**Priority Area "Sustainable management of Europe's natural resources"**

**CONTRACT No. SSPE-CT-2006-0044201 (STREP)**
**Project start: 01 January 2007**
**Duration: 45 months**

# DELIVERABLE 5.3
# "The interrelationships between demography, structural change, and policies in Hungary and Poland"

Hauke Schnicke[1]

| | |
|---|---|
| **WP leader for this deliverable** | **UL** |
| **Partners involved** | **IAMO, AKI, WUDES** |
| **Document status:** | **Final Version** |
| **Due date of deliverable:** | **30 April 2009** |
| **Date:** | **24 September 2010** |

| **Dissemination level** (see DoW p. 27-30) | | |
|---|---|---|
| **PU** | Public | ☑ |
| **PP** | Restricted to other programme participants (including the Commission Services | ☐ |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | ☐ |
| **CO** | Confidential, only for members of the consortium (including the Commission Services) | ☐ |

[1] The order of authors represents the time input allocated to each partner institution in WP5 of SCARLED.

The author gratefully acknowledges financial participation from the European Community under the Sixth Framework Programme for Research, Technological Development and Demonstration Activities, for the Specific Targeted Research Project "SCARLED" SSPE-CT-2006-044201. The author would like to thank Alfons Balmann for the internal review of this deliverable.

## Abstract

This deliverable studies the impact of demographic structures of farm households on structural change in selected regions in Hungary and Poland. The first part of this deliverable presents survey results of Hungarian and Polish farm households' demographic structures. The survey data refer to the composition of individual farm households, the age structure of farm operators, and the issues of farm succession, e.g. the existence and designation of potential farm successors. In the second part of the deliverable, the empirical findings are implemented in an extended version of the agent-based model AgriPoliS which allows to consider demographic structures of farm households for regional adaptations. For two selected regions in Hungary and Poland, simulation experiments are carried out to analyse the impacts of the demographic structure. The simulations show how heterogeneous farms evolve in response to demographic characteristics such as age patterns or uncertainty of farm successions but also in response to external conditions such as the impacts coming from the agricultural policy scheme which has been introduced in the course of both countries' EU accession. The analyses focus on indicators which show the direction, speed, and intensity of structural changes

## Executive Summary

Regarding the impacts of demographic patterns on structural change actual conditions and the future prospects differ significantly between the Hungarian and the Polish study region. However, for both regions one can predict a steady continuation of structural change through the exiting of small individual farms mainly after the farmers' retiring. In the Hungarian region, the exiting process of individual farms is in all scenarios stronger since there comes a strong pressure from large corporate and individual farms which demand for land as they are able to use the land more efficiently. Moreover, the off-farm labour market provides higher wages there. An important role plays the demographic patterns as observed in the Hungarian farm survey. Over-ageing of operators in the small size classes provoke a shift in the exiting process while large groups of middle-aged farmers in small size classes will lead to an accelerated structural change in ten to fifteen years. One can conclude that the age distribution of farmers strongly affects the timing of persistence or exiting of farms. However, also the Polish region is characterised by small farms exiting.

With regard to the implementation of an age-dependent decline of opportunities, it was shown in a first simulation sequence that this slows down the number of farm exits significantly. This applies to both regions.

In view of the problem of missing farm successors, the conclusion can be drawn that the impacts are not as strong as one would have supposed ex ante in Hungary. There are typical 'exit farms' which leave anyway and even before a potential succession event.

Regarding the Polish region the demographic structure is less problematic, i.e. the problem of over-ageing is less pressing which is also approved by EuroStat data. The whole sample of farms is constituted solely by individual farms. Furthermore, these are more homogenous and they are more equally distributed among size classes. Additionally, the livestock density is much higher and thus the regional agricultural labour input. But in contrast to the Hungarian region, there is an even more pronounced uncertainty with regard to farm successions and the implementation of this uncertainty via a specific scenario has a strong impact as it appears an accelerated structural change. This applies to all indicators under consideration. Particularly by regarding the development on the land distribution in different size classes it becomes obvious that the Polish region is less dynamic with regard to tremendous structural changes, such as a strong growing of farms or an increase of labour efficiency. The rather slight changes are solely 'disturbed' by assuming the farm succession as a crucial and decisive process.

It should be taken into account that the agricultural policy framework with its increasing area payments leads to an increase in rental prices and farm profits in both regions. This can in turn somewhat 'overlay' the demographic issues which have been addressed in this analysis. However, increasing payments to farmers lead to the problem of the capitalisation of the premium benefits to landowners in the middle- and long-term perspective. This problem concerns particularly the Hungarian region since the share of rented land is significantly higher. But the policy framework does not inhibit the trend of small farms exiting. This is surprising since other studies (BLAAS et al., 2007) found that increasing premiums lead to a significant time delay of this adjustment reaction.

## SCARLED Consortium

This document is part of a research project funded by the 6th Framework Programme of the European Commission. The project coordinator is IAMO, represented by Prof. Dr. Gertrud Buchenrieder (buchenrieder@iamo.de).

**Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO) - Coordinator**
Theodor-Lieser Str. 2
06120 Halle (Saale)
Germany

Contact person: Judith Möllers
E-mail: scarled@iamo.de

**Catholic University Leuven (KU Leuven)**
LICOS Centre for Institutions and Economic Performance & Department of Economics
Deberiotstraat 34
3000 Leuven.
Belgium

Contact person: Johan Swinnen
E-mail: jo.swinnen@econ.kuleuven.be

**University of National and World Economy (UNWE)**
St. Town "Chr. Botev"
1700 Sofia
Bulgaria

Contact person : Plamen Mishev
E-mail: mishevp@intech.bg

**Corvinus University Budapest (CUB)**
Department of Agricultural Economics and Rural Development
Fövám tér 8
1093 Budapest
Hungary
Contact person: Csaba Csáki
E-mail: csaba.csaki@uni-corvinus.hu

**Research Institute for Agricultural Economics (AKI)**
Zsil u. 3/5
1093 Budapest
Hungary
Contact person: József Popp
E-mail: poppj@akii.hu

**Warsaw University, Department of Economic Sciences (WUDES)**
Dluga 44/50
00-241 Warsaw
Poland
Contact person: Dominika Milczarek-Andrzejewska
E-mail: milczarek@wne.uw.edu.pl

**Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara (USAMVB)**
Calea Aradului 119
300645 Timisoara
Romania
Contact person: Cosmin Salasan
E-mail: cosminsalasan@xnet.ro

**University of Ljubljana (UL)**
Groblje 3
1230 Domzale
Slovenia

Contact person: Luka Juvančič
E-mail: luka.juvancic@bfro.uni-lj.si

**The University of Kent, Kent Business School (UNIKENT)**
Canterbury
Kent CT2 7NZ
United Kingdom
Contact person: Sophia Davidova
E-mail: s.davidova@imperial.ac.uk

**University of Newcastle upon Tyne, Centre for Rural Economy (UNEW)**
Newcastle upon Tyne NE1 7RU
United Kingdom

Contact person: Matthew Gorton
E-mail: matthew.gorton@newcastle.ac.uk

# CONTENT

## LIST OF TABLES



## LIST OF FIGURES

## LIST OF MAPS

## LIST OF ABBREVIATIONS

| | |
|---|---|
| AgriPoliS | Agricultural Policy Simulator |
| Av. | Average |
| AWU | Annual Working Unit |
| CAP | Common Agricultural Policy |
| CEE | Central and Eastern European |
| CF | Corporate Farms |
| CNDP | Complementary National Direct Payments |
| e.g. | exempli gratia (for example) |
| etc. | et cetera |
| ESU | European Size Unit |
| EU | European Union |
| EuroStat | Statistical Office of the European Union |
| € | Euro |
| FADN | Federal Accountancy Data Network |
| FSS | Farm Structure Survey |
| ha | Hectare |
| i.e. | id est (that is) |
| IF | Individual Farms |
| LU | Livestock Unit |
| Mea-Scope | Micro-economic instruments for impact assessment of multifunctional agriculture to implement the Model of European Agriculture |
| Min. | Minimum |
| Max. | Maximum |
| NMS | New Member States |
| NUTS | Nomenclature des unités territoriales statistiques |
| No. | Number |
| OECD | Organisation for Economic Cooperation and Development |
| SGM | Standard Gross Margin |
| SAPS | Single Area Payment Scheme |
| SCARLED | Structural Change in Agricultural and Rural Livelihoods |
| TLL | Thüringer Landesanstalt für Landwirtschaft (Federal Office for Agriculture of Thuringia) |
| UAA | Utilised Agricultural Area |
| % | per cent |

# 1 INTRODUCTION

Socio-economic characteristics, economic framework conditions and activities of farm households highly influence structural change in agriculture whether as accelerating or inhibiting factors (BUCHENRIEDER et al., 2007). Structural change results from the dynamic interplay among different driving factors. Some driving factors are internal to the farm, such as the location of the farm, the financial situation or the socio-economic characteristics of the farm household. Other driving factors are external to the farm – and partly even to the agricultural sector. Examples of the first type are competitive forces within the sector, such as structural characteristics, e.g., the farm size distribution, financial structures, rental prices, product prices. Examples of the later type are interest rates, wages in other sectors of the economy, and the (agricultural) policy environment (HAPPE et al., 2009). Several studies focus on the impacts of the European Union (EU) accession on the agricultural sector in the Eastern New Member States (NMS) (BLAAS et al., 2007, JELINEK et al., 2007). However, only a few studies analyse this political process against the background of socio-economic conditions such as the challenges coming from demographic change.

This deliverable focuses on the role of socio-economic characteristics, such as demographic patterns of farm-households. It is structured as follows: firstly, there is a general introduction on the main issues and challenges coming from demographic change. Then, these general aspects are addressed against a more specific background of rural areas and the group of farm households as major actors in rural areas. These introductory remarks are followed by the two main parts of this deliverable: the first part is devoted to a survey of farm households which has been carried out in five Central and Eastern European (CEE) countries. Three Hungarian and five Polish survey regions are addressed in-depth for this study. While Hungary has a dualistic farm structure, the farm structures in the Polish survey regions are not dualistic. Furthermore, the demographic patterns differ. The Polish survey regions can be characterised by a rather "natural" age-distribution resulting from the fact that its agricultural sector has not been collectivised during socialist times like in other CCE countries. In Hungary – and other CEE countries like Slovakia and the Czech Republic – the age structure has to be seen as an outcome of the transition process. However this is just a snapshot in time and and due to the complexity and high dimensionality of structural change, problems in one point in time may offer potentials in the future.

The survey analyses are focussed on demography and related issues of farm households. The age patterns of farm family members serve as a basis for further analyses since age patterns are considered to be an important internal driving factor within dynamically changing agricultural farm structures. Apart from the collection of data on age structures, the survey analyses offer more details on a broader range of demography-related characteristics of farm households. Particularly, this refers to the status and activities of farm household members and the farmers' plans regarding succession. In the second part of this deliverable, scenarios are set up based on these issues and simulation experiments are carried out with the agent-based model AgriPoliS (Happe et al. 2006) which has been adapted for both model regions. For Hungary the dualistic farm structures of the model region are represented by differentiated legal types of individual and corporate farms. The Polish model region is solely represented by individual farms.

The analyses of the simulations are driven by the question of how heterogeneous farms evolve in response to their own specific characteristics – which include the aspects of demography – but also in response to their economic and political environment, including the demographic characteristics of competing farms. These analyses are focussed on indicators which show the direction, speed and intensity of structural change within the farm structures.

## 2 DEMOGRAPHY AND DEMOGRAPHIC CHANGE

Demographic change is determined by changes in a population's fertility (thus, change in the reproduction behaviour), mortality and migration as well as the given age structure. Actually, almost all policy fields are affected by the tremendous challenges coming from demographic change. Table 2.1 specifies major fields of operation and challenges connected with this topic.

**Table 2.1: Demographic change: fields of operation and challenges**

| Field of operation | Challenge |
|---|---|
| Employment / economy | Change in supply and demand for labour |
| | Education and qualification |
| | Demand for goods and services |
| Migration | Volume of immigration / outmigration, successful integration |
| Social security | Pension systems, health care system, nursing care insurance |
| State budget | Tax revenues, structure of administration |
| Family | Lifestyle / habitation, child care, elderly care |
| Education | School system, universities, further education |
| Land use planning, rural areas, municipalities | Sustainable spatial and settlement development, infrastructure, traffic, tourism, culture, sports |

Source: own, based on a depiction of the Federal Office for Agriculture of Thuringia (TLL, 2006)

Demographic changes require strong future adjustments in order to cope with budget restrictions while ensuring for a minimum of inter-generational fairness. Key issues are, for instance, increasing life expectancy as well as a declining share of people working who must support a growing share of retired people. This point reflects the problem which is most frequently emphasised as the most critical: the predictable imbalance of the social security systems with their elements of pensions and health care which were built upon past age structures. This problem and possible solutions are addressed in a study by WAGNER (2005) for the EU NMS. The impossibility of financing the increasing costs of pensions arises thereby independently of the chosen pension scheme: whether the pensions are paid directly by the group of contributors to social insurance or indirectly by the state – and thus by taxpayers.

From a more general perspective, one can describe the main problem of demographic change as follows: actual conditions – in all spheres listed in Table 2.1 – are well adapted to the population structure as it had developed in the past. Currently, the main problem is the necessity for adjustments, but adjustments entail adjustment costs, including a rethinking and a change of mindset. The main challenges relate to coping with an ageing and shrinking population, while past thinking and policy measures were oriented towards growing processes. Rural areas are particularly affected by negative impacts of demographic change. Particularly, it has to be expected that aging and outmigration result in a reduction in public services which cannot be further maintained, because of losing a minimum critical mass.

From the welfare economics point of view, one can expect an increasing deviation from an optimal allocation of resources as older employees are less flexible, both, with regard to where they live and to an optimal allocation across professions. I.e., younger employees are more flexible while older employees have already invested in a specific education and are less able – and willing – to switch to other professions. In addition, the potential payoff of an adjustment is lower for older employees since their remaining working life is shorter (CHAMPION, 1998).

For some specific reasons, CEE countries are particularly affected by demographic change. Their demographic development is generally characterised by the conjunction of a rapidly ageing and comparatively poor population. Additionally, labour force participation rates are notably low in older age groups and retirement usually takes place earlier compared to the OECD average.

## 2.1 Farm households' demography in rural areas of CEE Countries

As in Western Europe, many rural areas in the CEE countries are affected by an outflow of the young and flexible members of the population as a result of labour migration. This leads to an increase in the average age of the remaining population. Besides this ageing process, decision makers have additionally to cope with an overall shrinking of the rural population. This is especially valid if the increase in life expectancy cannot compensate for the migration outflow.[1] Both developments lead to an ageing of the remaining rural population and to an inversion of the population pyramid.

This study does not aim to explain the reasons for changes in the indicators of demographic change. Instead, the analyses focus on the age patterns in the subgroup of agricultural farm households and the impacts on structural change in agriculture. Table 2.1 gives an overview of the role of individual farms in Hungary, Poland, the Czech Republic and Slovakia. The first section reflects the importance of individual farms with regard to their share in the total number of farms, land use, labour input and production. While the Czech Republic and Slovakia are similar with regard to the dualism in their farm structures, Hungary and Poland are different. Polish individual farms hold an important position. In contrast, Hungary shows a kind of 'moderate dualism' as individual farms occupy half of the total agricultural area (46.3%) and contribute almost half of the total output (45.3%).

The second section of Table 2.1 gives details on the age structure in the group of individual farms by focussing on both ends of the age distribution, i.e. the share of young farmers (younger than 35 years) and old farmers (those aged 55 or over, and aged 65 or over). Except for Poland, less than 10% of the farmers are younger than 35 years in all countries. The share of farmers facing retirement in the short- to medium-term perspective (aged 55 or over) ranges between 39% and 46%. These farms will soon face a generational transfer or closure of their business if the operator retires. The subgroup of farmers who have already reached the retirement age (those aged 65 or over) is extremely high in Hungary and Slovakia with 27.8% and 32.9%, respectively.

[1] LUTZ et al. (2004) found that in the Federal State of Saxony-Anhalt (a federal state in Eastern Germany) two-thirds of the rural population decline is caused by out-migration and one third by a decrease in birth rates.

**Table 2.1: Individual farm characteristics in Hungary, Poland, Czech Republic, and Slovakia, 2007**

| | Unit | Hungary | Poland | Czech Republic | Slovakia |
|---|---|---|---|---|---|
| All individual farms[A] | | | | | |
| Total | % of all farms | 95.8 | 99.7 | 89.0 | 88.1 |
| Land | % of total agricultural area | 46.3 | 89.6 | 28.8 | 18.2 |
| Labour | % of total annual work units | 61.6 | 96.8 | 22.7 | 21.6 |
| Economic size | ESU[B] | 6.3 | 6.6 | 16.6 | 6.3 |
| Production | % of total standard gross margin | 45.3 | 90.8 | 23.8 | 18.7 |
| **Age distribution of individual farmers** | | | | | |
| Age < 35 years | % of individual farms | 7.6 | 12.3 | 9.8 | 3.6 |
| Age >= 55 years | % of individual farms | 45.3[C] | 38.7[C] | 41.0[C] | 45.8[C] |
| Age >= 65 years | % of individual farms | 27.8 | 16.2 | 18.5 | 32.9 |

Notes: [A] Individual farm: synonymously the terms 'private farm' or 'single-holder farm' are in use. The main characteristic is the fact that the farm is managed by an actually existing person person who takes the risks and benefits of the farming activity.

[B] ESU: for each activity on a farm (e.g. wheat, dairy cows etc.), a standard gross margin (SGM) is estimated, based on the area (or the number of heads) and a regional coefficient. The sum of all margins, for all activities of a given farm, is referred to as the economic size of that farm. The economic size is expressed in European Size Units (ESU), 1 ESU being recently equal to €1,200 of SGM.

[C] Data from 2003.

Source: EuroStat, 2007: FSS – Farm Structure Survey

Owing to similar historical development paths, farm structures in the newly formed German states ('New Länder') are to some extent comparable with the dualistic farm structures in the Czech Republic, Slovakia, and Hungary. For the 'New Länder', the negative impacts resulting from demographic change have already been realised (LUTZ et al., 2004, WIENER, 2004). However, these studies focus on corporate farms since they dominate agricultural production and employment. Corporate farms run their business on a full-time basis while a high share of individual farms are only engaged part-time in agriculture and often have less professional and commercial objectives. In addition, individual farms are more heterogeneous, which makes it difficult to define them as a target group. There are two major challenges for individual farms coming from demographic change: the ageing of their workforce and the uncertainty of farm succession. Hence, the challenges differ between individual and corporate farms. The latter generally operate on a mode of hired employment. and have to ensure the availability of qualified hired labour at all hierarchical levels inside the firm.[2] By contrast, in the range of individual farms with its family labour mode of operation, the problem of ageing and the uncertainty of the farm succession is more often an additional and current question concerning the continuation of farming. However, irrespective of their size and legal type of farming, the vast majority of farms will be affected by the ageing of their operators or employees.

[2] For simplicity and structural reasons the coincidence between employment and the ownership of production means is neglected as these often overlap in reality. The principles of cooperatives – as a subgroup of the sum of corporate farms – are even based on this inter-relationship.

# 3 A SURVEY OF FARM HOUSEHOLDS IN CEE COUNTRIES

One part of SCARLED was the accomplishment of a farm household survey in five CEE countries (Bulgaria, Hungary, Poland, Romania, and Slovenia). The survey was conducted in the winter of 2007/2008 and requested important data on farm household level, e.g. the activities of household members, their personal characteristics (age, education), their time allocation (on-farm, off-farm), their agricultural production etc. The survey took place in different regions in order to capture some of the variation and heterogeneity existing between regions.

## 3.1 The Hungarian survey regions

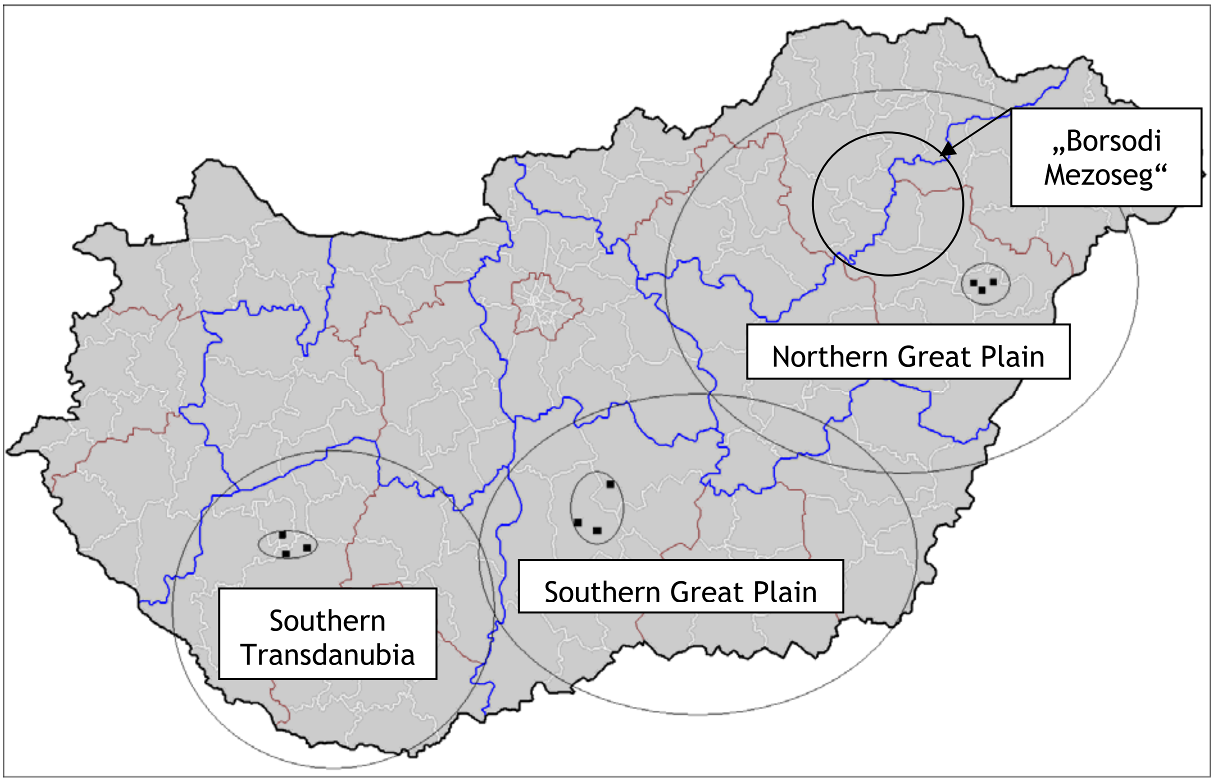
The Hungarian survey data cover about 250 farm households, 80 in each of three study regions. Within each region, interviews were conducted in three villages. The chosen study regions (NUTS 2 level) are the Northern Great Plain region in the Northeast, Southern Transdanubia in the Southwest, and Southern Great Plain in the Central South of the country as shown in Map 1 (blue borders mark NUTS 2 regions). The small black boxes show the participating villages in which the farm household survey was carried out. Map 1 contains also the location of the natural area of 'Borsodi Mezoseg' [3] which is a smaller sub-region adjacent to and partly inside the Northern Great Plain region.

In the first step, the surveyed farm households were categorised as being smaller or larger than 4 hectares (ha) since the typical farms in the subsequent agent-based modelling approach are at least 4ha.[4] The model application is based on a set of typical farms representing the region This is important as a strict transferability of the survey results to the aforementioned sample of typical farms is only feasible for farm households larger than 4ha in the Northern Great Plain region. For the Polish model region the considerations were different as the model region is not located in one of the survey regions. There, the findings of all survey regions build the empirical basis which will be shown in more detail in section 3.2 'The Polish survey regions'.

---

[3] For this region, a collection of data based on regional statistics and on the Federal Accountancy Data Network (FADN) was done within the EU-project Mea-Scope 'Micro-economic instruments for impact assessment of multifunctional agriculture to implement the Model of European Agriculture' – A Policy Oriented Research Project (STREP) of the Sixth Framework Programme. A brief description of this model region is given in 6.1 The Hungarian model region 'Borsodi Mezoseg'.

[4] This constraint has to be made as the model represents typical production activities of farms focussed on market production and disregards subsistence and semi-subsistence farms.




**Map 3.1 Administrative borders of Hungary - the survey regions and the model region**

Source: wikimedia (http://commons.wikimedia.org/wiki/File:Hungary_admin_divisions.png).

A brief overview on the size structure of the farm households[5] shows that the farm structures – as represented by the survey data – are characterised by larger farms in the Northern Great Plain region (mean farm size 28ha) while farms are generally smaller in the southern regions (16ha and 8ha, respectively). Accordingly, the share of farms larger or equal to 4ha amounts to 67% in the north eastern part of Hungary while this value amounts to only 61% and 36% in the other regions (Table 3.1).

Regarding the land use (lower part of Table 3.1), it is obvious that the major part of all farms in all regions uses the land predominately for crop production by growing annual crops – if the quality of the land is sufficient. In the Northern Great Plain region are numerous small farm households which operate only on arable land. On the other hand there is a comparatively high share of larger farms which use grassland by extensive sheep or cattle livestock production. In the Southern Great Plain region the share of farm households equipped with grassland is even higher. In contrast to the Northern Great Plain region, fruit orchards and vineyards play an important role in the southern regions. While irrigation is used in the Northern and Southern Great Plain region it is less important in Southern Transdanubia.

[5] In the following sections the term ‘farm household’ is used interchangeable with the terms ‘farm’, ‘individual farm’, ‘private farm’ or ‘single holder farm’.

**Table 3.1 Classification of the Hungarian survey farms**

| Region | Northern Great Plain | | Southern Great Plain | | Southern Transdanubia | |
|---|---|---|---|---|---|---|
| Size class | all | >= 4ha | all | >= 4ha | all | >= 4ha |
| Number of surveyed farms | 73 | 49 | 89 | 54 | 84 | 30 |
| Farms >= 4ha | | 67% | | 61% | | 36% |
| Average farm size (ha) | 28 | 41 | 16 | 25 | 8 | 22 |
| Min. | 0 | 4 | 0 | 4 | 0 | 4 |
| Max. | 335 | 335 | 300 | 300 | 124 | 124 |
| Standard deviation | 54 | 62 | 36 | 44 | 18 | 25 |
| Variance | 2899 | 3837 | 1291 | 1922 | 314 | 621 |
| **Land use (No. of farms using their land as follows)** [6] | | | | | | |
| Annual crops | 63 | 42 | 66 | 46 | 76 | 24 |
| Pasture (Meadows) | 17 | 15 | 35 | 32 | 22 | 14 |
| Irrigated land | 16 | 9 | 15 | 6 | 5 | 0 |
| Fruit orchards | 3 | 1 | 13 | 6 | 11 | 7 |
| Vineyards | 2 | 0 | 29 | 16 | 23 | 9 |

Source: Questionnaire SCARLED.

### 3.1.1 Internal composition of the Hungarian survey farm households

In order to analyse the dynamic implications of the demographic composition of farm households, the survey has been analysed with regard to the number of farm-family members and their labour capacities. Hence, Table 3.2 shows characteristics with regard to the composition of the survey farm households in the region Northern Great Plain. The table specifies the activities of children (the children generation) of the farm household and those of the parents of the farm operator or his/her partner (the parental generation). It is worth noting that the number of children working actively on the parental farm is very low. The majority of children fall into the categories 'below working age (aged under 16)' and 'in education'. The farm households where children explicitly work on their parents' farm are comparatively large. These farms are all in the group of larger farms (with sizes 20ha, 45ha, 54ha, and 70ha). In these farm households the children are also already designated as farm successors. Interestingly, there are only a few farm households where the parent generation is counted as part of the farm household. The number of farm households where the parent generation contributes actively by labour input to the farm household is even lower.[7]

These survey results for the Hungarian study regions are somewhat astonishing since the basic literature on farm households draws a different picture of a family farm household. In the literature, farm households are often perceived to be a complex structure where

[6] Multiple answers permitted.

[7] This finding has been checked for the two other regions as well and it applies also to these regions.

several generations of a family contribute to and benefit from the farm household entity (SCHMITT, 1989). This can be a main advantage of individual farm households as it has been posited that they are very resilient since there are farm family members who are paid in kind and not by wages for their labour input on the farm (SCHMITT, 1992). Accordingly, one can assume that the labour input of the parental generation (and also the children generation) lowers the need for liquidity by farm households since the labour input does not need to be remunerated by actual labour costs (as would be the case for hired labour). The lower need for liquidity in turn increases the persistence of these farms compared to corporate farms which have to remunerate all labour input by wage payments. The divergence between this rather traditional understanding of a farm household and the survey results may be explained by peculiarities of the transition process with huge shifts within the agricultural sector as well as the rural society. On the one hand, many farms are newly or re-established or were developed from household plots. On the other hand, there was and is a strong outmigration of rural areas as employment opportunities are rather poor.

**Table 3.2: Farm household composition in the region Northern Great Plain**

| Sub-sample (by size) | < 4ha | >= 4ha |
|---|---|---|
| Number of farm households | 24[A] | 49 |
| *Sum of children related to the farm household* | 22 | 44 |
| *of which:* | | |
| Children are below working age (<16 years), no. of farm households | 6 (25%) | 8 (16%) |
| Children definitely working on the farm, no. of farm households | - | 4 (8%) |
| Children could potentially work on the farm household (>=16 years) but formal status 'in education', no. of farm households | 6 (25%) | 10 (20%) |
| Off-farm occupation, no. of farm households | 4 (17%) | 4 (8%) |
| Unemployed, no. of farm households | - | 3 (6%) |
| Farm households without children | 8 (33%) | 20 (41%) |
| *Parents of the farm operator (or partner)* | | |
| Parents (or single parent) alive and living on the farm | - | 3 |
| No. of farm households | - | 3 (6%) |
| of which working on the farm household | - | 1 |
| No. of farm households | - | 1 (2%) |

Note: A Farm households with no agricultural area are not included in this analysis.

Multiple answers permitted, i.e. farm households with several children might appear in several categories.

Source: SCARLED Questionnaire

### 3.1.2 Age patterns of the Hungarian farm households

Data on age structures of the surveyed farm households provide mainly two things. First, they reveal the demographic situation of family farms. Second, the data on age structures provide the empirical basis for applying a dynamic agent-based simulation approach. These simulation results in turn can be used to identify driving forces on the farm level which entail structural change in the agricultural sector.

Table 3.3 presents data on the number of farm households and statistical data on the age distribution of farm operators in the region Northern Great Plain. About 60% of the surveyed farm households are larger than (or equal to) 4ha, slightly more than a third are larger than or equal to 10ha, and some 8% are larger than or equal to 75ha. The age range of operators is from 28 years to 77 years. In the sub-sample of farm households larger than or equal to 10ha the age ranges between 28 and 74 years while the range is smallest in the group of the largest farm households (larger than or equal to 75ha). In this group the farm operators are between 28 and 61 years old.

Assuming the age of starting a farming career as a farm successor is 30 years and the end is at 65 years, the theoretical mean value would be 47.5 years. Therefore, one observes an over-ageing of some farms in all size classes except for the size class of large farm households (larger than or equal to 75ha).

**Table 3.3 Age structure of farm household operators in the region Northern Great Plain**

| | All | >= 4ha | >= 10ha | < 4ha | < 10ha | >= 75ha |
|---|---|---|---|---|---|---|
| **Number** | 83 | 49 | 29 | 34[A] | 54[A] | 7 |
| **% of all farms** | 100% | 59% | 35% | 41% | 65% | 8% |
| **Mean age** | 50.6 | 51.6 | 51.0 | 49.1 | 50.4 | 45.0 |
| **Median age** | 51 | 52 | 52 | 50 | 50 | 50 |
| **Standard deviation** | 10.9 | 10.2 | 10.8 | 11.7 | 7.1 | 12.4 |
| **Variance** | 117.8 | 104.7 | 116.1 | 136.7 | 50.4 | 154.0 |
| **Min.** | 28 | 28 | 28 | 30 | 29 | 28 |
| **Max.** | 77 | 74 | 74 | 77 | 77 | 61 |
| **Min-Max range** | 49 | 46 | 46 | 47 | 48 | 33 |

Note: [A] Includes also farm households with no agricultural area (ten farm households).

Source: SCARLED Questionnaire

Figure 3.1 gives more detailed information on the age distribution. On the one hand, quite a number of farmers are 65 and older. However, most farmers are younger than 55. This is particularly visible for the group of small farms with less than 10 ha. Accordingly, one has to suppose that most of these small farmers either have additional income sources or they face low incomes. Ages in the group of farm households larger than or equal to 75ha tend to be even younger. However, this group consists only of seven farms and one can assume that farm succession has already taken place in some of these farm households.

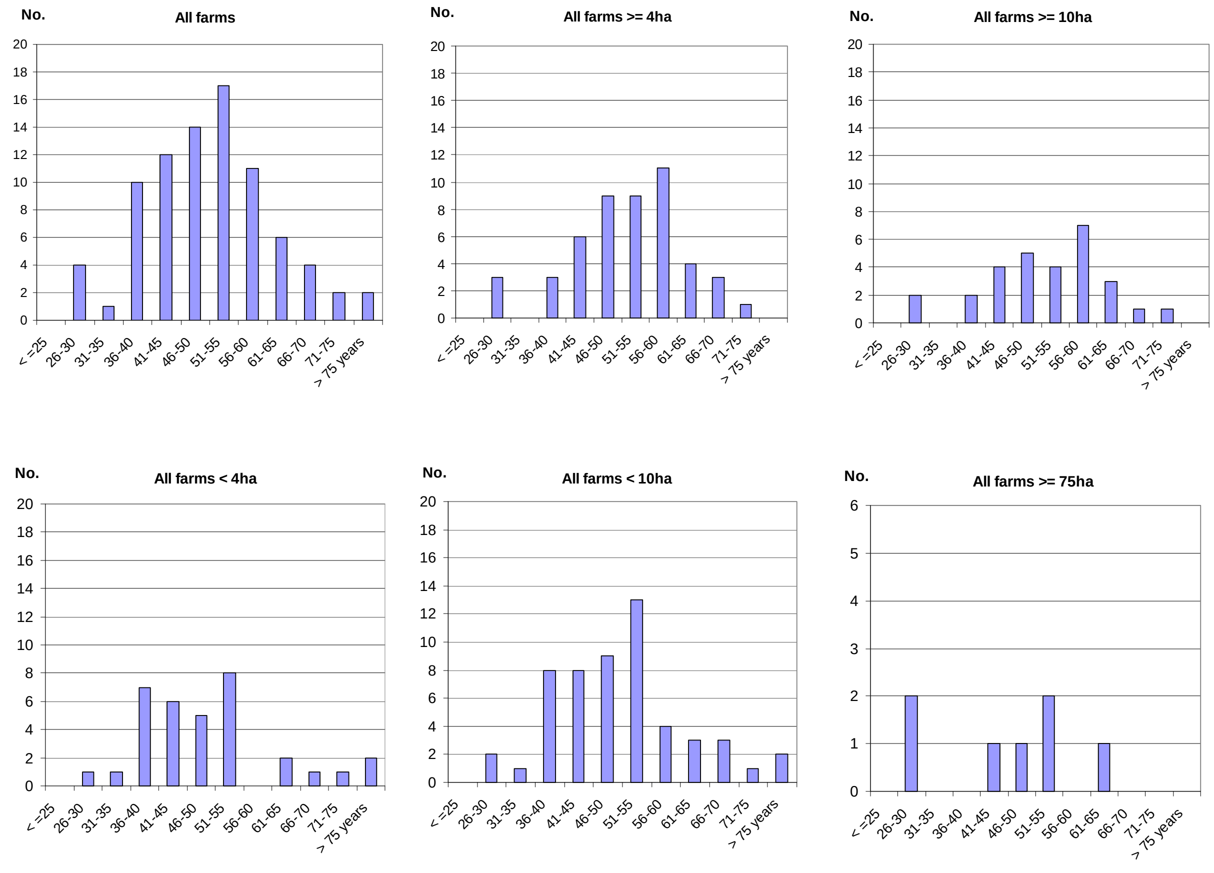



**Figure 3.1 Age distribution by age groups in the region Northern Great Plain**

Note: The scaling is different for the size class 'All farms >= 75ha'.

Source: own based on SCARLED Questionnaire

### 3.1.3 Farm succession prospects of the Hungarian survey farms

Over-ageing as a part of demographic change becomes crucial for farm households when the farm succession is uncertain. Particularly, the lack of a successor is an important driver of structural change. Hence, the surveyed farms were questioned about their future plans.

Table 3.4 shows that only 13 of 49 farm households (27%) have already designated a farm successor while 61% have not.[8] Within the latter group, 19 farm households (39%) state that a potential successor exists but his/her future plans are still unclear.

The average farm sizes of those farm households stating that a farm successor has already been designated and those which suffer from unclear succession plans do not differ significantly (42.7ha versus 44.8ha). But median farm sizes differ – 20.0ha in the first group compared to 9.9ha in the second group. This indicates that the latter group is more

[8] Only the farm households in the region Northern Great Plain larger than or equal to 4ha were chosen since these farms compose the target group with regard to the subsequent modelling.

skewed towards smaller farms. Also, one can conclude that larger farms tend to have more definite plans regarding their future.

Among the 13 farm households with a farm successor which has already been designated (Answer 'Yes') are four where the successor, generally the child of the both farm household heads, is already working on the farm.[9]

There are four farm households without own children and one with a baby which state that a farm successor is designated. I.e., a potential farm successor does not necessarily come from inside the family but can also be someone from outside the family. Four farm households have children in the age range between 21 and 40 which have off-farm occupations.[10]

Comparing the average (and median) ages of the farm operators between the group of those stating 'Yes' and those stating 'No', it can be seen that the average (and median) values in the group with clear succession plans are higher (55.7 years and 56.0 years, respectively). Those stating 'No' are younger (49.3 years and 50.0 years, respectively). The older the farm operators the more they are faced with the question of the future farm development after their own working life. The farm households who do not have – or not yet – a successor have the largest average farm size (65ha) while the median is very low (8ha).

[9] Those farm households where the successor is already working on the parental farm (n=4) are all larger than or equal to 20ha. In the sample of 49 farm households larger than or equal to 4ha are 21 farm household larger than or equal to 20ha, i.e. in the subgroup of farm households larger than 20ha, some 20% of farm households include the designated successor directly into the operational farming business.

[10] Off-farm activities of children can be part of a concept that allows children to get off-farm experiences (working as an employee on another farm) until the operator hands over the farm management to the children. This strategy reveals that working on the parents' farm should not be considered as a precondition to taking over the farm at a later stage. On the contrary, experiences outside the parental farm can be valuable for the subsequent taking over of the parental farm, in addition to which it generates additional income.

**Table 3.4 Future plans and succession on farm households (Hungary, region Northern Great Plain, all farms >= 4ha)**

| | Characteristics of farm households | | | | |
|---|---|---|---|---|---|
| | **No. of farm households** | **Av. farm size** | **Median farm size** | **Av. age operator** | **Median age operator** |
| **Has a successor already been designated?** | | | | | |
| **'Yes'** | 13 (27%) | 42.7 | 20.0 | 55.7 | 56.0 |
| **Among 'Yes': children working on household** | 4 | 47.3 | 49.5 | 54.0 | 55.5 |
| **Among 'Yes': no children/too young** | 5 | 25.5 | 7.0 | 53.0 | 56.0 |
| **Among 'Yes': children with off-farm job** | 4 | 59.5 | 18.5 | 60.8 | 61.5 |
| **'No'** | 30 (61%) | 44.8 | 9.9 | 49.3 | 50.0 |
| **Among 'No': a potential successor exists but succession still unclear** | 19 | 29.9 | 10.0 | 49.7 | 50.0 |
| **Among 'No': definitely no successor (yet)** | 9 | 65.3 | 8.0 | 48.1 | 52.0 |
| **'No answer'** | 6 (12%) | 18.5 | 15 | 54.2 | 54.0 |
| **Total** | 49 | | | | |

Source: own calculations based on SCARLED Questionnaire

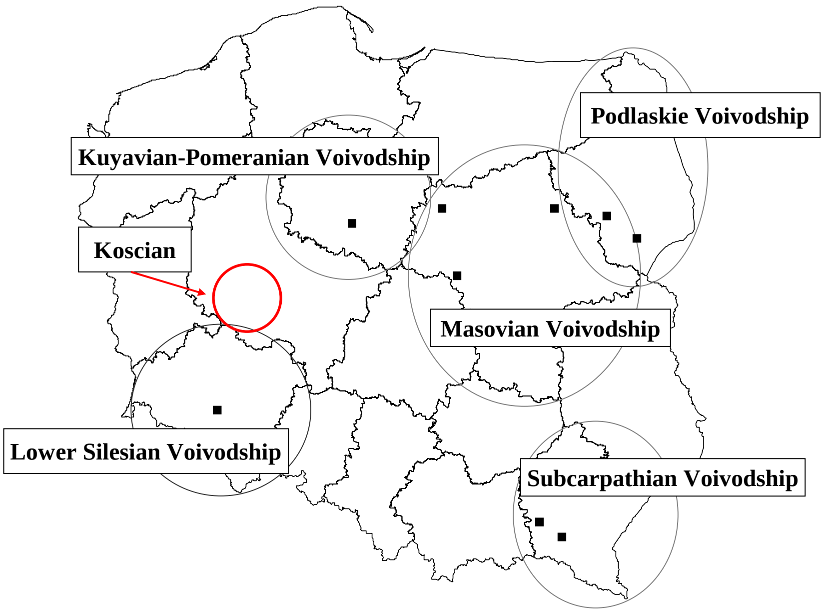
## 3.2 The Polish survey regions[11]

In Poland the farm household survey was carried out in accordance to the Hungarian survey presented in previous sections. Map 3.2 shows the five study regions which are Polish voivodships, according to the Nuts 2 level: 'Kuyavian-Pomeranian Voivodship' in the central western Poland, 'Masovian Voivodship' in the eastern central Poland, 'Podlaskie Voivodship' in the Northeast, 'Sub Carpathian Voivodship' in the Southeast and 'Lower Silesian Voivodship' in the Southwest of the country. There are large differences within the agricultural farm structure in Poland. This is caused by different natural production conditions but to a high extend also due to historical reasons (GORZELAK, 2007).

In contrast to Hungary, the participating villages are quite scattered across the study regions. 'Kościan' marks the region around the town of the same name in the Greater Poland Voivodship. This region corresponds to the model region 'Borsodi Mesoszeg' in Hungary as there is also a collection of data based on regional statistics and on the Federal Accountancy Data Network (FADN) from the EU-project Mea-Scope.

[11] The author would like to thank Ms Geesche Merkle from Georg August University of Göttingen who contributed substantial parts to this section during her stay at IAMO.

**Map 3.2 The Polish survey regions (NUTS 2 level) and the model region 'Koscian'**




Source: Own depiction based on http://ec.europa.eu/eurostat/ramon/nuts/pngmaps/pl2.png

Table 3.5 gives an overview on farm sizes and the land use of the survey farms in Poland. Although this data compilation is not based on regional statistics but on the sample of survey farms, the characteristic small-scaled polish farming structures becomes quite obvious (cp. Table 2.1). However, the samples of farms which have been chosen for the survey do not necessarily reflect regional farming structures. Hence, the following analyses focus on the survey data. Table 3.5 illustrates the differences between the regions. Especially the southern regions are characterised by small-scale farming structures which are reflected by a low average farm size as shown for the Sub Carpathian Voivodship which has been confirmed by ŻMIJA and TYRAN, 2004. The remaining survey regions show larger average farm sizes. This applies particularly to the Northern regions (Kuyavian-Pomeranian and Podlaskie). With regard to the maximum farm size the sample of survey farms is of limited representativity as the largest farm has only 43ha. In the region 'Kuyavian-Pomeranian' is a large difference between median and mean farm size in the group of all farm households. This difference does not appear for the subgroup of farm households larger 2ha. In this sub-group (>= 2ha) the data reveal a comparatively 'large-scale mode of farming' for Polish conditions. In connection with the difference between median and mean values in the group of all farms it reveals a pronounced dualism[12] within the group of the survey farms in this region. From that, one can conclude that there is a homogenous

[12] In this context 'dualism' refers to the phenomenon of a frequent number of small farms and a few larger farms. However, all farms belong to the group of individual farms in contrast to Hungary where the two strands of dualistic structures are constituted by two different legal types.

group of a few comparatively large farms. However, the number of farms in this group is rather small (12). In comparison to the other regions, the share of farms >= 2ha among all farms is the smallest which gives a hint for the prevalence of rather small-scaled farming.

The Podlaskie voivodship shows the largest mean and median farm size if all farms are considered. The difference between the two categories (all farms and farms >= 2ha) of this region is comparatively small. The share of farms larger or equal to 2ha within the sample of all farms is the highest in this sample.

Regarding the use of land, almost all farms grow annual crops. The share of farms only engaged in annual crops is high in Kuyavian-Pomeranian and Lower Silesian Voivodship whereas it is lower in the eastern voivodships Podlaskie and Sub Carpathian. In connection with the higher share of meadows in these regions, this gives an indication for more extensive livestock farming in these regions.

**Table 3.5 Classification of the Polish survey farms**

| Region (Voivodships) | Masowian | | Kuyavian-Pomeranian | | Lower Silesian | | Sub Carpathian | | Podlaskie | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Size class** | all | >= 2ha | all | >= 2ha | all | >= 2ha | all | >= 2ha | all | >= 2ha |
| **No. of surveyed farms** | 81 | 66 | 26 | 12 | 27 | 21 | 58 | 40 | 53 | 46 |
| **Farms >= 2ha** | | 81% | | 46% | | 78% | | 69% | | 87% |
| **Mean farm size (ha)** | 10,4 | 12,5 | 9,9 | 20,4 | 10,2 | 12,5 | 2,9 | 3,6 | 12,6 | 14,4 |
| **Median** | 8,9 | 11,3 | 1,9 | 21,1 | 6,2 | 10,2 | 2,4 | 3 | 10,9 | 12,1 |
| **Min.** | 0,2 | 2,0 | 0,5 | 4,3 | 1,1 | 2,4 | 1,1 | 2,0 | 0,5 | 2,1 |
| **Max.** | 37,0 | 37,0 | 41,1 | 41,1 | 32,9 | 32,9 | 11,6 | 11,6 | 43,0 | 43,0 |
| **Standard deviation** | 8,4 | 8,0 | 12,8 | 12,7 | 9,2 | 8,9 | 2,0 | 3,6 | 9,9 | 9,4 |
| **Variance** | 71 | 63 | 163 | 162 | 83,8 | 80 | 4,0 | 2,1 | 97,4 | 89,1 |
| *Land use* **(No. of farms using their land as follows)** | | | | | | | | | | |
| **Annual crops** | 80 | 65 | 26 | 12 | 26 | 21 | 57 | 39 | 52 | 45 |
| **Pasture (Meadows)** | 36 | 34 | 5 | 4 | 5 | 4 | 36 | 28 | 32 | 32 |
| **Irrigated land** | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| **Fruit orchards** | 15 | 7 | 1 | 0 | 0 | 0 | 9 | 5 | 3 | 3 |

Source: Questionnaire SCARLED

One quarter of farms in the survey is smaller than two hectares. In the following, these small farms are not considered in order to focus on market orientated farms, for the same reasons as already explained for the Hungarian model region. Because of the smaller average farm size and the generally small-scaled character of Polish agriculture the minimum threshold is consequently lower with >= 2ha. The model application has been adjusted for this smaller threshold, too.

### 3.2.1 Internal composition of the Polish survey farm households

Table 3.6 shows the main characteristics of the surveyed Polish farm households larger than or equal to 2ha (10ha) with regard to their internal personnel composition. This data compilation reveals clear differences compared to the corresponding analysis of the Hungarian survey (cf. Table 3.2). On the one hand this concerns the number of children and their participation in farm work. On the other hand there are differences with regard to the parental generation as being still an active part of the family farm households.

Altogether there are 274 children counted. That means on average 1.5 children per farm household. On slightly more than one third of the farm households, the children are younger than 16 years. The participation rate of children working on the parental farm is higher than in the Hungarian survey region (11% in the group of farms larger than or equal to 2ha and 15% in the group of farms larger than or equal to 10ha, respectively). The section on future farm prospects and farm succession (section 3.2.3) shows that those farms where the children actively work on the farm and where they are already designated as farm successors are comparatively large ones. 27% of farms larger than or equal to 2ha have children in the formal status ‘in education’ (the children are 16 years and older). This value is quite similar to that in Hungary.

Differences between both countries occur with regard to the role of the parent generation of the farm operator (or partner, respectively). The number of parents alive and living on the farm is much higher in Poland than in Hungary. While for the polish sample of survey farms this affects 30% of farms, this share amounts to only 6% for the Hungarian sample. But also in the polish sample are very few farms where the parents contribute actively to the activities of farms. This is in accordance to the findings for the Hungarian survey. To summarise the survey results of this section, it seems that the traditional farm household still somehow exists in Poland. This differs in comparison to the Hungarian survey findings.

**Table 3.6 The composition of the Polish farm households**

| **Sub-sample (by size)** | **>= 2ha** | **>= 10ha** |
|---|---|---|
| **Number of farms** | 185 | 87 |
| *Sum of children related to the farms* | *274* | *131* |
| of which: | | |
| Children are below working age (< 16 years), no. of farms | *65 (35%)* | *30 (34%)* |
| Children definitely working on the farm, no. of farms | *20 (11%)* | *13 (15%)* |
| Children could potentially work on the farm (>= 16 years) but formal status 'in education', no. of farms | *50 (27%)* | *25 (29%)* |
| Off-farm occupations, no. of farms | *31 (17%)* | *14 (16%)* |
| Unemployed, no. of farms | *5 (3%)* | *2 (2%)* |
| Farms without children | 56(30%) | 22 (25%) |
| Parents of the farm operator (or partner) | | |
| Parents (or single parent) alive and living on the farm, no. of farms | *56 (30%)* | *34 (40%)* |
| of which working on the farm, no. of farms | *5 (3%)* | *1 (~0 %)* |

Note*: Multiple answers permitted, i.e. farm hh with several children might appear in several categories.
Source: Questionnaire SCARLED.

### 3.2.2 Age patterns of the Polish survey farm households

As shown in the overview of Table 2.1, the age structure inside the group of Polish individual farms stands out as an exception compared to the age structures in Hungary, Slovakia and the Czech Republic. In Poland the share of young farmers (< 35years) is comparatively high (12.3%) and the share of old farmers (>= 65years) is rather low (16.2%).

In the following the age patterns within different size groups of farm households are analysed. In accordance to the Hungarian survey regions, the analyses have been done on the basis of the SCARLED questionnaire and the results are used as an empirical basis for the scenario definition as a first step within the agent-based model application. As already mentioned, Polish farm structures in general - and the selected Polish survey households in particular - are characterised by relative small farms. Because of that reason the minimum farm size threshold is set to 2ha.

Table 3.7 shows some descriptive statistics on different sub-samples of the polish survey farm households regarding the age of the farm operators and its distribution. One can observe that operators of the smallest farms (< 2ha) are the oldest ones (mean 55.4years) while those of larger farms are by tendency younger. The same tendency has been noticed for the Hungarian survey region 'Northern Great Plain' as well, but more pronounced.

In comparison to the data of the Hungarian survey the span of the minimum-maximum age range is similar in Poland (64 years in Poland and 65 years in Hungary). But this age range is on a lower level in Poland, e.g. for all farms the minimum age is 23 and the maximum amounts to 87 years. In all Polish size classes the mean age exceeds the mean age of 47.5 years which has been deducted to define a measurement of 'over-ageing'.[13]

**Table 3.7 Statistical data on age of farmers in all survey regions in Poland**

| All farms ... | All | >= 2ha | >= 10ha | >= 20ha | < 2ha | < 10ha |
|---|---|---|---|---|---|---|
| **Number** | 245 | 185 | 87 | 33 | 60 | 158 |
| **% of surveyed farms** | 100% | 75% | 36% | 13% | 25% | 64% |
| **Mean age** | 50.8 | 49.4 | 47.6 | 48.0 | 55.4 | 52.6 |
| **Median age** | 51 | 50 | 49 | 49 | 54 | 51 |
| **Standard deviation** | 13.5 | 13.0 | 11.1 | 12.3 | 14.0 | 14.3 |
| **Variance** | 181.9 | 169.0 | 124.2 | 152.5 | 197.0 | 205.8 |
| **Min.** | 23 | 23 | 23 | 23 | 30 | 26 |
| **Max.** | 87 | 84 | 81 | 73 | 87 | 87 |
| **Min-Max range** | 64 | 61 | 58 | 50 | 57 | 61 |

Source: Questionnaire SCARLED

Figure 3.2 illustrates the age distribution by farm size groups. In contrast to Hungary slightly older farm operators are in the group of smallest farms (< 2ha). With regard to the shape of distribution one observe a kind of triangular distribution for all size classes - except for the groups of farms '< 2ha' and '>= 20 ha'. The distribution within these groups can rather be represented by an equal distribution.

[13] The implementation of age patterns in the model will be based on the age distribution in narrower farm size classes which will be shown in the section of scenarios.

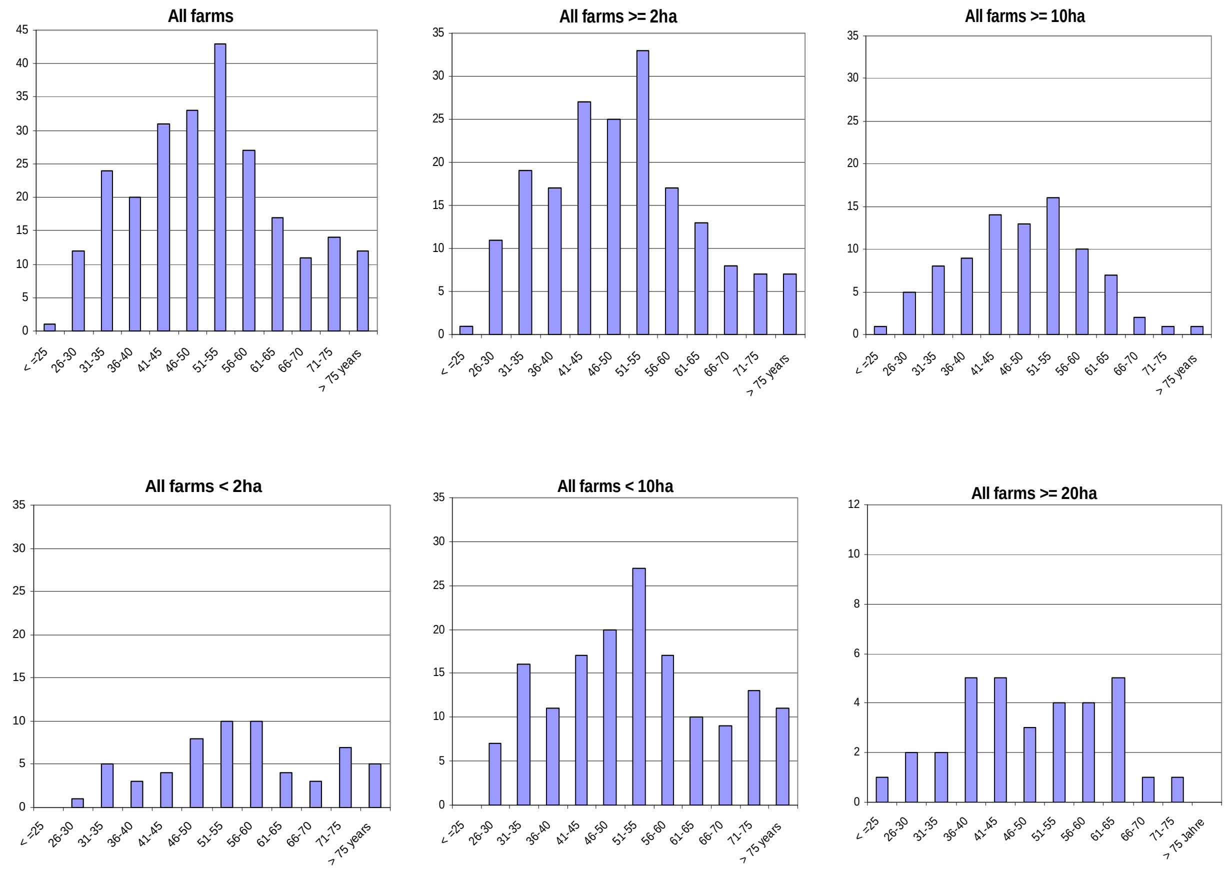



**Figure 3.2 Age distribution by age groups (Poland, all survey regions)**

Note: The scaling is different for the size class ‘All farms’ and ‘All farms >= 20ha’.

Source: Questionnaire SCARLED

### 3.2.3 Farm succession prospects of the Polish survey farms

The main survey results with regard to the farm future and succession plans of the selected Polish survey farms are shown in Table 3.8. The results differ from those of the Hungarian sub-sample of farm households. Firstly, the share of farmers giving no answer to the question if a successor has already been designated is very high for the polish survey farms (58%) while this share amounts to only 9% for the Hungarian ones. This might be explained by the fact that the average age within this group is the lowest of all groups and these farmers are not yet faced to questions on farm succession in the near future. However the high number of no answers to this question reduces the validity of conclusions to be drawn and the comparability of the Polish results. The share of operators having detailed plans concerning their farm succession – expressed by stating that a successor has already been designated – is with only 18% lower than in Hungary (28%). On the other side the share of farms which state that a farm successor has not yet designated is also very low within the Polish sample (24%) compared to 64 % in Hungary. Among those 'No'-farms the majority has a potential successor but nevertheless the farm succession is still unclear. This indicates an unfinished decision making process.

Comparing the age of the farms answering 'Yes' and those stating 'No' the data show that farm operators in the 'Yes'-group are significantly older and their farms are larger. If children do already work on the parental farm, the farms are even larger.[14]

In contrast to the Hungarian survey results the differences between the mean and median farm sizes are not that high, which is based on the higher number of farms within the different groups but which also gives a hint for rather homogeneous farm groups.

[14] Both findings are consistent and plausible. However, one should have in mind that there are no information given on the chronology of the decision making on farms as e.g. a small farm size can be the reason for a potential successor not to succeed but it can also be the result that the farm proceeds a down-sizing after an off-farm choice of a potential successor.

**Table 3.8 Future plans and succession on farm households (Poland, all farms >= 2ha)**

| | Characteristics of farm household | | | | |
|---|---|---|---|---|---|
| | **No. of farms** | **Av. farm size** | **Median farm size** | **Av. age operator** | **Median age operator** |
| **Has a successor already been designated?** | | | | | |
| **'Yes'** | 33 (18%) | 13 | 11 | 57,8 | 60 |
| **Among 'Yes': children working on farm** | 17 | 17,5 | 15,1 | 49,7 | 53 |
| **Among 'Yes': no children / too young** | 10 | 8,7 | 6,1 | 56,3 | 57,5 |
| **Among 'Yes': children with off-farm job** | 6 | 7 | 5,3 | 66,2 | 70,5 |
| **'No'** | 44 (24%) | 9,5 | 6,7 | 48,5 | 49,5 |
| **Among 'No': a potential successor exists but succession still unclear** | 26 | 9,3 | 6,6 | 48,5 | 50 |
| **Among 'No': Definitely no successor (yet)** | 15 | 9,2 | 5,5 | 51,5 | 51 |
| **'No answer'** | 108 (58%) | 11,9 | 9,4 | 47,1 | 46,5 |
| **Total** | 185 | | | | |

Source: Data from Questionnaire SCARLED, own calculations

# 4 THE MODELLING APPROACH

The further analyses are based on the agent-based model AgriPoliS (HAPPE et al., 2006, KELLERMANN et al., 2008). This spatial and dynamic model of a regional agricultural sector allows for endogenous structural change. AgriPoliS treats agricultural farm structures as complex adaptive systems with farms as the main agents which perceive their environment and act and interact in response to changes in their environment and the own state. The key characteristics of regional farm structures such as heterogeneous farms, space, product markets and production factors are considered in regional adaptations. There are farm-internal factors which relate to specific human and physical conditions of the farms, e.g. the age of the farm operator or the quality of the farm's land. In addition, there are farm-external factors representing outside forces (e.g. wage levels, agricultural policy framework) which also induce adjustment reactions. A sample of weighted typical farms represents the characteristics of specific regional farm structures (SAHRBACHER and HAPPE, 2008).

Starting the modelling, the initial endowments of farms with production factors of labour, land, machinery, buildings, liquidity, and borrowed capital are specified based on farmn-level accountancy data (e.g., FADN) as well as on standard farm management norms and technical data. The production and investment decisions of each farm are calculated by using a mixed integer programming model. Each line of production is valued with a specific gross margin. In view of investment options (buildings and machinery), there are economies of size since the fixed costs per unit and the labour demand are lower for larger operations. Farms have a farmstead and their farmland can be owned or rented-in.

The farms interact and compete indirectly in the land market which is endogenous to the model so that actions of farms directly influence land prices. The land market is implemented via an iterative sequential auction. Farms calculate a bid for a free plot of land. This bid is equal to the shadow price minus a specific share of the shadow price for costs such as taxes and fees minus transport costs. Finally, free plots are allocated to the farms with the highest shadow prices via land auctions. AgriPoliS allows also for farm closures. If this happens, the timing and the reasons for a farm exit are of particular interest. In the standard version of AgriPoliS farms exit if they are illiquid or if their opportunity costs of the farm-owned production factors of labour[15], land, and capital are higher than the expected farm household income.

## 4.1 Modelling different farm structures in Hungary and Poland

The Hungarian study region has a moderately dualistic structure, i.e. there is a small group of large farms which are mainly organised as corporate farms (CF). These farms utilise almost half of the agricultural land. The other strand of the dualistic structure is composed by a large number of small individual farms (IF) which utilise slightly more than half of the agricultural land. CF and IF differ in several aspects: these concern their objectives, their

[15] As corporate farms are assumed to operate only on the basis of hired labour they only count the opportunity costs of land and capital. Concerning the opportunity costs of farm-family labour on individual farms, different assumptions are made compared to the standard version of AgriPoliS. These assumptions are defined in the section on the scenario description.

labour endowment, and the assumptions in the course of the inter-generational transfer of the farming operations. IF are equipped with family labour (and additional hired labour if necessary) while CF operate solely based on external hired labour. The farm family labour of IF can partly be allocated to off-farm activities if this is more profitable. Furthermore, IF are assumed to maximise their household income while CF maximise profits.

The farm structure of the Polish study region is constituted by individual farms only. Hence, this region is represented solely by IF. The assumptions with regard to the implementation of farm succession processes as one major topic of this study are explained in the following section. These assumptions apply to the Polish individual farms as well as to those in Hungary.

## 4.2 Modelling entry and exit dynamics - successions in individual farm households

The difference between IF and CF with regard to the inter-generational transfer of the farm is the assumption for IF that the farm operator runs the farming operations for a period of 35 years and then the operations have to be continued by a successor. As the existence and willingness of a potential successor are often connected with uncertainty, these aspects are explicitly included within the scenario settings. CF are not faced with any issues on farm succession because it is assumed that the necessary labour input can be hired irrespective of generational change of the employees. The assumption of a working life of 35 years of the IF household members is based on two considerations: first, WEISS (1999) approximates the mean age of entering the farming business as a successor as 30 years. Second, the date of the farm transfer to the next generation is assumed to take place at an age of 65 years.[16] These considerations lead to a generational change of 35 years.[17]

In any case, a potential successor only enters if the expected farm income is higher than the expected off-farm income. A specific assumption is that there is a mark-up of 25% to the off-farm wage level for a potential successor in the year when he starts his farming activities. This is based on the assumption that the potential successor has either to invest in an agricultural education or for off-farm employment opportunities. Once a successor has decided to enter farming (and thus choosing the agricultural education), opportunity costs revert to the original level without the mark-up. However, if the opportunity costs for the successor and for the own capital and land are higher than the expected farm household income, the farm is closed down and all farm land is released onto the land market.

[16] In Hungary, the official retirement age is 62 years. This applies to dependent employees. For private farmers there is no fixed retiring age. The survey data show that only a few farm operators continue farming once they have reached the age of 65 years. This was the case for only 33 of all 256 farm households surveyed (that is, 12.9%). In many countries, there are disadvantages to continuing to work after reaching the official retirement age, since further profits from farming are offset against pension rights. Thus there is an incentive to stop farming or transfer the business to a successor.

[17] The survey data show that the farm operator and the partner are usually of the same age. Hence, the working life is assumed to be the same for the operator and the partner as well.

## 4.3 The agricultural policy framework

The simulations start in 2004 when both countries, Hungary and Poland, became Member States of the EU. Both countries opted for an implementation of a simplified single area payment scheme (SAPS) which consists of incrementally increasing payments year by year with a starting level of 25% of the direct payment level of established Member States (EU15). These payments are augmented by coupled Complementary National Direct Payments (CNDP), so called 'top-ups', for specific crops and livestock. This policy framework applies to all scenarios.

# 5 SCENARIOS

The impacts of the regional demographic characteristics will be analysed by four scenarios with alternative settings. The first scenario is rather simplistic and abstract. The further scenarios are increasingly realistic. The scenarios focus on three issues concerning the ageing and succession of farmers:

(i) The level of opportunity costs for farm family members over the period of their professional life. Opportunity costs could be constant or declining with increasing age.

(ii) The initial age distribution within the sample of individual farmers. This is an equal distribution in the standard version of AgriPoliS. In this application it is calibrated to an empirical age distribution as detailed in the scenario 'Empirical'.

(iii) The assumptions regarding the existence of a successor.

Scenario 'Reference'

In this scenario, it is assumed that the opportunity to find a job outside agriculture is constant over the working life of a farmer, i.e. old farmers face the same opportunity costs as their younger colleagues.

Specific model parameters and key assumptions applying to all scenarios in the Hungarian and Polish model region are shown in an Annex.

Scenario 'Age-dep'

This scenario assumes an age-dependent decline of opportunity costs over time. This assumption is based on the understanding of a farm operator as a person who has a specific agricultural education and skills which cannot fully be remunerated outside the farming sector. Moreover, the mobility to switch to another (off-farm) profession declines with advancing age following CHAMPION (1998) who states that the potential payoff of a new job is lower for older employees since their remaining working life is shorter. This can also be explained by using the concept of sunk costs (BALMANN et al., 1996). Furthermore, there are several studies on the agrarian labour market in CEE countries which state that middle-aged and old farmers have little or no off-farm job opportunities (BAUM et al., 2006; RIZOV and SWINNEN, 2004; and BOJNEC et al., 2003). The decline in opportunity costs is implemented step-wise: it is assumed that a successor becomes the farm operator at 30 years of age and he/she hands over the farm at 65 years. For the first 15 years of operating the farm it is assumed that the farmer still has full opportunities, i.e. he would receive the full off-farm wage level. For the next 10 years he would receive only half the off-farm wage, and for the last 10 years aged from 55 to 65, he would receive nothing. These assumptions apply to all farm family labour, i.e. the operator and the partner.

Scenario 'Empirical'

A further step towards more realistic model assumptions concerns the initial age distribution within the group of individual farmers (IF). In previous applications of AgriPoliS as well as the scenarios 'Reference' and 'Age-dep', the initial age assignment followed an equal distribution owing to a lack of empirical data on the age of farmers. Each individual farm operator was assigned a random age which leads to a random distribution of age among all individual farm operators, irrespective of any farm characteristics. This is now extended by implementing age structures according to empirical data sources, e.g. based on survey data. The initial assignment of age to the farm operator (and the partner) is based on findings on the relationship between farm size and age as shown in Table 5.1 and 5.2.[18] The mean age of 52.5 years in the smallest farm size group (larger than or equal to 4ha and larger than 10ha) for the Hungarian region is approximated by a triangular function which has its peak at an age of 52.5 years, i.e. the centre is skewed to the right according to the mean value in the respective farm size class.[19] This initial position is applied for each size class separately. Only the size class of the largest farms (larger than or equal to 60ha) is not affected by an 'over-ageing' as the mean value is only 47.0 years.

**Table 5.1 Age of operators in different size classes (farms larger than or equal to 4ha in the Hungarian survey region Northern Great Plain)**

| Farms between ... | >=4ha and <10ha | >= 10ha and <25ha | >=25ha and <60ha | >= 60ha |
|---|---|---|---|---|
| **Number (total 49)** | 20 | 10 | 9 | 10 |
| **Mean age of operator** | 52.5 | 54.1 | 52.1 | 47.0 |

Source: SCARLED Questionnaire

Table 5.2 shows the figures for the Polish region and the more narrow size classes. The oldest farm operators are in the size class of smallest farms ('>=2 and <5ha') while in tendency younger operators are in the size classes '>=5 ha and <10ha' and '>=10ha and <20ha' which has already been shown in the section of age patterns on the Polish farm households.

For the three larger size classes (>= 5ha) the average age corresponds to the theoretical mean age of 47.5 years which has been deducted as a threshold of over-aging. Hence, this scenario is quite different between the both model regions as the 'Empirical' scenario in Hungary represents an over-aged structure within the group of IF which is only for the small group of farms between '>= 2ha and < 5ha' the case in Poland. Furthermore, the frequency within this small farm size class is in the Polish model region much lower compared to Hungary, i.e. the over-ageing affects only a marginal group of IF in Poland while it is the vast majority of farms in Hungary.

[18] The setting of the farm size borders is somehow arbitrary but chosen with a view to a suitable fitting for the sample of typical farm households within the modelling.

[19] A symmetric triangular age distribution within the borders of 30 and 65 years has its peak at a value of 47.5 years. A peak at 52.5 years reflects the over-ageing within this farm size class since this procedure generates an age distribution where most farm operators are aged 52.5 years while only a few are older and even fewer are younger farmers. It should however be mentioned, that using the average age of the empirical distribution for defining the peak in the triangular distribution leads in the model to an average age which is lower or higher than the empirical average. The bias depends on the skewness of the triangular distribution.

**Table 5.2 Age of operators in different size classes (farms larger than or equal to 2ha in the Polish survey regions)**

| Farms between … | >=2 and <5ha | >=5 and <10ha | >=10 and <20ha | >= 20ha |
|---|---|---|---|---|
| **Number (total 185)** | 57 *(31%)* | 41 *(22%)* | 54 *(29%)* | 33 *(18%)* |
| **Mean age** | 53 | 48 | 47 | 48 |

Source: SCARLED Questionnaire

Scenario 'Succ_random'

Closely linked to the problem of ageing is the problem of farm succession. This problem becomes even more pressing the older the farm operators are as the main exit reasons at the end of the professional farming career are: reaching the regular retirement age, poor health, or death (GALE, 2003, BREUSTEDT and GLAUBEN, 2007, WEISS, 1999). If no potential successor exists, the farm will be closed down. A potential successor's decision to succeed the farming business highly depends on his educational choice which is generally determined in earlier periods of life (MANN, 2007a, 2007b). Besides the classical economic balancing of opportunities, i.e. balancing with off-farm working options, there might be also non-economic reasons fostering a non-farm occupation, such as personal characteristics, education, experience, age, or skills (KANCS et al., 2007). The survey results of both countries confirm these findings as farm succession processes are obviously connected with uncertainty. The number of farm households which state definite plans regarding the farm succession is comparatively low (27% in the Hungarian survey region and 18% in the Polish). Accordingly, the number of those farm households stating 'a potential successor exists but succession is still unclear' is comparatively high.[20] The scenario 'Succ_random' covers this issue of uncertainty in a stylised way by setting the probability that there is no willing successor at 50%.[21] This assumption is independent of any other characteristics of IF.

Table 5.3 summarises all scenario settings in a matrix and introduces the scenario naming (first column) for the section of simulation results.

[20] In the Hungarian survey region this is answered by 39% of farms, in the Polish survey regions by 12%, but in the Polish regions the number of farms which don't answer the question of a farm successor designation is extremely high with 58%. This can be interpreted as a kind of uncertainty on this topic as well.

[21] Inversely, one can say that the probability that a farm has a successor is 50%. All other scenarios assume that there is always a willing successor existent on individual farms.

**Table 5.3 Scenario matrix**

| Scenario name | Opportunity costs | Initial age distribution | Succession |
|---|---|---|---|
| **Reference** | Constant over work life | Equal | Always successor |
| **Age-dep** | **Age-dependent** | Equal | Always successor |
| **Empirical** | Age-dependent | **Empirical** | Always successor |
| **Succ_random** | Age-dependent | Empirical | **Randomly (50%) no successor** |

Source: own

# 6 THE AGRICULTURAL STRUCTURE OF THE MODEL REGIONS

The simulation model was calibrated to represent the regional farm structures of the region 'Borsodi Mezoseg' which is located in the North-East of Hungary and 'Koscian' which is located in the middle western part of Poland.

## 6.1 The Hungarian model region 'Borsodi Mezoseg'

The Hungarian model region is a sub-region adjacent to and partly inside the Northern Great Plain region (NUTS 2 level). The area of the model region has a size of about 33,400ha.[22] About 55% of the area is managed by individual farms (IF) which constitute 97% of farms, the remaining share is occupied by corporate farms (CF) (Table 6.1 below). The average farm size of IF is 21ha while that of CF is 625ha. The group of IF is quite heterogeneous as the majority (60%) is smaller or equal than 10ha. The two largest IF operate on 130ha and 300ha. The average livestock density is comparatively low in the model region (0.16 livestock units (LU)/ha). For the IF the livestock density is slightly higher (0.20 LU/ha) compared to CF as they are engaged in all livestock activities (Table 6.1 below). However, livestock activities are unequally distributed among IF since only 53% of them keep livestock. The specific lines of livestock production – different kinds of cattle and sheep – reveal that livestock is predominantly kept to make use of grassland (28% of the utilised agricultural area (UAA)) and less fertile parts of the arable land. The region is not characterised by intensive livestock activities such as fattening pigs, sows, chicken, or egg production.

**Table 6.1 Importance of individual farms in the Hungarian model region**

| Regional characteristics | All farms | Share of Individual farms |
|---|---|---|
| Farms (no.) | 901 | 97% |
| UAA (ha) | 33,362 | 55% |
| of which grassland (ha) | 9,357 | |
| Dairy cows (no.) | 2,185 | 59% |
| Beef cattle (no.) | 1,645 | 76% |
| Suckler cows (no.) | 9,140 | 78% |
| Sheep (no.) | 27,250 | 58% |

Source: Based on Hungarian Census of Agriculture, 2000

[22] Farms smaller than 4ha are not considered, i.e. this area refers to all farms larger than or equal to 4ha.

## 6.2 The Polish model region 'Koscian'

The Polish model region 'Koscian' is located in the Greater Poland Voivodship ('Wielkopolski', NUTS 2 level) which is between two of the survey regions, the voivodships Kuyavian-Pomeranian and Lower Silesian (cp. Map 3.2). The 'Koscian' administrative district is located in the area of the West Polish Lowland, about 50 kilometres in the South of the provincial capital Poznan. The model region has a size of 30,693ha[23] of which are 5,710ha used as grassland (19%). The model region is represented by 2,499 farms which have an average size of about 12ha. Table 6.3 shows the distribution of farms according to farm size classes.[24] The number of livestock shows that the livestock density is significantly higher compared to the Hungarian model region (0.78 LU/ha). Beside the higher intensity of livestock activities, the specialisation within the livestock sector is different: Piglet production (sows) and fattening pigs play an important role in addition to milk and beef meat production. This specialisation is related to the high share of arable land compared to the 'Borsodi Mezoseg' region. While the 'Koscian' region is characterised by light soils the precipitation ranges around 650mm which is a factor favouring a more intensive agricultural production.

**Table 6.2 Regional characteristics of the Polish model region**

| Regional characteristics | |
|---|---|
| Farms (No.) | 2,499 |
| UAA (ha) | 30,693 |
| of which grassland (ha) | 5,710 |
| Dairy cows (No.) | 7,164 |
| Beef cattle (No.) | 4,861 |
| Suckler cows (No.) | 2,883 |
| Sows (No.) | 10,727 |
| Fattening pigs (No.) | 81,115 |

Source: Polish National Census of Agriculture, 2004

[23] Farms smaller than 2ha are not considered, i.e. this area refers to all farms larger than or equal to 2ha.

[24] The shares of land use are shown within the section of results (Figure 7.5 and Figure 7.6).

**Table 6.3 Distribution of farms according to farm size classes**

| Number of farms per size class | | |
|---|---|---|
| >= 2ha - < 5ha | 456 | 18% |
| >= 5ha - < 10ha | 409 | 16% |
| >= 10ha - < 15ha | 1159 | 46% |
| >= 15ha - < 20ha | 174 | 7% |
| >= 20ha - < 30ha | 172 | 7% |
| >= 30ha - < 50ha | 103 | 4% |
| >= 50ha | 26 | 1% |
| Total | 2,499 | 100% |

Source: Polish National Census of Agriculture, 2004

# 7 SIMULATION RESULTS

The following sections focus on selected aspects of agricultural structures and structural changes. Each simulation runs for 35 periods, so that inter-generational transfer takes place at least once.[25] Results are based on five independent replications where the age of assets, the farm location, and the variable production costs are varied randomly.[26] In the first step, the impacts of the different assumptions on the opportunity costs of labour of the farm household members are analysed (scenarios 'Reference' and 'Age-dep'). In the next scenario ('Empirical'), the impacts of an empirically-based initial age distribution are addressed to show the influence of demography on the speed and intensity of structural change. Closely linked to this issue, the impacts of a 50%-probability of farm successions are examined in the scenario 'Succ_random'.

Furthermore, the analyses cast light on the different developments within the competing legal types (only for the Hungarian model region). Thereby, e.g. labour input and rental prices give some indication of the efficiency and costs of production. Moreover, the livestock density reveals insights on the production intensity and the farm profitability reflects the remuneration of the whole producing entity and the factors used in it.

## 7.1 Speed of structural change in the Hungarian model region

The starting year of the simulations is 2004, and as Figure 7.1 (a) shows, in the 'Reference scenario' the number of IF declines significantly over the simulation period of 35 years, The decline is fastest in the beginning if the opportunity costs are assumed to be constant over the working life period of farm family members. Later, structural change slows down.[27] The initial average size of IF amounts to 21ha.

The decline in IF is notably slower in the beginning of the simulation runs by assuming that age plays a role with regard to the existence and value of opportunities ('Age-dep' scenario). An analysis of the farm-level data shows that the only reason for exiting are uncovered opportunity costs of the owned production factors of labour, land, capital, and quotas.[28] While the group of IF is quite numerous and heterogeneous in the beginning, the

---

[25] The reasonably long 35-year period was chosen because of this fact. For the analyses of rental prices and incomes the time frame was reduced to a narrower time frame of 10 years.

[26] As in reality, there are differences with regard to the managerial performance of farms which is reflected in the way in which some farm operators have lower variable production costs compared to others (10% variation). However, these differing managerial abilities are assigned to farms randomly, i.e. independently of any other characteristic such as age (experience) or farm size and they remain constant throughout the entire simulation.

[27] The 'kink' of the curve at iteration 13-14 marks a point where all potential 'exit farms' of the smallest farm size classes have closed. Afterwards, the exiting concerns other farms and slows down.

[28] The slightly different final levels of the curve of the scenario 'Reference_IF' and 'Age-dep_IF' are caused by complexity since in the scenario 'Age-dep_IF' some farms do not exit which exit within the other scenario (or at another moment during the simulations which makes a difference). Hence, the inter-dependencies can cause farms to exit in one scenario that do not exit in the other, simply because their competitive environment – provided by the other farms – has changed.

group of CF is relatively homogenous. Their number (24) is constant over all simulation periods and in all scenarios. For that reason, only the scenario 'Reference_CF' is depicted in Figure 7.1 (a) and in the following figures.[29] However, CF are declining in size: the average size of initially 625ha shrinks to 510ha in period 35. This issue will be discussed in the next section.

Figure 7.1 (b) shows the developments in the number of IF in the scenarios 'Empirical_IF', 'Succ_random_IF' and 'Age-dep_IF'. The shapes of the curves differ. Taking empirical age structure together with age-dependent opportunity costs results in an even slower structural change in the first periods than in the scenario 'Age-dep_IF'. However, structural change accelerates after some ten years and slows down again in the final periods. The combination of the two assumptions that: a) the initial farm sample is over-aged (according to the empirical findings); and b) opportunity costs decrease over time, means that many farmers are initially old and have fewer opportunities (scenario 'Empirical'). Hence, these farms persist for a while because these farmers are locked-in until they retire. When the number of annual generational changes increases, the potential young successors consider the high opportunity costs, and the speed of exits increases (iterations 8-23). Towards the end of the simulations there are increasingly fewer farms confronted with a generational change (compared to the scenario 'Age-dep_IF') and at the end of the simulations (iteration 35) there are as many farms as in the scenario 'Age-dep_IF' with its implementation of an equal initial age distribution. The comparison of these two scenarios shows that the timing of farm exits and their persistence depends on the initial age patterns.

These effects are even stronger in the scenario 'Succ_random_IF' assuming a 50% chance that a willing successor exists. This scenario is characterised by a significantly stronger decline in the number of IF (this would be expected a priori). This can be explained by the fact that there are many typical 'exit farms' which quit anyway. The assumption of having no willing successor at the generational change simply substitutes somehow for the farm's internal calculation of opportunity costs. I.e., if a relatively inefficient farm is not affected by a missing successor, it would exit from farming anyway because of uncovered opportunity costs.

[29] A further reason for focussing firstly on IF is that CF are not affected by the scenario differentiations in opportunity costs, age patterns, and the issue of uncertainty of farm successions.

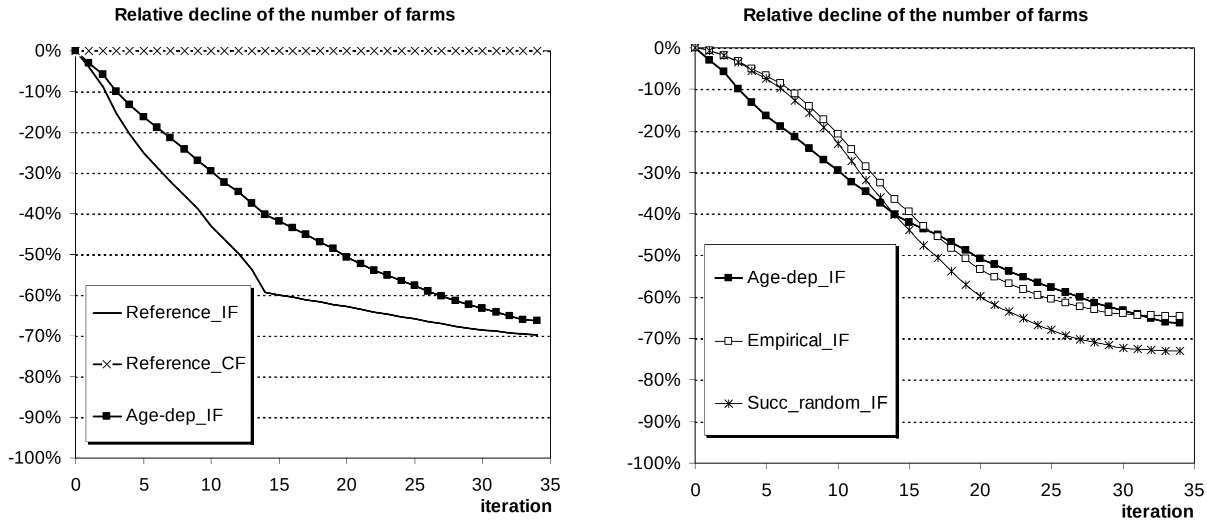



**Figure 7.1 Number of farms in different scenarios (relative decline) in the Hungarian model region**

Source: own calculation

## 7.2 Distribution of land in different farm size classes ('Borsodi Mezoseg')

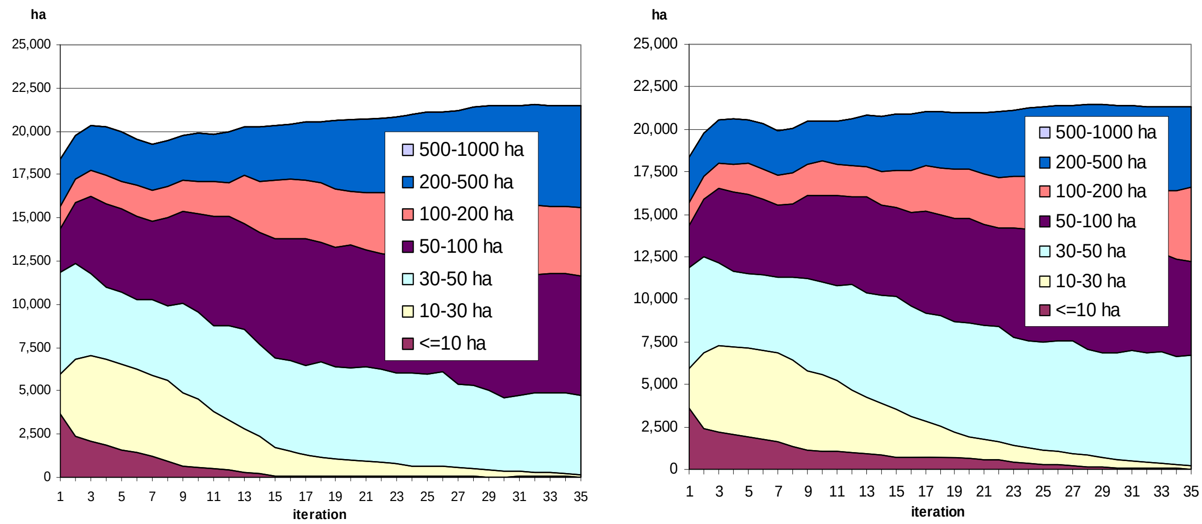
Figure 7.2 (a and b) shows the distribution of land use shares in different size classes for the Hungarian study region in the scenarios 'Reference' and 'Age-dep'. Regarding Figure 7.2 (a) it is obvious that predominantly IF belonging to the two smallest farm size classes (<= 30ha) lose land during the simulation runs while the classes larger or equal to 50ha expand. The whole model region has a size of about 33,400ha, whereof 18,400ha are initially used by IF and the rest of 15,000ha by CF. The reduction of land use shares of the smallest farms is mainly caused by the exit of the smallest IF in the sample. Only a few manage to increase in size, which is a second – but almost negligible – reason for the land decline in the group of small farms. Interestingly, the overall share of land farmed by IF increases only slightly (except for some significant land gains in the early simulation runs). Apart from the competition for land among IF themselves, they are also competing with the group of CF. In the early periods, CF lose parts of their farming area while the loss of area is moderate in the later periods. Accordingly, the total amount of land of the IF increases.[30]

The comparison of the 'Reference_IF' and 'Age-dep_IF' scenario demonstrates that the situation in the scenario 'Age-dep_IF' where the two smallest farm size classes hold larger land shares for longer is caused by the fact that the old farm operators have less (or no) opportunity to exit and so continue farming. There are hardly any differences between the

[30] The two smallest farm size classes should be rather considered as one because there are many farms in the size class less than or equal to 10ha which grow immediately after the start of the simulations into the next size category (greater than 10ha but less than or equal to 30ha).

scenarios ‘Age-dep’ and ‘Empirical’ with regard to the land distribution in different size classes.

Scenario:
‘Reference_IF’ ‘Age-dep_IF’




(a) (b)

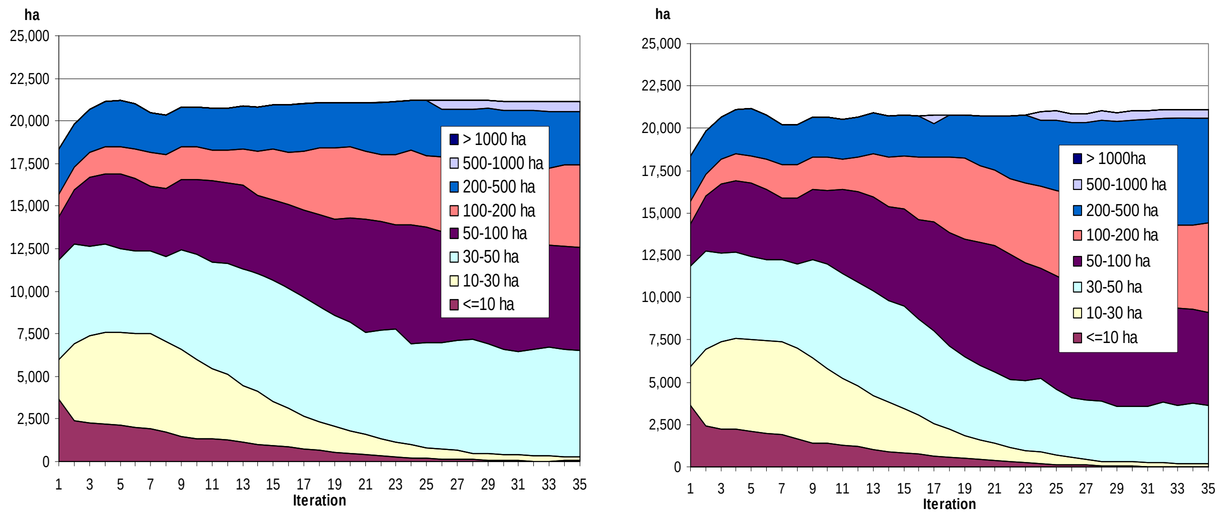
**Figure 7.2 Area used by individual farms (IF) in different size classes (region ‘Borsodi Mezoseg’)**

With regard to the scenario ‘Succ_random’ (Figure 7.3 (b)) the size class of large farms (>= 200ha) benefits most from the strong reduction in the number of farms. However, this phenomenon does not appear as pronounced as in the Polish study region.[31]

[31] This gives a hint that generating a kind of ‘distortion’ by assuming a certain degree of uncertainty in the farm succession process is in favour of the class of the largest farms, i.e. for them this situation contains the most growth potentials. However the empirical survey part shows that these distortions - or uncertainties - are a substantial part of real world conditions.

Scenario:
'Empirical_IF'

'Succ_random_IF'




(a) (b)

**Figure 7.3 Area used by individual farms (IF) in different size classes (region 'Borsodi Mezoseg')**

Source: own calculation

## 7.3 Speed of structural change in the Polish model region

The 'Koscian' region is characterised by an overall lower exit rate of individual farms compared to the Hungarian model region. The speed of farm exits differs within the simulation runs: regarding at first the 'Reference' scenario (Figure 7.4), there is an abrupt exiting of farms in the second iteration followed by a continuous exiting of farms until iteration 18. Then, the speed of farm exits slows down until the end of the simulations. The phenomenon of 'typical exit farms' does not appear as pronounced as in the Hungarian region. However, there are also typical exit farms coming from the group of very small farms (2ha-farms) which exit in the early simulations runs (iteration 2-3).[32] The assumption of lower opportunity costs in later stages of the farming work life (scenario 'Age-dep') induces also in the Polish region a slowing down of farm exits. However, at the end there are as many farms quitted as in the 'Reference' scenario. But the shape of the exiting curve differs as it is characterised by a constant farm exit rate (mean annual exit rate: 1.6% of farms).

The 'Empirical' scenario does not differ compared to the 'Age-dep' scenario as the empirical age patterns do not strongly differ to the standard assumption of an equal

[32] The reasons for farm exits are uncovered opportunity costs of farm-owned factors. The early exiting farms generate losses from their farming activities. This does not entail illiquidity in the short-run but the remuneration of production factors is even lower compared to the exiting farms in the Hungarian application. There, also the exiting farms generate profits – however they are too low to remunerate adequately farm owned production factors.

distribution of age among farmers. The only difference within the empirical age implementation is an over-aged structure in the size class of very small farms (>= 2ha - < 5ha). However, the effect of age-dependent reduced opportunity costs in the scenarios 'Age-dep' and 'Empirical' is significant as it slows down structural change for the first 15 periods. Obviously, many farmers with low profits continue until the next generational change while they would have exited farming if they could find employment opportunities with higher wages.

There is also a strong impact of the 'Succ_random' scenario by assuming that there is on 50% of farms no willing successor. Since the impacts of this assumption are low in Hungary (as there are numerous small 'exit farms' leaving anyway) this assumption affects the farm exit rate quite strongly in 'Koscian'. There is a less strong concentration of small farms in the small farm size classes but a wider spreading of farms over all size classes.

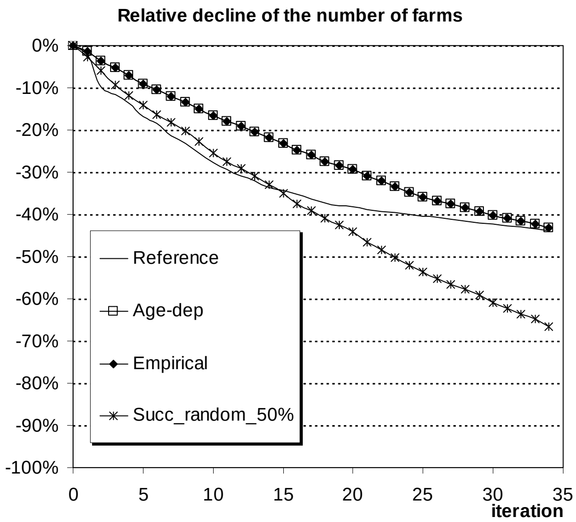



**Figure 7.4 Number of farms in different scenarios (relative decline) in the Polish model region**

Source: own calculation

## 7.4 Distribution of land in different farm size classes ('Koscian')

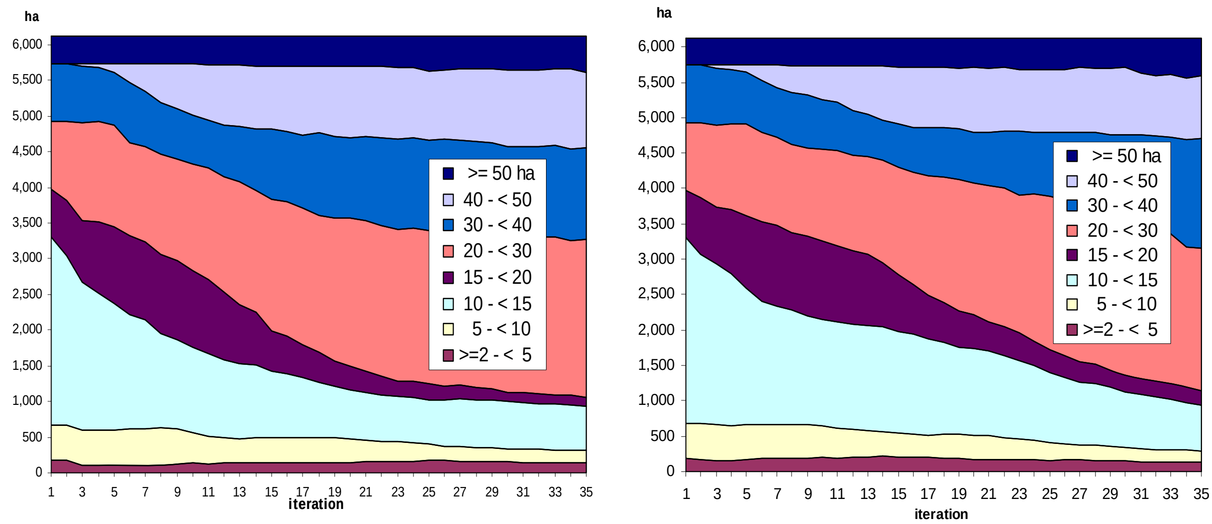
Figure 7.5 and Figure 7.6 show the distribution of land within different farm size classes[33] and the shifts within the land distribution over the simulation runs. There are significant differences between the 'Reference' and 'Age-dep' scenario on the one hand (Figure 7.5 a and b) and between the 'Empirical' (and 'Age-dep') scenario and the 'Succ_random' scenario on the other hand (Figure 7.6 a and b). By comparing the 'Reference' and the 'Age-dep' scenario one observes a longer persistence of farms in the farm size classes between 10-15ha and 15-20ha. The two smallest farm size classes (all farms < 10ha) show a similar development in all scenarios. However, they are not important with regard to the

[33] Note that farm size borders were set differently to capture the different scale of farming in both regions.

land use. The smallest farm size class (>= 2ha and <= 5ha) shows a continuous persistence over the whole simulation runs with only a negligible loss of area. Interestingly, in all scenarios (except for the 'Succ_random' scenario) the largest farm size class of farms larger or equal to 50ha remains constant in view to the share of land used within this class, i.e. the medium farm size classes (between 20-50ha) grow and benefit from losses in the smaller farm size classes (except for the smallest farm size class). Against the background of a very narrow setting of the borders between farm size classes and the fact that the largest farm size category is composed by farms which are (only) larger or equal to 50ha, it is remarkable that the redistributions of area appear within these borders, i.e. the dynamics are not that strong in the way that the size classes of the largest farms expand tremendously.[34] This may be explained in the scenario 'Age-dep' by an incentive to overcome hidden unemployment on small and medium-sized farms.

Scenario:

'Reference' 'Age-dep'




(a) (b)

**Figure 7.5 Area used by farms in different size classes (region 'Koscian')**

Note: The region is represented by a fifth of the original size due to computational reasons. The model region has a size of approximately 30,615ha with 2,499 farms while the simulations have been done for a fifth of the region sized 6,123ha. This proceeding can be justified as there are hardly any differences within the simulations between simulating the whole region and just a fraction of it.

Source: own calculation

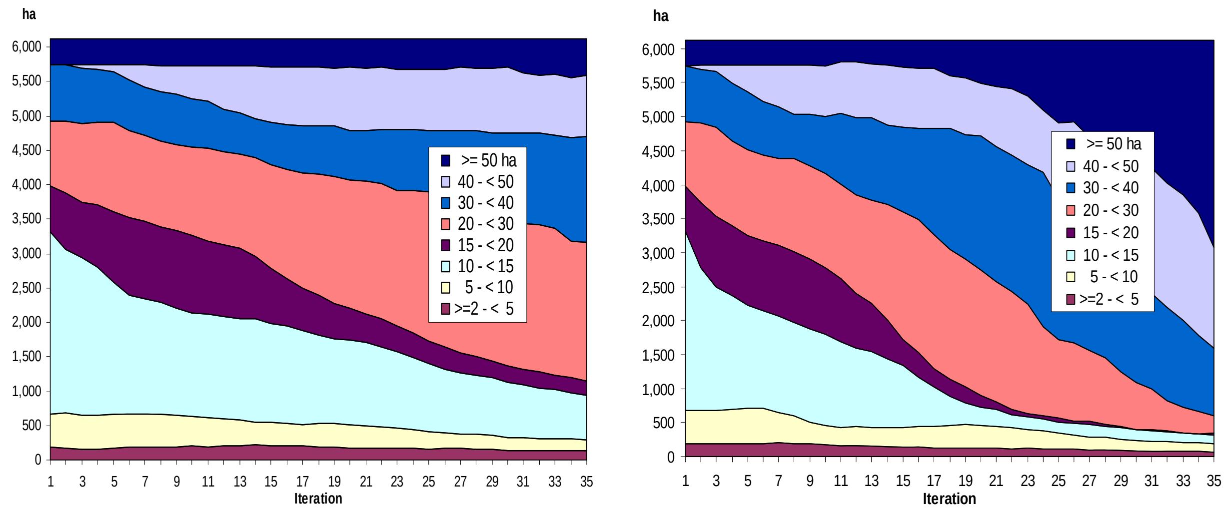
Strong dynamics of a tremendous structural change show up in the scenario 'Succ_random' assuming a lack of successors on 50% of farms (Figure 7.6 (b)). In this scenario, the middle-size farm classes benefit in the first half of the periods (until iteration 17) but then starts a process which is characterised by two developments: On the one hand, the surviving farms

[34] This is even more astonishing as the simulation horizon of 35 years is comparatively long.

of the middle-sized farm size classes start growing into larger size classes. On the other hand, a number of larger farms expands quite tremendously. The continuous reduction of the number of farms (cp. Figure 7.4) in this scenario triggers a strong growth potential for the largest farms.

Scenario:

'Empirical' 'Succ_random'




(a) (b)

**Figure 7.6 Area used by farms in different size classes (region 'Koscian', scenarios 'Empirical' and 'Succ_random')**

Source: own calculation

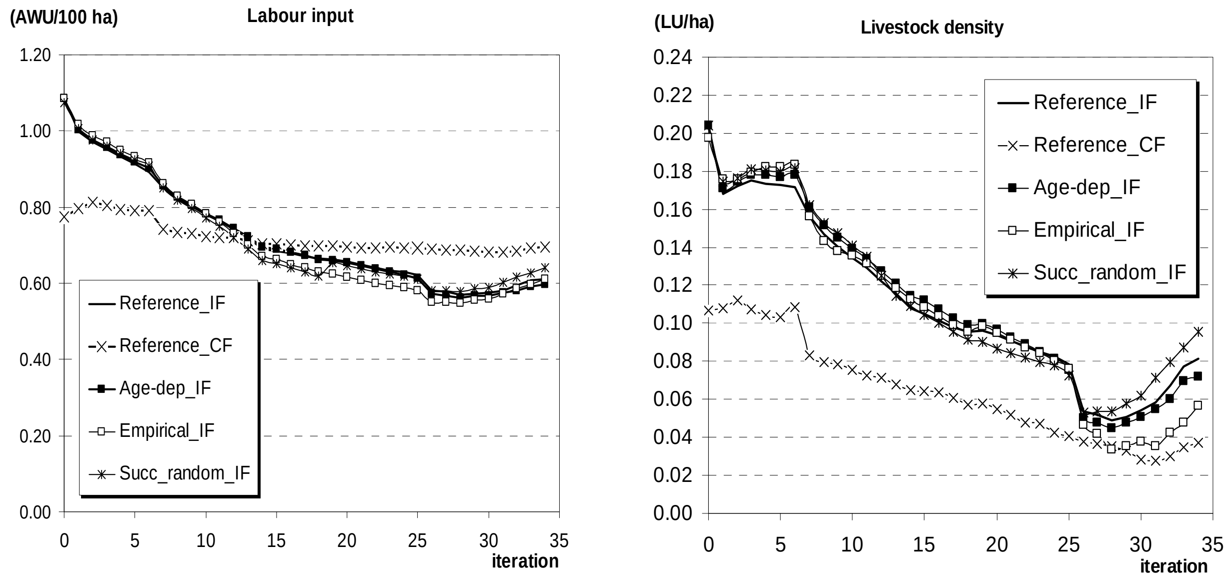
## 7.5 Labour input and livestock in the Hungarian model region

The initial labour input of IF and CF differs in the Hungarian model region (Figure 7.7 (a)). While IF show a value of 1.1 agricultural Annual Working Units (AWU) per 100ha, this figure is only 0.8 AWU/100ha for CF. Both values are comparatively low which indicates a low livestock density (Figure 7.7 (b)) and mirrors the large-scale farm structures where most land is managed by large CF or large IF.[35]

The reduction in the labour input is stronger in IF than CF, where it remains almost constant. The reduction in IF is primarily caused by the decline in livestock production (Figure 7.7 (b)) which, in turn, is the result of the exiting of small IF. The exit of small IF and the simultaneous increase in size of other IF causes an absolute decrease in labour input but an increase in labour efficiency since larger farms are more able to exploit economies of scale.

[35] Within the model economies of scale are reproduced as unit costs which are lower in large production units. The CF make up only 3% of farms in the model region but operate on 45% of the regional area. If the two largest IF (130 and 300ha) are included, then 5% of farms use 57% of the land.

The comparably lower labour decline on CF is caused by some re-investment in sheep and milk production facilities. Within livestock production, there is a strong decline in beef and suckler cow production, while the decline in milk and sheep production is moderate.[36] There are hardly any differences in the different scenarios. This is the reason why the analyses are extended to capture the differences between legal types.




(a) (b)

**Figure 7.7 Labour input (a) and development of livestock density (b), IF and CF**

Note: For reasons of clarity for the CF only the scenario 'Reference_CF' is depicted because the developments of labour input and livestock density do not significantly differ in the three other scenarios for this legal type.

Source: own calculation

## 7.6 Rental prices and profits in the Hungarian model region

The simulations show an increase in rental prices for both legal types and for all scenarios in the Hungarian model region (Table 7.1). While IF start from a rental price level of €70/ha (arable land), this level increases rapidly to approximately €130/ha after 5 years. Then the increase becomes more moderate up to approximately €140/ha. The slightly higher levels in IF in the scenario 'Age-dep_IF' are caused by the fact that the competitive pressure is higher in this scenario since there are fewer farms leaving the sector.

For CF, the starting level of €65/ha is even lower than for IF, then prices increase up to approximately €100/ha in the 5-year perspective and even more in the middle term (up to €179/ha).

[36] However, this depends on many assumptions concerning prices (for costs and revenues), premiums, and the production needs of land, labour, and capital. The sudden decline at the 6th period is caused by peculiarities of the implemented policy scheme as the top-up premiums are fully converted into an area-related premium over time.

**Table 7.1 Average rental prices (€/ha) in the Hungarian model region**

| | Legal type | IF | | CF |
|---|---|---|---|---|
| | Scenario | 'Reference_IF' | 'Age-dep_IF' | 'Reference_CF' |
| iteration | | | | |
| t=0 | | 70 | 70 | 65 |
| t=5 | | 131 | 132 | 99 |
| t=10 | | 138 | 144 | 179 |

Note: the developments in the scenarios 'Empirical_IF' and 'Succ_random_IF' are not depicted here as they do not differ from the scenario 'Age-dep_IF'. Similarly for the other CF scenarios.
Source: own calculation

The large increase in rental prices results from the comparatively low starting level and the strong impacts from the Common Agricultural Policy (CAP) with SAPS increasing stepwise and specific top-up payments. The top-up payments are reduced in the middle-term perspective.

With regard to total farm income, there are strong differences between the legal types. Initially, the average total farm income of CF amounts to €90,000/farm while it is €11,000/farm for the IF.[37] The remuneration with regard to an AWU is shown in Table 7.2. The strong increase of the profit per AWU on IF is caused by a 'sampling effect' since many of the small and inefficient IF leave the sample in the first simulation periods. Regarding the indicator of profit per AWU one has to be aware that the agricultural labour input of the small IF is on a comparatively low absolute level and the main contribution to the total household income is generated by additional off-farm income of both farm household heads. An further impact on the tremendous increase of the remuneration per AWU comes from the strong and continuous decline of the livestock production since the production is ceased at first in the inefficient production facilities. The increasing volume of payments has only a small effect on the increase of profits since there is a capitalisation of payments to the landowners via increasing rental prices. This affects particularly CF because more than 90% of their land is rented. This is reflected in the very slight increase of profit per AWU on CF. Initially, CF show a higher remuneration for farm labour. In the middle term the remuneration levels converge, driven by the increase in IF. This phenomenon of convergence is partly due to a few IF which grow strongly and then show characteristics which were previously observed only in the CF.

[37] Naturally these figures are not comparable between both legal types. They are given to get an impression of the average absolute income level of both groups. The indicator of 'profit - costs for family labour per AWU' is somehow crucial since the majority of small farms allocate only a small fraction of their total labour endowment on-farm. Additionally, the current modelling of small farms tends to underestimate the real amount of on-farm labour, i.e. the 'economies of scale' as implemented in the model are increasingly fuzzy the smaller farms are. The reasons for a higher on-farm labour input in reality are for instance the use of very old and inefficient machinery or the parcelling of land to numerous small plots etc.

**Table 7.2 Farm profit (profit - costs for farm family labour in €) per AWU in Hungary**

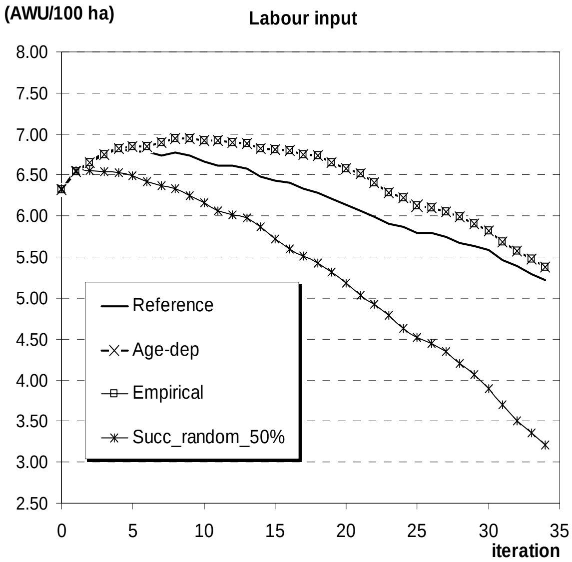
| | Legal type | IF | CF |
|---|---|---|---|
| | Scenario | 'Reference_IF' | 'Reference_CF' |
| iteration | | | |
| t=0 | | 2,060 | 18,222 |
| t=5 | | 8,627 | 18,526 |
| t=10 | | 16,425 | 19,779 |

Note: The developments in the scenarios 'Age-dep_IF', 'Empirical_IF' and 'Succ_random_IF' are not depicted here as they do not differ from the scenario 'Reference_IF'. Similarly for the other CF scenarios.
Source: own calculation

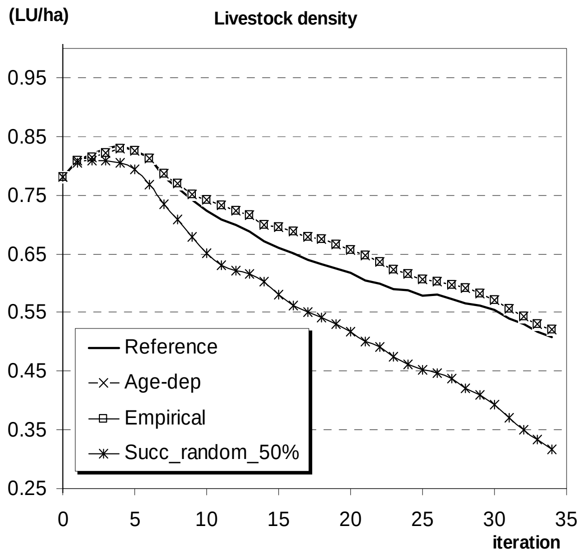
## 7.7 Labour input and livestock in the Polish model region

The Polish model region shows a significant higher labour input (Figure 7.8 (a)). Initially the labour input amounts to 6.4 AWU/100ha. This has two reasons: on the one hand the livestock density is much higher in this region (0.78 LU/ha) and on the other hand the scale of farming is smaller within the crop and livestock production. This small-scaled character of the region entails additionally a higher labour input per ha (and stable place) compared to the Hungarian region. The initial labour input level is high and it even increases slightly to a maximum at iteration steps 8-10 (except for the scenario 'Succ_random'). This is caused by an increase of livestock activities (Figure 7.8 (a)).[38] Regarding the different development within the scenarios it is obvious that the persistence of farms - which is induced by the assumption of age-dependency – has also a persisting impact on the livestock production and the labour input. This would have been expected ex ante, too. This phenomenon does not appear from the simulation start, but from iteration 6-7. I.e., the abrupt exiting of small farms in the 'Reference' scenario (cp. Figure 7.4) has no immediate impact on the labour input - as the leaving farms have only a minor agricultural use of their labour. The labour-binding effect of the 'Age-dep' scenario appears strongest in the medium phase of the simulations while decreasing towards the end. There are no differences between the 'Age-dep' and 'Empirical' scenario. The 'Succ_random' scenario leads to a strong erosion of both indicators focused.

[38] The increasing livestock density in turn is caused by policy-induced incentives (increasing premiums for specific livestock lines of production in the short- and medium run). The curves of the livestock density and the labour input are not necessarily congruent as there are some livestock activities which require more labour while being equal in view to the livestock units (LU).




(a)




(b)

**Figure 7.8 Labour input (a) and development of livestock density (b), in the Polish model region**

Source: own calculation

## 7.8 Rental prices and profits in the Polish model region

The rental prices in the Polish model region are initially on the same level as those in the Hungarian model region (€65/ha, Table 7.3). The rental price increase is even stronger in the short (t=5) and medium turn (t=10) as the level reaches the €200-line and €250-line, respectively. This price increase is even more pronounced than in the Hungarian region. This is mainly caused by the fact that the absolute and relative share of rented land is very low in the Polish model region.[39] Hence, the land rental market is very small with only a few transactions per year. The length of rental contracts is randomly fixed in the range between 9 -18 years in the setting of model assumptions (cp. Annex 'Polish model region'). This means that on average a contract runs for 13.5 years. This implies that only 7.4% (=100/13.5) of rental contracts end every year. Additional area is released to the land market by exiting farms. However, leaving farms are less in Poland (all scenarios except for 'Succ_random') compared to Hungary and thus there are very few free plots of land.[40] These reasons cause the tremendous increase of rental prices. For the same reasons one can assess this increase to be less important than the rental price increase in the Hungarian region. Additionally, the problem of capitalisation of payments to the

[39] This finding has also been identified in the survey data.

[40] Free plots of land can be rented-in by other farms within the auction.

landowners is less pressing since Polish farms have generally a high share of owned land.[41] The impact of an accelerated exiting of farms on the rental price level becomes obvious in the 'Succ_random' scenario as there are steadily farms leaving (also large ones). All leaving farms release area to the rental market which becomes more vivid in turn. Hence, the rental price level is significantly lower in t=10 in this scenario.

**Table 7.3 Average rental prices (€/ha) in the Polish model region**

| Scenario | 'Reference' | 'Age-dep' | 'Empirical' | 'Succ_random' |
|---|---|---|---|---|
| iteration | | | | |
| t=0 | 65 | 65 | 65 | 65 |
| t=5 | 203 | 196 | 196 | 203 |
| t=10 | 252 | 248 | 248 | 233 |

Source: own calculation

Initially, the average profit per AWU amounts to €3,185/farm in the Polish model region (Table 7.4). The conditions in the Polish region differ also in view to this indicator in comparison to the Hungarian model region. Firstly, one has to point out that average values are more convincing in this region as the individual farms are more homogenous in comparison to the group of IF in Hungary. The profit increase in the short- and medium turn is much lower in the Polish region because the actual level of agricultural labour remuneration is almost the same (comparing IF). Also in Poland, the general trend of increasing profits is caused by increasing SAPS and top'up payments in the course of phasing-in. Comparing the labour profitability in a 10 years projection (t=10), the simulation results show that the labour remuneration is much lower in the Polish region, i.e. agricultural labour will be used less efficiently. Regarding the differences between the scenarios, the results show that the profit increase is strongest in the 'Reference' scenario which is caused by the assumption of full labour mobility (100% opportunity costs over the whole work life) which induces that only the most efficient farms continue farming. The exiting ones leave because of better off-farm opportunities. Contrary, the 'Succ_random' scenario shows the lowest increase of profits since this sampling effect is 'disturbed' by the assumption of randomly missing farm successors. This affects also well-performing farms. Hence, the average profit increase is the lowest in this scenario.

[41] Naturally, capitalisation happens irrespectively of the landowner structure. Ceteris paribus, the land value increases with an increase of area-coupled payments. But the problem of capitalisation is frequently addressed as it describes an outflow of means which should originally support active farmers and not the owners of the land which are often non-farmers, e.g. the state or farmers who ceased farming due to retirement or other reasons.

**Table 7.4 Farm profit (profit - costs for family labour in €) per AWU in Poland**

| Scenario | 'Reference' | 'Age-dep' | 'Empirical' | 'Succ_random' |
|---|---|---|---|---|
| iteration | | | | |
| t=0 | 3,185 | 3,185 | 3,185 | 3,185 |
| t=5 | 4,309 | 4,213 | 4,213 | 4,116 |
| t=10 | 5,000 | 4,741 | 4,741 | 4,504 |

Source: own calculation

# 8 SUMMARY AND CONCLUSIONS

The agent-based model AgriPoliS has been adapted to two regions in CEE Countries (to the Hungarian region 'Borsodi Mezoseg' and the Polish region 'Kocian'). Compared to previous analyses AgriPoliS has been extended by using empirical findings from a farm household survey among Hungarian and Polish farms. The survey served as the empirical basis for gaining insights into the dynamics of demography-related issues at the farm household level. The data refer to the composition of individual farm households, the age structure of farm operators, and issues of farm succession (e.g. the existence and designation of potential farm successors).

With regard to the impacts of demographic patterns on structural change, the actual conditions and the future prospects differ significantly between both regions. For the Hungarian model region one can predict a steady continuation of structural change through the exiting of small individual farms. The exiting process of individual farms is in all scenarios stronger in the Hungarian region. However, also the Polish region is characterised by small farms exiting. The demographic patterns as observed in the Hungarian farm survey provoke a shift in the exiting process and there will be phases of slow and accelerated structural change, i.e. the process of structural change happens in waves instead of being a continuous development there. The empirical analysis shows particularly for the Hungarian region that – despite of the over-ageing of some farms – the largest group of farmers are middle-aged. This applies also to the group of small farms with less than 10 ha. Accordingly, many of these small farms either will have to develop growth strategies – which is unlikely – or will have to find alternative sources of income if they want to participate in general economic growth.

The acceleration of small farms' quitting agriculture happens if there is a peak of frequent generation changes because many potential farm successors decide not to enter the farming business owing to better off-farm opportunities. Hence, one can conclude that the age distribution of farmers strongly affects the timing of persistence or exiting of farms. This phenomenon is slightly more pronounced if it is assumed (with a probability of 50%) that no willing successor exists. With regard to the implementation of an age-dependent decline of opportunities, it was shown in a first simulation sequence that this slows down the number of farm exits significantly. This applies to both regions. Eurostat data, the survey results and the simulation experiments give an indication that the next 15 years will be characterised by frequent farm successions or 'non-successions' in Hungary. Both will have impacts on structural change in agriculture. The non-succession will lead to a reduction of farmers and, since many exiting farms stem from the group of small farms, the land use share within these small size classes will shrink while it will increase in the classes of larger farms. Within the model, a successful farm succession can be interpreted as a survival of the farm. In reality, successful farm successions often imply increasing investment activities (e.g. expansion in farm size, investing in larger buildings, opening of additional lines of production). The group of corporate farms – as competitors within the dualistic farm structure in Hungary – seems to be well established since none of them is leaving due to illiquidity or uncovered opportunity costs. It can be assumed that they benefit from economies of scale which are implemented within the model as well. However, they are suffering a small loss of land in favour of growing individual farms.

In view of the issue of missing farm successors in Poland, the conclusion can be drawn that the impacts are not as strong as one would have supposed ex ante in Hungary. There are typical 'exit farms' which leave anyway and even before a potential succession event. This phenomenon also leads to the finding that the impacts of the different scenarios with regard to the indicators of labour input, livestock density, rental prices, and profits appear rather negligible. However, this finding depends also on the nature of the sample farms which constitute the model region. If, for example, livestock activities are mainly located on small farms it can be assumed that the differences between the scenarios ‘Reference_IF’ and ‘Age-dep_IF’ with regard to livestock and the livestock density would increase as well in the Hungarian model region. The differences between the two legal types are significantly more pronounced compared to the differences within the different scenarios.

Regarding the Polish region the demographic structure is less problematic, i.e. the problem of over-ageing is less pressing which is also approved by EuroStat data. Furthermore, the whole sample of farms is constituted solely by individual farms. Furthermore, these are more homogenous and they are more equally distributed among size classes. Additionally, the livestock density is much higher and thus the regional agricultural labour input. Regarding specific age patterns of farmers, there are no visible impacts since these patterns are quite well represented by a simple equal age distribution. But in contrast to the Hungarian region, there is an even more pronounced uncertainty with regard to farm successions and the implementation of this uncertainty via the ‘Succ_random’ scenario has a much stronger impact, too. This applies to all indicators under consideration, e.g. shares of land use in different size classes, labour input, livestock activities, rental prices and farm profits. Particularly by regarding the development on the land distribution in different size classes it becomes obvious that the Polish region is less dynamic with regard to structural changes, e.g. growth of farms or a increasing labour efficiency. The rather slight changes are solely ‘disturbed’ by assuming the farm succession as a crucial and decisive process (50% probability of no willing successor). Notably is the fact that the agricultural labour efficiency is initially the highest on CF in Hungary and through strong structural adjustments also the Hungarian IF can improve profitability. In contrast, in the Polish region these adjustment processes are significantly weaker due to an overall slower structural change.

Generally, it should be taken into account that the agricultural policy framework with its increasing area payments leads to an increase in rental prices and farm incomes in both regions. This can in turn somewhat ‘overlay’ the demographic issues which have been addressed in the analysis. However, increasing payments to farmers lead to the problem of the capitalisation of the premium benefits to landowners in the middle- and long-term perspective. This problem concerns particularly the Hungarian region with high shares of rented land. But the policy framework does not inhibit the trend of small farms exiting. This is surprising since other studies (BLAAS et al., 2007) found that increasing premiums lead to a significant time delay of this adjustment reaction.

## List of references

BALMANN, A., M. ODENING, H.-P. WEIKARD, W. BRANDES (1996). Path-Dependence Without Increasing Returns to Scale and Network Externalities. In: Journal of Economic Behavior and Organization 29 (1): 159-172.

BAUM, S., P. COOK, H. STANGE, P. WEINGARTEN (2006). Agricultural employment trends in an enlarged European Union: does the CAP reform / introduction matter? Paper presented at the 46th Annual Conference of the Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V., Giessen, 4-6 October, 2006.

BLAAS, G., M. BOZIK, S. BUDAY, H. SIPOVA, E. UHRINCATOVA, L. LATRUFFE, S. DAVIDOVA, H. SCHNICKE, K. HAPPE, C. SAHRBACHER, K. KELLERMANN (2007). Effects of the CAP direct payments on Slovakian agriculture. Deliverable 29 of the EU Specific Targeted Research Project IDEMA SSPE-CT-2003-502171.

BOJNEC, S., L. DRIES, J.F.M. SWINNEN (2003). Human capital and labor flows out of the agricultural sector: Evidence from Slovenia. Paper presented at the 25th International Conference of Agricultural Economists (IAAE), Durban, South Africa, 16 - 22 August 2003.

BREUSTEDT, G., T. GLAUBEN (2007). Driving Forces behind Exiting from Farming in Western Europe. Journal of Agricultural Economics 58 (1): 115-127.

BUCHENRIEDER, G., J. MÖLLERS, K. HAPPE, S. DAVIDOVA, L. FREDRIKSSON, A. BAILEY, M. GORTON, D'A. KANCS, J. SWINNEN, L. VRANKEN, C. HUBBARD, N. WARD, L. JUVANČIČ, D. MILCZAREK, P. MISHEV (2007). Conceptual framework for analysing structural change in agriculture and rural livelihoods. Deliverable 2.1 of SCARLED (SSPE-CT-2006-0044201 (STREP)).

CHAMPION, A. G. (1998). Demography. in: T. Unwin (Ed.) A European Geography, pp. 241 – 259. Harlow: Longman.

EUROSTAT (2007). Farm Structure Survey (FSS) 2005 – Czech Republic, Hungary, Poland, and Slovakia: EUROSTAT.

GALE, F. H. (2003). Age-specific patters of exist and entry in U.S. farming 1987-1997. Review of Agricultural Economics 25 (1): 168-186.

GORZELAK, E. (2007) Development of the Polish agriculture before and after 2004 (Attempt of diagnosis and forecast). In: Zagadnienia ekonomiki rolnej. Dodatek do zeszytu 2/2007, 110-120.

HAPPE, K., K. KELLERMANN, A. BALMANN (2006). Agent-based analysis of agricultural policies: an illustration of the Agricultural Policy Simulator AgriPoliS, its adaptation and behavior. Ecology & Society Vol. 11 No. (1): Art. 49. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art49/

HAPPE, K., H. SCHNICKE, C. SAHRBACHER, K. KELLERMANN (2009). Will they stay or will they go? Simulating the Dynamics of Single-Holder Farms in a Dualistic Farm Structure in Slovakia. Canadian Journal of Agricultural Economics. Vol. 57 No. 4., 497 – 511.

HUNGARIAN CENTRAL STATISTICAL OFFICE (2004). Census of Agriculture 2000. Budapest 2004.

JELINEK, L., C. SAHRBACHER, T. MEDONOS, K. KELLERMANN, M. BRADY, O. BALKHAUSEN (2007). Effects of the CAP direct payments on Czech agriculture. Deliverable 27 of the EU Specific Targeted Research Project IDEMA SSPE-CT-2003-502171.

KANCS, d'A., J. SWINNEN, L. VRANKEN (2007). Rural labor markets in transition. In Conceptual framework for analysing structural change in agriculture and rural livelihoods, Deliverable 2.1 of the EU Specific Targeted Research Project "SCARLED" SSPE-CT-2006-044201, edited by G. Buchenrieder, J. Möllers, K. Happe, S. Davidova,

L. Fredriksson, A. Bailey, M. Gorton, d'A. Kancs, J. Swinnen, L. Vranken, C. Hubbard, N. Ward, L. Juvančič, D. Milczarek, P. Mishev.

KELLERMANN, K., K. HAPPE, C. SAHRBACHER, A. BALMANN, M. BRADY, H. SCHNICKE, A. OSUCH (2008). AgriPoliS 2.1 – Model documentation. Technical Report. Halle (Saale): IAMO: http://www.agripolis.de/documentation/agripolis_v2-1.pdf, accessed November 2009.

LUTZ, B., H. MEIER, B. WIENER (2004). Thesen zu Wegen aus der „demographischen Falle' für die ostdeutsche Landwirtschaft. Thesenpapier. Zentrum für Sozialforschung Hallee.V.http://www.qualifizierungspool.de/fileadmin/Dokumente/Seite__Das_Projekt/Thesen_LW.pdf, accessed 27.06.2009.

MANN, S. (2007a). Tracing the process of becoming a farm successor on Swiss family farms. Agriculture and Human Values 24 (4): 435-443.

MANN, S. (2007b). Understanding Farm Succession by the Objective Hermeneutics Method. Sociologia Ruralis 47 (4): 369-383.

RIZOV, M., J.F.M. SWINNEN (2004): Human capital, market imperfections, and labor reallocation in transition. Journal of Comparative Economics 32: 745-774.

SAHRBACHER, C., K. HAPPE (2008). A methodology to adapt AgriPoliS to a region. Technical Report. Halle(Saale): IAMO: http://www.agripolis.de/documentation/adaptation_v1.pdf, accessed November 2009.

SCHMITT, G. (1989). Warum ist die Landwirtschaft eigentlich überwiegend bäuerliche Familienwirtschaft? Berichte über Landwirtschaft 1989, S. 161–219.

SCHMITT, G. (1992). Der Zusammenhang zwischen Organisationsform und Betriebsgröße in der Landwirtschaft: Eine institutionenökonomische Erklärung und agrarpolitische Implikationen. Berichte über Landwirtschaft 70 (4), S. 505–528.

Thüringer Landesanstalt für Landwirtschaft (2006). Auswirkungen des demographischen Wandels auf die Thüringer Landwirtschaft. 1. Teilbericht. [online] URL: http://www.tll.de/ainfo/pdf/dem11206.pdf, accessed November 2009.

WAGNER, H. (2005). Pension Reform in the New EU Member States: Will a Three-Pillar Pension System Work? Eastern European Economics 43, no. 4: 27-51.

WEISS, C. (1999). Farm growth and survival: econometric evidence for individual farms in upper Austria. American Journal of Agricultural Economics 81: 103-116.

WIENER, B. (2004). Großer Nachwuchskräftebedarf an landwirtschaftlichen Fachkräften in den neuen Bundesländern am Beispiel Sachsen-Anhalt. In: Laschewski, L., Neu, C. (Hrsg.): Sozialer Wandel in ländlichen Räumen. Theorie, Empirie und politische Strategien. Aachen: Shaker, S. 93-112.

ŻMIJA, J., E. TYRAN (2004). Agriculture in Southeastern Poland – Main Problems of the Systemic Transformation Process. In: Petrick, M., Weingarten, P. (Hrsg.): The role of agriculture in Central and European Rural Development. Engine of Change or Social Buffer? S. 73-82.

## Annex

Specific model parameters and key assumptions – model region 'Borsodi Mezoseg'

| Description | Details |
| --- | --- |
| Farm is handed over to next generation (Generation change) every ... periods | 35 |
| Labour hours per annual work unit (AWU) | 1,800 h/AWU |
| Off-farm income_1 (operator) | 2.9 €/h |
| Off-farm income _2 (partner) | 2.8 €/h |
| Costs of hired labour | 3.3 €/h |
| Annual increase of labour costs | 2.0% |
| Minimum annual withdrawal of farm household annual work unit (AWU) | 2,300 €/AWU |
| Interest rate level | |
| Long-term borrowed capital | 3.00% |
| Short-term borrowed capital | 3.50% |
| Equity capital interest | 2.00% |
| Equity finance share[a)] | 30% |
| Managerial ability (% of variable costs) | [95, 105] % |
| Plot size | 1.0 ha |
| Length of rental contracts [fixed length] | 9 -18 years |
| Annual transport costs | 30 €/km |
| Overhead costs (Administration, taxes, professional association etc.) | 1% of gross margin from agriculture |

| Specific model parameters and key assumptions – model region 'Koscian' | |
|---|---|
| Description | Details |
| Farm is handed over to next generation (Generation change) every ... periods | 35 |
| Labour hours per annual work unit (AWU) | 1,800 h/AWU |
| Off-farm income | 2.3 €/h |
| Costs of hired labour | 2.9 €/h |
| Annual increase of labour costs | 0.5% |
| Minimum annual withdrawal of farm household annual work unit (AWU) | 2,000 €/AWU |
| Interest rate level | |
| Long-term borrowed capital | 1.20% |
| Short-term borrowed capital | 6.00% |
| Equity capital interest | 2.00% |
| Equity finance share[a)] | 30% |
| Managerial ability (% of variable costs) | [95, 105] % |
| Plot size | 1.0 ha |
| Length of rental contracts [fixed length] | 9 -18 years |
| Annual transport costs | 30 €/km |
| Overhead costs (Administration, taxes, professional association etc.) | 1% of gross margin from agriculture |