SECTORAL MOBILITY OF PRODUCTION FACTORS IN AGRICULTURE AND PREDICTIONS FOR THE FUTURE

VANDERMEULEN VALERIE [*], **METTEPENNINGEN EVY** [1], **CALUS MIEKE** [1]

[1] Ghent University, Department of Agricultural Economics, Coupure links 653, 9000 Gent, Belgium

[*] Corresponding author. Tel.: +32 (0)9 264 59 43; fax: +32 (0)9 264 62 46;
e-mail: Valerie.Vandermeulen@Ugent.be

Paper prepared for presentation at the 114th EAAE Seminar
'Structural Change in Agriculture', Berlin, Germany, April 15 - 16, 2010

Abstract[1]

European agriculture has been characterized by a shift in structure towards larger farms with less labour employed. Within the current article we investigate the case of Flanders, a region in Belgium, and try to define what the sectoral shifts of labour and land have been in the past. Thereby we try to analyze and quantify structural change in Flemish agriculture, and to make projections for the future. The research was based on a Markov analysis of secondary census data, complemented by primary data obtained through a survey. In general it seems that structural change in Flemish agriculture follows the general trend of farms getting bigger, more specialized and employing more people per farm. This has consequences for productivity, efficiency, social and ecological effects of agriculture.

Key Words

Factor mobility, Agricultural sectors, Markov analysis, Structural change

[1] *Acknowledgments*

The data for this article have been collected in the framework of the project "Wijkers en Blijvers" executed by the Department of Agricultural Economics, University of Ghent and the Institute for Agricultural and Fisheries Research, and was financed by the Department Monitoring and Studies of the Administration for Agriculture and Horticulture of the Flemish Government.

1. INTRODUCTION

Since the second half of the 20th century, industrial countries are faced with a rapidly changing structure of their agricultural sector: labour is constantly leaving the sector, farm size is increasing and a growing share of agricultural production is done by a decreasing number of highly specialized farm businesses (OECD, 2002). Notwithstanding this general trend, structural change is a subtle, prolonged and spatially differentiated process (Lobley and Potter, 2004). While in some areas intensification of agriculture is dominating, in others agriculture is extensifying or diversifying or new types of productivism arise which are linked to external capital. The result will probably be a more diverse land management community in which professionally run farms exist next to multifunctional businesses and farms occupied for other purposes than professional farming (Marsden et al., 2002). According to Lobley and Potter (2004), structural change however won't change the fact that agricultural households are the key units of land occupancy and management in the countryside.

This paper will present a quantitative analysis of structural change in the Belgian region of Flanders. The case of Flanders is very interesting in the context of structural change, because the high population density is exerting increasing pressure on agricultural development (Vandermeulen, 2008). Moreover, the intensive livestock sector, typical for this region, has increasing difficulties complying with EU environmental regulations (Deuninck *et al.*, 2004).

Structural change in Flanders follows the general trend with regard to the number and size of farms. In the period 1980-2008, the number of Flemish farms has halved (75 898 to 30 666), while the total agricultural area remained more or less constant (634 397 to 623 699 ha). Average farm size thus has increased with 142% (from 8.4 in 1980 to 20.3 in 2008). The slight decrease in area of agricultural land was mainly in favour of natural areas such as heath land, pools, swamps, wastelands, rocks, beaches and dunes (57% increase from 2000 till 2008). The agricultural landscape has changed and farms have become more labour and capital intensive. The total number of people working on farms has decreased with 51% the last thirty years (from 124 658 in 1980 to 60 563 in 2008), but the number of workers per farm increased from 1.6 in 1980 to 2 in 2008. The standard gross margin of the average Belgian farm increased with 83% or €49,680 between 1990 and 2005. Nowadays, most of farms in Flanders are family farms in sole proprietorship (87%), meaning that the burden of highly capital-intensive production systems rests on the family itself. (Federal Public Service Economy SMEs Self-employed and Energy, 2008)

The changes in land and labour that occurred during the last decades are the result of factor markets that enhance the structural change in the Flemish agricultural landscape. Structural change in agriculture entails that there is a shift of land and labour within the agricultural sector, but also outside the agricultural sector. The objective of this research is twofold: (1) quantifying and analyzing the changes that occur in the factors land and labour, taking into account sectoral mobility, and (2) making projections of the future agricultural landscape in Flanders. The latter is done through a Markov-analysis, complemented with a survey to confirm general tendencies. The methodology is further explained in section 3 of the paper. This is preceded by a literature review on possible causes and impacts of structural change in section 2. Section 4 gives more information on the case study and the process of data collection and section 5 describes the results. The paper ends with a conclusion and discussion in section 6.

2. STRUCTURAL CHANGE: CAUSES AND IMPACTS

In order to better explain the changes in Flemish agriculture's land and labour use, this section gives a general picture of possible causes and impacts of structural change, see Figure 1.

<< insert Figure 1>>

In the middle of Figure 1 structural change is depicted. Immediately it can be seen that the different factor markets involved will influence each other. According to Ahituv and Kimhi (2002) there is a strong negative association between off-farm labour and farm capital accumulation, indicating that family labour and farm capital are complements in farm production. Research of Kim et al. (2005) revealed that with increasing farm size there is a decrease in the marginal product of labour and an increase in the marginal product of financial capital.

2.1. Causes of structural change

The top part of Figure 1 shows the different causes of structural change. A first group is related to the **farm enterprise**. Literature has shown that the size of the farm plays a role in the farm's ability to survive over time, with larger farms having advantages because of economies of scale (Mann and Mante, 2004). Moreover, the labour characteristics of the farm will influence the exit rates. Breustedt and Glauben (2007) showed that exit rates are lower in regions with a high share of part-time farmers. It seems that family farms are more successful, leading to lower exit rates (Breustedt and Glauben, 2007), because they allow a flexible combination of on-farm and off-farm earnings (Ahituv and Kimhi, 2002). The availability of a successor is an important factor as well.

A second category of factors relates to the **farmer**. Literature often mentions the effect of the farmer's age, stating that an aged farming population will increase the rate of adjustment (Moreno-Perez and Ortiz-Miranda, 2008). It is very typical for the agricultural sector that farms are only rarely being abandoned during the work life of the farmer (Mann and Mante, 2004). Farmers' values and perceptions, risk considerations (Serra et al., 2004), past experience (Mann and Mante, 2004) and possibility to influence others (Moreno-Perez and Ortiz-Miranda, 2008) also play a role. It seems that farmers are often strongly committed to continue farming and pass on land to their children, which will lower the incidence of structural change (Iraizoz et al., 2007).

Thirdly, structural change can be caused by specific characteristics of the **agricultural sector** in general. According to Dennis and Iscan (2009), the reallocation of labour out of the agricultural sector is the result of:

- low income elasticity for agricultural products (Engel-effect);
- fast productivity growth in agriculture pushing farmers to produce complementary non-farm goods (Baumol-effect); and
- more rapid capital deepening pushing labour into the more labour intensive non-farm sector.

Agriculture also differs from other economic sectors in the fact that economies of scale are limited because of the spatially dispersed nature of production and related difficulties in monitoring labour (Iraizoz et al., 2007).

A fourth and obvious factor influencing structural change is **research and technological developments**. Research provides the basis for a highly innovative agriculture on capital-intensive, large scale farms (Kim *et al.*, 2005) while technological developments are needed to create size-augmenting and labour-saving changes (Flaten, 2002).

The fifth group of factors causing change in agriculture consists of **policies** (Vandermeulen *et al.*, 2006). A good example of the effect of policies is given by Flaten (2002) who found that after succession to the EU the number of farms annually declined with 6% in Finland. In Norway however, a country that did not join the EU, the annual decline was only 3%. In the EU in general, the MacSharry reforms of the Common Agricultural Policy reinforced the necessity for farm resizing after 1992 because of decreasing per hectare margins (Moreno-Perez and Ortiz-Miranda, 2008). Generally, it seems that policies supporting farmers, like direct payments, ease down structural change (Iraizoz et al., 2007; Piorr et al., 2009). Policies promoting structural change are farmer retirement schemes, certain interventions in the land market (Shucksmith and Herrmann, 2002) and environmental regulations which involve high fixed costs and as such put smaller farms at a disadvantage (Flaten, 2002). Specifically for the milk sector, improved quota mobility speeds up structural change (Van der Straeten et al., 2009).

General **economic developments** are a sixth factor influencing structural change. Examples here are changes in the price ratio labour/capital, economic growth with increasing non-farm wages, shortage of land (Goddard et al., 1993) or changes in food prices (Breustedt and Glauben, 2007). Differences in capital markets among countries can affect farmers' investment decisions and hence can cause structural change (Benjamin and Phimister, 2002).

The final influencing factor is **path dependency**. According to Balmann (1997) structural change in agriculture is path dependent, meaning that initially different agricultural structures show significant differences for a long time. One reason for path dependency within the farm's lifecycle can be sunk costs: when farmers have invested in assets with a low mobility, then these assets and family labour are trapped in farming because of sunk costs and uncertainty (Flaten, 2002).

The **farm sector**, which will influence the farm itself and is part of the agricultural sector in general, also seems to play a role. For example, Breusted and Glauben (2007) found that farmers in regions with a high share of crop production quit at faster rates. Another example can be given: farms with a lot of seasonal production are more vulnerable, and might be more involved in structural change, because the processing industry demands more and more non-seasonal products (Hennessy, 2007). Therefore, this article will have a closer look at sectoral differences in agricultural structural change.

2.2. Impacts of structural change

Structural change will have a lot of impacts on agriculture (more specifically on productivity, efficiency, quality and equity), on the environment and on society. Below, a non exhaustive list of possible impacts is given.

The best described effect of structural change in literature is the shift in **productivity** and **efficiency** of farming. According to research by Van Passel (2007) in Flanders, larger farms work more efficiently than smaller farms. However, Flaten (2002) claims that the full exploitation of size economies only results in small cost savings in relation to the structural changes required. According to Van Passel (2007), productivity and efficiency also increase with an increasing share of owned land on the farm and lower solvency rates (or higher debts).

Another effect of structural change is the shift in **quality** of produce. Van der Straeten et al. (2009) analyzed the impact of farm-size distribution on milk quality parameters in Flanders and found that larger farms produce higher quality milk than smaller farms, especially regarding microbiological parameters.

While increasing farm size and structural change can enhance sectoral efficiency, it can also have adverse **equity** and social effects. Structural change shouldn't lead to social problems if it's the effect of farmers retiring. However, when active farmers have to leave the sector, this can cause severe social hardship and a waste of human resources (Mann and Mante, 2004).

Environmental effects can also be expected since having larger farms means the merging of fields, resulting in less border zones and landscape mosaics. This in turn leads to losses of habitats and a decline in biodiversity. If land from quitting farmers is obtained by farmers with expansion and intensification strategies, there may be adverse effects on landscape, flora and fauna (Shucksmith and Herrmann, 2002). On the other hand, research has shown that the uptake of agri-environmental schemes increases with farm size, so that this adverse effect might be offset (Arnaud et al., 2007).

Finally, structural change can effect the **wellbeing of rural communities**, since job loss in agriculture implies a danger of rural depopulation, loss of services, loss of local culture and knowledge (Lobley and Potter, 2004). Movements of farmers towards cities and the diffusion of land rentals by urban owners result in a growing part of control over resources and factor remuneration to be diverted towards urban areas (Moreno-Perez and Ortiz-Miranda, 2008).

3. METHODOLOGY

There are several methods available for analyzing structural change in agriculture and making projections for the future. Most of the recent studies on structural change make use of secondary data to develop statistical models (e.g. Mann and Mante, 2004; Breustedt and Glauben, 2007). A couple of recent studies made use of cluster analysis and supplemented secondary data with primary, qualitative data collected through in-depth interviews and focus groups (e.g. Moreno-Perez, 2008; Shucksmith, 2002).

Structural change in agriculture can also be analyzed on the basis of a Markov analysis. Next to older studies (e.g. Hallberg, 1969; Macmillan *et al.*, 1974), more recently Zepeda used this methodology to analyze farm size distribution of US milk producers (Zepeda, 1995a) and how this is influenced by technical change (Zepeda, 1995b). Van der Straeten et al. (2009) used a

Markov chain model to analyze the dynamics in farm-size distribution among the Flemish dairy sector and the impact of quota policy regulation on such changes.

Within the current research, continuous Markov analysis will be used to analyze changes and make future projections concerning factor use on Flemish farms. The assumption is made that future trends in factor use change will resemble recent historical trends (Pocewicz et al., 2008). Therefore the Markov chain method was chosen, and it is assumed that the historical data on land and labour use in agriculture follow a deterministic, first-order Markov chain process (Huirne and Dijkhuizen, 1996). This means that the conditional probability of any future "event", given any past "event" and the present state, is independent of the past event and depends only upon the present state of the process (Anderson and Goodman, 1957). These conditional probabilities, which can be calculated based on series of past data, are called transition probabilities and can then be used to describe the shifts of farms and entry and exit behaviour (Van der Straeten et al., 2009).

A transition probability is defined per category, in this case farm sector, and per year. It represents the probability that a unit of land or labour (X) belonging to farm sector i in the year t shifts to farm sector j in the year t+1 (Anderson and Goodman, 1957):

$$P_{ij} = Pr\ (X_{t+1}=j|X_t=i)$$

The individual probabilities can be grouped into a probability or transition matrix which will help to define the transition of each production factor to a different sector. The matrix can be described as P (Anderson and Goodman, 1957):

$$P = \begin{matrix} p_{0,0} & \cdots & \cdots & \cdots & \cdots & p_{0,18} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ p_{3,0} & \cdots & p_{3,3} & p_{3,4} & \cdots & p_{3,18} \\ p_{4,0} & \cdots & \cdots & p_{4,4} & \cdots & p_{4,18} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ p_{18,0} & \cdots & \cdots & \cdots & \cdots & p_{18,18} \end{matrix}$$

In the first column of the matrix, you can find the *stop probabilities* or the probabilities that one unit of a production factor belonging to a certain farm sector in year t, will have left agriculture in year t+1. In the first row, you can find the *new probabilities*, or the probabilities that one unit of a production factor which wasn't in agriculture in year t will belong to certain farm sector in year t+1 and thus has entered agriculture. On the diagonal, the *stable probabilities* can be found, which are the probabilities that one unit of a production factor in year t+1 is still in the same farm sector as in year t. All other p-values are the probabilities that a labour unit has shifted from a certain farm sector to another farm sector during the period from t till t+1. These are called *shift probabilities*.

The Sign test will be used to define whether the estimated probabilities are different from each other. The Sign test can be compared to the paired samples T-test, but is a non-parametric test and therefore makes less assumptions about the nature of the distribution and can therefore more generally be applied (Mendenhall *et al.*, 1989).

4. CASE STUDY AND DATA COLLECTION

In this research, fluctuations in production factors were studied for the agricultural and horticultural sector in Flanders (Belgium) during the period 1990-2007. For the Markov analysis secondary data were used as yearly collected by Statistics Belgium (Statistics Belgium, 2008). Information was available for all individual farms in Flanders on the used amount of hectares, the number of people working at the farm, the standard gross units of the farm and on a number of other personal characteristics (education level of the farmer, sex, age, location of the farm, etc.).

The definition of the different Markov groups, in this case farm sectors, was based on the EU typology (European Commission, 1985). Although this classification normally creates 9 general types, 17 principal types and multiple particular types of farming, 18 different sectors have been selected most frequently occurring in Flemish agriculture. In this way, the sector to which a farm belongs is determined by the relative contribution of different activities to the total standard gross margin of the farm (European Commission, 1985). See Table 1 for the 18 sectors that have been distinguished.

The Markov analysis was supplemented by a survey with active farmers and farmers who have left the sector, in order to get a better idea of farm dynamics and to put the results of the

Markov analysis into perspective. The selection of farmers was based on a quota sample that took the type of production and the age of the farmer into account. In total, 2500 questionnaires were sent to people still active in farming and people that stopped the farm business. The response rate was 14.2% of which 59 % were people still active in farming and 41% stopped the farm business. Both surveys contained socio-demographic questions (on age, eduction, etc.), questions about the farm (area, labour, type of farm, etc.), and questions about land use, production rights, quota and use of farm infrastructure after quitting agriculture. Next to these questions, the questionnaire for active farmers contained extra questions on current problems on the farm and farm succession. The questionnaire for farmers who have left the sector asked specific information about this decision and also about the social consequences it has. All questions were closed format questions, with room for comments by the respondent.

5. RESULTS

Table 1 shows that Flanders has a high number of farms in the sector specialist field crops, specialist milk and specialist cattle-rearing and fattening. The number of farms has about halved (-47%) between 1990 and 2007 and nowadays a little less than 30,000 farms exist. The biggest decrease in absolute terms can be found in the sectors specialist milk (-5,369 farms) and specialist cattle rearing and fattening (-2,482 farms) and in relative terms in the sectors specialist poultry and various granivores combined (-73%) and field crops and dairying combined (-73%).

<< insert Table 1>>

These shifts in amount of farms have been occurring together with some major shifts in land and labour uses.

5.1. Shift in land use

Because of farmers stopping and new farmers beginning, there has been an evolution in the amount of land used by agriculture in Flanders. After a farmer retires or changes profession, most of the land remains in agriculture. About 30% of land in ownership as well as in tenancy will be turned over to the successor. About 20% of the land in ownership will be given in tenancy to other farmers and 15% will be sold to other farmers and another 16% of the owned land will be used by the former farmer. When the land was leased, a higher percent is expected to be given in tenancy to other farmers (26%) and in about 22% of the cases the lease will stop (this land can be leased out to other farmers again). Other destinations included keeping the land by the retired farmer or transferring to non-farmers.

When one looks at **total agriculture** in Flanders, the land use has remained quite constant during the last fifteen years. Because of the decreasing amount of farms, it can be concluded that the amount of land per farm has increased (see Figure 2).

<<insert Figure 2>>

There are however major differences **among the sectors**, when it comes to land use. The sectors field crops and dairying combined have significantly ($p<0.05$, based on Duncan test for comparing means) larger farms (11.6 ha per farm), while the sectors specialist poultry and various granivores combined have the smallest farms (0.1 ha per farm, significantly different from the other sectors, $p<0.05$, based on Duncan test for comparing means). As was described before, both types are characterized by a relatively high degree of drop out by farmers. Especially the drop out in the sector field crops and dairying, will probably have a great impact on land use.

Based on the Markov analysis (see Table 2), the **sectoral mobility of land** can be described. The stable probability is higher than 50% for all sectors, meaning that more than half of the land will next year still be used by a farm in the same sector. The *most stable sectors* are specialist field crops, specialist milk, specialist cattle-rearing and fattening, specialist flowers and ornamentals, specialist fruit and citrus fruit and permanent crops combined. All of these sectors have a stable probability of more than 80%. Those sectors, for which the probability that one hectare is changed to another sector in the next year *(the shift probability)* is significantly higher (based on a Sign test, $p<0.05$) than the rest are: mixed crops (shift prob.=0.42), mixed livestock, mainly grazing livestock (shift prob.=0.39), general market garden cropping (shift prob.=0.47). These are the less specialised farm types. The sector with the largest probability for land to disappear from agriculture is specialist field crops (with a stop probability of 3,6%). However, this sector also has the highest new probability (20%, significantly higher than the other sectors, Sign test, $p<0.05$), meaning that there is a high chance that new land will be introduced into this sector, which was beforehand not used in agriculture. As a result, the land use in the specialist field crops sector is rather stable.

There seems to have been a trend in land shifts going from mixed types towards more specialist types. If this trend continues (so if the Markov probabilities don't shift), **what will happen** with land in agriculture in Flanders? This is shown in the last two columns of Table 2. It seems that in the sector where the highest amount of land is used, namely the specialist milk sector, it is expected that the amount of land will decrease with about 21% until 2017. Similarly, in the sectors cattle dairying, rearing and fattening combined, field crops and dairying combined and various crops and livestock, more than 20% of the land will be lost to other sectors or will go out of agriculture. On the other hand, sectors like specialist poultry and various granivores combined, specialist flowers and ornamentals and general market garden cropping will have an increase of more than 100% of the land used. However, these are sectors that use relatively little land, and in the case of specialist poultry and various granivores combined the increase only means that the level of 1990 is reached again. The total amount of land in agriculture, based on this sectoral analysis, will decrease with about 5%.

The increase or decrease in land use can be **explained** by looking at the **individual farmers**. It seems that in Flanders, especially the smaller farms have stopped farming. Based on the survey it can be seen that the average size of an existing farm is 29.7ha, while the average size of a stopped farm was significantly smaller, namely 19.8ha. There is also a significant difference between the amount of land in tenancy: 20.9ha (or 70%) for an existing farm while only 10.6ha (or 53%) for a stopped farm. After a farmer stops (he retires or changes profession) most of the land he owns remains in agriculture. Sometimes land goes to private use, nature, industry or recreation, but within the survey this was only the case for 2% of the owned land (17ha out of 667ha). Of the land the farmer has in tenancy, about 21ha or 3% leaves agriculture (most of it goes to private use). This is in line with the results of the Markov analysis that suggests that only about 5% of the land will disappear from agriculture in the next 10 years.

Although Flanders is a densely populated area, and often land scarcity is mentioned as a big problem for farmers, the evolutions in the land market are not often seen as a problem neither for continuation nor for finding succession. Only 3 out of 127 farmers mentioned they stopped farming because of expropriation or of insecurity concerning tenancy and only 5 farmers stopped because of problems to attain more land. Of the 42 existing farmers who did not yet have a successor at the time of the survey, only 3 farmers stated that the limitations on using more land is a reason for not having succession. This, together with the expected evolution in agricultural land, suggests that land as a production factor is not the main limiting factor for development of agriculture in Flanders.

<< insert Table 2>>

5.2. Shift in labour use

Looking at the labour factor in Flemish agriculture, one should start by mentioning the **age structure** of the farmers. About 29% of all active farmers are, in 2007, older than 65 and are in fact at the age when one normally retires. Only 42% of all active farmers are younger than 50, meaning that the whole agricultural population is quite old and has become older during the last decades. While in 1990 the average age of the farmer was 52 years old, the average age in 2007 has increased to 55 years old. This increase in average age has a major influence on the continuation of farming, after these farmers have retired. The survey has shown that for most of the farmers that stopped (61%), reaching the retirement age of 65 was the main reason for stopping.

Total **Flemish agriculture employs** around 110,000 people, including 95,500 family members and 14,500 non-family labour. This equals about 62,600 full time labour equivalents (FLEs) in 2007. Compared with early 1990s there has been a reduction in FLEs of about 18%. Because the number of farms has decreased, during the same period with 47%, the average employment on a farm has increased. In 2007 a Flemish farm employs 2.3 people, equivalent to 1.3 FLEs. Most of the people working at a farm are family members. Only about one fifth of a full time labour equivalent is executed by non-family.

<< insert Figure 3>>

Again there are significant **sectoral differences**, in the amount of people employed as well as in the evolution of the last ten years. The most labour intensive types are general market garden cropping (4.3 FLE in 2007), permanent crops combined (2.7 FLE in 2007), specialist flowers and ornamentals (2.6 FLE in 2007) and specialist market garden vegetables (2.3 FLE in 2007). In these sectors a strong increase in full time labour equivalents per farm has occurred (more than 50% increase, except for specialist flowers and ornamentals, only 35%). Only in two sectors, the FLEs have decreased: specialist field crops and specialist sheep and goats. On average less than one FLE is employed in these sectors.

<< insert Table 3>>

Based on the Markov analysis (see Table 3), the **sectoral mobility of labour** can be described. The amount of labour used in a sector seems to be more *stable* than the amount of land. For nine out of the 18 sectors the stable probability is higher than 80%, meaning that the chance that one FLE remains in the sector in the next year is very high. The probability that a FLE is *shifted* to another sector is significantly higher (higher than 0.35) for mixed crops and mixed livestock, mainly grazing livestock than most other sectors (based on the Sign test, $p<0.05$). Also in the other mixed or combined sectors, the shift probability is clearly higher than for the specialist sectors. The *stop* probability that a LFE is no longer employed in agriculture in the coming year is quite low and never reaches 10%. In the specialist sectors of sheep and goats and poultry and various granivores, this probability is significantly higher (based on the Sign test, $p<0.05$) than in the other sectors with a probability lower than 0.4. This can be explained by the fact that often farms are transformed into sheep and goats farms before ending the farm business (Calus and Vandermeulen, 2009). The sector of specialist poultry and various granivores has a quite high *new* probability, but not significantly higher than any other sector. The same holds for the sectors of specialist market garden vegetables and permanent crops combined.

The trend of land moving from mixed to specialist types, is not completely followed in labour. If the Markov trend **continues**, the amount of FLE will diminish with 31% so that only 29,036 FLE are employed in agriculture in 2017. The greatest decrease between 2007 and 2017 is expected to happen in the sector general market garden cropping (-80%) and in the sectors specialist poultry (-55%), specialist pigs (-42%) and specialist flowers and ornamentals (-42%). Only in the sector of specialist field crops will the decrease be lower than 20% (namely -12%) which will become the sector with the second largest number of FLEs. Mixed sectors are in general characterized by a lower decrease (often less than -30%) in labour units than the specialist sectors (often more than -30%), although the difference is very small. When looking at absolute values, the specialist sectors remain those with most FLEs in total. We conclude that the shift in labour units is less than the shift in land units oriented from mixed to specialised farm types.

Again, the survey can shed some light on the shifts in labour use by looking at the **individual farmers**. It seems that in Flanders, especially the farms with fewer labour units have stopped farming. Based on the survey it can be seen that the average number of people employed at the farm at an existing farm is 2.0, while the average number at a stopped farm was slightly lower, namely 1.8 (no significant difference). At 87% of the existing farms, the farmer or his/her partner are working full-time; while at only 84% of the farms that recently stopped, the farmer or his/her partner were working full-time at the farm. At 10% of these stopping farms, both of them were at the most working part-time at the farm, while this occurred only at 5% of the existing farms. After a farmer stops (he retires or changes profession) most of the labour leaves agriculture. This is in line with the results of the Markov analysis that suggests that about 31% of the labour will disappear from agriculture in the next 10 years.

Concerning the future, it should be mentioned that only 11 farmers out of 90, with an age over 50, are sure that there will be a **successor** to take over the farm. The surveys have showed that these successors are in most cases the children of the farmer or other family members (which happened in 38% of the farms that stopped). Therefore the reasons for not having a successor are very related to the family situation: not having children (6 farms), the children are not interested in farming (21 farms), the children work off the farm (21 farms), the children are not yet old enough to know whether they want to be farming (29 farms). Other reasons are that the farmers believe that they are still young enough not to have to think about succession

(21 farmers) or the agricultural sector is not doing as well to find successors (22 farms). Although the number of farmers indicating that succession is certain is low, about 50% of the farmers indicate that the farm will stay within the family after retirement (through children, other family or farming after retirement).

6. Conclusion and Discussion

The objective of this paper was to analyze and quantify structural change in Flemish agriculture, specifically for the factors land and labour, and to make projections for the future. This was mainly done by analyzing sectoral mobility of land and labour on the basis of a Markov analysis, using secondary data from national censuses. These results were however complemented by primary data obtained through a survey, in order to create a higher understanding and to put the results into perspective.

In general it seems that structural change in Flemish agriculture follows the general trend in industrialized countries. Within the period 2001-2008 the results indicate that 22 % of the Flemish farms stopped the business, the total labour force decreased with 16%, and 5% of the land was no longer used for agricultural purpose any more, which reflects a rather limited decrease in agricultural land. Most of the land that is freed up after exiting is used by existing farmers and only a small part is available for farmers who want to start up a new business. So, in general, farms are getting bigger and employ more people. They however stay family-based with a capital intensive production system. The continuation of a family farm is mainly based on the availability of a successor within the family.

Based on the Markov-analysis, the prognoses towards 2017 for the Flemish agricultural landscape indicate that more land will be used by specialized farms, and less by farm types that combine animal production and arable farming. The highest increase in amount of land was found for the following sectors: specialist poultry and various granivores combined, specialist flowers and ornamentals and general market and garden cropping. For the production factor labour the same trend from mixed to specialized farm types, although more moderate, could be observed. The highest increase in amount of labour used per farm was found for the sectors general market and garden cropping, permanent crops combined, specialist flowers and ornamentals and specialist market garden vegetables. In general, the labour use in a sector was found to be more stable than the land use.

As was found by Kimhi and Rekah (2006) this macro trend of increasing farm size and increased specialization is mainly due to the fact that older farmers, who have traditional mixed farms and still a high share of land in ownership, disappear. Developments in technology allow for increasing productivity, but this requires more specialized investments and knowledge. Because of the fixed costs involved in these investments, they are more interesting when specialized production is higher. Another reason why specialized farms are more interesting nowadays is because of the increased amount of administration on farms. A specialized farm goes along with a more uniform administration, thus allowing to save on transaction costs. A possible reason why especially the sectors specialized flowers and ornamentals and general market and garden cropping obtain more land in the future could be the fact that in these sectors there are more possibilities for product specification and less bulk production.

The consequences of all these changes might be substantial. They will probably allow a higher productivity and efficiency of farming, possibly with higher quality products, but the question is at what cost. The evolution towards more specialized, industrial farm types can cause general agricultural knowledge to get lost. This not only leads to a loss of cultural heritage, but may also have an effect on environment and the landscape. It can already be observed nowadays that farmers have less knowledge on nature. Literature has already given ample attention to the multifunctionality of agriculture being lost as a result of specialization.

To prevent this, support for multifunctional agriculture should be kept and maybe even increased so that multifunctional farms can resist the pressure from their specialized colleagues in their search for new farmland. Good farm retirement schemes and interventions in the land market are necessary to facilitate the farms who have chosen the path of specialization and size-increase.

The methodology of a stationary Markov analysis used here has its weaknesses. An example of its shortcomings is that it predicted a decrease in land used by the specialized milk sector. With the abolishment of the milk quota which is coming up, this scenario seems highly unlikely. The reason why the Markov analysis predicted this is because it only takes into account land use in the past, and doesn't pay any attention to changing policies, prices, etc. in the future. A non-stationary, higher-order Markov analysis is therefore planned for the near future. Although this will require more data, the predictions will be more accurate.

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	1997		2007		1997-2007	
	N	%	N	%	N	%
SPECIALIST FIELD CROPS	6061	11%	4860	16%	-1201	-20%
SPECIALIST MILK	9216	16%	3847	13%	-5369	-58%
SPECIALIST CATTLE-REARING AND FATTENING	7051	12%	4569	15%	-2482	-35%
CATTLE-DAIRYING, REARING AND FATTENING COMBINED	2197	4%	1435	5%	-762	-35%
SPECIALIST SHEEP AND GOATS	3887	7%	1994	7%	-1893	-49%
SPECIALIST PIGS	3636	6%	2295	8%	-1341	-37%
SPECIALIST POULTRY AND VARIOUS GRANIVORES COMBINED	1117	2%	304	1%	-813	-73%
MIXED CROPS	2451	4%	948	3%	-1503	-61%
MIXED LIVESTOCK, MAINLY GRAZING LIVESTOCK	2139	4%	653	2%	-1486	-69%
MIXED LIVESTOCK, MAINLY GRANIVORES	2951	5%	1379	5%	-1572	-53%
FIELD CROPS AND DAIRYING COMBINED	1763	3%	470	2%	-1293	-73%
FIELD CROPS AND NON-DAIRYING COMBINED	3850	7%	2161	7%	-1689	-44%
VARIOUS CROPS AND LIVESTOCK	1719	3%	868	3%	-851	-50%
SPECIALIST MARKET GARDEN VEGETABLES	4400	8%	2152	7%	-2248	-51%
SPECIALIST FLOWERS AND ORNAMENTALS	2185	4%	998	3%	-1187	-54%
GENERAL MARKET GARDEN CROPPING	252	0%	95	0%	-157	-62%

SPECIALIST FRUIT AND CITRUS FRUIT	**1770**	**3%**	**1001**	**3%**	**-769**	**-43%**
PERMANENT CROPS COMBINED	**965**	**2%**	**571**	**2%**	**-394**	**-41%**
SUM	**57610**		**30600**		**-27010**	**-47%**

Table 1 Types of farming in Flanders (number, % and evolution, 1990 and 2007)

	1990	2007	1990-2007				2017	2007-2017
	ha	ha	stable prob.	shift prob.	stop prob.	new prob.	ha	%
specialist field crops	77767	99648	0,829	0,135	0,036	0,195	106977	7%
specialist milk	163915	134078	0,865	0,126	0,009		105796	-21%
specialist cattle-rearing and fattening	43227	65316	0,821	0,157	0,022	0,004	61540	-6%
cattle-dairying, rearing and fattening combined	35747	51460	0,671	0,322	0,007		39322	-24%
specialist sheep and goats	11446	11761	0,694	0,231	0,075	0,053	16446	40%
specialist pigs	17314	29914	0,856	0,133	0,011	0,000	26132	-13%
specialist poultry and various granivores combined	2140	780	0,698	0,284	0,018	0,003	1884	141%
mixed crops	34144	22449	0,569	0,418	0,013	0,001	27171	21%
mixed livestock, mainly grazing livestock	35011	22977	0,605	0,390	0,005		20241	-12%
mixed livestock, mainly granivores	40067	39911	0,774	0,221	0,005		36184	-9%
field crops and dairying combined	43152	22871	0,688	0,302	0,010		17819	-22%
field crops and non-dairying combined	43007	47333	0,665	0,312	0,023	0,008	45234	-4%
various crops and livestock	21377	26128	0,670	0,322	0,008	0,002	20813	-20%
specialist market garden vegetables	16433	14545	0,764	0,213	0,023	0,095	21881	50%
specialist flowers and ornamentals	2722	2856	0,867	0,106	0,027	0,039	7402	159%
general market garden cropping	370	256	0,524	0,465	0,011	0,002	531	107%
specialist fruit and citrus fruit	11806	14118	0,941	0,033	0,026	0,027	16499	17%
permanent crops combined	4030	4909	0,894	0,087	0,019	0,015	6524	33%
Sum	603674	611311					578396	-5%

Table 2 Sectoral mobility of land (ha: 1990, 2007, 2017, Markov probabilities: 1990-2007)

	1990	2007	2001-2007				2017	2007-2017
	FLE	FLE	stable prob.	shift prob.	stop prob.	new prob.	FLE	%
specialist field crops	4926	4497	0,810	0,139	0,051	0,005	3952	-12%
specialist milk	9421	5708	0,864	0,124	0,012	0,000	4015	-30%
specialist cattle-rearing and fattening	5570	4313	0,827	0,144	0,029	0,000	3021	-30%
cattle-dairying, rearing and fattening combined	2405	2182	0,664	0,328	0,008	0,000	1391	-36%
specialist sheep and goats	2735	1288	0,739	0,177	0,084	0,004	806	-37%
specialist pigs	3513	3216	0,884	0,091	0,025	0,003	1850	-42%
specialist poultry and various granivores combined	1013	461	0,750	0,178	0,071	0,010	208	-55%
mixed crops	2631	1653	0,620	0,362	0,019	0,000	1235	-25%
mixed livestock, mainly grazing livestock	2555	1123	0,610	0,381	0,006	0,000	858	-24%
mixed livestock, mainly granivores	3566	2325	0,770	0,221	0,005	0,000	1618	-30%
field crops and dairying combined	2086	740	0,690	0,297	0,011	0,001	560	-24%
field crops and non-dairying combined	3331	2199	0,640	0,332	0,030	0,001	1647	-25%
various crops and livestock	1696	1392	0,660	0,333	0,012	0,000	888	-36%
specialist market garden vegetables	6196	4967	0,900	0,069	0,031	0,012	3518	-29%
specialist flowers and ornamentals	4045	2632	0,930	0,030	0,039	0,003	1516	-42%
general market garden cropping	536	412	0,850	0,102	0,049	0,005	81	-80%
specialist fruit and citrus fruit	963	1391	0,940	0,025	0,033	0,002	860	-38%
permanent crops combined	1621	1534	0,920	0,051	0,028	0,011	1010	-34%
Sum	58811	42031					29036	-31%

Table 3 Sectoral mobility of labour (FLE: 1990, 2007, 2017, Markov probabilities: 2001-2007)

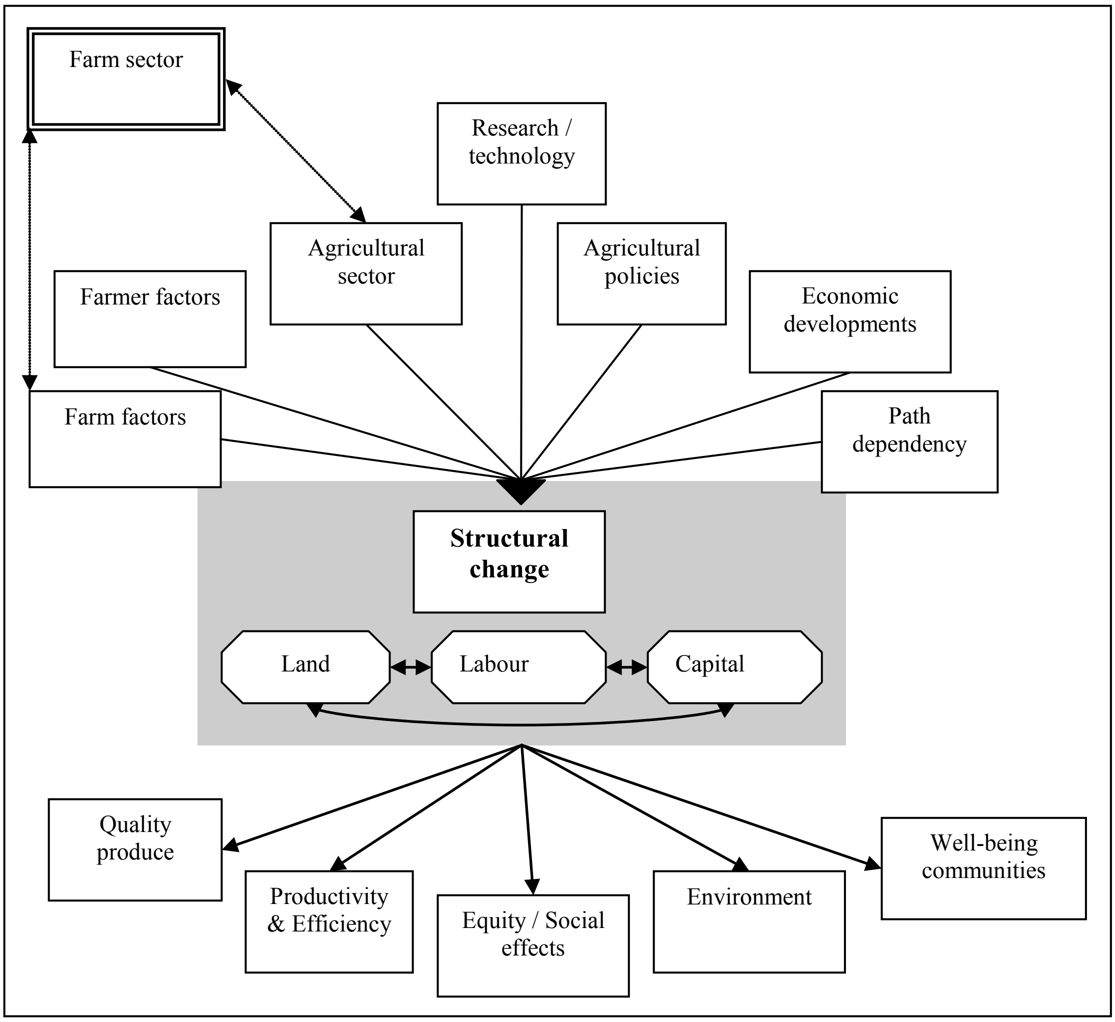

Figure 1 Causes and impacts of structural change

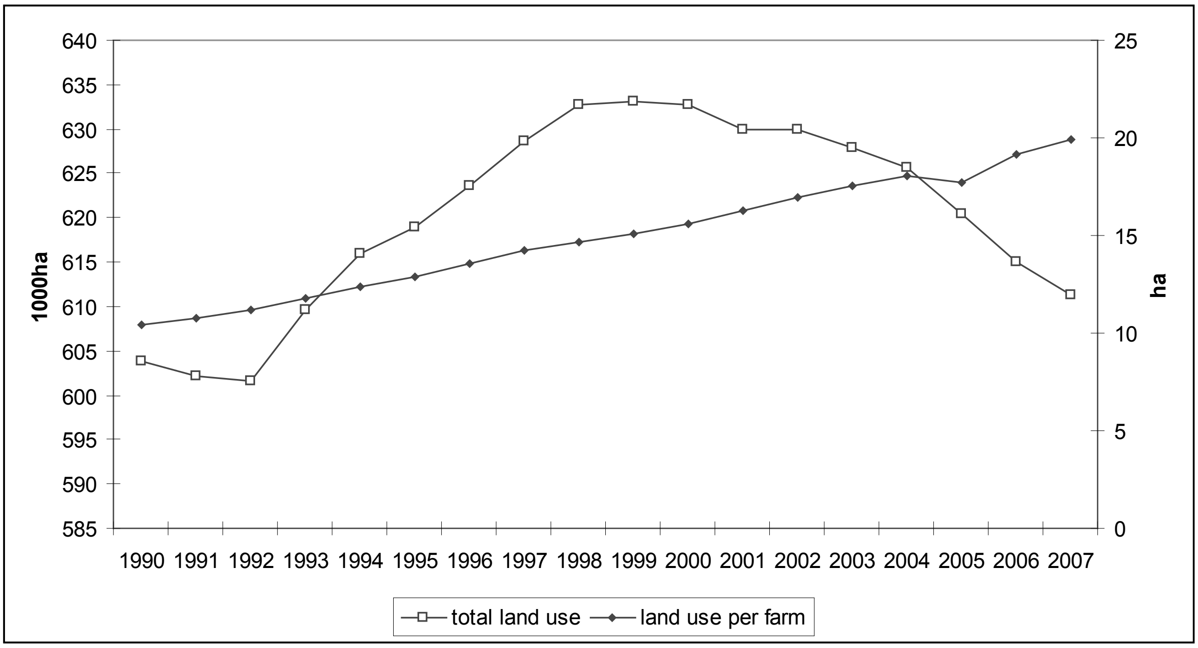

Figure 2 Land use in Flemish agriculture (1000ha, 1990-2007)

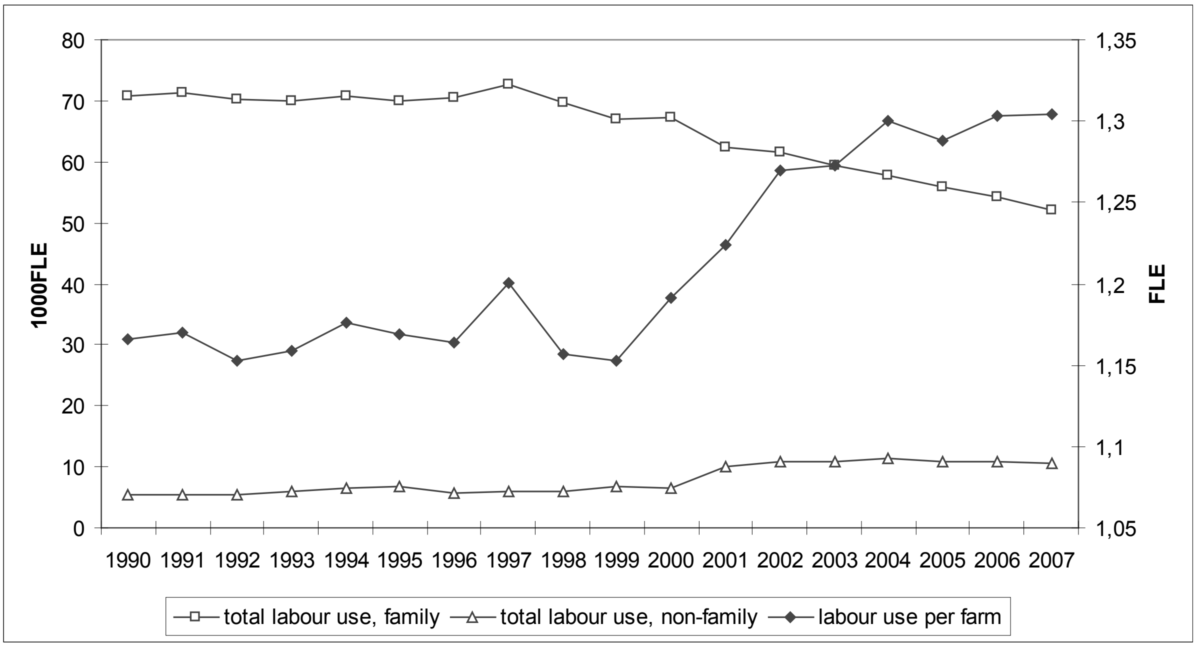

Figure 3 Labour use in Flemish agriculture (total: 1000FLE, per farm: FLE, 1990-2007)