

*Future farmland requirements in a densely populated
area: the case of Flanders in Europe*

Valerie Vandermeulen, Xavier Gellynck

Department of Agricultural Economics

Ghent University

Coupure Links 653

9000 Gent

Belgium

Tel: +32 9 264 59 43

Fax: +32 9 264 62 46

Valerie.Vandermeulen@UGent.be

ABSTRACT

The paper describes the results of a research that tried to build a well structured method to estimate future requirements on land, by agriculture or other sectors, in densely populated areas. By using, amongst others, scenario analysis and strategic orientation rounds, a method is developed to support policy optimisation and to explore alternative future developments. Secondly, this method is applied to the case of agriculture in Flanders as to show the applicability of the model and to deliver some discussion material for policy makers in Flanders. The results of this research can be used by policy makers to build a new Spatial Plan Flanders for the period 2007-2013.

KEYWORDS

Agricultural production, farmland requirements, strategic orientation round, urbanisation.

1 INTRODUCTION AND OBJECTIVES

European land use and its policy face large modifications and conversions as a consequence of the ongoing world trade liberalisation, EU enlargement, and climate change (Verburg et al. 2006; Verboom et al. 2007). Furthermore, diversification of the regional economy, structural changes in agricultural production and major demographic changes influence agricultural land use in different regions of the EU (Busch 2006). Driving forces influencing agricultural areas and rural communities range from biophysical, economic and social factors, to spatial policies and neighbourhood characteristics (Verburg et al. 2004). All these long-term and large-

scale processes embody threats as well as opportunities (Verboom et al. 2007) and influence not only (demand for) agricultural production, but also changes in agricultural land use and land cover (Busch 2006).

One of the driving forces affecting land use changes, is demographic change (Heimlich & Anderson 2001). Increasing population density leads to a higher number of competitors for space, requiring space for different purposes (like housing, labour or infrastructure, agriculture, nature, recreation and tourism). This creates the 'need to meet a large number of societal needs on scarce urban land' (Deelstra et al. 2001). In densely populated areas, land needs to be used in a multifunctional way. Consequently, the space for farming activities in these regions is limited and the restrictions on how this land may be used become tighter. Land scarcity, caused by increasing population, has been reported as a standard problem for farmers in peri-urban regions (e.g. Vesterby & Heimlich 1991; Bryant & Johnson 1992; e.g. Heimlich & Barnard 1992; Heimlich & Barnard 1997; Luijt 1997; Johnson et al. 1998). As land is the most significant fixed input factor for farming (Drummond & Goodwin 2001) it becomes important that enough land is available for agriculture if a high potential agricultural production wants to be reached. Land enables farmers to expand, to make their farm profitable and to attract succession (Luijt 1997). Moreover, land possesses some typical characteristics that make it different from other inputs: location and geoclimatic environment are fixed, supply is limited and it is a very heterogeneous resource (soil type, topography, climate etc) (Carlson et al. 1993). Therefore, it becomes interesting to elaborate research on agricultural land use to more densely populated areas, like Flanders where population density is about 448 inhabitants per km².

Both national and European Union policies attempt to influence the direction of land use developments (Westhoek et al. 2006). This can be done through agricultural policy, stimulating agricultural production and consequently the demand for agricultural land will remain (e.g. through the EU CAP measures) or through spatial policy, defining the destination of land. In densely populated areas a restrictive spatial planning policy is generally believed to be necessary to balance the numerous and often contradictory claims on space from households, industries, infrastructure and agriculture (Rouwendaal & van der Straaten 2007). In Flanders, a Spatial Plan was built to designate land use to different users for the period 1997 until 2007 (Ministerie van de Vlaamse Gemeenschap 1998). Because this plan is only operational until 2007, a new Spatial Plan Flanders has to be developed.

In order to fine tune such a spatial policy, policy makers need to know the effects of certain policy measures in order to be able to anticipate future evolutions in agricultural land use. In this lies a role for scientists who need to deliver conceptual support, methods, insights and data to explore possible future developments (Verboom et al. 2007). By studying the long-term effects of changes visible today, the discussion on the future land use issues will be stimulated (Westhoek et al. 2006). Taking into account many driving forces it becomes possible to explore the potential dynamics of land use change (Verburg et al. 2006).

Therefore, the objectives of the current research consist of building a well structured method to estimate future requirements (by agriculture or other sectors) on land. By using amongst others scenario analysis and strategic orientation rounds, a method will be developed to support policy optimisation and to explore alternative future developments (Westhoek et al. 2006; Verboom et al. 2007). Secondly, this method

will be applied to the case of agriculture in Flanders as to show the applicability of the model and to deliver some discussion material for policy makers in Flanders. The results of this research can be used by policy makers to build a new Spatial Plan Flanders for the period 2007-2013.

The remainder of the paper is structured as follows. Part 2 consists of a description of the conceptual framework and used methodology to examine future land requirements. Part 3 gives a description of the case study (Flanders) and available data. How these data will be analysed is described in part 4 – empirical analysis. In part 5, the build method is applied to one agricultural activity and the results are given. A discussion of the general results and used methodology is given in part 6 and the paper ends with a conclusion and suggestions for future research agendas.

2 CONCEPTUAL FRAMEWORK

The basic assumption of the current paper is that although the contribution of agriculture to GDP in Europe and Flanders is limited, agriculture has an important role to play in society, and should therefore be seen as a valuable activity. Society increasingly expects agriculture to contribute to environmental and landscape services, water management and flood control, social care and cohesion. Furthermore, agriculture continues to be the far most largest user of land (more than 50 % of total EU area) and rural areas are increasingly shifting from a productive area to what can be called a consumptive area (Potter & Tilzey 2005) providing social, recreational or maintenance functions (Van Huylenbroeck et al. 2007). Therefore, agriculture should be given enough opportunities to develop and survive, whether as a producer of food and fiber or as a producer of non-commodity goods and services like landscape building, environmental care, social activities and so on.

The amount of land that to the agricultural sector needs, depends on the level of potential agricultural production on the future (see Figure 2.1).

<< insert Figure 2.1 >>

As can be seen in the conceptual framework Figure 2.1, agricultural production is influenced by both internal (like structure, conduct and performance) and external factors (social forces, economic forces, factor conditions and policy). Explaining the evolution in agricultural production in the past (between 1990 and 2005) enables to identify the exact impact and importance of each factor. In order to forecast the potential of agriculture in 2020, the expected future evolution of these driving forces has to be identified. Because forecasting until 2020 encompasses many uncertainties, a scenario analysis is used to examine several alternatives of how the future might evolve (Shearer 2005). The use of scenarios for describing the future has been taken from the research Eururalis (Verboom et al. 2007). In this scenario study complex models of climate, world trade and policy are integrated. Four different scenarios are developed and extrapolated to land use in rural areas in Europe. The scenarios are: ‘specified by developing a matrix consisting of four world views or development paradigms. It is structured along two axes ranging from increasing globalisation to a world of regional economic and cultural blocks and ranging from a future of lean governments to a world pursuing its goals with ambitious government regulation’ (Westhoek et al. 2006). Each of the scenarios is fully described by Klijn, et al. (2005). The first scenario, is the ‘global economy’ scenario where market based solutions are most efficient to achieve strong economic growth. It is characterised by strong globalization and low governmental organization. The second scenario, ‘regional communities’, depends on self-reliance, environmental stewardship and sustainable

development. It is based on regional development and high governmental organization. The third one is called 'global co-operation', with high regulation and a global focus. The latter resembles best the current situation in Flanders and is therefore used as a reference scenario. For each scenario and each agricultural activity, the potential of agriculture in 2020 is estimated. This potential can only be reached if a certain amount of land is available. To safeguard this land, spatial policy might need to be adjusted, which in turn will influence the starting external factors.

3 CASE STUDY

3.1 The Case Study and the Available Data Set

Because land availability and land designation is an important bottleneck, especially in more urbanised, research is focused on densely populated Flanders located in the centre of Europe, bordering the North Sea, France, Germany and the Netherlands. The region is about 13.5 thousand square kilometres large and has a population of about 6 million people. This is about the same population as the state Washington although the state has almost 14 times as much land. In a European context, almost every community in Flanders is characterized as being urban. On average, 448 inhabitants live per km². The mean population density in the EU is only 116 inhabitants per km² and the OECD uses a cut off boundary of 150 inhabitants per km² to categorize areas into urban regions. This boundary classifies only 7% of the Flemish municipalities (305 in total) as being rural.

Data on this region was collected by looking for existing data sources, amongst others at the Department of Agriculture, the National institute of Statistics and the National Bank (see further). After a first econometric trend analysis, these data were presented

to twenty experts in the fields of economics, politics and agricultural sciences. Some of them were contacted personally and were interviewed so they could give their opinion on our analysis made. Others were invited to join a strategic orientation round in which they could discuss their vision on the future of agriculture in Flanders. In order to incorporate all data into one model, a consensus needed to be reached between the different participating stakeholders. Through this process of extensive deliberation, the data are fine-tuned, correct proxies are found and future land requirements by agriculture are estimated.

3.2 Agricultural Characteristics

About 50% of the land in Flanders is used by agriculture. Cattle production uses most of this land, about 30% is used by arable farming and 10% by horticulture. This large use of land doesn't correspond to a high contribution of agriculture to gross value added. The share of agriculture in total gross value added in Flanders is about 1.3% (Nationale Bank van België (NBB) 2005). Most of the end production value is created by the production of pigs, cattle and vegetables. Flemish farms are limited in size (17.4 ha average) which is about a tenth of the average farm size in the US.

As shown in Figure 3.1, the agricultural area in Flanders has increased slightly from 1990 until the year 2000 and afterwards has started to decrease to 633,000 hectares in 2005. The farm area including space for roads, hedges, stables etc. has decreased since 1990 with about 20,000 hectares to 674,000 hectares in 2005. The number of farmers is declining since 1990, leading to larger farms.

<< insert Figure 3.1 >>

4 EMPIRICAL ANALYSIS

4.1 Dependent Variables

To study the amount of land needed for agriculture, we divide the agricultural sector into four subsectors and 14 activities (see Table 4.1). The arable surface used to grow grain has decreased during the period 1990-2005 and the area other arable crops, including maize, has increased. In total the area used by the sector arable crops has increased by 4%. In the horticultural sector, about 20% more land is used in 2005 as compared to 1990. This increase is visible in almost every activity. In contrast, the amount of land used for grazing and fodder crops has decreased as well as the number of cattle. Within the sector of non-grazing animals, the number of pigs has decreased (as a consequence of environmental restrictions) while the number of poultry has increased.

The data on end production values have been collected from the database of the Administration of Agriculture and Horticulture, Flanders. Originally, we wanted to collect data on the added value of agriculture, because this clearly shows the importance of the sector in the economy. However, many farms are involved in several activities, e.g. combination of crops, combination of animals and combination of crops and animals. In order to find the added value per activity, we need to allocate all intermediate expenses to a specific activity. This kind of specified data is however not available for Flemish farmers and therefore we decided to work with end production values.

<< insert Table 4.1 >>

4.2 Independent Variables

Data on many different independent variables were collected. However, only those that were used to explain the agricultural production of potatoes (which will serve as an example of how the methodology can be applied) will be discussed here. In the following table, a short description is given of the independent variables (their value in 1990, in 2004, the minimum, maximum and mean value during the period 1990-2004).

<< insert Table 4.2 >>

Information on the different scenarios being used (global co-operation, global economy and regional communities) is found in the research project Eururalis. This project developed a tool which stimulates strategic discussions on the future of Europe's rural areas by considering the long-term effects of decisions taken today (Westhoek et al. 2006).

4.3 Methodology

The used methodology can be represented as in Figure 4.1. By describing the evolution of agricultural production in the past, we will be able to identify the most important driving forces of agricultural production in the past. These can be quantified by using proxies from existing databases. In the next step we investigate whether these driving forces will also be of importance in the future. We use a strategic orientation round and the scenario approach to forecast the expected future driving forces to 2020 and implement them into a structural analysis. The last step involves a conversion of the forecasted agricultural production into land need.

<< insert Figure 4.1 >>

Describing the evolution of agricultural land and production (1990-2005). In this first step, simple trend regression is used to describe the evolution of agricultural land and production. This analysis will give information on the recent developments of agriculture and will help to forecast future evolutions. The autoregressive integrated moving average method of forecasting is used (Gujarati 2003). This method analyses properties of time series on their own, without inclusion of other variables. In a first step, the model is identified and parameters are estimated of the chosen model. Secondly, diagnostics are checked to verify whether the estimated residuals have white noise or not. And finally, forecasts are obtained.

This, rather simple, analysis has the advantage of being easy to apply and interpret. It shows immediately whether a certain activity is expected to grow or shrink if the past tendency continues. It gives us a first impression on what to expect from the future, and the forecasts are more reliable than those from traditional econometric modelling. However, this analysis does not give any information on what causes this tendency and therefore cannot anticipate changes in certain internal or external factors that might influence the future development of agriculture. It is not derived from any economic theory and therefore no such theory can be used to justify the forecast.

Identifying Driving Forces for Agriculture. Based on literature a comprehensive list of driving forces that might have an impact on the development of agriculture can be built. To gain a good grasp of all driving forces, a framework (see Figure 4.2) based on Porter's diamond (Porter 1995; Viaene et al. 2003) for explaining external factors and the Structure Conduct Performance Model (Bain 1968; Minns et al. 2001; Viaene et al. 2003) for explaining the internal evolutions within the agricultural sector is used.

<< insert Figure 4.2>>

Porter's diamond (Porter 1995) is suited to understand how a sector develops successful and normally exists out of six elements: factor conditions, demand conditions, related and supporting industries, policy, strategy of the company and structure of the sector and coincidence. Because we want to quantify driving forces, coincidence or luck is not taken up in the framework. In econometric models, any residual value can be attributed to coincidence. The demand conditions are replaced by the term social forces in order to capture more specific agriculture related aspects and contain consumer behaviour (e.g. Antonides & van Raaij 1998), societal evolutions, the relation between citizens – consumers – farmers (e.g. Driesen 1997). The same holds for related and supporting industries (e.g. Cardol 1988), which is incorporated into a more general term of economic forces, including also farmers abroad, international trade and economic growth (e.g. Goddard et al. 1993). Factor conditions consist of limitations on land (e.g. Van Eck 2001), labour (Verspecht et al. 2003) and capital. Policy is a combination of political-economical factors (like trade policy or agricultural policy (Helming & Wiggering 2003)) and political-social factors (like rural policy (IDEA Consult 2003) or environmental policy (Vlaamse Landmaatschappij (VLM) 2002)). The strategy of a company and structure of the sector, which occurs in the Porter diamond, is in our framework replaced by the Structure Conduct Performance paradigm (Bain 1968; Minns et al. 2001), often used in industrial economy to describe internal developments in a sector. This model starts from a description of the economic structure of a certain activity, defined by organisation characteristics. These will mainly influence the conduct of firms. In agriculture, the conduct mainly exists of closing down the farm or shifting to another

activity. In turn, this will influence the performance of the agricultural activity, which can be measured by productivity and end production value.

Using this framework, we will be able to define which driving forces have affected agricultural production in the past and which ones might affect production in the future. In the following step, the driving forces are quantified so that they can be used in econometric analysis.

Quantifying these Driving Forces. For each driving force, a proxy is selected (based on availability and econometric suitability of data) and introduced in a regression analysis. Factor conditions and economic forces have a direct impact on the internal functioning of an agricultural production activity and are therefore relatively easy to be quantified. The impact of other forces, such as social forces or rural policy, spatial policy, environmental policy is more indirect. Their influence is most important in a qualitative way and can only be quantified by using proxies.

Using these proxies, the evolution of the end production value during the period 1990-2005 can be analysed and the relative importance of each force can be estimated. The used model can be represented as follows:

$$vEP_{ta} = \alpha + \sum_{i=1}^p \beta_i (External\ factors) + \sum_{i=1}^q \delta_i (Internal\ factors) + \mu \quad \text{eq. 1}$$

vEP: value of end production

t: indication of time

a: indication of production activity

α, β, γ : estimated coefficients

μ : error term

p: number of external factors

q: number of internal factors

In which the end production value of activity a at a certain time t is defined by:

- a term based on the evolution in the past;
- p external factors;
- q internal factors; and
- luck or coincidence.

Forecasting the driving forces (2020). In order to estimate the potential end production value of an activity in the future, it is now necessary to estimate the future evolution of the selected driving forces.

This estimation is done using the Strategic Orientation Round. The SOR method is based on the well-known SWOT approach, within which factors are categorized into internal (strengths and weaknesses) and external (opportunities and threats) (Shrestha et al. 2004), and the TOWS approach, within which the different factors are paired up (Dyson 2004). Both methods, however, cannot give the researcher any quantitative measurement of the importance of each factor (Shrestha et al. 2004). Therefore many efforts have been made to accomplish the SWOT analysis with some kind of quantitative method, weighing or rating (Rauch 2007). The SOR approach, which we used, is quite similar to the SWOT-Analytic Hierarchic Process (AHP) method (often referred to as the A'WOT approach (Kangas & Kangas 2005)). In this method, SWOT is used as a basic frame within which to perform an analysis of the decision situation (Kajanus et al. 2004). SWOT factors are compared pair-wise, leading to a computation of the relative priority value of each factor (Shrestha et al. 2004). In addition to this, Strategic Orientation Round describes how the pair-wise comparison can be carried out and how a consensus about the priority strategies can be reached by involving relevant stakeholders or experts (MDF Training & Consultancy 2004). The

SWOT or TOWS matrix serves as a foundation and is integrated with interactive expert knowledge in decision analysis (Kangas et al. 1996). The pair-wise comparison score is given according to what extent the experts believe the strengths of an activity will enable the sector to act on external opportunities and threats. They also score whether they believe that weaknesses characterizing the activity will hinder the development of the sector, taking into account the opportunities and threats occurring. The total scores give an indication about how important the different strengths, weaknesses, opportunities and threats are. Using this methodology, combines subjective preferences, expert knowledge and objective information are (Kurttila et al. 2000).

Because forecasting up to 2020 encompasses many uncertainties, we want to base our decisions on assumptions, by examining several alternatives of how the future might evolve (Shearer 2005). Looking at the future in Flanders from a different scenario will lead to clear differences in potential for agricultural activities. Therefore, the analysis of how activities can react on threats and opportunities will be different. Each activity will have more potential to grow in one scenario than another, leading to a different demand for input factors like land. The total expected value of agricultural end production in Flanders is supposed to be different under each scenario. The 20 experts in the fields of agriculture or policy who were invited to join the strategic orientation round therefore had to vote three times on the refined TOWS matrices. They made pair-wise comparisons between external and internal factors for each agricultural activity per scenario, after which a consensus was reached through deliberation (an example for the potato production is given in Annex 1). The consensus votes were used to adjust the structural analysis that was build in the former step. A high vote

leads to a higher estimated value of the driving force in the future, a low vote leads to a lower estimated value. This leads to an adjusted forecast of potential agricultural production in 2020.

Converting to Land Need. As a final step, the expected production value has to be converted into land need in order to know whether to claim land for agriculture or not. The amount of land needed for producing a certain agricultural product depends on the productivity per hectare or per animal. In this paper the expected productivity of agricultural production per activity is calculated based on a time series from 1990 until 2005. This leads to an estimate for productivity in the future, which of course has to be adjusted to expected shifts in productivity or in legislation. For example, the maximum amount of animals per hectare is limited in Flanders and it is known what the limit will be in the near future.

5 RESULTS

Although the research forecasted land use for each agricultural activity in Flanders, we will only describe one activity in detail and give an overview of the rest of the results.

5.1 Potato Production

The evolution of the end production value of potato production has followed an increasing trend between 1990 and 2005. The time series was found to be stationary: using a unit root test we found a p-value of 0.03 which is beneath the threshold of 0.05 and therefore we conclude that there is no unit root. This enables us to use the time series in further analysis. The end production value can best be explained by using a deterministic trend and the results are shown in the top part of Table 5.1. The table

shows that the F-statistic, which tests the overall significance of the model, is small (which can be explained by the limited number of observations) but significant. As this table shows, the trend analysis only explains 44% of the variation in the end production between 1990 and 2004 (measured by the R^2) (Gujarati 2003).

<< insert Table 5.1 >>

Using other variables to explain the evolution in end production value, second part of Table 5.1, increases the explanatory power to 88% (the second R^2 in the table). Because the Durbin Watson coefficient was significantly different from 2, we use the Newey-West HAC standard errors and covariance, which doesn't affect the coefficients but only the significance (Gujarati 2003). This structural analysis shows that the end production of potatoes is positively influenced by higher output prices, higher export to import ratio, lower population density in agricultural areas, higher investment support in agriculture and less parcelled out areas. To forecast the production value in 2020 it is necessary to estimate the value of each of these variables in the future.

To find these estimates, the afore mentioned SOR strategy was used. Each included variable in the regression corresponds to a certain opportunity or threat. 20 experts were asked to give their opinion on how these opportunities and threats will influence the production of potatoes in the future and a consensus was reached. This was done while envisioning the three different scenarios. The votes given for the production of potatoes are given in Annex 1. Using these votes, the variables in the structural equation can be changed and using the estimated coefficients, the end production value of potato production in 2020 is estimated. Figure 5.1 combines the results of the structural regression for the three scenarios with the trend analysis. The experts

together with the researchers believe that the potato sector still has a lot of potential growth. This is mainly based on the believe that the sector, characterised by high productivity, being market oriented and involved in many promotion efforts is able to take advantage of opportunities like increasing consumption, a strong potato processing sector and the future of bio-energy production. Furthermore, the weaknesses of soil erosion, parcelled out areas, small scale farms and the strong focus on one variety (Bintje) do not disable the sector to counteract threats like increasing competition, fluctuation in prices caused by the weather or price pressure by the retail sector.

<< insert Figure 5.1 >>

This forecasted increasing end production value might lead to an increase in the need for land, if land productivity doesn't increase at the same rate. For the potato sector, trend analysis shows that the productivity will increase from €4482/ha in 2004 to €5071/ha in 2020 (using a logarithmic trend). Therefore, the increase in production value is not followed by an equal increase in needed agricultural land, although an increase will occur. In fact, we estimate that to reach the potential of the potato sector, we need an increase in land of about 85% in the reference (global co-operation) and regional communities scenario and of about 60% in the global economy scenario (see Table 5.2).

5.2 Discussion

Table 5.2 gives an overview of the results for all activities. The study shows that certain sectors and activities of agriculture have growth potential and that in the year 2020 still a large land need will exist for agriculture. Some sectors will only reach their potential if more space becomes available, others will be able to produce a

similar amount on less land because of rising productivity. This will lead to a shift in production activities.

<< insert Table 5.2 >>

Firstly, the total requested space in 2020 depends on the chosen scenario. Under the regional communities scenario giving much attention to social values, environmental standards, own identity and regional markets, more space is necessary for agriculture to be able to fulfil its many tasks (more than only producing food. In this scenario more attention is given to broadening activities, as a result of which production activities such as grains and dairy cattle get more chances. In the global economy scenario in which a number of the production tasks can be equally well fulfilled by foreign producers, less space must be reserved for agriculture in. Moreover, in this scenario little attention is given to broadening and more potential is seen in industrial and international competitive activities like vegetable, fruit or pig production. In the reference, global co-operation, scenario which assumes developments in environmental and societal norms, building on what exists today, the need for space increases slightly in 2020. With regard to the environment, requirements like the Kyoto norms are continued, with regard to society the state will try to develop further towards a welfare state and on the international market developments will occur resembling those that exist now (e.g. abolishing import and export tariffs conditional to minimum standards for employment, environment and animal welfare). Relatively more land will be needed for the production of sugar beets and fruit.

Secondly, the expected need for agricultural land in 2020 depends on the expected production potentials. Defining these potentials is complicated and encompasses an extended literature review, validating previous research actions (Viaene et al. 2003),

encouraging expert discussions as well as common sense. Changes in the expectations, for example triggered by policy shifts, will have an impact on land requirements. It is not the intent of the used methodology to deliver the only true estimation of the future, but like any scenario based research, to deliver a model that captures all relevant available information in a reproducible (Verboom et al. 2007). The results are based on assumptions, rather than on facts (Shearer 2005). By going through a structured process of dealing with complex issues, using knowledge from various scientific disciplines and stakeholders, integrated insights are made available to decision makers (Kok et al. 2007). By highlighting differences between scenarios, rather than interpreting the final results, the research becomes robust in spite of uncertainties and simplifying assumptions (Verboom et al. 2007). Therefore, one should be careful in interpreting the data: they show in what direction land requirements will evolve in the future, given some assumptions. Furthermore, the data don't reflect the actual use of farmland in the future, but only the demand for land if agriculture wants to take advantage of all identified development potentials. Other actors claiming land are not taken into consideration (like nature, forest, recreation, living, working etc).

Even though the results differ amongst activities, sectors and scenarios, they clearly state that agriculture in the future will need quite some land if we want the sector to benefit from the opportunities. As was mentioned at the beginning of the paper, the basic assumption of the project was that agriculture can contribute to society and should therefore be given enough opportunities to develop and survive. To do this, in the 'worst case' scenario (global economy), agriculture would need about 57,000 ha less than what the sector is using in 2005. However, if the Spatial Plan Flanders 1997

is completed, already 46,000ha should be redesigned as being non-agricultural land. Therefore, the new Spatial Plan Flanders should not limit the agricultural area much further, if the basic assumption is to be reached. In the reference scenario, as well as the regional communities scenario, completing the Spatial Plan Flanders 1997 will already put strains on agricultural potential in Flanders.

6 POLICY RECOMMENDATIONS AND RESEARCH AGENDA

The Spatial Plan Flanders is an instrument which has to enable spatial policy to make assessments between and interpretations of several societal tasks like creating spatial quality, facilitating certain developments and offering legal security. Regarding agriculture, the revised spatial plan should take into account the added value of the agricultural economic production process as well as the social appreciation of agriculture as an open space administrator in a balanced way. This must become evident through a support to intensification of land use on the one hand (deepening) and creating possibilities for directions with a clearer focus on landscape management on the other (broadening).

In order to allow actual changes in the field, it is necessary not only to look at the Spatial Plan Flanders as a general policy format with accompanying spatial balances, but much more as a strategic policy plan in which specific projects can be embedded for the next governmental period. The area safeguarded for agriculture in the future can act as a target figure. The current study introduces some ideas on a differentiated demarcation and quantification of agriculture production space during this demarcation. The research shows that there might evolve two differentiated farm models (Gellynck et al. 2007). One type of farms, in the research labelled as being chain companies, will focus on agricultural production at a global scale. Their intent

is to be able to face international competition with other farmers or producers. They build chains with other farms in the neighbourhood and construct agribusiness complexes in order to gain more market power. For these types of companies, having enough land at their disposal, without additional restrictions so that production can be carried out efficiently is the primary concern. Other farms, however, might focus more on the multifunctional aspects of agriculture and the partnership with other users of open space. These partnership companies can more easily be placed in zones where other spatial functions are expected. This does not mean that partnership companies are no longer real agriculture companies nor are they supposed to be economically unprofitable (and for this must receive the necessary space), but that these companies can also be efficient (in the sense of social-societal cost-saving) in the management of open space (Van Huylenbroeck et al. 2007).

The methodology used in this research allows a lot of interaction with experts, farmers, consumers, policy makers and other stakeholders. By starting from collected data from the past, a solid basis is build on which discussions are organised. Researching literature on different driving forces for agriculture and finding out if these can explain the evolution from the past, enables a first summing up. Putting these in a SOR analyses leads to refined results which can resist a lot of critiques. Using different scenarios allows some degrees of freedom in interpreting the results. Finally, it is up to policy makers to decide which scenario they intend to follow and their choice can easily be incorporated in the model. By collecting basic data indicating in an unprejudiced way whether it is socially beneficial to maintain agriculture and at what scale, it gives policy makers an instrument to make better underpinned decisions about land use planning.

7 REFERENCES

- Antonides, G. & van Raaij, F. (1998). *Consumer Behaviour, a European Perspective*. Erasmus University. Rotterdam: John Wiley & Sons.
- Bain, J. S. (1968). *Industrial Organization*. New York: John Wiley & Sons Inc.
- Bryant, C. & Johnson, T. R. R. (1992). *Agriculture in the City's Countryside*. London: Belhaven Press.
- Busch, G. (2006). Future European Agricultural Landscapes - What Can We Learn from Existing Quantitative Land Use Scenario Studies? *Agriculture Ecosystems & Environment*, 114, 1, 121-140. May.
- Cardol, G. (1988). Space for Agribusiness Complexes: Structure, Position and Dynamics of the North Limburg Horticulture Complex from Functional, Geographical and Regional Perspective (Ruimte Voor Agribusiness-Complexen : Structuur, Positie En Dynamiek Van Het Noordlimburgse Tuinbouwcomplex Vanuit Functioneel, Geografisch En Regionaal Perspectief). Amsterdam, Koninklijk Nederlands Aardrijkskundig Genootschap (Royal Dutch Geography Organisation).
- Carlson, G., Zilberman, D. & Miranowski, J. (1993). *Agricultural and Environmental Resource Economics*. New York, Oxford.
- Deelstra, T., Boyd, D. & van den Biggelaar, M. (2001). Multifunctional Land Use, an Opportunity for Promoting Urban Agriculture in Europe. *UA Magazine*, 33-35.
- Demuynck, E. & Bernaerts, E. (2005). *Regionale Rekeningen Van De Landbouw*. (ALT), M. v. d. V. G. A. L.-e. T.
- Driesen, L. (1997). Image Research: Citizen Thinks No Good About Agriculture and Horticulture (Imago-Onderzoek: Burger Denkt Weinig Goeds over Landbouw En Tuinbouw). *VILT*, 7, 10. March 7th 1997.

Drummond, E. & Goodwin, J. (2001). *Agricultural Economics*. New Jersey: Prentice Hall.

Dyson, R. G. (2004). Strategic Development and Swot Analysis at the University of Warwick. *European Journal of Operational Research*, 152, 3, 631-640. Feb.

Gellynck, X., Van Huylenbroeck, G., Vandermeulen, V., Bervoets, K., Leinfelder, H., Verhoestraete, D., Van Orshoven, J., Bomans, K., Gullinck, H., Vloebergh, G., Laureys, G., De Greef, J. & Wuillaume, P. (2007). Analyse Van De Huidige and Toekomstige Ruimtebehoefte Voor Land- En Tuinbouw En De Toekomstige Ruimtelijke Ontwikkelingen Binnen Land- En Tuinbouw. Brussel, Departement Landbouw en Visserij - Afdeling Monitoring en Studie,, 114.

Goddard, E., Weersink, A., Chen, K. & Turvey, C. G. (1993). Economics of Structural-Change in Agriculture. *Canadian Journal of Agricultural Economics-Revue Canadienne D Economie Rurale*, 41, 4, 475-489. December 1993.

Gujarati, D. N. (2003). *Basic Econometrics*. New York: McGraw-Hill/Irwin.

Heimlich, R. E. & Anderson, W. D. (2001). *Development at the Urban Fringe and Beyond: Impacts on Agriculture and Rural Land*. Economic Research Service - U.S. Department of Agriculture. Agricultural Economic Report No. 803.

Heimlich, R. E. & Barnard, C. H. (1992). Agricultural Adaptation to Urbanization: Farm Types in Northeast Metropolitan Areas. *Northeastern Journal of Agricultural and Resource Economics*, 21, 1, 50-60. April.

Heimlich, R. E. & Barnard, C. H. (1997). Agricultural Adaptation to Urbanization? Farm Types and Agricultural Sustainability in U.S. Metropolitan Areas. In Audirac, I. (Ed. *Rural Sustainable Development in America*.(pp. 283-303) New York: Wiley and Sons.

Helming, K. & Wiggering, H. (2003). *Sustainable Development of Multifunctional Landscapes*. Berlin: Springer.

IDEA Consult (2003). *Evaluatie Van Het Vlaamse Programma Voor Plattelandsontwikkeling (Evaluation of the Flemish Program for Rural Development)*. Brussel, Consortium van de afdeling Landbouweconomie en het Laboratorium voor Bosbouw van de Universiteit Gent, Belconsulting, het Centrum voor Landbouweconomie en IDEA Consult.

Johnson, N. L., Kelleher, F. M. & Chant, J. J. (1998). *The Future of Agriculture in the Peri-Urban Fringe of Sydney*. (Paper presented at: Australian Agronomy Conference, Waga Waga).

Kajanus, M., Kangas, J. & Kurttila, M. (2004). The Use of Value Focused Thinking and the A'wot Hybrid Method in Tourism Management. *Tourism Management*, 25, 4, 499-506. Aug.

Kangas, J. & Kangas, A. (2005). Multiple Criteria Decision Support in Forest Management - the Approach, Methods Applied, and Experiences Gained. *Forest Ecology and Management*, 207, 1-2, 133-143. Mar.

Kangas, J., Lauhanen, R. & Store, R. (1996). Assessing the Impacts of Ditch Network Maintenance on Water Ecosystems on the Basis of Expert Knowledge and Integrating the Assessments into Decision Analysis. *Suo*, 47, 2, 47-57

Kok, K., Verburg, P. H. & Veldkamp, T. (2007). Integrated Assessment of the Land System: The Future of Land Use. *Land Use Policy*, 24, 3, 517-520. Jul.

Kurttila, M., Pesonen, M., Kangas, J. & Kajanus, M. (2000). Utilizing the Analytic Hierarchy Process (Ahp) in Swot Analysis - a Hybrid Method and Its Application to a Fores-Certification Case. *Forest Policy and Economics*, 1, 41-52. 2000.

- Luijt, J. (1997). *Regionale Grondbalansen Tot 2015, Een Verkenning Van De Agrarische Grondmarkt Op Basis Van Drie Lange Termijnsenario's Van Het Cpb*. LEI-DLO. Onderzoeksverslag. Den Haag: LEI.
- MDF Training & Consultancy (2004). *Tango for Organisations, 40 Tools for Institutional Development and Organisational Strengthening*. Ede.
- Ministerie van de Vlaamse Gemeenschap (1998). *Ruimtelijk Structuurplan Vlaanderen. Integrale Versie*. Gemeenschap, M. v. d. V. Brussel.
- Minns, A., Finn, J., Hector, A., Caldeira, M., Joshi, J., Palmborg, C., Schmid, B., Scherer-Lorenzen, M., Spehn, E. & Troumbis, A. (2001). The Functioning of European Grassland Ecosystems: Potential Benefits of Biodiversity to Agriculture. *Outlook on Agriculture*, 30, 3, 179-185
- Nationaal Instituut voor de Statistiek (NIS) (1990). *Landbouwtelling*. Statistische Studiën. Brussel.
- Nationaal Instituut voor de Statistiek (NIS) (2005). *Landbouwtelling*. Statistische Studiën. Brussel.
- Nationale Bank van België (NBB) (2005). Belgostat. *Nationale Bank van België*,
- Porter, W. (1995). Knowledge Utilization and the Process of Policy Formation: Toward a Framework for Africa. *AFR/SD Washington*, 62
- Potter, C. & Tilzey, M. (2005). Agricultural Policy Discourses in the European Post-Fordist Transition: Neoliberalism, Neomercantilism and Multifunctionality. *Progress in Human Geography*, 29, 5, 581-600
- Rauch, P. (2007). Swot Analyses and Swot Strategy Formulation for Forest Owner Cooperations in Austria. *European Journal of Forest Research*, 126, 3, 413-420. Jul.

- Rouwendal, J. & van der Straaten, J. W. (2007). Measuring Welfare Effects of Spatial Planning. *Tijdschrift Voor Economische En Sociale Geografie*, 98, 2, 276-283
- Shearer, A. W. (2005). Approaching Scenario-Based Studies: Three Perceptions About the Future and Considerations for Landscape Planning. *Environment and Planning B-Planning & Design*, 32, 1, 67-87. Jan.
- Shrestha, R. K., Alavalapati, J. R. R. & Kalmbacher, R. S. (2004). Exploring the Potential for Silvopasture Adoption in South-Central Florida: An Application of Swot-Ahp Method. *Agricultural Systems*, 81, 3, 185-199. Sep.
- Van Eck, W. (2001). *Naar Een Waardenvolle Landbouw*. (Paper presented at: Lezing opening academisch jaar, Wageningen universiteit).
- Van Huylenbroeck, G., Vandermeulen, V., Mettepenningen, E. & Verspecht, A. (2007). Multifunctionality of Agriculture: A Review of Definitions, Evidence and Instruments. *Living Reviews in Landscape Research*, 1. Maj 2007.
- Verboom, J., Alkemade, R., Klijn, J., Metzger, M. J. & Reijnen, R. (2007). Combining Biodiversity Modeling with Political and Economic Development Scenarios for 25 Eu Countries. *Ecological Economics*, 62, 2, 267-276. Apr.
- Verburg, P. H., van Eck, J. R. R., de Nijs, T. C. M., Dijst, M. J. & Schot, P. (2004). Determinants of Land-Use Change Patterns in the Netherlands. *Environment and Planning B-Planning & Design*, 31, 1, 125-150. Jan.
- Verburg, P. H., Veldkamp, A. & Rounsevell, M. D. A. (2006). Scenario-Based Studies of Future Land Use in Europe. *Agriculture Ecosystems & Environment*, 114, 1, 1-6. May.
- Verspecht, A., Van Lierde, D. & Taragola, N. (2003). *Job Expectations of School Leavers in Agricultural and Horticultural Education in Flanders (Werkverwachtingen*

Van Schoolverlaters in Het Land-En Tuinbouwonderwijs in Vlaanderen). Center for Agricultural Economics (CLE). Brussels.

Vesterby, M. & Heimlich, R. E. (1991). Land-Use and Demographic-Change - Results from Fast-Growth Counties. *Land Economics*, 67, 3, 279-291. Aug.

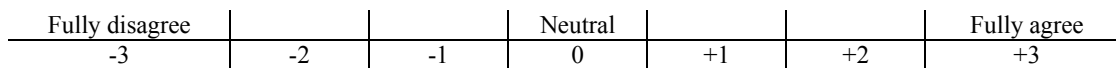
Viaene, J., Gellynck, X. & De Belder, T. (2003). Het Economische Belang Van De Paardensector. In opdracht van de Belgische Confederatie van het Paard. Gent, Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen, 82.

Vlaamse Landmaatschappij (VLM) (2002). Beheersovereenkomsten Natuur. *Nationaal Instituut voor de Statistiek - Het Leefmilieuportaal*,

Westhoek, H. J., van den Berg, M. & Bakkes, J. A. (2006). Scenario Development to Explore the Future of Europe's Rural Areas. *Agriculture Ecosystems & Environment*, 114, 1, 7-20. May.

ANNEX 1 TOWS MATRIX FOR POTATO PRODUCTION

	Opportunities	Threats						
Strengths High productivity Market oriented sector Promotion	All strengths together, enable the sector to exploit all opportunities.			All strengths together, enable the sector to overcome all threats.				
	Scenario:	s1	s2	s3	Scenario:	s1	s2	s3
	Consumption	2	1	3	Competition	2	0	2
	Potato processing sector	2	2	2	Price fluctuation (caused by the weather)	1	1	2
	Bio-energy	1	0	2	Price pressure by the retail sector	1	1	1
Weaknesses Soil erosion Parcelled out areas Small scale farms Strong focus on Bintje	All weaknesses together, disable the sector to exploit all opportunities.			All weaknesses together, disable the sector to overcome all threats.				
	Scenario:	s1	s2	s3	Scenario:	s1	s2	s3
	Consumption	-1	0	-1	Competition	-1	1	-1
	Potato processing sector	-2	-1	-1	Price fluctuation (caused by the weather)	0	0	-1
	Bio-energy	-1	0	0	Price pressure by the retail sector	-2	-1	-2



s1 : the reference scenario, namely Global co-operation

s2: the second scenario, namely Global economy

s3: the third scenario, namely regional communities

Table 4.1 Agricultural activities: agricultural area, number of animals and end production value, in ha, number and € 1990 and 2005. Source: NIS (1990; 2005), Demuyneck and Bernaerts (2005).

	1990	2005	1990	2005	2005
	Arable area (10,000 ha)		Number of animals		End production value (€ million)
SECTOR ARABLE FARMING					
o Grain	12.5	9.1			66.3
o Sugar beat	4.1	3.3			114.3
o Potatoes	3.8	4.0			187.6
o Other arable crops (corn)	1.6	6.5			65.7
SECTOR HORTICULTURE					
o Vegetable in open air	2.3	2.7			313.2
o Greenhouse vegetables	0.1	0.1			256.9
o Fruit	1.2	1.5			303.5
o Ornamental plant cultivation	0.4	0.6			457.2
SECTOR GRAZING ANIMALS					
			(×10,000)		
o Dairy cattle			90.9	61.2	549.2
o Meat cattle			67.1	58.1	491.4
o Fodder crops and grazing land	37.1	35.5			
SECTOR NON-GRAZING ANIMALS					
			(×1,000,000)		
o Pigs			6.4	6.0	1295.2
o Laying hens			10.5	11.6	231.1
o Fryers			14.9	17.6	113.8
Totaal	63.0	63.3			

Table 4.2 Independent variables used in the regression of potato production. Source: CLE (Centre for Agricultural Economics), NBB (National Bank of Belgium), NIS (National Institute of Statistics), VLIF (Flemish Investment Fund), Mestbank (Agency for Manure Accounting)

abbrev	name	1990	2004	Period 1990-2004			scale	source
				min	max	average		
OPAAR	output price of potatoes	222.52	182.71	90.89	461.66	191.02	index	CLE
XMAAR	ratio of exports to imports, potatoes	178.35	170.64	163.84	268.07	195.08	ratio	NBB
BEVAGR	inhabitants per ha farmland	9.09	9.50	9.09	9.50	9.28	number	NIS
VLIFSTEUN	support for investments	3.33	38.21	3.33	42.84	23.63	million euro	VLIF
VERSN	parcelled out	73.00	64.60	64.60	73.00	68.80	perimeter/area	Mestbank

Table 5.1 Regression of end production value of potato production.

Dependent Variable: EWAAR

Sample (adjusted): 1990 2004

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	117.59	21.52	5.46	0.000
@TREND	8.32	2.61	3.18	0.007
R-squared	0.437675	Mean dependent var		175.87
Adjusted R-squared	0.394420	F-statistic		10.11
Durbin-Watson stat	2.186978	Prob(F-statistic)		0.01

Newey-West HAC Standard Errors & Covariance (lag truncation=2)

OPAAR	0.29	0.06	4.95	0.001
XMAAR	0.87	0.18	4.67	0.001
BEVAGR	-493.36	160.73	-3.06	0.013
VLIFSTEUN	1.89	0.72	2.61	0.028
VERSN	-28.36	8.97	-3.159	0.012
C	6434.10	2067.49	3.11	0.013
R-squared	0.88	Mean dependent var		175.87
Adjusted R-squared	0.82	F-statistic		13.93
Durbin-Watson stat	2.63	Prob(F-statistic)		0.00

Table 5.2 Farmland in 2005 and the estimated need for farmland in 2013 and 2020 (for three scenarios), in ha.

	Need for farm land (ha)	2005	2020, Global co- operation	2020, Global economy	2020, Regional communities
Arable farming	Cereals	93,363	59,035	43,942	73,827
	Sugar beets	33,496	44,998	36,873	44,946
	Potatoes	41,135	77,717	67,304	77,853
	Other	66,835	49,191	49,168	49,213
	Energy crops	153	1,163	0	2,328
	Total	234,982	232,104	197,287	248,167
Horticulture	Vegetables in open air	33,183	39,939	36,457	43,357
	Greenhouse vegetables	3,392	5,935	5,533	5,935
	Ornamental plants	9,094	9,761	7,526	12,017
	Fruit	15,006	25,638	23,918	25,650
	Total	60,675	81,273	73,434	86,959
Animal production	Cattle	369,652	358,950	331,796	402,833
	Horses	10,191	15,150	15,130	15,150
	Pigs	903	1,408	1,314	1,425
	Fryers	231	265	216	292
	Laying hens	353	159	157	182
	Total	381,330	375,932	348,613	419,882
	Total Flemish agriculture	676,987	689,309	619,334	755,008

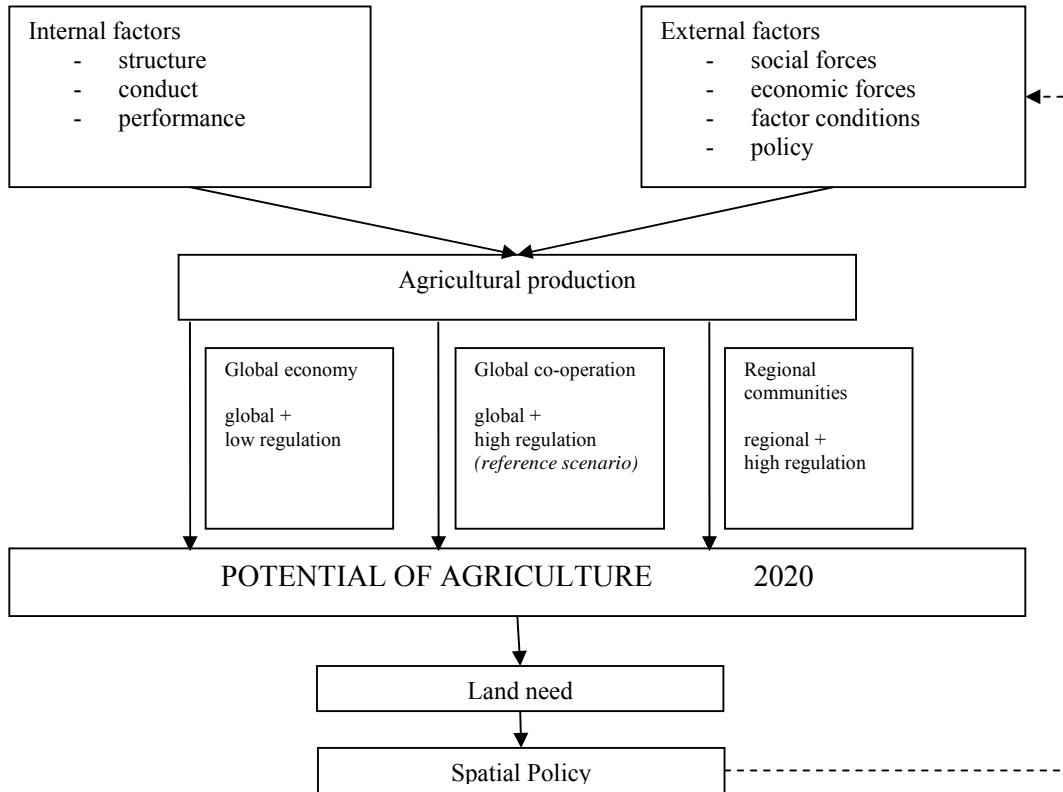


Figure 2.1 Conceptual framework: estimating future farm land requirements.

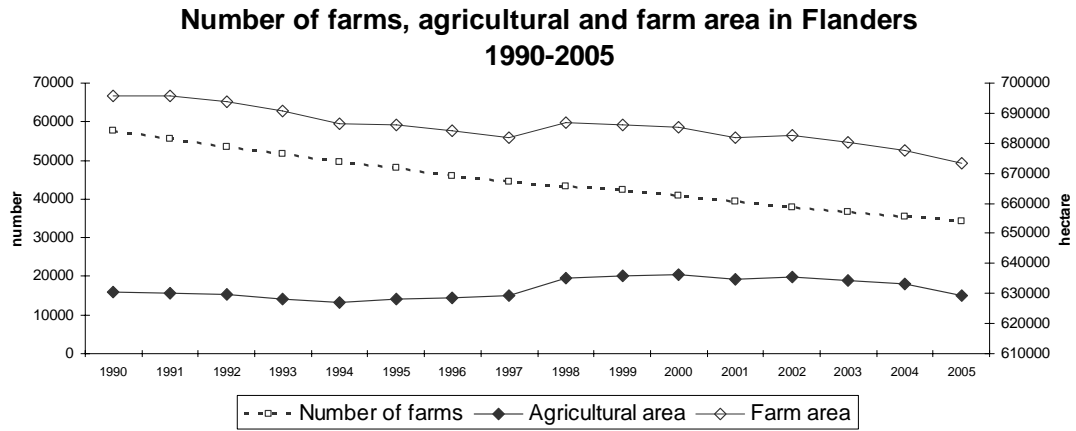


Figure 3.1 Evolution of the number of farms, agricultural and farm area in Flanders between 1990 and 2005. Source: NIS (1990; 2005).

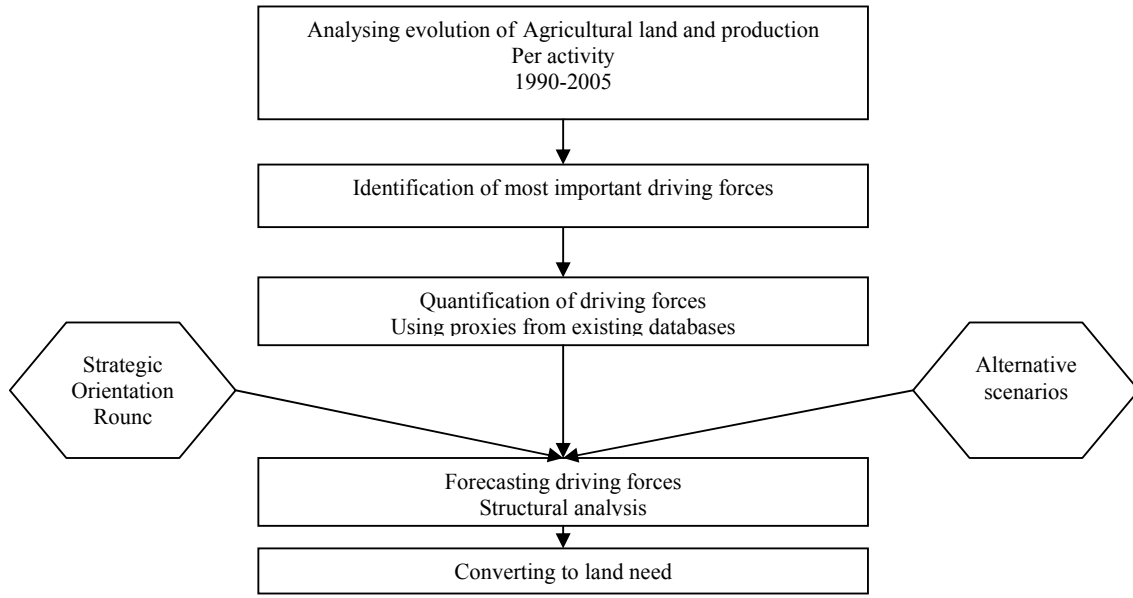


Figure 4.1 Methodology.

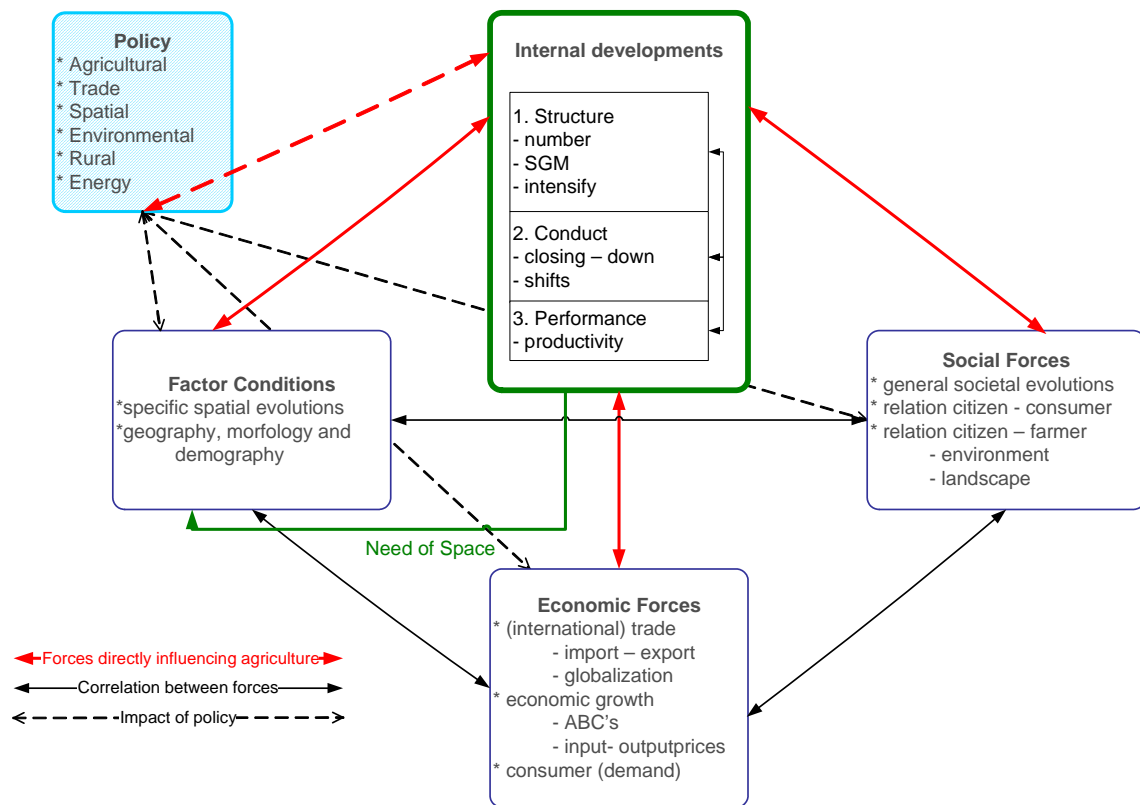


Figure 4.2 Identifying driving forces for agriculture. Based on: Porter, 1990 and Scherer and Ross, 1990.

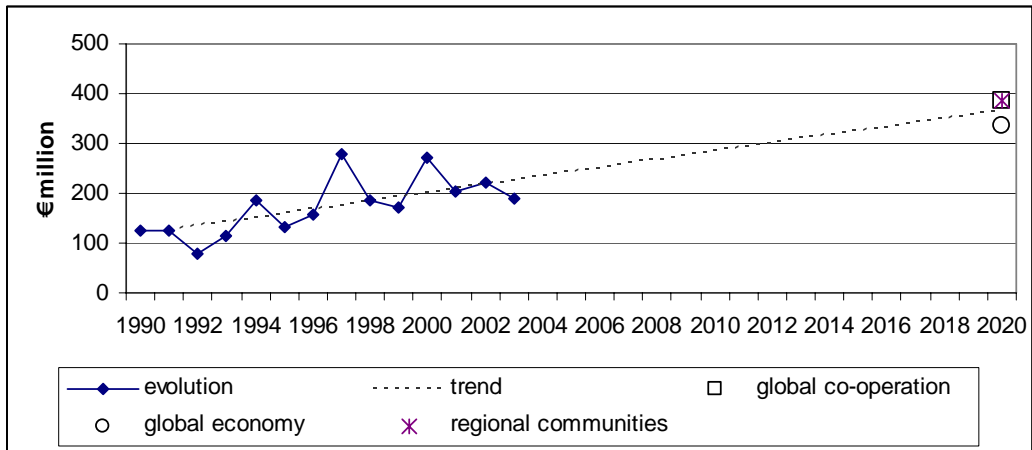


Figure 5.1 Production value of potato, 1990-2004, and forecast of production value, 2020.