4F – Future Crops

Cost Analysis & Economic Evaluation

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PART I. METHODOLOGY

Introduction

The main objective of WP3 is to identify the cost of production of 4F crops in EU countries. The analysis will cover not only conventional but also "future" crops. It is of interest to examine the most promising new crops in comparison with competing conventional in each country or region in Europe.

The selected conventional and future crops will be subjected to a comparative cost analysis. For the economic appraisal of crops, monitoring of economic parameters, such as commodity prices, interdependency of crops and the new CAP amendments will also be included. Economic analysis of new and conventional crops will look into the economic and financial details of production of agricultural products from the point of view of the producer. Computerised analytic methods will be used in order to estimate the economic viability and performance of the selected crops.

The economic analysis of crop production requires good knowledge of the cultivation operations, the requirements and productivity of various crops in different climatic conditions, soil types and methods of cultivation. Local labour costs and the degree of mechanisation also play a very important role in overall economics of the plantation under examination, thus making the economic analysis more or less a site specific matter. Therefore, one must undertake different studies of specific conditions for different cases or scenarios by taking into account the existing conditions in the region under consideration.

The use of computerised models for the investigation of economic performance, gives the opportunity to explore and compare a large numbers of cases and draw useful conclusions. It also gives the maintenance of all cases under common analysis format, for uniformity of definition and easy comparison of assumptions and results.

Cost data

In order to extract satisfactory results, the analysis should be based on detailed and reliable technical and economic data. The most important categories of the information needed for the economic analysis of 4F crops are the following:

a. *General economic data*. This category consists of economic data that concern a region or a country. Such data include the currency, short/long-term borrowing rates, tax rate, discount rate, inflation rate, risk premium etc. Such information is generally known (legislation, banks, statistical

reports etc) or can be easily estimated by the experts, for example economists. Such data are recorded taking care of the special conditions of every country under study.

b. *Crops details*. Includes the economic life of each crop (annual or perennial), annual yield per region, selling price of products, demand for agricultural land type (for example irrigated) etc. Such data are collected from experts (agricultural engineers and agricultural economists) and from the literature.

c. *Cultivation activities details*. This category records all the information that is related to the agricultural production of crops. This includes timing and technical details of crops production. Timing refers to the period that each activity is performed, while the technical details concern the means required for each activity, such as machinery, labour, raw materials etc. Those data will be collected from a) experts, b) literature, c) previous research project results, d) AUA databases etc.

d. *Irrigation needs*. Irrigation can be an important cost factor for agricultural production that varies between regions and countries. For example, the production of arable crops in North European countries, with higher precipitation levels, may be performed under low or no irrigation. On the other hand, there are cases where there is low availability of water that leads to high irrigation cost. The data for crops' irrigation should be collected from the same sources as the details of cultivation activities.

e. *Production factors databases*. Contain data for agricultural land, machinery, raw materials and labour.

    - Crops can grow on different land types and climatic regions. The characteristics of each crop determine the appropriate soil and climatic type for its growth. On the other hand, the same crop may grow under different land and climatic conditions, which differentiates the performance of the crop. For example, a crop on marginal land will need more intensive soil preparation activities and higher irrigation, while its yield will be low. There is a variety of land types available for agricultural production, for example irrigated, dry, marginal etc. The cost of land and the land rent varies according to the land type and the region. Data that concern agricultural land type characteristics and cost may be recorded from international and regional statistical databases, regional agronomist and agricultural organizations (agricultural cooperatives, directorates of agriculture etc).
    - Machinery databases record technical and economic data for mechanical equipment needed for agricultural production. These data include purchase cost, economic life, maintenance and insurance cost, fuel type etc. Given the average annual operation, one may estimate the hourly cost of machinery usage. Fuel consumption, depends upon the type of operation that the machinery performs. For example, in "heavy" operations, such as ploughing, a tractor consumes much more fuel than in operations like seeding and

spraying. Such data are collected from manufacturers' and statistical databases and from agricultural engineers and other experts.

- For agricultural input products (seeds, rhizomes, fertilizers, pesticides, water etc) we mainly need their purchase cost. Data for raw materials are collected from manufacturers and importers and also from statistics (FAO, Eurostat, etc.) and the internet. In some cases, the cost of agricultural inputs differs among regions.
- There is a number of available labour types (skilled, unskilled, operator) in agriculture and their corresponding hourly rate varies not only by type, but also from region to region. Such data is available in international and regional statistical databases and studies.

f. Selling prices of crops' products. Income from agricultural production depends on yield of production and the corresponding selling price. Subsidies and other types of revenue related to the production of specific products are also added to the total income. Selling prices differ among countries and these data are also collected from international statistics.

In general, the cost figures that will be used in the analysis of 4F crops, will be derived from:

- Published cost studies of European crops
- Statistics (FAO, Eurostat. National statistics, etc.)
- AUA extensive experience on the subject and existing databases and costing models.
- Information from all collaborators in this project

Statistics

One of the main sources of data for this analysis will be the available statistical databases. Eurostat, and FAO (Food and Agriculture Organisation) statistical data bases cover a great variety of agricultural data and there are an international source of reliable and generally accepted figures. The cost data recorded in the above databases include:

- Agricultural data, such as land use, crops' cultivated area and production quantities and yield of crops production
- Agricultural product prices in various EU markets
- Land rent by region
- Labour cost in each country
- Agricultural inputs prices

The following sections present analytically the above categories of statistical data that are useful for the analysis.

EU 27 Agricultural Land Use – Current Status

This section presents the current status of the EU27 agricultural land use and arable crops production. The data were derived from published statistical databases of the FAO (Food and Agriculture Organization) and cover a period from 2000 to 2007. This analysis shows the basic arable crops for EU agriculture and the respective share and importance of those crops in each country's agricultural sector. The selected years cover the whole period of the previous CAP (Common Agricultural Policy), from 2000 to 2006 and the period where the CAP was reformed (2006-2007). In this way, we may extract basic conclusions for potential changes in arable crops production.

According to FAO 2005 data, total EU 27 agricultural land is about 190 million hectares (see Table 1 in Annex I). Arable land covers 58% of this, while 21% is covered with temporary crops, 6% with permanent crops and 3% is fallow land (set aside area). Germany, The Netherlands, Poland, Romania, Italy, Spain, Portugal, Greece, France and UK are the countries with the greatest agricultural land (about 80% of the total agricultural land of the EU).

The basic cultivated arable crops of EU 27 are Wheat, Barley, Maize, Rapeseed, Sunflower and Sugar beet (see Annex I, Table 2). Figures 1a and 1b (Annex I) show the harvested area and the production quantities of each one of the above crops, as a total for EU 27 countries, during the period 2000-2007. Although Bulgaria and Romania became EU members in 2008, this figure presents data for all countries from 2000, for comparison reasons.

Wheat (25 m. ha)

The total EU 27 wheat harvested area in 2007 was about 25 million hectares (13% of EU 27 agricultural area). This area was higher (about 27 m. ha) during the period 2000-2005, with a small decrease in 2003 (24 m. ha). Nevertheless, the harvested area of wheat in EU 27 is almost steady for the last eight years (see Figure 1a in Annex I).

According to FAO 2007 statistical data, the main wheat producer in EU was France, where, in 2007, 5.3 million hectares of wheat were harvested and the production of wheat seeds exceeded 33 million tonnes (see Figures 2a and 2b in Annex I). Germany is the second EU wheat producer (over 21 million tonnes and about 3 million hectares, for 2007), while UK is the third in Europe (about 13 m. t of wheat production and over 2.1 m. ha in 2007).

Barley (14 m. ha)

The total barley harvested area for EU 27 countries is almost steady for the last 8 years (2000-2007). This area is about 14 m. ha (see Figure 1a in Annex I). This area covers the 7% of total EU 27 agricultural area. The main producer of barley in EU is Spain (see Annex I, figure 3a and 3b), which in 2007 produced 11.5 million tonnes in 3.2 million hectares (FAO data). During the same period, Germany and France produced 11 million tonnes (2 million hectares) and 9.5 million tonnes (1.7 million hectares) respectively.

Maize (8 m. ha)

In 2007, maize is the third most important arable crop in EU agriculture. In particular, in this year, 8 million hectares (3% of EU agricultural area) of maize were harvested. Contrary to wheat and barley production, maize is produced only in 18 of 27 EU countries.

It is important to notice that while EU maize harvested area was slightly increased between 2000 and 2004, from 9.3 million hectares to 10 million hectares, there was a great decrease during the last 3 years (see Figure1 in Annex I). According to FAO data, the total area harvested in 2007, for EU 27 countries, reached 8 million hectares that is 20% decrease compared to 2004 area.

In EU 27, France was the main maize producer for 2007 (13 million tonnes, 1.5 million hectares), followed by Italy and Hungary with production of 10 and 8.5 million hectares respectively (see Annex I, Figures 4a and 4b).

Rapeseed (6.5 m. ha)

Rapeseed is the fourth most important arable crop in EU agriculture, since, in 2007, it was cultivated in the 3% of total EU agricultural area (6.5 m. ha). From 2000 to 2008 there was a significant increase of the rapeseed harvested area (see Figure 1a in Annex I). This increase was mostly took place during period 2005-2007. In 2000 the total rapeseed area in EU 27 was 4 million hectares, while in 2005, the recorded area reached about 5 million hectares. As mentioned, the greatest increase in rapeseed area, took place the last three years (35% increase between 2005 and 2007). A reason for this was the increase of the use of rapeseed as a raw material for Biodiesel production.

Germany and France are the greatest rapeseed producers in EU 27. Germany's rapeseed production in 2007 reached 5.3 million tonnes from 1.6 million hectares (Annex I, Figure 5a and 5b), while France produced 4.5 million tonnes from 1.5 million hectares also. Poland and UK produced also 2 million tonnes rapeseed each, in 2007.

Sunflower (3.5 m. ha)

Sunflower is the fifth most important arable crop in the EU agriculture, based on the harvested area of 2007.In this year, 14 of 27 EU countries produced sunflower. The total harvested area was about 3.5 million hectares (2% of total EU agricultural area), while the EU production reached about 5 million tonnes (see Annex I, Figures 1a and 1b). The above figures are more or less stable during years 2000 to 2007.

The main sunflower producers in EU are Romania, Spain, Bulgaria, France and Hungary (see Annex I, Figures 6a and 6b). The harvested area of the above countries reached more than 3 million hectares in 2007, with a respective production of 4.2 million tonnes. This means that these five countries produce about 85% of the total EU sunflower production.

Sugar beet (2 m. ha)

In 2007, sugar beet harvested area reached 1.8 million hectares with a respective production of 113 million tonnes (see Table 2 in Annex I). During the period 2000-2007, the harvested area of sugar beet has been decreasing. The greatest decrease (16%) occurred between 2005 and 2006 production period (see Annex I, Figure 1a). On the other hand, the production quantity has increased in 2004 and 2006, while in 2007 is the lowest of the last 8 years.

Sugar beet is produced in 23 of 27 EU countries. The main producers in EU are France (32 million tonnes of production and about 400 thousand hectares of harvested area in 2007), Germany (26 million tonnes and 400 thousand hectares) and Poland (11 million tonnes of production and 250 thousand hectares). Other important producers are UK, Italy, Netherlands Belgium and Spain (see Annex I, figures 7a and 7b).

Other arable crops

Other important arable crops for EU agriculture are alfalfa and soybean. Alfalfa is mainly produced in Italy, Romania, France, Spain and Hungary. The total EU cultivated area in 2007 reached about 2 million hectares.

Soybean production is much lower. In particular, in 2007 the total harvested area was about 70 thousand hectares and the production reached 135 thousand tonnes. On the other hand, for Italy and Romania, the cultivation of soybean is very important, since the harvested area for each country in 2007 was 130 and 110 thousand hectares respectively.

Conclusions

According to the above analysis, the most important arable crops for EU 27 are wheat, barley, maize, rapeseed and sunflower. Additionally, alfalfa and soybean play an important role in EU agriculture. These crops are the main conventional crops that should be regard as competitors of energy crops for solid and liquid biofuels production. Additionally, set aside area that represents 3% of the total EU agricultural area, should be considered as a potential land for energy crops production. Additionally, among the 27 countries of EU, Germany, The Netherlands, Poland, Romania, Italy, Spain, Portugal, Greece, France and UK are the ones that cover greatest part of the total EU agricultural land.

Crop Yields

Yield is important in cost analysis of agricultural production. Countries with higher productivity, may potentially achieve lower cost of production per tonne of product. This part examines the yields of the main conventional crops that will be analysed. The main source of the data is FAO databases that record average yield per country.

Note that yields for future crops (not regularly cultivated), such as energy and fiber crops, are not available in statistical databases such as FAO and Eurostat, or in the regional statistical services. This is because those crops are not produced commercially at a large scale. For this reason, data for the productivity of new crops is only available from published studies, research projects etc. In some cases, the productivity of conventional crops is an indication of the potential productivity of new crops with similar characteristics. Countries with high yields of conventional crops, due to advantageous soil and climatic conditions, will potentially achieve high yields in "future" crops production.

Table 3 of Annex II presents the yields of the main arable crops in EU27, during 2007. Based on this, the table below summarises the results from the statistical analysis of the yields.

Table A: Average yields in EU 27 (t/ha), year 2007

	Wheat	Barley	Maize	Rapeseed	Sunflower seed	Sugar beet
Average	**4.55**	**3.87**	**6.98**	**2.51**	**1.80**	**52.15**
Min	**1.13**	**1.10**	**1.46**	**1.00**	**0.63**	**12.68**
Max	**8.11**	**7.53**	**10.33**	**3.57**	**2.58**	**82.29**
Standard Deviation	**1.93**	**1.61**	**2.65**	**0.76**	**0.59**	**15.95**

Source: FAO

Figures 8a to 8f (Annex II) present the yield of each crop in different countries, ranked by yield size. Among EU 27, Ireland, Belgium, UK, Germany, Netherlands, Denmark and France are the countries that present the higher yields in small cereals (wheat and barley) production, while Romania and Cyprus have the lowest. With regard to maize seed production, Belgium and Spain have the highest yield,s while Romania and Bulgaria have the lowest.

Rapeseed production has high productivity (higher than 3 t/ha) in Belgium, Netherlands, Germany, Luxemburg Ireland and Denmark. France and Germany have highest yields for sunflower production. For both crops, Romania has the lowest yield among EU countries.

Finally, sugar beets have high productivity in France (about 80 t/ha) and Portugal (about 75 t/ha), while in Bulgaria the productivity is very low (lower than 15 t/ha).

It is important for this project to examine the reasons of this variation of yields. For example, there are countries, like Romania and Bulgaria that record low figures systematically. Additionally, it is very important to determine how this variation of conventional crops yields is reflected on “future” crops production.

Agricultural Product Prices

The prices of agricultural products are necessary in order to estimate agricultural income and profits from crop production and to identify income and expenses of agricultural enterprises or production sectors. In this part, the products form 4F crops may be categorised into two main categories:

a) Products with existing market prices. These products might be conventional products such as wheat and maize seed for food and feed, or new products, for example energy crops with known market prices, such as straw for heating or rapeseed for biodiesel production.

b) Products of future crops with unknown market prices. This category covers the crops that are not produced or traded on a commercial level and for this reason their prices are not quite established in the market. In this case, the price of "future" crops should be imputed from prices of substitutes, by taking into account the specific characteristic of each product.

In Annex III, Tables 4 and 5 present the prices of the main arable crops in EU countries for 2006 and 2007. The EU average prices of the main arable crops, for 2006 and 2007, are summarised in the table below.

It is known that there was a great change in agricultural products market prices between 2006 and 2007. Those changes where more obvious in cereals. Table B shows that cereals prices had a huge increase. In most of the cases, the increase exceeded 50% from 2006 to 2007. The price change was higher for maize and soft wheat. As regard sunflower, there was also a great increase of 40%, while the rapeseed price was increased 21%. Among the main arable crops, the only product with decreased price was sugar beet.

Table B: EU 27 average prices (€/t) and change between 2006 and 2007

	2006	2007	%
Maize	121	197	63%
Soft wheat	113	182	61%
Barley	108	168	56%
Durum wheat	128	200	56%
Rye	105	163	56%
Triticale	100	150	50%
Oats	118	167	42%
Sunflower	257	361	41%
Sorghum	112	157	40%
Soya	198	249	26%
Rape	225	271	21%
Rice	195	235	20%
Sugar beet	34	31	-9%

Source: Eurostat

Cost of Land

Land is an essential factor of agricultural production and in most cases a major cost item. The cost of agricultural products may be significantly increased if planted on high cost land and vice versa. Therefore, land cost must be carefully estimated in all agricultural projects. The cost of land might be considered as one of the major cost factors of agricultural production. In some cases, the cost of land exceeds 30% of the total cost.

The cost of land varies due to a large number of factors, the most important of which are the type of land (fertile, semi-fertile, meadow, mountainous, irrigated or non-irrigated, etc.) and the region or country, where market conditions are determined. If there is a fairly competitive market for land, one may assume that land rent adequately reflects its real cost. However, if there is no market, the cost of land is not easily identifiable. In such cases one needs to estimate its opportunity cost as expressed by the net economic output of current or alternative land use.

The cost of land varies significantly between EU countries. Table 6 in Annex III, presents the land prices and the land rents of various land types of EU countries, where available. In Netherlands, Denmark and Luxemburg land prices are the highest in Europe, while Malta, Denmark, Greece and The Netherlands have the highest land rent of agricultural land.

Cost of Labour

Labour, especially in small farms, such as the ones in southern regions, is usually provided by the farmer and his family, but it may also be hired, especially during peak labour demand, e.g. at planting or harvesting times. Hired labour in most cases has a market specified rate, which can be used in the analysis. Imputed labour cost should be principally evaluated at market or opportunity cost, i.e. the amount of income forgone for shifting family labour from current activity due to the needs and requirements of the project. When there is no market for a commodity or service, the opportunity cost of the relevant factor of production should be used to estimate the cost of inputs. Opportunity costs should in general reflect market values.

Labour cost in agricultural production depends on:

a) The ***cultivation characteristics*** of crop production. For example, arable crops demand less person hours than vegetable production. Another example is perennial energy crops, where their production is mostly performed by mechanical means.
b) The ***type of labour*** needs. The rates of skilled labour, where necessary, are much higher than unskilled labour rates.
c) The ***country*** and the ***region***. In most of the cases, the labour rates differ significantly not only between countries but also between different regions of a country.

Unfortunately, Eurostat databases do not include statistical data about labour rates in agriculture. For this reason, data of regional statistical services are necessary. Tables 7 and 8 in Annex III, based on Eurostat figures, present the general hourly labour cost and the hourly labour cost in services sector, across EU countries. The countries with the highest labour costs are Luxemburg, Denmark, Sweden, Germany, France and Belgium, while the ones with the lowest are Romania and Bulgaria.

Agricultural Input Prices

This section examines the prices and cost of raw materials and other agricultural inputs, such as energy, fertilisers, pesticides, water etc. Input prices differ between EU countries. Tables 9-14 in Annex III, present the prices of agricultural inputs, as they appear in Eurostat databases. The prices of some of these products have significant differences between countries (see for example electricity, heating gas and diesel oil). Among fertilizers, Sulphate of ammonia, Ammonium nitrate (26% N) and Superphosphate (18% P205) are also priced differently in different countries.

The following table present the average prices of selected basic products used in agricultural production.

Table C: Average Prices (EU27) of basic agricultural inputs

		Average Prises 2007	Average Prices 2006	% Change
Electicity	**€/MWh**	317	251	26%
Diesel oil	**€/m3**	485	473	2%
Sulphate of ammonia	**€/ton of nutritive substance**	512	511	0%
Ammonium nitrate (26% N) (in sacks)		660	593	11%
Ammonium nitrate (33% N) (in sacks)		548	465	18%
Urea		564	479	18%
Superphosphate (18% P205)		675	527	28%
Triple Superphosphate (46% P205)	**€/ton merchandise**	520	402	29%
Ternary fertilizers 20 - 10 - 10		323	289	12%
Ternary fertilizers 9 - 9 - 18		253	243	4%
Ternary fertilizers 10 - 20 - 20		275	320	-14%

Source: Eurostat

Selected Regions and Crops

This part presents a first attempt to specify the most important regions and the most important 4F crops for economic analysis. The selection was based on:

1. The proposals of our project partners and especially UNI.CT and EC BREC (Bologna Meeting, September '08).
2. The economic significance of conventional and future crops.
3. The fact that among the EU countries, Germany, The Netherlands, Poland, Romania, Italy, Spain, Portugal, Greece, France and UK cover the greatest part of the total EU agricultural land. In addition, these countries also cover a wide range of the selected climatic regions.
4. The suitability of selected crops in the climatic and soil conditions in the selected countries.

The following table summarises the basic climatic regions and the selected countries.

Table D: Combination of countries and climatic regions

	Continental	Pannonian	Atlantic Central	Atlantic North	Lusitanian	Med. North	Med. South
UK			x	X			
France			x		x	x	x
Netherlands			x	X			
Germany	x		x	X			
Portugal					x	x	x
Spain					x	x	x
Italy						x	x
Greece						x	x
Poland	x						
Romania	x	x					

The following table (Table E) shows the basic cultivated arable crops of EU-27 and their contribution in each country's agriculture. These crops are Wheat, Barley, Maize, Rapeseed and Sunflower. Additionally, less widespread crops, such as Soybean, Sugar beet and Alfalfa, are significant for some of the countries.

Table E: Table of regions and crops

	Soil and Climatic Regions	Agricultural Land	Current Crops	% Agr. Land	Suggested Future Crops	
Germany	• Continental • Atlantic Central • Atlantic North	17 million ha **9%** of EU27 Total Agricultural Land	• Wheat • Barley • Rapeseed • Maize • Sugar beet	18% 11% 9% 2% 2%	• Sweet sorghum • Fiber sorghum • Arundo • Switchgrass	• Flax (Linseed) • Willow
Netherlands	• Atlantic Central • Atlantic North	1.9 million ha **1%** of EU27 Total Agricultural Land	• Wheat • Sugar beet • Barley • Maize	7% 4% 2% 1%	• Sweet sorghum • Fiber sorghum • Arundo • Switchgrass	• Flax (Linseed) • Willow
Poland	• Continental	15,9 million ha **8%** of EU27 Total Agricultural Land	• Wheat • Barley • Rapeseed • Maize • Sugar beet	13% 8% 5% 2% 2%	• Sweet sorghum • Fiber sorghum • Arundo • Switchgrass	• Flax (Linseed) • Hemp
Romania	• Continental • Panonian	14,5 million ha **8%** of EU27 Total Agricultural Land	• Maize • Wheat • Sunflower • Barley • Alfalfa • Rapeseed	15% 13% 6% 3% 2% 2%	• Sweet sorghum • Fiber sorghum • Arundo • Switchgrass	• Flax (Linseed) • Hemp
Italy	• Med. North • Med. South	14,7 million ha **8%** of EU27 Total Agricultural Land	• Wheat • Maize • Alfalfa • Barley	14% 7% 5% 2%	• Rapeseed • Sweet sorghum • Arundo • Miscanthus	• Switchgrass • Flax (Linseed) • Poplar
Spain	• Lusitanian • Med. North • Med. South	29 million ha **15%** of EU27 Total Agricultural Land	• Barley • Wheat • Sunflower	11% 6% 2%	• Rapeseed • Cardoon	• Flax (Linseed) • Hemp • Poplar
Portugal	• Lusitanian • Med. North • Med. South	3,7 million ha **2%** of EU27 Total Agricultural Land	• Maize • Wheat • Barley	3% 2% 1%	• Sunflower • Rapeseed • Sweet sorghum	• Cardoon • Poplar
Greece	• Med. North • Med. South	8,4 million ha **4%** of EU27 Total Agricultural Land	• Wheat • Barley • Maize	8% 1% 2%	• Sunflower • Rapeseed • Sweet sorghum • Arundo	• Cardoon • Miscanthus • Switchgrass • Poplar
France	• Atlantic Central • Lusitanian • Med. North • Med. South	29,6 million ha **15%** of EU27 Total Agricultural Land	• Wheat • Barley • Maize • Rapeseed • Sunflower	18% 6% 5% 5% 2%	• Sweet sorghum • Miscanthus • Switchgrass	• Flax (Linseed) • Hemp • Poplar
UK	• Atlantic Central • Atlantic North	16,6 million ha **9%** of EU27 Total Agricultural Land	• Wheat • Barley • Rapeseed	11% 5% 4%	• Sweet sorghum • Fiber sorghum • Arundo • Switchgrass	• Flax (Linseed) • Willow

PART II. CROPS ECONOMIC EVALUATION

The economic analysis of crops is tracing all costs incurred in the production and harvesting of the plants. Soil preparation, seeding or planting, fertilisation or harvesting and other operations are broken down into single activities, each with specific needs, duration and cost. After crop establishment there are one or more periods (normally years) of the plant's life, during which a number of cultivation *operations* are required for growing and maintaining the plant in good condition. The harvesting operation takes place in the first or subsequent years of the plant's life. Sometimes harvesting may occur a few years after the installation of the plantation (especially in the case of trees), or even year after year, etc. Yields consequently vary due to the reasons just described. They may also differ from year to year due to maturity and other plant characteristics. Yield variation due to weather conditions is not easily predicted, therefore in most cases, meaningful averages are widely used.

Cost breakdown is useful not only because it measures and reveals major or important cost elements, but because it indicates possible improvement or cost saving opportunities. For managerial analysis, the definition of cost is broader than the cost reported for tax purposes. In accounting, the concept of actual historical cost is central, but it ignores several important components of economic costs. These items are costs associated with the use of financial capital (including equity), long-lived factors such as equipment and buildings owned and used by the business, paid labour and the contribution of unpaid time and effort provided by the farm operator and family members. Estimates of such implicit costs are obtained using the economic concept of "opportunity costs". (AEEA, 2000).

The Methodology is general enough to evaluate conventional plants or plantations as well as future crops with sufficient description. This allows the analyst to evaluate conventional crops which compete directly with the future crops for the same land, and draw useful conclusions. The analysis consists of all the steps necessary for decision making and capital budgeting, i.e. cost analysis, and investment appraisal. For this purpose it estimates and analyses the full cost of crop production and calculates the most important financial indices, consistent with current financial standards.

1. Cost Analysis of Agricultural Projects

Agricultural production differs from industrial activity mainly because of the significance of land as a production factor and the fact that a number of production inputs, such as labour and land, are not "paid and bought", but usually belong to the typical producer, the farmer. Furthermore, *farm* and *family income* or *return to own land* is usually reported in agricultural accounts which indicate the significance of the farmer family and land in the production process. Here, we attempt a more business- like approach and a compromise between agricultural accounts and usual financial reporting in order to be consistent with financial accounting common practice.

Cost analysis is required for the correct valuation of production processes of agricultural products. It is traditionally exercised for the identification of cost of goods sold and inventory valuation. However, the prime target of cost analysis here will be the estimation of costs for decision making and price setting. For this reason costs of production are examined along the lines of two major costing bases: (a) Cost by activity or operation (*Activity Based Costing*, ABC[1]) and (b) cost by input or factor of production. The first identifies production as a total of the necessary activities for the completion of the task and values each one of them. The second accumulates the cost of all factors or inputs required for the production.

Activity Based Costing, identifies all major production and non-production activities of the economic unit, traces their costs and assigns them to the product or products that use the resources of the consuming activities. *Activity Based Costing* helps to assign to final products a larger amount of total costs, because it identifies and classifies a large part of agricultural production overheads into production related activities. ABC is equally useful in the case of multi product farming using varying significant amounts of different production activities because it results in more accurate estimation of product costs.

1.1 Direct and Indirect Costs

Direct costs are costs that may easily be traced to a product, such as for example raw materials or man-hours consumed for its production. However, some costs are not so easily traced to the product(s). These are called *indirect costs* and are allocated with difficulty to the products produced.

[1] See for example Meigs R.F., Meigs W.B., 2002.

Indirect costs include cost of utilities, depreciation, taxes, etc. All costs, if possible, should be allocated, even at the expense of some minor allocation errors. When this is very difficult, it makes sense not to allocate some indirect costs, especially when their magnitude is small, in order to preserve credibility to the outcome of the analysis. The rules of allocation should always be objectively based on available non-negotiable data regarding the nature of the cost item and its utilisation in the production process.

1.2 Paid Expenses and Imputed Costs

It is customary to record *Paid Expenses* separately, (a) because it is easier to identify them, especially in agriculture, where the economic units are usually small and their accounting records are not ideal, (b) because they affect directly the unit's cash flow and (c) because there is no much doubt about their value, unlike *Imputed Costs,* which should usually be estimated in the light of their *opportunity cost*.

Paid expenses are in general real amounts spent for the purchase of raw materials, maintenance of capital investments or the payment for the use of resources required for agricultural production, e.g. rented land, hired labour, etc.

Imputed costs include the cost of deterioration (or *depreciation*) of the productive capacity of factors such as own machinery and buildings, the opportunity cost of own labour, land as well as the imputed interest on all invested capital.

1.3 Fixed and Variable Costs

The distinction between fixed and variable costs is important for decision making, because it signifies how volume and price changes affect profits. A product may be worth producing if its selling price covers at least its variable cost and generates some, even smaller than profit making, contribution towards the recovery of fixed costs. *Fixed costs* are costs not changing, at least in the short run, within a range of production activity. *Variable costs* are proportional to volume of output. It is understood that all costs are variable in the long run. Examples of fixed costs are land rent, the remuneration of permanent personnel, interest, insurance, depreciation of fixed assets, property taxes, etc. *Variable costs* include seasonal labour, raw materials used, irrigation water, hired machinery and equipment, etc. The distinction between fixed and variable costs is also used for the estimation of production break-even points.

1.4 Product Costs and Period Costs

Product costs are costs assigned directly to the product. They include direct labour, machinery & equipment, materials and production overheads and are the constituents of *Cost of Goods Produced*. All other costs are regarded as operational expenses consumed over each accounting period and are not assigned directly to the products.

1.5 Full Product Cost

The *Full Product Cost* includes not only the costs of direct labour and materials, but also the cost of all production and other activities required for the product, as well as the interest for the capital required. For example, the cost of agricultural production includes not only the cost of direct labour, fuel, seeds, water, other production materials, etc, but also the cost of land, depreciation, insurance, interest on own and borrowed capital, cost of marketing and administration, etc.

Cost analysis estimates the full product cost and reports it in two main formats (a) by operation or activity and (b) by input factor or factor of production. Energy is reported separately because of its importance in environmental analysis.

2. Project Economic Evaluation Methodology

The purpose of the proposed methodology is to encourage agricultural economists to adopt some aspects of financial and economic analysis as customarily used in industry and commerce. This will not only improve its effectiveness, but will also facilitate investment decisions, usually based on well established investment appraisal methodologies.

The most important objective of financial analysis is to *assess the financial impact* of projects on the farmers and enterprises involved, as well as any others who may be affected by the project. This is achieved by analysing all costs and benefits due to the project and by projecting them into the foreseeable future, in order to anticipate the net financial effect on all actors involved. In most cases financial analyses are based on some form of computerised mathematical model for profit and cost calculations and investment appraisal (*Gittinger* 2000).

A second equally important objective of financial analysis is the preparation of *financial plans* or *scenarios*. These financial or business plans are somehow indirectly obtained while in the process of assessing the impact of the project or, to put it another way, they are the means through which project financial assessment is usually made.

Financial analysis is also concerned with the measurement of performance against set targets on every aspect of the project. It identifies the *efficiency of use of resources* and provides the tools of improving overall performance. It also measures the effectiveness of management in mobilising the factors of production for the achievement of financial goals and supports the search for improved approaches.

Financial analysis requires three easily identifiable steps. The first is *Farm Income Analysis*, based on Income and Expense as well as property data. This is based on Farm Budgets projecting income and expenses for the following years. The second step consists of gross estimates of future Balance Sheet items based on Farm Income forecasts and on assumptions regarding the timing of receipts and payments. This step approximates project related future *Cash Flows*. The third step is *Farm Investment Analysis.* It utilises Cash Flows to estimate the attractiveness of the project, by comparing future net inflows against initial investment requirements.

In practice, most Farm Accounts do not identify the full cost of agricultural production, probably due to lack of consensus and data on imputed costs, such as family labour, own land, etc. For financial analysis, these items should be estimated at their opportunity cost and be included in cost analysis, in order to identify net income attributed to the project.

The proposed methodology demands the decomposition of the project into a number of *operations* (or *activities*), which sufficiently describe all required jobs for plant establishment, cultivation and harvesting activities. Each *operation* is characterised by its duration and frequency. It is also associated with its requirements for *labour, equipment, materials* and *capital*. Fuel consumption depends upon the operation and machinery used and can easily be estimated.

Mechanical equipment may be hired if own machinery is insufficient or non existent. When hired, its cost is equal to the rent paid (provided that there is a reasonably large rental market to justify a competitive market rent; otherwise its cost is the sum of economic depreciation, maintenance, insurance, labour and fuel.

Land is an essential factor of agricultural production and in most cases a major cost item. The cost of agricultural products may be significantly increased if planted on high cost land and vice versa. Therefore, land cost must be carefully estimated in all agricultural projects. If there is a fairly competitive market for land, one may assume that its rent adequately reflects its real cost. However, if there is no market, the cost of land is not easily identifiable. In such cases one needs to estimate its opportunity cost as expressed by the net economic output of current land use. For project evaluation purposes involving alternative use of the same land, the cost of land can be excluded, since it is a common cost item in both the "with" and "without" the project situations.

Labour in small farms is usually provided by the farmer and his family, but it may also be hired, especially during periods of peak labour demand, e.g. planting or harvesting times. Hired labour, in most cases, has a market specified rate, which can be used in the analysis. Imputed labour cost should be principally evaluated at its opportunity cost, i.e. the amount of income forgone for shifting family labour from current activity due to the needs and requirements of the project. However, own labour imputed cost is in most cases set equal to the market rate, since this adequately reflects the opportunity cost of labour if the market is sufficiently competitive.

Subsidies are sometimes granted in order to support current agricultural policies. These are temporary cash injections, influencing production decisions, but external to the financial mechanism and the identity of production. It is important to isolate the effect of subsidies by entering these amounts at the bottom of Profit & Loss accounts, although common practice requires subsidies to be added to income from sales in order to calculate "total income". However, this is scrutinising the real economic characteristics of production and impairs many important financial indices. It may be argued though, that subsidisation is a decisive factor in agricultural decision making (this is after all the purpose of subsidising activities that wouldn't otherwise be undertaken) and that this financial support is part of the projects' financing. Nevertheless, we still believe that the existence of temporal

subsidies should not hide the market or true value of the project, which is revealed if one considers the subsidies at the end.

Project evaluation or *Investment Appraisal* is based on project related Cash Flows. By applying Discounted Cash Flow (DCF) methods, it compares the present value of the net benefit from future inflows and outflows against the cost of the initial investment required. There is a large number of investment criteria and huge amount of bibliography on the subject. For practical reasons at least three indices must be estimated, namely, Net Present Value, Internal Rate of Return and Payback Period. The choice of appropriate discount rate is a complex task, but very important for the appraisal. Good financial accounting textbooks explain the job in detail (e.g. Dickerson et al). *Systematic Risk* is usually handled by some kind of agricultural insurance, but it is more difficult to defend against *Unsystematic Risk*, especially in the agricultural production sector, which is in general less informed than Industry and Commerce. Discount rates may be increased appropriately in order to express anticipated risk levels.

2.1 Cost Analysis

The methodology can equally handle conventional and future crops with individual characteristics. Each crop is cultivated on identified own or hired land and has its individual *operations* or *activities* as described in the crop's associated data. It may also use resources common to other crops in the same farm, such as buildings & constructions, utilities, administration, etc., the cost of which is allocated according to user selected rules.

Labour and Machinery & Equipment are used according to the operations' requirements.

2.2 Operations & Overheads

Agricultural production for each crop is decomposed into a number of necessary *operations* or activities. Each operation needs all or some of factors such as labour, raw materials, water, machinery & equipment, etc.

Operation requirements are satisfied by farm labour and equipment and by purchased raw materials. If labour or equipment is not available or uneconomic to be offered by the farm, they may be hired or rented.

Administration overheads (Management), Buildings, Utilities and *Other Costs* are identified as general expenses (overheads) required for agricultural production. The allocation of overheads to the various crops is a difficult task, equivalent to allocating overheads to company divisions and/or products. However, in agricultural projects, overheads are in most cases rather insignificant, and a less precise

or no allocation may be more satisfactory than having to go through complex allocation rules for each crop and each overhead category.

2.3 Useful Economic Life

The Useful *Economic Life* of various assets such as Machinery & Equipment, Buildings, Crops, etc, is the number of years before they should be substituted, in order to maintain economic efficiency.

For example, a tractor with a useful economic life of 15 years should be replaced 15 years after purchase, although it may still be physically functioning. The replacement makes economic sense when the old asset is too expensive to maintain and service or its efficiency has dropped significantly or the new machine is much more efficient or technologically advanced and therefore the expected benefits of the replacement outrange the expense of extra investment in the new asset.

2.4 Interest & Discount Rates

Interest rates measure the cost of capital (or the cost of time). In the absence of risk and inflation, the time value of money is expressed by *r*, which is termed *real interest rate.* This rate is alternatively called the *time value of money* and shows the opportunity, or best alternative use of the monetary capital. For example, the real interest rate of investing an amount for the purchase of a productive machine is the amount foregone by not using this amount in its best alternative opportunity.

If *f* is the inflation rate, then the interest rate which incorporates inflation is termed *nominal interest rate*[2] *(i)*, and is calculated by means of the *Fisher* equation:

$$(1+ i) = (1+ r) \times (1+ f)$$

The real rate of interest is used when comparing real magnitudes, while nominal interest rates are used when using current values, i.e. values including inflation.

Discount rate (*d*), is the interest rate used to discount and compound magnitudes that appear in different months or years. The choice of the appropriate discount rate depends on the nature of the cash flows being considered (i.e. if the amounts are real, then one should use real discount rates and vice versa). If values are real, i.e. deflated, then *r* can be used as the discount rate, since it correctly represents the cost of money in the absence or *risk*.

[2] Nominal interest rates should not be confused with J_m which is the nominal interest rate of frequency *m*, i.e. the 1/*m* of the year interest rate multiplied by *m*.

When evaluating agricultural projects, the choice of interest and discount rate is equivalent to the rigorousness with which we evaluate investment proposals. If the interest rate is high, a project has to be very profitable to be positively evaluated. This feature is used in order to introduce the existing or anticipated *risk* or future uncertainty of the outcomes of various agricultural projects. Risk is introduced by means of increasing the *risk-free* interest rate by a *risk premium*. There are many methods for measuring the risk and approximating a proper risk premium in the literature, (see for example Bierman and Smidt, 1993).

2.5 Land

Land is essential for agricultural projects. It is distinguished into various *land types*, e.g. irrigated, non-irrigated, marginal, etc. This is important because different types of land have different rent or opportunity cost and relative operations may also differ.

All projects involve some use of land. Even when land has no financial cost, (i.e. when no rent is being paid), its economic value should be estimated and included in the calculation of economic viability. The demanded price for land does not always give an accurate reflection of the economic value of land because supply cannot be expanded and land can be held for speculative, as well as productive, purposes or to meet immediate needs. The value of land is best determined through its *opportunity cost*, what it would have been used to produce without the project. In a relatively competitive land rental market, land rent is generally a good estimate of the opportunity cost.

Cash costs are incurred when factors of production are purchased or rented. Non-cash costs are incurred when factors are owned. For example, a farmer who fully owns the land used to produce a commodity (e.g. wheat) has no cost for land rental or loans to pay for purchasing land. Yet, an economic cost arises. By owning the land and using it to grow plants, the farmer forgoes income from other uses of his land, such as e.g. renting it to another producer.

2.6 Labour

There are two categories of labour: (a) *Direct labour* for the operations of agricultural production and (b) *Administrative labour* or overhead labour. In agricultural production the second category is less significant. In the case of coordinating a large number of producing farms, some supervisory and coordinating staff should be necessary.

Direct labour can be distinguished into several usual *labour types* with different cost. These types may include: Farmer, spouse, other unpaid, hired farm labour, contract labour, mechanic, bookkeeper, machine operator, field worker, etc.

The most important distinction is between paid and non-paid labour. *Paid labour* (hired) has a cost equal to its market rate. The opportunity cost of *non-paid labour* (non-hired) may also be set equal to the market rate for equal labour skills. In a stricter implementation of the opportunity cost issue, it should be set equal to the best alternative opportunity the farmer or his spouse, etc. would have. However this more difficult to estimate.

In effect, labour, hired or own, is evaluated at its going market rate, (assuming that such a labour market exists in the area under examination). The distinction between own and hired labour is useful for the estimation of overall human labour needs in different periods and the consequent identification of possible labour peaks.

2.7 Machinery & Equipment

The total cost related to machinery & equipment is the sum of (a) Economic Depreciation, (b) Opportunity Cost of holding the asset (i.e. interest), (c) Maintenance cost, (d) Insurance, (e) Fuel and (f) Operator(s) cost. The last two can be reported separately.

Economic Depreciation (*D*), is the loss of value during the period (year) due to breakage, wear and tear, technological devaluation, etc. In general, it is the difference between the value of the asset at the beginning and at the end of the period. Economic depreciation reflects (a) service reduction capacity, (b) change in the price of the capital asset, etc. The most widely used method of depreciation is *linear depreciation*, which is defined as

$$D = \frac{V_0 - \frac{V_n}{(1+d)^n}}{n}$$

Where V_o is the initial value of the asset at the beginning of the evaluation period and V_n is its value at the end of the last period of its *useful economic life* (*n*). The above formula suggests that V_n (*Salvage value*) is subtracted from V_o after being discounted to the beginning of the first period and therefore the nominator of the fraction is equivalent to net purchase price.

Capital Service Cost (CSC) is the annual equivalent of the annuitised stream of the amount:

$$V_0 - \frac{V_n}{(1+d)^n}$$

plus annual Machinery and Equipment Maintenance (*M*) *plus* annual Machinery and Equipment Insurance (*Ins*)

This is equal to

$$CSC = \frac{V_0 - \frac{V_n}{(1+d)^n}}{a(n,d)} + M + Ins$$

where $a(n,i)$ is the unitary annuity present value[3]. The capital service cost consists of *Depreciation*, the *Opportunity Cost of holding the asset* (i.e. the *interest* or *cost of capital* captured in the asset during its useful economic life), annual *Maintenance* and *Insurance* cost. One way of splitting CSC into its components, which maintains the uniformity of all annuity payments as well as of the familiar depreciation amount, is to subtract *D, M* and *Ins* from *CSC* and define the difference

Opportunity Cost of Holding the asset = Interest = CSC – (*D + M + Ins*)

Holding cost is the uniform *interest* part of the Capital Service Cost, which is not charged, as usual, on the remaining (not yet depreciated) value of the asset, but it is the annual equivalent of this holding cost.

The information supplied with regard to *machinery & equipment* includes data that fully describe each item such as machinery purchase cost, average annual operating hours, useful economic life, salvage value, maintenance cost, fuel type , etc. This makes possible the calculation of its annual and hourly *depreciation & maintenance* and *interest charge*. Fuel consumption of machinery & equipment depends upon the operation being performed; for example, a tractor is consuming more fuel when ploughing and less when spraying. Fuel consumed for moving the machine to and from the operation location is introduced by means of an *additional fuel consumption coefficient*. This coefficient usually ranges from 5% to 10%. (AAEA, 2000).

One or more of the requirements of each operation may be rented or hired. It is for example not unusual in certain periods to hire extra labourers, e.g. for hand-collection of the product, or to hire the service of expensive machinery used for very short period in the year. When a machine is hired, the rent paid by the farmer covers machine depreciation, interest, maintenance, insurance, fuel, operator(s), and a *rental premium*, which is the profit of the third party offering the required service.

[3] $a(n,r) = \frac{1-(1+d)^{-n}}{d}$ see for example Cissell and Cissell, or any other book on financial discounting.

2.8 Plantation Establishment and Useful Life

There are two types of plantation / crop: (a) *annual* and (b) *multiannual* or *perennial*. For the *annual crops*, it is assumed that the life cycle of the plant is one year, during which it is established, grown and harvested. This cycle is uniformly repeated year after year.

For *multiannual crops*, it is assumed that establishment takes place in *year zero* (a period of one or more years) and that annual treatment and harvesting is taking place until the end of the plant's useful life, when the plantation should be re-established to repeat the same life cycle. The expense of establishing the plantation is depreciated over the useful economic life of the crop (in similar manner as with machinery & equipment depreciation as described above). By assuming zero salvage plantation value, economic depreciation (*D*) is equal to

$$D = \frac{V_0}{n}$$

where V_0 is the establishment cost and n is the plantation's useful economic life. The establishment cost of the plantation is the sum total of all operations of year zero plus the corresponding cost of land and overheads.

Economic depreciation reflects the reduction of the value of the plantation as it reaches the end of its useful economic value.

Due to different useful lives of perennial plants, only one life cycle of each plant needs to be explicitly studied. This is sufficient because each full life cycle includes all the variety of operations required for economic analysis.

Investment appraisal is based on annual equivalent flows. If a given time horizon needs to be appraised, such as for example a time period equal to the useful life of a product treatment plant, crop life cycles are repeated as many times as necessary to fill this time period.

2.9 Buildings & Constructions

Buildings & Constructions include all necessary fixed structures such as dedicated office buildings, farm roads and paths, irrigation channels, water reservoirs, product storage facilities, etc. For agricultural applications, Buildings & Constructions are usually of less importance than Machinery & Equipment and in many cases their cost is disregarded. However, in some situations they may be of great significance, e.g. when storage at certain temperature is required or accommodation of large number of workers must be provided.

The economic manipulation of Buildings & Constructions is very much the same as Machinery & Equipment. Their cost is the sum of (a) Economic Depreciation, (b) Opportunity Cost of holding the asset (i.e. interest), (c) Maintenance cost and (d) Insurance cost. The description of the economic calculations is the same as in the case of Machinery & Equipment.

The Buildings & Constructions cost of agricultural production is usually relatively small, therefore this cost item is treated as a "total", irrespective of the number of different buildings and constructions that might exist.

2.10 Overheads

Overheads is a cost item that includes all costs incurred due to the need of supervisory management, and other costs that cannot be easily allocated to the production units and which may be as simple as a caretaker, telephone bills, travel, etc., or as complex as an administration system including sales, accounting and marketing departments, etc.

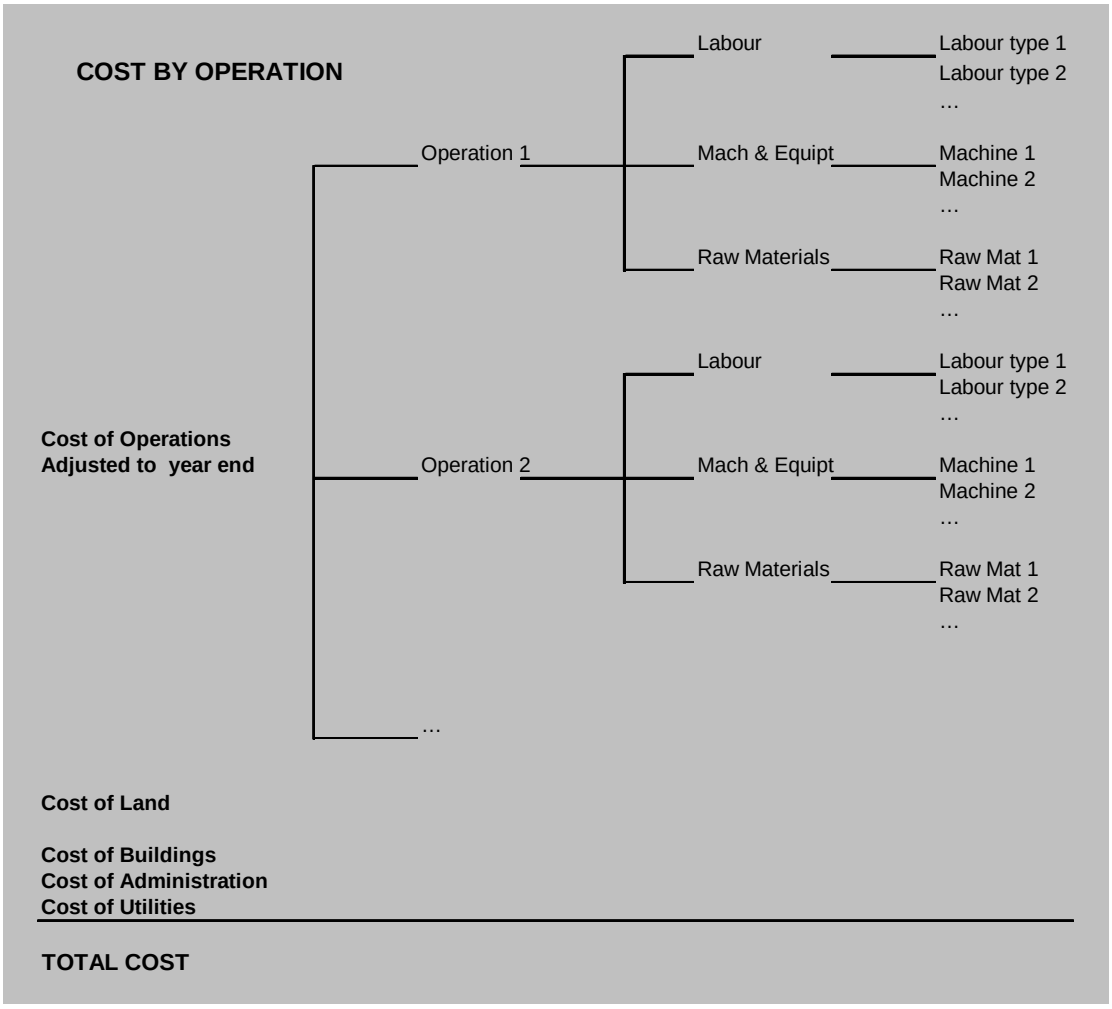
The administration overheads of agricultural production are usually relatively small, therefore the Agri-Cost model records this cost item as a total, irrespective of the number of crops which are simultaneously cultivated.

3. Cost Analysis Layout

Two main forms of cost analysis are used, in order cover the majority of the needs of the analyst.

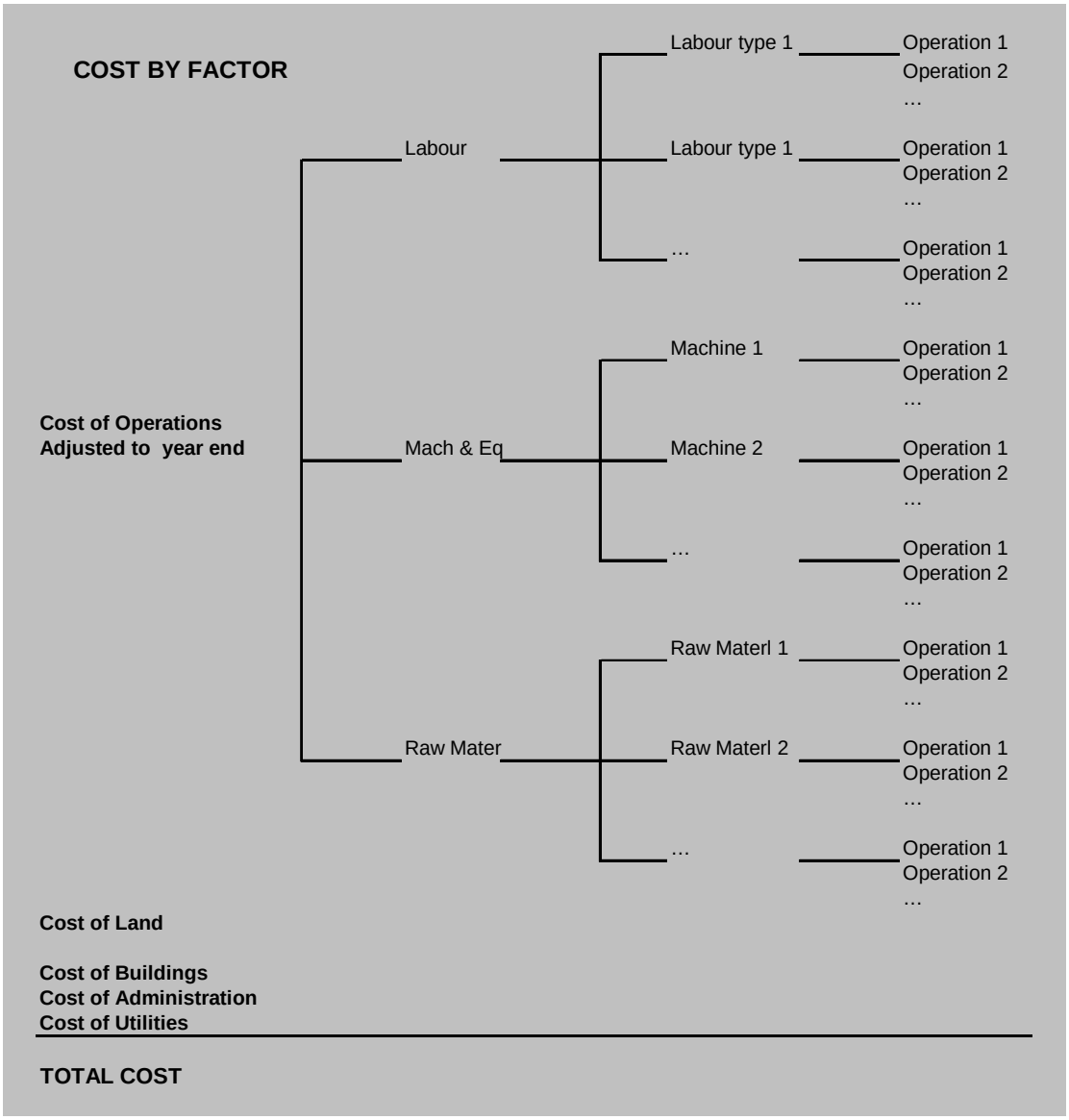
- *Cost breakdown by operation or activity*
- *Cost breakdown by input factor*

The structure of the first is:



This form can be detected at any depth of detail and describes the importance of the various operations required for crop production.

The second structure (by Factor) is somewhat similar, but it emphasises on the use of resources such as labour, machinery and raw materials. The layout can be inspected below:



Each of the cost analysis forms and formats may be inspected in a large number of monitoring (pivot) tables which are calculated on the fly for

- Each crop
- Each land type
- Each year

in any combination. This is very useful mainly for auditing purposes, since every detail is being available.

However, if overall cost estimation is required, inspecting the individual cost in such analysis is of no use because some operations are not performed regularly and uniformly year after year and therefore, annual cost may differ among the years of the plantation life.

The overall cost estimates are calculated as *annual equivalent costs,* i.e. costs that express lifetime averages incorporating the time value of money. To calculate the annual equivalent cost, the present value of all costs over the useful life of the plantation is transformed into an equivalent annuity with an annual uniform payment which is the annual equivalent cost.

As an example, assume the following annual costs of a project:

Discount Rate= 10%					*thousnand eur*
year:	*0*	*1*	*2*	*3*	*4*
Operating costs	30	20	15	15	20
Land	10	10	10	10	10
Overheads	5	7	8	8	8
TOTAL COST	45	37	33	33	38
PV of Cost	156.66				
Annual Equivalent Cost		49.42	49.42	49.42	49.42

The present value of all costs, including the base year (year zero) investment cost, is equal to 156.66 thousand eur, which is then distributed by means of an annuity to 49.42 thousand eur per typical year.

The present value of total cost (*PV*) is calculated by means of the *Present Value* formula:

$$PV = \sum_{t=0}^{n} TC_t \times (1+d)^{-t}$$

where *d* is the discount rate, and TC_t is the Total Cost in year *t*, and *n* is the number of years of useful economic life.

The Annual Equivalent Cost is then calculated from the annuity formula:

$$Annual\ Equivalent\ Cost = \frac{PV \times d}{1-(1+d)^{-n}}$$

The format of a standard Annual Equivalent Cost table is as in the following example:

ANNUAL COST ANALYSIS BY OPERATION

Crop: **xxx**

Land type: **Irrigated**

Yield (t/cul.ha)= **20**

Occupied Land Area (ha)= **120**

Cultivated Land Area (ha)= **100**

Hired land %= **50%**

DIRECT COST

OPERATION	FACTOR	Units	Cost/unit	Volume/cul.ha	Cost/cul.ha	Cost/ton	Total Cost	%on Tot
Fertilisation	Labour	hrs	10	20	200	10	1000	17%
	Fertiliser	kg	24	10	240	12	1200	21%
….								
Cost of Operations					440	22	2200	38%
	Land*				600	30	3000	52%
Total Direct Cost					1040	52	5200	90%
INDIRECT COST								
	Overheads				120	6	600	10%
Total Indirect Cost					120	6	600	10%
TOTAL COST					1160	58	5800	100%

*Land rent is 500 eur/ha. However since cultivated land is only 5/6 of occupied land, effective rent is 500 x 6/5 = 600 eur/cul.ha

4. Agricultural Projects Evaluation

Investment Appraisal differs from cost analysis because it is not concerned with profits (sales minus costs), but concentrates on cash inflows & outflows and measures Net Present Values, i.e. compares the Present Value of Net Benefits (net inflows) caused by the project versus Initial Investment. The attractiveness of the Project is then measured by the difference of those two magnitudes.

There are two methods for the identification of cash flows, (White et al., 2003).

The *direct cash determination method*, utilises data regarding the terms of receipts & payments, inventory & receivables policies and other cash-flow related information, and then calculates flows based on the timing of production and sales.

The second *indirect cash determination method,* estimates regular (monthly) *Balance Sheets* based on the same information and then calculates what is sometimes called the *Sources and Uses of Funds Statement*.

The resulting cash levels are the same irrespective of the method of calculation.

The justification of using cash-flows rather than profitability measures in investment appraisal lies on the fact that profitability does not by itself secure cash availability and company viability, because the timing of receipts and payments is overlooked. Also, satisfactory cash flows guarantee in the long run satisfactory profits (Lumby & Jones 2002).

The model is reading the opening Balance Sheet from user data and calculates consequent Balance Sheets with the *indirect cash determination method*, i.e. it calculates Balance Sheets for every period.

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Annex I: Land Use and Agricultural Production in EU27

This Annex presents statistical information a) about land use in EU-27 and b) the most important arable crops of EU countries. The following tables include statistical data for EU 27, as a total, and for each country separately.

Table 1: EU 27 land categories 2005 (000 ha), per country *(Source: FAO)*

Countries	Country area	Agricultural area	Arable land	Temporary crops	Fallow land	Permanent crops	Forest area	Other land
Austria	8,387	3,263	1,387	1,215	95	66	3,862	1,120
Belgium	3,053	1,386	844		28	23	667	970
Bulgaria	11,100	5,265	3,173	2,617	490	201	3,625	1,974
Cyprus	925	165	120	100	20	41	174	585
Czech Republic	7,887	4,259	3,047			238	2,648	819
Denmark	4,309	2,589	2,237	1,777	20	7	500	1,154
Estonia	4,523	834	591		26	12	2,284	1,121
Finland	33,815	2,266	2,234		241	6	22,500	5,693
France	55,150	29,569	18,507		1,310	1,128	15,554	9,887
Germany	35,705	17,030	11,903	9,304	794	198	11,076	6,771
Greece	13,196	8,359	2,627		447	1,132	3,752	779
Hungary	9,303	5,864	4,600			207	1,976	1,121
Ireland	7,027	4,227	1,215			2	669	1,993
Italy	30,134	14,694	7,744			2,539	9,979	4,738
Latvia	6,459	1,734	1,092			13	2,941	1,554
Lithuania	6,530	2,837	1,906	1,248	156	40	2,099	1,332
Luxembourg	259	129	60		2	2	87	43
Malta	32	10	9			1	0	22
Netherlands	4,153	1,921	908		2	33	365	1,102
Poland	31,269	15,906	12,141	11,112	1,029	378	9,192	5,535
Portugal	9,212	3,680	1,262	888	374	649	3,783	1,687
Romania	23,839	14,513	9,288	7,951	517	540	6,370	2,115
Slovakia	4,903	1,941	1,391		10	26	1,929	940
Slovenia	2,027	508	176	149	2	27	1,264	242
Spain	50,537	29,030	13,700			4,930	17,915	2,974
Sweden	45,029	3,219	2,703		321	3	27,528	10,286
United Kingdom	24,361	16,956	5,729	4,396	140	47	2,845	4,392
EU 27 Total	433,124	192,154	110,594	40,757	6,024	12,489	155,585	70,948

Table 2: EU 27 crops harvested area (2007) as a percentage of the total agricultural area, per country and total *(Source: FAO)*

	Wheat	Barley	Maize	Rapeseed	Sunflower	Sugar beet
Austria	9%	6%	5%	1%	1%	1%
Belgium	14%	3%	4%	1%		6%
Bulgaria	21%	4%	4%	1%	11%	
Cyprus	5%	33%				
Czech Republic	19%	12%	2%	8%	1%	1%
Denmark	27%	24%		7%		2%
Estonia	11%	17%		9%		
Finland	9%	24%		4%		1%
France	18%	6%	5%	5%	2%	1%
Germany	18%	11%	2%	9%		2%
Greece	8%	1%	2%			
Hungary	19%	6%	21%	4%	9%	1%
Ireland	2%	4%				
Italy	14%	2%	7%		1%	1%
Latvia	13%	8%		6%		
Lithuania	12%	13%		6%		1%
Luxembourg	10%	7%		4%		
Malta	20%	4%				
Netherlands	7%	2%	1%			4%
Poland	13%	8%	2%	5%		2%
Portugal	2%	1%	3%			
Romania	13%	3%	15%	2%	6%	
Slovakia	19%	11%	8%	8%	3%	1%
Slovenia	6%	4%	8%	1%		1%
Spain	6%	11%	1%		2%	
Sweden	11%	10%		3%		1%
United Kingdom	11%	5%		4%		1%
EU 27 Total	13%	7%	4%	3%	2%	1%

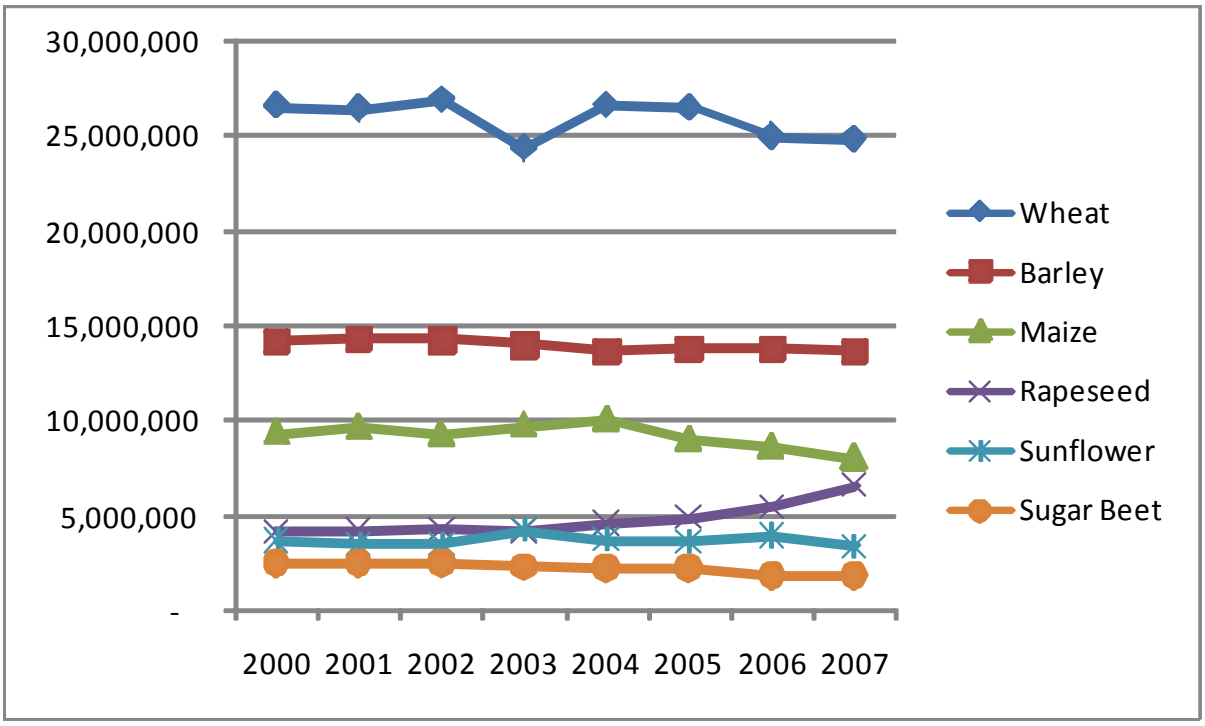

Figure 1a: Harvested Area (ha) of the basic arable crops in EU27 countries, during 2000-2007

(Source: FAO)

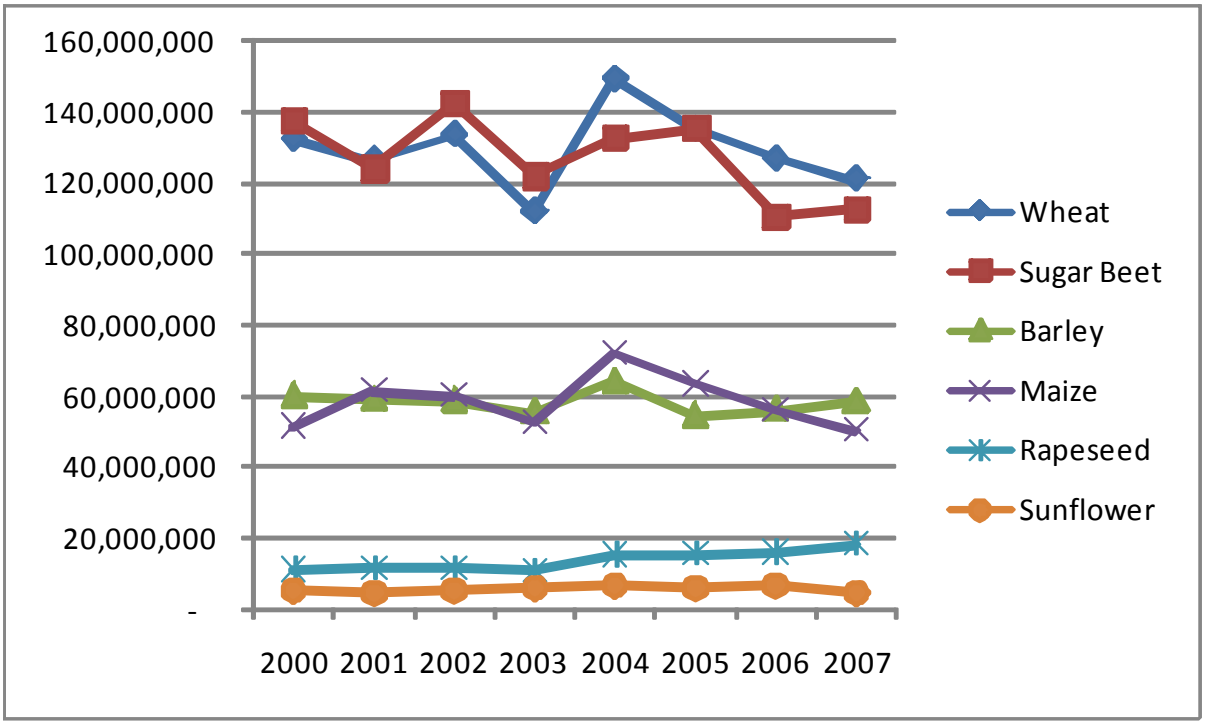

Figure 1b: Production Quantities (t) of the basic arable crops in EU27 countries, during 2000-2007

(Source: FAO)

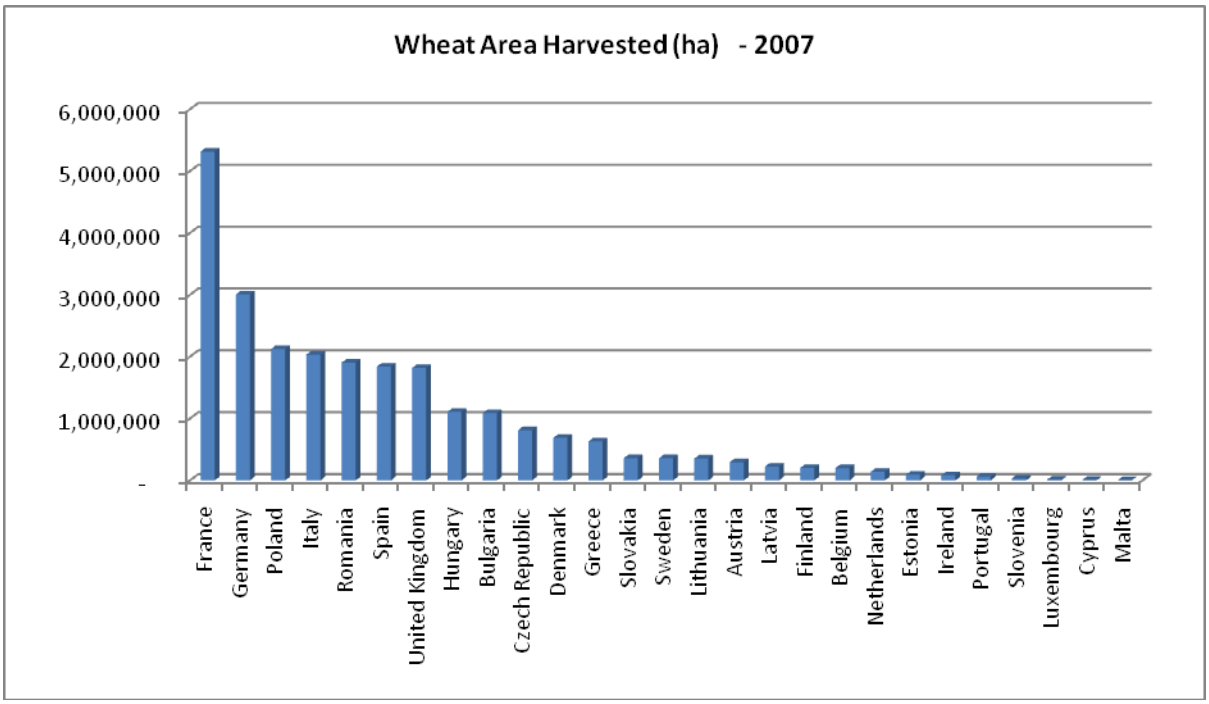

Figure 2a: Wheat harvested area in EU27 for 2007 *(Source: FAO)*

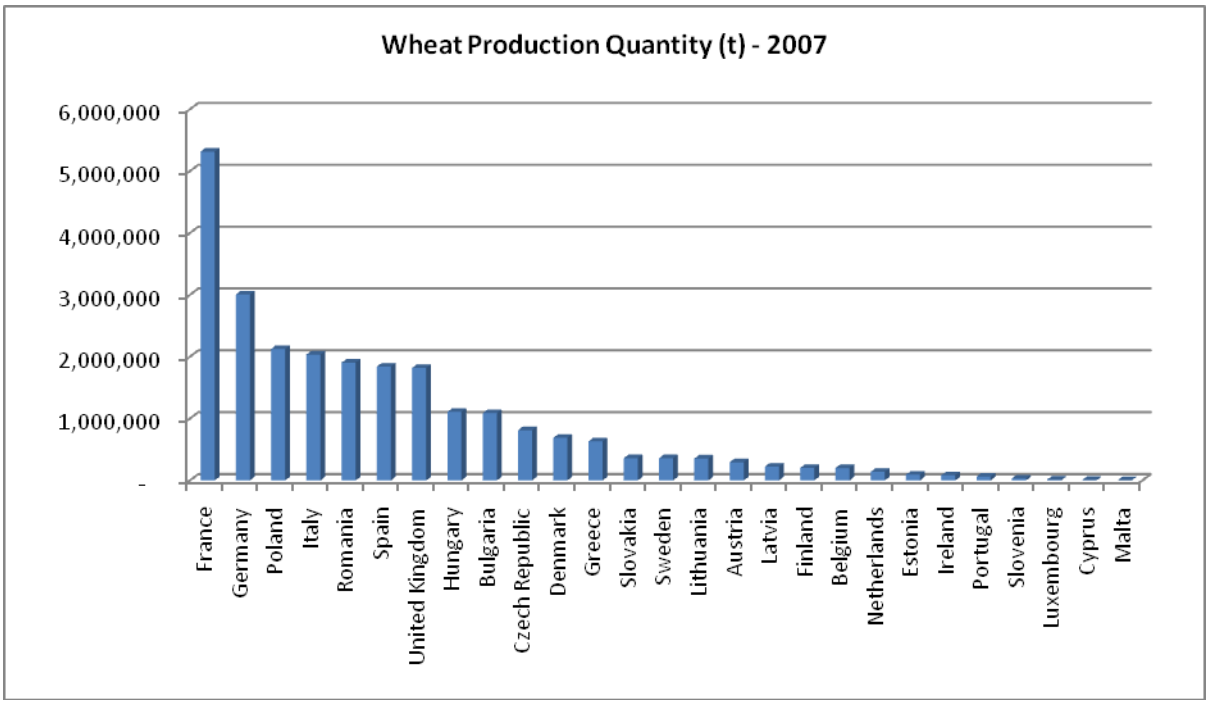

Figure 2b: Wheat production on EU27 for 2007 *(Source: FAO)*

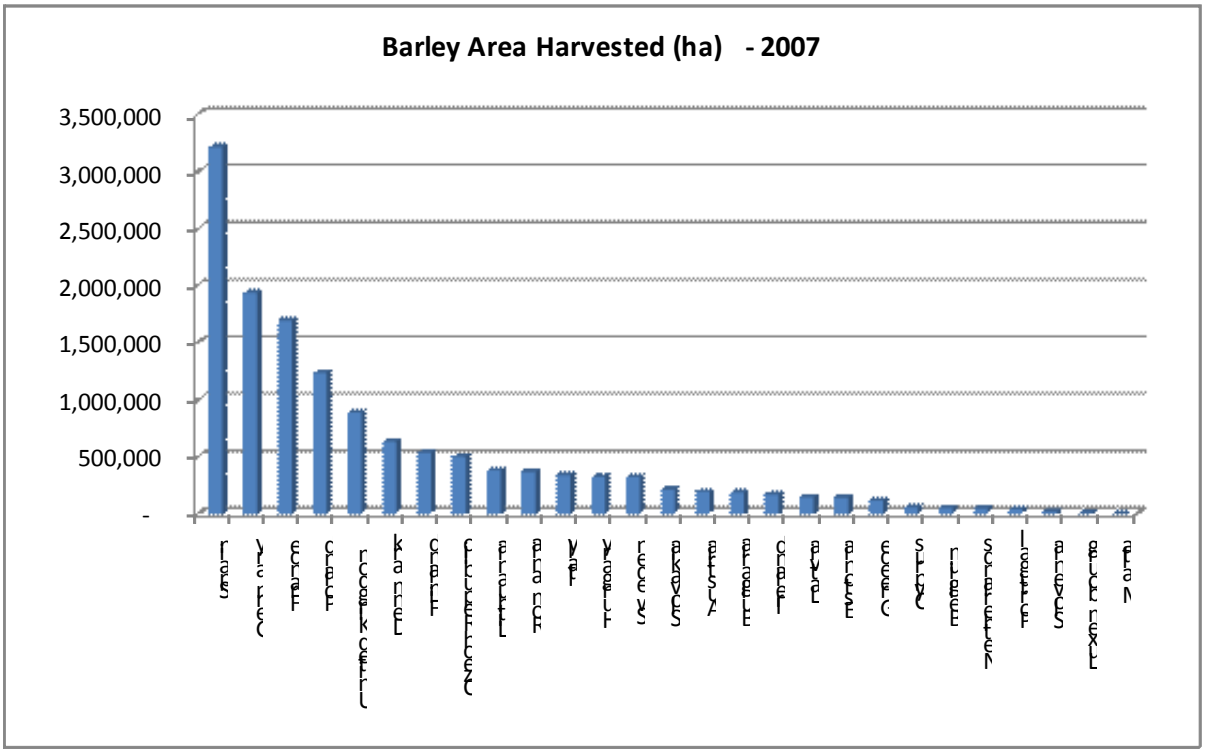

Figure 3a: Barley harvested area in EU27 for 2007 ***(Source: FAO)***

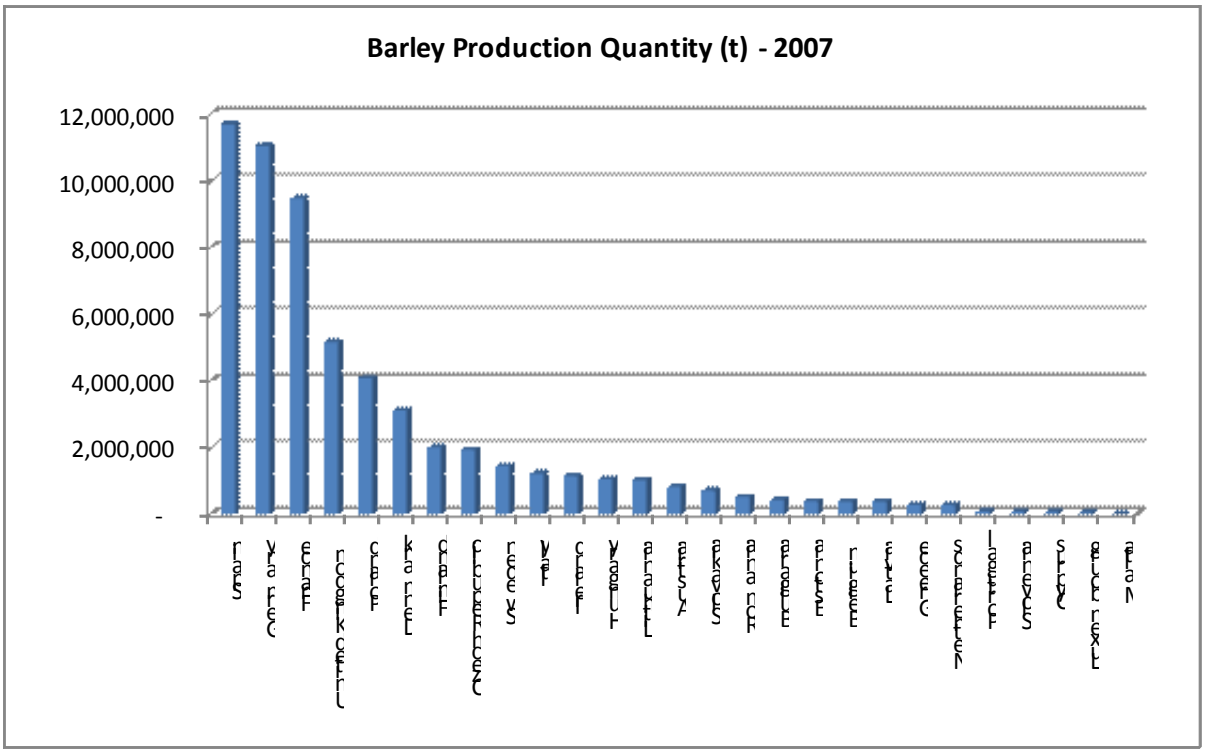

Figure 3b: Barley production on EU27 for 2007 ***(Source: FAO)***

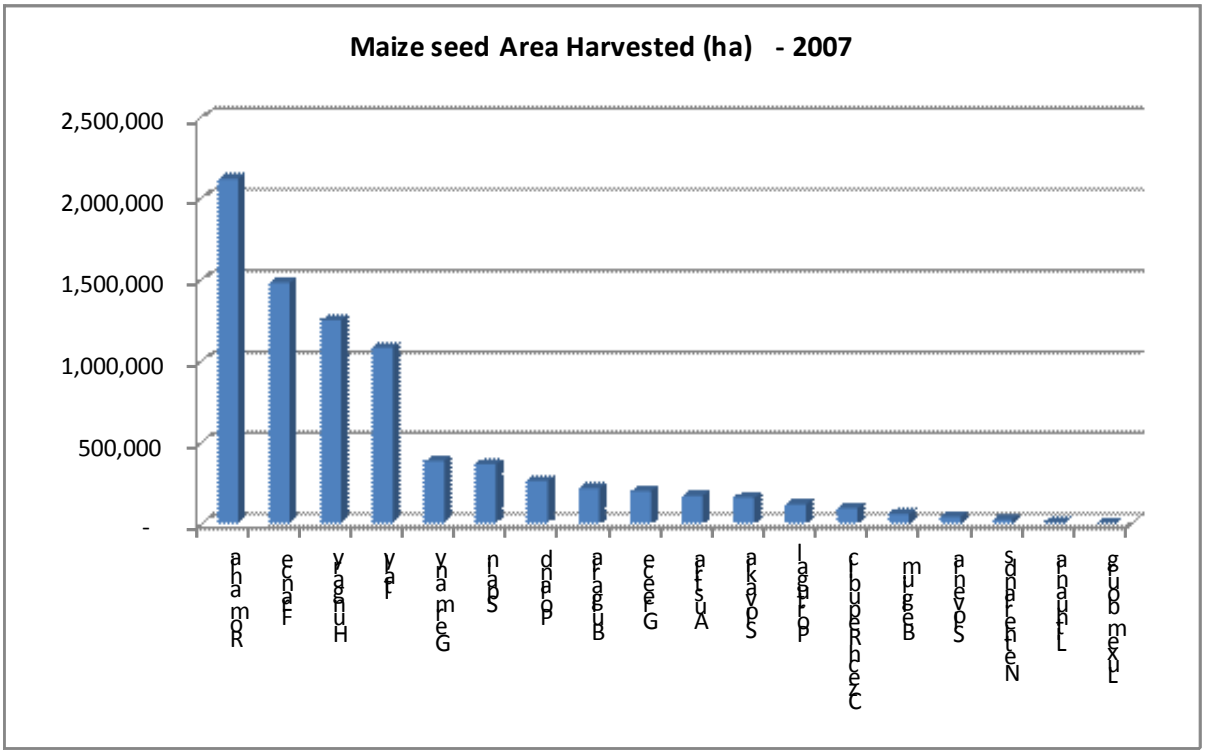

Figure 4a: Maize harvested area in EU27 for 2007 *(Source: FAO)*

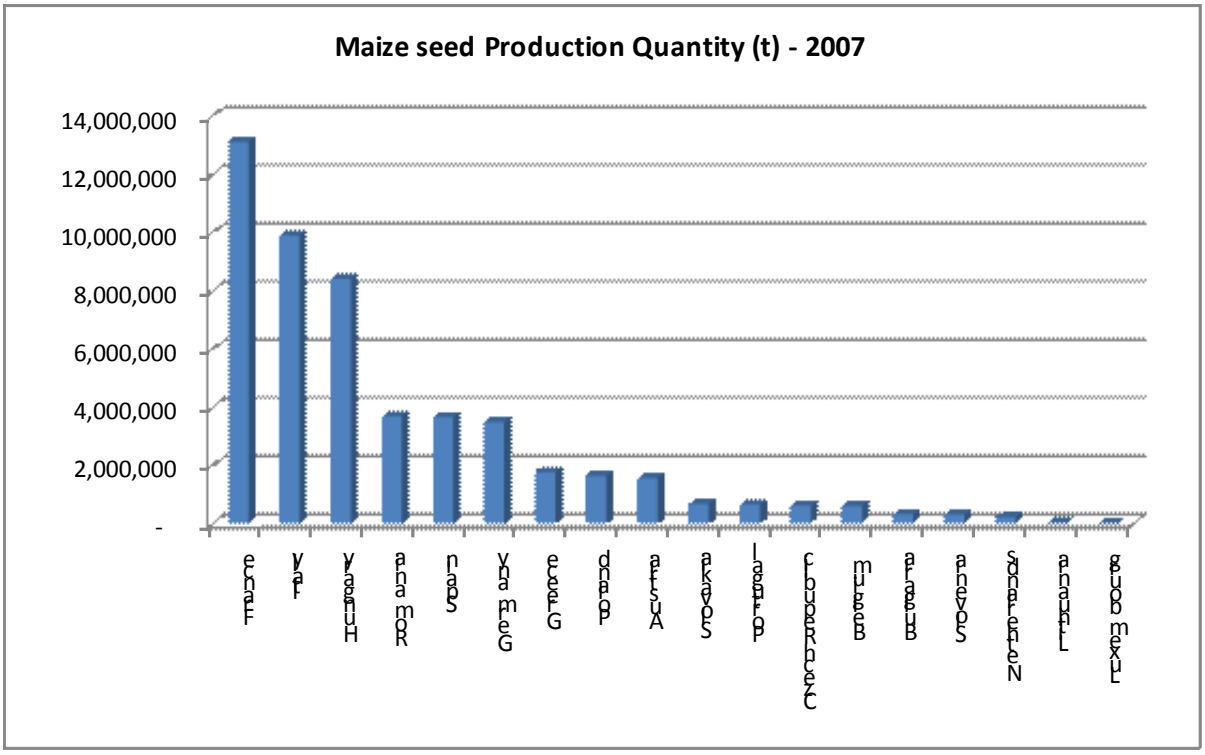

Figure 4b: Maize production on EU27 for 2007 *(Source: FAO)*

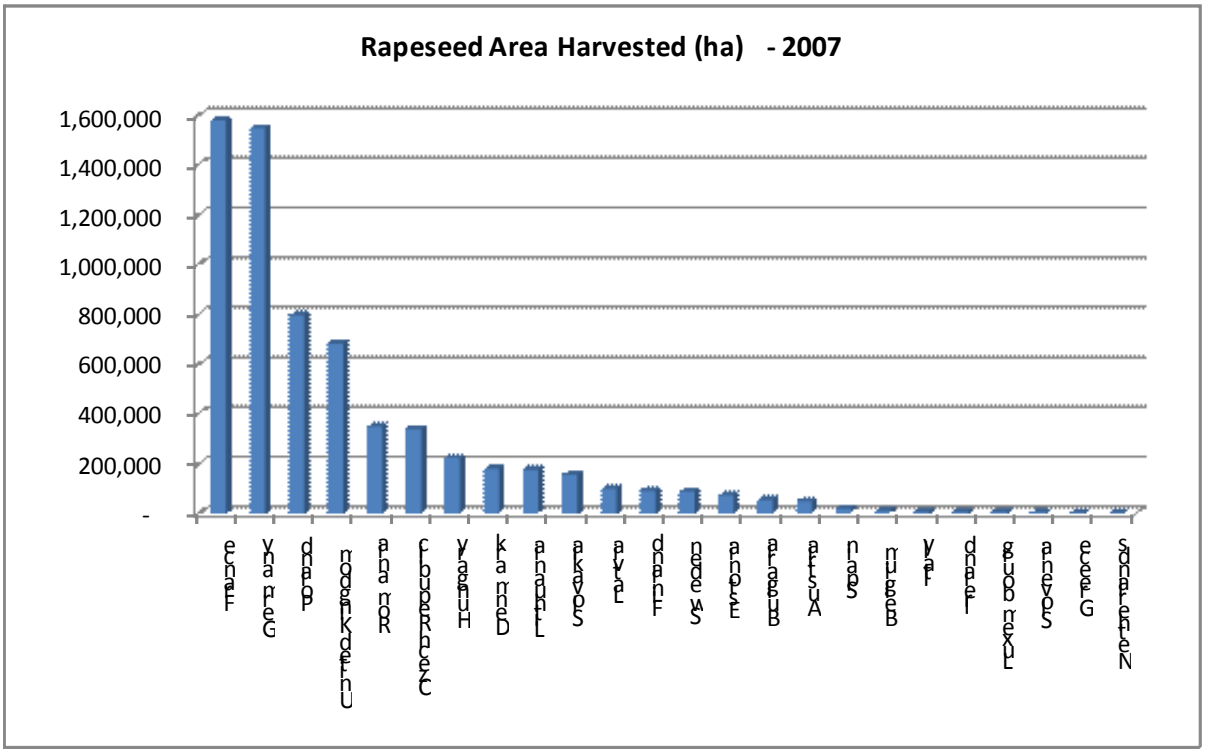

Figure 5a: Rapeseed harvested area in EU27 for 2007 *(Source: FAO)*

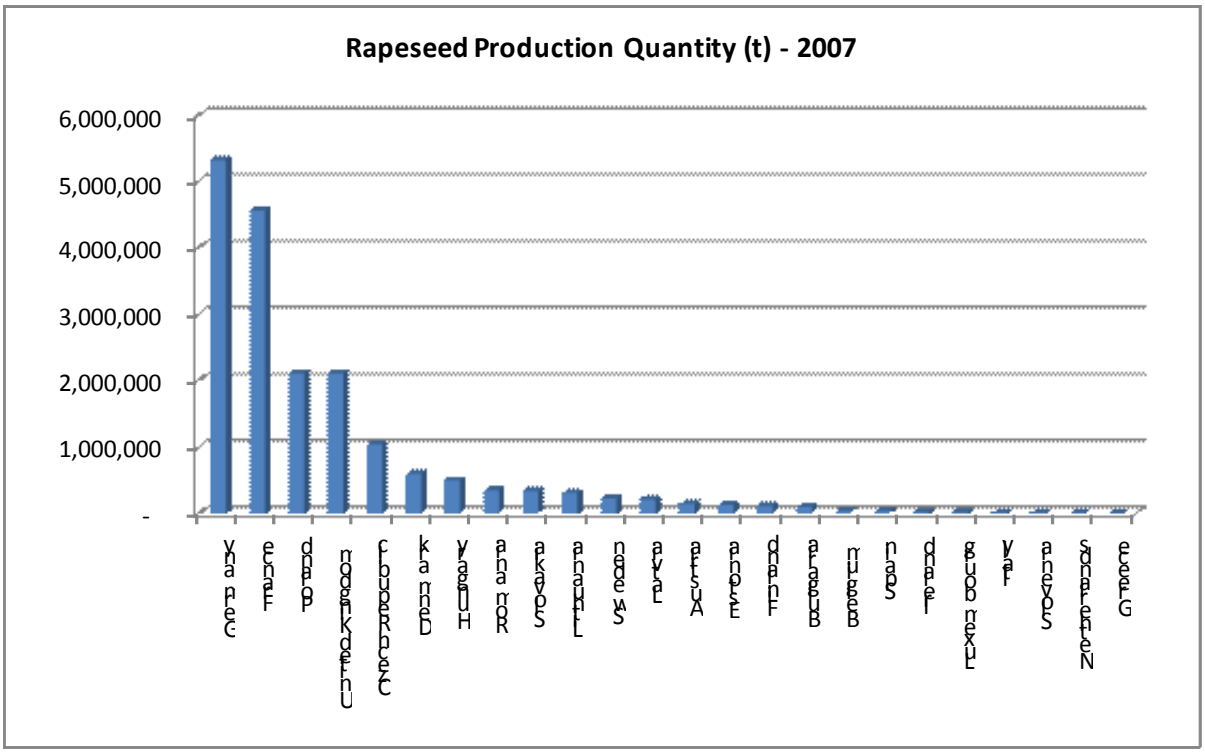

Figure 5b: Rapeseed production on EU27 for 2007 *(Source: FAO)*

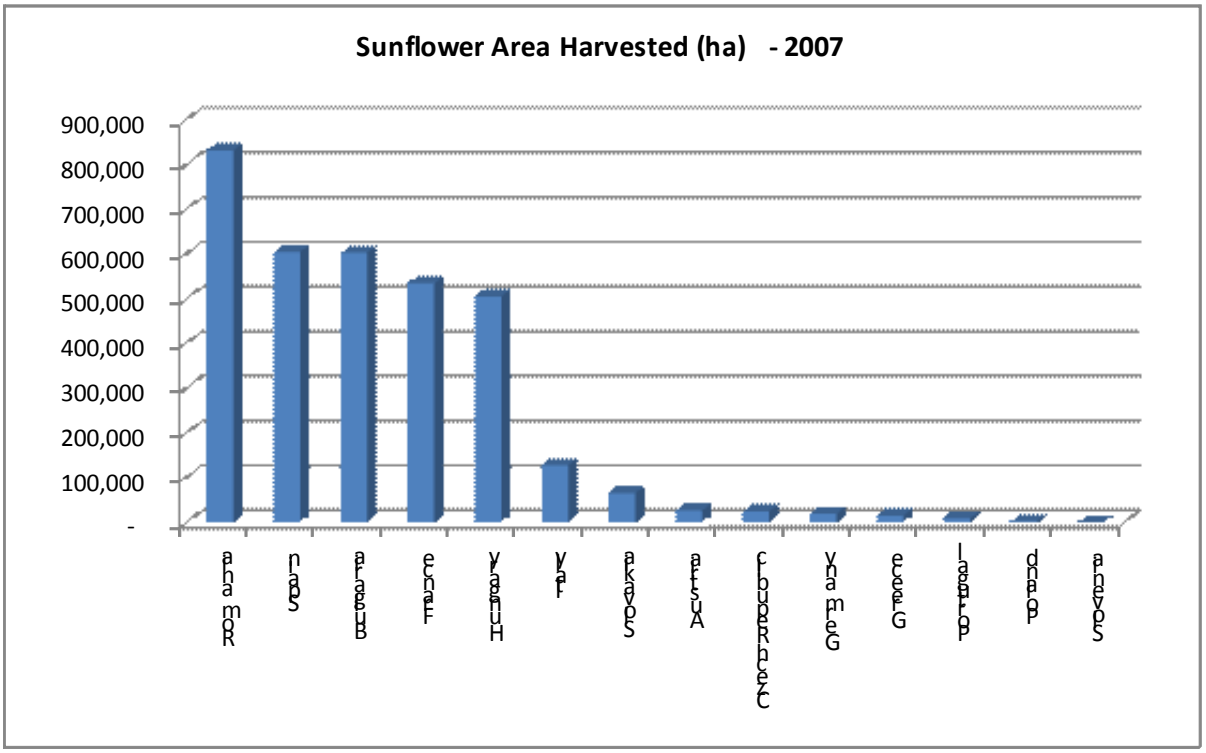

Figure 6a: Sunflower harvested area in EU27 for 2007 *(Source: FAO)*

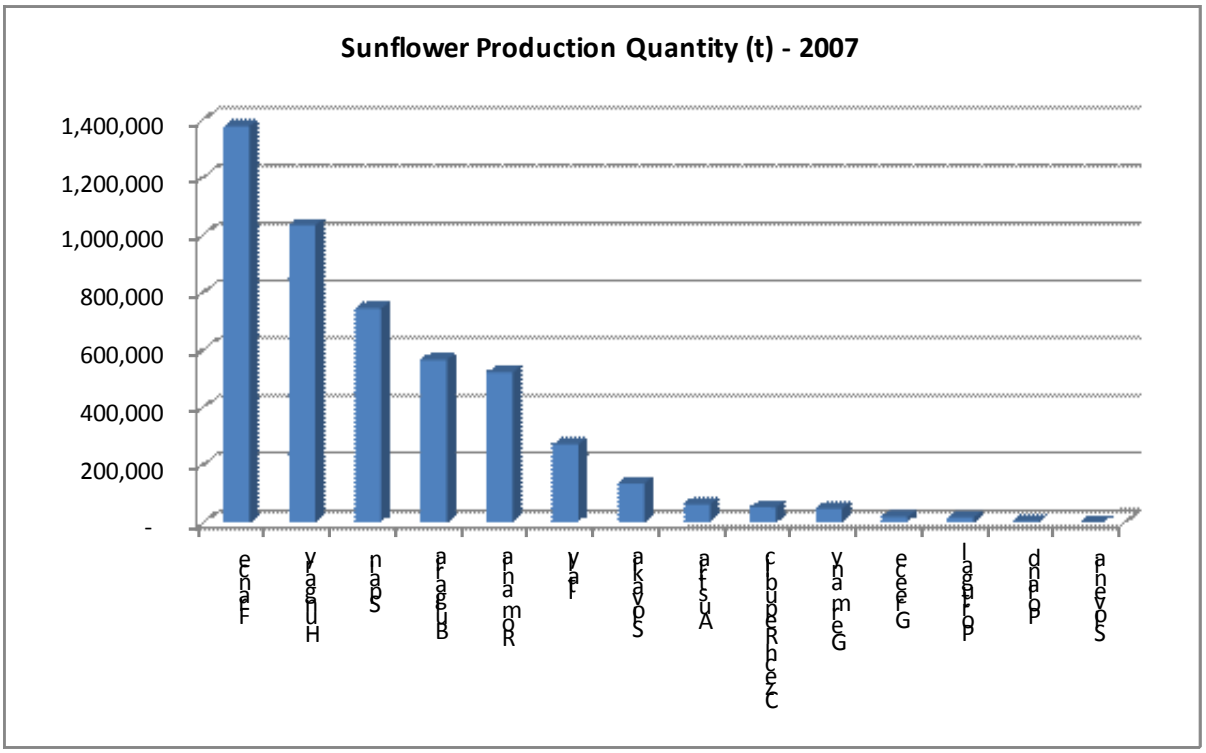

Figure 6b: Sunflower production on EU27 for 2007 *(Source: FAO)*

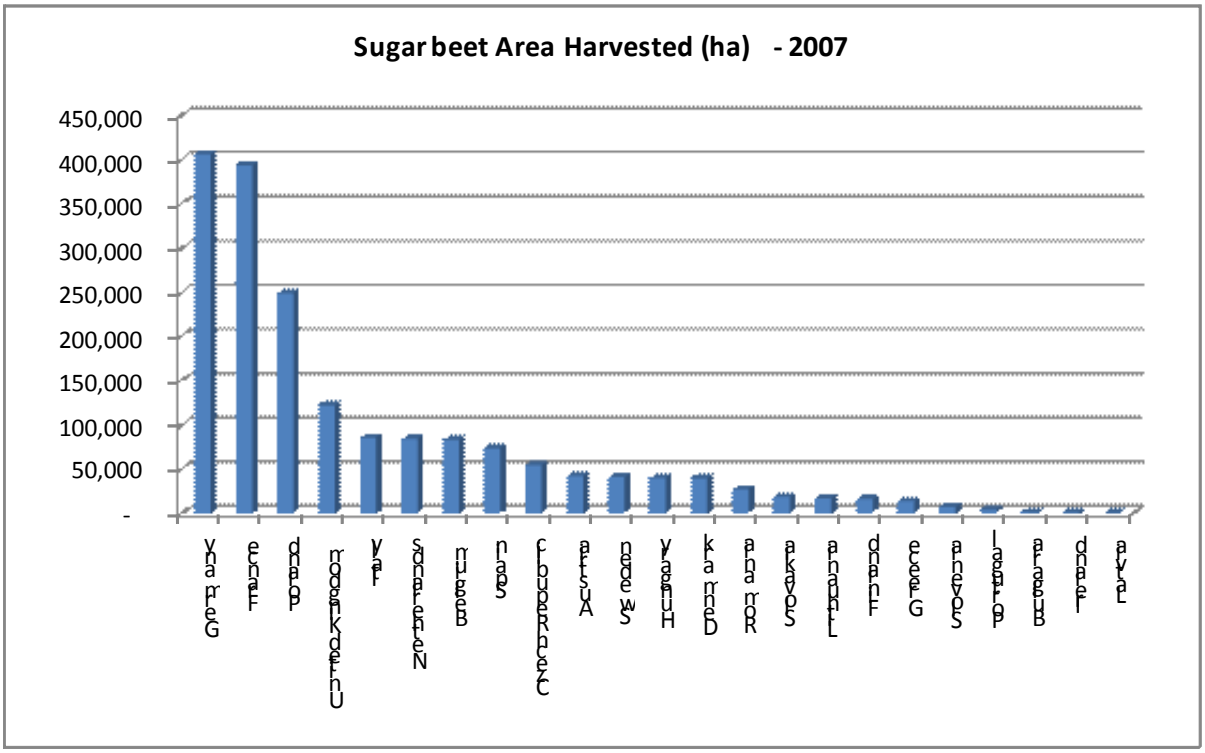

Figure 7a: Sugar beet harvested area in EU27 for 2007 *(Source: FAO)*

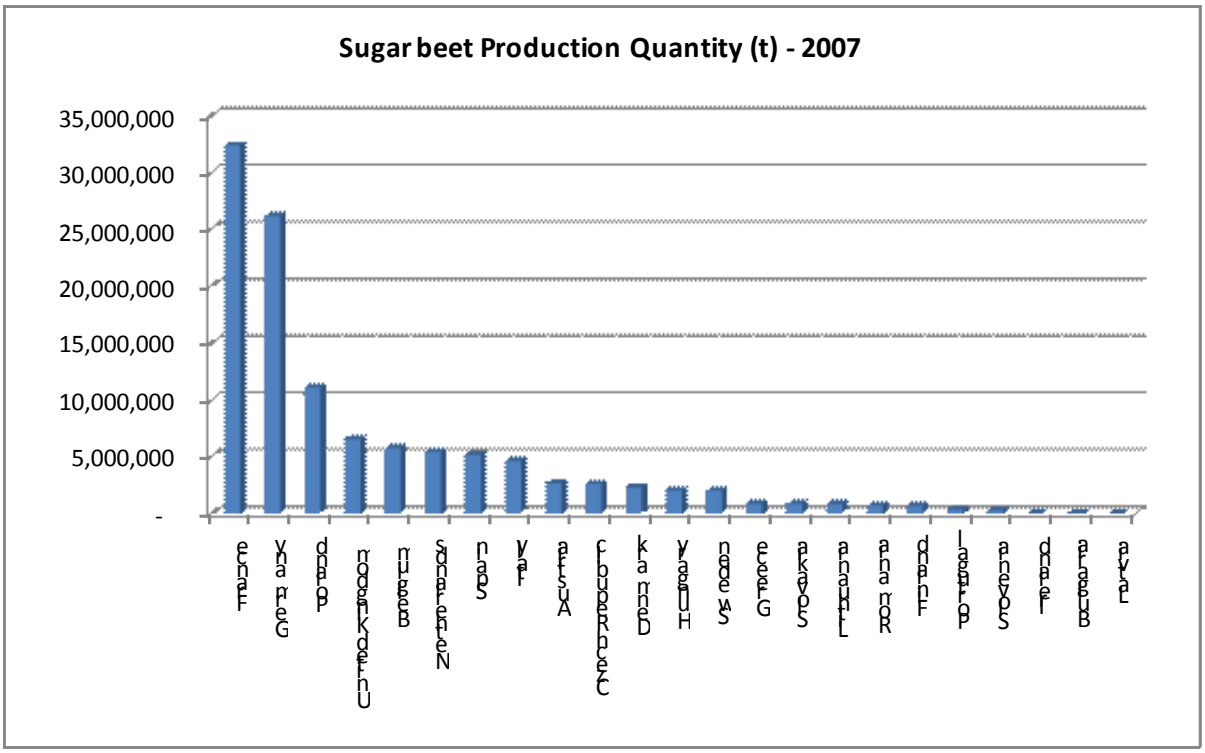

Figure 7b: Sugar beet production on EU27 for 2007 *(Source: FAO)*

Annex II: Yields in EU-27

Table 3: Yield of main arable crops (t/ha), year 2007

Country	Wheat	Barley	Maize	Rapeseed	Sunflower seed	Sugar beet
France	6.25	5.60	8.85	2.89	2.58	82.29
Portugal	2.18	1.86	5.54		1.83	74.42
Spain	3.46	3.64	10.01	2.02	1.23	69.95
Belgium	7.42	7.53	10.33	3.57		69.49
Germany	7.11	5.71	9.09	3.44	2.50	64.32
Netherlands	7.07	5.78	9.04	3.50		64.29
Austria	4.78	4.19	9.10	2.93	2.38	63.11
Greece	2.22	2.30	8.90	1.50	1.27	62.94
Denmark	6.56	4.92		3.33		57.24
Italy	3.57	3.57	9.14	2.08	2.13	54.09
United Kingdom	7.34	5.82		3.10		53.28
Hungary	3.59	3.21	6.72	2.23	2.04	50.00
Sweden	6.26	4.48		2.53		49.04
Czech Republic	4.88	3.85	6.53	3.08	2.12	47.88
Lithuania	3.92	2.66	4.81	1.79		47.33
Slovakia	3.99	3.30	4.27	2.17	2.08	45.33
Ireland	8.11	6.74		3.33		45.00
Poland	3.94	3.29	6.27	2.66	1.79	44.44
Finland	3.93	3.72		1.26		42.07
Slovenia	4.16	3.66	7.54	2.75	1.74	38.24
Latvia	3.60	2.52		2.13		36.00
Romania	1.50	1.38	1.74	1.00	0.63	26.01
Bulgaria	2.20	2.25	1.46	1.72	0.94	12.68
Luxembourg	5.54	4.80	6.33	3.41		
Estonia	3.43	2.65		1.81		
Malta	4.60	4.00				
Cyprus	1.13	1.10				
Average	**4.55**	**3.87**	**6.98**	**2.51**	**1.80**	**52.15**
Min	**1.13**	**1.10**	**1.46**	**1.00**	**0.63**	**12.68**
Max	**8.11**	**7.53**	**10.33**	**3.57**	**2.58**	**82.29**
Standard Deviation	**1.93**	**1.61**	**2.65**	**0.76**	**0.59**	**15.95**

Source: FAO

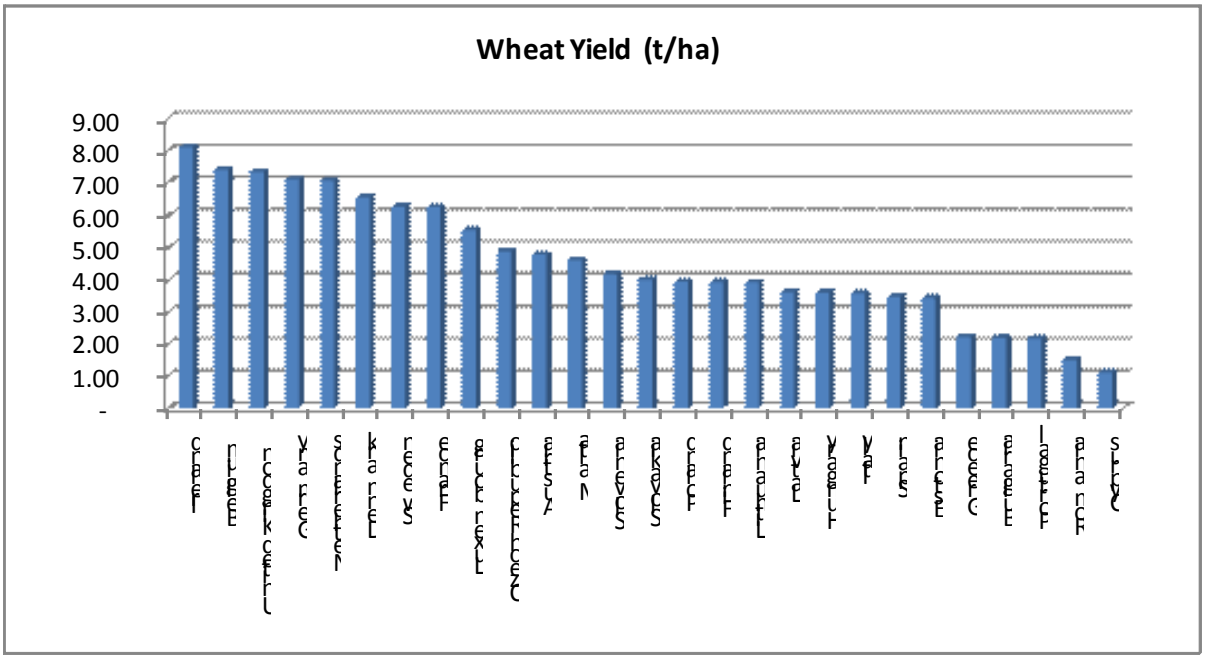

Figure 8a: Wheat Yield, year 2007 (source: FAO)

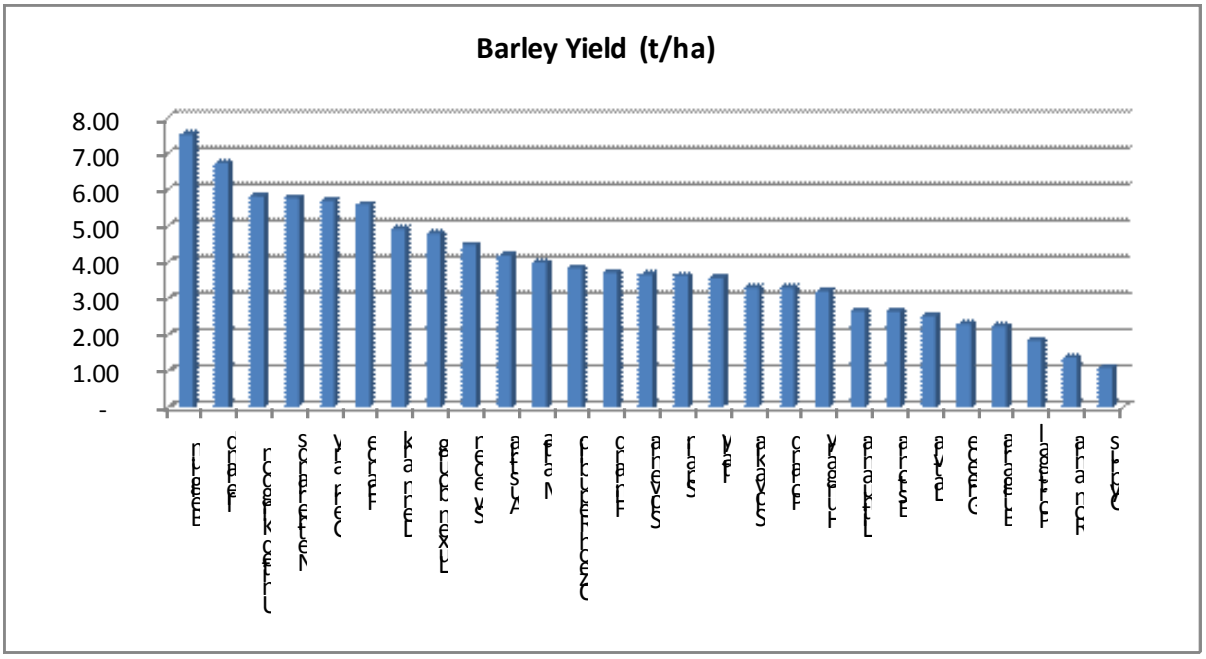

Figure 8b: Barley Yield, year 2007 (source: FAO)

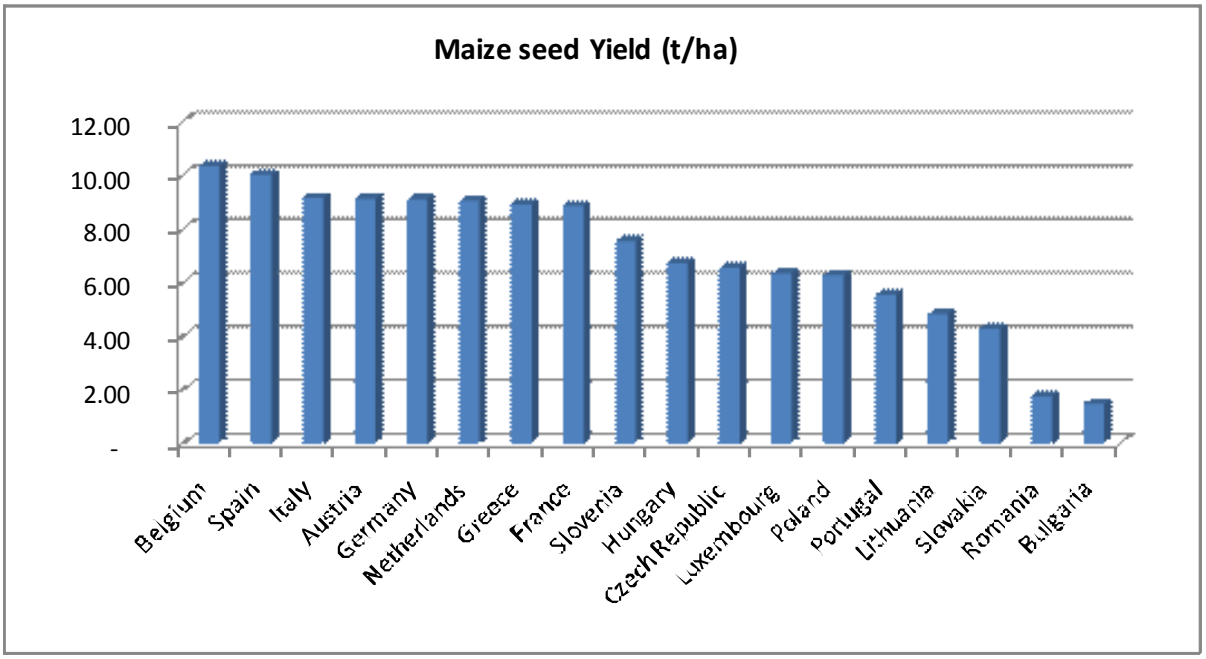

Figure 8c: Maize Yield, year 2007 (source: FAO)

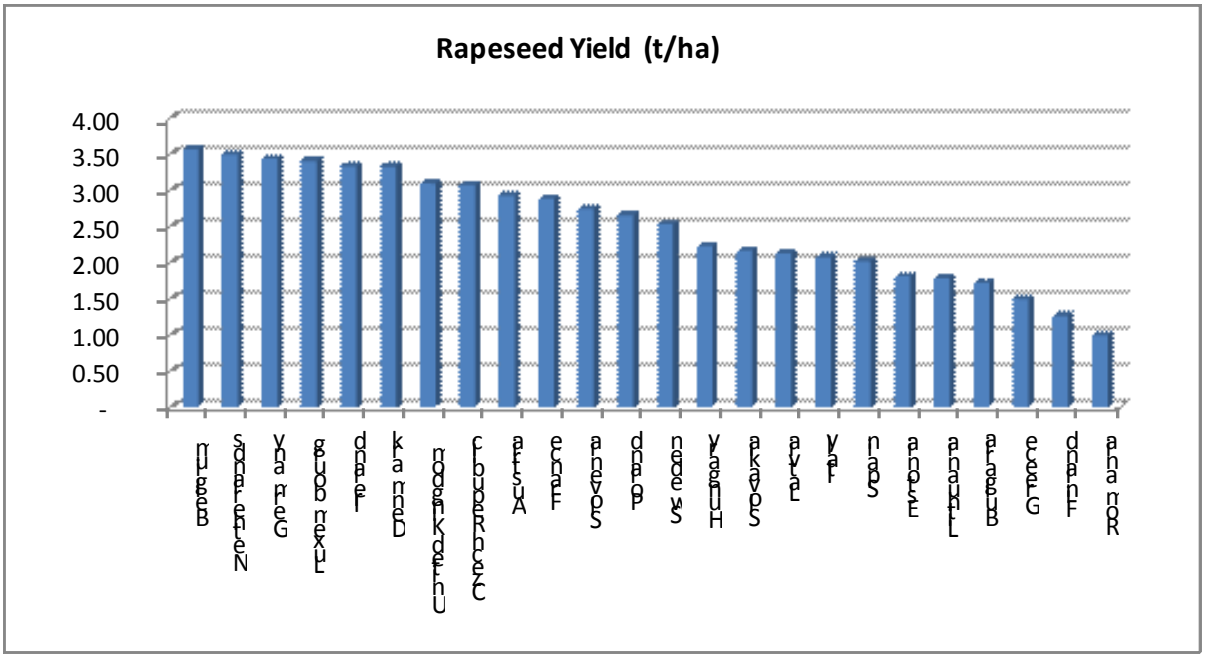

Figure 8d: Rapeseed Yield, year 2007 (source: FAO)

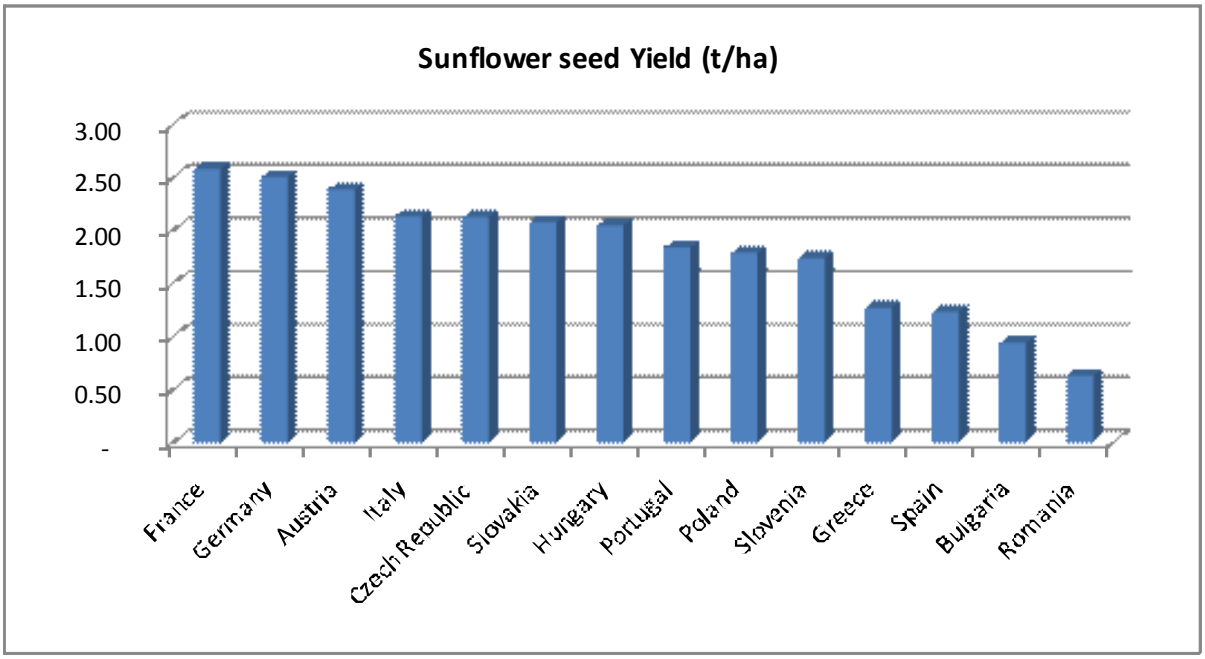

Figure 8e: Sunflower Yield, year 2007 (source: FAO)

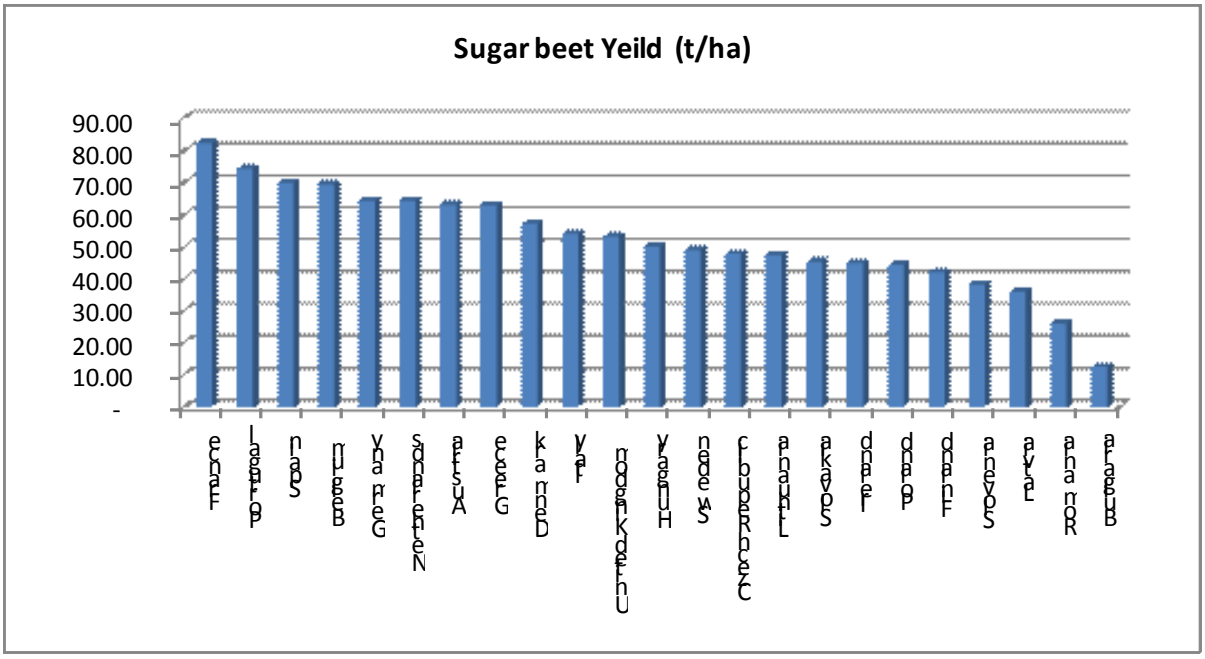

Figure 8f: Sugar beet Yield, year 2007 (source: FAO)

Annex III: Agricultural Production Cost Data

This annex summarises the statistical information concerning the selling prices of agricultural products, as well as the prices of the factors of production in EU 27 countries. The basic categories presented in this annex are:

- Agricultural product prices
- Cost of land
- Cost of labour
- Prices of agricultural inputs

Table 4: Main Arable crops product prices (2006)

	Soft wheat	Durum wheat	Rye	Barley	Oats	Maize	Rice	Sorghum	Triticale	Rape	Sunflower	Soya	Sugar beet
Belgium	119		87	109	89				90				32
Bulgaria	87	98	83	84	82	85	186	83	81	172	184	240	22
Czech Republic	109		101	101	116	102				234	219		36
Denmark	110		101	112	112				107	232			
Germany	109		101	102	95	131			103	235	798		33
Estonia	112		108	101	87					259			
Ireland	122			110	128								
Greece	141	141		152	204	159	162				162		25
Spain	140	139	126	126	128	152	218	150	140	208	221	214	41
France													
Italy													
Cyprus		156			365								
Latvia	112		96	96	85				91	234			32
Lithuania	129		109	106	86	149			92	244			35
Luxembourg	126		101	102	88	94			100	219			
Hungary	100	115	76	96	83	99	188	105	84	214	200	196	36
Malta													
Netherlands	102		109		126				110				47
Austria	105	140	117		86	124			86	222	173	184	37
Poland	115		99	103	90	115			95	240			33
Portugal	124	126	120	128	102	162	223		118		215		43
Romania	96			113	128	108				210	199	162	26
Slovenia	109		108		128	109			118	198			33
Slovakia	99	113	97	104	97	101			88	220	194	191	30
Finland	111		140	102	107					244			35
Sweden	112		112	99	111					235			
United Kingdom	119			108	112					226			
Average	**113.33**	**128.39**	**104.72**	**107.73**	**118.07**	**120.71**	**195.40**	**112.43**	**100.09**	**224.60**	**256.50**	**197.68**	**33.75**
Min	**86.80**	**97.50**	**76.10**	**84.20**	**82.10**	**85.20**	**162.40**	**82.80**	**81.20**	**171.50**	**162.00**	**161.70**	**21.50**
Max	**140.70**	**156.30**	**139.80**	**151.90**	**364.70**	**161.80**	**222.80**	**149.70**	**139.60**	**258.60**	**797.60**	**239.90**	**47.10**
Standard Deviation	**13.08**	**19.04**	**14.88**	**14.35**	**58.71**	**25.62**	**25.04**	**34.10**	**16.02**	**19.98**	**191.09**	**26.74**	**6.44**

Source: Eurostat

Table 5: Main Arable crops product prices (2007)

	Soft wheat	Durum wheat	Rye	Barley	Oats	Maize	Rice	Sorghum	Triticale	Rape	Sunflower	Soya	Sugar beet
Belgium	177		89	180	95				124				33
Bulgaria	153	153	130	123	100	143	201	127	103	203	226	245	22
Czech Republic	165		158	142	192	151				267	269		31
Denmark	166		159	178	184				167	279			
Germany	179		167	169	159	190			182	287	894		30
Estonia	183		173	154	140					319			
Ireland	202				187								
Greece	235	234		225	226	254	175				250		23
Spain	203	230	178	184	158	205	271	198			394		32
France													
Italy													
Cyprus		155			360								
Latvia	189		164	167	142				146	271			34
Lithuania	187		154	182	149	219			154	264			34
Luxembourg	203		193	171	140	210			150	266			
Hungary	174	222	163	151	166	182	250	147	148	252	340	272	30
Malta													
Netherlands	190		167		192	195			188	304			42
Austria	165	218	158		135	210			143	260	316	248	31
Poland	187		159	169	140	174			162	253			29
Portugal	179	210	160	180	155	219	281		164		325		32
Romania	183			201	228	231				237	252	234	27
Slovenia													
Slovakia	163	183	173	170	149	171			117	247	341	244	27
Finland	160		192	146	150					285			32
Sweden	206		201	173	163					332			
United Kingdom	160			135	134					277			
Average	**182.17**	**200.45**	**163.24**	**168.36**	**167.10**	**196.60**	**235.44**	**157.27**	**149.78**	**270.76**	**360.68**	**248.72**	**30.59**
Min	**152.50**	**152.60**	**89.40**	**123.30**	**95.30**	**143.20**	**174.80**	**126.80**	**103.20**	**203.30**	**225.90**	**234.00**	**22.26**
Max	**235.10**	**233.80**	**201.00**	**224.80**	**360.40**	**253.60**	**280.80**	**198.10**	**187.50**	**332.40**	**893.60**	**271.60**	**42.00**
Standard Deviation	**19.44**	**32.87**	**24.70**	**23.48**	**53.20**	**30.57**	**45.91**	**36.76**	**24.26**	**30.48**	**194.34**	**13.89**	**4.69**

Source: Eurostat

Table 6: Land Prices and Land Rent

	Price (€/ha)					*Land Rent (€/ha)*		
	Agricultural land	Arable land	Meadow	Irrigated land	Non-irrigated land	Agricultural land	Arable land	Meadow
Malta	303					932	932	
Denmark	25,745	26,858	13,561			551	579	237
Netherlands	34,969					444		
Luxembourg	18,001	18,365	16,571			179		
Spain	11,070	13,259	4,475	29,134	8,132	167	192	79
Hungary						87	92	39
Slovakia	1,121					17		
Lithuania	241					12		
Finland	6,250							
Sweden	3,957							
Latvia	2,500							
Czech Republic	1,867							
Belgium								
Bulgaria		1,202					102	
Germany								
Ireland								
Greece				12,024	4,952		508	
France								
Italy								
Austria							305	154
Poland		848	574				26	18
Romania								
United Kingdom								
Average	**9,638**	**12,106**	**8,795**	**20,579**	**6,542**	**298**	**342**	**105**
Min	**241**	**848**	**574**	**12,024**	**4,952**	**12**	**26**	**18**
Max	**34,969**	**26,858**	**16,571**	**29,134**	**8,132**	**932**	**932**	**237**
Standard Deviation	**11,731**	**11,222**	**7,515**	**12,099**	**2,249**	**322**	**311**	**90**

Source: Eurostat

Table 7: Average Hourly Labour Cost (€)*

	2000	2001	2002	2003	2004	2005	2006
Austria							
Belgium					29.19	29.67	30.56
Bulgaria	1.20	1.28	1.35	1.42	1.51	1.61	1.71
Cyprus	9.88	10.24	10.86	11.44	12.03	12.71	13.13
Czech Republic	3.69	4.46	5.24	5.47	5.78	6.56	7.14
Denmark						30.74	31.80
Estonia	2.84	3.19	3.62	3.98	4.25	4.71	5.49
Finland	22.13		23.40	24.36	24.87	26.15	26.83
France							
Germany	25.10	25.70	26.30	26.80	26.90	27.10	27.50
Greece							
Hungary				5.34	5.72	6.57	6.52
Ireland							
Italy							
Latvia	2.24	2.34	2.50	2.49	2.64	2.91	3.58
Lithuania	2.60	2.73	2.90	3.11	3.26	3.62	4.27
Luxembourg					30.34	31.40	32.39
Malta			8.52	8.77	8.68	9.51	9.69
Netherlands							
Poland	4.51	5.39	5.38	4.88	4.92	5.78	6.28
Portugal					11.30	11.70	12.13
Romania	1.39	1.52	1.64	1.60	1.78	2.38	2.82
Slovakia	2.84	3.04	3.32	3.85	4.23	4.59	5.15
Slovenia	9.56	10.44	10.36	11.36	11.12	11.49	12.01
Spain	14.38	13.28	13.84	14.47	15.03	15.53	16.15
Sweden					29.00	29.44	30.21
United Kingdom	23.27	23.93	24.66	23.19	24.49	24.89	
European Union 27	**n/a**	**n/a**	**n/a**	**n/a**	**18.05**	**18.50**	**-**
Min	**1.20**	**1.28**	**1.35**	**1.42**	**1.51**	**1.61**	**1.71**
Max	**25.10**	**25.70**	**26.30**	**26.80**	**30.34**	**31.40**	**32.39**

Source: Eurostat

****All NACE branches except agriculture, fishing, private households with employed persons***

Table 8: Hourly Labour Cost (€) in services

	2000	2001	2002	2003	2004	2005	2006
Austria	22.38	22.73	22.89	23.95	24.10	25.02	25.49
Belgium	25.51	26.71	27.92	28.53	29.07	29.49	30.29
Bulgaria	1.12	1.20	1.24	1.31	1.39	1.52	1.64
Cyprus	9.01	9.36	9.79	10.49	10.90	11.37	11.62
Czech Republic	4.10	4.94	5.66	5.74	6.21	7.25	7.48
Denmark	27.30	29.86	29.72	31.01	31.34	32.70	33.66
Estonia	2.90	3.33	3.86	4.23	4.38	4.73	5.61
Finland	22.34	23.69	22.90	23.90	24.61	25.78	26.35
France	24.81	26.01	27.08	27.69	28.38	29.24	30.36
Germany	23.20	23.70	24.20	24.90	24.90	25.20	25.30
Greece	11.04	11.74	12.67	13.71			
Hungary				5.27	5.75	6.30	6.67
Ireland							
Italy		19.90	20.52				
Latvia	2.24	2.29	2.43	2.41	2.55	2.81	3.45
Lithuania	2.65	2.82	2.98	3.22	3.29	3.68	4.24
Luxembourg	26.74	28.26	29.28	30.53	32.39	33.64	34.58
Malta			8.08	8.03	8.22	8.98	9.22
Netherlands	21.57	23.35	24.68	26.00	26.64	26.78	
Poland	4.72	5.57	5.55	4.94	4.94	5.76	6.21
Portugal	9.34	9.90	10.60	11.30	12.00	12.60	13.03
Romania	1.42	1.57	1.72	1.67	1.80	2.37	2.72
Slovakia	3.12	3.44	3.79	4.05	4.44	5.04	5.48
Slovenia	10.07	10.84	10.82	11.83	11.25	11.64	12.35
Spain	13.97	12.84	13.36	13.84	14.34	14.82	15.36
Sweden	29.14	27.94	29.22	30.85	30.88	31.39	32.18
United Kingdom	23.81	24.64	25.25	23.48	24.45	23.81	
European Union 27	**18.17**	**18.79**	**19.41**	**19.13**	**19.59**	**19.81**	**-**
Min	**1.12**	**1.20**	**1.24**	**1.31**	**1.39**	**1.52**	**1.64**
Max	**29.14**	**29.86**	**29.72**	**31.01**	**32.39**	**33.64**	**34.58**

Source: Eurostat

Table 9: Prices of agricultural inputs, 2007

	Electicity €/MWh	Heating gas oil €/m3	Residual fuel oil €/ton	Motor spirit €/m^3	Diesel oil €/m^3
Belgium	109		298	481	485
Bulgaria	78	923		968	944
Czech Republic					
Denmark		556			584
Germany					
Estonia					
Ireland				1,107	
Greece	40	586		1,017	961
Spain					592
France					
Italy					
Cyprus	258	584		584	172
Latvia					752
Lithuania	705	456		665	473
Luxembourg	1,307	4,824			4,724
Hungary		874	322	917	874
Malta					955
Netherlands					651
Austria	154	553			862
Poland					
Portugal	120				627
Romania		397	308	987	945
Slovenia					
Slovakia					
Finland	82	519			
Sweden					849
United Kingdom				1,377	588
Average	**317**	**1,027**	**309**	**900**	**943**
Min	**40**	**397**	**308**	**584**	**172**
Max	**1,307**	**4,824**	**322**	**1,377**	**4,724**
Standard Deviation	**466**	**1,512**	**10**	**268**	**1,094**

Source: Eurostat

Table 10: Prices of agricultural inputs, 2006

	Electicity €/MWh	Heating gas oil €/m3	Residual fuel oil €/ton	Motor spirit €/m^3	Diesel oil €/m^3
Belgium	102		277	484	473
Bulgaria	63	847		857	858
Czech Republic	75	463	214	1,044	1,022
Denmark		553			583
Germany					
Estonia					
Ireland		622	475	1,096	
Greece	38	576		975	926
Spain					584
France					
Italy					
Cyprus	261	591		591	174
Latvia					
Lithuania	691	390		617	464
Luxembourg	1,252	4,788			4,688
Hungary		689	559	797	726
Malta					982
Netherlands		650	360	1,232	650
Austria	145	571			841
Poland	113	663			987
Portugal	114				606
Romania		358	239	962	933
Slovenia	80	516		835	801
Slovakia					
Finland	79	523			
Sweden					873
United Kingdom				1,340	592
Average	**251**	**853**	**354**	**902**	**935**
Min	**38**	**358**	**239**	**591**	**174**
Max	**1,252**	**4,788**	**559**	**1,340**	**4,688**
Standard Deviation	**406**	**1,225**	**139**	**257**	**1,047**

Source: Eurostat

Table 11: Prices of fertilizers, 2007

	Sulphate of ammonia	Ammonium nitrate (26% N) (in sacks)	Ammonium nitrate (26% N) (in bulk)	Ammonium nitrate (33% N) (in sacks)	Urea	Superphosphate (18% P205)	Triple Superphosphate (46% P205)	Muriate of potash	Sulphate of potash
	€/ton of nutritive substance								
Belgium	117	202				164		208	298
Bulgaria	634			591	457	1,101	421	499	
Czech Republic									
Denmark									
Germany			749		595		262	407	
Estonia									
Ireland			851		682			427	
Greece	215	259		270	335	215	379		385
Spain	769	822		757	653	896	531	383	739
France	1,097		915	831	749	987	699	455	643
Italy									
Cyprus	258	292		343	378		343		240
Latvia				24		182		243	
Lithuania		747		572	457	797	692	374	
Luxembourg			727				543	395	
Hungary				631	558	895		338	
Malta									
Netherlands		847	730		790	991	635	501	579
Austria			207		288			231	
Poland									
Portugal	925	990			754	1,027		456	
Romania				746	620				
Slovenia									
Slovakia	79		184		264	169			375
Finland		782							
Sweden		1,002							
United Kingdom				711	880		700	403	
Average	**512**	**660**	**623**	**548**	**564**	**675**	**520**	**380**	**466**
Min	**79**	**259**	**184**	**24**	**264**	**169**	**262**	**231**	**240**
Max	**1,097**	**1,002**	**915**	**831**	**880**	**1,027**	**700**	**501**	**739**
Standard Deviation	**426**	**288**	**300**	**272**	**198**	**378**	**168**	**81**	**190**

Source: Eurostat

Table 12: Prices of fertilizers, 2006

	Sulphate of ammonia	Ammonium nitrate (26% N) (in sacks)	Ammonium nitrate (26% N) (in bulk)	Ammonium nitrate (33% N) (in sacks)	Urea	Superphosphate (18% P205)	Triple Superphosphate (46% P205)	Muriate of potash	Sulphate of potash
	€/ton of nutritive substance								
Belgium	107	180				126		157	225
Bulgaria	546			510	422	952	376	499	
Czech Republic	111	184		174	276	173	233	214	326
Denmark									
Germany			691		528		211	384	
Estonia									
Ireland			827		674			412	
Greece	205	251		256	316	204	347		366
Spain	695	795		726	582	849	485	352	721
France	1,045		866	786	644	918	538	420	609
Italy									
Cyprus	226	278		313	347		330		226
Latvia				194		187		216	
Lithuania		690		507	393	742	605	313	320
Luxembourg			667				453	385	
Hungary	545			558	483	535		327	524
Malta									
Netherlands		808	691		663	958	554	488	555
Austria			190		278			215	
Poland				201	247	147	217		227
Portugal	819	919			649	920		429	
Romania	1,256			713	561				1,577
Slovenia		708			534				
Slovakia	70		168		237	145			343
Finland		749							
Sweden		960							
United Kingdom				643	788		475	335	
Average	**511**	**593**	**586**	**465**	**479**	**527**	**402**	**343**	**502**
Min	**70**	**251**	**168**	**194**	**237**	**145**	**211**	**215**	**226**
Max	**1,256**	**960**	**866**	**786**	**788**	**958**	**605**	**488**	**1,577**
Standard Deviation	**425**	**254**	**288**	**231**	**172**	**356**	**138**	**82**	**398**

Source: Eurostat

Table 13: Prices of fertilizers, 2007

	Binary fertilizers 1 - 1 - 0	Binary fertilizers 0 - 1 - 1	Binary fertilizers 0 - 20 - 20	Ternary fertilizers 1 - 0;5 - 0;5	Ternary fertilizers 20 - 10 - 10	Ternary fertilizers 1 - 1 - 1	Ternary fertilizers 17 - 17 - 17	Ternary fertilizers 1 - 1 (in bulk)	Ternary Fertilizers 17 - 17 (in bulk)	Ternary fertilizers 1 - 1 - 2	Ternary fertilizers 9 - 9 - 18	Ternary fertilizers 1 - 2 - 2	Ternary fertilizers 10 - 20 - 20
							€/ton merchandise						
Belgium	267		198										
Bulgaria	225						309						
Czech Republic													
Denmark													
Germany	253	189						246					273
Estonia													
Ireland		235						274		288			
Greece	279					199							
Spain				343	343	193	286			175		175	
France		332	260			319	319	303	303	330	276		
Italy													
Cyprus			292		343	343							
Latvia					284	311	257						
Lithuania		246							194				277
Luxembourg	221	199							234			265	
Hungary							243		245				
Malta													
Netherlands	278					250	319					288	
Austria													
Poland													
Portugal	338							229		239			
Romania	288			243		243		308	288				
Slovenia													
Slovakia											230		
Finland													
Sweden													
United Kingdom		266		254		848	848			251		262	
Average	**269**	**245**	**250**	**280**	**323**	**338**	**369**	**272**	**253**	**257**	**253**	**248**	**275**
Min	**221**	**189**	**260**	**243**	**284**	**193**	**243**	**229**	**194**	**175**	**230**	**175**	**273**
Max	**338**	**332**	**292**	**343**	**343**	**848**	**848**	**308**	**303**	**330**	**276**	**288**	**277**
Standard Deviation	**39**	**52**	**22**	**55**	**34**	**213**	**232**	**34**	**44**	**58**	**33**	**49**	**3**

Source: Eurostat

Table 14: Prices of fertilizers, 2006

	Binary fertilizers 1 - 1 - 0	Binary fertilizers 0 - 1 - 1	Binary fertilizers 0 - 20 - 20	Ternary fertilizers 1 - 0;5 - 0;5	Ternary fertilizers 20 - 10 - 10	Ternary fertilizers 1 - 1 - 1	Ternary fertilizers 17 - 17 - 17	Ternary fertilizers 1 - 1 (in bulk)	Ternary Fertilizers 17 - 17 (in bulk)	Ternary fertilizers 1 - 1 - 2	Ternary fertilizers 9 - 9 - 18	Ternary fertilizers 1 - 2 - 2	Ternary fertilizers 10 - 20 - 20
	€/ton merchandise												
Belgium	239		159										
Bulgaria	200						269						
Czech Republic	305						239				246		
Denmark													
Germany	231	169						226					320
Estonia													
Ireland		225						271		283			
Greece	266					189							
Spain				353	353	165	256	162	162	284	284		
France		277	216			288	288	274	274	303	254		
Italy													
Cyprus			278			295							
Latvia					227		199						
Lithuania						151			200		214	194	
Luxembourg	196	159							216			245	
Hungary						212	214					218	
Malta													
Netherlands	266					236	307					275	
Austria													
Poland					288		265				257		
Portugal	265							207		220			
Romania	248			233		233		288	243				
Slovenia													
Slovakia											202		
Finland													
Sweden													
United Kingdom		197		220		673	673			215		222	
Average	**246**	**205**	**218**	**269**	**289**	**271**	**301**	**238**	**219**	**261**	**243**	**231**	**320**
Min	**196**	**159**	**216**	**220**	**227**	**151**	**199**	**162**	**162**	**215**	**202**	**194**	**320**
Max	**266**	**277**	**278**	**353**	**353**	**673**	**673**	**288**	**274**	**303**	**284**	**275**	**320**
Standard Deviation	**28**	**48**	**44**	**74**	**63**	**159**	**163**	**48**	**42**	**41**	**34**	**31**	**-**

Source: Eurostat