterwards the growth of real incomes, since industrialization brought higher real wages, allowed the households to choose more pleasant and quality food.

Another factor in changing the diet was the processing foods after they had left the farm. The processing of foods was transferred from the farm to factories and concentrated in bigger, high productive and technological establishments.

This by no means exhausts the considerations about the changes in the diet, a closer examination would be required to deal with the complexities of: urbanization, wholesaler structure, transport network, income evolution and etc.

1.3 Structural Changes in Food Consumption

The period which goes from the 1950s till nowadays was characterized by a growing integration among European countries with the creation of the European Economic Community in 1958. With the constitution of the European Union's internal market, tariff barriers were abolished and the Common Agricultural Policy was established. In 1992, the creation of the Single Market brought to the abolition of non-tariff barriers which favoured the exchange of goods, people and services. In 2002 the Euro currency was adopted by eleven countries, while in 2007 the European Union was enlarged to 27 members. The importance of food consumption on the household total expenditure has been remarkably reduced in

the European Union, going from almost 30% in the 1960s to 12% in 2007 in EU-15. The convergence process to similar food consumption values on the total expenditure was well marked, especially for the Eu-15 countries whose integration process was longer (Fanfani, 2009). These values have lowered also considering the EU-27, even if with less significant figures. Despite the aggregate convergence process, the single European countries still show differences regarding the structure and composition of food consumption.

1.4 Prices and income

Key determinants of the food consumption evolution are income and prices. In fact, the economic theory suggests that, real consumer income and the price of complementary and substitute goods, play a significant role in explaining the food consumption variations. 'In the case of food, few other goods can be considered close substitutes. Thus, it is likely that the principal economic determinant of long run changes in per capita food consumption is the variation of real consumer income' (Gil, Gracia, Pérez y Pèrez; 1995). Generally, a positive correlation between income and consumption is shown, that is to say the higher the countries' income, the greater the consumptions levels. However, since food is a basic necessity, a minimum threshold of food consumption must be attained. Therefore, as the Engel's law explains, with low income levels, food consumption is relatively high and, as income grows, food consumption increases at a lower rate until people reach the calorie saturation level.

1.4.1 Engel's Law

By the end of the nineteenth century, Ernst Engel discovered a relationship that connects household incomes with the food consumption. This relationship was discovered by analysing the consumption expenditures compared to the incomes in a sample of Belgian families, but later on it was proved to be true in both developing and developed countries. The poorer the household, the greater the income share allocated to the purchase of basic necessities such as foodstuff.

Engel's law highlights the relationship between income trend and the required amount of agricultural and nutritional goods, determining that the percentage of

the available household expenditure directed to food is decreasing as the household income increases (whereas such percentage is influenced by several factors besides the income, as household habits and dimensions,…).

Basic necessities expenditures as bread and milk, for example, don't grow proportionally to the income; above a certain threshold, a doubling in the household income will hardly correspond to a doubling in the consumption of such goods; while as the income grows, consumers will shift their consumption choices towards superior and luxury goods.

That means the demand elasticity with the respect of income is smaller than 1. Let F be the food expenditures and I the income, the income-elasticity correspond to

$$\varepsilon I = \frac{\Delta F/F}{\Delta I/I} = \frac{\Delta F/\Delta I}{I/F}$$

Knowing that the average propensity to consume is $APC = F/I$ and marginal propensity to consume corresponds to $MPC = \Delta F/\Delta I$, the income elasticity to the demand can be written as: $\varepsilon I = MPC/APC$. For small variations of income (ΔI) and (ΔF) the ratio $\Delta F/\Delta I$ can be relate to the derivative of the Engel function. It is important to underline that food expenditure assumes a greater importance (in percentage) with lower expenditure levels (Fanfani, 2009).

Also the Nutrition of Transition model it is closely related to the income. "As income increases in developing countries, consumers diversify their diets away from staples, such as cereals and starchy roots, towards food groups with positive income elasticities of demand, such as fruit and vegetables, meat and livestock products" (Pingali, 2006). These assumptions have been confirmed with evidences gathered in most of countries, since cereals and starchy roots consumption decreased everywhere, but with different trends. Nowadays, starchy staples still accounts as the most important component of diets, but the from 1961 until 1992 all the developed countries decreased such consumption, whereas in the developing countries it followed the opposite trend. It is worth noting that developing countries consume higher calorie amounts of starchy staples as it can be seen in the table below.

Table 1.1 – Starchy Staples: Trends in Consumption, 1961-1963 to 1990-1992

	Calories Per Capita Per Day				
	1961 - 1963	1969 - 1971	1974 - 1976	1979 - 1981	1990 - 1992
Developed countries	1299	1202	1166	1152	1039
Developing conutries	1342	1423	1509	1600	1630
World	1328	1394	1414	1481	1420

Source: (Grigg, 1996)

The price trend of agricultural and nutritional products, has received a growing attention due to its effects on the inflation and on the household nutritional consumptions. The general trend of prices compared to the agricultural production, the industrial transformation and the final consumption, has underlined a deep contrast. In fact, it is possible to notice a slow reduction regarding the prices of agricultural production, with an accentuation on their annual and monthly variability. The reduction of production prices is mainly due to the change of Common Agricultural Policy, which since 1992 has progressively replaced its support to agricultural prices with immediate help to farmers' incomes, favouring the realignment between world market and European prices.

The decreasing trend regarding prices of agricultural production, contrasts with the increase occurred in the case of industrial transformation and consumption prices. Only during the year 2007, agricultural prices have gone through a considerable hike and have recovered, if compared to those of the other food chain components, but this has been substantially determined by the worldwide increase regarding the main commodities (which later on will decrease again, in 2008). Whereas consumption prices and those related to food industry, have progressively increased from 1995 to 2003. However, the introduction of Euro currency, without an effective control of the trend followed by the prices, has increased the gap between the prices of agricultural production and those of consumption (Fanfani, 2009).

The trend followed by agricultural prices is influenced also by a demand that has witnessed the affirmation of a remarkable "deseasonalization" of food consumptions, which has been caused by recent production techniques and importations coming from the Southern hemisphere. In 2007, it has been registered a strong increment in the price of agricultural products worldwide; this

is something that has determined deep repercussions on many national and international markets.

The historical connection between the price of oil and nutritional goods (which had already manifested in occasion of the first oil crisis, in 1972-74), appears to have strengthened in the last years, not only for its link with the increasing global demand, but also due to the realization of policies that allow agricultural productions to be used as sources of energy. The increase of cereal quotations in global markets, has been particularly relevant, and many have been the analysis made in order to verify how such increments have been transferred over national wholesale prices and partially over consumption prices.

Through an analysis made by Mazzocchi and Capacci (2008), it is possible to notice how between 1996 and 2005 all the prices were stable or decreasing. In conjunction with the increasing prices of oil (in dollars) and grain alcohol, a considerable increment of cereal prices has been registered. Such growth has also moved over the wholesale prices of flour and its derived, although in a smaller amount. The increase of bread prices, considering at least the last available data, appears to be justified by the international economic dynamics (Fanfani, 2009).

The dynamics of prices from agricultural production to the consumption, underlines also the need to develop production chain deals along the whole food chain. The purpose of such operation is the reduction of the several passages which often characterize the food chain, with the consequence of a decreasing difference among prices.

1.5 Food consumption determinants

The food chain is divided in three levels: consumers, food manufactures and retailers. At each step there can be plenty of food determinants, and their importance varies significantly over time and space. The situation of the agri-food industry and the distribution channels in each country affect consumption trends and patterns in Europe. Consumers are the most important agents in determining food consumptions, therefore their characteristics, attitudes and behaviour influence the food consumption determinants. Food manufactures and retailers

have gone through a dramatic change in their structure, to face the increasing competitiveness in the saturated food markets.

1.5.1 Consumers

'Consumers cannot and are not willing to eat more, but their food demand is shifting among different products. Nowadays food consumption is a matter of choice, and great efforts must be carried out to attract consumer food choice' (Gracia & Albisu, 2001).

1.5.1.1 Socio Demographic Characteristics

Socio demographic characteristics are important to explain consumers' behaviours and preferences. In fact, in the last year, per capita food consumption, in quantity terms, has changed only slightly in Europe, especially referring to the EU-15. European consumers prefer to buy more added values products.

In the last years European population growth is stable, therefore there are just few potential consumers and more elders. It was estimated that, in the last decade, most significant changes occurred in the 20-29 age group, facing a large decline in population, and the 65 and over age group, facing a large increase (Gracia & Albisu, 2001). Older consumers tend to reduce their energetic intake and usually, they prefer eating more traditional foods. Moreover, they rarely try new food products or take-away meals, preferring the food products they used to eat in the past. Generally, elders are more concerned about their health and for this reason they allocate a greater share of their income to buy fruits and vegetables, consuming less fats (Gracia & Albisu, 2001).

Another change in demographics has been caused by the recent immigration flows that affected especially EU-15 countries. Generally, Northern African and Middle Eastern people have arrived in the old continent, carrying different cultures and traditions. The majority of these immigrants believes in the Islamic religion which requires some restrictions in food consumption, such as alcohol and pig-meat. Moreover, it is required to slaughter the meat through the traditional Islamic procedure. Also others cultural characteristics brought by immigrants are determinant in analysing the changes in food consumption.

An interesting study, conducted by Hartwell et al (2011), analyses the international students' food habits whilst studying in the United Kingdom. The results were 'food behaviour is integral to individual and collective identity embedded in cultural process and practice. Food traditions reinforce identity, which in turn is conducive to psychological well being' (Hartwell et al, 2001). More over the socio-cultural factors have a strong role in deciding which foods are to be consumed and the existence of large cultural groups creates a need for traditional foodstuffs. Students were willing to buy more expensive foodstuff in order to keep on eating what they were used to. Cultural traditions have affected places where the purchases are made, Asian students were less comfortable with takeaways. Even though international students are generally open-minded, it has been noticed that traditional habits are hard to change (Hartwell et al, 2001).

The average household size in EU is diminishing whereas the total amount of household is increasing, that means single-person household are increasing. In general, those households are composed by two different categories: elders who live alone or young people. Usually, the latters are more willing to take ready-to-eat meals.

In the last decades, thanks to wider education opportunities and anti-gender discriminations laws, women moved into paid work (Reich, 2010). However, women are still largely in charge for family nutrition and main family meal planners. This brought to two majors evidences, the increased real household incomes – at least at the beginning – and a lesser amount of time for cooking. The consequences are a higher demand in convenience food and ready-to-eat meals, and the increasing number of meals consumed away from home.

After these considerations in changes of the consumer characteristics (growing income, ageing population, smaller households, increasing number of working women, etc.) it is evident that European consumers at have shifted their preferences to added-value food products.

1.5.1.2 Demand for Quality

The market requires quality: all the agents in the agri-food chain claim that market demands quality products. However, quality is a complex word that involves many different aspects. There are also many definitions, the most

significant of which is the one provided by the International Standard Organisation, since they have developed several Quality Standards. The mentioned definition is:

> *"The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs."*[1]

According to this definition, many features of food products are able to satisfy such requirements. Besides these characteristics, also other aspects closely linked to the product, such as the places where it is sold or the services provided, may satisfy their implied needs. Eventually, such perception of quality is related to the final price, which the consumer is willing to pay. In fact, the consumer decides to buy a food product depending on its food attributes, such as smell, taste, appearances, convenience, nutritive and healthy aspects, packaging, etc.

From now are briefly presented the attributes related to product development, convenience, production origin, health and safety concerns since they influence consumers' quality perception.

New products are launched to the market constantly in order to improve costumers' satisfaction. An interesting European tendency is the introduction food products from other cultures, thanks to many cross-cultural expositions. In particular, new four food types are interesting in the latest years: **functional foods**, which possess a hypothetical metabolic and regulatory (physiological) role, which is major than the one contained in common foods. The consumption of such foods brings to a final result which is controllable and positive for man's health; **special dietetic foods**, which are formulated to satisfy determined dietetic needs due to specific physical conditions, pathologies and disorders; **enriched or fortified goods**, which present the addition of nutrients in order to prevent or adjust proven lacks of nutrients in a specific group of people; **dietary supplement**, which are formulated in order to complement the diet in case it presents a lack of nutrients or when these increase their requirement.

[1] ISO 8402:1994 Quality management and quality assurance Vocabulary, withdrawn and revised by ISO 9000:2000 Quality management systems -- Fundamentals and vocabulary, March 2004.

An attribute that is increasing in consumers' preferences is a better convenience and functionality. For instance packaging is becoming an important component of the product appreciation. In fact, a smaller or bigger packaging, for a single use or an environmentally friendly envelope could improve their perceived quality. Convenience is especially related to time saving, the changing in the society brought to an increase in the demand of ready-to-eat, highly prepared foods, such as bakery and frozen food. It is worth noting that in 2001 the expenditure on processed food represented 43.7% of total food expenditure in the EU, and it was expected to rise in later years (Gracia & Albisu, 2001).

Although globalization, increasing trade, and consumer exposure to new products the interest in food with a place or region of origin has been renewed. This brought to an increase in local traditions and ancient production processes, especially in Mediterranean countries, such as France Italy and Spain (Gracia & Albisu, 2001).

The recover of local marketing and traditions, represents another path followed in order to put in contact producers and consumers in a context that appears to be more general, if compared to the one which implies the decrease of differences between the prices of production and those of consumption. In fact, nowadays local agri-foods can be easily distinguished due to the large presence certifications such as PDO (Protected Denomination of Origin) and PGI (Protected Geographical Indicator). The distinction of agri-foods productions is the object of several promotional initiatives carried on by local governments and it is useful to promote traditions and local food.

The aim of European Union Designation Origin (EUDO) certification is that products may be perceived as a high-quality food, produced in a specific area, through certified method of production, which ensures quality and traceability. However, the actual perceived quality varies, significantly, among countries and along with it also the tendency to buy such EUDO products. The quality of productions, if not perceived by the consumer, is not able to find a market suitability in terms of prices and may reduce itself to a simple additional cost for the firm.

1.5.1.3 Demand for quality: Health concerns

Consumers are increasingly interested in healthier food products, such as organic, natural, low fat, functional, fortified and home-produced products. Costumers who buy these type of foodstuffs recognise an higher quality in such products.

The food safety attribute is usually taken for granted by European consumers, but recently the confidence on food safety have been damaged by several scares, such as the BSE epidemic, salmonella, swine fever and bird flu. These worries brought to a stricter regulation, for instance, after the BSE epidemic, an improved and stricter labelling policy was introduced in Europe, which allows tracing all the passages occurred in the supply-chain. In general EU commission have played an active role in promulgating regulations in order to give consumers more tools and information.

The increased health concern of consumers prompts to select food based on its nutritional properties. A significant relationship between diet and chronic diseases has been pointed out in recent studies.

Health Concerns: Mediterranean and Asian diets.

Mediterranean and Asian diet are well-known for being an excellent model of healthy eating, since it is associated with low rate of a number of diseases usually related to food intake.

The Mediterranean diet is a nutritional model, which is typical of Mediterranean countries as Italy, and was studied for the first time by the American scientist Ancel Keys, who noticed an extremely low incidence of coronary diseases among the inhabitants of Cilento and the Island of Crete. Through the study of the characteristic nutrition belonging to that geographical area, Keys supposed that such nutrition could determine the state of health of these specific populations. Moreover, a further study ("Seven Countries Study") analysed a comparison made among seven different countries (Finland, Japan, Greece, Italy, Netherlands, United States and former Yugoslavia). The results of such researches showed how the number of deaths caused by heart attacks was

severely inferior in Mediterranean countries, compared to those of Northern Europe, whose diet is rich of saturated facts. In general, among the confirmed advantages, we can find an inferior risk of heart conditions and cancers. In Italy, the Mediterranean diet had been abandoned during the economic boom of the 1960s and 1970s since it was considered "poor", but nowadays it has regained its importance (Fanfani, 2009). The models related to such diet share a high consumption of bread, fruits, vegetables, cereals, olive oil and fish, while there is a limited presence of wine. Cereals, vegetables and fruits are recommended due to their fibre content, while fish brings an important contribution of essential fatty acids; on the other hand, diary products, livestock and sugar, play a smaller role in the total consumption.

In the last years there was a generalized trend in increasing the consumption of meat and dairy products in exchange of cereals pulses and wine (Grigg, 1999). Moreover, in two studies has been shown that Spain and Italy, two countries of the Mediterranean diet, approached slightly to the Western lifestyles. In Spain meat consumption increased, along with fruit and vegetables, but the intake of Northern products (sugars, fats and milk) even decreased (Gracia &Albisu, 1999). Instead, in Italy some Northern regions, characterized by lesser Mediterranean food traditions, even reconsider some key aspects of Mediterranean diet (Pilati &Fanelli, 2003). It can be argued that, in the last years, in Mediterranean countries, due to the growth of the income, increased of expensive products, such as meat, usually considered Northern diet, but the main healthy pattern remains. The most significant Northern pattern followed by these countries is the new lifestyle, characterized by time saving and convenience choices in food consumption.

Similarly, in the last years the Asian diet has gone through several changes, due to the growth in income, and they started a path towards Western food habits. In particular, Pingali (2006) found that Asian countries witnessed: (1) the reduction of per capita consumption of rice; (2) increased consumption per capita of wheat and wheat based products. Traditional rice eating societies are consuming increasing quantity of wheat in the form of bread, cakes, pastry, pizza, etc; (3) rise in high protein and energy dense diets. Especially higher income

groups started to eat more livestock and dairy food; (4) increased consumption of temperate zone products. In Asia it has increased the consumption of temperate zone vegetables, such as potatoes; dairy products, such as cheese; beef and temperate fruits, such as apples; and finally, (5) the rising popularity of convenience food and beverages.

It is worth noting the changes occurred in Asia moved a step further from the Nutrition of Transition model, in fact Pingali underlined that in Asia there is an increased tendency in to consume in typical Western products along with traditional Asian food. Moreover, Asia went through a deep transformation in the food supply system which, nowadays relies on food imports and a Western-style selling facilities, such as super market and fast food chains. Not by chance, this transformation affected principally the cities placed on the coast, where port facilities make easier to ship products (Pingali, 2006).

1.5.1.4 Consumer preferences

Preferences, testes and attitudes play an important role in determining food consumption, since they have build several differences in food behaviour. From empirical findings Herrmann and Röder (1995) stated that differences in preferences are more important determinants in consumption levels than differences in income and the availability of food. "Cultural values, learned preferences, and lifestyles each have a significant impact on food consumption. Attitudes and preferences for food products are shaped during the process of habit formation, and these habits continue over time. Many international differences in dietary patterns are the consequence of physical availability and local production in the past" (Gracia & Albisu, 2001). For instance, olive oil is now widely spread in all the European region, at similar prices to those in Mediterranean countries, but in Northern countries, consumption levels have not increased much because different cultural traditions and preferences.

Lifestyle is another key aspect to determine why and where people spend their money for foodstuffs. Scholars profiled some major lifestyle segments in order to find if some of them belonged to a particular region. In interesting profile is the European consumer of traditional food. Vanhonaker et al. (2010) used data referring to 4828 people resident in six European countries (Norway, Belgium,

France, Spain, Italy and Poland). The participants were analysed in order provide two profiles: the European Traditional Food Consumer (TFC) and the European Non Traditional Food Consumer (NTFC). TFC is typically found in Southern Europe, rather than in Northern European countries. TFC typically belong to older age groups, live in larger household and are, at least, second generation natives in their country. People in the TFC group are interested in food and they look for information into magazines. Moreover, they are more religious than the ones in the NTFC segment, but this could be due to the fact most of them lives in Southern Europe. People in TFC segment typically commit more time in the preparation of meals, and cooking is also seen as an expression of caring their family. They spend more time and a higher share of their income also for buying food in local markets. Finally they pay more attention to labels and they try to buy more organic food (Vanhonaker, Lengard, Hersleth, & Verbeke, 2010).

Finally, eating patterns have changed in the last years, for instance people are eating more meals away from home. In addition, the meal structure is changing, even if with different trends.

1.5.2 Food Manufacturing and retailing

Food manufacturing and retailing have gone through several structure changes in the last 50 years, for instance we may think to the shopping facilities such as malls and hypermarkets. Since nowadays the market is more saturated, they tend to be more integrated. However the power relationship between them is shifting to retailers, just think to own-label products.

Since local foods has increased in consumers' preferences, territorial marketing, which has developed during the last decade as a specific sector of general marketing, tries to increase the value of peculiarities of a certain territory regarding the production of goods and services as element of durable local development. Territorial marketing can be included therefore in a more general matter as the one represented by local development. Its strong point is the inclusion of qualitative aspects, production process, food safety of health and cultural aspects of traditional food products that must be inserted in a context of sustainable local development.

The seller structure changed surprisingly since 1960s, then consumers had to shop in several small food sellers, nowadays beyond that, there are shopping centres, hypermarkets, hard discounts and supermarkets. Consumers choose where to buy depending upon proximity, convenience and services provided. Depending upon which European country is considered, there are different pattern in where going shopping. In particular, traditional retailers are still preferred by one fifth of the population of the Southern European countries, whereas in the remaining countries it is almost disappeared. One of the last trends in retailers structure is the possibility to shop food online, however is not very common yet and it is principally provided as an additional service of retailer chains (Gracia & Albisu, 2001).

1.5.3 Regulations

As already mentioned, the recent scares have damaged the confidence in food safety of consumers. In order to deal with this issue, the European Union was quite active in this process of drawing general guidelines and specific regulations in order to improve food safety. Along with it, also private companies, both manufacturing and retailing, started to highlight the quality and food safety of their products.

The White Paper on Food Safety (2000) establishes the standards and the general principles for a common strategy among European countries and its general aim is that a "farm to fork" integrated approach is necessary. Moreover, the European Commission stresses on the importance of controls and adequate information for consumers. Finally with the White Paper, the European Food Safety Authority (EFSA) was established in order to gather information and make scientific evaluation of risks.

In 2008 the European Commission enacted Green Paper on Agricultural Product Quality, in which general guidelines on product standards, farming requirements and quality schemes are defined. The Green is divided in three parts: (1) production requirements and marketing standards, (2) Specific EU quality scheme, such as geographical indications and organic farming; and (3) Certification schemes and the EU oversight.

European regulations extend the use of Hazard Analysis and Critical Control Points (HACCP) to farms. "HACCP is a tool that can be useful in the prevention of food safety hazards. While extremely important, HACCP is only one part of a multi-component food safety system. HACCP is not a stand alone program. Other parts must include: good manufacturing practices, sanitation standard operating procedures, and a personal hygiene program" (Rushig & Ward).

Further national laws may affect the supply chain, but the analysis expressed has been restricted to the major regulations of the European Commission, since they are equally in force in 27 countries (EU-27) of the 39 considered.

1.6 Are European Consumptions Converging?

Several scholars have studied the possibility of a convergence related to the consumption in developed countries, which have been chosen due to their data availability. From this point on, some studies on food consumption will be described.

In his pioneering work Blandford (1984) stated that OECD were getting closer, since the differences in food consumption were decreasing, and "overall, a comparison of the groupings derived for 1956 and 1978 further reinforces the conclusion that OECD countries have tended to become increasingly similar in the overall structure of their diet. […] Although differences still exist in dietary patterns in the OECD area, most dramatically between such countries as Japan and the United States, the general picture is one of increasing similarities in the structure of the diet in the majority of OECD countries" (Blandford, 1984). Hermann and Röder (1995) affirmed that OECD countries converged in their total food demand. Similarly Gil et al. (1995), through the analysis of the sigma- and beta-convergence measures, found that all the food categories showed some degree of convergence, even though not all of them were significant.

In more recent years, scholars have studied the convergence of food pattern between developed and developing countries and about this issue, an interesting example was proposed by Elsner and Hartmann (1998). They studied the convergence of food consumption patterns between Western and Eastern Europe

(Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia). The analysis went through some difficulties because they had to produce the estimates for the countries that did not exist before 1990. After that, convergence measures were calculated between each Eastern country and the EU-15 (considered as a whole), confirming some degree of convergence. A similar study was proposed by Mauracher and Valentini (2006), who studied the convergence between the CEEC (Central and Eastern European Countries) and the EU-15 countries. The analysis highlighted the occurring of a homogenization process. However, such process represents just the "surface" of the changes that are taking place.

From this brief analysis it is worth noting that the European countries are witnessing a homogenization of their food consumption patterns, but all the scholars suggest to analyse deeply the cultural and traditional preferences since they restrain the "perfect" convergence.

2 Dataset and Methodology

Analysing food consumption is a complex activity since human beings eat a huge variety of foods. One way to deal with this complexity is to group foods into classes (Grigg, 1996), for this reason the data used in this work are divided in 14 categories. This dataset contains information on the average daily per capita calorie (Kcal) consumption of 14 food aggregates annually detected from 1961 to 2009. The data used in this work are taken from the statistics provided by FAO[2] and the food aggregates are (all the definition below are provided by FAO Statistics):

1. **Alcoholic beverages**: it includes beverages obtained through fermentation of many vegetable crops and undenatured ethyl alcohol with alcoholic strength by volume of less than 80 percent, and usually between 40 and 50 percent, such as beer, wine and the distilled alcoholic beverages, whether or not sweeteners and/or flavourings have been added.
2. **Animal fats**: it includes butter processed by milk and animal fats that are obtained in the course of dressing the carcasses of slaughtered animals (slaughter fats), or at a later stage in the butchering process when meat is being prepared for final consumption (butcher fats).
3. **Cereals**: values are without the cereals needed for the production of beer. Cereals include Wheat, Rice Paddy, Barley, Maize, Popcorn, Rye, Oats, Millets, Sorghum, Buckwheat, Quinoa, Fonio, Triticale, Canary Seed, Mixed Grain and Cereals N.e.s[3].
4. **Eggs**: it includes hens eggs and of other birds.

[2] Data available at the following website faostat.fao.org
[3] N.e.s.: not elsewhere specified.

5. **Fish and Seafood**: it includes aquatic animals, aquatic plants, cephalopods, crustaceans, demersal fish, freshwater fish, marine fish, molluscs and pelagic fish.
6. **Fruits and Tree Nuts**: fruit crops consist of fruits and berries that, with few exceptions, are characterized by their sweet taste. Nearly all are permanent crops, mainly from trees, bushes and shrubs, as well as vines and palms. Although melons and watermelons are generally considered to be fruits, FAO groups them with vegetables because they are temporary crops. Tree nuts are dry fruits or kernels enclosed in woody shells or hard husks, which in turn are generally covered by a thick, fleshy/fibrous outer husk that is removed during harvest. Similar products, such as groundnuts, sunflower seeds and melon seeds, although often used for similar purposes, are included with oil-crops. FAO includes in this group only dessert or table nuts. In the calculus of fruits, grapes used in the production of wine have been excluded.
7. **Meat and Offals**: meat from animals, fresh, chilled or frozen, with bone in. Offals are aggregates in this work.
8. **Milk**: it is the sum of whole fresh milk production from Buffalos, Camels, Cows, Goats and Sheep. The quantity of milk used for the production of butter has been excluded.
9. **Miscellaneous**: it is a collector of different type-food which cannot be put in other categories, their caloric contribution in the whole diet is negligible.
10. **Starchy Roots and Pulses**: Starchy roots include potatoes, sweet potatoes, yams, taro, and cassava[4]. Pulses are annual leguminous crops yielding from one to 12 grains or seeds of variable size, shape and colour within a pod. They are used for both food and feed. The term "pulses" is limited to crops harvested solely for dry grain, thereby excluding crops harvested green for food (green peas, green beans, etc.) which are classified as vegetable crops. Also excluded are those crops used mainly for oil

[4] Definition taken from Encyclopædia Britannica.

extraction (e.g. soybean and groundnuts) and leguminous crops (e.g. seeds of clover and alfalfa) that are used exclusively for sowing purposes. They include Bambara beans, Beans, dry, Broad beans, horse beans, dry, Chick peas, Cow peas, dry, Lentils, Lupins, Peas, dry, Pigeon peas, Pulses, nes, and Vetches.

11. **Stimulants and Spices**: stimulants include coffee, cocoa and tea. Spices are vegetable products such as leaves, flowers, seeds and roots that are rich in essential oils and aromatic principles. They are used mainly as condiments. They include pepper, pimento, vanilla, cinnamon, nutmeg and mace and cardamons, cloves, anise and badian and fennel, ginger, spices nes.
12. **Sugar and Sweeteners**: this category includes sugar crops, sugar beets and sugar cane and under the name sweetners; FAO includes products used for sweetening that are derived from sugar crops, cereals, fruits or milk, or that are produced by insects.
13. **Vegetable Oils and Oilcrops**: as vegetable oils, the FAO concept includes raw, refined and fractioned oils, but not chemically modified oils. Oil-bearing crops or oil crops include both annual (usually called oilseeds) and perennial plants whose seeds, fruits or mesocarp and nuts are valued mainly for the edible or industrial oils that are extracted from them. They include: Castor oil seed, Coconuts, Cottonseed, Groundnuts, with shell, Hempseed, Jojoba Seeds, Karite Nuts (Sheanuts), Linseed, Melonseed, Mustard seed, Oil palm fruit, Oilseeds, Nes, Olives, Palm kernels, Palm oil, Poppy seed, Rapeseed, Safflower seed, Seed cotton, Sesame seed, Soybeans, Sunflower seed and Tung Nuts.
14. **Vegetables**: they are mainly annual plants cultivated as field and garden crops in the open and under glass, and used almost exclusively for food. Vegetables grown principally for animal feed or seed should be excluded. Certain plants, normally classified as cereals and pulses, belong to this group when harvested green, such as green maize, green peas, etc. This grouping differs from international trade classifications for vegetables in

that it includes melons and watermelons, which are normally considered to be fruit crops.

The sum of these fourteen categories gives the 100 per cent of the daily total caloric intake per capita of every country analysed in this work.

The use of caloric equivalents facilitates the analysis, since they are assumed to be common across countries for a given food product, and it simplifies the cross country comparisons. But the use of caloric weights implies greater emphasis on food which are high in calories per unit e.g. fats, oils, cereal and starchy foods (Blandford, 1984). However, per capita food consumption only catches one aspect of the complexity of the food system, beyond what is eaten, it comprehends how and where it is eaten. For example, the preference of the consumer to purchase already transformed food, the necessity of time-saving purchases, the attention paid to quality and the increasing interest in eating as a social issue are new profiles of the food system (Pilati & Fanelli, 2003).

Countries analysed in this study are all 39 European countries, that are: Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Former Yugoslav Republic of Macedonia (the FYROM), Ukraine and United Kingdom.

Some problems arose in creating the dataset since certain countries are quite recent and did not exist before 1992. The geopolitical asset was quite different before the 1990s and countries like Latvia and Ukraine belonged to USSR until 1991 and then became independent in 1992. From 1990 to nowadays 15 new countries have been created from the former territories of USSR[5], Socialist Federal Republic of Yugoslavia and Czechoslovakia. The 15 new countries are: Bosnia and Herzegovina, Croatia, Federal Republic of Yugoslavia (in 2003 split in two different countries: Serbia and Montenegro), Slovenia and the FYROM from the Socialist Federal Republic of Yugoslavia; Czech Republic and Slovakia

[5] Union of Soviet Socialist Republics.

from Czechoslovakia; finally, from the USSR block we have Belarus, Estonia, Latvia, Lithuania, Moldova, Russia and Ukraine. Actually, from the former territory of USSR other countries were created, e.g. Georgia, Kyrgyzstan and Turkmenistan to name a few; however, since these countries are not in Europe, geographically speaking, we did not considered into the analysis. A similar problem arose with Belgium and Luxembourg whose records were gathered together from 1961 to 1999 and separated later on.

In the final dataset, I considered the countries whose territories belong to Europe and with the boundaries and names used internationally in 2009. For countries which did not exist for the whole period, I imputed the values of the former country, i.e. for Latvia, values from 1961 to 1991 are taken from USSR records and then from 1992 to 2009 I used Latvia records. Since data values are average daily per capita calorie (Kcal) consumption, there was no need to recalculate values imputed before 1992. It must be kept in mind that records taken in these countries before 1992 are an average of the whole former nation. Therefore, values are the same even if traditional habits or climate condition may differ a lot.

Data are taken from the Food Balance Sheets calculated by FAO from records made available by every country belonging to UN organization.

> *Food Balance Sheets (FBS) are compiled every year by FAO, mainly with country-level data on the production and trade of food commodities. Using these data and the available information on seed rates, waste coefficients, stock changes and types of utilization (feed, food, processing and other utilization), a supply/utilization account is prepared for each commodity in weight terms. The food component of the commodity account, which is usually derived as a balancing item, refers to the total amount of the commodity available for human consumption during the year. Besides commodity-by-commodity information, the FAO FBS also provide total food availability estimates by aggregating the food component of all commodities including fishery products. From these values and the available population estimates, the per person dietary energy and protein and fat supplies are derived and expressed on a daily basis. In the FBS production data refer only to primary products while data for all other elements also include processed products*

derived there from, expressed in primary commodity equivalent (http://www.fao.org).

These are not consumption data, but estimates of the available supplies, calculated from national statistics of production, quantities taken from store, and imports, from which exports, food put into stores and used for seed, feed and industrial purposes are deducted. A further deduction of 10% is made for waste estimation between farms and retail outlets. The final figures are food supplies available at a retail level in calories per capita. Food balance sheets overstate consumption as recorded in households consumption surveys (Grigg, 1999). Although data may not be treated as precise estimates of consumption, they provide a useful approximation to changes that have taken place over the time (Gil, Gracia, & Pérez y Pérez, 1995). The definition of edible food, movements of food via tourism, wastage and levels of food production are problems that arise when making comparisons between countries. These problems do not follow random distribution among countries and must be kept in mind when using food balance sheet data (Gil, Gracia, & Pérez y Pérez, 1995).

As already mentioned, the use of caloric equivalents has some benefits: it facilitates aggregation of different foods and the derivation of shares by types of foodstuff. Cross-country comparisons of changes in consumption are simplified by the fact that caloric equivalents are assumed to be constant over time and to be common across the countries. Conversely, using monetary measures implies to take into account differences in price levels between countries. 'However, the use of a common set of caloric conversion factors for all countries and years to convert from product weights to caloric equivalents, is the main limitation' (Gil, Gracia, & Pérez y Pérez, 1995).

2.1 Data at Glance

An analysis of the average diet composition in 2009 shows that more than sixty per cent of the calories consumed are derived from: cereals (29.32%), vegetable oils (12.39%), sugar and sweeteners (11.10%) and meat (10.77%) aggregates, although with marked differences across regions. The situation has changed a lot

since 1961, when more than sixty per cent of calories consumed were derived from: cereals (41.64%), sugar and sweeteners (10.38%) and milk (9.16%).

Table 2.1 gives per capita daily food consumption for the 39 European countries for 1961 and 2009. The table indicates that average apparent consumption for these countries, considered as a group, is currently over 3200 kilocalories per day, ranging from roughly 2700 kilocalories in Moldova, to 3800 in Austria. In 1961 the average calorie intake was almost 3050kcal/capita/day and Switzerland with 3500 kcal/capita/day was taking the highest caloric intake in the whole European region. Still in 1961 Albania presents the lowest per capita food consumption with 2234 kcal/capita/day, under the recommended average calorie intake set by the World Health Organisation (WHO) around 2300-2500 (Cornia, 1994). In the same year also in Portugal the caloric intake was quite low and very close to the recommended average while all the other countries succeeded in providing higher levels of nutrients. Looking at table, in average the calorie intake per capita has slightly increased over the period: the average calorie intake in 1961 was 3048 kcal/capita/day and in 2009 it rose to 3292 kcal/capita/day. Almost all countries show an increase in consumption in 2009 compared to 1961, with the exception of Slovakia, Moldova, Bulgaria, Serbia, Latvia, Montenegro, Switzerland, the FYROM and Finland. If the decrease of most of them can be explained by the fact that, in 1961, data were provided together with other countries at the time belonging to URSS or Yugoslavia, a more interesting case is Switzerland, which had the highest caloric intake in 1961, but whose consumption decreased to 3454 kcal/capita/day over the period. It is worth noting that this value is still higher than the mean of European countries and it is much more than 2300-2500 kcal/capita/day, which is the minimum recommended average caloric consumption per day set by the World Health Organization. By these standards, in 1961 only Albania and Portugal had a consumption below the level suggested by the WHO.

Figure 2.1, which shows per capita food consumption, in calories, on a daily base in 2009, is a geographical map. At glance, Eastern countries consume less

Table 2.1 - Per capita food consumption by country in calories per day, 1961 and 2009

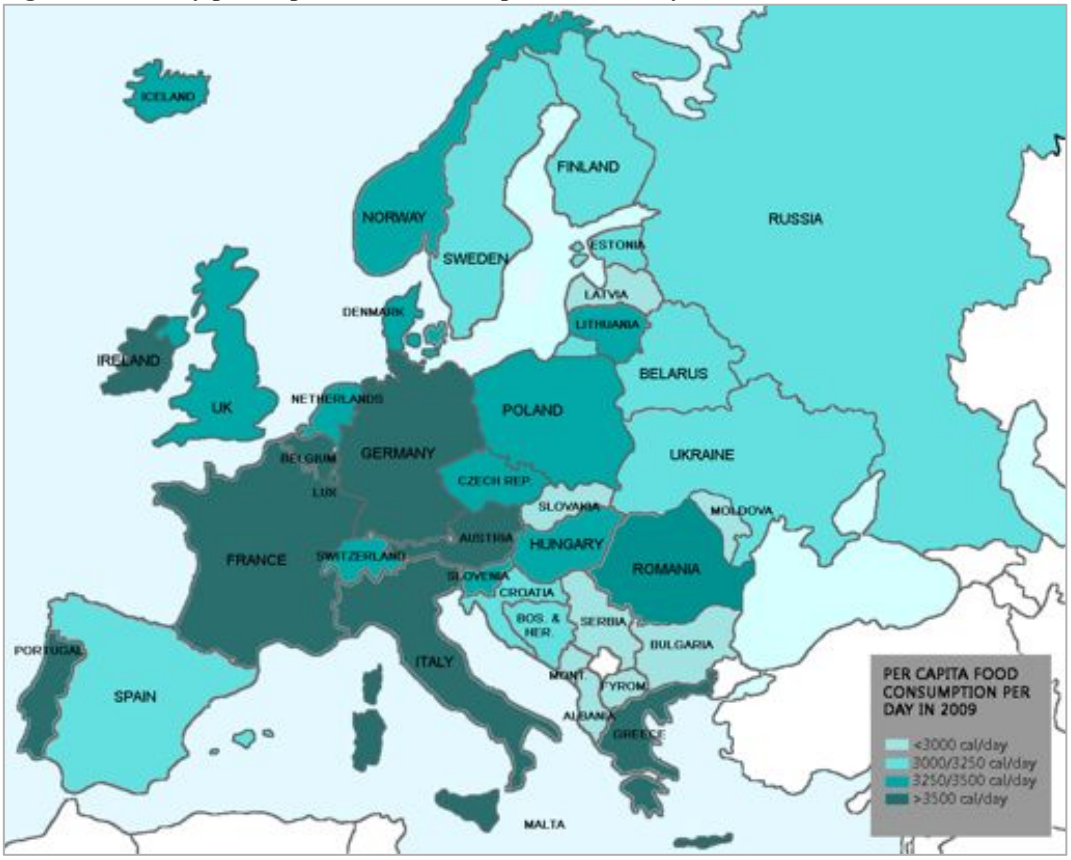
Country	Year		Country	Year	
	1961	2009		1961	2009
Albania	2234	2903	Malta	2846	3438
Austria	3192	3800	Moldova	3095	2707
Belarus	3095	3186	Montenegro	3049	2887
Belgium	2942	3721	Netherlands	3061	3261
Bosnia and Herzegovina	3049	3070	Norway	3002	3453
Bulgaria	3170	2791	Poland	3337	3392
Croatia	3049	3130	Portugal	2473	3617
CzechRepublic	3301	3305	Romania	2841	3487
Denmark	3188	3378	Russian Federation	3095	3172
Estonia	3095	3163	Serbia	3049	2823
Finland	3265	3240	Slovakia	3301	2881
France	3194	3531	Slovenia	3049	3275
Germany	2888	3549	Spain	2633	3239
Greece	2824	3661	Sweden	2829	3125
Hungary	3078	3477	Switzerland	3566	3454
Iceland	3256	3376	TheFYROM	3049	2957
Ireland	3359	3617	Ukraine	3095	3198
Italy	2955	3627	UnitedKingdom	3231	3432
Latvia	3095	2923			
Lithuania	3095	3486			
Luxembourg	2942	3637	Mean	3048	3292

Elaboration of FAO data

calories than Western Europe, and more specifically in the Balkan peninsula consumes are generally lower or around 3000 calories per day with the only exception of Greece. In the middle of the map we find the countries which consume the greatest amount of calories, with more than 3500 kilocalories a day.

Economic theory suggests that variations in real consumer income and in the price of complementary or substitute goods are the main determinants of changes in food consumption. Few other goods could be considered close substitutes of food. Thus, it is likely that variation in real consumer income is the main economic determinant of long-run changes in per capita food consumption. Generally, a positive correlation between consumption and income can be observed: countries with higher income levels have higher consumption levels (Gil, Gracia, & Pérez y Pérez, 1995). An example could be seen in low levels of

Figure 2.1 - Daily per Capita Food Consumption in 2009 by Countries



Elaboration of FAO data

food consumption in the Balkan peninsula and for all countries with less 3000calories per day.

Following this thinking, Sweden presents a tricky situation, since it is one of the countries with the highest per capita income of the whole European region, but its caloric intake is quite low (3125 calories/capita/day). In theory, this problem has been taken into account and it has been demonstrated that the caloric intake does not grow to infinite, but tends to reach a certain plateau. Although the level of this plateau could differ among countries, and there could be room for further growth, the idea is that per capita consumption is quite fixed (Blandford, 1984). Therefore, with low income levels, food consumption accounts for a high percentage of the income. Initially, food consumption increases very fast and, as the income grows, such consumption increases at a lower rate up to a threshold which is difficult to cross because of physical limitations (Gil, Gracia, & Pérez y Pérez, 1995).

Focusing on the whole period trough the analysis of time series, the evolution in food consumption has been very varied. An interesting situation can be noticed in all the countries belonging to the former Communist Regimes, i.e. those in the Balkan peninsula and those affiliated to the U.S.S.R. In all the time series graphs (see Figure A.14) the initial level of total calories consumed per day in 1961 is around 3200kcal/capita/day, even above the mean for Europe that year. In the following years the value keeps a slight, but stable, increase until 1991. In 1992 a sharp fall for all countries once belonging to U.S.S.R and Yugoslavia was registered. In countries like Croatia, Bosnia and Herzegovina and the FYROM, the caloric intake drops from more than 3400 to around 2400, going under the average value suggested by the WHO. It must be pointed out that between 1991 and 1995 in the Balkans the Yugoslav Wars took place. These wars, for sure, affected the supply of food in the whole period. In fact, some of ex-Yugoslav countries showed a very low consumption in the following years, with values around, and in some cases even under, the threshold of 2500 kcal/capita/day set by WHO.

Moreover, national statistics in this region may be affected and not so accurate. In 1991 the period of dissolution of the U.S.S.R. is ending; a dozen of countries declare the independence from the former state. It is a period of reforms, one of which is the return to the market system. While in the past countries only relied on what could be produced in the socialist block, now hard currency could be used to import food products from market economies. The year 1992 is the first year in which single data are available for these countries, which need some time to rearrange. In fact, most of these countries after 1992 restart increasing consumption and, by 2009, consumption is almost at the same level of 1991. However, in the following years, for some of them the consumption was stable or even decreased, showing that ex-socialist countries reacted differently to the end of planned economies. These findings support the statement that consumption was not as similar among socialist countries as one might expect (Elsner & Hartmann, 1998).

Countries that did not formally belong to the socialist regimes, but were somehow linked to them, such as Hungary, Czech Republic and Slovakia, show a

similar path, with a sharp drop in the first years of the 1990s and a recovery for the first two, while Slovakia shows no increase during the last two decades.

The majority of Western countries presents a path of almost stable increase during the period from 1961 and 2009, even tough with some differences and some peaks of decrease. It is worth noting that Albania, one of the poorest countries considered in this work, shows very low levels of consumption, especially in the first decades in which total caloric intakes are under the threshold set by WHO, and for the whole 1970s the values are just around of it. The following years represent a stable increase up to 2009, except for the first years of 1990s in which Albania likely suffered for the wars happening in the close countries.

2.2 Methodology

The statistical tools used in this work is clustering of time series data. Cluster analysis does not require a priori known groupings, hence it is a good tool when no previous patterns are defined. However, definite conclusions cannot be drawn from the results of cluster analysis because they depend on subjective choice of the clustering method and the distance (Maharaj, 2000). Giving a more general definition:

> *Clustering is an unsupervised learning task aimed to find similarities and differences among data objects to classify them into a small number of homogeneous groups (Pértega Diaz & Vilar, 2010).*

The majority of clustering analyses has been used on static data. 'Data are called static if all their feature values do not change with time, or change negligibly' (Liao, 2005). Theoretically clustering methods for static data have been classified in five categories: partitioning methods, hierarchical methods, density-based methods, grid-based methods, and model-based methods (Liao, 2005).

A partitioning method constructs k partitions of the data, where each partition is a cluster containing at least one object and $k \leq n$, given a set of n unlabeled data tuples. The partition could be considered crisp, if each object belongs to only

one cluster, or fuzzy if one object is allowed to be in more than one cluster. Hierarchical method groups data objects into a tree of clusters. The procedure could be done upwards agglomerating individual clusters in a bigger one until data are merged in just one cluster, or downwards, doing just the opposite. The first method is called agglomerative, while the second, divisive. Density-based method consists in the continuous growth of a cluster until the density in the "neighbourhood" exceeds a certain threshold. Grid-based methods evaluate the object space into a finite number of cells that create a grid structure where all operation for clustering are performed. Model-based method assumes a model for each of the clusters and assigns objects to the model which fits the best (Liao, 2005).

When the objects to be clustered are time series data, a classification might be useful to detect a few representative patterns, quantify an affinity, conduct a survey etc. One key point in cluster analysis is to determine a similarity or dissimilarity measure between two data objects. However, when dealing with time series, the concept of similarity is not simple and can be established in different ways. Usually the conventional dissimilarity measures, such as Euclidean distance, do not work well in time series setting since they are based on the closeness of the observed values, without taking into account the serial autocorrelation structure (Pértega Diaz & Vilar, 2010).

Time series clustering needs a clustering algorithm or procedures to form clusters given a set of unlabeled data objects. Depending on the type of data available and on the particular purpose of the application different clustering algorithms can be chosen. Various algorithms have been developed to cluster different types of time series data (Liao, 2005). The idea behind them is to modify existing algorithms for clustering static data in such a way that time series data can be handled or to convert time series data into the form of static data so that the existing algorithm for clustering static data can be directly used. The former approach, also known as raw-data-based approach, has been used in this work for producing clusters. It works directly with raw time series data and the major change lies in replacing the similarity/distance measure for static data with a more

appropriate one for time series (Liao, 2005). Only three of the five categories used for static data have been used or adapted for time series clustering.

2.2.1 Clustering methods and procedures

The clustering methods/procedures used in this work are agglomerative hierarchical clustering and *c-means* methods that belong to hierarchical and partitioning categories respectively.

A hierarchical clustering method works by grouping time series data into a tree of clusters. As mentioned before, two methods are possible: agglomerative and divisive, depending upon whether a bottom-up or top-down strategy is followed. The agglomerative procedure is more popular, and it starts by placing each object in its own cluster and then merges these singular clusters into larger and larger ones until all the objects are in a single cluster (Liao, 2005). To form the clusters various algorithms that produce different results exist, then in the analysis the one which fits the most, or the one which explains best, will be chosen. However, in this work most of the time the hierarchical procedure has been used, and more specifically the complete linkage algorithm since it produced better outputs.

Hierarchical Clustering

In the agglomerative hierarchical clustering the single linkage algorithm which measures the similarity of the closest pair of data points belonging to different clusters could be used. Then the clusters with the minimum distance are merged, and this process is repeated as long as all the objects are eventually merged in one cluster. The complete linkage algorithm works in a similar way evaluating the farthest distance of two clusters, instead of the smallest, and then merges the two clusters with the minimum distance. The *Ward's minimum variance algorithm* merges the two clusters that will result in the smallest increase in the value of the sum-of-squares variance. The procedure tries all the possible mergers of two clusters, at every step. As always, the smallest value of the sum-of-squares variance is selected. Hierarchical clustering method performance suffers from its inability to adjust once the mergers have been executed (Liao, 2005).

C-means Clustering

The second method is the *c-means* and the major idea behind it is the minimization of an objective function, which is usually chosen to be the total distance between all patterns from their respective cluster centres. The solution is drawn from an iterative scheme which starts with an initial cluster membership chosen arbitrarily. The two fundamental steps of the *c-means* algorithm are the distribution of the objects among clusters and the updating of the clustering centres. These two steps are alternated by the algorithm as long as the value of the objective function cannot be reduced anymore. Given n patterns $\{x_k | k = 1, \dots, n\}$, c-means determine c cluster centres $\{v_i | i = 1, \dots, k\}$, by minimizing the objective function given as

$$Min\, J_1\,(U, V) = \sum_{i=1}^{k} \sum_{k=1}^{n} u_{ik} \|x_k - v_i\|^2$$

Subject to $u_{ik} \in \{0,1\}\ \forall i, k, \sum_{i=1,c} u_{ik} = 1\,, \forall k$. In the absolute value brackets of the equation above, the Euclidean distance measure is used, but eventually other distance measure could be used. The iterative solution procedure generally has the following steps (Liao, 2005):

1. "Choose $c(2 \leq c \leq n)$ and ε (a small number for stopping the iterative procedure). Set the counter $l = 0$ and the initial cluster centres, $V^{(0)}$, arbitrarily.
2. Distribute x_k, $\forall k$ to determine $U^{(l)}$ such that J_1 is minimized. This is achieved normally by reassigning x_k to a new cluster that is closest to it.
3. Revise the cluster centres $V^{(l)}$.
4. Stop if the change in V is smaller than ε; otherwise, increment l and repeat Steps 2 and 3".

This algorithm works better with time series of equal length, because the concept of the cluster centres becomes unclear when time series have different lengths. Since time series in this work are of the same length, the *c-means* algorithm could be used in the clustering without tricky results.

2.3 Similarity/distance measures

One of the key aspects in clustering is the function used to measure the similarity in the data. One of the most common is the Euclidean distance. Let x_i and v_j each be a P-dimensional vector then the Euclidean distance is computed as

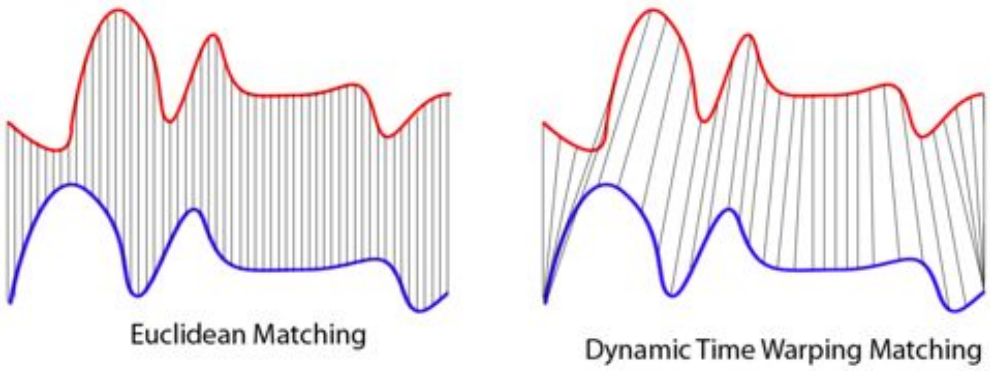
$$d_E = \sqrt{\sum_{k=1}^{P} (x_{ik} - v_{jk})^2}$$

The Euclidean distance has been used in a vast amount of work in treating the clustering procedure in time series data. However, in theory there is an increasing awareness that the Euclidean distance is a very brittle one (Keogh & Ratanamahatana, 2004).

Dynamic Time Warping

Dynamic Time Warping (DTW) method, instead, allows an elastic shifting in the time axis, to adjust time series sequences that are similar but out phase. The idea of how DTW works is better explained by the Figure 2.2, while the Euclidean algorithm simply evaluates the distance in the time series, the DTW method warps the two series to match the best fit.

Figure 2.2 - Euclidean measure versus DTW measure



Given two time series, Q and C, of length n and m, respectively, where

$$Q = q_1, q_2, \dots, q_i, \dots, q_n$$
$$C = c_1, c_2, \dots, c_j, \dots, c_m.$$

To align the sequences using DTW, it is constructed an n-by-m matrix where the (i^{th}, j^{th}) element of the matrix contains the distance $d(q_i, c_j)$ between the two

points q_i and c_j (i.e. $d(q_i, c_j) = (q_i - c_j)^2$). A warping path W is a contiguous set of matrix elements that defines a mapping between Q and C. The k^{th} element of W is defined as $w_k = (i,j)_k$. So we have

$$W = w_1, w_2, \dots, w_k, \dots, w_K \qquad \max(m,n) \le K < m + n - 1$$

The warping path is subject to several constraints.

- *Boundary conditions*: $w_1 = (1,1)$ and $w_K = (m,n)$. This means the warping path has to start and finish in top left and bottom right corner of the matrix.
- *Continuity*: given $w_k = (a,b)$, then $w_{k-1} = (a',b')$, where $a - a' \le 1$ and $b - b' \le 1$. This restricts the allowable steps in the warping path to adjacent cells (including diagonally adjacent cells).
- *Monotonicity*: given $w_k = (a,b)$, then $w_{k-1} = (a',b')$, where $a - a' \ge 0$ and $b - b' \ge 0$. This forces the points in W to be monotonically spaced in time (Keogh & Pazzani, 2001).

The warping path that has the minimum distance between the two time series is of interest, and it can be written mathematically as

$$d_{DTW} = min \frac{\sum_{k=1}^{K} w_k}{K}$$

Dynamic programming can be used to effectively find this path by evaluating the following recurrence, which defines the cumulative distance as the sum of the distance of the current element and the minimum of the cumulative distances of the adjacent elements (Liao, 2005):

$$d_{cum}(i,j) = d(q_i, c_j) + \min\{d_{cum}(i-1, j-1), d_{cum}(i-1, j), d_{cum}(i, j-1)\}.$$

An interesting feature is that Euclidean distance between two sequences can be seen as a special case of Dynamic Time Warping where the k^{th} element of W is constrained such that $w_k = (i,j)_k,\ i = j = k$ (Keogh & Ratanamahatana, 2004).

In constructing the distance matrix for the clustering procedure, in this work, I used only the DTW distance measure since it has been preferred in literature for its ability to give better results and to be more fitting to original data.

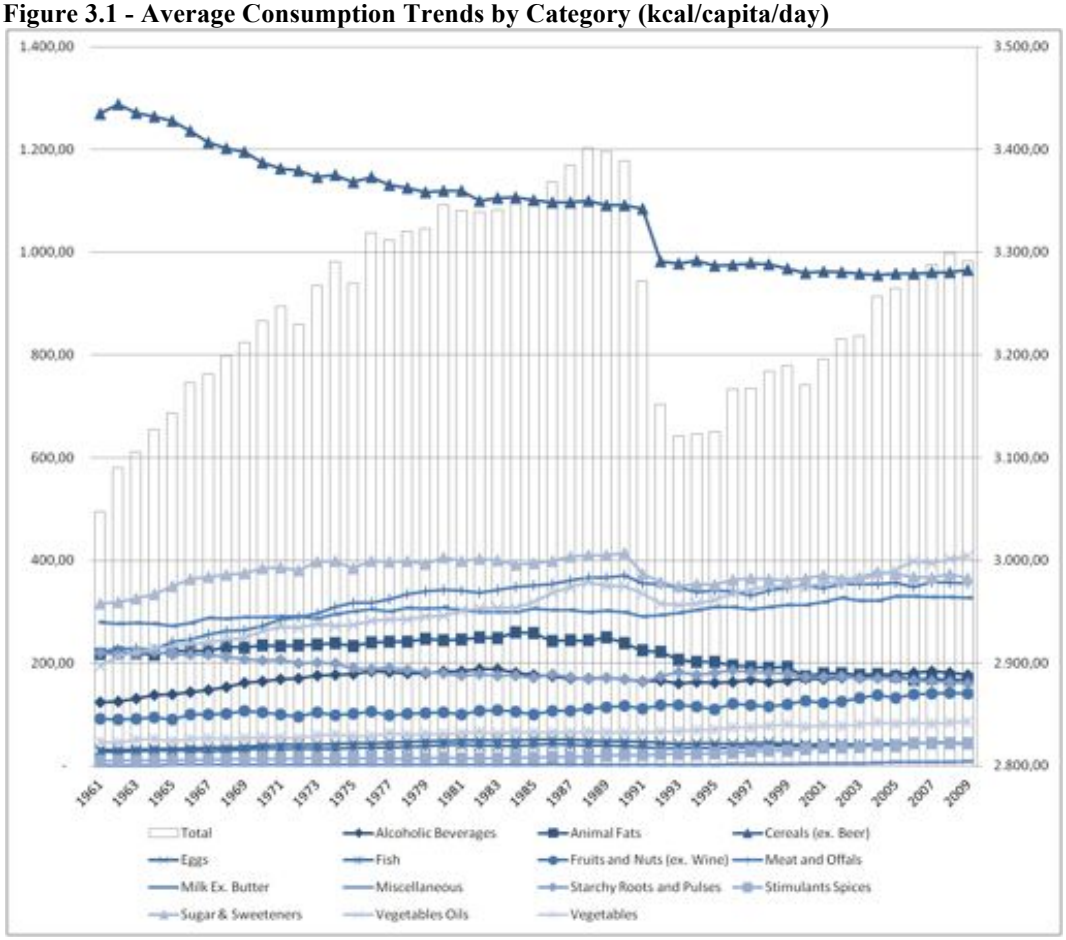
3 Food Consumption Categories

People do not eat calories, they eat food, hence analysing food consumption is a complex activity since human beings eat a huge variety of foods. In just one dish we could find several of the categories considered in this work, so one way to deal with this complexity is to group foods into classes and then measure their relative importance in terms of caloric contents (Grigg, 1996). As already seen in the previous chapter, 14 categories are derived from the Food Balance Sheets provided by FAO and they are: alcoholic beverages, animal fats, cereals (excluding beer), eggs, fish and seafood, fruits (excluding wine) and tree nuts, meat and offals, milk (excluding butter), miscellaneous, starchy roots and pulses, stimulants and spices, sugar and sweeteners, vegetable oils and oil crops and, finally, vegetables.

One of the major limits using these aggregates is the impossibility to catch substitution effects that happen inside one category. Let us imagine a situation with an economic crisis and that people's income is affected negatively, it is likely that the composition of food-basket would change and, for example, beef-meat is exchanged for pork-meat, because it is less expensive. Under this circumstance, we cannot see the differences occurred, since the calories remained inside the same category. To catch these aspects the singular category should be analysed instead. On the other hand, if in the same imagined situation, people exchange meat for cheese, this is visible, so it could give a rough indicator of what is happening. Nevertheless, the use of these aggregates is the best choice to handle the complexity of the topic.

Of course not every category has the same weight in the composition of the diet and a good example is the miscellaneous category, which by definition

Figure 3.1 - Average Consumption Trends by Category (kcal/capita/day)



Source: elaboration on FAO data.

collects all the food not already categorized and it represents a negligible share in explaining the diet composition (see Figure 3.1). Furthermore, the diet composition will vary also among countries, depending on income, traditional and cultural aspects and eating habits.

Before any other consideration it is important to know that the averages calculated in this chapter do not take into account the populousness of each countries. Therefore when some average data will be proposed, they cannot be considered as per capita European consumption, but just a rough indicator of the general trend.

In Figure 3.1 the lines explain the time series average trend of all the fourteen categories and the grey bars in the background represent the total consumption over the period.

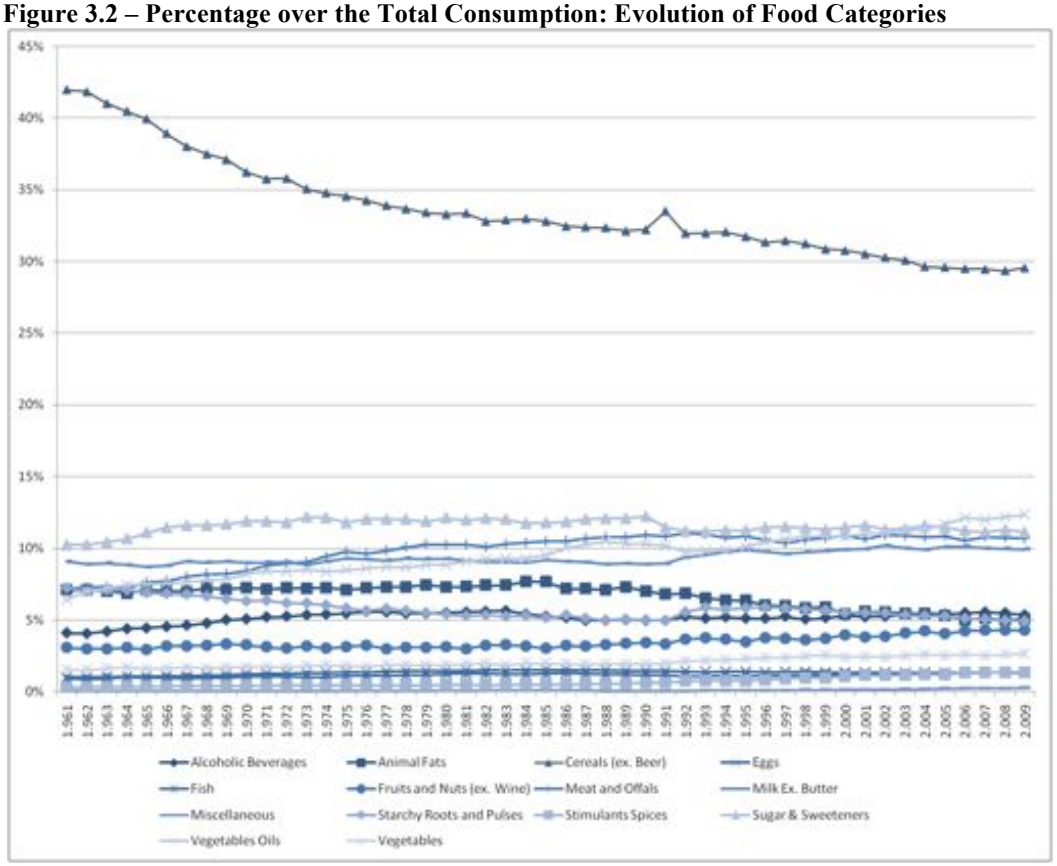
The average consumption levels expanded dramatically in the first thirty years reaching the peak in 1988 when in Europe the average diet consisted in 3401

kilocalories per day. In the early 1990s a sudden drop in consumption can be seen, due to two different causes: the fall of the Berlin Wall and the Balkans wars. In these years the falling of communism affected all the countries belonging to the former Soviet Bloc, because of the passage from a planned to a market economy that changed people lifestyles. In the middle of the 1990s the consumption began to grow again but without managing to get the to previous records and probably it is not going to happen in the very next future for two reasons. First, GDP per capita in 2009 decreases in all European countries[6], due to the financial crisis of 2008. Second, in wealthy countries, where the calorie saturation is achieved, the concern is shifted from quantity to quality: people want to eat better as their intake requirements diminish (Gracia & Albisu, 2001).

It is worth noting that not all the categories behave in the same way: some of them tends to decrease, such as cereals, starchy roots and pulses, while most of them show upwards paths. Therefore the ranking of these categories to show the contribution in explaining the caloric intake changed in the period. In 2009 cereals still are the most eaten food-type, even though they went through a significant decrease, they still explain almost the 30% of the diet. Vegetable oils are in second position (12.34%) overtaking no less than five aggregates, that are sugars and sweeteners, milk, meat starchy roots and animal fats. Proceeding in decreasing order, in 2009, the third position is held by sugar and sweeteners (11.10%), meat (10.68%), milk (9.92%), alcoholic beverages (5.34%), animal fats (5.06%), starchy roots and pulses (4,90%), fruits and nuts (4.26%), vegetables (2.64%), stimulants and spices (1,34%), fish (1.31%), eggs (1.29%) and miscellaneous (0.25%). Nevertheless, it is worth remembering that here calories are considered and not grams, that means that food with high-caloric content per weight will assume a greater importance in the rank. Therefore it can be expected that food-type with high calorie content per weight, such as vegetable oils, sugar and animal fats, are in the first positions (Grigg, 1998).

[6] Data taken from the World Bank database of World GDP per capita at PPP.

Figure 3.2 – Percentage over the Total Consumption: Evolution of Food Categories



Source: elaboration of FAO data

It is important to remember that these are just some average data synthetizing the whole European region and, of course, if countries are considered singularly, there are some remarkable differences on the followed path. Moreover, the focus in the rest of the chapter is a deep analysis of each category. All the graphs that follow are an elaboration of the FAO data and time series graphs divided by categories are available in the appendix.

3.1 Staple Food Consumption

One food group that has been fundamental in describing the dynamics of food consumption is *starchy staples*; this category comprehends cereals and root crops, and some authors also include starchy fruits, such as bananas. Starchy staples are a key aspect because their consumption accounts for more than 50% of all calories consumed worldwide (Grigg, 1996).

There are some good nutritional reasons to motivate the choice of starchy food over other food categories. They usually provide a high proportion of calories, and compared to other livestock products, they are quite inexpensive. Fruits and vegetables have very low caloric and protein content per unit weight, and therefore they cannot play the role of a basic supply. Pulses instead provide a good source of proteins and have a high caloric content and usually are complementary to starchy staples consumption (e.g. wheat and beans in Europe, soybean and rice in China, beans and maize in the Americas) (Grigg, 1996). Another important feature of starchy staples is the durability, especially for harvested cereal crops which are stored for long periods. Furthermore cereals are versatile and used in several preparations which, depending on the crop and the region, can be used in preparing bread, pasta, noodles, porridges, tortillas, etc. Nevertheless, the most important factor in determining the popularity of starchy staples is their cost per calorie. In an interesting work made by Bennet by in 1954, he ranks all the food categories by their cost per calorie, assuming that the distribution order is almost the same worldwide. The rank is as follows: cereals and starchy roots and tubers have the lowest cost, followed by vegetable fats and oils, dried pulses, sugar, milk and milk products, meat (in increasing order: pork, beef, mutton, goat, poultry), eggs and finally, at the top, vegetable and fruits. However, according to other studies, this rank is not completely reliable because it changes depending on the regions, but the main idea is a good starting point.

Calories from cereals, pulses and sugar are always less expensive than all types of meat. It is the different position in the food chain to cause a higher costs for animal food or, in other words, animals need to eat plants to survive and only then they can be used to yield meat or milk.

Since society is more concerned about environmental issues, studies have been conducted to quantify precisely the resources required to produce food, so we can have more detailed information to evaluate such costs. For example, a calculation was made to estimate the use of land: 'it takes six to seven times as much land to produce a calorie from animals as it does from plants, hence the different cost per calorie' (Grigg, 1996). Another example is to evaluate the water footprint, "the global average virtual water content of maize, wheat and rice is 900, 1300 and

3000 m^3/ton respectively, whereas the virtual water content of chicken meat, pork and beef is 3900, 4900 and 15500m^3/ton respectively" (Hoekstra & Chapagain, 2006).

As mentioned above, income is a determinant factor in food consumption and its effects could be seen in quantity changes and also in category composition of the diet. Generally, when the income increases, food consumption increases, but as Adam Smith (1910) observed: "The desire of food is limited in every man by the narrow capacity of the human stomach. [...]". Therefore, after reaching a certain threshold of total food consumption per day, the absolute value stands almost still, and consumption equilibria in food-basket are changing. Now that people are more wealthy, they exchange caloric staple food with products with higher quality. For example Grigg in 1996 found some evidence to prove people receiving adequate protein nourishment quit consuming pulses in favour of meat. Similarly "the decline in the absolute consumption of starchy staples that occurs with economic development is accompanied also by a decline in the starchy-staple ratio, that is, the number of calories derived from the starchy staples as a percentage of total calories consumed per capita per day. The concept (but not the term) was introduced over half a century ago in an article by M. K. Bennett (1941). Bennett presented a world map showing the percentage of total calories derived from cereals and roots, and offered some explanations of the distinctive pattern of consumption. He (1954) later coined the term "starchy-staple ratio," and investigated its relationships with the cost per calorie of the major types of food and with income. Bennett pointed out that the starchy-staple ratio declined as national income per capita increased so that the ratio was high in poor countries and low in rich ones" (Grigg, 1996)

3.1.1 Cereal Consumption

On average, cereals consumption in Europe has decreased over the whole period, with almost the same slope. The average consumption value in the early 1960s ranged between 1250 and 1300 kcal/capita/day and in 49 years the consumption of an European has diminished around 300 calories on average. Furthermore, the importance of cereals diminished also in the composition of the

Figure 3.3 – Dendrogram of Cereal Consumption (kcal/capita/day)

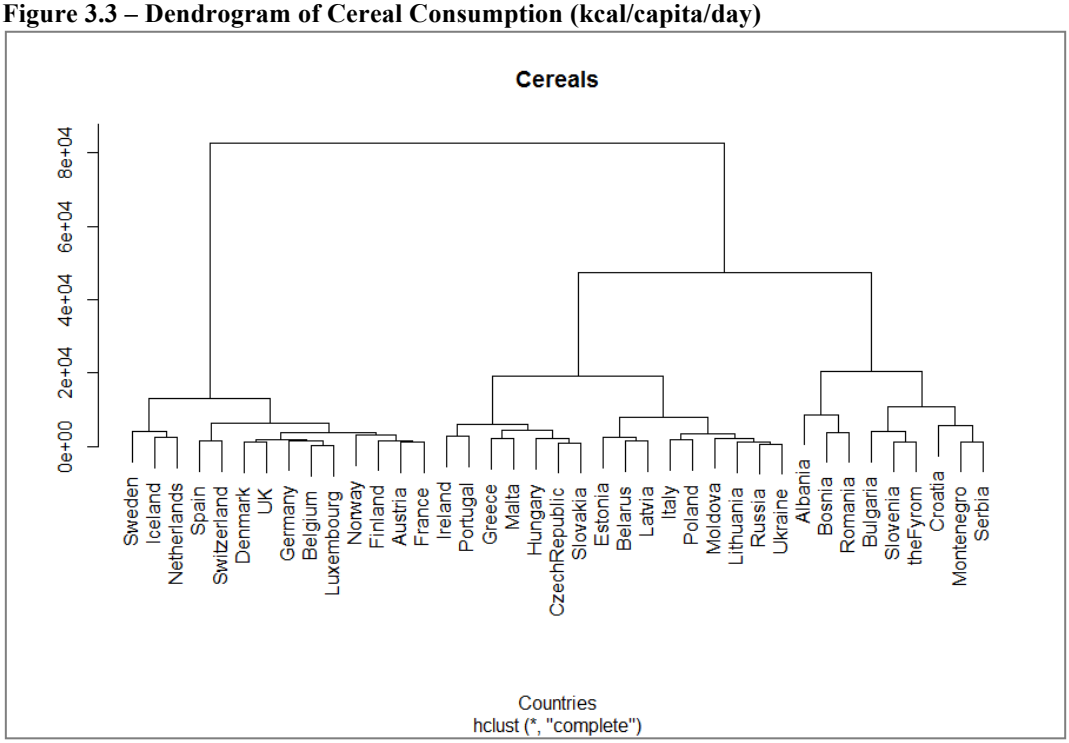


Figure 3.4 - Map of Cereal Consumption in Europe (kcal/capita/day)

diet of the average European. In 1961 cereals accounted for more than 40% of the daily caloric intake, while nowadays they account for less than 30%. However, the pattern followed by countries changes dramatically if considered singularly.

The complete linkage procedure has been used to operate the cluster analysis and its graphical representation is available in Figure 3.3. The dendrogram has been cut into six groups and to each of them it is assigned one colour in order to create the European map of Cereal consumption represented in Figure 3.4.

The countries painted in blue (Belarus, Estonia, Italy, Latvia, Lithuania, Moldova, Poland, Russia and Ukraine) share almost the same pace: they start with a high consumption in cereals, above the European mean, and the values decrease constantly over the period stabilizing in the last years around 1100 kcal/capita/day, which is a much higher value than the mean in Europe.

It is worth noting that the majority of the members of this group are countries formerly belonging the Soviet Bloc, and located in the North East of Europe. Italy follows a slightly different path, showing a sharp drop in cereal consumption in early 1980s and from that point until nowadays the values are almost stable. In the light blue group (Czech Republic, Greece, Hungary, Ireland, Malta and Portugal) the pace recorded is quite similar to what characterised the blue group, but they follow a more stable path.

The light green group (Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, Norway, Spain, Switzerland and United Kingdom) shows a pace which is less uniform, among countries, than seen in the blue group. However, all the countries follow a U-shape curve; this means that their consumption decreased in the first period and then they start to eat more cereals. It is worth noting that in the early years the cereal intake was lower than the average, but with the amazing growth of the last decades they got closer to the mean. The members of this cluster are situated in the so-called Western Europe and Northern Europe, except Spain, which can be considered a real outsider of the group both for the location and for the different path followed, in fact its consumption just declined for the whole period. The increased cereal consumption that took place in the last period contrasts with what was theorized by Bennett, that is, the starchy staple ratio should decrease during time. Such increase could be due to an increasing concern

in health and cereals are very good against fibre-deficiency diseases (Grigg, 1996).

The dark green group (Iceland, Netherlands and Sweden) is characterized by a pretty stable trend, with consumption values that stay by far down the average of the European mean ranging around 600 and 700 calories per capita per day.

Finally, the yellow group (Bulgaria, Croatia, Montenegro, Serbia, Slovenia and the FYROM) shares a pace which is slightly decreasing from 1961 to 1991 and shows a dramatic fall in consumption in 1992 and from that shock all the data stabilized to a level that is just above the European mean, except for Bulgaria in which cereals decreased over the period. The orange group is composed by Albania, Bosnia and Herzegovina and Romania and their paces are peculiar but all of them share a high consumption of cereals which peaks at 1800 daily calories per capita.

It is worth noting that in the 1960s, the diet in the Balkans is highly dependent on cereals consumption, which accounts for more than 50 per cent of the daily caloric per capita intake. This characteristic still holds afterwards for Albania, in which the share of cereals in the diet is even above 60 per cent until the early 1990s. As theorized by the starchy-staples ratio, here we have some evidence that the ratio was high in poor countries and low in rich ones.

3.1.2 Starchy Roots and Pulses Consumption

The consumption of starchy roots and pulses decreased slowly during the period. In 1961 the average intake was around 260 kcal/capita/day and such value reduced to 200 kcal/capita/day in 2009. The consumption diminished also if we focus on their importance in the diet composition, over the period the share of this category went down from 7.20 per cent to less than 5 per cent. The cluster analysis allows gathering data in five groups and one of them is a single object cluster, containing Poland. The cluster analysis gathers countries whose histories appear to be quite different and looking at time series (see Figure A.9) they are very irregular. Attempts have been made to run also a c-means procedure to check if there was a better cluster, but the output gathers almost the same countries.

The tree dendrogram of Figure 3.5 provides the information to realise the European map of starchy roots and pulses consumption.

Figure 3.5 - Dendrogram of Starchy Roots and Pulses Consumption (kcal/capita/day)

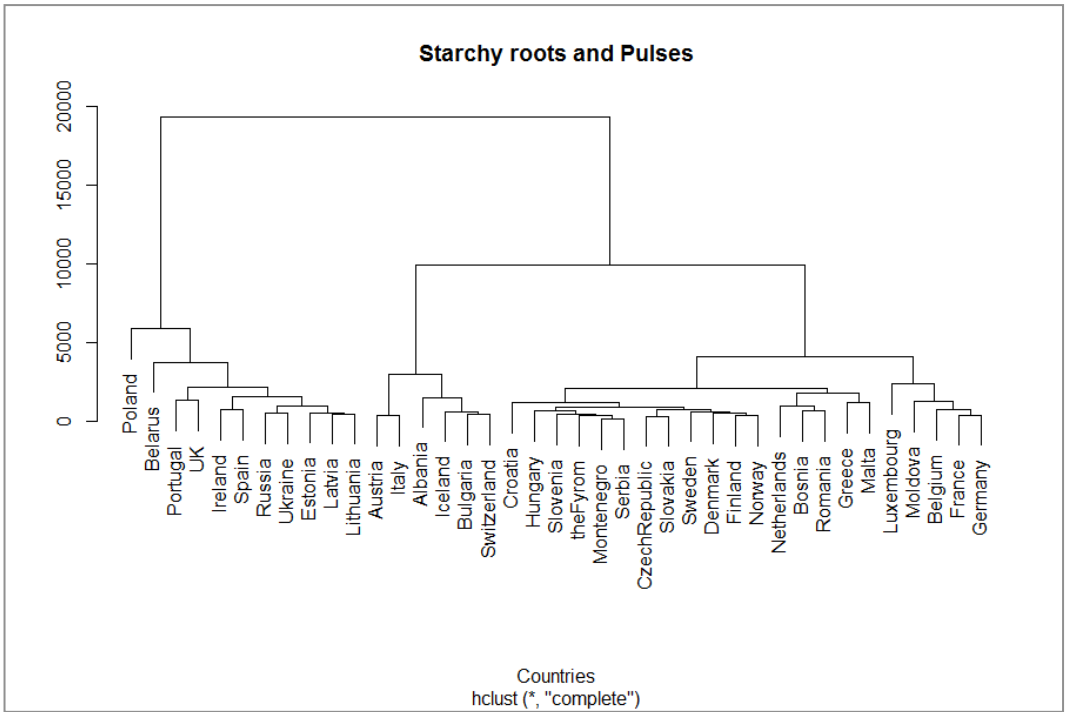


Figure 3.6 - Map of Starchy Roots and Pulses Consumption in Europe (kcal/capita/day)

Poland is isolated because it followed a peculiar path, in the 1960s it had the highest value in consumption but in the other four decades, the value diminished constantly, insomuch as in 2009 Poland consumed just a little more than the European mean. The intake of starchy roots still plays a major role in the diet of Poland, accounting for almost the double of the rest in Europe.

The second group comprehends the countries painted in blue (Belarus, Estonia, Ireland, Latvia, Lithuania, Portugal, Russian Federation, Spain, Ukraine and United Kingdom). These countries do not follow a common path but, generally, they consume more starchy roots and pulses than the average in Europe.

The orange cluster (Albania, Austria, Bulgaria, Iceland, Italy and Switzerland) shows the opposite situation, its characteristic is to consume far less than the average in Europe.

All these countries start with a small consumption level and it is even declining over the period, except for Albania, which starts with an even lower level, around 50 kcal/capita/day, and during the whole period it tries to reach the other members. The cluster in which we can find Belgium, France, Germany, Luxembourg and Moldova, is the most compact, following a path characterized by a smoothly decreasing trend, just below the average line. The last group includes Bosnia and Herzegovina, Croatia, Czech Republic, Denmark, Finland, Greece, Hungary, Malta, Montenegro, Netherlands, Norway, Romania, Serbia, Slovakia, Slovenia, Sweden and the FYROM. There is no clear pattern undergoing these countries, which can show either very bumpy graphs or quite linear as in the Scandinavian region, with both decreasing and increasing paths.

From the analysis of these two macro-categories, some evidence about what was theorised by Bennett can be found, that is to say that the "starchy – staple ratio" is low in wealthy countries and high in poorer. For example, as already mentioned, in Albania almost 60 per cent of the total calories were derived from cereals while in other wealthier countries it was just around 25%, such as in Germany and Sweden.

On the other hand, this thinking could be applied also to a time perspective, this means that if the income is increasing during the years we would expect that

countries rely less on starchy staples calories. Since the GDP per capita increased in almost all the countries, therefore I expect that starchy staple ratio would decrease. In wealthier countries, such as Western and Northern Europe, this effect arrived in the early years of 1960s. However, the thinking of the "starchy-staples ratio" cannot be used on the other way round, that is that is not true that countries with lesser percentage on starchy staples consumption are always wealthier. It must be kept in mind that consumption levels also differ because of the different dietary habits.

3.2 Sugar and Sweeteners

Sugar can be extracted from a great number of plants but the most important are sugar-cane and sugar-beet. Sugar consumption has become important only in the last 200 years, when such extraction techniques were invented. Before that, sweetness could only be obtained by eating honey or plants with high sweet content, particularly fruits and vegetable (Grigg, 1998).

It is an important source of energy providing 394 kilocalories per 100 grams of refined sugar, but in the other hand it contains no proteins, minerals or vitamins.

"Sugar is also useful as preservative in brewing, mixed with preserved meats to temper the salt, and as a bulking agent in cakes [...]. Sugar-cane and sugar-beet provide more calories per hectare than most crops, and this century sugar has been one of the cheapest sources of calories [...]. In the 1990s it was, in many countries, cheaper than rice or beans [...]" (Grigg, 1998). About the latter point it is worth noting that in the whole XIX century sugar was very expensive and therefore rarely used. "At the beginning of this century richer households in Britain consumed two and half times the amount sugar as the poorer" (Grigg, 1998) and also several studies conducted on households in Northern Europe showed a strong positive relationship between sugar consumption and income. Already in the 1950s this relationship was not very marked, and by 1980s the consumption of packet sugar was inversely related to household incomes. In Latin America, and particularly in Cuba, sugar and the sweeteners category are one of the most important components in the diet (Grigg, 1998). At a worldwide level, depending

Figure 3.7 - Dendrogram of Sugar and Sweetners Consumption (kcal/capita/day)

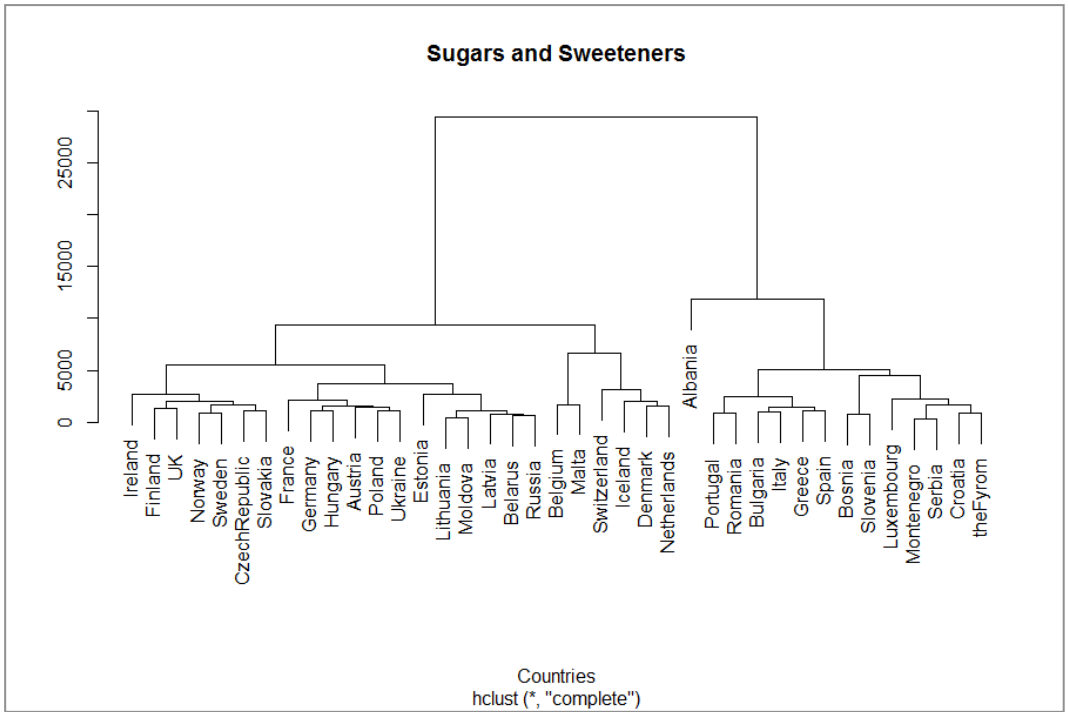


Figure 3.8 - Map of Sugar and Sweetners Consumption in Europe (kcal/capita/day)

on the country where it is produced, both the sugar-cane or the sugar-beet, the consumption or the price could change dramatically. However, in Europe, sugar price is affordable by every household, so it is interesting to see if sugar follows the rule of the starchy-staple ratio, or it behaves like a normal good.

The consumption of sugar and sweeteners, on average, expanded steadily in the first 30 years reaching its peak in 1990, in which the intake was 413 daily calories per capita. From 1961 the consumption grew around 100 kcal/capita/day, but between 1990 and 1993 sugar consumption dropped more than 60 kcal and after followed a stable decade in which consumption stayed around 360 and 370 kcal/capita/day. In 1961 sweeteners accounted for 10 per cent of the total caloric intake in Europe and in 2009 the value increased by just 1 per cent.

The clustering procedure has been done using the complete linkage algorithm and the output can be represented in Figure 3.8. Looking at the picture, we can see the existence of a strong relationship between the countries' trend and the geographical position: it seems that Europe is cut in two by an imaginary line which is passing through the Alps. Actually, the map shows 4 groups, but looking at the dendrogram it would be right to cut it in just two branches, highlighting the difference.

Before any other consideration, it must be pointed out that Albania's consumption of sugar and sweeteners is far behind the amount consumed in the rest of Europe and just in recent years it reached comparable values. Given that in the early twentieth century sugar consumption was highly related to high income, it is reasonable to think that, in Albania, sugar became more affordable only in the second part of the century.

Countries painted in yellow (Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Italy, Luxembourg, Montenegro, Portugal, Romania, Serbia, Slovenia, Spain and the FYROM) almost match with what is usually defined as Mediterranean countries. All these countries increased their consumption in sugar following a path that resembles the mean trend characterised by an increase in the first 30 years. Since 1990, after a sudden drop, the value has increased again, anyway without reaching the peak of 1990. The countries of Belgium, Denmark, Iceland, Malta, Netherlands and Switzerland (painted in green in the Figure 3.8)

are characterised by a high consumption in sugar, always higher than the mean consumption. The remaining countries (Austria, Belarus, Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Latvia, Lithuania, Moldova, Norway, Poland, Russian Federation, Slovakia, Sweden, Ukraine and United Kingdom), painted in blue in the map, have different levels of consumption but generally they are positioned in the middle, consuming less than the green countries but more than the yellow ones.

The most relevant aspect that appears in this analysis is the strong division between Northern and Southern countries of Europe, with a far smaller consumption in the latters.

As already mentioned, the income per capita cannot explain anymore this marked differentiation, if before 1960 the consumption was highly related to income per capita, afterwards sugar and sweeteners were more accessible due to the increase of income and the fall of the prices. Furthermore, the growth of income in Northern countries, after 1960, has not led to further increases in consumption, or it has even declined probably due to augmented concern in the health-risks of high sugar consumption. Moreover, Grigg (1999) in his research of food consumption in the Mediterranean region, found out that the consumption of sugar is almost the same in the whole region, regardless if we are analysing richer countries, such as Italy or Spain, or poorer like the North Africans. Then the plausible explanation is the difference in diets; in the Mediterranean diet there is a greater consumption of fruits and less importance in pastries and puddings (Grigg, 1999).

Finally, sugar and sweeteners cannot be considered as staples, since the percentage consumption is still higher in wealthier countries. Sugar and sweeteners occupied, for almost the whole period, the second place in explaining the total caloric intake in Europe. But in the last years the second position is occupied by vegetable oils, and sugar passed in third position while cereals are always stable in the first place.

3.3 Meat

When we usually consider meat in the diet composition we think about protein intake. Actually, proteins are contained also in fish, milk and milk products; but the major production is, actually, obtained by plant food. In 1995 Grigg wrote: 'two thirds of all proteins is obtained from plant foods and nearly half from the cereals alone. Nuts and seeds, pulses and vegetables make up most of the rest. One third of total protein is derived from animals; meat is the most important of these foods. Indeed it, milk and fish, each exceed in importance any category of foods except cereals' (Grigg, 1995). As may be expected, there are striking differences depending upon whether we are considering the consumption of proteins in developed or in developing countries: for the first group more than half proteins are derived from animals, while in developing countries nearly four fifths of all proteins are derived from plants.

Difference in consumption are not driven just by different income levels, in fact cultural habits and religion play an important role (Mauracher & Valentini, 2006). Religion is a factor that affects particularly meat and alcohol consumption, for example, following the precepts imposed by Islamism and Judaism, it is forbidden to eat pig-meat. The recent immigration of people coming from Northern Africa and the Middle East, brought in Europe a significant number of Muslims, that are already changing the traditions. Even if this effect will be slightly perceived with the data used in this work, it is a fundamental aspect that needs to be taken into account.

Nevertheless, it might be more useful to focus on the cost of proteins. The major difference between plant and animal protein is the latter being invariably of greater cost per unit weight. This is because they are in different positions of the food chain, to produce animals it is necessary to feed them with vegetables, cereals etc. Furthermore, it is been proved that the production of animal proteins consumes more resources, such as land (Grigg, 1995) and water (Hoekstra & Chapagain, 2006). Hence, meat has a higher cost per unit weights, and for this reason some positive relation with income in several studies has been shown: Blandford (1984), Cornia (1994), Gil, Gracia and Peréz y Peréz (1995) Elsner and Hartmann (1998) Grigg(1999).

Figure 3.9 - Dendrogram of Meat and Offals Consumption (kcal/capita/day)

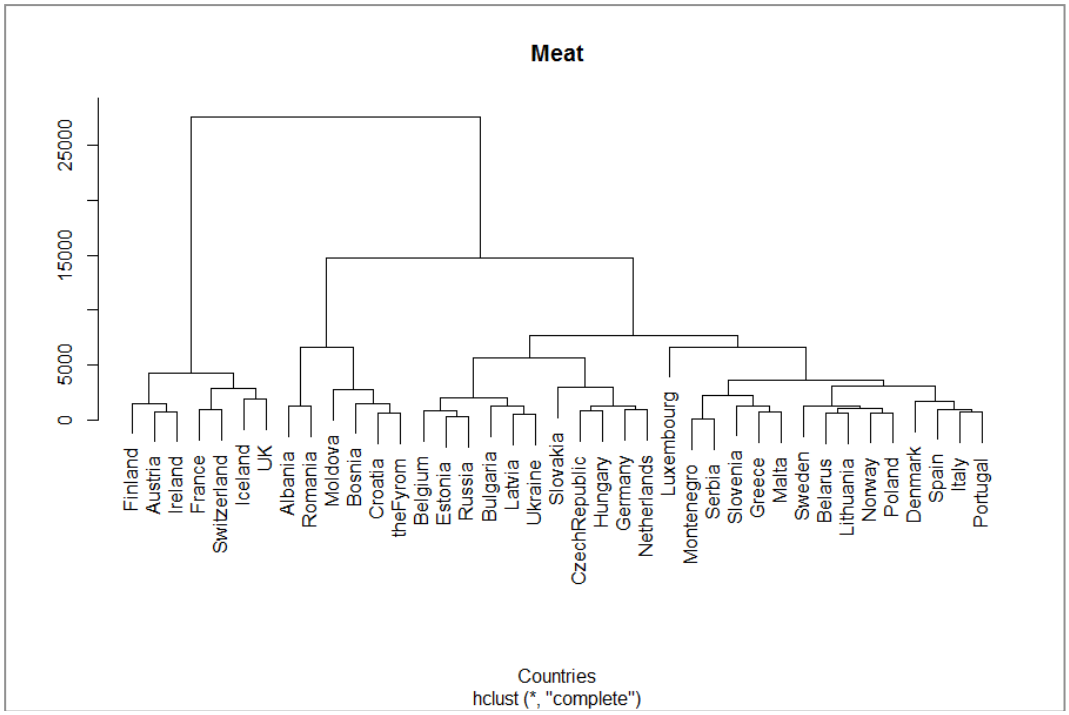


Figure 3.10 - Map of Meat and Offals Consumption in Europe (kcal/capita/day)

First of all, the consumption evolution considering Europe as one single unit will be described, then it will go on with a more detailed analysis on countries.
The mean consumption of meat in 1961 was around 220 daily kilocalories per capita, since then the consumption expanded until 1990, year in which there was the peak of 370 kilocalories per capita per day (Figure 3.1). In this years the consumption decreased until 1997 arriving at its lowest point of 330 kcal/capita/day, afterwards consumption slightly went up till the last record I have, 2009. The category of meat increased also in proportion of other categories, in fact, meat in 1961 was accounting for seven per cent of the total caloric intake, while in 2009 the share is almost at 11 per cent.

It is worth noting that consumption, in absolute values, reduced from 1990 to 1997, but it remained stable in percentage. That is, during the fall in consumption of the early 1990s, Europeans preferred reducing other food categories than meat.

With the clustering analysis, I divide Europe in four regions (Figure 3.9), each of them with a clear trend and evolution. Looking at Figure 3.10, the first group has the following green-painted countries: Austria, Finland, France, Iceland, Ireland, Switzerland and United Kingdom. This group is characterised by a high consumption of meat, at least always higher than the European mean. The general path is increasing; this is due to the stable and wealthy economic situation of these countries.

On the opposite side, there is the group of yellow countries: Albania, Bosnia and Herzegovina, Croatia, Moldova, Romania and the FYROM. In these countries per capita income is quite low, this causes low consumption of meat, which is always under the mean line. For the first three decades the trend is generally growing for most of the countries, but in the early 1990s there was a sharp collapse in consumption because of the Balkan wars and the following changes in political regimes.

Between these two extreme groups there are other two clusters characterised by middle consumption levels. Orange-painted countries are: Belarus, Denmark, Greece, Italy, Lithuania Luxembourg, Malta, Montenegro, Norway, Portugal, Serbia, Slovenia, Spain, and Sweden. Even though they share a very cohesive trend, geographically speaking the countries are very far away from each other.

However, all of them start in 1961 with low meat consumption and through an expansive pace they reached the mean trend and eventually they crossed it over.

Finally, the blue-painted countries include almost all the nations linked to the Soviet Bloc. They started with middle consumption levels, which were generally a little higher than the latter cluster, and grew until 1990. Then the consumed meat amount dropped in the early 1990s but in the last fifteen years consumption has retaken. It needs to be pointed out that the pace is true for almost all the members of the group, but with different proportions. It is not by chance that this collapse in consumption happened just after the fall of the Berlin Wall, in most of these nations, the transition phase from a planned economy to a market one involved several changes in consumers' purchasing powers and then their food habits. Hence the consumption of meat is one of the categories which were affected the most since it is a luxury good, due to its very high cost.

3.4 Milk

This aggregate comprehends milk together with dairy products, except for butter, which is considered an animal fat. The definition of dairy products includes all the milk products such as: cheese, yogurts, ice creams etc. If milk itself is considered a basic food, dairy products cost more due to a necessary transformation process. Europe has a long run tradition in producing and eating milk and dairy products. Indeed milk consumption is much higher in European countries rather than in the rest of the world, and this is because in Europe only a small part of the population suffers from lactose malabsorption (Grigg, 1995).

Considering the average consumption in Europe from Figure 3.1 it can be seen that milk went through a steady increase in consumption starting from around 280 kcal/capita/day in 1961, and achieving almost 330kcal/capita/day in 2009. The progression is quite small, especially if compared to other categories, but if we look at Figure 3.2, it can be seen that, in early 1990s, the percentage has a jump of one per cent. Given that the consumption in absolute values remained quite stable

Figure 3.11 - Dendrogram of Milk Consumption (kcal/capita/day)

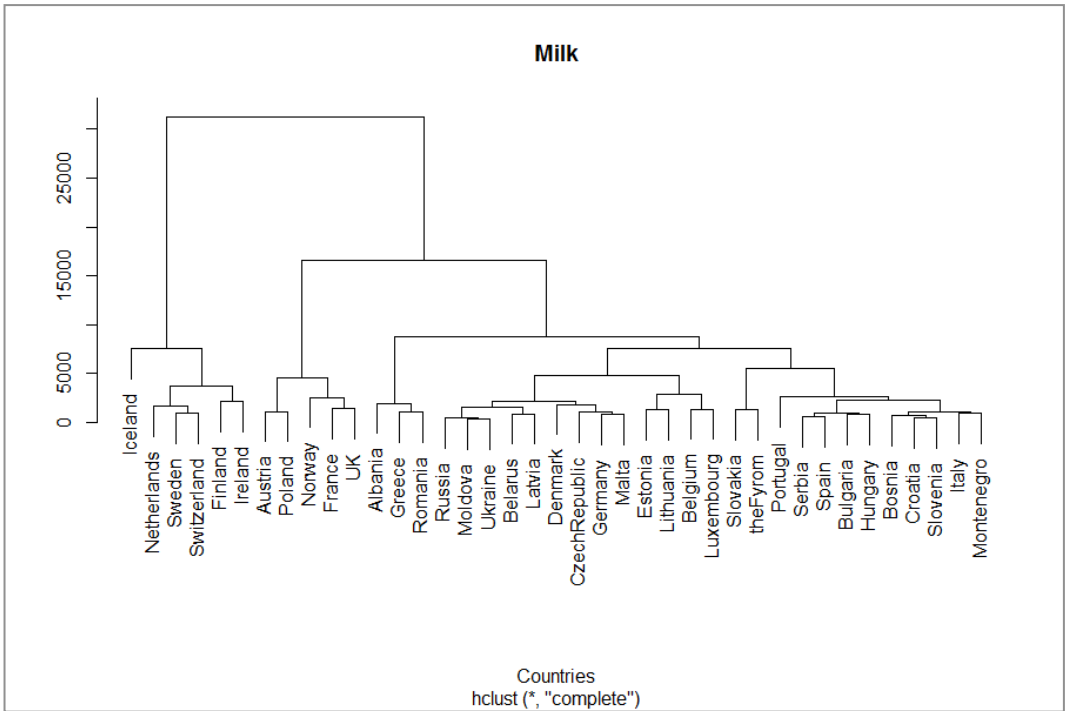


Figure 3.12 - Map of Milk Consumption in Europe (kcal/capita/day)

during the whole period, it follows that this jump was due to the fall of total calories happened in the early 1990s, that is to say that people refuse to quit consuming milk and dairy products, and preferred reducing their consumption on other aggregates, similarly to what happened in the meat category.

As usual, a cluster analysis for the milk category has been done, and the dendrogram is represented in Figure 3.11, the information extracted from the dendrogram lead to the map in Figure 3.12. Before starting any consideration it is worth giving a look at the time series graph in Figure A.8 and at glance it can be seen that the most remarkable characteristic is heterogeneity, time series graph are very irregular, hence it is quite difficult to highlight an underlying pattern for the clusters. Furthermore, in some cases there are sharp falls and rises in consumption from a year to another, like in Denmark or in Netherlands. However, there are some similarities that will be discussed from now on.

The first cluster is painted in yellow and includes: Finland, Iceland, Ireland, Netherlands, Sweden and Switzerland; these countries are characterised by a quite high income level. Iceland is an outsider of its group, as can be noted in the dendrogram of Figure 3.11. Indeed, looking the time-series graph in Figure A.8 Iceland exhibits very high consumption levels of milk especially in the '60s and the '70s. In fact in 1962, Iceland consumed 677 kcal/capita/day which is the maximum value for Europe during the whole period. From the initial levels in Finland, Iceland, Ireland and Switzerland there are downwards paces, while in Netherlands and Sweden the consumption is much more irregular.

Green-painted countries (Austria, France, Norway, Poland and United Kingdom) have lower consumption levels than the latter group, but still higher than the European mean. They do not follow a common pattern, and it is worth noting the peculiar path of Austria, which is quite stable until 2002 but in a year the consumption loses 100 kcal/capita/day and from then on the consumption remains flat. Looking at the map (Figure 3.12) it is quite evident that a high consumption of the milk category takes place in the Northern and Western Europe. The remaining clusters comprehend countries with a very heterogeneous time series path, in which underlying patterns cannot be identified.

3.5 Vegetable Oil and Oil Crops

As already mentioned, vegetable oils went through an extraordinary increasing path among all the other categories, doubling the consumed calories on average. From Figure 3.1 it can be seen that vegetable oil consumption was around 200 kcal/capita/day in 1961 and year by year achieved more than 400 kcal/capita/day, on average, with just a small stall in the early 1990s probably because of the fall in total consumption. The growth in vegetable oils was driven also by people concerned about their health, who started exchanging animal fats for vegetable oils in the preparation of dishes. Vegetable oils are close substitutes of the animals fats since both of them are used in dressing and in the preparation of food.

In this category a great variety of oils are considered and the most important ones are derived from sunflowers, olives, maize germs, soybeans and palm tree. Obviously, depending on the countries, some varieties are more important than others. For example, olive oil, one of the symbols of the Mediterranean diet, is cultivated and consumed more in Southern Europe. Olive trees are so evocative of the Mediterranean culture that the French writer Georges Duhamel wrote: 'the Mediterranean ends where olives ceases to grow' (Grigg, 1999). Historically, olive oil has been rarely used north of the Alps, and even if today its healthy features are widely advertised, consumption is negligible outside the Mediterranean region (Grigg, 1999).

Looking at vegetable oil composition, it can be seen that olive oil is widely used in Mediterranean countries, while in the rest of Europe people prefer oilseeds. In particular Portugal, France and the Balkans consumed far less olive oil than Spain Greece and Italy. The latter three countries are grouped together in one cluster as it can be seen in Figure 3.13, because they share a high consumption of vegetable oils. Looking at time series graph represented in Figure A.13, it can be seen that consumption in these three countries, during the last period, peaked at more than 700 kcal/capita/day which is the highest value in whole Europe. Already in 1961 these countries started with a value much higher than the European mean, around 300 kcal/capita/day, but after that they even doubled their consumption.

Figure 3.13 - Dendrogram of Vegetable Oils Consumption (kcal/capita/day)

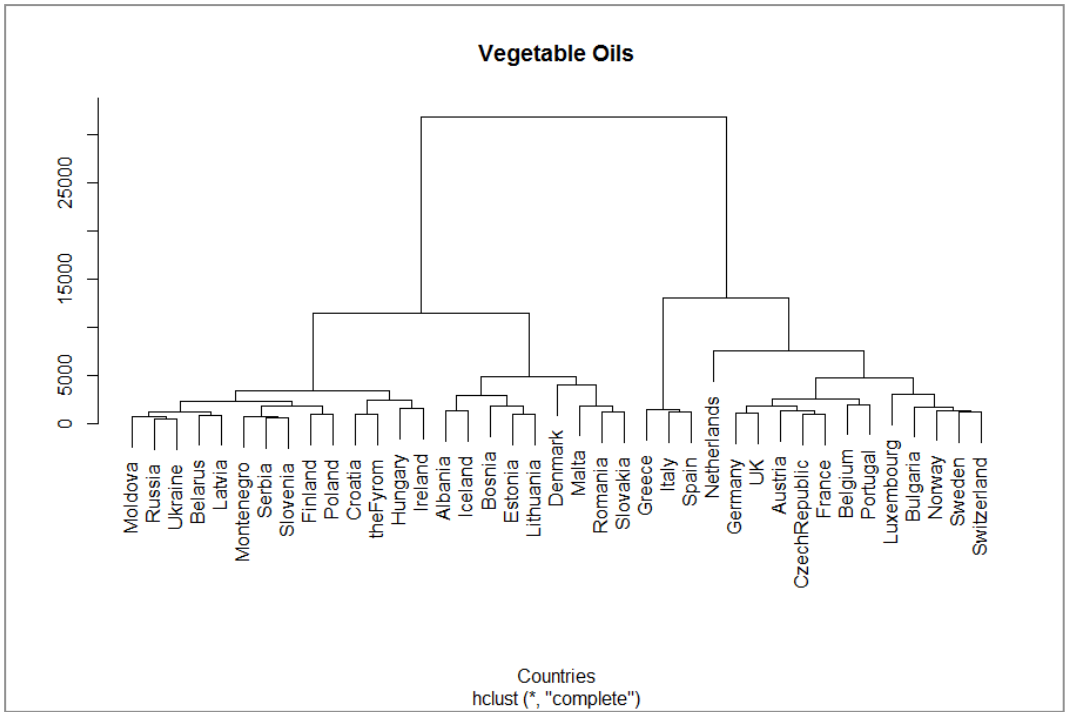


Figure 3.14 - Map of Vegetable Oils Consumption in Europe (kcal/capita/day)

The other great consumers in vegetable oils are: Austria, Belgium, Bulgaria, Czech Republic, France, Germany, Luxemburg, Netherlands, Norway, Portugal, Sweden, Switzerland and United Kingdom; which are painted in green in Figure 3.13. Generally, their path is characterised by a positively sloped trend that is always above the European average. However, Luxembourg in the last decade dropped its consumption, this is probably due to change in keeping records, in fact, now data are provided singularly but until 2000 data were provided together with Belgium.

The third cluster includes the following blue-painted countries: Belarus, Croatia, Finland, Hungary, Ireland, Latvia, Moldova, Montenegro, Poland, Russian Federation, Serbia, Slovenia, the FYROM and Ukraine. The general consumption for this group follows an increasing path that runs just below the average line.

Finally, the last group comprehends: Albania, Bosnia and Herzegovina, Denmark, Estonia, Iceland, Lithuania, Malta, Romania and Slovakia. In these countries there is the lowest consumption of oils, for example in Bosnia and Herzegovina, Albania and Lithuania the daily caloric intake, it could be even under the 100kcal.

Furthermore, it is worth observing that Denmark is the only country that shows a clear countertrend, in fact its consumption if vegetable oil diminished from 300kcal/capita/day in 1961 to below than 200 kcal/capita/day.

From the analysis of this category it looks like vegetable oils are positively related to income and Southern countries. In fact, the countries which consume the most are located in Southern Europe (in which both conditions are met), while in the second position there are Western and Northern Europe countries, in which there is just one conditions, that is high per capita income.

3.6 Animal fats

Animal fats can be considered as substitutes of vegetable oils. If the latter went through an extraordinary growth, animal fats increased up to late 1980s and from then on, in Europe average consumption declined (see Figure 3.1). In the 1980s,

in fact, almost all European countries reached the amount of necessary calories, and when people start to be more concerned about health one of the first categories to be eliminated are the fats, because over-consumption of animal fats could cause serious diseases, such as obesity and cardio-vascular disorders. Obviously, the importance of animal fats decreased in relative terms over the total: in 1961 they accounted for around the seven per cent of the total intake, with an absolute value around 200kcal/capita/day, while its relevance in 2000 was just about five per cent even.

It would be reasonable to think that the clustering procedure returned more or less the same clusters of the previous category, but showing the opposite characteristics. This is true just for countries of Southern Europe: Italy, Portugal, Greece and Spain, which show very low level in using animal fats. In fact, the latter two countries together with Albania form one cluster (see Figure 3.16) which has the smallest records in the consumption of animal fats. Also the group of countries painted in blue show low levels of intaking animal fats calories. Italy and Portugal started 1961 with quasi-negligible consumption levels that increased until 2000s and then have kept stable. The other members of the cluster (Belarus, Bulgaria, Estonia, Latvia, Lithuania, Moldova, Romania, Russian Federation and Ukraine) followed a path that resemble the European average, increasing until the late 1980s and then, with different levels of intensity, there is a reduction of animal fat calories.

The orange-painted countries stands in middle with their consumption levels, and they comprehend Bosnia and Herzegovina, Croatia, France, Iceland, Malta, Montenegro, Netherlands, Norway, Serbia, Slovenia, Sweden, Switzerland and the Fyrom. Even if with different path, all these countries tend to stay around the line of the average consumption and in the last years they diminish the consumption in animal fats. Austria, Czech Republic, Finland, Germany and Iceland, Poland, Slovenia and United Kingdom consume more animal fats than the average in Europe, even if from 1961 all the countries went through a declining pace. This cluster, in Figure 3.16, is coloured in light blue.

Figure 3.15 - Dendrogram of Animal Fats Consumption (kcal/capita/day)

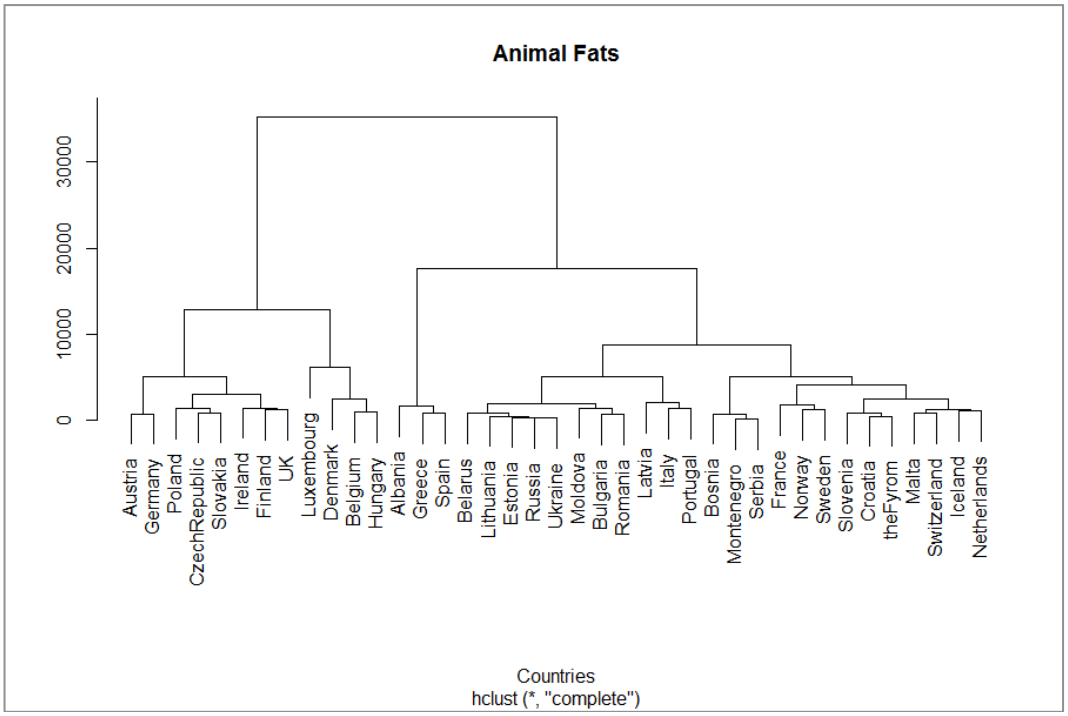


Figure 3.16 - Map of Animal Fats Consumption in Europe (kcal/capita/day)

Finally, the countries that consume the most are Belgium, Denmark, Hungary and Luxembourg. The latter shows a dramatic fall in 2000 suggesting that animal fats were consumed more in Belgium than in Luxembourg, (2000 is the years of the change in statistics tracking). Even if the consumption declined in the last decades, still consumption is very high.

Concluding, from the map it can be seen that a strong relationship among all countries of the former USSR still persists; probably in these countries the use of animal fat is part of the typical cuisine. More generally, fats are preferred in the Northern region than in the Southern one, but the pattern is not so marked as it was in the vegetable oils case.

3.7 Alcohol

An unarguable fact is that the consumption of alcohol varies between countries, and about this issue, common wisdom suggests that wine is mostly consumed in the Southern countries while beer and spirits are preferred beyond the Alps. Fact is that recent studies (Grigg, 1999), have proved that such a similar belief does not completely correspond to reality, since the results show how in countries like Portugal and Spain, beer is now preferred over wine. Alcohol is consumed largely for its physiological and psychological effects, but it is often consumed within specific social contexts and may even be a part of religious practices. Because of the effects that alcohol has on the body and on behaviour, governments often regulate its use. Due to the limitations imposed by the governments, the consumption is usually limited to adults and the price is quite expensive.

Also religious beliefs can affect alcohol consumption, considering that for some confessions, such as Islamism, drinking alcohol is forbidden. In countries like Albania and the FYROM, a great percentage of population is Muslim while in the rest of Europe Muslims came recently through immigration flows. There is no doubt on the fact that the significant increment of non-drinking population causes changes in drinking habits.

The average consumption (see in Figure 3.1) followed a wave-shaped trend which increased until 1984, it later declined for about ten years and then started increasing once again from 1994 to 2009. Nowadays drinking wine, beer, and spirits amounts to more than five per cent on the total consumption with an average consumption around 180kcal/capita/day. It means that we assume more calories from alcoholic beverages than from consuming animal fats or vegetables. Unlike the case of other categories, about which it can be argued that the change in consumption was mainly imputable to an increased attention to health, in alcohol there are other components, such as social attitudes, that could cancel the effect of health concerns.

In the early 1960s the alcohol consumption in Europe was less important, about 125 kcal/capita/day, which represents just the four percent of the total. This increase was not due to a generalized increasing trend, considering that some countries diminished its consume of alcohol in the whole period, such as France and Italy (see Figure A.1). These two countries, along with Belgium, Slovakia and Switzerland, form the orange cluster represented in the map (Figure 3.18). All these members show an early decline of consumptions compared to other countries, a trend that went on until nowadays. It is worth noting that all these States started with high consumption values in 1961, much higher than the European mean, but by 2009 they consumed a smaller alcohol quantity than the European average. The opposite trend is found in the "light-blue countries" (Austria, Czech Republic, Estonia, Germany, Ireland, Luxembourg and Portugal) that went through an upwards tendency. In Czech Republic, Estonia and Luxembourg, consumption went through an astonishing increase especially in the last years, suggesting that a further growth is still possible in the next future. In the case of Luxembourg, this extreme boom of the last decade is likely due to the fact that data are now evaluated in a different way; in fact the Food Balance Sheets before 2000, treated Belgium and Luxembourg as one country, while from 2000 to nowadays FAO provided two different data instead of one. The results regarding the consume of alcohol in Luxembourg, Czech Republic and Estonia are interesting, in fact the percentage amount of calories derived from alcohol is respectively the 8.53%, 9.32% and 10.59% of the total food consumption.

Figure 3.17 - Dendrogram of Alcohol Consumption (kcal/capita/day)

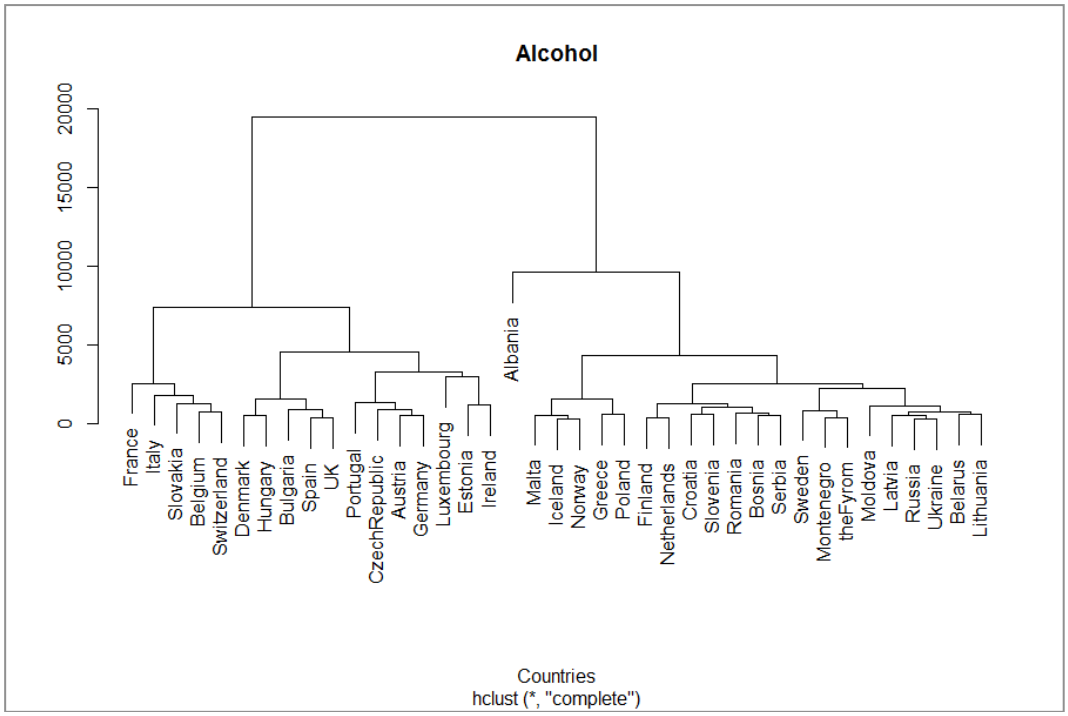


Figure 3.18 - Map of Alcohol Consumption in Europe (kcal/capita/day)

The yellow-painted countries compose the third cluster: Bulgaria, Denmark, Hungary, Spain and United Kingdom. Their consumption is placed just a little above the average and approximately follows the same wave-shape trend described before. The forth cluster is composed by the blue countries, most of which were formed after the downfall of the Soviet Bloc: Belarus, Bosnia and Herzegovina, Croatia, Finland, Latvia, Lithuania, Moldova, Montenegro, Netherlands, Romania, Russia Federation, Serbia, Slovenia, Sweden, the FYROM and Ukraine. The trend of this group is quite heterogeneous; all have low consumptions, or at least below the mean line and in almost every country there is a tendency to grow in the last years.

Finally Greece, Iceland, Malta, Norway and Poland share low (but increasing) drinking habits while Poland has reached the average trend in the last period. Albania recorded the minimum data in alcohol consumption, the peak was around 50 kcal/capita/day in 2007, such low levels are probably due to low-income per capita levels.

3.8 Fruits and Vegetables

Fruits and vegetables are the most expensive in terms of cost per calorie (Grigg, 1996) because they have low calories per weight and are also more perishable than other categories. The amount of fruits and vegetable consumed in 2009 is quite small if compared with the total, the shares on the total are just 4.26% and 2.64% respectively. This is due to the fact that this food provides very low calories per weight; for example 100g of apple gives 38 kcal, for the same quantity a peach gives 25 kcal, while looking at other results provided by Inran[7] we know that the mean of fruits confers between 30 and 50 kcal. Vegetables are even less caloric, in fact at the weight of 100g most of the vegetables range between 15 and 40 kcal. The point is that if compared to other categories, such as vegetable oils (olive oil gives 899 kcal in 100g) or meat (100g of bovine meat

[7] Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione, literally translated in English it is National institute of Research for Food and Nutrition.

gives 140kcal), at weight parity vegetable and fruits provide less nourishment. In other words, it is necessary to eat three and a half apples to provide the same calories contained in an olive oil spoon.

Fruits and vegetables are the categories more affected by the seasonality, which affects all the process in agriculture and therefore all the categories considered so far, even though through the years mankind has developed processes that allow to conserve food for longer time (as in the case of the ancient storage systems that used to preserve alcohol or cereals). But until the invention of refrigeration, more perishable food, such as fruits and vegetable, had to be eaten straightforward. Thanks to these quite recent techniques, producers are able to supply the market with fresh products almost all the year. Also a more extensive use of greenhouses allows to prolong the normal season time. However, depending on varieties, there are some kind of food which are not always available. Before the introduction of these technologies, consumers would find only the seasonal variety, which limited consumer's choices, especially in the winter time. Since the use of these techniques was not as common as it is nowadays, they may positively affect the consumption trends.

3.8.1 Fruits

From the fruit category all the grapes necessary for wine production have been excluded, all the other fruits generally end up eaten by consumers or they are destined to simple a transformation process in order to produce jams or patisseries. The consumption of fruits in the period considered, increased from 90 to 140 kcal/capita/day in the whole Europe following a linear path. But if in the total perspective the pace could appear quite smooth, a closer look to each country reveals that it has been following different tracks. The cluster analysis gives us a better insight, so it has been decided to cut the dendrogram to form 5 clusters. First of all Bulgaria is the outsider, since it is the only country showing a clear declining trend, as it can be seen in Figure A.6. Generally Italy, Switzerland, Austria and Greece have eaten more fruits than any other, particularly in the case of Greece the value has amounted to more than 280 kcal/capita/day. However, in this cluster there is not a common trend, since Italy went up in the last years while Switzerland did just the opposite.

Figure 3.19 - Dendrogram of Fruits Consumption (kcal/capita/day)

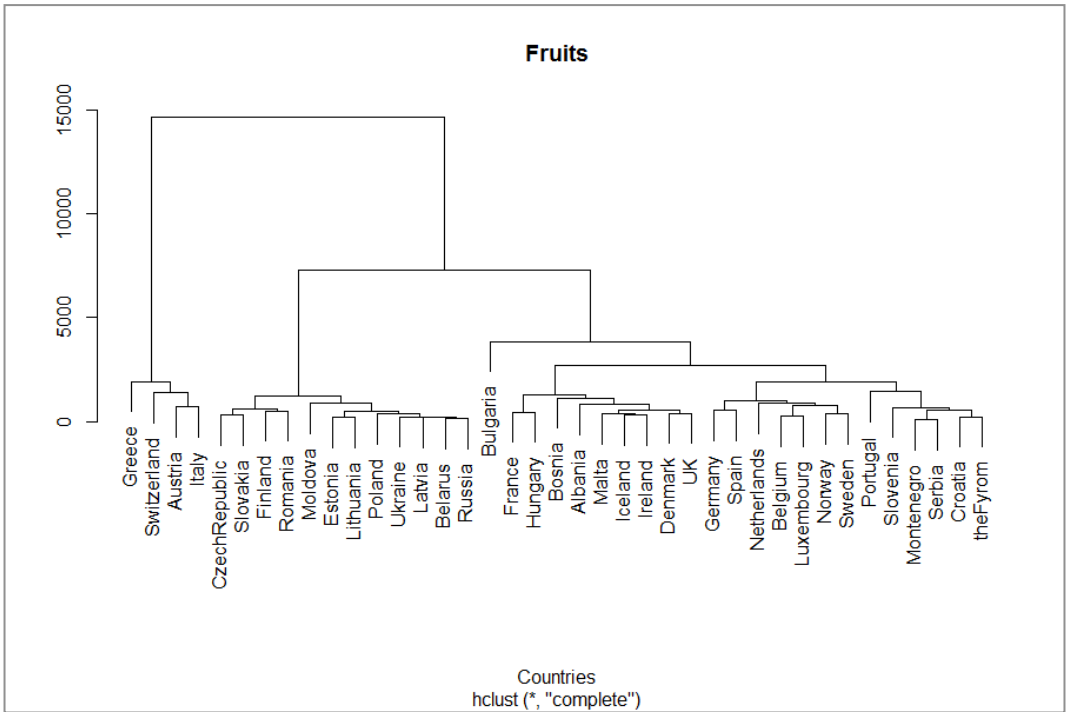
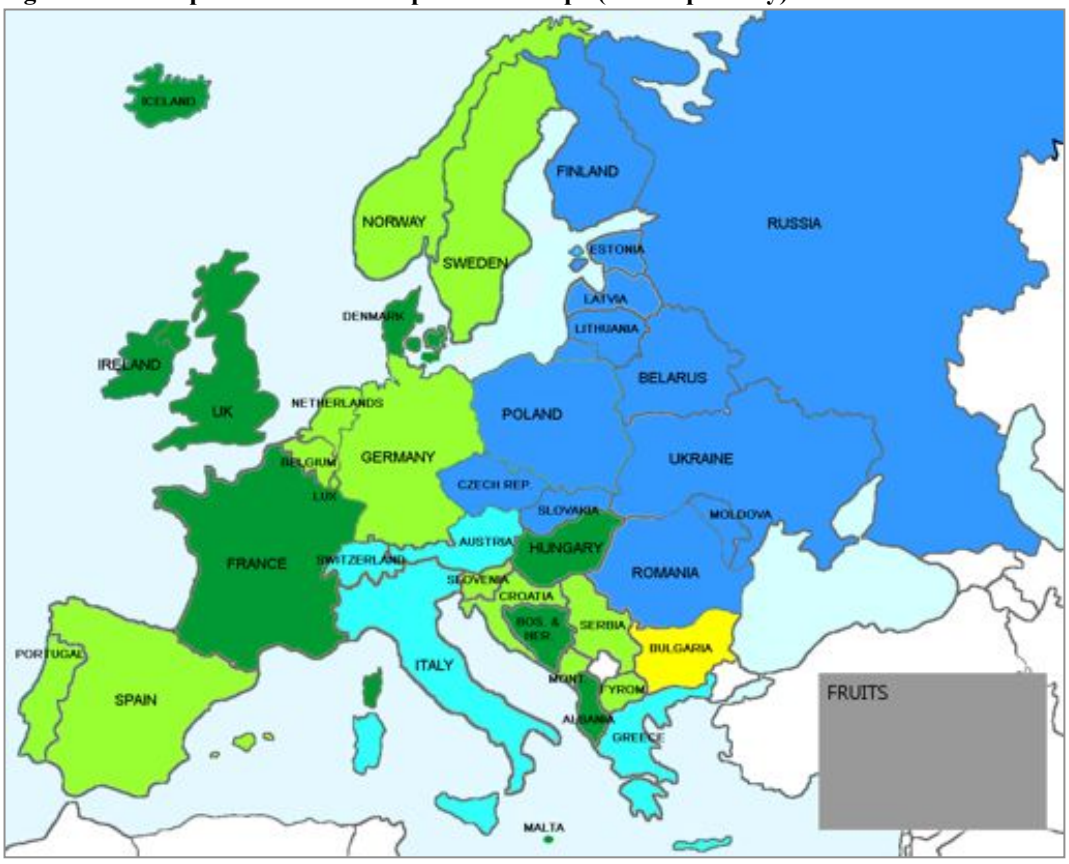


Figure 3.20 - Map of Fruits Consumption in Europe (kcal/capita/day)



The second cluster, composed by light-green-painted countries (Belgium, Croatia, Germany, Luxembourg, Montenegro, Netherlands, Norway, Portugal, Serbia, Slovenia, Spain, Sweden and the FYROM), presents a good level of fruit consumption, which was above the average in 1961 and it kept growing until 2009. It can be noticed that countries of the former Yugoslavia have had a strong expansion in later years, suggesting that a stable point has yet to come, just like in the case of FYROM, Serbia, Montenegro, and Croatia. The third cluster contains Albania, Bosnia and Herzegovina, Denmark, France, Hungary, Iceland, Ireland, Malta and United Kingdom. These countries consume a little less than the ones belonging to the previous group and they tend to have a more stable consumption, even if some of them have started to consume fruits only in the last ten years. The last group is mainly composed by countries of the former USSR and started in 1961 with very low levels of eating fruits and even though they followed an upward path they have always stayed under the middle line. These low values are probably due to unfavourable geographic conditions, which prevent the growth of certain species of fruit trees. Moreover, during the communism, the system of planned economy obligated people to eat only the food produced in the Soviet Bloc.

3.8.2 Vegetables

Vegetables are usually eaten directly or just after a minimal transformation and, based on variety, they are generally more perishable than fruits. Therefore, their expansion should be largely favoured by the use of recent techniques. During these five decades the consumption of vegetable almost doubled in Europe passing from 46 to 86 kcal/capita/day. As shown in the Figure 3.1, the increase has been linear and with a very stable slope. The cluster procedure has returned the dendrogram of Figure 3.21, which has been cut in four clusters. The one in which the countries have shown the best growth, is coloured in orange (see Figure 3.22) and presents these members: Albania, Belgium, Bosnia and Herzegovina, Greece, Malta, Portugal, Romania and the FYROM. It is worth noting that these countries started with similar levels of the other European countries and the values have remained stable for the first three decades, but from the 1990s their consumption boasted until nowadays, especially in the case of Albania, Belgium,

Figure 3.21 - Dendrogram of Vegetable Consumption (kcal/capita/day)

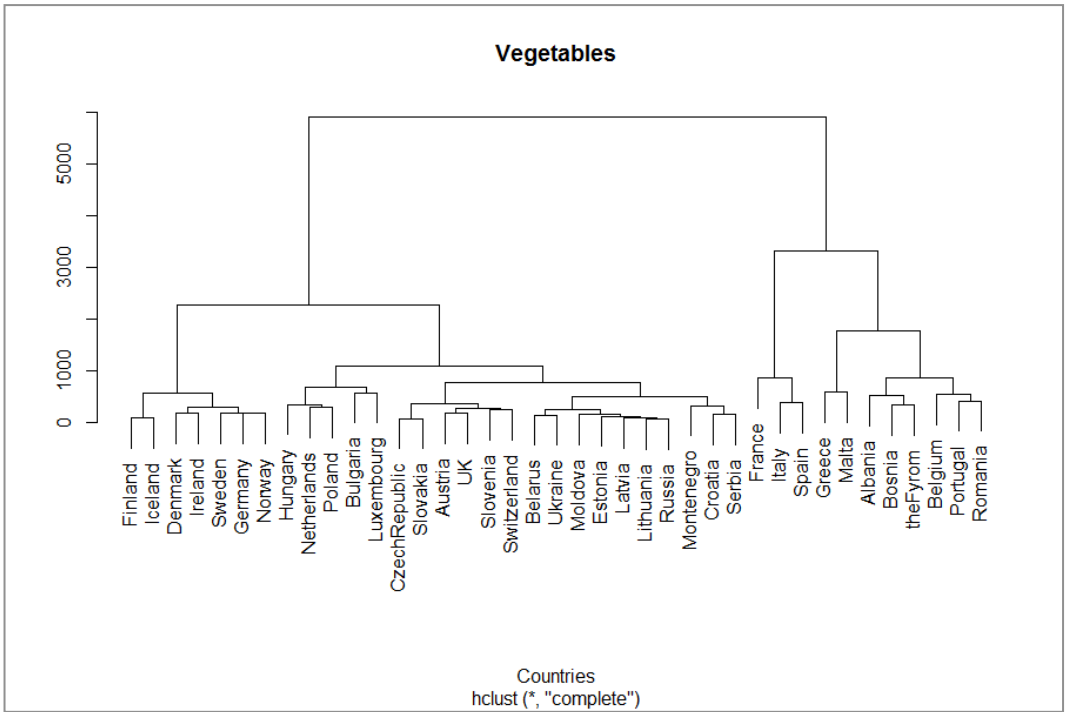


Figure 3.22 - Map of Vegetable Consumption in Europe (kcal/capita/day)

Bosnia and Herzegovina and the FYROM. The highest value is recorded in 2004, when the citizens of Greece ate 179 kcal/capita/day, more than the double of the mean. France, Italy and Spain, together form a second cluster characterized by a good intake, higher than the mean, but far from the previous group. Furthermore, the three trends are different, considering that France has declined and has fallen under the average by 2009, Spain has kept a stable condition, while Italy has been the only one with an increasing pace.

The remaining countries are divided in two further clusters whose members increase their consumption in vegetables, with a more marked tendency in the yellow-painted countries (Denmark, Finland, Germany, Iceland, Ireland, Norway and Sweden). It must be said that these latter countries eat less vegetable calories than the ones painted in blue.

David Grigg (1999), in his study named "Food Consumption in the Mediterranean Region", found some difficulties in treating the data regarding vegetables and fruits, since they did not appear as reliable as the ones of other major kinds of food listed in Food Balance Sheets. However, the author kept reporting his data and wrote: 'Within the Mediterranean region the highest consumption (of fruits and vegetables) is found in the East Mediterranean to Greece to Israel, and in the West Mediterranean, while the lowest is in the Balkans and North Africa' (Grigg, 1999). With the new evidence found in the Food Balance Sheets, it can be confirmed that Greece is still the biggest consumer in fruits and vegetables, not only in the Mediterranean area, but also in Europe. Balkan countries have been through an amazing rise, since nowadays most of them are consuming more than West Mediterranean countries.

Pattern behind these two categories may be expected to look more similar, but cluster analysis has highlighted some major differences between them. For example, Eastern countries consumed less fruits than the Western and Northern countries, but just the opposite happens with the consumption of vegetables. It looks like there is a sort of compensation between who eats more fruit but less vegetable and vice versa. But this thinking does not suit the case of Southern and Balkan countries, where vegetables are eaten in major quantities.

Eventually, the generalised increase in the consumption of fruit and vegetable can be explained by the introduction of new techniques that enable to find more fresh products everywhere and in every period of the year. Moreover, during this period per capita incomes have grown and last but not least, the concern about a healthy nutrition, in order to prevent diseases such as obesity and cardiovascular dysfunctions.

3.9 Fish

The consumption of fish in Europe is very low and it is even less significant when it comes to explaining the total caloric intake in Europe, since its percentage value ranges from 0.90 to 1.30 in the whole period. The consumption of fish augmented also in absolute values, passing from 26 kcal/capita/day in 1961 to 44 in 2009, but still at values that look quite negligible if compared to other categories. The Figure 3.1 shows that consumption followed a linear increase in the whole period with a small depression in the early 1990s, a period characterized by a significant loss of consumption in the whole Europe

However, it is significant to analyse the trend followed by this category since it has been advertised as food with very good health properties. In many studies have shown that 'the consumption of fish may be protective for cancers of the prostate, breast, colon and other parts of the digestive tract. There is also good evidence for a protective effect of consumption of fish in cardiovascular disease, although this is probably limited to high-risk populations' (A A Welch, 2002). Given that, an increase of consumptions is expected especially in the wealthiest countries, since generally the cost of fish per calorie is more expensive than meat (direct substitute) or other food categories.

From the clustering analysis (see Figure 3.23) four different groups emerged, three if we consider that Iceland is one component cluster. Iceland, in fact, due to its geographical position, is an island far away from any other country which consume more fish and seafood. In fact, from the time series graph (see Figure A.5), Iceland consumption is around 150 kcal/capita/day with the exception of the years around 1981 in which consumption peaked to 313 kcal/capita/day and 9.5

Figure 3.23 - Dendrogram of Fish Consumption (kcal/capita/day)

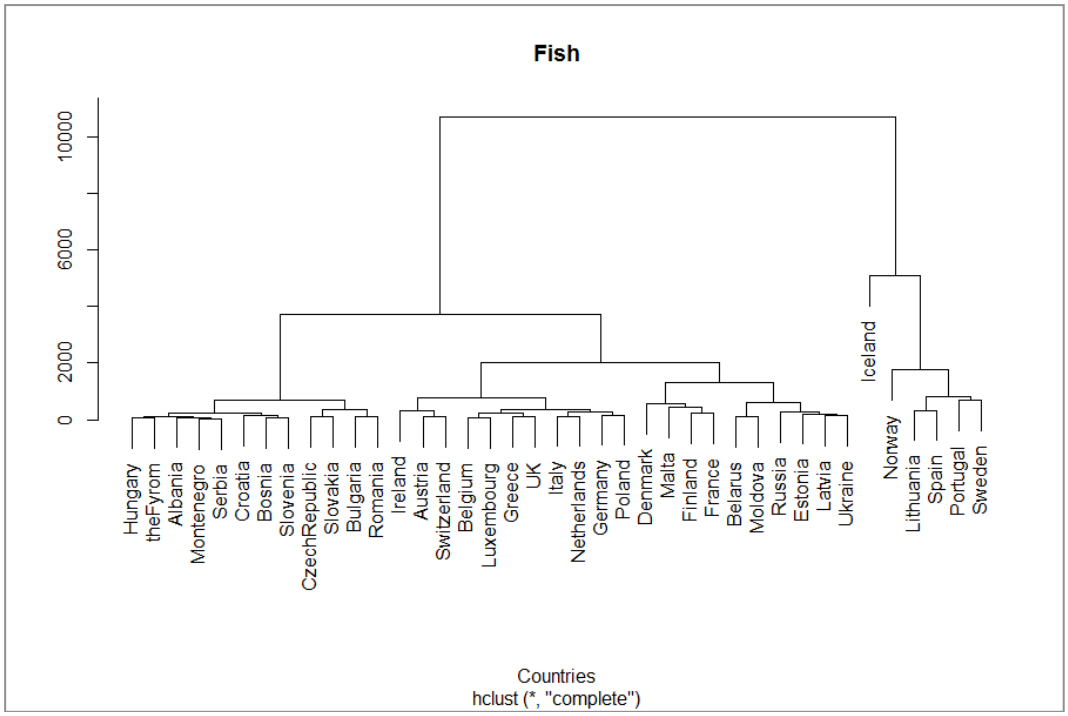


Figure 3.24 - Map of Fish Consumption in Europe (kcal/capita/day)

per cent of total calories came from fish. The second group of countries with an high fish consumption is composed by Lithuania, Norway, Portugal, Spain and Sweden, these countries are characterised by an access to the sea. During this period the fish consumption grew notably especially if we think they started with levels much higher than the rest of Europe. A similar trend is followed by the light-blue-painted countries (Austria, Belgium, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Switzerland and United Kingdom) that expanded constantly their fish consumption but with levels that follow the mean. The maximum peak recorded in this group was 51 kcal/capita/day eaten in Belgium in 2007. The orange-painted countries (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Montenegro, Romania, Serbia, Slovakia, Slovenia and the FYROM) have negligible consumption in fish which barely hits the value of 20 kcal/capita/day even though not in every nation, which is probably due to the low income levels. The rest of countries form the last cluster in which no common trend can be highlighted, anyway the consumption in certain nations, such as France and Finland, peaked around 70 kcal/capita/day in the last years suggesting it is expanding (see Figure A.5).

Finally, as it could be expected, the wealthiest countries have increased even more their fish consumption than the others, probably for the advertised health effects. Good examples of this aspect are France, Finland, Spain, Italy, Belgium and Netherlands, in which fish consumption increased until 2009. Looking at time series graphs of these countries (see Figure A.5), it seems that there is still room to exploit this market and a further growth is yet to come. On the other hand it is less understandable why United Kingdom and Ireland increase so little in the whole period. In 2009 they ate less fish than all the continental countries and also France, Spain and Italy, even though they are island-countries with a great tradition on fishery.

3.10 Overlook on Eggs, Stimulants and Spices

Because of the scarce importance in literature given to the consumption of eggs, stimulant and spices, and the relative low importance on the total amount of

calories consumed by people, the data of these categories will be briefly described.

The category of eggs was little discussed, probably because they correspond just to 1.30 per cent over the total consumption. However, they are one of the key ingredient in the preparation of sweets, such as cakes and patisseries but they are widely used also in preparing pastas, pastries and sauces. Eggs are quite energetic too, 100g of hen eggs provide 150 kcal.

As can be seen in Figure 3.1, in 1961 the intake of eggs was around 30 kcal/capita/day, then the consumption increased during the first three decades peaking at 50kcal/capita/day in late 1980s. After a small decline in the first years of the 1990s, the usage of eggs became stable until nowadays with a value that is around 42 kcal/capita/day.

With the cluster analysis it is possible to create four groups that share common patterns in the whole period. The Figure 3.25 shows how the clustering procedure created two small groups. The first, composed by Albania, Bosnia and Herzegovina, Montenegro and Serbia is characterized by a small consumption of eggs. The other small group comprehends United Kingdom, Ireland and Luxembourg, where the intake in eggs has declined during the whole period. In 1990 Hungary has recorded the highest consumption value which equals to 87 kcal/capita/day. All the countries in the same cluster as Hungary, eat a significant amount of eggs and generally they consume more than the countries painted in blue in Figure 3.26.

Remembering the definition provided by FAO, stimulants include coffee and tea, which principally are used for the preparation of beverages, and cocoa for sweets. Instead, spices are plant products such as leaves, flowers, seeds and roots that are rich in essential oils and aromatic principles. They are used mainly as condiments.

It is important to notice that the relative importance of these categories has grown significantly during the period. In fact, in 1961 the consumption was just of 9 kcal/capita/day, which corresponds to an insignificant 0.30 per cent on the total caloric intake, but in 2009 it accounts for 44kcal/capita/day, that is 1.30 per cent

Figure 3.25 - Dendrogram of Egg Consumption (kcal/capita/day)

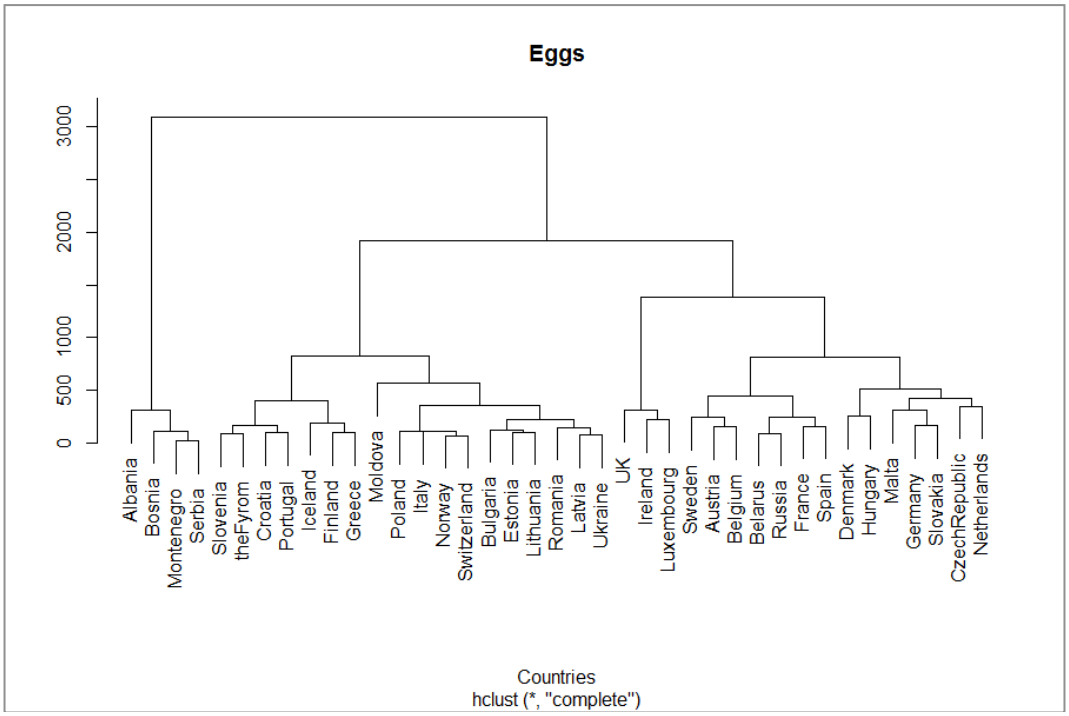
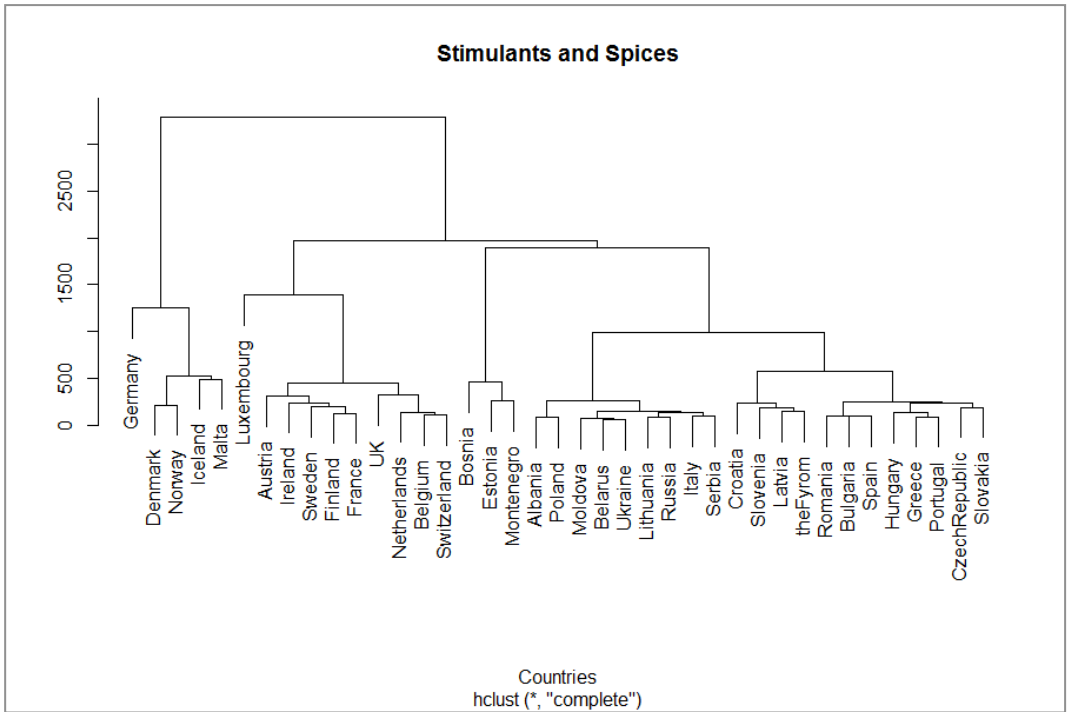


Figure 3.26 - Map of Egg Consumption in Europe (kcal/capita/day)

Figure 3.27 - Dendrogram of Stimulants and Spices Consumption (kcal/capita/day)



on the total. Moreover, in the last years the slope is steeper and probably the consumption of stimulants and spices could be an interesting subject for future studies.

The highest consumption levels of these two categories was recorded in Luxembourg during 2001, when its citizens used 141 kcal/capita/day. The pattern underlying the countries' consumption is very heterogeneous, see Figure A.10. Furthermore the small values recorded in these two different categories do not allow to make reliable considerations on what happened, since major changes could be caused by both stimulants and spices, or by just one of them. However, it is important to notice that also looking at each time series, there is a generalised increasing trend in the last twenty years.

3.11 Discussions

Basing on the results of the analysis made on food categories, some analogies and peculiarities have arisen from each country. In fact, the clustering analysis has helped find the common trends of different countries in a specific category. In some cases different countries have shared the same cluster in different categories,

for example Italy, Greece and Portugal have shared the same cluster in: eggs, meat, sugar and vegetable oils.

Among all the countries, those who have shared a common trend are usually those that belonged to former USSR; this is determined by the fact that these countries share common traditions and cultures. It may be argued that such similarities are just the result of the fact that for 30 years, these countries have been sharing the same data. A similar situation can be found in other European regions; in fact former Yugoslavian states as well as Luxembourg and Belgium, have been presenting the same time series for 30 or more years. Recent years data have been so different among these countries that the cluster analyses have placed them in different groups. A meaningful example is represented by the consumption of alcohol in Belgium and Luxembourg in which it can be noted how Luxembourg has a major drinking intake compared to Belgium. This is just one of many examples that could be made between these two countries.

Cultures and traditions have played a fundamental role in defining the actual food consumption. Researches made by sociologists have shown how cultural traditions have persisted among groups of immigrant, such studies have proven that food habits have passed from a generation to another (Bernardi, 2004). This makes us understand how difficult a change in terms of culinary habits is.

The trend of food consumption in Europe can be summarized in four major steps: "(1) a decrease in the proportion of expenditure allocated to food already reaching very low levels; (2) a maximum level in total food consumption, in quantity terms, (3) a shift in the food consumption structure; and (4) an increase in the proportion of food consumed away from home" (Gracia & Albisu, 2001). The data analysis has made it possible to find evidence regarding the statements mentioned above at the second and third point.

An emblematic example is the one of animal fats, which have increased for the first twenty years till they has reached the caloric saturation (this corresponds to the second step). Later on, an improvement of living conditions brought to a shift in food consumption; people became more concerned about their health and this lowered animal fat consumption.

4 Diet Profiles: a Cross Section Analysis

In this chapter a cross section analysis to identify the similarities among the European diets has been carried out. All the 39 countries considered in this work, have their own characteristics, but the tool of the cluster analysis allows highlighting the countries that share the most similar eating patterns. The purpose of this analysis is to trace four or five diet profiles which may be the most representative among the European varieties.

The cross section was made in 1961, 1991 and 2009. The years 1961 and 2009 were chosen because they represent the starting and final points of time series data. The choice of the year 1991 was determined by the fact that it is a crucial moment because it established the end of communism era in Europe. It must be kept in mind that until 1991 USSR and Yugoslavia comprehended some territories that later became independent nations. Instead of the year 1992, the previous one was preferred, as the provided data were referring to the former geographic structure; such characteristic simplifies the comparison between the years 1961 and 1991. The Czech Republic and Slovakia became independent from Czechoslovakia in 1993, therefore, from that year on, these two countries have different data. As far as Belgium and Luxembourg are concerned, their data have been listed individually in the Food Balance Sheets only since 2001.

In order to identify some dissimilarities among countries and categories, the analysis of the coefficient of variation may be useful. In fact, the Coefficient of Variation is a normalized measure of dispersion that allows comparing data with different units of measurement. The coefficient of variation CV is defined as the ratio of the standard deviation σ to the mean μ:

$$CV = \frac{\sigma}{\mu}$$

The closer to zero the value of the CV, the lower the dispersion in the category analysed (Parpinel & Provasi, 2004). As Table 4.1 shows, European countries reveal some dissimilarity. The categories of food consumption exhibiting in 1961 the highest values in the coefficient of variation were in the order: fish, stimulants and spices, vegetables oils along with fruits. In 1991, the first two positions remained the same, while in third spot there are fruits along with animal fats. In 2009 the situation did not change with the exception of fruits, which reveal a more homogeneous consumption pattern in Europe. On the contrary, the categories with the lowest variability were in 1961 starchy roots & pulses, cereals and sugar & sweeteners. In 1991 they were sugar &sweeteners, meat and eggs; while in 2009 these categories were replaced by cereals, sugar & sweeteners and eggs. By reading values of the coefficient of variation, a major heterogeneity emerges, especially for fish, stimulants & spices and fruits. These three categories are characterised by low percentages on the total calorie amount unlike cereals and sugar & sweeteners which reflect a major homogeneity in Europe.

Table 4.1 - Homogeneity of Food Consumption

Categories	Coefficient of variation		
	1961	1991	2009
Alcoholic Beverages	0,48	0,40	0,37
Animal Fats	0,55	0,46	0,58
Cereals	0,31	0,29	0,18
Eggs	0,50	0,27	0,29
Fish	0,98	0,81	0,76
Fruits	0,56	0,46	0,34
Meat	0,46	0,27	0,30
Milk	0,43	0,27	0,31
Starchy Roots & Pulses	0,30	0,30	0,33
Stimulants Spices	0,85	0,80	0,63
Sugar & Sweeteners	0,39	0,22	0,27
Vegetables Oils	0,56	0,41	0,36
Vegetables	0,42	0,39	0,32

Source: elaboration of FAO data

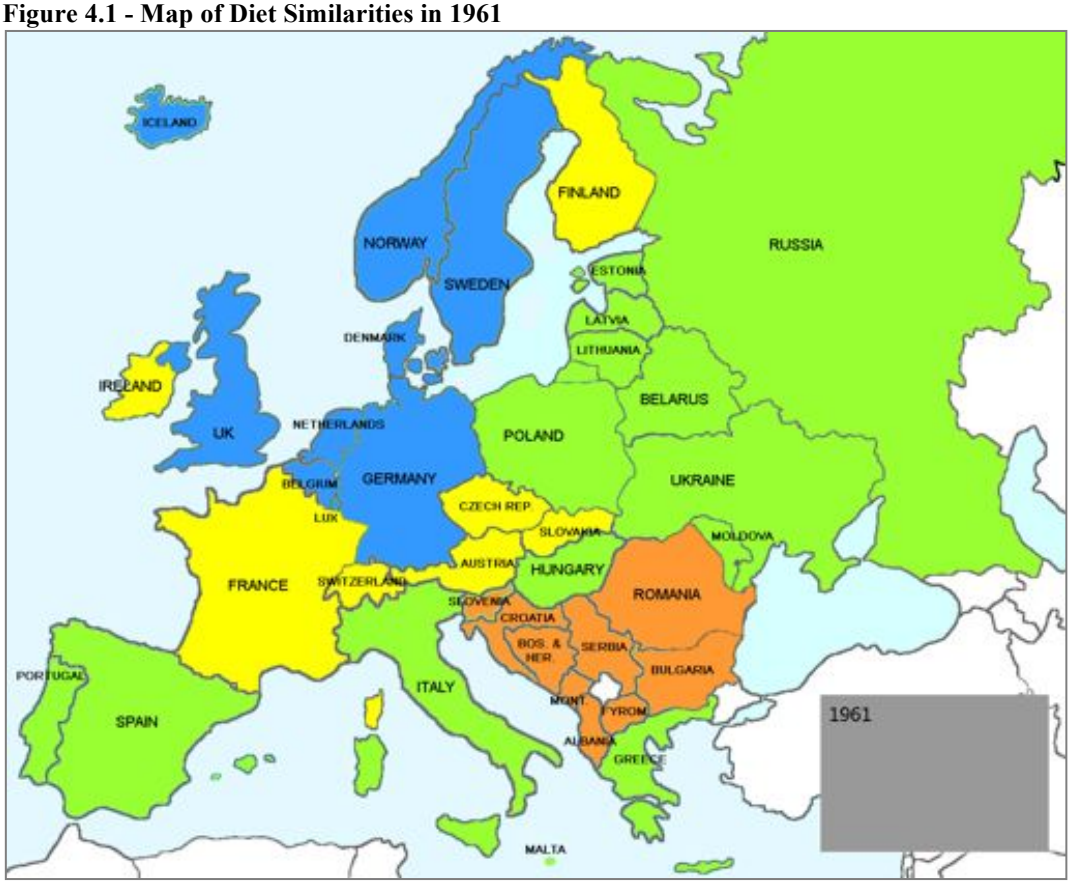
Generally it is possible to note how in the year 2009, the per capita consumption of calories presents a major homogeneity compared to the two years already examined.

Before going on with the analysis, it is worth recalling that the average calorie food consumption values were 3048, 3272 and 3291 Kcal/capita/day respectively in 1961, in 1991 and in 2009.

4.1 Diet Analysis in 1961

Via the Cluster Analysis four homogeneous groups have been identified in the year 1961. The "complete linkage" procedure was used to derive the dendrogram (see Figure 4.4) leading to the map of Figure 4.1.

Figure 4.1 - Map of Diet Similarities in 1961



The classification obtained offers a picture of the Europe divided in four different and connected great regions: the Northern countries, with the exception of Ireland and Finland, that are comprehended in the continental cluster; the Balkans, and the Mediterranean countries linked with eastern countries.

The first two clusters of North-Continental Europe are characterised by a high consumption of sugars and animal products, such as meat, eggs, milk and animal fats. The Balkan area presents a diet prevailing on cereal consumption. The last group comprehends South and East Europe, that is characterised by the consumption of fish, vegetables, starchy roots & pulses and cereals; even though the distribution of food consumption in different categories appears scarcely homogeneous. In fact, the dendrogram structure reveals two regional sub-groups defining the cluster.

Quasi-continental countries (cluster A)

The countries belonging to this group are mostly located in the central part of Europe; they are: Austria, Czech Republic, Finland, France, Ireland, Slovakia and Switzerland. These members present a diet which is largely based on daily per capita consumption of animal products, with the exception of fish. The majority of food consumption categories considered below, presents average values which are higher than European means. The categories that have particularly high average values are: meat, alcohol, animal fats, milk, eggs, sugar & sweeteners and stimulants & spices. On the contrary, they reveal a low average consumption of fish and cereals.

Northern countries (cluster B)

The nations of the second cluster are placed in the Northern territories and they are: Belgium and Luxembourg, Denmark, Germany, Iceland, Netherlands, Norway, Sweden and United Kingdom. Their average values of calorie consumption are even higher than those of the previous group with which they share the consumption of a considerable amount of animal products. Other categories which express average values that are remarkably higher than the European mean are: stimulants & spices, fish and vegetable oils. Even though the greatest calorie amount is provided by cereals, their consumption is very much inferior if compared to the European average. Furthermore, their diet is marked by a scarce presence of vegetables.

As mentioned in the previous chapter, cereals are a staple food category: lower mean consumption of cereals, along with significantly higher average values in most of the other categories, suggest that these countries are more developed.

Balkan countries (cluster C)

The territories of this group are situated in the Balkan region and, considering the current borders, they are represented by the following countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Montenegro, Romania, Serbia, Slovenia and the FYROM. With the exception of Albania, Bulgaria and Romania, the remaining lands composed the former Yugoslavia and, for this reason, they were placed in the same cluster. In general, they show average values that are dramatically lower than the European mean. Emblematic examples could be those of fish and eggs, which bring an insignificant calorie contribution on the total amount. Two exceptions are represented by cereals and fruits, which are the only categories which show positive values in the last column of the Table 4.4.

Southern and Eastern countries (cluster D)

The last cluster includes Portugal, Spain, Italy, Greece, Hungary, Poland and the territories of the former USSR (Estonia, Latvia, Lithuania, Belarus, Ukraine Moldova and Russian federation). Despite the scattered geographical position of these countries, they present similar patterns in consumption.

Sometimes the values of the coefficient of variation of this cluster are higher than those evaluated in all the countries. This suggests that the countries contained in this cluster are heterogeneous and, analysing with more attention every category, it appears that the data are very different in fruits and animal fats categories. This is because Southern countries consume much more fruit but less animal fats than the others. Moreover these internal differences are confirmed by the dendrogram in Figure 4.4.

The majority of consumption categories present lower mean values than the European average. For these countries the diet is characterised by higher average values in fish, vegetables and starchy roots & pulses; whereas the lowest average levels are found in animal fats and meat.

Table 4.2 - Differences between average values of food consumption in cluster A (1961)

Group 1	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	63	306	175,57	77,10	0,44	124,31	41,24
Animal Fats	193	377	300,00	74,75	0,25	218,36	37,39
Cereals	949	1210	1073,71	103,49	0,10	1269,13	-15,40
Eggs	28	54	40,71	8,75	0,21	30,49	33,55
Fish	10	37	18,00	10,57	0,59	26,67	-32,50
Fruits	58	203	109,14	61,61	0,56	91,44	19,37
Meat	257	431	327,43	56,96	0,17	221,67	47,71
Milk	243	588	376,86	129,08	0,34	279,21	34,98
Starchy Roots and Pulses	135	271	205,00	44,67	0,22	220,21	-6,90
Stimulants and Spices	9	19	12,57	3,78	0,30	9,10	38,11
Sugar and Sweeteners	296	520	436,14	77,08	0,18	316,38	37,85
Vegetable oils	79	340	189,14	85,78	0,45	193,49	-2,25
Vegetables	13	103	46,14	28,16	0,61	46,36	-0,47

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.3 - Differences between average values of food consumption in cluster B (1961)

Group 2	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	38	184	114,00	58,04	0,51	124,31	-8,29
Animal Fats	193	516	334,00	96,32	0,29	218,36	52,96
Cereals	578	799	739,56	80,09	0,11	1269,13	-41,73
Eggs	17	59	45,56	13,70	0,30	30,49	49,43
Fish	21	142	48,44	39,40	0,81	26,67	81,67
Fruits	62	124	89,00	17,59	0,20	91,44	-2,66
Meat	222	527	295,89	113,42	0,38	221,67	33,48
Milk	234	657	372,22	126,48	0,34	279,21	33,31
Starchy Roots and Pulses	157	268	220,22	38,69	0,18	220,21	0,01
Stimulants and Spices	10	33	18,56	6,77	0,36	9,10	103,85
Sugar and Sweeteners	267	561	421,00	105,96	0,25	316,38	33,07
Vegetable oils	228	442	300,22	61,95	0,21	193,49	55,16
Vegetables	8	58	36,44	17,18	0,47	46,36	-21,39

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.4 - Differences between average values of food consumption in cluster C (1961)

Group 3	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	15	124	88,22	30,28	0,34	124,31	-29,03
Animal Fats	73	192	156,67	53,43	0,34	218,36	-28,25
Cereals	1467	1870	1767,00	115,21	0,07	1269,13	39,23
Eggs	6	24	11,67	6,26	0,54	30,49	-61,73
Fish	3	5	3,44	0,88	0,26	26,67	-87,08
Fruits	63	130	104,33	17,70	0,17	91,44	14,11
Meat	96	167	129,89	17,82	0,14	221,67	-41,40
Milk	144	200	187,11	16,80	0,09	279,21	-32,98
Starchy Roots and Pulses	40	209	175,67	62,18	0,35	220,21	-20,23
Stimulants and Spices	0	5	3,67	1,41	0,39	9,10	-59,72
Sugar and Sweeteners	107	198	174,11	37,26	0,21	316,38	-44,97
Vegetable oils	58	257	103,44	61,24	0,59	193,49	-46,54
Vegetables	39	62	43,11	8,27	0,19	46,36	-7,01

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.5 - Differences between average values of food consumption in cluster D (1961)

Group 4	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	25	226	128,50	51,57	0,40	124,31	3,37
Animal Fats	29	423	142,86	105,29	0,74	218,36	-34,58
Cereals	1026	1528	1387,21	176,89	0,13	1269,13	9,30
Eggs	13	36	27,79	5,65	0,20	30,49	-8,86
Fish	4	71	31,93	14,96	0,47	26,67	19,73
Fruits	25	243	75,86	69,70	0,92	91,44	-17,04
Meat	96	302	180,07	55,97	0,31	221,67	-18,76
Milk	90	335	229,79	62,56	0,27	279,21	-17,70
Starchy Roots and Pulses	133	427	256,43	74,48	0,29	220,21	16,45
Stimulants and Spices	1	24	4,79	5,62	1,17	9,10	-47,42
Sugar and Sweeteners	148	367	280,71	62,40	0,22	316,38	-11,27
Vegetable oils	41	446	184,93	111,19	0,60	193,49	-4,42
Vegetables	42	105	54,93	18,60	0,34	46,36	18,49

Source: elaboration of FAO data, values in kcal/capita/day

4.2 Diet Analysis in 1991

Cluster analysis allowed the division of Europe in five groups. The first group includes countries from the Eastern European area, from the former Yugoslavia to the former U.S.S.R. these are characterised by a high consumption of cereals.

Figure 4.2 - Map of Diet Similarities in 1991

Another cluster, marked by a high consumption of vegetable oils, vegetables and fruit, comprehends countries from Southern Europe. A third area includes the so-called territories of Western Europe; these show a high consumption of alcohol, meat, fats and oils. The remaining territories are divided in two clusters with countries belonging to different European areas. In fact, pink-coloured countries form the Northern European group and are characterised by a high consumption of fish and milk. Finally, the other countries from the Central-Eastern and Northern European area show values similar to the European average

Eastern countries (cluster E)

The first cluster includes all the countries of the former USSR and the former Yugoslavia, along with Romania and Bulgaria. It is possible to note that the geographical position of this group looks like the combination of the third and fourth clusters of the previous year, although Southern Europe was left out. Cluster C and D in 1961 showed evident similarities in the diet composition; therefore, cluster E in 1991 also presents lower average values than the European mean. In particular, its average consumption values of fruit, fish and alcohol are significantly below the European mean values. The only exception is provided by cereals, since its average calorie consumption is higher than European mean.

Quasi-continental countries (cluster F)

France, Belgium, Luxembourg, Germany, Denmark, Switzerland, Austria and United Kingdom belong to the second cluster. This group presents a situation that is simply the opposite of the previous cluster. In fact, looking at Table 4.7, it is possible to observe that all of the average consumptions are higher than the European mean. In specific, the diet is characterised by the consumption of a relevant calorie amount derived from animal fats, alcohol, fruit and stimulants & spices. Cereals are the only category that shows a negative value in the last column of Table 4.7.

For the diet composition, this group presents major resemblances with the first cluster of the year 1961.

Northern countries (cluster G)

The third cluster comprehends the following Northern countries: Iceland, Netherlands, Sweden and Finland. In general, the third cluster is characterised by average consumption values higher than the European mean. In fact, compared to the European mean there is a high consumption of the fish, milk, sugar and stimulants categories. However, this cluster shows a low consumption of cereals and vegetables. The diet of this group resembles an evolution of the diet shown by group 2 in 1961. In fact, these two diets share an extremely high consumption of fish and an important consumption of sugar and milk as well. Besides this, both

diets present very low negative figure in cereals and vegetables as the last column in Table 4.8 shows.

Mediterranean countries (cluster H)

Cluster H is a new group formed by Southern European countries, in specific: Portugal, Spain, Italy and Greece. They are characterised the typical elements of the Mediterranean diet, that is to say, they show higher average values than the European mean in the consumption of fruit, fish, starchy roots and pulses and alcohol. An even more significant consumption can be noticed in vegetable oils and vegetables, with figures reaching over the double of the European average. Another feature of the Mediterranean diet is the low use of animal fats and sugars; the negative values in Table 4.9 are evidence of this.

Central-eastern and Northern Europe (cluster I)

Cluster I includes both Central-Eastern European countries and Northern European countries. In fact, it comprehends: Ireland, Norway, Poland, Hungary, the former Czechoslovakia and with the addition of Malta. Compared to the other clusters, this group distances itself very little from the European average. Only animal fats and stimulants show values which are slightly above the European mean. No other average value in this group allows the diet of these countries to distinguish itself from the European mean.

Table 4.6 - Differences between average values of food consumption in cluster E (1991)

Group 1	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	16	181	116,06	31,53	0,27	163,79	-29,14
Animal Fats	65	219	179,31	40,53	0,23	224,00	-19,95
Cereals	1238	1608	1406,56	161,99	0,12	1084,85	29,66
Eggs	14	56	43,00	13,58	0,32	46,85	-8,21
Fish	1	49	24,88	22,05	0,89	36,33	-31,54
Fruits	51	116	73,06	21,64	0,30	110,72	-34,01
Meat	125	342	279,25	65,43	0,23	354,46	-21,22
Milk	207	295	240,25	35,32	0,15	291,26	-17,51
Starchy Roots and Pulses	64	159	140,50	27,77	0,20	162,69	-13,64
Stimulants and Spices	1	17	9,88	4,46	0,45	20,59	-52,04
Sugar and Sweeteners	146	353	322,56	56,81	0,18	373,82	-13,71
Vegetable oils	186	318	250,63	62,56	0,25	336,10	-25,43
Vegetables	52	68	56,13	4,94	0,09	65,13	-13,82

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.7 - Differences between average values of food consumption in cluster F (1991)

Group 2	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	194	294	230,38	36,87	0,16	163,79	40,65
Animal Fats	175	476	332,13	111,59	0,34	224,00	48,27
Cereals	723	821	749,13	31,06	0,04	1084,85	-30,95
Eggs	40	58	50,25	6,76	0,13	46,85	7,27
Fish	19	65	36,38	14,14	0,39	36,33	0,11
Fruits	94	210	155,50	42,23	0,27	110,72	40,45
Meat	376	571	451,00	76,96	0,17	354,46	27,24
Milk	275	427	330,13	59,96	0,18	291,26	13,35
Starchy Roots and Pulses	93	228	167,50	50,99	0,30	162,69	2,96
Stimulants and Spices	19	65	33,88	15,20	0,45	20,59	64,52
Sugar and Sweeteners	352	444	412,63	27,95	0,07	373,82	10,38
Vegetable oils	230	473	409,00	79,77	0,20	336,10	21,69
Vegetables	48	92	67,00	15,75	0,24	65,13	2,87

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.8 - Differences between average values of food consumption in cluster G (1991)

Group 3	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	94	196	152,75	46,07	0,30	163,79	-6,74
Animal Fats	186	243	203,75	26,58	0,13	224,00	-9,04
Cereals	550	781	677,75	102,49	0,15	1084,85	-37,53
Eggs	37	49	42,50	5,51	0,13	46,85	-9,28
Fish	22	134	70,75	46,57	0,66	36,33	94,72
Fruits	100	160	121,50	28,44	0,23	110,72	9,74
Meat	265	491	402,25	96,57	0,24	354,46	13,48
Milk	395	444	422,75	21,64	0,05	291,26	45,15
Starchy Roots and Pulses	109	209	153,75	42,00	0,27	162,69	-5,50
Stimulants and Spices	18	74	33,50	27,04	0,81	20,59	62,70
Sugar and Sweeteners	393	588	488,00	92,88	0,19	373,82	30,54
Vegetable oils	177	453	307,75	131,13	0,43	336,10	-8,44
Vegetables	29	55	41,75	10,69	0,26	65,13	-35,90

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.9 - Differences between average values of food consumption in cluster H

Group 4	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	131	283	192,00	66,67	0,35	163,79	17,22
Animal Fats	38	159	110,00	58,79	0,53	224,00	-50,89
Cereals	760	1164	997,75	170,76	0,17	1084,85	-8,03
Eggs	32	59	45,25	11,50	0,25	46,85	-3,41
Fish	34	88	56,00	23,94	0,43	36,33	54,13
Fruits	153	241	191,50	37,06	0,19	110,72	72,96
Meat	284	413	354,50	66,75	0,19	354,46	0,01
Milk	200	346	269,75	60,22	0,22	291,26	-7,38
Starchy Roots and Pulses	128	284	216,00	69,80	0,32	162,69	32,77
Stimulants and Spices	11	19	16,00	3,83	0,24	20,59	-22,29
Sugar and Sweeteners	268	298	289,00	14,07	0,05	373,82	-22,69
Vegetable oils	481	701	629,25	101,91	0,16	336,10	87,22
Vegetables	99	168	124,00	30,84	0,25	65,13	90,39

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.10 - Differences between average values of food consumption in cluster I

Group 5	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	86	260	187,00	80,70	0,43	163,79	14,17
Animal Fats	153	495	279,29	111,14	0,40	224,00	24,68
Cereals	907	1132	1015,57	68,50	0,07	1084,85	-6,39
Eggs	37	81	55,14	16,52	0,30	46,85	17,71
Fish	7	109	31,57	35,48	1,12	36,33	-13,11
Fruits	50	138	93,29	29,23	0,31	110,72	-15,74
Meat	307	458	388,71	55,61	0,14	354,46	9,66
Milk	201	483	300,57	99,51	0,33	291,26	3,20
Starchy Roots and Pulses	121	282	182,57	57,04	0,31	162,69	12,22
Stimulants and Spices	7	50	25,14	17,81	0,71	20,59	22,11
Sugar and Sweeteners	377	493	429,86	37,27	0,09	373,82	14,99
Vegetable oils	181	380	296,86	69,93	0,24	336,10	-11,68
Vegetables	41	84	63,29	16,97	0,27	65,13	-2,83

Source: elaboration of FAO data, values in kcal/capita/day

4.3 Diet Analysis in 2009

The cluster analysis has allowed to create five different European areas. Observing this map, it is possible to notice how the division of countries is more scattered than what appears in the previous maps. Southern countries form one group characterized by the Mediterranean diet. In the Balkan areas there is another group characterized by high consumption on cereals. A third area comprehends the Eastern region with the addition of Ireland. Finally, the remaining territories are scattered throughout the old continent, but mainly in Western and Northern Europe.

Eastern countries (cluster J)

The first cluster corresponds to the Eastern European (Russian Federation, Estonia, Lithuania, Ukraine, Poland, Moldova and Bulgaria) area along with Ireland and Malta. In general, the average values of these countries distance themselves very little from the European mean. It is important to notice how the average consumption of fats and fruit are clearly lower compared to the European

mean. In 1991, most of these states still belonged to the first cluster, but their consumption was further from the European mean than nowadays. In fact, they present average values higher than the European mean for alcohol, sugar and eggs (see Table 4.11).

Figure 4.3 - Map of Diet Similarities 2009

Balkan countries (cluster K)

The second cluster covers approximately the Balkan area, in particular: Slovenia, Serbia, Bosnia and Herzegovina, Romania and Albania. Their diet is characterised by an average consumption of cereals, fruit and vegetables higher than the European mean, while fats, oils, sugar, meat and fish follow radically opposite trends.

As the previous cluster, these countries have witnessed an evolution in their diet; in fact, now, they have more positive figures, as shown in the last column of

Table 4.12. This suggests that they have varied their diet, becoming less dependent on cereals.

Quasi-Northern countries (cluster L)

These countries do not occupy contiguous places, precisely, they are: Iceland, Sweden, Finland, Netherlands, Denmark, Luxembourg, Switzerland and Montenegro. In 1991 the third cluster comprehended only the first four countries, which were later joined by the remaining ones. These new members have brought some changes to the diet. However, fish, milk and sugar are still relevant, even though their figures have decreased. Once again, they show a relatively low consumption of plant foods.

Mediterranean countries (cluster M)

The fourth cluster is composed by the same countries of 1991, which are: Portugal, Spain, Italy and Greece. They have almost kept the Mediterranean diet structure which shows a relatively low consumption of fats and sugars, while fruit and vegetables are still important components of the diet. Moreover, as far as the consumption of vegetable oils and fish is concerned, it may be argued that the average values are even 50 percent greater than the European mean. Another interesting consideration is that these countries have increased their consumption of meat. Finally, it is worth noting that alcohol has decreased its absolute values and therefore, its average values compared to the European mean has followed the same trend.

Quasi-continental countries (cluster N)

The fifth cluster includes: Norway, United Kingdom, Latvia, Belarus, France, Belgium, Germany, Czech Republic, Slovakia, Austria, Hungary, Croatia and the FYROM. This cluster comprehends many countries, which are located throughout Europe and they show homogeneous data, as confirmed by the coefficients of variation reported in Table 4.15. In addition, they are characterized by high average values in the following categories: animal fats, vegetable oils and eggs, while milk and fish provide a small contribution to their diets.

Table 4.11 - Differences between average values of food consumption in cluster J (2009)

Group 1	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	110	295	190,78	65,46	0,34	177,00	7,78
Animal Fats	70	223	127,33	49,11	0,39	168,92	-24,62
Cereals	923	1178	1097,89	75,12	0,07	965,10	13,76
Eggs	33	60	45,00	9,60	0,21	42,51	5,85
Fish	10	105	43,11	28,26	0,66	44,10	-2,25
Fruits	50	141	95,33	30,62	0,32	140,44	-32,12
Meat	129	419	296,78	95,08	0,32	354,49	-16,28
Milk	213	431	297,00	73,22	0,25	327,05	-9,19
Starchy Roots and Pulses	77	259	187,44	61,38	0,33	160,33	16,91
Stimulants and Spices	10	85	35,33	26,60	0,75	43,62	-18,99
Sugar and Sweeteners	299	578	395,33	89,88	0,23	365,38	8,20
Vegetable oils	193	437	318,44	75,39	0,24	407,92	-21,94
Vegetables	36	141	84,56	28,75	0,34	86,36	-2,09

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.12 - Differences between average values of food consumption in cluster K (2009)

Group 2	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	47	226	153,00	66,09	0,43	177,00	-13,56
Animal Fats	36	205	90,80	68,66	0,76	168,92	-46,25
Cereals	1028	1380	1190,80	160,13	0,13	965,10	23,39
Eggs	19	49	30,20	13,48	0,45	42,51	-28,96
Fish	10	20	13,40	3,97	0,30	44,10	-69,62
Fruits	85	213	164,20	51,31	0,31	140,44	16,92
Meat	152	360	268,80	78,10	0,29	354,49	-24,17
Milk	239	496	369,00	117,65	0,32	327,05	12,83
Starchy Roots and Pulses	117	211	166,00	38,99	0,23	160,33	3,53
Stimulants and Spices	10	96	45,20	38,75	0,86	43,62	3,63
Sugar and Sweeteners	147	288	226,40	55,44	0,24	365,38	-38,04
Vegetable oils	229	358	285,00	54,93	0,19	407,92	-30,13
Vegetables	64	131	100,80	28,92	0,29	86,36	16,72

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.13 - Differences between average values of food consumption in cluster L (2009)

Group 3	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	77	385	173,50	92,26	0,53	177,00	-1,98
Animal Fats	55	416	169,63	114,96	0,68	168,92	0,42
Cereals	629	893	757,13	105,77	0,14	965,10	-21,55
Eggs	22	69	37,75	14,47	0,38	42,51	-11,20
Fish	7	165	60,50	46,85	0,77	44,10	37,18
Fruits	102	200	160,25	33,50	0,21	140,44	14,11
Meat	350	654	467,88	105,04	0,22	354,49	31,99
Milk	310	570	441,50	85,73	0,19	327,05	34,99
Starchy Roots and Pulses	90	184	125,00	29,25	0,23	160,33	-22,04
Stimulants and Spices	21	120	59,75	37,99	0,64	43,62	36,99
Sugar and Sweeteners	303	573	417,38	84,22	0,20	365,38	14,23
Vegetable oils	165	471	337,25	110,84	0,33	407,92	-17,33
Vegetables	53	133	75,75	25,54	0,34	86,36	-12,28

Source: elaboration of FAO data, values in kcal/capita/day

Table 4.14 - Differences between average values of food consumption in cluster M (2009)

Group 4	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	117	205	159,00	42,21	0,27	177,00	-10,17
Animal Fats	47	237	127,75	87,22	0,68	168,92	-24,37
Cereals	770	1121	1003,75	158,98	0,16	965,10	4,00
Eggs	36	54	44,00	8,91	0,20	42,51	3,50
Fish	37	98	67,75	29,34	0,43	44,10	53,62
Fruits	147	233	199,25	40,34	0,20	140,44	41,88
Meat	303	422	382,00	53,67	0,14	354,49	7,76
Milk	220	430	295,75	92,25	0,31	327,05	-9,57
Starchy Roots and Pulses	124	181	156,00	24,04	0,15	160,33	-2,70
Stimulants and Spices	16	45	33,00	13,29	0,40	43,62	-24,34
Sugar and Sweeteners	238	312	273,25	37,70	0,14	365,38	-25,22
Vegetable oils	529	755	671,25	99,41	0,15	407,92	64,55
Vegetables	96	143	114,75	21,00	0,18	86,36	32,88

Source: elaboration of FAO data

Table 4.15 - Differences between average values of food consumption in cluster N (2009)

Group 5	Min	Max	Average (B)	Standard Deviation	Coefficient of variation	European Average (A)	Difference % of the averages ((B-A)/A)*100
Alcohol	70	282	184,38	60,56	0,33	177,00	4,17
Animal Fats	116	384	240,00	86,72	0,36	168,92	42,08
Cereals	844	980	902,46	48,03	0,05	965,10	-6,49
Eggs	30	59	48,00	9,20	0,19	42,51	12,91
Fish	10	114	39,23	27,82	0,71	44,10	-11,05
Fruits	71	205	132,23	36,77	0,28	140,44	-5,84
Meat	209	466	349,15	80,93	0,23	354,49	-1,50
Milk	153	349	270,92	70,34	0,26	327,05	-17,16
Starchy Roots and Pulses	109	336	162,46	60,59	0,37	160,33	1,33
Stimulants and Spices	16	65	42,08	16,74	0,40	43,62	-3,53
Sugar and Sweeteners	283	547	394,46	69,88	0,18	365,38	7,96
Vegetable oils	303	622	479,62	95,99	0,20	407,92	17,57
Vegetables	55	128	79,85	23,40	0,29	86,36	-7,54

Source: elaboration of FAO data, values in kcal/capita/day

4.4 Discussion

After looking at the European diet "mapping", it may be interesting to verify whether in the considered period (1961-2009) European countries have gone through an homogenisation of the diet or not. The values ascribed by the coefficient of variation of the European household food consumptions, related to the year 2009, highlight a smaller heterogeneity if compared to 1961. In relation to the considered food categories, the coefficients of variation listed in Table 4.1 are smaller than those of 1961, with the exception of the figures of animal fats and starchy roots & pulses. This is symptomatic of the decreasing differences among food consumption levels throughout Europe. It is worth noting that the categories of animal fats and stimulants & spices present elevated coefficients of variation, which are representative of a considerable dispersion in the figures.

It may be interesting to notice that the group formation operated by the cluster in 2009 presents a less relevant geographic homogeneity than the 1961 clusters. This geographic fragmentation might suggest a growing similarity of the European diets. Moreover, in 2009 the percentage difference between averages, as shown in the last columns of the previous tables, are in general lower than the

previous years. This means that the various clusters distance themselves less from the European mean. Considering what has been previously said, it can be affirmed that in Europe the differences among food consumption structures are attenuating.

In 1961 Europe was divided into two big blocs. The first was formed by the Northern and Western European countries and it was characterised by a high consumption of animal-source foods and sugars. The second group is composed by the Southern and Eastern European countries, which show a high consumption of cereals and fibres, fruit and vegetables. The theory of "nutrition transition" suggests that, with the passing of time, the diet of the latter group will resemble more the diet of more developed countries. It is worth noting that the Balkans are latecomers since, still in 2009, they reveal a strong dependence from cereals and fibres, but a scarce usage of sugars and animal meat and fats. Eastern countries share the major features of the Balkan diet, but they differ for consuming more alcohol and sugars and eating less fruit and vegetables.

Northern countries, besides keeping a high consumption of meat and milk, distinguish themselves for eating great quantities of fish and significant quantities of fruit. Compared to this group, Continental and Western countries are characterised by a greater consumption of alcohol, oils and fats.

Finally, the Mediterranean cluster, geographically speaking, has maintained the same composition throughout the years. It also kept the typical characteristics of the healthy Mediterranean diet, that is to say: a high consumption of cereals and fibres, the preference of oils rather than animal fats, and a scarce usage of sugar. However, it must be pointed out that the consumption of certain animal-source foods, such as meat and eggs, has increased.

A good summary is represented by the Table 4.16, in which countries with a similar diet are gathered. The definitions of such diets depend on the geographical position and it is interesting to notice that, during the years, some countries belong to different "diets". For example, the composition of the so-called Continental Diet, geographically speaking, has significantly changed over the years, in fact nowadays there are countries ranging from the Northern Europe to the Balkans (see Figure 4.3).

Table 4.16 - European countries sharing a similar diet.

Diets	1961	1991	2009
Continental and Quasi-Continental	**Cluster A** Austria Czech Republic Finland France Ireland Slovakia Switzerland	**Cluster F** Austria *Belgium* *Denmark* France *Germany* *Luxembourg* Switzerland *UK*	**Cluster N** Austria *Belarus* Belgium *Croatia* *Czech Republic* France Germany *Hungary* *Latvia* *Norway* *Slovakia* *The FYROM* UK
Northern and Quasi-Northern	**Cluster B** Belgium Denmark Germany Iceland Luxembourg Netherlands Norway Sweden UK	**Cluster G** *Finland* Iceland Netherlands Sweden	**Cluster L** *Denmark* Finland Iceland *Luxembourg* *Montenegro* Netherlands Sweden *Switzerland*
Eastern	**Cluster D** Belarus Estonia Greece Hungary Italy Latvia Lithuania Malta Moldova Poland Portugal Russian_Fed Spain Ukraine	**Cluster E** *Albania* Belarus *Bosnia & Herzegovina* *Bulgaria* *Croatia* Estonia Latvia Lithuania Moldova *Montenegro* *Romania* Russian_Fed *Serbia* *Slovenia* *The FYROM* Ukraine	**Cluster J** Bulgaria Estonia *Ireland* Lithuania *Malta* Moldova *Poland* Russian_Fed Ukraine

(…Table continues from previous page)

Diets	1961	1991	2009
Balkan	**Cluster C**		**Cluster K**
	Albania		Albania
	Bosnia & Herzegovina		Bosnia & Herzegovina
	Bulgaria		Romania
	Croatia		Serbia
	Montenegro		Slovenia
	Romania		
	Serbia		
	Slovenia		
	The FYROM		
Mediterranean Diet		**Cluster H**	**Cluster M**
		Greece	Greece
		Italy	Italy
		Portugal	Portugal
		Spain	Spain
Hybrid		**Cluster I**	
		Czech Republic	
		Hungary	
		Ireland	
		Malta	
		Norway	
		Poland	
		Slovakia	

Source: elaboration of FAO data

4.5 Dendrograms

In this section cluster dendrograms, which made possible the creation of the maps used in this chapter, are collected.

Figure 4.4 - 1961 Cluster Dendrogram

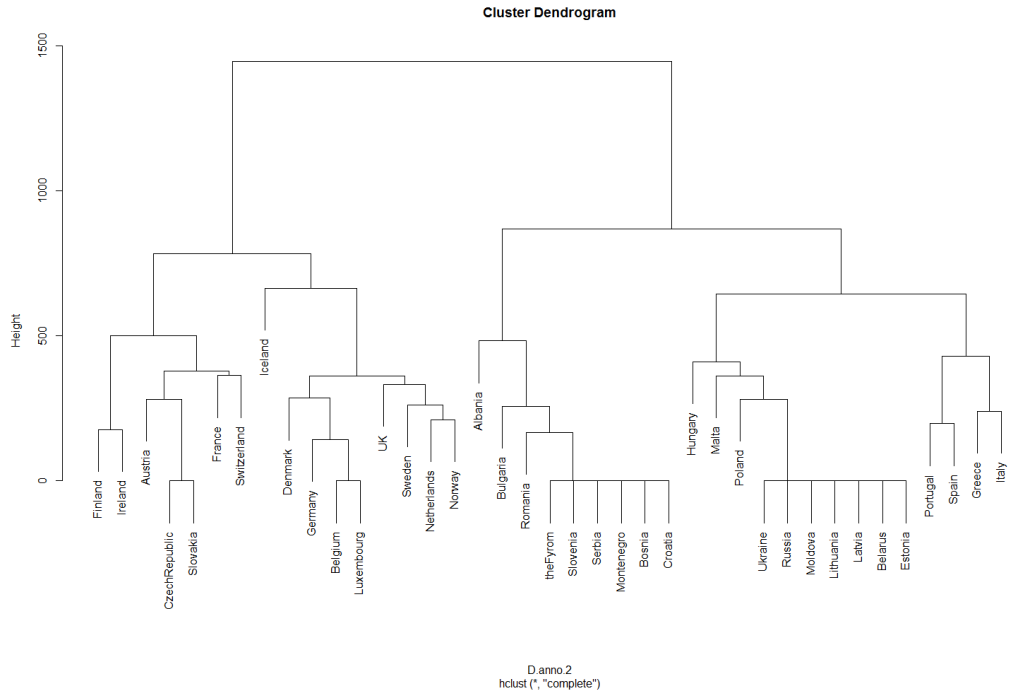


Figure 4.5 – 1991 Cluster Dendrogram

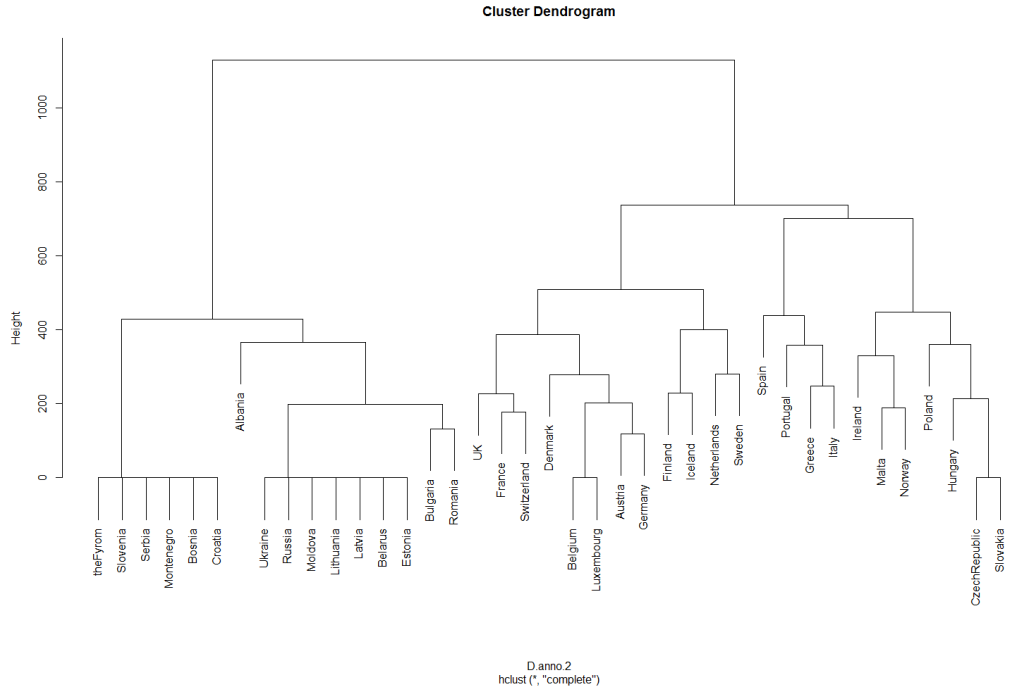
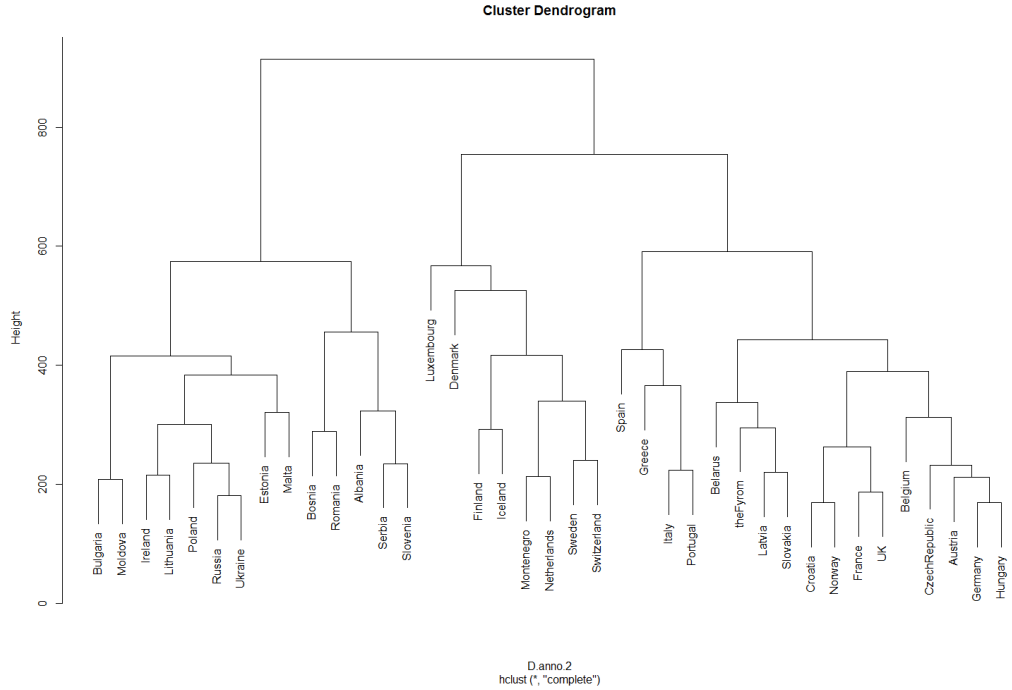


Figure 4.6 - 2009 Cluster Dendrogram



Conclusions

In the period between 1961 and 2009 several were the events that marked the history of Europe and deeply influenced the lifestyle and eating habits of the European population. In fact, the economic boom in the 1960s brought to an increase of incomes that led the European countries, and in particular Western European countries, to a greater general consumption, which included food. The economic growth of the 1960s slowed down in the 1970s due to two major energy crises. However, in the almost fifty years analysed in this study, the 1990s are the decade in which the most dramatic changes happened. For instance, after the fall of the Berlin Wall in 1989, Eastern countries went through a peculiar transition period, passing from a central planned economy to a market economy. The countries of the Former Yugoslavia were affected the most, because of the Balkan wars occurred in those years. For these reasons, in the first the 1990s the European daily average food consumption fell. The 2000s witnessed a certain geo-political stability until 2008, when the financial crisis broke out. This financial crisis has slowly evolved into a severe economic crisis that still affects European consumption nowadays.

Malassis describes three models that explain the evolution of food consumption linking them to the increase of incomes: first, a traditional model principally based on subsistence, which is followed by an agro-industrial model that allows to reach the calorie saturation and, finally, a 'satiety' model characterised by healthy and hedonistic choices in food consumption. Similarly, the Nutrition Transition theory states that, as income grows in developing countries, the proportion of starchy staples decreases, while more expensive and quality foods follow the opposite trend.

The statistical tool used in this graduation thesis is the Cluster Analysis of Time Series because it is an appropriate instrument to manage a great quantity of data referring to time series. In fact, due to the big amount of data, it would be dispersive to analyse each country separately; on the contrary, this method gives a synthetic view of the data by grouping them into a series of clusters. Among the several distance measures, the Dynamic Time Warping (DTW) has been chosen since it is the most suitable to warp the times series in order to match the best fit. This process allowed grouping the countries that have shown similar evolution patterns in each of the 14 categories taken from the Food Balance Sheets provided by FAO.

According to the theories which were previously mentioned, from the analysis of the 14 categories of the FAO data, a generalised increase in consumption has been observed in almost all types of food. On the other hand, the data collected about cereals show a significant decreasing trend in the average food consumption from 1961 until 2009. Starchy staples, once used to provide the major daily protein intake, nowadays are replaced by livestock products, such as meat, milk and eggs. If this process may be considered completed for Western countries, for latecomers, such as the Balkan countries, there is still room for improvement. In fact, as the cross section analysis highlights in 2009, the Balkan diet was still highly dependent on cereal consumption, while livestock products and sugar, which are typical of the Western diet, played a little role in the whole diet.

Because of the high cost of meat, in several studies (Blandford, 1984; Cornia, 1994; Gil, Gracia and Peréz y Peréz, 1995; Elsner and Hartmann, 1998; Grigg, 1999) this category has presented a positive relation with real per capita incomes. In fact, the European average consumption of meat increased in the whole period, with the exception of the 1990s due to the historical reasons previously explained. The consumption of meat is typical of the Western and Northern diets, as confirmed by the cross section analysis in 1961; but by 2009 the consumption of this category spread and became common throughout Europe. However, differences still persist in eating habits, especially driven by cultural traditions. Moreover, in the last twenty years meat consumption has been characterised by several epidemics that have played a significant role in changing the consumer

preferences for a limited period of time. BSE epidemic, Swine fever and the more recent Bird Flu have probably caused changes to the consumer basket of food goods, but considering the structure of the categories available, it is not possible to understand how this has affected the European consumer. A closer examination of the type of meat used could be helpful for next studies.

As well as meat, milk and its products should be divided in two categories in order to understand separately the incidence of milk (a basic necessity) and dairy products in the diet. In addition, starchy roots and pulses should be divided since, according to Grigg (1996), their consumption follows different patterns as income grows.

Sugar and sweeteners are another category typical of the Northern and Western countries; in fact, even if its consumption increased in almost all Europe, in 2009, sugar was far more consumed in the Continental and Northern diets.

Vegetable oils have gone through a significant increasing path, in fact nowadays they provide the second share in the total calorie consumption. Such increase seems to be driven by society health concerns; people have exchanged animal fats in favour of oils used to dress and cook meals. However, whether to use animal fats or vegetable oils is still highly linked to the traditional habits; in fact, in the Continental countries animal fats are preferred while in the Mediterranean diet vegetable oils are widely used.

Also for healthy reasons, vegetables and fruits consumption has increased significantly in the last years. These products, due to their higher cost per calorie and for their healthy features, are usually found in richer countries. In particular, the cross section analysis has allowed to discover that Southern countries reveal the greatest consumption of fruit and vegetables, Northern and Continental countries prefer fruit, while Eastern countries are more likely to consume vegetables.

Also fish consumption has been proved to be good for human health and its consumption increased in the considered period. In 2009, the Northern and Mediterranean diets were characterised by high consumption of this category. In particular, Iceland has shown the greatest consumption of fish during the whole period.

Due to the increase in health concerns, alcohol consumption might be expected to decrease in the last years; on the contrary, European average estimates have shown a generalised upswing in the last decade. In particular, Luxembourg, Czech Republic and Estonia have revealed alarming consumption levels, in fact almost ten percent of their daily total calorie per capita consumption is dedicated to drinking alcohol.

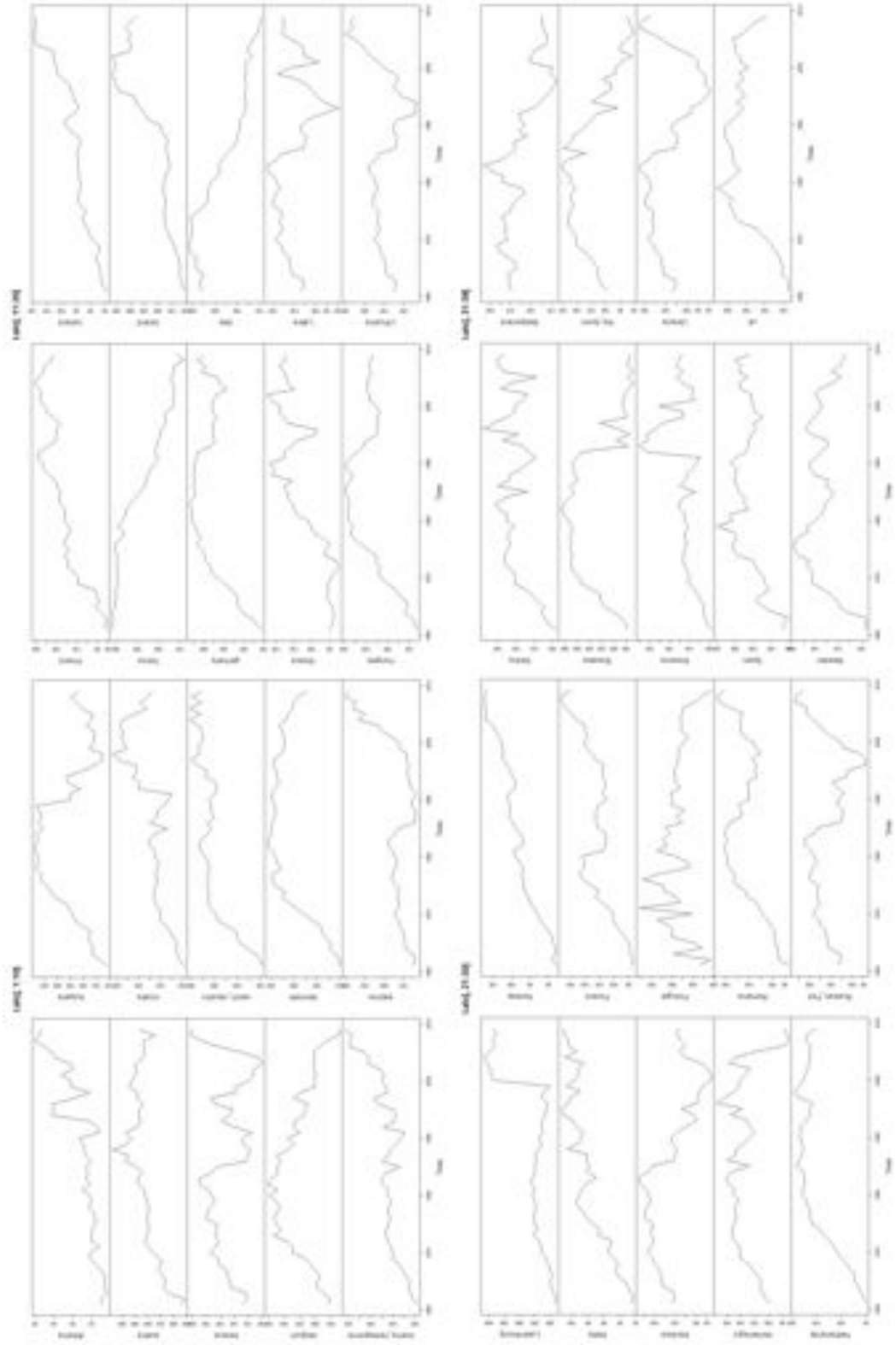
Finally, eggs and stimulants & spices play a little role in the European diet composition and their very low figures make a consumption evolution analysis difficult. However, it is interesting to notice that stimulants and spices went through a significant growth, especially in the period between 1990 and 2009.

The cross section analysis in 1961 individuated 4 distinct regions, which corresponded precisely to four different food diets; more cereals were eaten in Southern and Eastern European countries, while Northern and Western countries presented a major consumption of meat, sugar and animal fats. In 2009, the division became less distinctive, due to the scattering of some cluster members throughout Europe. However, some traditional features were still recognisable, such as livestock in Northern Europe and cereals in the Southern countries. It is worth noting that Southern countries are still characterised by the healthy Mediterranean diet.

Despite the simple tools used in the cross section analysis, it can be said that, from 1961 to 2009, a small homogenisation in the European food consumption probably occurred. In fact, the differences between the average clusters' diet and the European mean diet decreased during the period. However, it is worth remembering that preferences and traditional habits are more important in determining the consumption levels than the differences of income and the availability of food.

Appendix

Figure A.1 - Alcohol (kcal/capita/day) - Time Series



Elaboration of FAO data

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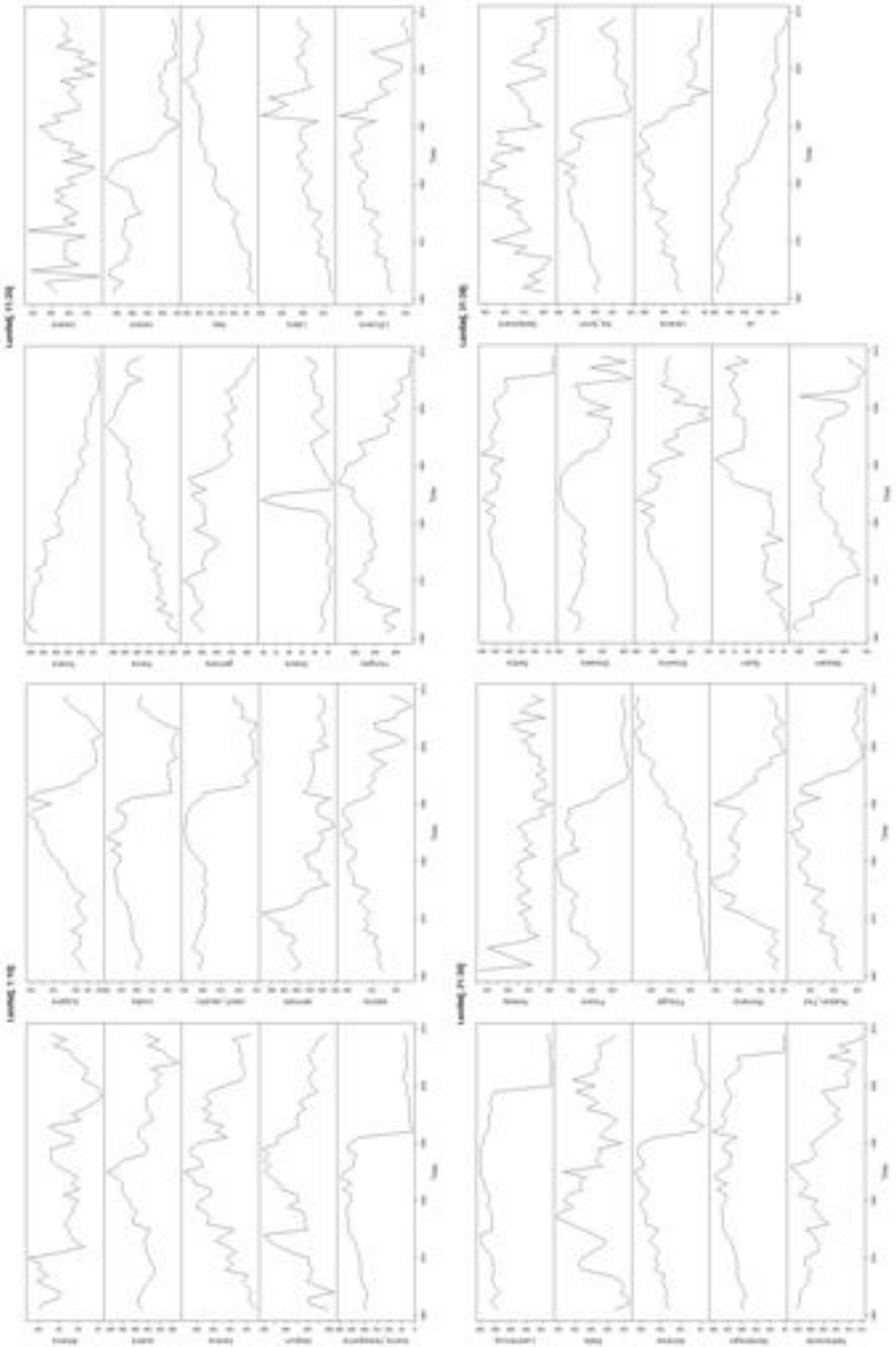
Figure A.2 - Animal Fats (kcal/capita/day) - Time Series



Elaboration of FAO data

Figure A.3 – Cereals (kcal/capita/day) - Time Series

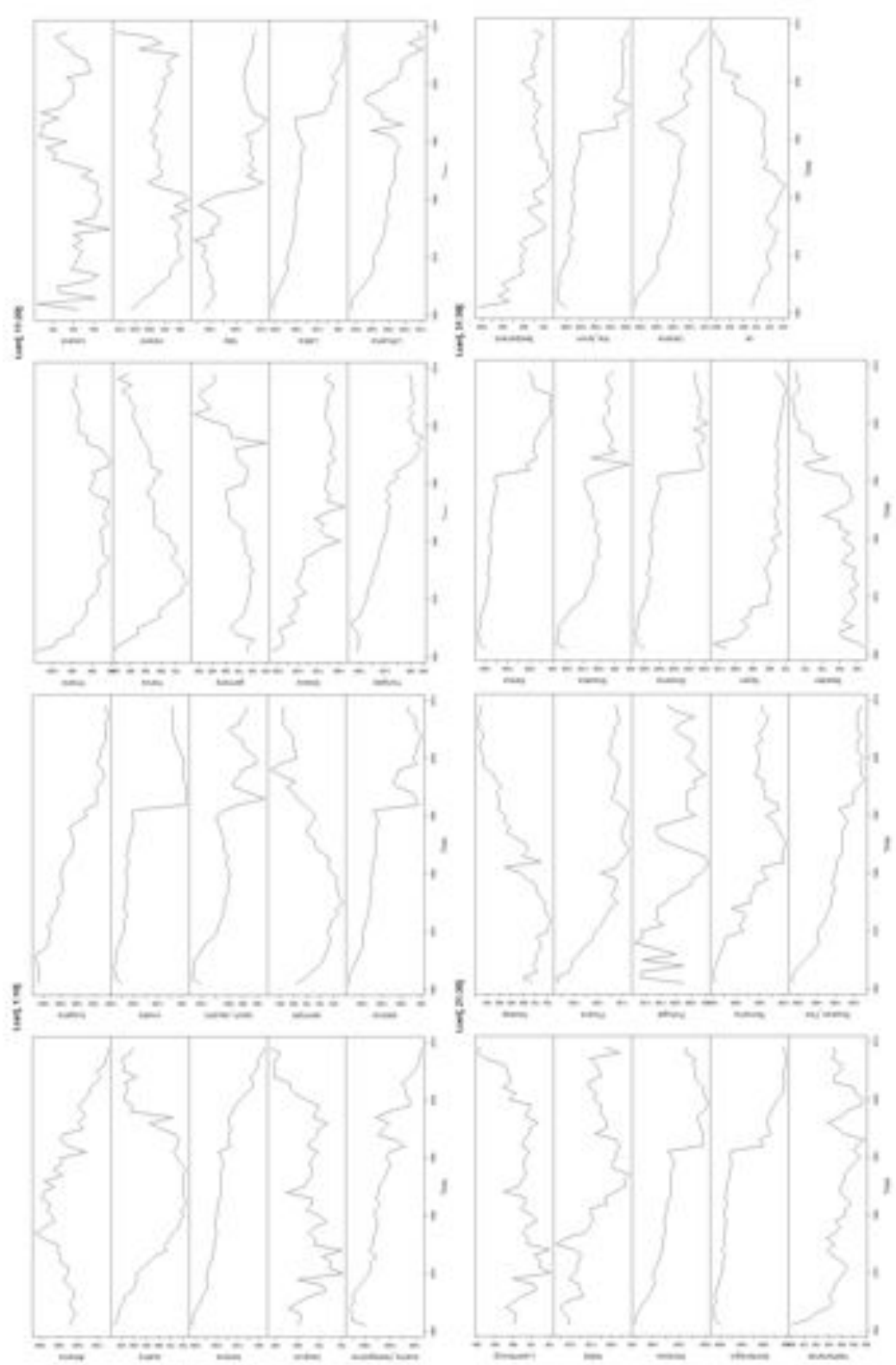


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Figure A.4 - Egg (kcal/capita/day) - Time Series

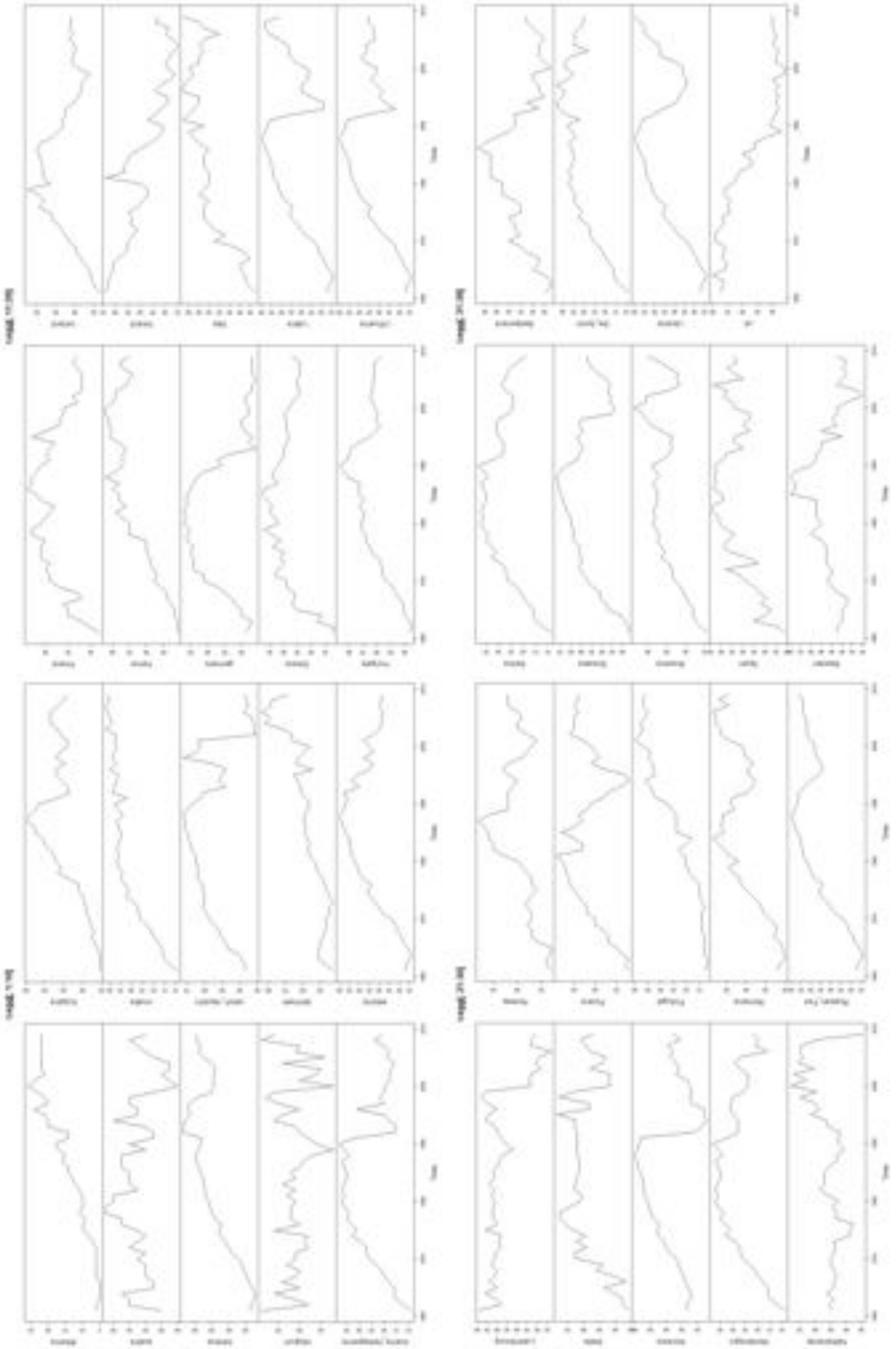

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Figure A.5 - Fish (kcal/capita/day) - Time Series

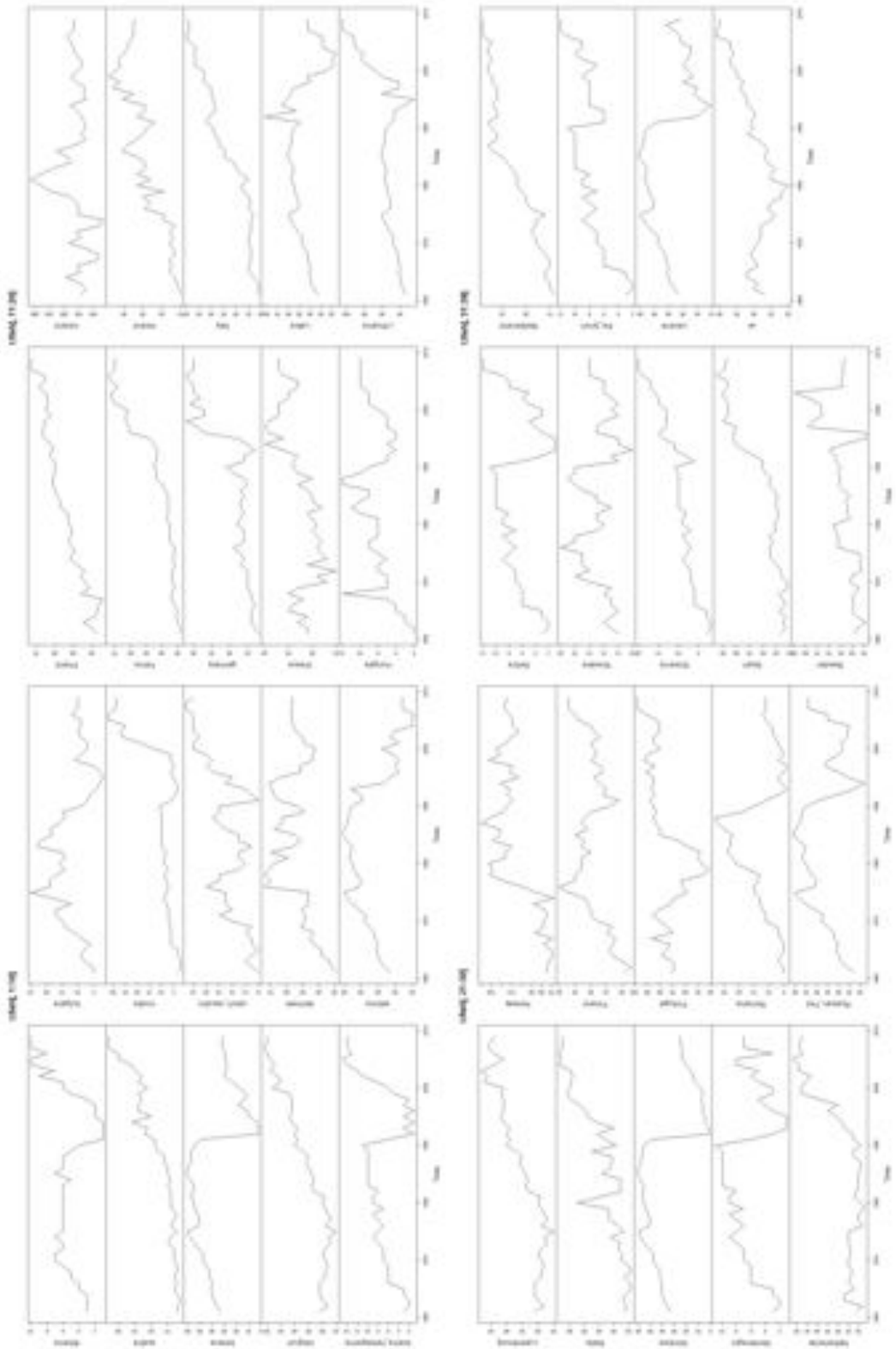

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Figure A.6 – Fruits (kcal/capita/day) - Time Series

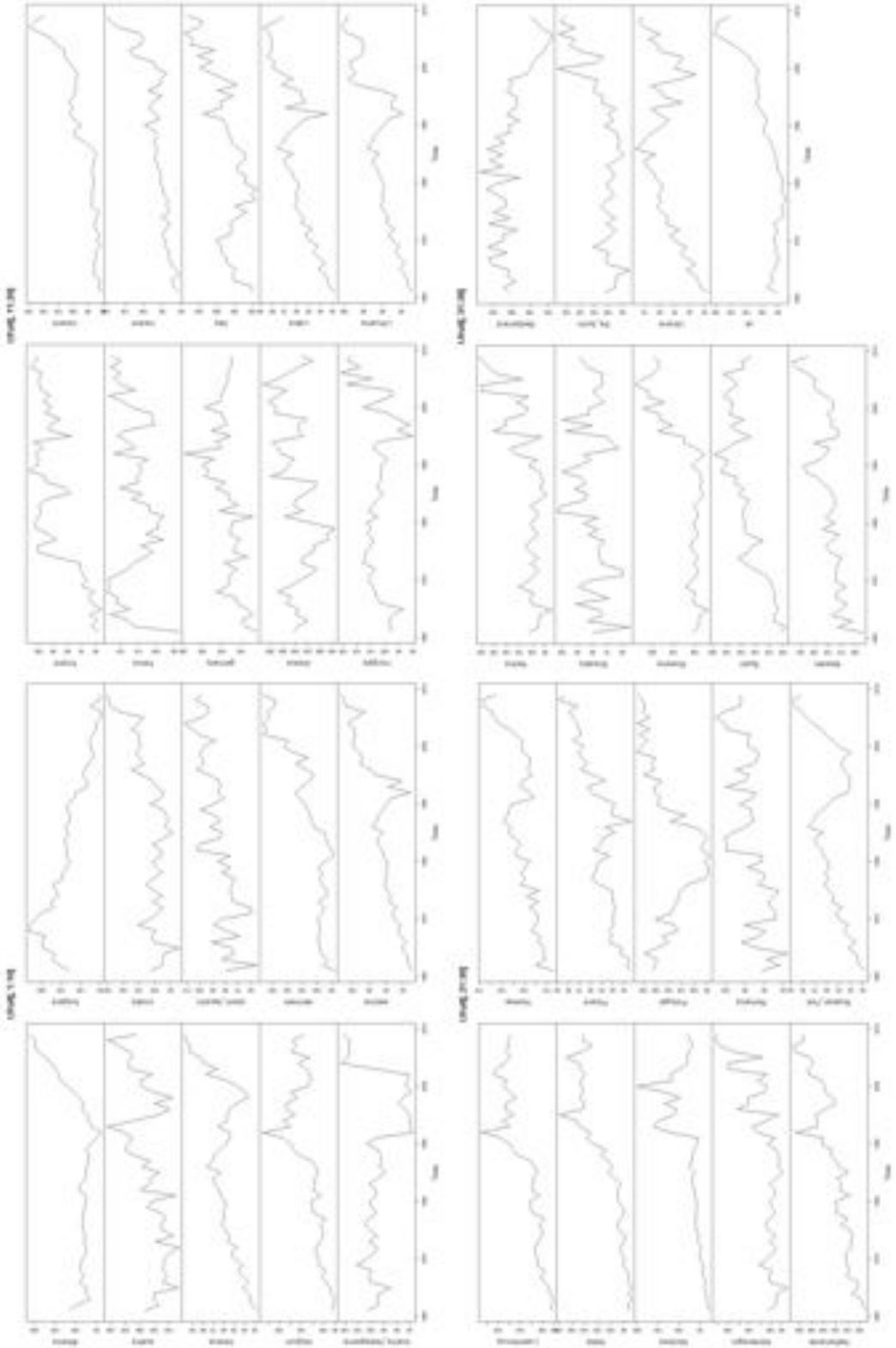

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Figure A.7 - Meats (kcal/capita/day) - Time Series

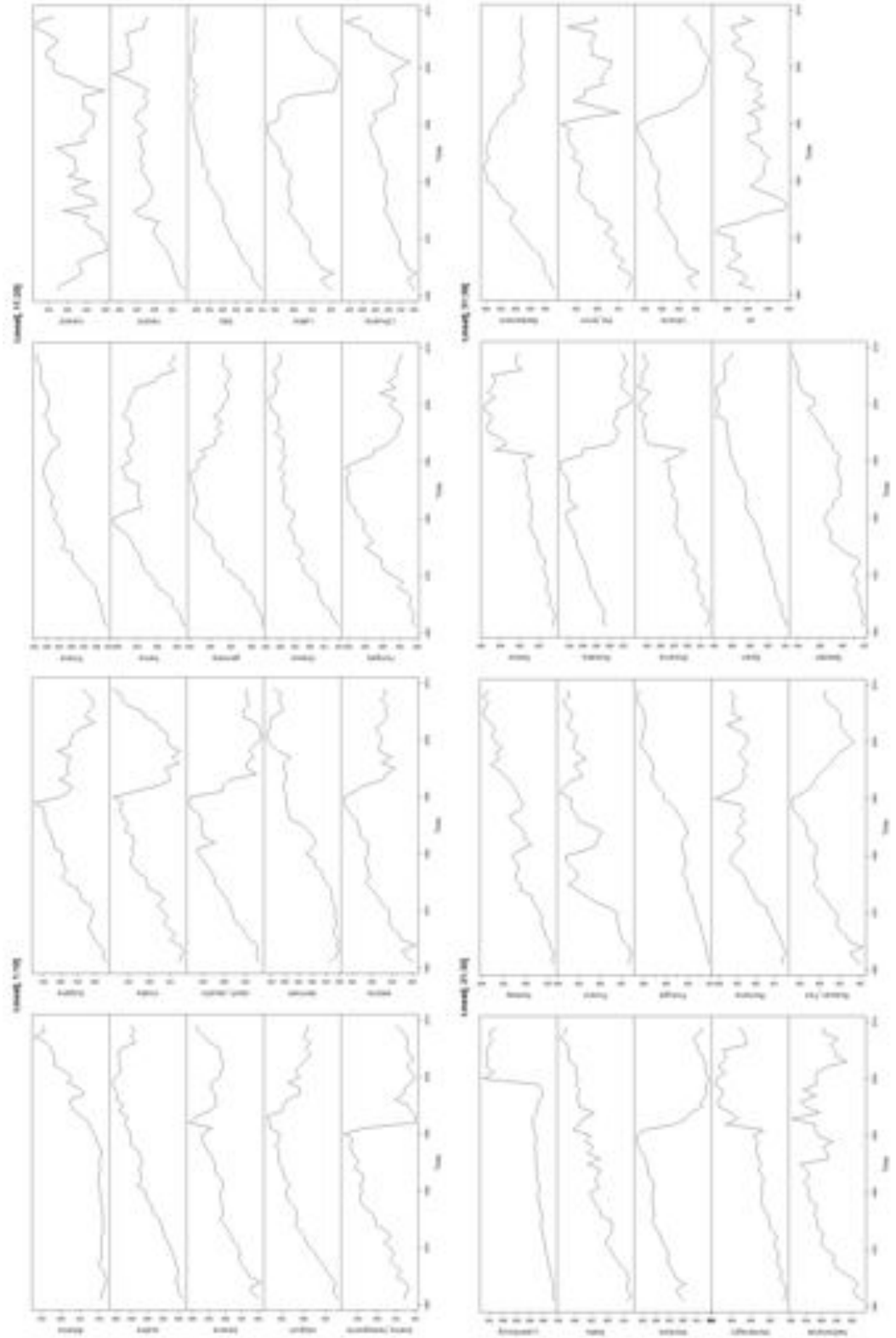

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Figure A.8 - Milk (kcal/capita/day) - Time-Series

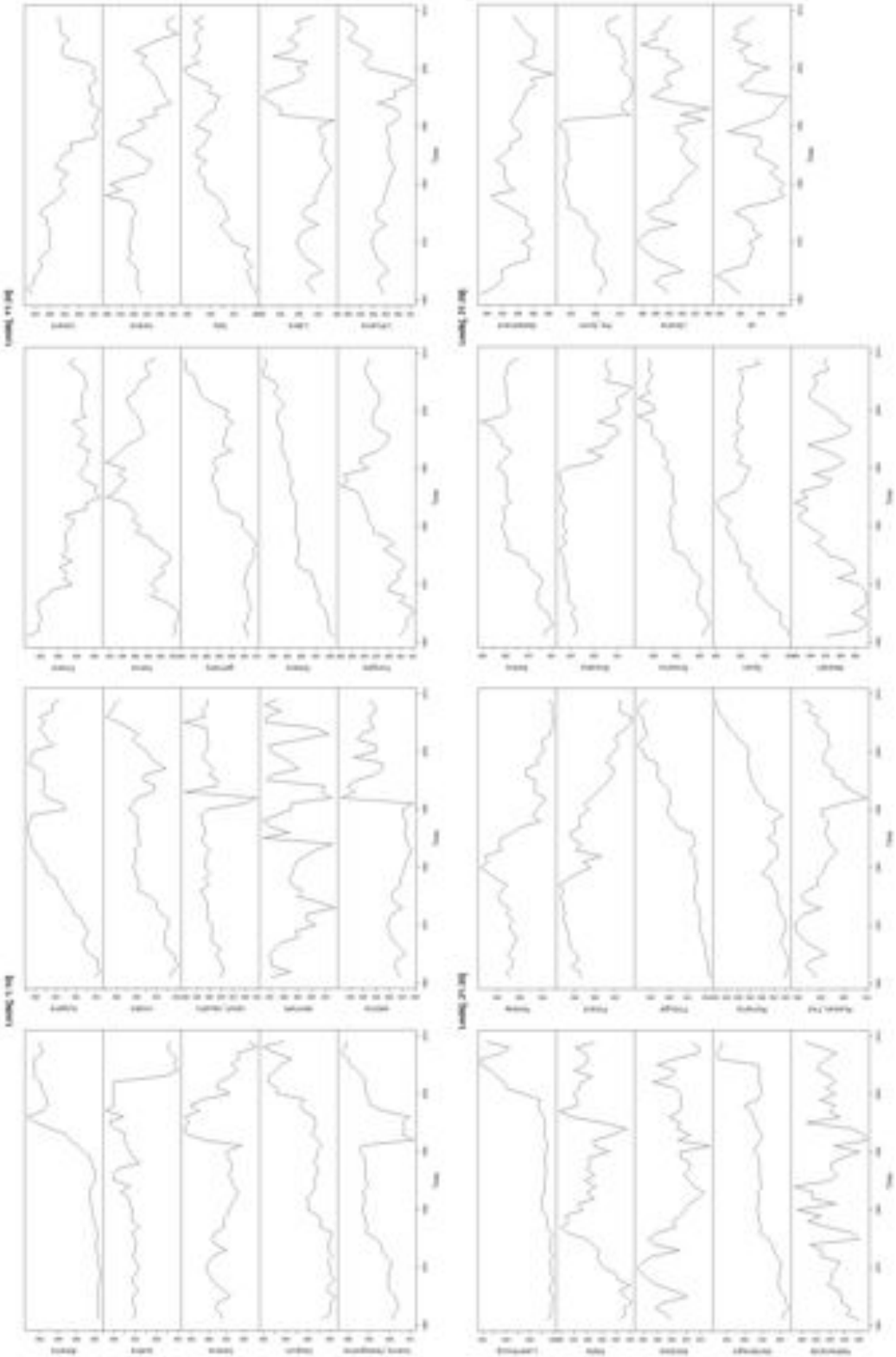

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Figure A.9 - Starcy Staple & Pulses (kcal/capita/day) - Time Series

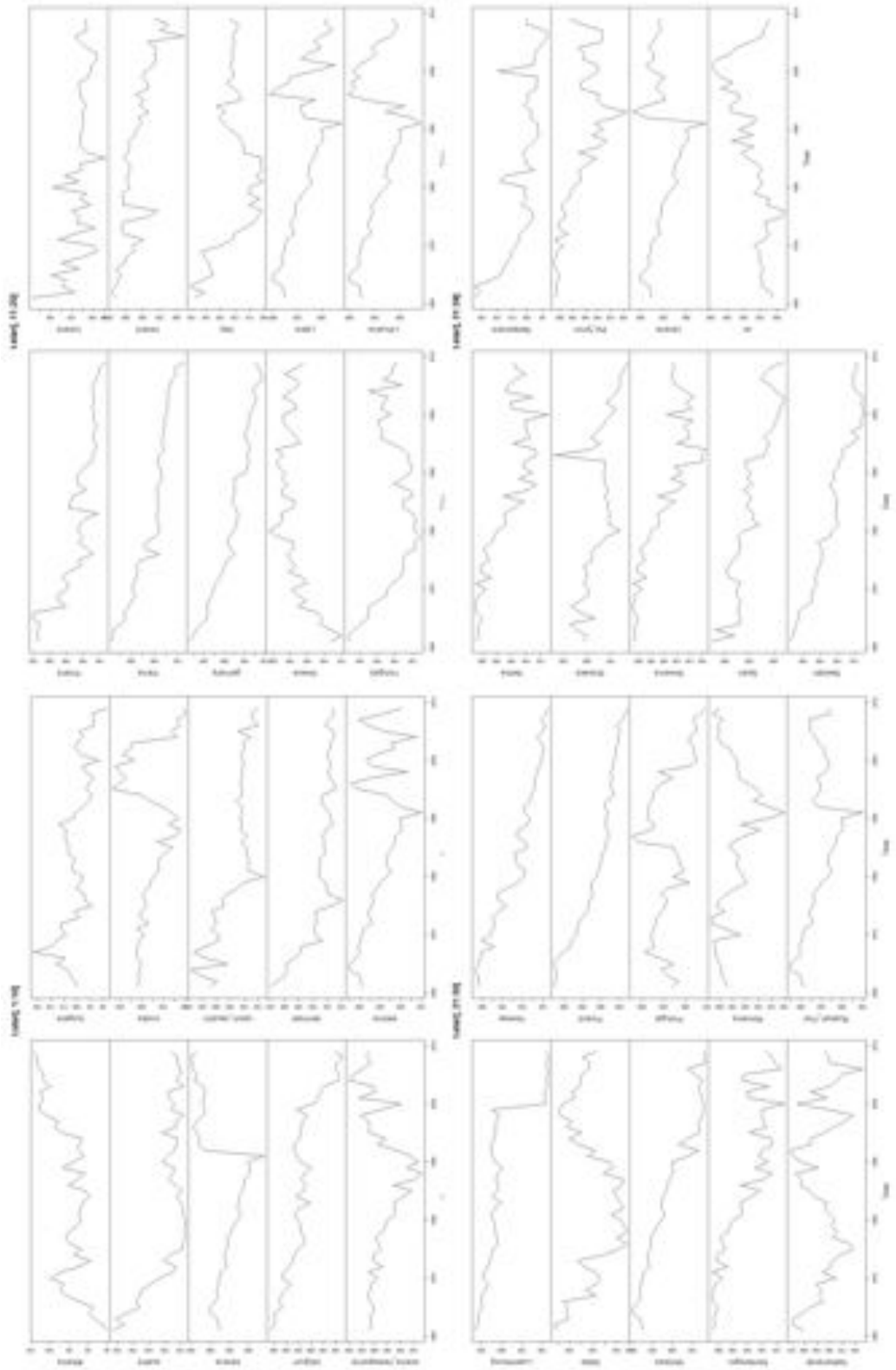

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Figure A.10 (kcal/capita/day) - Stimulants and Spices - Time Series

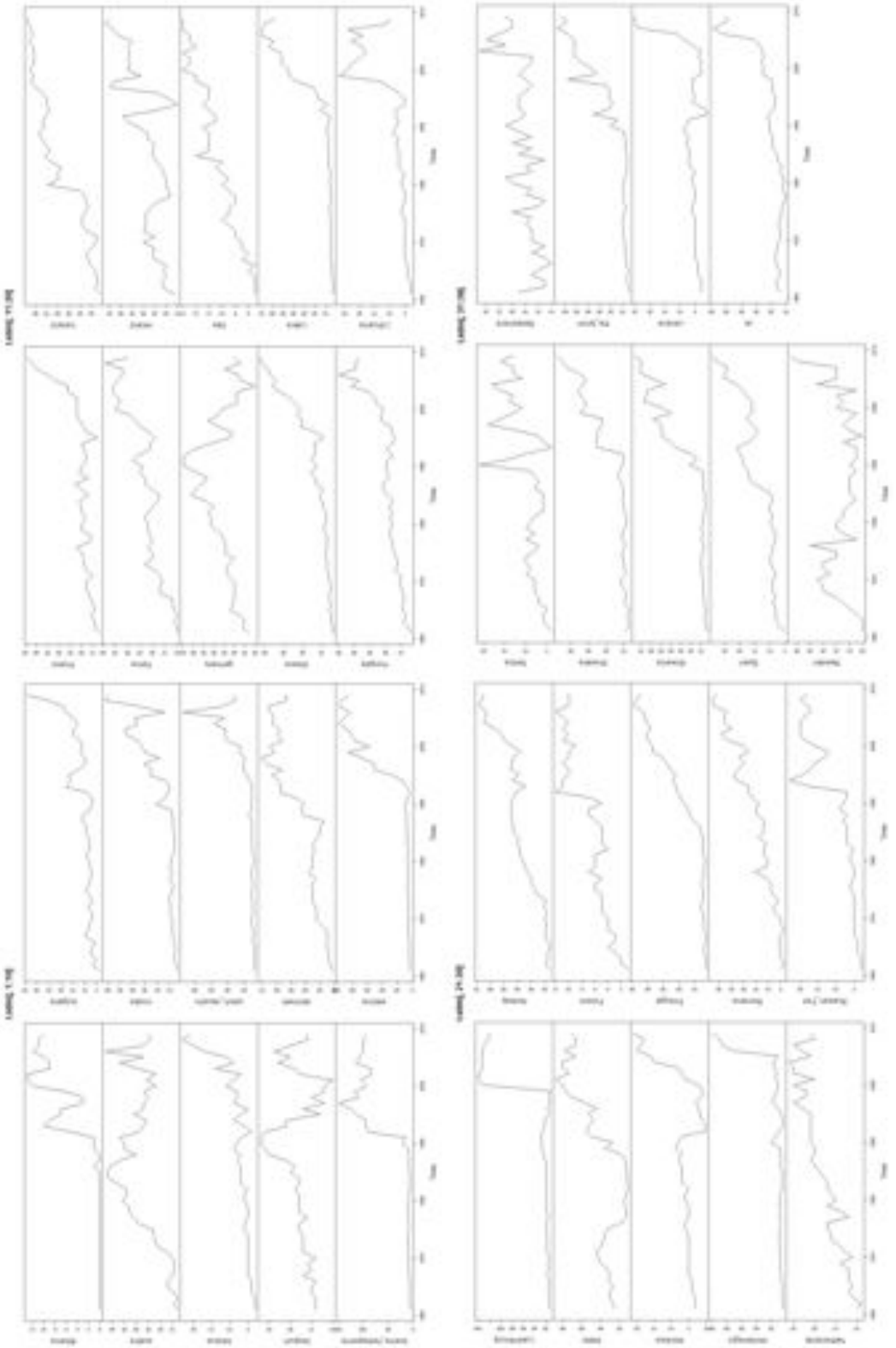

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Figure A.11 (kcal/capita/day) – Sugar - Time Series

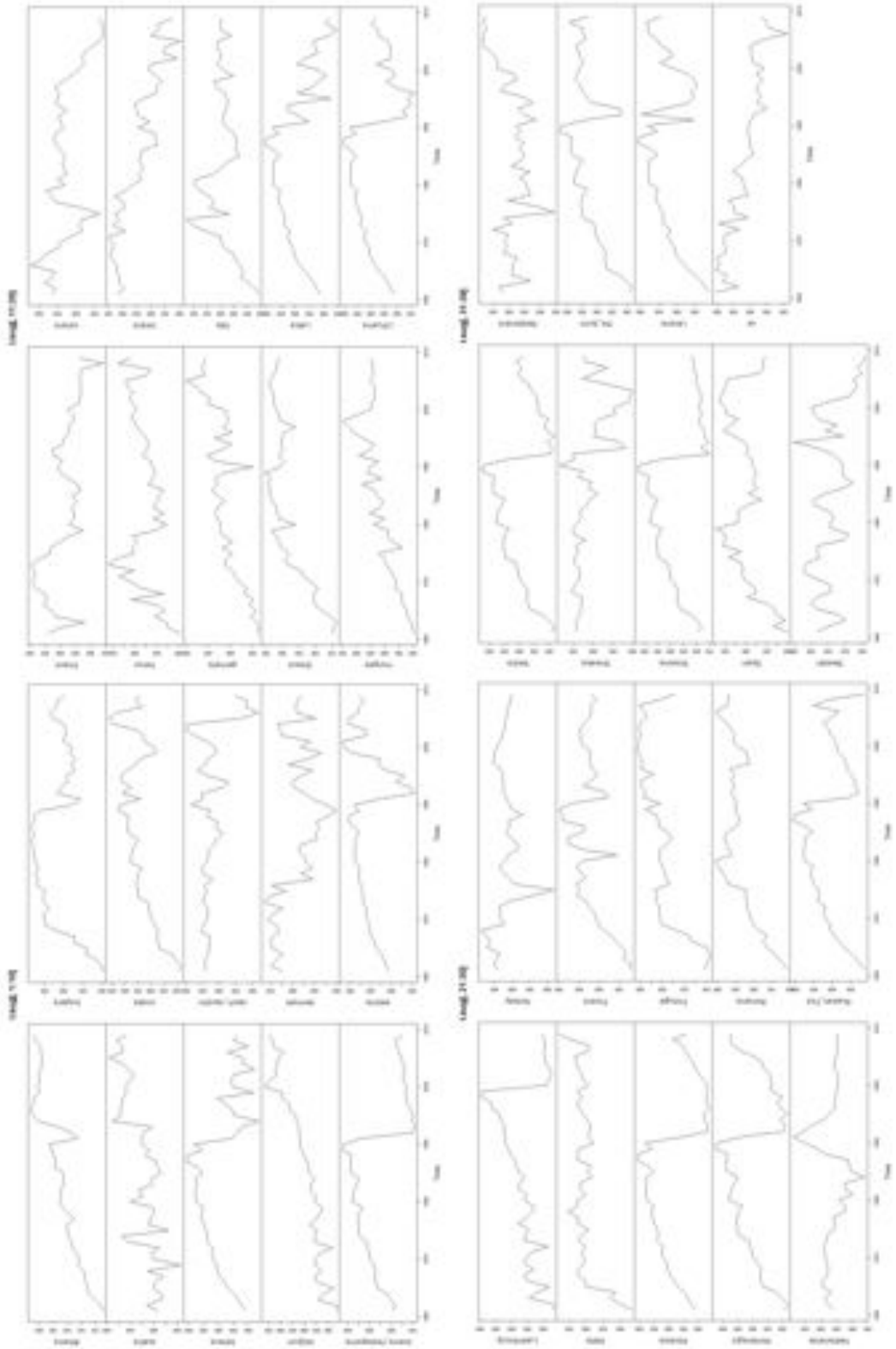

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Figure A.12 – Vegetable (kcal/capita/day) - Time Series

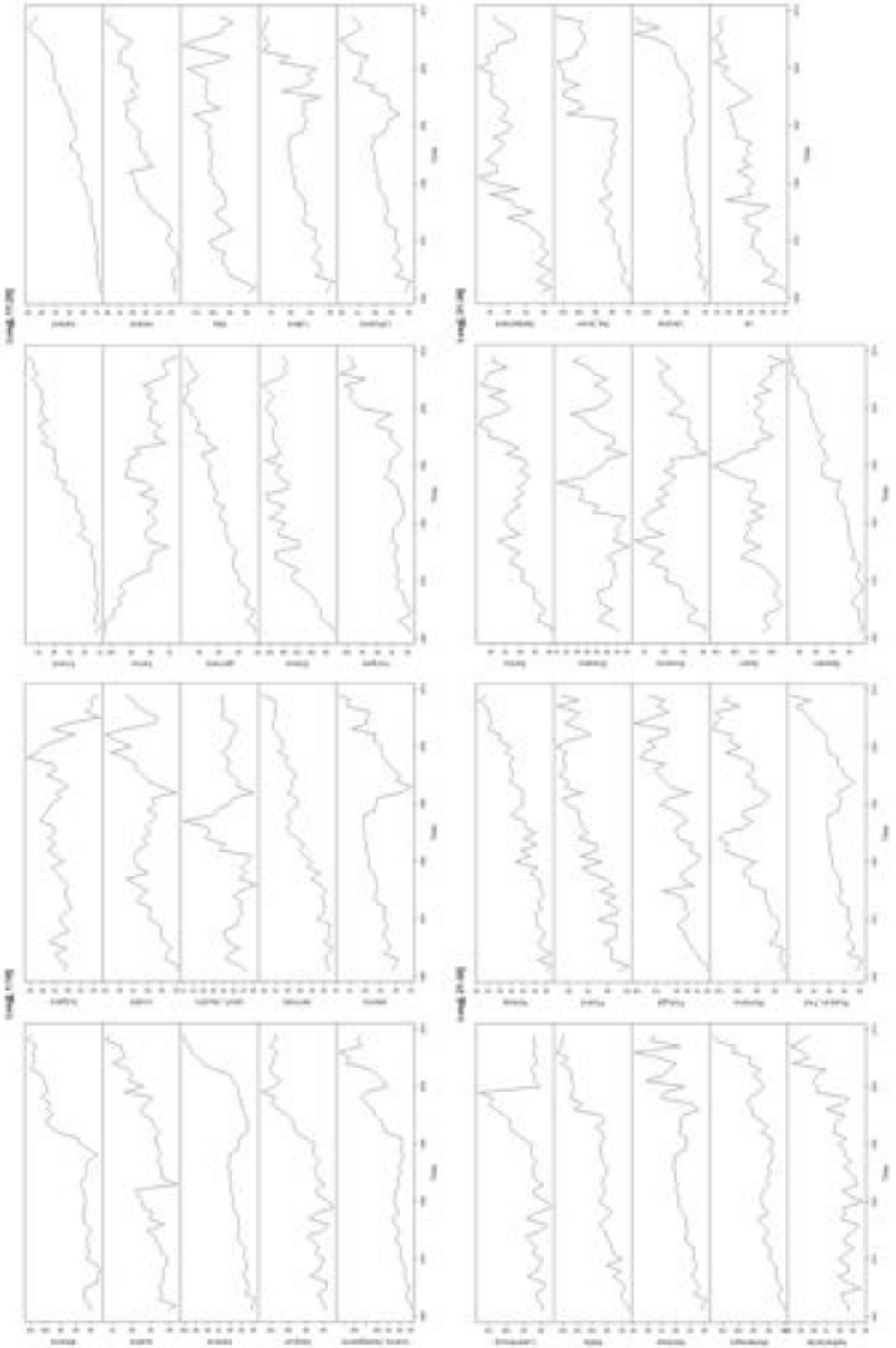

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Figure A.13 Vegetable Oils (kcal/capita/day) - Time Series

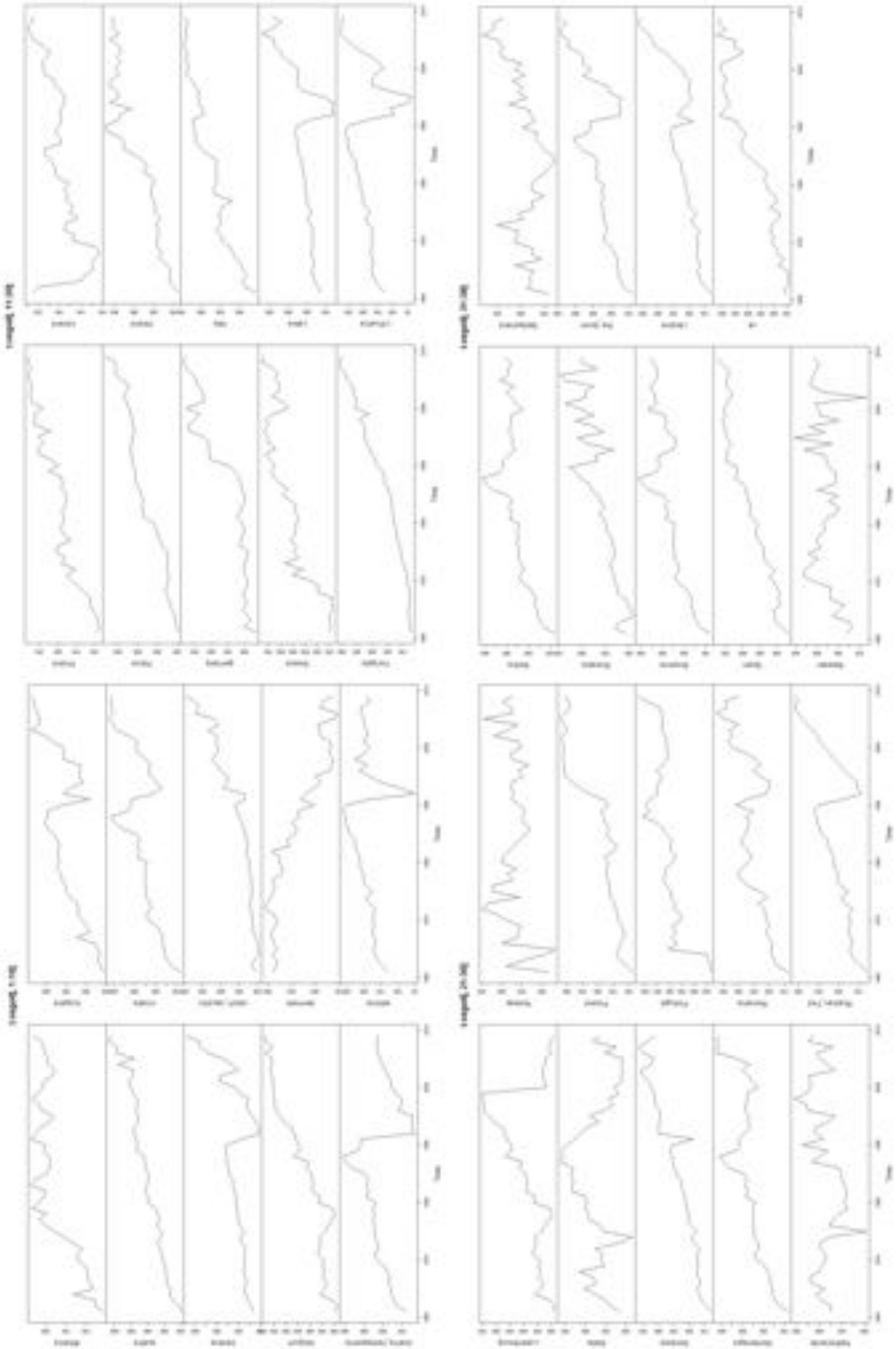

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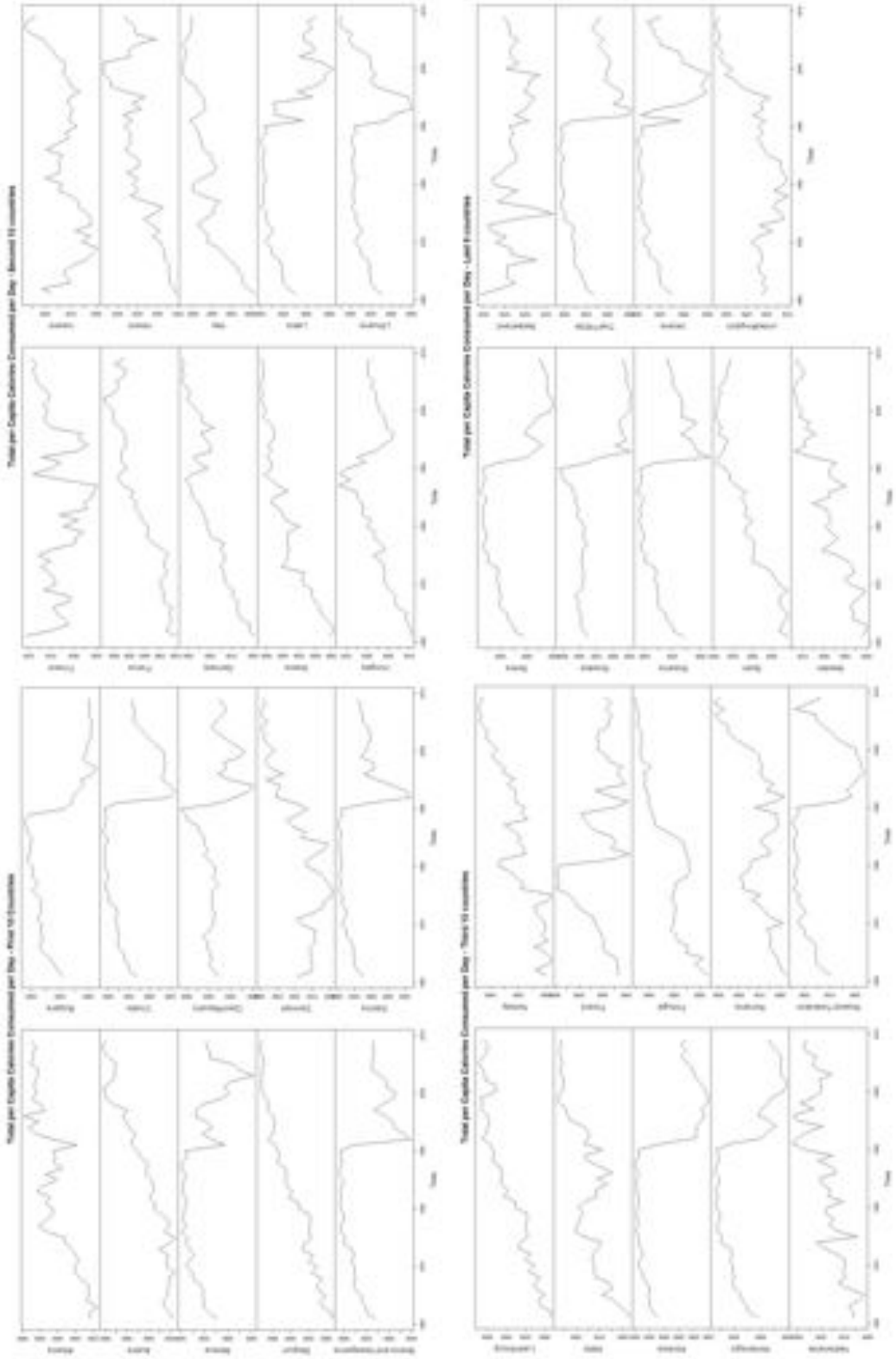
Figure A.14 Total food consumption (kcal/capita/day) - Time Series



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