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BELGIAN ENDIVE: FROM TRADITION TO INNOVATION

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ABSTRACT.

Belgian endive ('witloof', chicory) always played an important part in the production of vegetables in Belgium. The cultivation of this vegetable, which found its origin in Belgium around 1850, and expanded from here to France and later to the Netherlands, has been characterized by important innovation processes resulting not only in micro-economic but also in macro-economic, structural and geographical modifications. Due to the substitution of small holdings with traditional production methods by great, modern equipped and capital intensive holdings with hydroponic cultivation, the total number of holdings decreased considerably. The introduction of hydroponic cultivation resulted in an important increase of labour efficiency, allowing to produce at a lower cost price. Although the traditional area of production in the triangle Louvain-Brussels-Mechlin is still very important, the relative importance of this region has diminished considerably. In this traditional area of production, where the farmers do have the highest average age, the introduction of hydroponic cultivation was a slow process. Contrary to the slow adoption of innovations in the traditional area, in other regions hydroponic cultivation of 'witloof' was introduced successfully. The production of 'witloof' extended in the province of East-Flanders, but had a spectacular expansion in the province of West-Flanders.

At international level the introduction of hydroponic cultivation resulted in a growing competition, causing a decrease in prices received by the producer. At the moment the most important production area of 'witloof' is extending from the north of France and the Flanders to the southern and western part of the Netherlands. In these countries 'witloof' is almost completely produced by hydroponic cultivation. The total production of 'witloof' during the period 1975-1995 increased by 170.000 ton and reached the level of 410.000 ton 1995-96. Only a small part of this production is exported outside of this area of production. In order to obtain better prices extra efforts will be necessary to discover new markets.

1. Introduction

Belgian endive ('witloof', chicory) always had a leading position in the production of vegetables in Belgium. The cultivation of this vegetable found its origin in Belgium around 1850, and expanded from here to France and later to the Netherlands. Belgian endive was traditionally produced in the triangle Louvain-Brussels-Mechlin. The traditional production process of 'witloof' was characterized by a high labour intensiveness, allowing the small farms to obtain a reasonable income with limited capital investments. In almost one and a half century a long way has been gone, but the most radical evolution was taking place quite recently. The introduction of hydroponic cultivation of 'witloof' at the end of the seventies meant a radical innovation, causing a discontinuity in the path of technical progress. This innovation can not only be regarded as a major explanatory factor in the economic developments at the level of the farms and the industry but also lead to serious structural changes and geographical dislocations. In the paper the central question of the economic, structural and geographical impact of the introduction of hydroponic cultivation will be analyzed.

2. Innovations in the production process

The production process of 'witloof' is consisting of two phases. The first phase is the production of the roots on the field from April to October, followed by the second phase where the roots are forced in order to produce the 'witloof'. Because of the labour intensiveness of the production process and the growing scarcity and costs of labour, special efforts for rationalisation were made from the end of the seventies.

New developments in the cultivation of the roots were seed drilling, cultivation on ridges, introduction of hybrid varieties, sowing under plastic, use of selective chemical plant protection methods, ... Most important is the mechanisation of root production, leading to an increase of the scale of production.

The most radical innovations were taking place in the second and most labour intensive production phase, consisting of the production of the 'witloof'. At the traditional way of production the roots were covered by etching ground and straw and then put under sheets of corrugated iron, placed in the open air. Special heating boilers were used for heating the production beds. Because of the bad labour conditions during wintertime this kind of work was very hard. A first step of improvement of the labour circumstances was to force the roots in a barn. The next important step offering a lead to hydroponic cultivation was the introduction of varieties that could be forced without etching ground. The introduction of hydroponic cultivation at the end of the seventies can be regarded as a radical innovation and starting point for further incremental innovations of labour organisation and rationalisation.

As a consequence of the evolution to more complex technologies the investments at farm level are increasing to a large extent. In comparison to the traditional production methods the farm manager is becoming more bounded to the production of 'witloof'; even when the selling prices of 'witloof' are falling down he will be obliged to go on with this production. In order to make optimal use of the investments and to spread the labour over the year, at modern holdings the roots are conserved in cold stores permitting to produce 'witloof' all over the year. In recent years the production of 'witloof' evolved from a production during the winter months to a production spread over the year. The winter months are still the most important months but due to the introduction of hydroponic cultivation, production of 'witloof' during summer becomes more and more important.

3. Importance of 'witloof' in Belgian vegetable production

In the period 1975-1995 the production of 'witloof' in Belgium ranges from 80.000 to 110.000 ton and is estimated at 93.500 ton in 1995. 'Witloof' always had a leading position in the production of vegetables. During last twenty years however the relative importance is decreasing. In table 1 the evolution of the production value of vegetables at that time period is represented. The total value of vegetable production was amounting to 14,8 milliard Belgian Francs (BF) in 1975, of which 3,6 milliard BF or 24,4 percent was originating from 'witloof'. In 1995 the total production value of vegetables increased to 25,0 milliard BF; the production value of 'witloof' decreased to 3,2 milliard BF or only 12,8 percent of the total value of Belgian vegetable production.

Until 1984 'witloof' was the most important vegetable produced in Belgium. From 1985 this first place was taken over by glasshouse tomatoes, but 'witloof' still was the most important vegetable in the open air. However from 1990 'witloof' also lost this place in the advantage of leek.

In the beginning of the seventies Belgium exported more than 60.000 ton of 'witloof'. Ten years later the export is fallen down to some 30 to 35.000 ton. During the eighties the export stabilized at this level, however during the first half of the nineties the export decreased again until 17.343 ton in 1995. The most important importing countries of Belgian endive are Switzerland (33% of the total Belgian export), Germany (22%), Italy (15%) and the United States (15%). As a consequence of the increasing production of 'witloof' in France and the Netherlands the export to these countries decreased to a large extent.

4. Structural and geographical aspects

4.1. Area

In 1975 the area of 'witloof' in Belgium was estimated at 9.300 hectares. After a limited decline at the end of the seventies, the area of 'witloof' was characterized by a gradual extension during the eighties. At the beginning of the nineties again a decrease of the area was observed. In 1995 7.300 hectares of 'witloof' are left. During last decennium considerable restructurations were taking place within the sector of Belgian endive. The developments at the level of the farms and the industry lead to serious structural changes and geographical dislocations.

In table 2 the geographic dispersion of the area of 'witloof' during the period 1975-1995 is represented, based on yearly data collected in the census of May 15th by the National Institute of Statistics (N.I.S.). The greatest part of the area occurs in the Flemish part of the country, where both the production of chicory roots and the production of 'witloof' generally take place at the same holding. However due to the introduction of hydroponic cultivation a growing split between the two production phases can be observed, leading to specialisation of the holdings in one of the two phases.

Figure 1 gives a picture of the geographic dislocation of the chicory roots from 1980 to 1995. In 1980 the Flemish provinces (inclusive of Brabant) represented 98,5 percent of the total area, while in 1995 still 90,9 percent of the total area could be found in this part of the country. However behind these data important structural and geographical changes are hidden.

Although the traditional area of production in the triangle Louvain-Brussels-Mechlin is still very important, the relative importance of this area has diminished considerably during last twenty years. The province of Brabant, including the main part of this traditional production centre, still has the greatest share in the total area. However the relative importance decreased from 77,5 percent in 1980 to 65,8 percent in 1985 and decreased further to 53,1 percent in 1995. The production of 'witloof' extended in the province of East-Flanders, but had a

spectacular expansion in the province of West-Flanders. In 1995, 18,4 percent of the total area of 'witloof' was cultivated in the West-Flanders compared to 10,4 percent in 1985 and 5,8 percent in 1980. There can be noticed that in 1975 only 1 percent of the total area could be found in this province. In 1995 the East-Flanders represented 14,7 percent of the total area, compared to 12,0 percent in 1985 and 10,1 percent in 1980.

Among the Walloon provinces in Belgium the province of Hainault, representing 5,2 percent of the total area of 'witloof' in 1995, is the most important province. There should be mentioned that almost three quarters of the area of chicory roots in this province is not forced at the farm of production. Most of this root production is intended for holdings with hydroponic cultivation of 'witloof' in the northern part of the country.

In figure 1 the area of 'witloof' is represented per municipality. According to the census of May 15th 1995 the most important municipality is Kampenhout (170 ha), representing 5 percent of the total area registered in the census. Other important municipalities within the province of Brabant are Boortmeerbeek (73 ha), Merchtem (70 ha), Landen (68 ha), Tremelo (60 ha), Aarschot (58 ha) and Kortenberg (55 ha). In the West-Flanders the most important municipalities are Pittem (105 ha), Poperinge (55 ha), Zwevegem (44 ha) and Meulebeke (35 ha). In the East-Flanders Sint-Lievens-Houtem is the most important municipality with 102 hectares, followed by Zwalm (55 ha), Lede (52 ha) and Oosterzele (35 ha).

4.2. Number of holdings

According to the census of May 15th 1995 of the N.I.S. there are 1.393 holdings with production of chicory roots in Belgium. Of this number 1.050 holdings are forcing the roots to produce 'witloof'. As represented in table 3 the number of holdings that force 'witloof' decreased from 4.822 in 1975 to 3.381 in 1980 (-30%). Despite of the increase of the area during the eighties, the decrease of the number of holdings was going further. Especially from the second half of the eighties a sharp decline can be observed. The number of holdings decreased from 3.279 in 1985 to 2.124 in 1990 (-35%). In the first half of the nineties the area as well as the number of holdings decreased until only 1.050 holdings (-50 %) were left in 1995.

In figure 2 the evolution of the total area and the number of holdings during last twenty years is represented. The figure gives evidence of the fact that the area of roots that is forced at the average holding is increasing considerably from the second half of the eighties. During this period small holdings were substituted by great, modern equipped, but capital intensive holdings with hydroponic cultivation of 'witloof'.

In 1975 from the total number of holdings with production of 'witloof', three quarters were situated in the province of Brabant. East-Flanders represented 14 percent of the total number of holdings, while the province of West-Flanders was not yet important. Twenty years later, in 1995, the relative importance of Brabant decreased in the advantage of the West-Flanders. In 1995, 53 percent of the total number of holdings with production of 'witloof' are located in the province of Brabant, while 18 percent are situated in the East-Flanders and 15 percent in the West-Flanders. Despite of the fact that the area of 'witloof' in the West-Flanders is greater than in the East-Flanders, the number of holdings is smaller, indicating that the average forced area of chicory roots per holding is greater in the West-Flanders. This is strongly related to the higher degree of modernisation of the holdings in this more recent production area.

In the traditional production centre of 'witloof' in the triangle Louvain-Brussels-Mechlin, the cultivation of 'witloof' always played an important part in the regional agricultural production. The traditional production process was characterized by a high labour intensiveness, allowing the small family farms to obtain a reasonable income with limited capital investments. Although this traditional centre is still very important, the number of holdings cultivating 'witloof' decreased to a large extent. According to the census of May 15th of the N.I.S. the number of holdings in the province of Brabant decreased from 3.613 in 1975 to 2.140 in 1985, and decreased

further to 1.312 in 1990 whereas only 561 holdings were left in 1995. In this traditional area the classical production process of 'witloof' in the open air is still important. The application of hydroponic cultivation started at the end of the seventies, however the real breakthrough of this modern production process in the traditional region came quite late in 1988. At the moment about 80 holdings with hydroponic cultivation of 'witloof' are occurring in the province of Brabant, representing less than 10 p.c. of the total number of holdings.

At present it is often taken for granted that the driving force for growth in a production area lies in the development of process innovations, allowing to increase the competitiveness of a production system [2]. Also the existence of specific know-how is an important element in the development of traditional regions. This is particularly true if the traditional know-how can be updated and adapted to new technologies [4]. In the case of Belgian endive the more competitive production system was the introduction of hydroponic cultivation, permitting to produce at a lower cost price (see paragraph 5.2). However in the traditional production centre of 'witloof' the adoption of hydroponic cultivation was very slow.

Several explanations for the slow adoption of hydroponic cultivation in the traditional production area can be found. A first explanatory factor, which is characteristic for traditional production areas, was the scepticism of the traditional farmers to utilize hydroponic cultivation and to adapt the traditional know-how to this new technology. There must be recognized that the transition to hydroponic cultivation meant an important psychological step not only for the producers but also for the consumers of 'witloof'.

An important explanatory factor is the growing urbanisation of the region. As a consequence of the increasing urbanisation of the densely populated region, the agricultural area is decreasing very fast, resulting in limited possibilities of extension. Most of the modern holdings with hydroponic cultivation in the traditional production area are obliged to take on seasonal lease a great part of the area needed for the production of the roots. Because of the high rents (mostly seasonal rents) and the great distances of the parcels of land from the seat of the holding, the competitiveness of the region is decreasing.

Another possible explanation stems from the life-cycle theory, which can give a suitable insight into the situation in a region [5]. In a family firm, the family of the farmer will have a direct relation to the development of the firm and the decisions made. So the firm frequently shows a life cycle that corresponds with the life cycle of the farmer [1]. Edwards & Kay [3] make a distinction in four stages, namely 'entry', 'growth', 'consolidation' and 'exit'. The behaviour of the firm will be different if there is a successor or not. An analysis of the holdings according to the age of the farmer and the availability of a successor (see paragraph 4.3) shows that the holdings in the traditional area of production are less operating in a growing stage than in other regions, and are therefore less innovative.

In the province of East-Flanders the origin of production of 'witloof' can be situated around the turn of the century. The cultivation of this vegetable developed principally in the region around Vlierzele. A more recent production area, with hydroponic cultivation of 'witloof', developed in the region of Sint-Laureins, Eeklo and Zelzate. According to the census of the N.I.S. the number of holdings that force chicory roots decreased by one third from 669 in 1975 to 448 in 1980. During the first half of the eighties an increase of the number of holdings could be observed. In the period 1983-85 43 completely new establishments were founded; in 1985 the total number of holdings was amounting to 481 (+ 7 % compared to 1980). In that period also some 100 holdings built a barn for production of 'witloof'. During the second half of the eighties the number of holdings decreased again by one third from 481 in 1985 to 327 in 1990. However hydroponic cultivation of 'witloof' became more important; from 1987 three quarters of the starting holdings opted for hydroponic cultivation. In the first half of the nineties the decrease of the number of holdings was going further; in 1995 188 holdings were left. About 40 of these holdings are producing 'witloof' by hydroponic cultivation. In a period of 15 years the West-Flanders became the second most important production area of Belgian endive. According to the census of May 15th of the N.I.S.

the number of holdings that force 'witloof' increased from 97 in 1975 to 160 in 1980 and 287 in 1985 (multiplied by 3 compared to 1975). From the second half of the eighties the number of holdings decreased to 242 in 1990 and decreased further during the first half of the nineties to 158 holdings in 1995. In the West-Flanders the production of 'witloof' is characterized by a high degree of mechanisation and a fast introduction of hydroponic cultivation. The lack of firmly-fixed traditions existing in the traditional area of production was an advantage for the development of the new production area in the West-Flanders. According to experts in 1977 already at 50 percent of the holdings the 'witloof' was forced in a barn. In 1985 this part was grown to 98 percent, including 18 percent of hydroponic cultivation. At the moment, according to experts of the provincial research centre of Beitem-Rumbeke, in the West-Flanders 157 holdings are producing 'witloof' by hydroponic cultivation, which is almost the double of the number in the traditional production area.

4.3. Characteristics of the farm manager

4.3.1. Age

According to the census of May 15th 1995 of the N.I.S. the average age of the farm managers at the holdings producing 'witloof' in Belgium is 48 years. Of these farm managers 29 percent are older than 55 years; 17 percent are 35 years or younger. In figure 3 the dispersion of the age of the farm manager among different age categories is represented for the provinces of Brabant, the West-Flanders and the East-Flanders.

In Brabant the farm managers do have the highest average age of 49 years. One third of the farm managers is older than 55 years, only 37 percent are 45 years or younger and hardly 14 percent are 35 years or younger.

In the more recent production area of the West-Flanders the farm managers are relatively younger; the average age is amounting to 43 years. 60 percent of the farm managers are 45 years or younger. Only 14 percent are older than 55 years and 29 percent are 35 years or younger.

In the province of East-Flanders the age of the farm managers is spread more equally among the different age categories; 47 percent are 45 years or younger, 26 percent are older than 55 years and 16 percent are 35 years or younger. The average age of the farm manager in this province is 47 years.

At the holdings with hydroponic cultivation of 'witloof' the farm managers are relatively young. The average age of the farm managers is amounting to 42 years. Of these farm managers two thirds are 45 years or younger; only 10 percent are older than 55 years and 30 percent are 35 years or younger.

4.3.2. Succession

According to the census of May 15th 1995 445 managers of holdings that produce 'witloof' are older than 50 years. Of these farm managers only 96 or 21 percent declare to have a successor of at least 14 years old; 265 or 60 percent declare not to have a successor of at least 14 years old and 87 or 19 percent do not know yet if they will have a successor. On the basis of this low degree of succession a further decrease of the number of holdings with production of 'witloof' can be expected.

4.4. Evolution 1990-1995 and future developments

The data collected in the yearly census of the N.I.S. indicate that the number of holdings producing Belgian endive was declining rapidly during the first half of the nineties. However the global data of the census do not give any information about the holdings that stopped producing 'witloof'. Did they completely stop their activities ? Did they go over to other crops ? What is the age of the farm managers ? ... Also we do not have any information about holdings that started to produce Belgian endive during that period.

In order to obtain more detailed information an individual follow-up of the holdings in the census producing 'witloof' in 1990 en 1995 was executed. According to this analysis from the 2.087 professional and occasional holdings (categories 1 to 3 in the census) , only 864 or 41 percent are left in 1995; 422 or 20 percent stopped all their activities and 801 or 39 percent still existed but stopped forcing 'witloof'. As shown in table 4, at the holdings that stopped their activities, the greater part of the farm managers belonged to the oldest age categories. However attention must be paid to the fact that also in the younger age categories about 10 percent of the farm managers stopped their activities. On the other hand, in 1995 there are also holdings that started forcing 'witloof' chicory during the considered period or even are totally new. As represented in table 5, in 1995 there are 1.035 holdings that force 'witloof'; 84 percent of them also forced 'witloof' in 1990, 11 percent already existed in 1990 but did not force 'witloof' and 5 percent did not exist at all in 1990.

The evolution of the number of holdings with production of 'witloof' in the future will be dependent of several factors, for example the phase in the farm-firm life cycle of the existing holdings, the profitability of 'witloof' production,...The evolution of profitability in the future is not easy to predict and will be dependent of the international developments (see paragraph 6). However the life-cycle theory [1] can be a useful tool in order to predict the future developments.

Future developments can be estimated by using a Markov projection by dividing the holdings into age categories of the farm manager, representing the different phases in the farm-firm life cycle. In the Markov projection the hypothesis is made that the evolutions from 1990 to 1995 within each age category can be projected to the next five years. However the rate of disappearing of the holdings will also be influenced by the profitability of production of 'witloof'.

As a result of the Markov projection the number of holdings that force 'witloof' would decrease from 1.055 to 580 (-45%) in the year 2000. In the traditional production area in the province of Brabant the number of holdings would even be halved from 555 holdings in 1995 to 279 holdings in 2000.

At first sight these previsions seem very pessimistic, however supposing that the area of chicory roots can be stabilized at 7.500 hectares (depending on the international developments) at an average forced area of chicory roots ranging from 15 to 20 hectares per holding, a number of 375 to 500 holdings with hydroponic cultivation of 'witloof' can be expected in the future.

5. Micro-economic aspects

5.1. Profitability

In the Farm Accountancy Data Network of the Agricultural Economics Institute micro-economic data are collected and analyzed at holdings with production of 'witloof'. In figure 4 the development of the labour income per labour unit, the selling price of 'witloof' and the comparable income earned in the other socio-professional sectors are represented.

During the period 1975 to 1984 a quite favourable development of the income can be observed. With the exception of the campaign 1979-80 the comparable income could almost be reached in each year. Since the campaign 1985-86 however the income is falling down. During this campaign the income even decreased to only 45 percent of the comparable income. In the next three campaigns a limited improvement could be observed, however the income was still staying far beneath the level of the comparable income. After a sharp decline in 1991-92 a yearly improvement of the income could be observed in the beginning of the nineties, however the level of the income is staying far beneath the comparable income.

The differences in income during the years can almost completely be explained by differences in prices obtained for the 'witloof'. Among the different holdings that produce 'witloof' considerable differences in income can occur. The differences in profitability are strongly influenced by the level of modernisation of the holdings. In next paragraph the impact of the introduction of hydroponic cultivation on the income will be investigated.

5.2. Traditional versus hydroponic cultivation

In order to provide a better insight of the influence of the introduction of hydroponic cultivation at micro-economic level the different production methods are compared. A distinction is made between traditional and hydroponic cultivation. In table 6 profitability of the holdings cultivating 'witloof' in 1995-96 is represented for both of the production systems. The data are collected at the holdings of the Farm Accountancy Data Network of the Agricultural Economics Institute.

At the holdings with traditional production of 'witloof' (14 holdings) the average cultivation plan is consisting of 2,91 hectares of 'witloof', 0,79 hectares of other horticultural products and 8,28 hectares of agriculture. These holdings are characterized by important losses of 1.557.905 BF per holding; the output per 1.000 BF of input is only amounting to 605 BF. The inputs are composed of the really payed costs as well as calculated costs for the labour and capital of the farm manager and his family. As a result an average income of 407.784 BF per labour unit is obtained.

The results of the holdings with hydroponic cultivation of 'witloof' prove that innovation is an absolute necessity in order to obtain a reasonable income. In 1995-96, based on the data collected at 19 holdings with hydroponic cultivation, an average income per labour unit of 1.172.239 BF could be obtained. The output per 1.000 BF of input is amounting to 1.059 BF. The average cultivation plan is consisting of 14,91 hectares of 'witloof', 0,04 hectares of other horticultural products and 9,90 hectares of agriculture. These holdings are characterized by a high degree of mechanisation allowing to decrease the need for labour and resulting in a higher area of cultivated 'witloof'.

In figure 5 the composition of the cost price of 'witloof' during the campaign 1995-96 is represented both for traditional and hydroponic cultivation. On the basis of an inquiry at the holdings of the Farm Accountancy Data Network, the costs at farm level were split among the different technical orientations at the farm, allowing to estimate the cost price of 'witloof'. The level of the cost price is related to the yield and will be different from year to year. However the results of one year can give a good insight in the relative differences between the two production methods.

At the traditional holdings the cost price of 'witloof' during the campaign 1995-96 is estimated at 69 BF per kilogramme. The most important part of this cost price (73 percent) is consisting of labour costs. The other components of the cost price are the costs of land, buildings and machinery (12 percent), the direct costs (12 percent) and other costs (3 percent). More than 90 percent of the labour costs are consisting of calculated costs for the labour of the farmer and his family.

The cost price of 'witloof' at the holdings with hydroponic cultivation is situated at a remarkable lower level. In 1995-96 the cost price is estimated at 39 BF per kilogramme. This lower cost price is due to the lower labour costs, only representing 44 percent of the total cost price. The other components are composed of land, buildings and machinery (35 percent), direct costs (16 percent) and other costs (5 percent). From the total labour costs only 60 percent are consisting of calculated wages for the farmer and his family.

On the basis of the micro-economic data there can be concluded that hydroponic cultivation is the production method of the future. Only at these holdings 'witloof' can be produced at a profitable way. The question can be posed how traditional holdings can still survive at this moment despite of the suffered losses. As a consequence of the lower liabilities and the greater part of calculated costs in the cost price, in the short term the family income can be assured as long as the decrease in prices will be limited. However in the long term financial livability can not be assured because of the lack of reserves for new investments. As a consequence there can be expected that most of the traditional holdings will disappear as soon as the farmer retires.

Modern holdings producing 'witloof' by hydroponic cultivation are characterized by a lower requirement of manual labour resulting in a lower cost price. However because of the greater part of the payed costs the risk factor will become more important. In the future management of the holdings will become very important; only the holdings that will be able to produce good quality at a competitive cost price will survive. In this context it will be important to follow the international developments of production and consumption of 'witloof'. In next paragraph the international impacts of the introduction of hydroponic cultivation will be analyzed.

6. International aspects

6.1. Belgium, the Netherlands and France as the most important production area

Belgian endive found its origin in Belgium around 1850, and expanded from here to France and later to the Netherlands. The production of 'witloof' was introduced around 1920 by Belgian seasonal workers in the north of France. In consequence of the expansion of the area after the second world war, at the beginning of the fifties France became the most important producer of 'witloof'. After a decline during the seventies, an important extension of the production could be observed during last fifteen years. According to the official statistics the production increased from 144.100 ton during the campaign 1980-81 to 233.000 ton in 1995-96. The most important production region is the area Nord-Pas de Calais-Picardië. While hydroponic cultivation of 'witloof' was introduced quite lately in Belgium, the application of this new technology in France is already dating from the year 1976. The introduction of hydroponic cultivation also resulted in the development of new production areas in Picardië and the western part of the country (Finistère).

In the Netherlands the production of 'witloof' is quite recently and is characterized by an important expansion during last twenty years. The area of chicory roots expanded from only 2.280 hectares in 1975 to 6.457 hectares in 1991, followed by a decrease to 4.480 hectares in 1995. During the period 1975-1991 a quadrupling of the production from 23.200 ton to 95.400 could be observed. After this time period the production decreased and fluctuated around 85.000 ton. In the Netherlands the technology of hydroponic cultivation developed in a fast rate. The increasing application of this technology resulted in a growing split between the production phase of the chicory roots and the production phase of the 'witloof'. In 1995 three quarters of the area of chicory roots were produced under contract. As a consequence the production areas of the chicory roots do not correspond with these of the final product. Important production areas of chicory roots are: Flevoland, North- and South-Holland,

North-Brabant and Zeeland. The production of 'witloof' is mainly situated at holdings in the provinces of North- and South-Holland, North-Brabant, Limburg, Friesland and Gelderland.

With the exception of Spain and Germany the production of 'witloof' seems to be unknown in the other European countries.

6.2. Influence of the total production on the evolution of the prices

As mentioned before at the moment the most important production area of 'witloof' is extending from the north of France and the Flanders to the southern and western part of the Netherlands. The total production of 'witloof' during the period 1975-1995 increased by 170.000 ton and reached the level of 410.000 ton in 1995-96. Only 18 percent of the total production is exported outside of this area of production. During last years the international market of 'witloof' was confronted with a decrease in prices. In figure 6 the influence of the total production of 'witloof' in Belgium, France and the Netherlands on the real average price of 'witloof' obtained by Belgian producers is represented.

In order to analyse the effect of the increase of the total production on the received prices during last twenty years following regression could be obtained:

$$Y = 138,70 - 0,24 * X$$

$$R^2 = 0,87$$

$$s_b = 0,02 \text{ (deviation of the regression coefficient)}$$

with:

Y = Real price of 'witloof' (in values of 1995) received in Belgium

X = Total production in Belgium, France and the Netherlands

So during the considered period every increase of the production by 1.000 ton induced an average reduction of the real prices of 'witloof' in Belgium of 0,24 BF per kilogramme. There can be expected that an increase of the exported quantity could have a positive influence on the received price. As 'witloof' is still an unknown vegetable in many countries, efforts in order to discover new markets will be necessary.

7. Conclusion

At present it is often taken for granted that the driving force for growth in a production area lies in the development of process innovations, allowing to increase the competitiveness of a production system. The evolution of production of Belgian endive seems to be a good illustration of this statement.

In the case of Belgian endive the more competitive production system was the introduction of hydroponic cultivation, permitting to produce at a lower cost price. However in the traditional production centre of 'witloof' the adoption of hydroponic cultivation was a slow process. Contrary to the slow adoption of innovations in the traditional area, in other regions hydroponic cultivation of 'witloof' was introduced successfully. As a consequence competitiveness of the traditional production area decreased considerably.

Tab. 1. Production value of vegetable production and importance of 'witloof' in Belgium

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>
Total vegetable production (in million BF)	14768	14941	22819	29994	25024
<u>Part of (in percentual terms)</u>	%	%	%	%	%
vegetables for processing	11,9	5,5	7,6	4,2	5,7
veget. for fresh consumption	88,1	94,5	92,4	95,8	94,3
vegetables in the open air	57,3	60,2	55,3	53,1	48,7
'witloof'	24,4	26,6	18,7	11,8	12,8
glasshouse vegetables	27,9	29,8	33,3	38,9	40,5
mushrooms	2,9	4,5	3,8	3,8	5,1

Source: A.E.I.

Tab. 2. Dispersion (in %) of the area of chicory roots per province

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>
Brabant	84,4	77,5	65,8	56,3	53,1
West-Flanders	1,2	5,8	10,4	17,8	18,4
East-Flanders	9,4	10,1	12,0	13,6	14,7
Antwerp	3,7	4,9	5,5	5,8	3,5
Limburg	0,1	0,2	0,6	1,4	1,2
Hainault	0,8	1,2	2,8	2,9	5,2
Liège	0,2	0,1	1,5	1,3	1,1
Namur	0,1	0,1	1,1	0,8	2,9
Luxembourg	0,1	0,1	0,3	0,1	0,0
Belgium	100,0	100,0	100,0	100,0	100,0

Source: N.I.S.

Tab. 3. Number of holdings with production of 'witloof' per province (all categories)

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>
Brabant	3613	2479	2140	1312	561
West-Flanders	97	160	287	242	158
East-Flanders	669	448	481	327	188
Antwerp	261	202	222	151	79
Limburg	22	7	18	18	7
Hainault	120	59	79	48	41
Liège	22	8	24	10	4
Namur	19	8	20	10	10
Luxembourg	10	10	8	6	2
Total	4822	3381	3279	2124	1050

Source: N.I.S.

Tab. 4. Evolution of the number of holdings with production of 'witloof' in 1990 at the period 1990-1995 (cat. 1 to 3)

<u>Age category</u> <u>in 1990</u>	<u>Total in Situation of holdings in 1995</u>			<u>Stopped between</u> <u>1990 and 1995</u>
	<u>1990</u>	<u>with witloof</u>	<u>without witloof</u>	
<26	25	13	7	5
26-30	149	83	50	16
31-35	211	107	78	26
36-40	220	119	79	22
41-45	234	117	84	33
46-50	244	129	78	37
51-55	344	151	145	48
56-60	374	103	165	106
61-65	215	33	88	94
>65	71	9	27	35
Total	2087	864	801	422

Source: N.I.S.

Tab. 5. Evolution of the number of holdings with production of 'witloof' in 1995 at the period 1990-1995 (cat. 1 to 3)

<u>Age category</u> <u>in 1995</u>	<u>Total in Situation of holdings in 1990</u>			<u>New holdings between</u> <u>1990 and 1995</u>
	<u>1995</u>	<u>with witloof</u>	<u>without witloof</u>	
<26	5	1	1	3
26-30	42	26	6	10
31-35	133	100	18	15
36-40	127	110	10	7
41-45	138	123	8	7
46-50	145	120	20	5
51-55	148	131	17	0
56-60	173	152	19	2
61-65	91	80	9	2
>65	33	22	10	1
Total	1035	865	118	52

Source:
N.I.S.

Tab. 6. Profitability of holdings cultivating 'witloof' in 1995-96

	<u>Traditional</u>	<u>Hydroponic</u>
Number of holdings	14	19
<u>INPUT (BF per holding)</u>		
Calculated wages	2317797	2310553
Payed wages	166314	1273472
Hired labour	111513	298805
Total labour costs	2595625	3882830
Seed	118512	264360
Fertilizers	89742	217537
Plant protection prod.	97453	239440
Fuel	29403	107509
Selling costs	133925	486795
Other direct costs	36855	389670
Total direct costs	505890	1705311
Machinery	286612	1137324
Land+buildings	399737	1887438
Interest circulating capital	79224	150401
General costs	68611	429655
TOTAL INPUT	3935699	9192959
<u>OUTPUT (BF per holding)</u>		
Vegetables open air	1828861	9703358
Agriculture	412930	469060
Others	136003	106214
TOTAL OUTPUT	2377794	10278632
<u>PROFITABILITY</u>		
Gain or loss (BF per holding)	-1557905	1085673
Labour income (BF per labour unit)	407784	1172239
Output per 1000 BF of input	605	1059
Selling price of 'witloof' Kg/ha 'witloof'	43,37	46,12
	11036	15107
<u>AREA (Hectare)</u>		
'Witloof'	2,91	14,91
Other horticulture	0,79	0,04
Agriculture	8,28	9,90
TOTAL AREA	11,98	24,85
Area of buyed roots	0,09	2,21
Source: A.E.I.-Brussels		

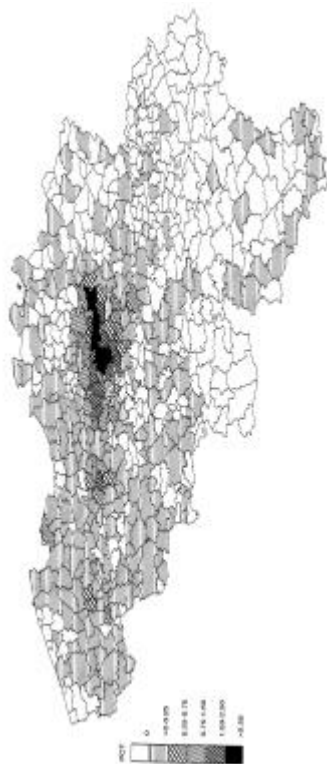
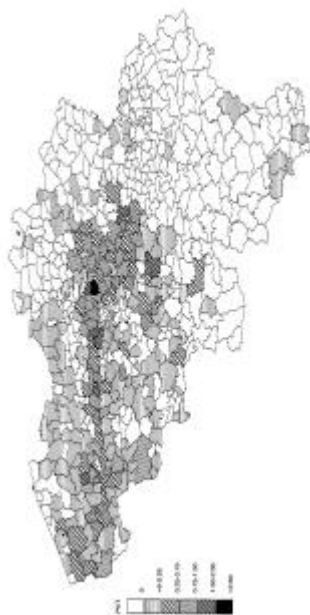


Fig. 1. Geographic dispersion of the area of chicory roots per municipality (in percent of the total area of chicory roots). Census May 15th 1980 (top) and 1995 (bottom)



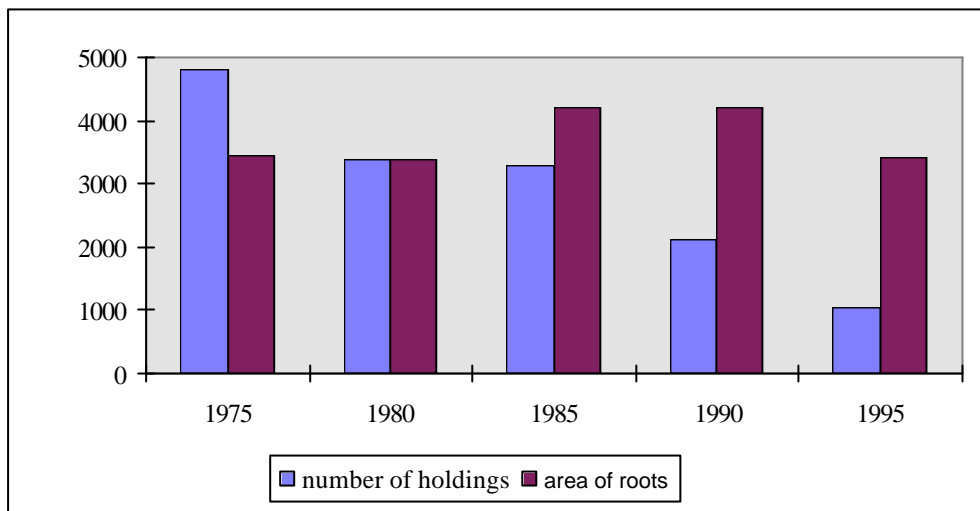


Fig. 2. Evolution of the number of holdings with production of Belgian endive and the total area of chicory roots (Source : Census May 15th N.I.S.)

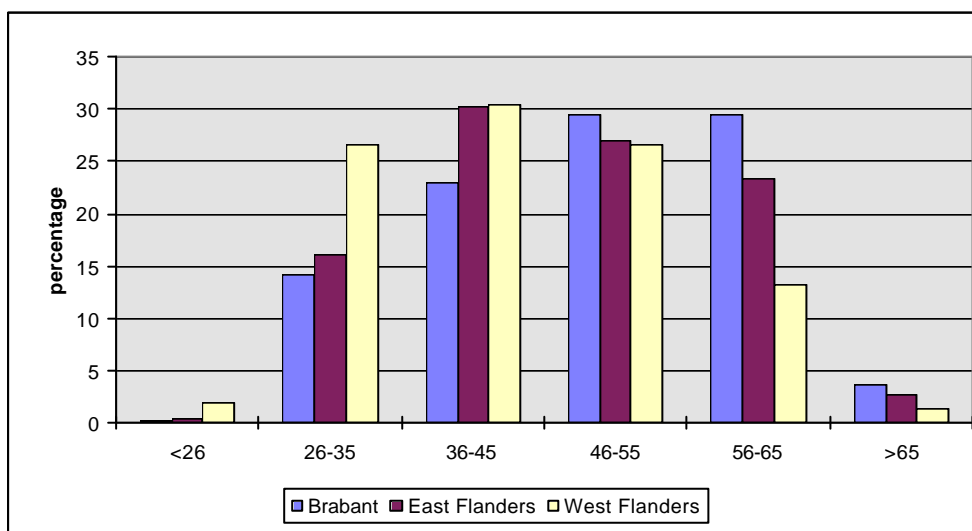


Fig. 3. Dispersion of the age of the farm manager at holdings with production of Belgian endive (Source : Census May 15th 1995 - N.I.S.)

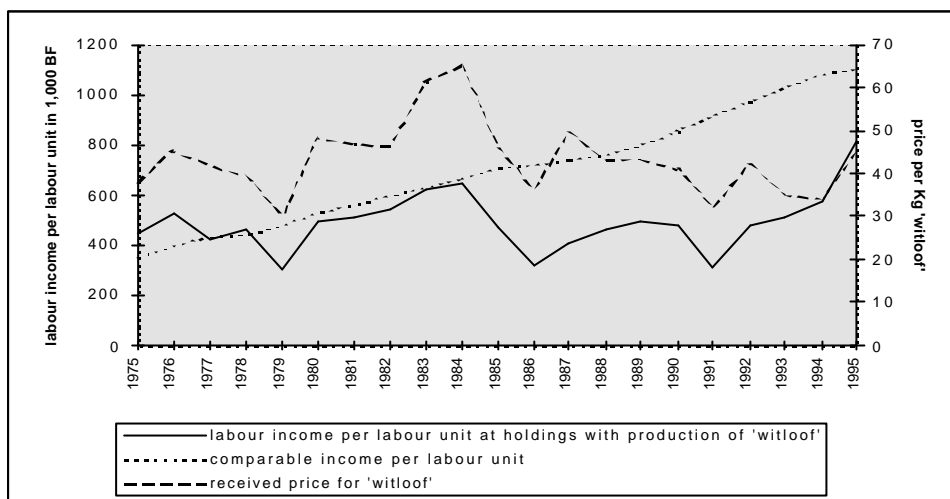


Fig. 4. Evolution of the labour income per labour unit at holdings with production of Belgian endive, the comparable income and the received price - Period 1975-76 to 1995-96

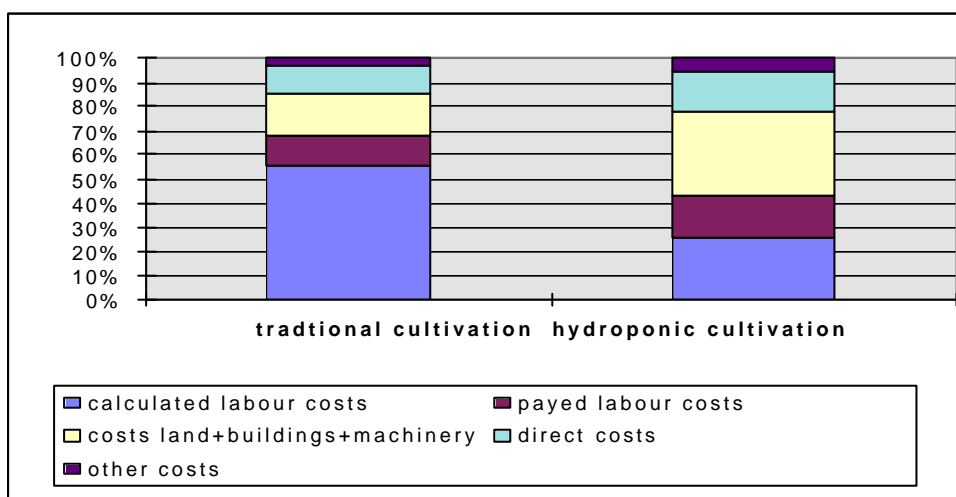


Fig 5. Composition of the cost price of Belgian endive during the campaign 1995-96 (Source : Farm Accountancy Data Network - A.E.I. - Brussels)

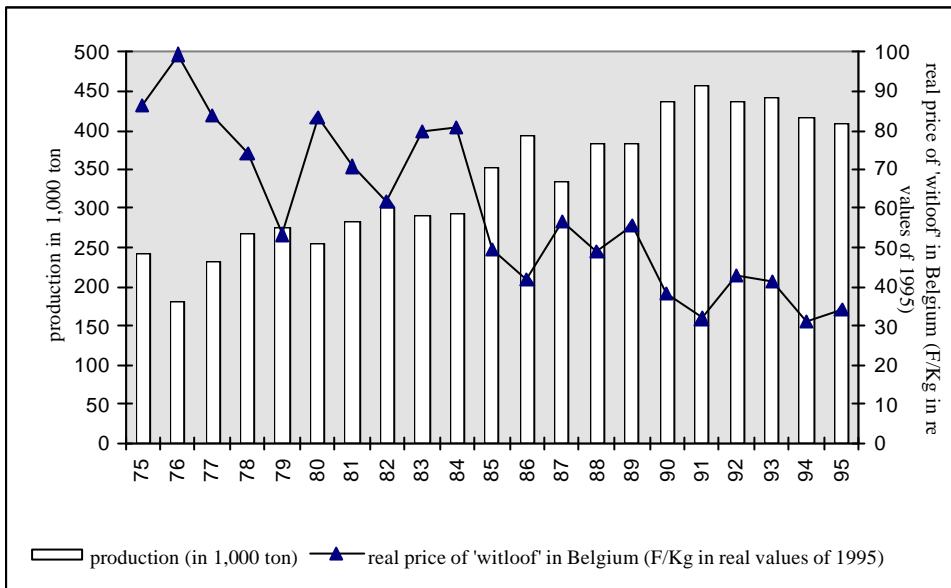


Fig. 6 Influence of the total production of 'witloof' in Belgium, France and the Netherlands on the real price of 'witloof' received in Belgium

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