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Pedersen, Søren Marcus; Bizik, Jan; Costa, Luisa Dalla; Coutinho, João; Dolezal, Frantisek; Gluska, Anna

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# Potato production in Europe – a gross margin analysis

Søren Marcus Pedersen, Jan Bizik, Luisa Dalla Costa, João Coutinho,  
Frantisek Dolezal and Anna Gluska

## *Abstract*

*The purpose of this paper is to examine different cropping practices, cost structures and gross margins for producing conventional table potatoes in 6 different regions within the European Union: Czech Republic, Denmark, Italy, Poland, Portugal and Slovakia. Findings from this study show that potato cropping practices varies significantly between these countries with major differences in yields and costs. Italy and Denmark are the two regions with highest gross margins due to high yields and revenues. Poland is by far the largest potato producing country among the 6 countries examined in this study. However, the production is primarily based on small scale farming with low yields and low economic revenues.*

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## Preface

This study is an integral part of the EU 5th framework programme project "Fertorganic" funded by the European Union and coordinated by the Danish Institute of Agricultural Sciences (DIAS). A main objective of the FERTORGANIC-project is to enhance the use of various fertilisers in farming systems and to develop new management strategies to improve the water and nitrogen application. The entire study focuses on potato cropping because the negative environmental effect in this high value crop is particularly high. In this subproject we emphasise on the production economic aspects of potato cropping practices in various regions, including production costs and gross margin levels for table potato production in different EU-member states. The study is conducted by:

Søren Marcus Pedersen, Food and Resource Economics Institute, KVL, Denmark

Jan Bizik, Hydromelioration, State Enterprise (RIIRDLE), Slovakia

Luisa Dalla Costa, University of Udine, Italy,

João Coutinho, Universidade de Trás-os-Montes e Alto Douro (UTAD), Portugal

Frantisek Dolezal, Research Institute for Soil and Water Conservation, Czech Republic (with co-authorship of Josef Zavadil, RISWC and Milan Cizek and Josef Vacek, Potato Research Institute Ltd.) and Anna Gluska, Plant Breeding and Acclimatization Institute (IHAR), Poland

Johannes Christensen, Food and Resource Economics Institute, KVL has assisted in the final revision of this working paper. Further information about the FERTORGANIC-project is available on the website: [www.fertorganic.org](http://www.fertorganic.org).

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Mogens Lund

# 1. Introduction

The accession of 10 new members into the European Union provides an opening and widening of the European market to 25 member countries for food and agricultural products and food commodities.

Table potato production and marketing is unique in the sense that the market price of potatoes fluctuates significantly during the season and from year to year. Moreover, table potatoes have a low durability compared to other agricultural bulk commodities. Unlike cereals and seed crops potatoes have to be consumed within a relatively short time. Cropping seasons and harvesting times may differ with several months between south and north European countries with relatively significant differences in table potato supplies. The market prices for fresh table potatoes can easily double the price of stored table potatoes.

The production of table potatoes has not, as for many other agricultural market regimes in European Union, been regulated by any production subsidies or area subsidies. In this respect an opening of the market with new member countries will, to a large extent, take place on equal terms from the very beginning.

In this study we present a comparative gross margin study of potato cropping in 6 European countries. The analysis includes 3 old member countries (Denmark, Italy and Portugal) and 3 new member countries (Poland, Slovak Republic and Czech Republic).

The 6 member countries represent a broad spectrum and variety of production regions in terms of soil characteristics, climate, land topography, labour costs and traditions.

## 1.1. Objectives

The objective of this project is to analyse the cost structure in various European potato producing countries and to describe the cropping practices in the 6 regions. Potatoes are regarded as high value crops which to a large extent depend on sufficient water supplies either from precipitation or irrigation, especially in the southern part of Europe. It is therefore important to understand what impact does climate, geographic location and differences in cropping practice have on crop yield, quality and eventually gross margins.

## **1.2. Method**

The project is divided in two parts. The first part is an explorative description of the cropping practices and market for potatoes in each country. The second part contains a multinational gross margin analysis for table potatoes among 6 field sites in different European countries. A questionnaire has been prepared and forwarded to colleagues at the research institutes in the 6 countries about economic costs and turnover and gross margin for producing table potatoes. The base reference year is 2002 for all countries except for the Czech Republic where 2003 data have been used. All costs are defined according to the same guidelines and principles although some management and cropping practices may differ between the various countries. Nevertheless, it is believed that a comparison like this provides a basic understanding of the cost structure and yield potential in the 6 countries despite of the differences.

Data for analysing the individual gross margins are based on sources like national statistics and data bases, including: Ministry of Agriculture of the Czech Republic, 2003 and 2004, Research Institute of Agricultural Economics, 2005, Cizek M., 2000, 2003 and 2005, The Danish Agricultural Advisory Service (Dansk Landbrugsrådgivning, Landscentret), several years, Central Statistical Office in Poland, 2001 and 2002, INE 2002, Portugal and Statistical yearbook of the Slovak Republic 2002.

## **1.3. Potato production, area and yield**

Poland is by far the largest potato producer in Europe in terms of potato area and total production. On the contrary, Slovakia is among the smallest producers. Improved management and technological development has, with the exemption of year 2003, enabled farmers to produce slightly higher yields in recent years. However, the production area for table potatoes has declined recently, implying that the total potato production has declined with about 40 percent in Poland and Czech Republic within the last 5 years. In Italy the potato area has declined with about 15 percent, whereas the potato area in Denmark, Portugal and Slovakia have declined between 5 and 10 percent.

**Table 1. Potato area, yield and production, 2003**

	Potato area harvested, 1,000 ha	Potato production, 1,000 tons	Potato seed production, 1,000 tons
Czech Republic	43	841	100
Denmark	36	1,530	90
Italy	73	1,604	190
Poland	766	13,732	2,050
Portugal	80	1,250	76
Slovakia	26	392	60

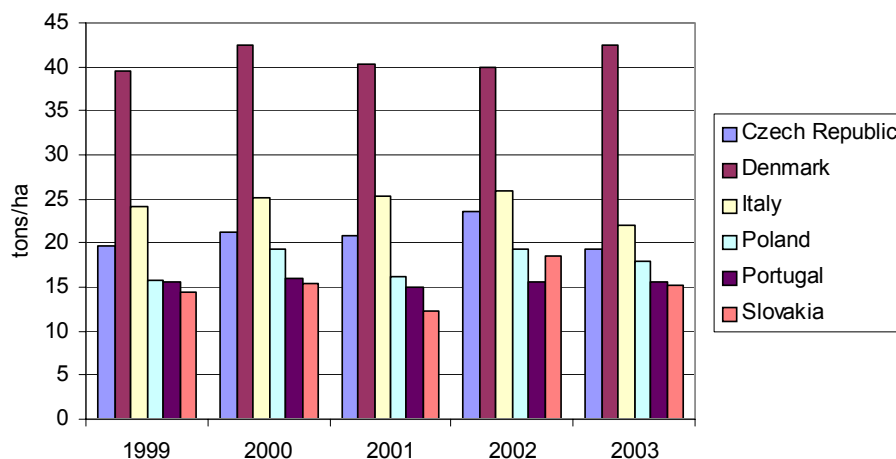
Source: FAO statistics, 2004.

In section 2-7 are provided a description of cropping practices, table potato production and supply in the 6 regions.

Figure 1 indicates that producers in most countries have obtained higher yields in recent years although the year 2003 was an exceptional harvest season. Particularly, in the southern part of Europe where drought and high temperatures have been the main reasons for modest yields in these areas.

In general, potato yields vary depending on crop variety, amount of precipitation and access to irrigation, solar radiation, fertility and soil conditions. In Denmark the average potato yield varies between 40 and 45 tons/ha whereas the average yield in Portugal, Poland and central European countries varies between 12 and 20 tons/ha.

**Figure 1. Potato yield, tons/ha**



Source: FAO 2004.

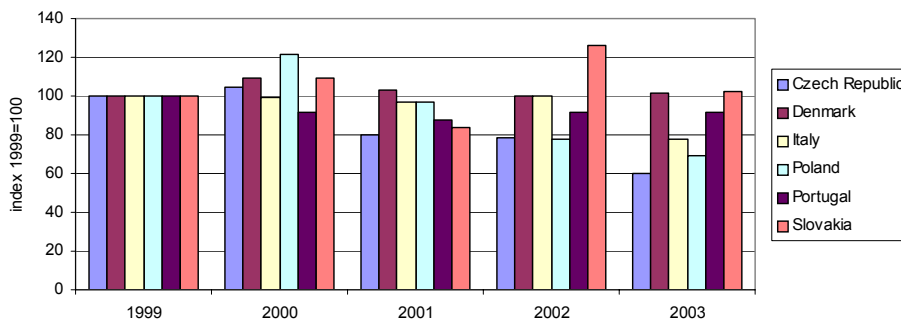
#### **1.4. Potato production**

The cropping season in 2003 turned out to be a very poor year in terms of potato yield in most European countries (especially the cropping season in Italy was recognised as a one of the driest periods for many years). Therefore we have focused on year 2002 for comparing gross margins as presented in section 8.

The general trend however, is that the total production of potatoes have diminished in Poland, Czech Republic and Italy whereas the production in the four other countries have been relatively stable partly due to higher yields on a reduced area with potatoes.



**Figure 2. Potato production**



Source: FAO 2004.

The production indices for potato seed production follow to some extent the pattern from potato production. It seems clear that potato seed production has declined in Poland (25 percent) and Czech Republic (40 percent) over the last five years whereas seed potato production has been fairly stable in Denmark, Italy, Portugal and Slovakia.

In the following section is given a short description of table potato production practices in the 6 EU-member countries.

It is attempted to describe the most common potato varieties and management practices in each region. What is characteristic for various regions regarding irrigation, input application and cultivation?

Moreover, a further examination of potato end applications have been made in this section (e.g. potatoes for human consumption, further processing, seed production or starch production).

## 2. Czech Republic

In the Czech Republic, the production of potatoes is divided between new table potatoes, ware table potatoes (other than new), potatoes for processing, for animal feed, starch production and seed potatoes.

The average yield in 2002 was 24 tons/ha with slightly higher average yields for starch potatoes (27.3 tons/ha) compared to ware potatoes and especially new potatoes (18,7 tons/ha).

The total potato area was 38,310 ha in 2002 of which 8,600 ha were planted with new potatoes and seed potatoes. The rest of the potato area was used for starch potatoes, and ware potatoes. In total, these cropping areas adds up to a total production in 2002 of 1.1 mill. tons, of which nearly 0.2 mill. tons are new table potatoes (Ministry of Agriculture of the Czech Republic, 2004). For many years a relatively large share of the potato harvest have been used for animal feed (pigs), in particular in years with good harvests (European Commission, 1998).

New potatoes are frequently grown under gun irrigation in lowlands. Late ware potatoes are grown in all regions but mostly on more elevated and more humid sites and without irrigation. Starch potatoes are grown in the same regions as the late ware potatoes, near the three existing potato starch processing plants in the Czech Republic.

Most widespread new table potato varieties (in 2002) were *Impala* and *Rosara*. Among the ware potatoes are the most common: *Marabel*, *Dali*, *Karin*, *Saturna*, *Laura*, *Agria*, *Filea* and *Marena*. Finally, the most common starch potato varieties are: *Ornella* and *Kuras*.

Farm ownership in Czech Republic is distributed among small independent private farmers, large commercial farms, cooperatives and state enterprises. The structure of the total land tenure (irrespective of potato growing) in 1997 was as follows: The average farm size among private independent farmers was 36 ha which accounts for about 25.1 percent of the agricultural land area. The share among the commercial farms was about 35.4 percent and the average farm size was here 666 ha. Moreover, the average size of the cooperatives was 1,349 ha with a total share of the agricultural area of 38.7 percent. Finally, state enterprises had an average size of 864 ha but the share of the total agricultural land area was only about 0.5 percent (Ministry of Agriculture of the Czech Republic).

New potatoes in lowlands are planted from the end of February up to the middle of April, depending on weather conditions. Late ware potatoes are planted from the middle of April and up to the second week of May. The amount of seed potatoes is about 2.8-2.9 tons/ha with 38-53,000 plants per hectare and the distances between rows are usually 75 cm.

Practically all potatoes are fertilised both with mineral fertilisers and with farmyard manure. Spraying of late ware potatoes with pesticides is performed about 8 times during the season, because their growing season is long and the risk of late blight attack increases with the length of the season. On the other hand, the new potatoes with a short growing season, require only few pesticide applications (up to about 2-3 sprayings). Early new potatoes are sometimes grown under a cover of synthetic non-woven fabric to speed up their growth.

**Table 2. Production and use of potatoes in the Czech Republic, 2002**

	1,000 tons
Total harvest	1,106
Import in processed products for human consumption	123
Import in raw tubers	37
<b>Total</b>	<b>1,265</b>
<b>Use of potatoes</b>	
Export in processed products for human consumption	21
Export in raw tubers	5
Seed potatoes	145
Starch production	175
Human consumption	778
Loss and use for animal feed	141
<b>Total use</b>	<b>1,265</b>

Source: Ministry of Agriculture of the Czech Republic, 2004.

Stone separation (prevailing on highlands) but also in lowlands is mostly provided as a paid service. Sometimes, but less frequently, also the spreading of farmyard manure is provided as a paid service. Other operations are performed by farm enterprises themselves. Ware potatoes are usually grown in a four-year rotation, while new potatoes under irrigation are grown in shorter rotations and sometimes annually.

Early new potatoes are irrigated with self-mowing guns. Some small-size farmers also use fixed or manually transferable sprinklers. Drip irrigation or micro-sprinklers are applied on a few hectares only. All this relates to lowlands regions. The irrigation of late ware potatoes has up to now been attempted in an experimental way on only a few negligible areas.

### 3. Denmark

In Denmark, the production of potatoes is divided between table-potatoes, starch potatoes and seed potatoes. The total Danish potato production is distributed on about 37,652 ha and the average farm area with potatoes was about 8 ha for table potatoes and 15.2 ha for starch potatoes in 2002. There were in 2002 about 1,708 farmers who produced table potatoes and about 1,348 farmers who produced starch potatoes. Moreover, due to climatic conditions, a relatively large number of farmers (412) produced seed potatoes for export in 2002 (Danish Statistics, 2003).

Table potato production is usually located in regions with sandy soils. Most of these areas are irrigated with rain-gun irrigation systems which yields about 39 tons/ha per year. The share of first class quality is on average about 34 tons/ha with about 5 tons of secondary quality. Common table potato varieties are *Bintje* and *Sava*.

The majority of the production is used for starch production of which a large share is used in the North European paper industry, especially other Scandinavian countries. Moreover, the disease pressure is fairly low among Danish potato cropping systems implying that the production of seed potatoes is fairly large in Denmark. A large share of this production is exported to the Southern part of Europe and Northern Africa.

The average area with table potatoes among independent farmers is about 8 ha., which is relatively low compared with the average area for industrial potato producers (15.2 ha).

The total potato harvest was 1.5 mill. tons in 2002 of which about half of the production is used for starch production. Moreover, about 300,000 tons are used for human consumption. The rest is either exported as table potatoes, seed potatoes or further processed to potato starch (see table 3).

Potatoes are usually grown in an annual rotation with cereals (e.g. winter wheat). Potato production is mainly carried out on the medium clays to sandy soils in Jutland (primarily northern part) and Mid-Jutland and the Northern part of Sealand.

Potatoes are usually planted between early and medium part of April when the soil temperature is about 8<sup>0</sup> Celsius. The dept of sowing is about 5-10 cm and the distance between the potatoes along the rows are about 35-40 cm. Row distances are usually 75 cm but sometimes up to 90 cm.

Commercial/mineral fertilisers are the most common fertiliser for table potatoes, whereas slurry is primarily used for starch potatoes. Slurry and animal manure is usually used in limited amounts for table potatoes due to the timing of the mineralisation process and also due to the taste and quality of the potatoes.

Spraying with herbicides, fungicides etc. are carried out 8 times during the season and a major part of the fieldwork is carried out by contractors, especially highly specialized tasks such as harvesting and soil separation (Mathiesen 1999).

**Table 3. Production and use of potatoes in Denmark 2002**

	1,000 tons
Total harvest	1,504
Harvest – after loss	1,354
Import	212
<b>Use of potatoes</b>	
Export	197
Seed potatoes	91
Potato starch production	763
Other applications	64
Human Consumption	306
Fodder	145

Source: Danish Statistics, Agricultural Statistics 2003.

Stone separation is a part of the seedbed preparation and is carried out to insure that stones are not mixed with potatoes before harvesting. Stone separation is not carried out at all fields but is still relatively common. Harrowing and ploughing is usually carried out by the farmer himself.

Although the precipitation level is fairly high in most parts of the country, irrigation is still a common practice among potato producers. Most systems are based on mobile gun irrigation systems with local wells on the fields.

## 4. Italy

Potato production has decreased by 20 percent in Italy due to reduced potato areas from 1999-2003 but the area restrictions have been compensated by higher yields 22.4 - 25.9 tons/ha. The annual potato production in Italy was about 2 mill. tons in year 2002 and 1.6 mill tons in 2003 with an total potato area at about 80.000 ha. About 65 percent of the production is located in the southern part of Italy. It is difficult to estimate and identify a mean yield because of the co-existence of several types of potatoes and varieties. Table potatoes for fresh consumption (common potato) will reach a yield of more than 30 tons/ha, but in the southern regions of Italy with low yields, it is often economic viable to have an extra-seasonal production.

The late-season potato are sown between August and September and harvested between January and March and the early potatoes are sown between January and February and harvested in June. Both rotations are far less productive (about 8 tons per ha) compared to one yield per season, but the price can vary due to variation in marked supply during the year.

Most of the Italian potato production (45 percent) is located in 3 regions: Campania (a region near Naples) 22 percent, Emilia-Romagna (the region around Bologna) 12 percent and Abruzzo, 11 percent. Other important areas for cultivation are Lazio, Veneto and Calabria.

The Italian potato farmers produce about 600,000 tons as extra-seasonal production. This production takes place on approximately 30,000 ha. The areas devoted to these crops (late-season potatoes and early potatoes) are located in southern Italy: Campania, Puglia, Sicily and Calabria.

Most common potato varieties are: *Monalisa*, *Spunta*, *Primura*, *Arsy*, *Sirco*, *Agata*, for common table potatoes; *Aminca*, *Alemania*, *Spunta* and *Nicola* for extra-seasonal. For ware potatoes and (industrial production) the most applied varieties are *Hermes* in the northern part, *Agria* in the central part, and *Lady Rosetta* in the Southern part of Italy.

As indicated, the Italian production of potatoes for human consumption is divided into ware potatoes, early potatoes, and late season potatoes of which the latter is planted in August-September. In addition there is a production of seed potatoes and starch potatoes.

The planting distance is usually 70-80 cm between rows and 16-25 cm along rows. Fertilization is normally applied with 140 kg N (max 250 kg N) generally in 2-3 split applications, 100 kg P and 180-250 kg K. The fertilizers that are chosen differs according to the soil type and farmers experiences, cultural background and preferences.

Every type of production is characterised according to the climatic zone and soil conditions with specific planting and harvest periods. Therefore, there may be several production seasons during the year. The quantity of harvested potatoes depends on the type of production. On average the yield is about 26 tons/ha, but for commercial potato production the average is higher at about 40 tons/ha.

Farm management is typically carried out by the farmer and his family on relatively small holdings. Almost all fertiliser that is used for potatoes are commercial/mineral types. Slurry and animal manure are seldom used due to a low diffusion of animal farm holdings.

**Table 4. Production and use of potatoes in Italy 2002**

	1000 tons
Total harvest	2,074
Harvest – after loss	1,959
Import	530
<b>Use of potatoes</b>	
Export	312
Seed potatoes	190
Other applications	300
Human Consumption	1,207

Source: FAOSTAT, 2003.

Weed control is generally applied in single treatments, in pre-sowing or, later, after the emergence of the plant. Only in case of severe weed attacks further treatments are required and specific herbicides will be applied. A further weed control is also obtained from ridging. Fungicide are usually largely used (5 or more applications, according to the seasonal requirements), and guided by thresholds values. Soil disinfestations in pre-planting or at ridging is crucial for obtaining a good plant stand, in fighting against *Elateridae* and *Noctuidae* and *Colorado Beetles*.

Harrowing (applied in case of planting of a catch crop after potato lifting) and ploughing (in case of winter-cereal planting) is normally carried out by the farmer himself.

## 5. Poland

Potato production in Poland covers about 10 percent of the total agricultural area and has always been an important crop in Poland produced by many farmers in small scale. Potatoes are semi-subsistence crops used mainly for consumption at home and animal feed with only a relatively small marketable share. Potatoes are often grown on poor sandy soils and yields have been relatively low compared to many neighbour countries. Average yield is about 19 tons/ha and a fairly large share of the production is used directly on the farm. The share used for processing is used for starch production and alcohol production. Moreover, a large share of the potatoes have been used for animal feed although this share have declined in recent years (European Commission, 1998).

There are about 112 registered potato varieties of which 77 percent are table potatoes and 35 varieties of starch potatoes. The most common table potato varieties are *Irga*, *Aster*, *Bryza*, *Sante*, *Drop* and *Bila*.

In year 2002, the cultivated potato area in Poland was about 0.8 mill. ha. About 540,000 ha are devoted to small scale farming with of about 1.4 mill. farmers. The total potato area is less than 0,5 ha on these farms and most of the farmers use their production for animal fodder, table potatoes for self provision, reproduction (seed potatoes) and any additional production might be used as a cash crop. In total, the small scale farmers produced about 9.5 mill. tons in 2002 (IHAR Jadwisin 2004).

In addition, about 200,000 ha is cultivated by specialized potato farmers. These farmers are specialized in table potatoes (100,000 farms), seed potatoes (6,500 plantations), starch potatoes (20,000 farmers) and potatoes for processing (400 farmers).

The first three groups have on average a plantation area of about 1-2 ha, whereas the farmers who produce potatoes for processing usually are much larger at about 50 ha. The application of animal manure is still fairly high on these farms (50-80 percent use manure) and the application of mineral fertiliser on the larger farms is much higher compared to the applications at the small scale farms. On those farms that produce potatoes for processing the application of manure is only occasional.

About 95 percent of the potato farmers use animal manure for fertilisation in combination with mineral fertilisers and the fertilisation level is about 25 percent of the level used on specialized potato farms.



Pesticide application varies also among the different holding types. The number of treatments against *Phytophthora infestans* varies between 1 and 12 times, whereas the number of treatments against *Phytophthora infestans* in small scale farming is either avoided or treated once a year.

Irrigation is primarily carried out on the specialized farms whereas the small farms have to rely on the annual precipitation.

Storage facilities are either cellars or clamps located on the field. For the specialised potato producers it is common to use warehouse facilities for the potatoes that are further used in the processing industry. For seed potatoes it is common to use adapted houses for storing the potatoes.

Stone removal on the field is carried out occasionally on the smaller farms and more regular on the larger farms.

The crop is usually cultivated in rotation with cereals and placed usually after cereals, one potato-field in a four year-rotation. Only at some farms, which produce early potatoes it might be possible to rotate after 3 years. A typical planting time for potatoes is in April.

Fertilization with manure and slurry is common on small farms where the dose rate is up to 30 tons/ha in autumn or spring depending on the organization and management on the farm. Mineral fertilizers are common as initial nutrients before planting: Mineral fertilizers are usually applied with 100-400kg/ha NPK depending on the farm type and the production target.

The row distances is usually between 67 cm and 75 cm and for some farms it goes up to 90 cm. Plant spacing along the rows is 35-50 cm, which adds up to a total number of plants of about 45,000 plants per hectare.

Row forming (ridging) and weed mechanical control is carried out with 3-4 treatments per year and chemical weed control, mainly *Afalon*, is applied before plant emergence in the middle of May. Herbicides are applied on about 78 percent of the cultivated area and sprayings against *Colorado Beetle* is carried out about 2-4 times during the year. Moreover, sprayings against late blight is carried out 2-4 times depending on the disease pressure but usually not on very small farms. When producing potatoes for processing the crop is treated up to 12 times during the year.

**Table 5. Production and use of potatoes in Poland 2002**

	1000 tons
Total harvest	15,441
Import	43
<b>Use of potatoes</b>	
Export	60
Seed potatoes	1,950
Human consumption - Self-provision	2,600
Human consumption - Ware potatoes	1,980
Industry and processing	1,610
Fodder	5,434
Wastes and losses	1,850

Source: SCO, 2002.

The natural maturity of the mid-early potatoes is in the first week of September and the natural maturity of the mid/late potatoes is in the second week of September. Moreover, the natural maturity of the late potatoes are usually in the third week of September. Harvest in full maturity stage is mainly carried out from mid September to mid October. Most common harvest methods are potato harvesters with two-row diggers or simply by picking the potatoes by hands. On the larger farm it is usually harvesters of different types that are applied. Storage facilities include mainly clamps and cellars whereas storage buildings are rare in Poland (IHAR Jadwisin, 2004).

## 6. Portugal

Portugal produces about 0.8-1.2 mill. tons on about 53,000 ha in 2002. The large majority of the production was table potatoes. Seed potatoes, which are mainly for domestic use, constitute a very small share of the area (INE, 2002).

The potato production is basically divided into 4 types:

- Seed potatoes, with a very small area (about 60 - 70 ha per year)
- First early varieties, which traditional are used on Eastern Sunday. Hereafter the demand decreases, as people are waiting for a reduction in the price. The most common variety for this type of production is *Spunta*.
- Table potatoes for long-term storage, which represents most of the area. Most common varieties are *Desiree*, *Kennebec*, *Jaerla*, and a few others.
- Potatoes for further processing to potato chips accounts for a small area. These potatoes are produced under contract with the two main processing factories, with the varieties imposed by the factories.

Most potato production is based on table potatoes with no production of potato starch as well as potatoes used for alcohol production.

Portugal has a large processing unit for potato chips (English crisps) that belong to the Pepsico group, but most of the raw material is coming from Spain. Moreover, two additional units, which are very small, produce potato chips for the Portuguese market. The amount of potatoes processed for chips is about 60,000 tons per year. About 45,000 tons are for the Pepsico factory and the small unit's process about 15,000 tons per year.

Potatoes are grown as spring crops and planted from February until May in the coastal regions, which are almost frost free. Most potatoes are grown in the Northern regions, where the winter is very cold, with late frost periods and farmers in the area along the Tagus Valley have initiated potato production in large scale, grown under contract to be processed as chips.

The application of seed varies between 1.5 and 2.5 tons/ha with row distances between 60 and 80 cm. Commercial and mineral fertilisers are the most common fertiliser for table potatoes, whereas farmyard manure is primarily used in the northern part of the country.

Spraying is carried out 3 to 6 times, depending on the year, region and time of the year. *Late blight* and *Colorado potato beetle* are important enemies of the crop, originating every year with heavy losses, due to lack of control. Moreover, poor irrigation management is often responsible for poor potato yields in many regions.

**Table 6. Production and use of potatoes in Portugal 2002**

	1,000 tons
Total harvest	781
Harvest – loss	-
Import	404
<b>Use of potatoes</b>	
Export	53
Seed potatoes <sup>1)</sup>	76
Potato starch production	-
Other applications	-
Human Consumption	964
Fodder	-

1) 2001 data.

Source: INE - Statistics Agr, 2001, 2002.

As the rain decreases, from March until September, the potatoes should be irrigated regularly. Usually potatoes are irrigated by furrow irrigation which is the most common method used for both small and large fields. Sprinkler systems, either mobiles or solid sets are used with medium range sprinkles.

Potatoes are harvested with traditional potato harvesters that harvest, charge and clean the tubers and drop them in a big-bags (one tons for each bag) for further handling and transport.

## 7. Slovakia

Slovakia is a small nation in terms of potato production. The total harvest of potatoes in Slovakia was between 0.3 and 0.5 mill. tons in the years 2001-2003. Potato production is divided between table-potatoes, starch potatoes and seed potatoes with an aggregated total of about 26,100 ha in 2002. The largest area was used for table potatoes (23,907 ha) and the rest is planted with seed potatoes (2,043 ha). Slovakia is almost self sufficient with table potatoes with an import of about 20-30,000 tons. Only a minor share of the production (150 ha) was processed to potato starch (Slovak Republic, 2002).

The production of table potatoes and potatoes for processing is usually located in regions with medium soils. Most of these areas are in the southern part of Slovakia and irrigated with rain-gun irrigation systems. Common table potato varieties in Slovakia are *Adora*, *Agria*, *Impala* and *Rosara*.

Planting of potatoes, planting density and harvesting times follows to a large extent the cropping practices in Czech Republic (see above).

Potatoes are usually grown in an annual rotation with cereals such as winter wheat. Commercial and mineral fertilisers are the most common fertiliser for table potato production, although farmyard manure, in a solid form, is more popular in comparison with slurry. Slurry and animal manure is usually used in limited amounts for table potatoes due to the timing of the mineralisation process and quality.

Spraying with herbicides, fungicides etc. are carried out 8 times during the season. Some fieldwork is carried out by contractors, especially highly specialized tasks such as harvesting and soil separation. Harrowing and ploughing is usually carried out by the farmer himself. Soil separation and stone separation is carried out only in some areas of North Slovakia and for comparison more often in the Czech Republic.

Some areas are irrigated with linear 480 m wide irrigation machines, developed by the Bauer company, and a few areas are under drip irrigation. In the year 2002, the total annual yield was about 18 tons per ha but farmers that use irrigation techniques usually achieve nearly 40 tons per ha.

Sensitive areas to water deficiencies and areas without the possibility of using irrigation are mostly located in the middle and eastern part of Slovakia. The yields here are often below the above mentioned average yields.

However, even though that the yield for many farmers are fairly modest without irrigation systems, there are also highly efficient potato farmers. Some farmers belong among the most efficient potato producers in Europe with total potato areas of about 300 ha. Several farmers use state of the art technologies and growing systems including irrigation with rain gun, linear type and drip irrigation systems. In this matter it is difficult to describe typical and average potato farming practices in Slovakia.

**Table 7. Production and use of potatoes in the Slovak Republic 2002**

	1,000 tons
Total harvest	484
Harvest - loss	478
Import	22
<b>Use of potatoes</b>	
Export	0,6
Seed potatoes	33
Potato starch production	3
Other applications	72
Human Consumption	368
Fodder	4

Source: Statistical yearbook of the Slovak Republic 2002.

## 8. Gross margins for table potatoes

Table 8 presents a gross margin analysis for table potato production in year 2002 for in the 6 European countries as presented above. The analysis is based on data provided by project participants from each country. As previously indicated, the various regions differ in terms of farm structure, soil conditions and climatic conditions.

Each participant have followed identical guidelines about data requirements outlined by the Food and Resource Economics Institute, KVL. In this respect the costs may be regarded as reasonable estimates for common table potato practices in the various regions. Nevertheless, the cost structure and gross margin studies for each area should be regarded as case studies for that particular region rather than average figures for the entire country.

This approach may involve some uncertainties and a direct comparison between the countries should be regarded with reservations. Market prices may vary significantly during cropping season and access to irrigation as well as soil conditions may also have a large impact on the economic revenue. Moreover, for some countries pests and insects may have been abnormal for that particular year with excessive application of pesticides.

In Czech Republic the region is divided between the highlands without irrigation (Bohemian-Moravian Highland region) and lowland areas with irrigation. The regions where the irrigated early new potatoes are grown comprise of the Labe and Ohre lowlands in Central and North Bohemia and the Dyje-Svratka lowland and the Lower Morava lowland in South Moravia. The soil texture in all potato growing regions is typically light or medium (loamy sand to loam).

In Denmark, the gross margin analysis may represent all regions in Denmark with sandy loam soils. Most potatoes are grown on the peninsula of Jutland on Sealand as well as the islands south of Sealand.

In Italy this case study can be related to the Veneto area in the northern part of Italy although most of the table potato production is located in the area around Bologna and in Southern Italy. In Portugal the gross margin analysis refers to the littoral centre of the country (Mondego and Tájus Valley). In Poland it is in the region of the central part of the country. Finally, in Slovakia the gross margin study refers to the lowland areas where it is possible to irrigate.

Despite the differences in cropping practices and climatic conditions this analysis might nevertheless give an indication of the cost levels for various cultivation practices between the individual countries. By comparing the various costs it is possible to establish a picture of the level of mechanization in the various countries and how intensive the input factors are applied among different regions.

The revenue from potato production consists of a first quality and a secondary quality. By subtracting the variable costs from the yearly revenue we obtain gross margin I. Here *variable costs* relates to the costs of using a particular variable input that may vary within a particular year (e.g. the use of nitrogen and pesticides).

*Cost of machinery and labour* is based on average annual contracting prices. In this respect it is assumed that these costs (price per unit) include capital costs (depreciation and cost of capital) and labour costs. For instance the cost of *distributing mineral fertiliser* in Denmark is 15 EUR/ha for one treatment (average cost including labour and capital costs).

A gross margin usually indicates the income farmers have left for fixed costs and profits. As presented here the gross margin II indicates the yearly amount left for paying the land rent and any profits. In this respect gross margin II also includes some of the fixed costs that are related to cultivating and harvest practices.

For all regions we have assumed medium soils with common potato cropping practices. Moreover the potato variety name, row distance, plant distance and share of organic and mineral fertilisers are indicated for each region in the appendix.



**Table 8. Gross margins for table potatoes 2002, EUR/ha**

REVENUE	CZECH I	CZECH II	DEN-MARK	ITALY	PO-LAND	POR-TUGAL	SLO-VAKIA
First quality:	3,080	3,490	5,145	5,455	2,500	3,000	2,358
Secondary quality:	52	30	125	590	185	150	180
<b>Total</b>	<b>3,132</b>	<b>3,520</b>	<b>5,270</b>	<b>6,045</b>	<b>2,685</b>	<b>3,150</b>	<b>2,538</b>
<b>VARIABLE COSTS:</b>							
Seed potatoes	802	802	550	705	375	558	806
<b>Fertilizers:</b>							
Nitrogen (N)	60	43	100	67	20	52	40
Phosphorus (P)	42	26	30	40	25	19	14
Potassium (K)	24	20	61	28	23	19	15
<b>Pesticides:</b>							
Herbicide	67	67	88	47	38	86	48
Fungi- and insecticides	167	56	63	103	51	36	31
Treatment for withering, desiccant <sup>2)</sup>	50	50	47		38		58
<b>Other cost:</b>							
Seed treatment with fungicides	25	25	69	120		120	30
Slurry and manure	66	66			200	350	50
Sorting/grading	155	110	983	518	450	500	270
Transport/packing to wholesalers <sup>3)</sup>	317	226	295	1,295	150	38	225
<b>Variable costs, total</b>	<b>1,774</b>	<b>1,490</b>	<b>2,284</b>	<b>2,923</b>	<b>1,370</b>	<b>1,778</b>	<b>1,587</b>
<b>GROSS MARGIN I</b>	<b>1,357</b>	<b>2,030</b>	<b>2,986</b>	<b>3,122</b>	<b>1,316</b>	<b>1,372</b>	<b>952</b>
<b>COST OF MACHINERY AND LABOUR</b>							
Mineral fertilizer distribution	12	12	15	120	25	18	7
Slurry and manure distribution	55	54			100	50	41
Pre-planting cultivation	33	33	20	50	63	17	10
Planting of seed potatoes	71	70	117	170	57	42	36
Ridging	64	63	81	40	45	15	19
Spraying	66	33	190	232	53	89	23
Cutting the top	5	5	66	35	26	35	15
Harvest/potato lifter	113	112	507	700	268	209	242
Transport to farm yard	78	77	134	180	58	18	88
Harrowing (after harvest)	5	5	17	45	20	45	15
Ploughing	35	35	60	75	78	34	44
<b>Other costs:</b>							
Irrigation, fixed costs		74	163	120		132	4)
Irrigation, variable costs (water use)		69	79	120		221	
Fabric cover in CZ		64					
Fixed costs 1)	457	444					
<b>Machinery and labour cost, total</b>	<b>992</b>	<b>1,150</b>	<b>1,449</b>	<b>1,887</b>	<b>793</b>	<b>905</b>	<b>540</b>
<b>GROSS MARGIN II</b>	<b>365</b>	<b>880</b>	<b>1,537</b>	<b>1,235</b>	<b>523</b>	<b>467</b>	<b>412</b>

Czech I is related to potato cropping in the highlands without irrigation, Czech II is on lowlands with irrigation.

1) Costs are separated and not distributed on the cultivation practices, all data are from 2003.

2) Desiccant is applied to control the tuber skin setting and tuber blight and to facilitate the lifting of tubers.

3) Same price used for Czech Republic as for Slovakia.

4) Fixed irrigation costs: 191 EUR/ha and variable costs (100 mm water): 130 EUR/ha.

The cost analysis should present a typical farming practice in potato specific regions on medium soil types for that region. However, a major difference is that for some regions it is common to irrigate whereas for other regions it is unusual to irrigate due to climatic conditions or simply because the farmers only manage very small plots.

In this gross margin analysis it is assumed that irrigation is applied in all countries except for late potatoes in the Czech Republic, Slovakia and Poland. Moreover, animal manure is applied in all countries except for Italy and Denmark.

Findings from this study show that the economic yield is highest in Italy followed by Denmark. Yield in Poland and the Slovak Republic is about half the size of the yield in Denmark and Italy. In general, the physical yields are highest in Denmark (see appendix) but the potato prices are fairly modest due to seasonality and market conditions implying that the economic yield is relatively low in Denmark. Differences in irrigation practices, soil conditions and farm structure are likely to explain some of the differences. However, for many areas it might also be possible to improve the farm management.

The costs of seed potatoes may be high in Czech Republic because the indicated mass of seed potatoes per hectare is high. Milan Cizek shows in Vokal et al. (2004) that typical costs of seed for ware potatoes and industrial potatoes are about 822 EUR/ha and 581 EUR/ha in Czech Republic, respectively.

Animal manure and slurry may be regarded as an internal cost for many farmers, implying that it is difficult to estimate the real costs for these inputs. In the Czech Republic the price of animal manure/slurry is about 4,8 EUR per tons, whereas the price in Portugal is assumed to be 35 EUR per tons.

The cost structure of mineral fertilisers seems to be more uniform among countries. Nitrogen fertiliser prices varies between 0,4 and 0,64 EUR per kg in most countries and the price of potassium is about 0,30 to 40 EUR per kg. However, the market price of potassium is significantly cheaper in Italy (0.14 EUR/kg) compared to the other European countries with the highest price in Portugal (0,63 EUR/kg). Potassium is only applied in large amounts in the Italian case region (200 kg/ha) and in Denmark (178 kg/ha) whereas the application level is only between 30 and 75 kg/ha in the other regions.

In Poland many farmers produce their own seed potatoes, which may explain the low costs for seed. However, the application levels of seed potatoes are relatively high in the East European countries despite similar planting densities to the other European countries. Especially in Czech Republic and Slovakia costs of seed potatoes seems fairly high.

Pesticide applications may depend on the weed pressure and the price of pesticides. In most countries the application levels include several treatments per year. However, the price of herbicides seems to vary significantly with relatively high prices in Portugal compared to the other countries. Fungi- and insecticide applications vary between 6-5 times in Denmark, Italy and the Czech Republic and between 2-4 treatments in the other countries. Again, the cropping practices may depend on cultural differences and climatic conditions.

In general, the cost of machinery and labour varies between about 800 and 1,900 EUR with the highest costs in Italy and the lowest costs in Poland. Spraying, harvest and seed potato planting costs are for instance significantly higher in Denmark and Italy compared to the other countries in this study.

In summary, gross margin II levels varies from about 360 EUR/ha on certain non-irrigated areas, whereas the gross margin II level on irrigated areas in Denmark and Italy may reach levels at about 1,200-1,500 EUR/ha. These findings may suggest a potential for optimizing cropping practices in several regions with focus on improved irrigation and fertilisation management as well as structural reforms towards larger production units.

## 9. Discussion and conclusions

This paper is an attempt to assess the cropping practices and cost structure for conventional potato cropping in 6 different regions within EU. Poland is by far the largest potato producing country among the 6 countries. However, the production is to a large extent based on small scale farming. Italy and Denmark are the two regions with highest gross margins due to high yields and revenues.

In recent years, table potato productions have declined in Poland, Czech Republic and Italy but have been relatively stable in Denmark, Portugal and Slovakia. The market for table potatoes is characterised by fluctuating market prices from year to year and within years.

Input application varies tremendously among the 6 regions. For most of the East- and Central European countries it is common to apply organic fertilisers such as farm yard manure and slurry. In Denmark and Italy it is more common to use mineral fertilisers. Potato prices and quality also seems to vary significantly, which may depend on the application levels and to what extent the farmer produce early or late potatoes.

The total potato area harvested has decreased significantly in particular Czech Republic and Poland. In the other countries the production output and acreage remains relatively stable.

Findings from this study show that potato cropping practices appear to vary between regions with significant differences in yields and costs. In Portugal and Italy, irrigation is a commonly used practice due to limited precipitation and high temperatures. In Denmark, irrigation is also a common practice in potatoes on sandy soils, whereas most of the east and central European countries do not irrigate.

Especially in the highlands of Czech Republic and Slovakia irrigation is rarely applied due to the land topography. Moreover in Poland the average farmer is more likely to grow potatoes on very small plots where it is difficult to justify investments in irrigation systems.

This gross margin analysis is based on average costs in typical potato producing regions. In this respect they do not represent an average estimate for each country. However, the study provides a good indication of cropping practices and economic performance in different regions of Europe.

Based on these findings it is clear that the implementation of new technology must be adapted to local conditions regarding field size, farm practice, animal production, access to organic farm yard manure and climatic conditions. Therefore, advisors and farm managers need to continue and make producers aware of the most profitable farming practices for their local conditions and markets.

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## Appendix

**TABLE A1 Gross margin analysis - Table potatoes, year/ha, Czech Republic I**

Number of plants pr. ha: <b>38-53000</b> pl/ha		Price per unit / EUR	Total EUR/ha
Fertiliser: Organic: Slurry and farm manure here: <b>50 percent</b> Commercial/Mineral share <b>50 percent</b>			
Soil type:	Medium		
YIELD	Kg		
First quality:	<b>22,943</b>	<b>0.1342</b>	<b>3079.0</b>
Secondary quality:	<b>3,262</b>	<b>0.0159</b>	<b>51.9</b>
Total	26,205		3130.8
<b>VARIABLE COSTS:</b>	Kg		
Seed potatoes	<b>2,900</b>	<b>0.3</b>	<b>801.7</b>
<b>Fertilizers</b>	Kg		
Nitrogen (N)	<b>125</b>	<b>0.5</b>	<b>60.1</b>
Phosphorus (P)	<b>81</b>	<b>0.5</b>	<b>41.9</b>
Potassium (K)	<b>59</b>	<b>0.4</b>	<b>23.6</b>
	Number of treatments		
Herbicide	<b>2</b>	<b>33.5</b>	<b>66.9</b>
Fungi- and insecticides	<b>6</b>	<b>27.9</b>	<b>167.5</b>
Desiccant	<b>1</b>	<b>49.9</b>	<b>49.9</b>
<b>Other cost:</b>			
Seed treatment with fungicides	<b>1</b>	<b>24.8</b>	<b>24.8</b>
Farmyard manure (tons)	14	4.8	65.9
	Kg		
Sorting/grading	<b>26,205</b>	<b>0.0059</b>	<b>154.6</b>
Transport/packing to wholesalers	<b>26,205</b>	<b>0.0121</b>	<b>317.1</b>
<b>Variable costs, total</b>			
<b>GROSS MARGIN 1</b>			
<b>Cost of machinery and labour</b>	Number of treatments		
Mineral Fertilizer distribution	<b>1</b>	<b>12.2</b>	<b>12.2</b>
Farm yard manure/Slurry distribution	<b>1</b>	<b>54.7</b>	<b>54.7</b>
Pre-planting cultivation	<b>2</b>	<b>16.6</b>	<b>33.1</b>
Planting of seed potatoes	<b>1</b>	<b>70.8</b>	<b>70.8</b>
Ridging	<b>1</b>	<b>63.7</b>	<b>63.7</b>
Spraying	<b>8</b>	<b>8.2</b>	<b>65.7</b>
Cutting the top	<b>1</b>	<b>4.6</b>	<b>4.6</b>
Harvest/potato lifter	<b>1</b>	<b>113.1</b>	<b>113.1</b>
Transport to farm yard	<b>1</b>	<b>77.6</b>	<b>77.6</b>
Harrowing (after harvest)	<b>1</b>	<b>4.6</b>	<b>4.6</b>
Ploughing	<b>1</b>	<b>35.1</b>	<b>35.1</b>
<b>Other costs:</b>			
Irrigation, fixed costs			
Irrigation, variable costs (e.g. 100 mm water)			
Soil separator			
Fixed costs	<b>1</b>	<b>456.8</b>	<b>456.8</b>
<b>Machinery and labour cost, total</b>			<b>992.1</b>
<b>GROSS MARGIN 2</b>			<b>364.7</b>

- (1) The expression "share" means the average percentage of the total nitrogen supply provided to the potato crop by a particular group of fertilisers (organic or mineral). Typically, the fertilisers of both groups are applied on the same field before potatoes: first the farmyard manure in autumn and then a mineral fertiliser in spring.
- (2) The quantity of mineral fertilisers is expressed in kg of elemental nutrients (N, P or K), without any balast.
- (3) High costs of pesticides and desiccants have been confirmed by a specialist and relate to late ware potatoes.
- (4) The actual typical application rate of farmyard manure is 40 t/ha. Here, only one third of this rate is taken, while the other two thirds are regarded as providing N to the other crops in the rotation.
- (5) The stone separation (stone windrowing) is included in the fixed costs.
- (6) The fixed costs include service (e.g., stone windrowing), overhead costs, depreciation, insurance and taxes, except for irrigation. The personnel costs are included in the machinery and labour costs.



**TABLE A2. Gross margin analysis - Table potatoes, year/ha, Czech Republic II**

Number of plants pr. ha pl/ha		38-53000	
Fertiliser: Organic: Slurry and farm manure are: <b>50 percent</b> Commercial/Mineral share <b>50 percent</b>		Price per unit / EUR	Total EUR/ha
Soil type:	Medium		
YIELD	Kg		
First quality:	16,785	0.2079	3490.0
Secondary quality:	1,865	0.0159	29.7
Total	18,650		
<b>VARIABLE COSTS:</b>	Kg		
Seed potatoes	2,900	0.3	801.7
<b>Fertilizers</b>	Kg		
Nitrogen (N)	90	0.5	43.2
Phosphorus (P)	50	0.5	26.0
Potassium (K)	50	0.4	20.0
	Number of treatments		
Herbicide	2	33.5	66.9
Fungi- and insecticides	2	27.9	55.8
Desiccant	1	49.9	49.9
<b>Other cost:</b>			
Seed treatment with fungicides	1	24.8	24.8
Farmyard manure (tons)	14	4.8	65.9
	Kg		
Sorting/grading	18,650	0.0059	110.0
Transport/packing to wholesalers	18,650	0.0121	225.7
<b>Variable costs, total</b>			1489.9
<b>GROSS MARGIN 1</b>			2029.8
<b>Cost of machinery and labour</b>	Number of treatments		
Mineral Fertilizer distribution	1	12.1	12.1
Farm yard manure/Slurry distribution	1	54.4	54.4
Pre-planting cultivation	2	16.5	32.9
Planting of seed potatoes	1	70.4	70.4
Ridging	1	63.2	63.2
Spraying	4	8.2	32.6
Cutting the top	1	4.6	4.6
Harvest/potato lifter	1	112.4	112.4
Transport to farm yard	1	77.1	77.1
Harrowing (after harvest)	1	4.6	4.6
Ploughing	1	34.9	34.9
<b>Other costs:</b>			
Irrigation, fixed costs	1	73.6	73.6
Irrigation, variable costs			69.3
Unwoven fabric cover	1	64.2	64.2
Fixed costs	1	443.7	443.7
<b>Machinery and labour cost, total</b>			1149.9
<b>GROSS MARGIN 2</b>			879.9

- (1) The expression "share" means the average percentage of the total nitrogen supply provided to the potato crop by a particular group of fertilisers (organic or mineral).
- (2) The quantity of mineral fertilisers is expressed in kg of elemental nutrients (N, P or K), without any balast.
- (3) High costs of pesticides and desiccants have been confirmed by a specialist.
- (4) The actual typical application rate of farmyard manure is 40 t/ha. Here, only one third of this rate is taken, while the other two thirds are regarded as providing N to the other crops in the rotation.
- (5) The price of the unwoven synthetic fabric cover including labour is about 40000 CZK/ha. It is assumed that its durability is two years and is used at about 10 % of total area.
- (6) The fixed costs include service (e.g., stone windrowing), overhead costs, depreciation, insurance and taxes, except for irrigation. The personnel costs are included in the machinery and labour costs.
- (7) The irrigation cost break down relates, in most cases, to another enterprise (irrigation provider). From the farmers' point of view, it usually all comes either as variable costs or as fixed cost.

**TABLE A3 Gross margin analysis - Table potatoes, year/ha, Denmark**

Number of plants pr. ha pl/ha	43-47000		
Fertiliser:		Price per unit / EUR	Total EUR/ha
Organic: Slurry and farm manure are: <b>0 percent</b> Commercial/Mineral share <b>100 percent</b>			
Soil type:	Medium		
YIELD	Kg		
First quality:	34,300	0.1500	5145.0
Secondary quality:	5,000	0.0250	125.0
Total	39,300	0.0	5270.0
<b>VARIABLE COSTS:</b>	Kg		
Seed potatoes	2,200	0.3	550.0
<b>Fertilizers</b>	Kg		
Nitrogen (N)	166	0.6	99.6
Phosphorus (P)	28	1.1	30.2
Potassium (K)	178	0.3	60.5
	Number of treatments		
Herbicide	2	43.8	87.5
Fungi- and insecticides	5	12.5	62.5
Treatment for withering/dying	1	46.9	46.9
<b>Other cost:</b>			
Seed Treatment with fungicides	1	68.8	68.8
	Kg		
Sorting/grading	39,300	0.0250	983.0
Transport/packing to wholesalers	39,300	0.0075	295.0
<b>Variable costs, total</b>			2284.0
<b>GROSS MARGIN 1</b>			2986.0
<b>Cost of machinery and labour</b>	Number of treatments		
Mineral Fertilizer distribution	1	14.9	14.9
Slurry distribution, organic 2)	0	0.0	0.0
Pre-planting cultivation	2	10.1	20.3
Planting of seed potatoes	1	116.9	116.9
Ridging	1	81.3	81.3
Spraying	8	23.8	190.0
Cutting the top	1	65.6	65.6
Harvest/potato lifter	1	507.0	507.0
Transport to farm yard	1	134.0	134.0
Harrowing (after harvest)	1	16.9	16.9
Ploughing	1	60.3	60.3
<b>Other costs:</b>			
Irrigation, fixed costs	1	162.5	162.5
Irrigation, variable costs			79.0
Soil separator	-	312.5	
<b>Machinery and labour cost, total</b>			1448.5
<b>GROSS MARGIN 2</b>			1537.5

**TABLE A4 Gross margin analysis - Table potatoes, year/ha, Italy**

Number of plants pr. ha	50000 pl/ha		
Fertiliser:		Price per unit / EUR	Total EUR/ha
Organic: Slurry and farm manure are: 0 percent			
Commercial/Mineral share 100 percent			
Soil type:	Medium		
YIELD	Kg		
First quality:	20,980	0.2600	5454.8
Secondary quality:	4,920	0.1200	590.4
Total	25,900		6045.2
<b>VARIABLE COSTS:</b>	Kg		
Seed potatoes	1,500	0.5	705.0
<b>Fertilizers</b>	Kg		
Nitrogen (N)	140	0.5	67.2
Phosphorus (P)	100	0.4	40.0
Potassium (K)	200	0.1	28.0
	Number of treatments		
Herbicide	2	23.4	46.8
Fungi- and insecticides	5	20.6	102.8
Treatment for withering/dying			
<b>Other cost:</b>			
Seed treatment with fungicides	1	120.0	120.0
	Kg		
Sorting/grading	25,900	0.0200	518.0
Transport/packing to wholesalers	25,900	0.0500	1295.0
<b>Variable costs, total</b>			2922.8
<b>GROSS MARGIN 1</b>			3122.4
<b>Cost of machinery and labour</b>	Number of treatments		
Mineral Fertilizer distribution	3	40.0	120.0
Slurry distribution, organic 2)	0	0.0	0.0
Pre-planting cultivation	1	50.0	50.0
Planting of seed potatoes	1	170.0	170.0
Ridging	1	40.0	40.0
Spraying	8	29.0	232.0
Cutting the top	1	35.0	35.0
Harvest/potato lifter	1	700.0	700.0
Transport to farm yard	1	180.0	180.0
Harrowing (after harvest)	1	45.0	45.0
Ploughing	1	75.0	75.0
<b>Other costs:</b>			
Irrigation, fixed costs	1	120.0	120.0
Irrigation, variable costs			120.0
Soil separator	-		
<b>Machinery and labour cost, total</b>			1887.0
<b>GROSS MARGIN 2</b>			1235.4

**TABLE A5 Gross margin analysis - Table potatoes, year/ha, Poland**

Number of plants pr. ha <b>45000</b> pl/ha			
Fertiliser: Organic: Slurry and farm manure are: <b>&gt;50 percent</b> Commercial/Mineral share <b>&lt;50 percent</b>		Price per unit / EUR	Total EUR/ha
Soil type:	Medium		
YIELD	Kg		
First quality:	<b>25,000</b>	<b>0.1000</b>	<b>2500.0</b>
Secondary quality:	<b>5,000</b>	<b>0.0370</b>	<b>185.0</b>
Total	30,000		<b>2685.0</b>
<b>VARIABLE COSTS:</b>	Kg		
Seed potatoes	<b>2,500</b>	<b>0.2</b>	<b>375.0</b>
<b>Fertilizers</b>	Kg		
Nitrogen (N)	<b>50</b>	<b>0.4</b>	<b>20.0</b>
Phosphorus (P)	<b>50</b>	<b>0.5</b>	<b>25.0</b>
Potassium (K)	<b>75</b>	<b>0.3</b>	<b>22.5</b>
	Number of treatments		
Herbicide	<b>1</b>	<b>38.0</b>	<b>38.0</b>
Fungi- and insecticides	<b>3</b>	<b>17.0</b>	<b>51.0</b>
Treatment for withering/dying	<b>1</b>	<b>38.0</b>	<b>38.0</b>
<b>Other cost:</b>			
Seed treatment with fungicides	<b>0</b>	<b>0.0</b>	<b>0.0</b>
Manure (tons)	<b>10</b>	<b>20.0</b>	<b>200.0</b>
	Kg		
Sorting/grading	<b>30,000</b>	<b>0.0150</b>	<b>450.0</b>
Transport/packing to wholesalers	<b>30,000</b>	<b>0.0050</b>	<b>150.0</b>
<b>Variable costs, total</b>			<b>1369.5</b>
<b>GROSS MARGIN 1</b>			<b>1315.5</b>
<b>Cost of machinery and labour</b>	Number of treatments		
Mineral Fertilizer distribution	<b>1</b>	<b>25.0</b>	<b>25.0</b>
Slurry distribution, organic 2)	<b>1</b>	<b>100.0</b>	<b>100.0</b>
Pre-planting cultivation	<b>2</b>	<b>31.5</b>	<b>63.0</b>
Planting of seed potatoes	<b>1</b>	<b>57.0</b>	<b>57.0</b>
Ridging	<b>3</b>	<b>15.0</b>	<b>45.0</b>
Spraying	<b>4</b>	<b>13.3</b>	<b>53.0</b>
Cutting the top	<b>1</b>	<b>26.0</b>	<b>26.0</b>
Harvest/potato lifter	<b>1</b>	<b>268.0</b>	<b>268.0</b>
Transport to farm yard	<b>1</b>	<b>58.0</b>	<b>58.0</b>
Harrowing (after harvest)	<b>1</b>	<b>20.0</b>	<b>20.0</b>
Ploughing	<b>1</b>	<b>78.0</b>	<b>78.0</b>
<b>Other costs:</b>			
Irrigation, fixed costs	-	-	-
Irrigation, variable costs (e.g. 100 mm water)	-	-	-
Soil separator	-	-	-
<b>Machinery and labour cost, total</b>			<b>793.0</b>
<b>GROSS MARGIN 2</b>			<b>522.5</b>

**TABLE A6 Gross margin analysis - Table potatoes, year/ha, Portugal**

Number of plants pr. ha pl/ha	<b>40-45000</b>		
Fertiliser: Organic: Slurry and farm manure are: <b>50 percent</b> Commercial/Mineral share <b>50 percent</b>		Price per unit / EUR	Total EUR/ha
Soil type:	Medium		
YIELD	Kg		
First quality:	<b>20,000</b>	<b>0.1500</b>	<b>300.0</b>
Secondary quality:	<b>5,000</b>	<b>0.0300</b>	<b>150.0</b>
Total	25,000		<b>3150.0</b>
<b>VARIABLE COSTS:</b>	Kg		
Seed potatoes	<b>1,800</b>	<b>0.3</b>	<b>558.0</b>
<b>Fertilizers</b>	Kg		
Nitrogen (N)	<b>82</b>	<b>0.6</b>	<b>52.5</b>
Phosphorus (P)	<b>30</b>	<b>0.6</b>	<b>18.9</b>
Potassium (K)	<b>30</b>	<b>0.6</b>	<b>18.9</b>
	Number of treatments		
Herbicide	<b>1</b>	<b>86.1</b>	<b>86.1</b>
Fungi- and insecticides	<b>2</b>	<b>18.0</b>	<b>36.0</b>
Treatment for withing/dyring			
<b>Other cost:</b>			
Seed treatment with fungicides	<b>1</b>	<b>120.0</b>	<b>120.0</b>
Manure	10	<b>35.0</b>	<b>350.0</b>
	Kg		
Sorting/grading	<b>25,000</b>	<b>0.0200</b>	<b>500.0</b>
Transport/packing to wholesalers	<b>25,000</b>	<b>0.0015</b>	<b>37.5</b>
<b>Variable costs, total</b>			<b>177.9</b>
<b>GROSS MARGIN 1</b>			<b>1372.1</b>
<b>Cost of machinery and labour</b>	Number of treatments		
Mineral Fertilizer distribution	<b>1</b>	<b>18.0</b>	<b>18.0</b>
Slurry distribution, organic 2)	<b>1</b>	<b>50.0</b>	<b>50.0</b>
Pre-planting cultivation	<b>1</b>	<b>17.3</b>	<b>17.3</b>
Planting of seed potatoes	<b>1</b>	<b>42.2</b>	<b>42.2</b>
Ridging	<b>1</b>	<b>15.2</b>	<b>15.2</b>
Spraying	<b>3</b>	<b>22.2</b>	<b>66.5</b>
Cutting the top	<b>1</b>	<b>35.0</b>	<b>35.0</b>
Harvest/potato lifter	<b>1</b>	<b>208.9</b>	<b>208.9</b>
Transport to farm yard	<b>1</b>	<b>18.4</b>	<b>18.4</b>
Harrowing (after harvest)	<b>1</b>	<b>45.0</b>	<b>45.0</b>
Ploughing	<b>1</b>	<b>34.5</b>	<b>34.5</b>
<b>Other costs:</b>			
Irrigation, fixed costs	<b>1</b>	<b>132.4</b>	<b>132.4</b>
Irrigation, variable costs			<b>221.5</b>
Soil separator			-
<b>Machinery and labour cost, total</b>			<b>904.8</b>
<b>GROSS MARGIN 2</b>			<b>467.3</b>

**TABLE A7 Gross margin analysis - Table potatoes, year/ha, Slovakia**

Number of plants pr. ha pl/ha	<b>42-44000</b>		
Fertiliser:		Price per unit / EUR	Total EUR/ha
Organic: Slurry and farm manure are: <b>50 percent</b> Commercial/Mineral share <b>50 percent</b>			
Soil type:	Medium		
YIELD	Kg		
First quality:	<b>14,870</b>	<b>0.1586</b>	<b>2358.4</b>
Secondary quality:	<b>3,720</b>	<b>0.0484</b>	<b>180.0</b>
Total	18,590		<b>2538.4</b>
<b>VARIABLE COSTS:</b>	Kg		
Seed potatoes	<b>2,600</b>	<b>0.3</b>	<b>806.0</b>
<b>Fertilizers</b>	Kg		
Nitrogen (N)	<b>80</b>	<b>0.5</b>	<b>40.0</b>
Phosphorus (P)	<b>15</b>	<b>0.9</b>	<b>14.0</b>
Potassium (K)	<b>50</b>	<b>0.3</b>	<b>15.0</b>
	Number of treatments		
Herbicide	<b>2</b>	<b>23.8</b>	<b>47.7</b>
Fungi- and insecticides	<b>4</b>	<b>7.8</b>	<b>31.3</b>
Treatment for withering/dying	<b>1</b>	<b>57.8</b>	<b>57.8</b>
<b>Other cost:</b>			
Seed treatment with fungicides	<b>1</b>	<b>30.0</b>	<b>30.0</b>
Manure	10	<b>5.0</b>	<b>50.0</b>
	Kg		
Sorting/grading	<b>18,590</b>	<b>0.0145</b>	<b>270.1</b>
Transport/packing to wholesalers	<b>18,590</b>	<b>0.0121</b>	<b>225.1</b>
<b>Variable costs, total</b>			<b>1586.8</b>
<b>GROSS MARGIN 1</b>			<b>951.6</b>
<b>Cost of machinery and labour</b>	Number of treatments		
Mineral Fertilizer distribution	<b>1</b>	<b>7.3</b>	<b>7.3</b>
Slurry distribution, organic 2)	<b>1</b>	<b>41.0</b>	<b>41.0</b>
Pre-planting cultivation	<b>1</b>	<b>9.7</b>	<b>9.7</b>
Planting of seed potatoes	<b>1</b>	<b>36.3</b>	<b>36.3</b>
Ridging	<b>1</b>	<b>19.4</b>	<b>19.4</b>
Spraying	<b>8</b>	<b>2.9</b>	<b>23.3</b>
Cutting the top	<b>1</b>	<b>14.5</b>	<b>14.5</b>
Harvest/potato lifter	<b>1</b>	<b>242.1</b>	<b>242.1</b>
Transport to farm yard	<b>1</b>	<b>87.9</b>	<b>87.9</b>
Harrowing (after harvest)	<b>1</b>	<b>14.5</b>	<b>14.5</b>
Ploughing	<b>1</b>	<b>43.6</b>	<b>43.6</b>
<b>Other costs:</b>			
Irrigation, fixed costs	-	-	-
Irrigation, variable costs (e.g. 100 mm water) 1)	-	-	-
Soil separator	-	-	-
<b>Machinery and labour cost, total</b>			<b>539.6</b>
<b>GROSS MARGIN 2</b>			<b>412.0</b>

1) Fixed irrigation costs: 191 EUR/ha and variable irrigation costs (100 mm water): 130 EUR/ha.

## Working Papers

Fødevareøkonomisk Institut

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