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THE AGRO-STRUCTURAL CHANGE IN THE ALPS AND ITS OUTLOOK UNTIL 2020 A MODEL BASED ON KEY DETERMINANTS

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Abstract

The agro-structural change in the Alps has been gaining intensity steadily since 1980. Farms continuously feel the pressure to adapt to changed economic, political, and social conditions. Those diverge significantly between the different alpine countries but also within a country. Based on the developments so far, the current situation and expected future framework conditions, this paper intends to indicate possible developments for future agro-structural trends in the Alpine arc. Using multivariate regression analyses, significant indicators were derived from harmonised parameters on municipality level, which influence farm abandonment. They form the basis of the forecast of farm abandonment until 2020. Based on agro-economic scenarios from the project Scenar 2020 (EC, 2006), the expected annual abandonment rates were calculated for each municipality. The scenario results vary widely between the national alpine areas as well as between the regions. The comparison with the effective, dynamic development 2000-2007 demonstrates how "realistic" the scenarios are.

Keywords:

Agro-structural change, farm abandonment, simulation models, Alps, Q10

1 Introduction

Since the 1980s, the structure of agriculture in the Alps has been changing continuously. Today, mountain farming is no longer essential for decentralized settlements, nor for food supply. Instead, it plays an increasingly important role in the conservation of natural resources and cultural landscapes. On the other hand, economic growth through improved labour productivity is hardly feasible, due to the limited availability of land on lease in a favourable location (Lauber, 2006). In mountain areas, land uses are commonly limited to grassland farming and animal husbandry, especially for milk production. There are hardly any other production alternatives (Dax et al. 2003). Product prices are increasingly volatile as a result of:

- globalized markets,
- the expiry of the milk quota system in 2015,
- political intervention measures that apply only when the market prices of certain products are extremely low, and
- export subsidies, which reduce the global price level (Rudloff, 2009).

All of that jeopardizes the production of milk and thus the agricultural future of mountain areas. However, the conservation of the cultural landscape depends upon the maintenance of dairy farming. Today, there is a tendency to cushion size-related price pressure by increasing the milk yield per cow through concentrated feed additives (Hoppichler et al., 2002). In areas that provide marginal returns, the percentage of grassland will therefore decline so that in the future the dairy and cattle farming will increasingly concentrate in fewer farms favourably located in the valleys and basins (Kirner, 2010). At the same time, however, the high quality of products and new consumer needs offer good market opportunities for mountain farming products. New framework conditions have encouraged various initiatives to secure the future of agriculture in the Alps. In 2009, political representatives of the seven Alpine countries adopted a Resolution on Mountain Farming containing the key points for the future promotion of mountain agriculture. The resolution defines the appropriate conditions for mountain farming and calls for measures to preserve the grassland and the dairy sector.

There are multiple causes contributing to the agro-structural change, including, very often, a generational change that lacks young farmers. In addition to the Common Agricultural Policy, due to be reformed by 2013, also economic, social, ecological, and technological factors are decisive: their influence on the agro-structural change varies across countries and regions. As a result of endogenous and exogenous factors, in the period 1980 – 2000, the Alpine Convention area witnessed a farm abandonment rate of approximately 40% (Streifeneder et al. 2007). The intensity of agro-structural change seems to be growing steadily. However, the repercussions of change are uneven, and vary according to the specific context of the Alpine area concerned. For instance, certain areas (Austria, South Tyrol, Bavarian Alps) enjoy favourable regional and production conditions, which contribute significantly to the stability of the sector. Yet, between 2000 and 2007, the farm abandonment rate increased also in those regions that have only moderately been affected up to now by the agro-structural change. At the same time regional differences grew, such as between Eastern and Western Austria.

Agro-structural change gained some ‘momentum’ in the German-speaking Alpine countries, but remained much more intense in Italy and France, confirming previous trends. Between 2000 and 2007 the farm abandonment rate resulting from the agro-structural change increased once more, even exceeding the 1980 – 2000 trend line (Figure 2).

The decision whether to make farming more intensive, extensive or to quit it altogether is ultimately made by each household based on family- and farm-specific circumstances. The rural families are faced with the challenge of either dealing with the production-specific and socio-economic aspects of the agrarian problem[1], or else accept the opportunity cost theory[2] (Sutter, 2004). It so happens that many farms opt in favour of part-time farming.

2 Empirical findings

A number of different models were developed to describe and analyse the complex correlations that characterise the agro-structural change. Such models cover a variety of spatial dimensions and pursue different objectives, depending on the issue under consideration. Table 1 provides an overview.

The SULAPS and AGRIPOLIS models focus on single farms. The SULAPS model investigates different development patterns and their impact on land use considering the specific economic, business and environmental conditions of mountain areas. Answers are generated by a multi-objective optimisation which aims at maximising the household income, taking into account the total operating resources, age and education of the farm managers, opportunity costs of labour and non-economic objectives (Lauber, 2006).

Instead, the normative, spatial-dynamic model AGRIPOLIS is a purely economic model that analyses the impact of agricultural policies on the regional agro-structural change and aims at the creation of more competitive agricultural structures. The issues of farm abandonment or land use change are directly related to the dynamics of factor and product price trends (Happe, 2004).

The CAPRI model is specific for the agricultural sector and is primarily used to break down the consequences of policy and trade measures from the global level to the level of NUTS 2-regions. A non-linear programming approach, which considers the production factors in use, including environmental factors and agricultural policy measures, aims at maximising Gross Value Added [GVA] in NUTS 2-regions. The restrictions on product prices derived from a global market model in which the main agricultural products, markets and bilateral trade relations are taken into account (Capri, 2010).

In contrast to the economic-oriented economy-oriented models, CLUE-S is focused on the analysis of changes in land use. The latter are determined by taking into account key bio-geophysical and social factors. Future changes in land use are described in the light of both historical trends and scenarios that estimate future demographics, overall conditions and land use policies (Clues, 2010).

Unlike previous models, the Scenar 2020 simulation is based on a multidisciplinary approach to modelling – just like CAPRI to a certain extent. The purpose of Scenar 2020 is to give an insight into the future of EU agriculture and the rural economy.

Scenar 2020 identifies future Europe-wide trends and agricultural drivers, which are decisive for the mutual interactions and overall conditions of European agricultural and regional economy in 2020.

Exogenous and endogenous factors were analysed by means of:

- economic models (LEITAP, ESIM, and CAPRI),
- an ecology-based model (IMAGE) and
- a model to define the land use distribution (CLUE-S)

and mapped into scenarios, whose development and consequences for the utilised agricultural area were simulated until 2020. Trends related to demographic change, technological and market development of agriculture, and natural and social constraints were taken into account (EC 2006, p. 112).

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[1] Nature and soil dependence of agricultural production, high percentage of immobile factors of production, strong links between business and family, mobility barriers and high transaction costs in the implementation of farm structural change (Henrichsmeyer et al., 1991).

[2] When compared to non-agricultural income opportunities, opportunity costs are often rated as ‘low’ by farmers. Baur (1999) maintains that this is due to the fact that farmers do not pursue income maximisation as their sole target. Farm abandonment and not directly quantifiable costs, or non-existent alternative economic opportunities to agriculture delay the adjustment process. The cessation of activity becomes an option in the case of too high opportunity costs (foregone benefits) only in the course of farm transfer, with the arrival of the next generation of farmers.

Table 1: Model approaches to estimate the agro-structural change.

ACRONYM	SULAPS	AGRIPOLIS	CAPRI	CLUE-S	SCENAR I / II
NAME	Sustainable Landscape Production Systems	Agricultural Policy Simulator	Common Agricultural Policy Regionalised Impact analysis	Conversion of Land Use and its Effects	Scenario study on agriculture and the rural world
AUTHOR(S)	Lauber S., 2006	Kellermann K., 2007, Happe K., 2004, Balmann, 2000.	Britz W. et al., 2007	CLUE Group, 2000	DG Agriculture & Rural Development; DG Economic analysis & evaluation, EC, 2006.
MODEL	Agent Based Model	Agent Based Model	Agro-economic, sector model	Grid based approach, logistic regression	Simulation Model
OBJECTIVE	Development patterns of mountain agriculture regarding different framework conditions and their effect on land use.	Maximisation of household income, competitive and efficient agricultural structures	Ex-ante impacts of the CAP and trade policies on production, income, markets, trade, and the environment, from global to regional scale.	Quantitative multi-scale analysis of actual land use, spatially explicit modelling of land use change scenarios.	Future trends that will be the framework for the European agricul-tural and rural economy.
STUDY AREA	63 farms, 8374 fields from 7 municipalities from Belfort and Surses, Switzerland.	Regions < 3000 farms Applied in the region 'Hohenlohe' in Baden-Württemberg.	EU27 plus Norway, and 16 non-EU regions	Applied worldwide on transnational and national scale.	European Union
MAIN UNIT	Single farms	Clones of typical farms	~300 NUTS 2-Regions (EU25)	Depending on the resolution of the remote sensing data	NUTS 2- and HARM 2-Regions
DATA	Qualitative and quanti-tative single farm data	FADN, land use data from satellite images, expert knowledge for deriving particular production technique.	Data sources: EURO-STAT, SPEL/EU and REGIO databases, FAO, OECD and FADN.	Bio-geophysical data from maps and/or satellite images, census data	Food Navigator Europe Website, FAO, OECD, Corine Landcover, Eurostat.
METHOD	Comparative-statistical, mixed-integer linear programming ap-proach; structural interviews	Mixed-integer linear programming approach to simulate the agents' behaviour; a two-phase revised Simplex method; GIS applica-tion,	Comparative partial static equilibrium model.	Analysis of land use systems as complex, multi-level systems: connectivity, hierarchi-cal organisation, stability and resilience, driving factors.	A chain of models is applied: ESIM, LEITAP, CAPRI: economic models; IMAGE: ecological-environmental model; CLUE-S: land use allocation model.

Abbreviations: CAP- Common Agriculture Policy; DG- Directorate general, EC- European Commission, EU- European Union; EUROSTAT- Statistical Office of the European Communities; FADN- Farm Accountancy Data Network; FAO- Food and Agriculture Organisation, HARM- Harmonised system of regions, NUTS- Nomenclature des unités territoriales statis-tiques; OECD- Organisation for Economic Cooperation and Development; REGIO- Regional Database from Eurostat; SPEL- Sectoral Production and Income Model of Agriculture.

These models that primarily focus on expected future development patterns of farm-related aspects of agro-structural change, were also employed by other scenario-based studies: SEAMLESS, SENSOR, EURURALIS or PRELUDE. The purpose of these studies centred on land use and landscape changes was to provide decision support to land use and agricultural policy (Helming et al., 2009).

3 Objectives and research questions

So far, no transregional model was available for the Alpine region that could show the spatially and temporally differentiated patterns of agro-structural change at municipal level and its contributing factors. Previous studies in the framework of EURAC's project AGRALP (www.eurac.edu /agralp) have focused on the agro-structural trends witnessed in the Alpine Convention area in recent decades (Streifeneder et al., 2007). Building on these, the project aims at filling the gaps left both by Scenar 2020, of which the spatial scale was too small, and by the detailed farm-related studies conducted at regional level using agent based modelling.

Harmonised municipal data were collected for the entire Alpine region and, by means of multiple regression analyses, the data base was used to estimate the future farm abandonment rate until 2020 under three different scenarios. As for the conditions and changes of parameters which are independent of the agricultural structure, the Scenar 2020 scenarios were used as a reference (EC, 2006).

This experimental approach modelled the effects of the agro-structural change in the Alps, which are representative of what happens in other mountain areas. The scenarios illustrate which farm abandonment rates can be expected under various agricultural policy options.

The following research questions, among others, were in the foreground:

- What will be the trend of the municipal farm abandonment rate until 2020 in relation to the three scenarios assumed for the national and regional levels?
- Will the spatial patterns of the past continue?
- Which determinants influence the farm abandonment rate?

4 Methodology

The present study is based on 'Scenar 2020', a set of scenarios for agriculture and rural development in Europe designed by the European Commission (EC, 2006). The model takes into account specific regional framework conditions and performs a municipal-level analysis of the possible development patterns of the agricultural structure in the Alps until 2020. By looking at the different magnitudes of regional farm abandonment rates, combined with information on the regional framework conditions, the socio-economic and natural consequences of agro-structural change in the various Alpine regions until 2020 can be inferred.

A two-step model was employed to forecast future farm demographics in the 5954 Alpine municipalities until 2020. In a first step, clusters were formed with the aim of defining and assessing those regions (NUTS 2) which appear to be influenced by similar exogenous conditions (chapter 4.1). In a second step, agricultural, socio-economic, demographic, and geographic indicators[3] were used to carry out municipal-level regression analyses for each cluster. Finally, using the significant independent indicators (Table 2) derived from regression analysis, the annual farm abandonment rates for three scenarios were calculated (chapter 4.4 and 4.2).

4.1 Clustering

Clusters were formed at the level of NUTS 2-regions, which were defined according to relevant socio-economic indicators (Table 1), such as GDP per inhabitant as an indicator of economic performance and prosperity of a region.

Out of the 27 'NUTS 2-regions', five clusters were identified for the Alpine Convention area: Germany, France, Italy, Slovenia, Austria and Switzerland / Liechtenstein. With a few exceptions, the clusters coincide with the Alpine regions as delimited by national borders, which therefore were considered as the basis for the modelling. It turned out that national framework conditions concerning agricultural and regional policies have a clear defining function. Another result of clustering is that the Slovenian and Italian Alpine areas and the Alpine areas of Switzerland and Liechtenstein were found to form a cluster.

Table 2: NUTS 2-indicators used to form even clusters.

Indicator	Definition and year
Unemployment rate (%)	Average unemployment rate 1990-2001 (Eurostat, 2009a)
UAA per workforce (ha)	Utilised agricultural area per workforce 2000 (Eurostat, 2009b)
GDP per inhabitant (€)	Average gross domestic product 1995-2005 (Eurostat,2009a)
Share of farmers older than 55 years (%)	Share of farmers (%) older than 55 years in 2000 (Eurostat, 2009b)
Agricultural income (€)	Agricultural income in € in 2000 (Eurostat, 2009b)
Wage level beyond agriculture (€)	Wage level beyond agriculture 2004 in € (Eurostat, 2009a)
Holidays on farms (%)	Share of farms (%) offering holidays on farm related to all accommodation facilities 2000*.

* *Source: (Avw 2009; Agreste 2002; Istat 2003; LI 2009; SI-Stat 2000; Statistik Austria 1999; Verband „Urlaub auf dem Bauernhof in Bayern e.V." 2008; Verein „Ferien auf dem Bauernhof" 2008).*

[3] Data collected during censuses which are conducted every ten years by national statistical institutions. Sources: Avw, 1980, 2000, 2009; Agreste, 1998, 2001, 2008; Bfs, 1980, 2001; Blw, 2008; Istat, 1982, 2003; SI-Stat, 1981, 2000; Statistik Austria, 1980, 1999 und Statistik Bayern, 1979, 2001.

4.2 Regression Model

Using Scenar 2020 and the municipal data for the entire Alpine region collected during censuses – which are conducted every ten years –, the future farm abandonment rates for farms larger than one hectare (EU standard) were calculated until 2020. 18 agro-structural, socio-economic, and geographical indicators were selected as independent variables at municipal level (Table 2). They were fed into the multiple regression model, usually with the average annual rates of change for the period 1980 – 2000 (Table 2). A stepwise regression analysis approach identified those significant indicators to define the basic models for the clusters (Table 2) that could best represent the recorded annual farm abandonment rates between 1980 and 2000. Since these basic models met the quality criteria of the regression analysis, given the high R^2 values (0.705 to 0.755) plausible predictions were expected for the future annual farm abandonment rates.

Table 3: The independent significant variables of the basic regression models for the five clusters.

Regression-coefficients Parameters	Austria	Switzerland / Liechten-stein	Germany	France	Italy & Slovenia
constant	-0.1380	-0.928	7.0577	-1.248	-0.1998
Δ farm < 5ha 1980-2000 (% p.a.)	0.0698	0.087	---	---	0.2945
Δ farm 5-10ha 1980-2000 (% p.a.)	0.0585	---	---	---	0.1557
Δ farm 10-20ha 1980-2000 (% p.a.)	0.0372	---	0.0509	---	0.0643
Δ farm 20ha 1980-2000 (% p.a.)	0.0438	---	---	---	0.1164
Δ full time farm 1980-2000 (% p.a.)	0.1017	0.161	0.1237	0.204	0.1306
Δ part time farm 1980-2000 (% p.a.)	0.1314	0.151	0.0456	0.347	---
Δ UAA 1980-2000 (% p.a.)	-0.2915	-0.354	-0.5901	-0.152	-0.2104
Δ arable land 1980-2000 (% p.a.)	0.0097	---	0.0180	0.039	0.0652
Δ permanent crops 1980-2000 (% p.a.)	---	---	---	0.0347	---
Δ grassland 1980-2000 (% p.a.)	0.1947	0.402	0.4145	0.059	0.1747
Δ live stock density 1980-2000 (% p.a.)	-0.0254	---	---	---	---
Δ Old age index 1990-2000 (% p.a.)	---	---	---	---	-0.0592
height difference of municipalities	0.0002	---	---	0.000	---
employed in primary sector	---	---	---	0.0084	---
beds per 1000 inhabitants	0.0001	---	---	9.98E-05	---
Δ SGM 1990-2000 (% p.a.)	-0.0289	---	---	---	---
SGM of each municipality (m)	---	9.45E-08	---	---	---
Subsidies per farm 2000 (€)	---	1.63E-05	-0.0003	1.05E-05	---
Stability index R^2	0.705	0.737	0.755	0.732	0.751

Δ average annual change between 1980 and 2000.
UAA utilised agricultural area
SGM standard gross margin

4.3 Scenarios used to derive the trends of farm abandonment rates

The basic models of Scenar 2020 (baseline scenarios, EC, 2006) illustrated in Table 3 were used to derive alternative scenarios that could help determine the maximum and minimum values of future annual farm abandonment rates (liberalisation and regionalisation options respectively).

The number of operating farms in 2020 was calculated for each scenario. Therefore, the authors defined specific multipliers (Table 4) to indicate, how the independent variables of the regression model could evolve in the future in a 'liberalised' or 'regionalised' context. For a better understanding, a brief summary of the scenarios (EC 2006, p. 98ff.) is presented below.

Trend-extrapolation/baseline-scenario

The agro-structural development patterns observed in the period 1980 – 2000 will continue unchanged until 2020. Policy measures will be primarily based on the outcome of WTO negotiations, which will be strongly influenced by EU proposals. That will further strengthen the second pillar of the Common Agricultural Policy (CAP).

On market side, a balanced approach is pursued, whereby public stocks shall not exceed 1-2% of total domestic consumption, but intervention prices are authorized where they are needed (EC, 2006).

As in the past, the most stable agricultural holdings will be those which specialise in a sector, find a niche (quality products), enlarge or can count on extra income thanks to good economic framework conditions in the region.

Regionalisation scenario

In principle, the agricultural policy measures in the regionalisation scenario aim at a comprehensive conservation of (mountain) agriculture. The tried and tested two-pillar structure of the Common Agricultural Policy (CAP) and the decoupling of direct payments from production will be maintained. Organic farming and smallholder agriculture will play a major role in this scenario (Netzwerk Land, 2010). It is particularly up to them to take care of the multi-functional tasks of mountain farming, including the conservation of cultural landscape and cultural heritage. In this scenario, a high proportion of farms will be involved in part-time farming, since only very few agricultural holdings will have the appropriate size to make a living by marketing their quality products alone.

This scenario – which is indeed the 'best-case scenario' for stabilising mountain farming – assumes that WTO negotiations will not be resumed. Hence, the importance of bilateral trade agreements will grow. At the EU level, between 2007 and 2013 5% of financial resources will be transferred from the first pillar to the second pillar of the CAP by means of gradual cuts (modulation) (EC, 2006, p. 105). However, after 2013, this redistribution will have served its time (Netzwerk Land, 2010).

To make taxpayers accept the allocation of funds to the second pillar of the CAP, the rural development programme will have to be changed, as already discussed by the EU Commission. The three current priority axes (competitiveness, land management, economic diversification and quality of life in rural areas) could be replaced by a list of objectives, and funding would be made dependent upon meeting such objectives (Netzwerk Land, 2010).

Here, one could imagine the introduction of a separate axis for mountain agriculture – with its own budget – under the second pillar of the CAP, as proposed during the mandate of the EU Agriculture Commissioner Mrs. Fischer Boel (Autonomous Province of Bolzano, 2009).

Liberalisation scenario

The liberalisation scenario assumes the completion of the Doha Round, the liberalisation of markets, as well as a reduction of trade barriers and tariff protection for agricultural products in industrial countries (Pomrehn, 2008). This puts mainly the smaller sized farms of the Alpine arc under a stronger adaptation pressure and effects a continuous and dynamic structural change. Even regions that have recorded only moderate farm abandonment rates so far will be involved. As a result, the first pillar of the CAP could be eliminated altogether and the second pillar of the CAP would be greatly downsized (EC, 2006). That would cause a reduction in agricultural subsidies of up to 80% in the EU alone (Pomrehn, 2008). To remain competitive against emerging countries in the field of agriculture and other economic sectors, some environmental provisions would need to be loosened (EC, 2006). At the same time, cuts would occur in the funding under the WTO's Green Box or the EU's Rural Development Programme. That is because these funds until now have been used to pay for unmarketable, multi-functional services such as, among other things, agro-environmental measures, or else to support extensive agriculture. Such actions have had remarkable income effects, but low environmental effects and can therefore be classified as trade-distorting (Ahrens et al., 2000).

It is expected that large-sized farms and farms located in economically vibrant regions will have a comparative advantage. Instead, small farms will lose competitiveness, unless they specialise in a sector, for instance fruit-growing, or can count on non-agricultural income.

4.4 Implementation of the scenarios in the regression model

Taking into account the framework conditions described in the three scenarios, farm trends were calculated anew for the municipalities of each cluster until 2020. To that end, as a first step, a positive-negative scale was used to qualitatively classify indicators for each scenario (Table 3).

Table 4: Multipliers for determining the regionalisation and liberalisation scenarios.

Variable [vj]	REG	LIB
Δ farm < 5 ha (%)	0	--
Δ farm 5-10 ha (%)	++	-
Δ farm 10-20 ha (%)	++	+
Δ farm > 20 ha (%)	0	0
Δ FF (%)	+	0
Δ PF (%)	+	-
Δ UAA per farm (%)	0	+
Δ arable land (%)	0	-
Δ permanent crop (%)	0	-
Δ grassland (%)	const.*	-
Δ life stock density (%)	-	0
Δ Old age index (%)	0	0
height difference of municipalities (m)	0	0
employed in primary sector (%)	0	-
Δ tourist-beds / 1.000 inhabitants	0	0
Δ SGM 1990-2000 in (% p.a.)	+	0
subsidies 2000 (€)	0	--

** The change must be „0“ so that the original variable value remains unchanged.*
Multipliers: -- = -1,0; - = -0,5; 0 ; += 0,5; ++ = 1,0;
Δ: average annual change 1980 - 2000; REG: Regionalisation; LIB: Liberalisation; FF: fulltime Farm; PF: part-time farm; UAA: Utilised agricultural area; SGM: Standard Gross Margin.

Then, for each cluster-municipality (j) the annual changes of the independent variables for the period 1980-2000(v_{ij}) were adjusted to the regionalisation or liberalisation scenario. For the relevant variables (v_i) of each cluster, a coefficient of variation was calculated, that is the percentage variation of the standard deviation ($SDEV_{vi}$) from the mean value (μ_{vi}). This ensures that the newly calculated variable values fall within the standard deviation, with an approximate probability of 68%.

At that point, the value of the data variable (v_{ij}(trend)) for each municipality stated in the trend-extrapolation scenario was multiplied by the coefficient of variation and a scenario-specific multiplier (m_i) (Table 2). By means of these multipliers, one can control the behaviour of the coefficient of variation and determine how it should influence the recalculation of the indicator values in the different scenarios (intensity and direction). So, one or two plus signs (‘+’) or minus signs (‘-’) are used to reduce or increase the rate of change by the half or the full variation coefficient. Instead, a ‘0’ multiplier means that the observed change of the indicator for the period 1980-2000 is the same as that used for the calculations of the scenarios in 2020 (Table 2 & 3). The multipliers therefore reveal nothing regarding the trend of the absolute indicator value of the year 2000. To include multipliers mathematically in the calculation according to the classification, one must consider whether the annual rate of change of the variable in the trend-extrapolation scenario was positive or negative (Table 3).

$$\Delta v_{ij(reg/lib)} = \Delta v_{ij(trend)} + \Delta v_{ij(trend)} \times \frac{SDEV_{v_i}}{\mu_{v_i}} \times m_{i(reg/lib)} \qquad v_{ij(trend)} > 0 \tag{1}$$

$$\Delta v_{ij(reg/lib)} = \Delta v_{ij(trend)} - \Delta v_{ij(trend)} \times \frac{SDEV_{v_i}}{\mu_{v_i}} \times m_{i(reg/lib)} \qquad v_{ij(trend)} < 0 \tag{2}$$

Equation 1: Algorithm to adapt significant variables to the regionalisation- or liberalisation scenario.

The independent indicators of each municipality newly recalculated for the regionalisation or liberalisation scenario [Δv_{ij}(lib), Δv_{ij}(reg)] were employed in the basic regression model to calculate the annual farm abandonment rates for the scenarios identified. These rates were then applied to the farm figures for the year 2000 to derive the estimated number of farms in 2020 for each municipality. Results were aggregated at NUTS 3- (Figure 1) or national/cluster level (Figure 2) to compensate for fluctuating farm numbers at municipal level and facilitate interpretation.

5 Results

The influence of each independent variable on the dependent variable ‘farm abandonment rate’ varies from cluster to cluster. However, the variables ‘share of full time and part-time farming’, ‘utilised agricultural area per farm’ and ‘proportion of arable and pasture land’ play an important role in all clusters (Table 3). Endogenous indicators (‘inside agriculture’) proved to be more appropriate for determining the farm abandonment rate than exogenous indicators (‘outside agriculture’).

The farm abandonment rate varies widely across scenarios (Figure 1). The development pattern from 2000 to 2007 gives a good indication of which scenario is closest to actual trends. For the sake of comparison, the results of each scenario are presented juxtaposed in the graphs (Figure 2, a-e) and maps (Figure 1).

5.1 Characteristics of the scenario results by cluster

As expected, cluster results vary considerably across scenarios. The patterns of the trend-extrapolation scenario are in line with those of the past. By contrast, results scatter remarkably with the different policy approaches of alternative scenarios. Despite the very farm-friendly regionalisation model, farm abandonment rates for the year 2020 are sometimes relatively high in the individual clusters. Although the regionalisation scenario recorded lower abandonment rates than both the trend-extrapolation and liberalisation scenarios in all clusters, the intensity of abandonment is largely uneven (Figure 2, a-e).

The consequences of the liberalisation approach appear to be more realistic. In almost all clusters except in Austria (Figure 2, a: -44%) and Germany (Figure 2, c: -32.2%) the number of farms is expected to drop again by 56% to 64% (Figure 2, b, d and e) until 2020. The current number of farms between 2000 and 2007 (Eurostat, 2009b) is – with the exception of Switzerland, where it is quite in line with the trend-extrapolation – close to the liberalisation scenario. In the German Alps, farm abandonment between 2000-2007 was so high that it even exceeded the estimates of the liberalisation model (Figure 2, c).

Notwithstanding the subdivision into clusters, trends vary remarkably across regions of the Alpine countries. Only minor differences in terms of farm abandonment rates were displayed in Austria’s eastern and western regions. And also none of the scenarios revealed major discrepancies between the NUTS 3-regions in Germany (Figure 1). In contrast, other countries like Italy have witnessed and are still witnessing a heterogeneous agro-structural change in all scenarios (Figure 1). But while the Autonomous Provinces of Bolzano and Trento maintain a relatively stable number of farms, Italy also hosts 7 of 10 NUTS 3-regions with the highest annual farm abandonment rates. Nor is the situation much different in the Switzerland/Liechtenstein cluster or in France. The development patterns produced by the scenarios are very similar to the recorded trend. Differences remain between the northern and southern Cantons in Switzerland. No major changes are observed in France’s development pattern, although the intensity and dynamics of farm abandonment rates have increased once more everywhere, with the exception of Drôme, Isère and Vaucluse (Figure 1).

Trend-extrapolation scenario

The Swiss Cantons on the northern edge of the Alps, Bavaria and Austria, and the Autonomous Provinces of Bolzano and Trento have relatively stable, hardly changing structural conditions (Figure 2). Current farm abandonment rates are assumed to remain unchanged in the future and estimates are made to see whether by extrapolating and prolonging past trends one can realistically forecast the number of farms to be expected in the year 2020. However, with the exception of Switzerland, in no other Alpine country will the agro-structural change match the trend-extrapolation scenario. In fact, between 2000 and 2007 (Figure 1 & Figure 2) all other national clusters saw a significant intensification of the agro-structural change (Eurostat, 2009b).

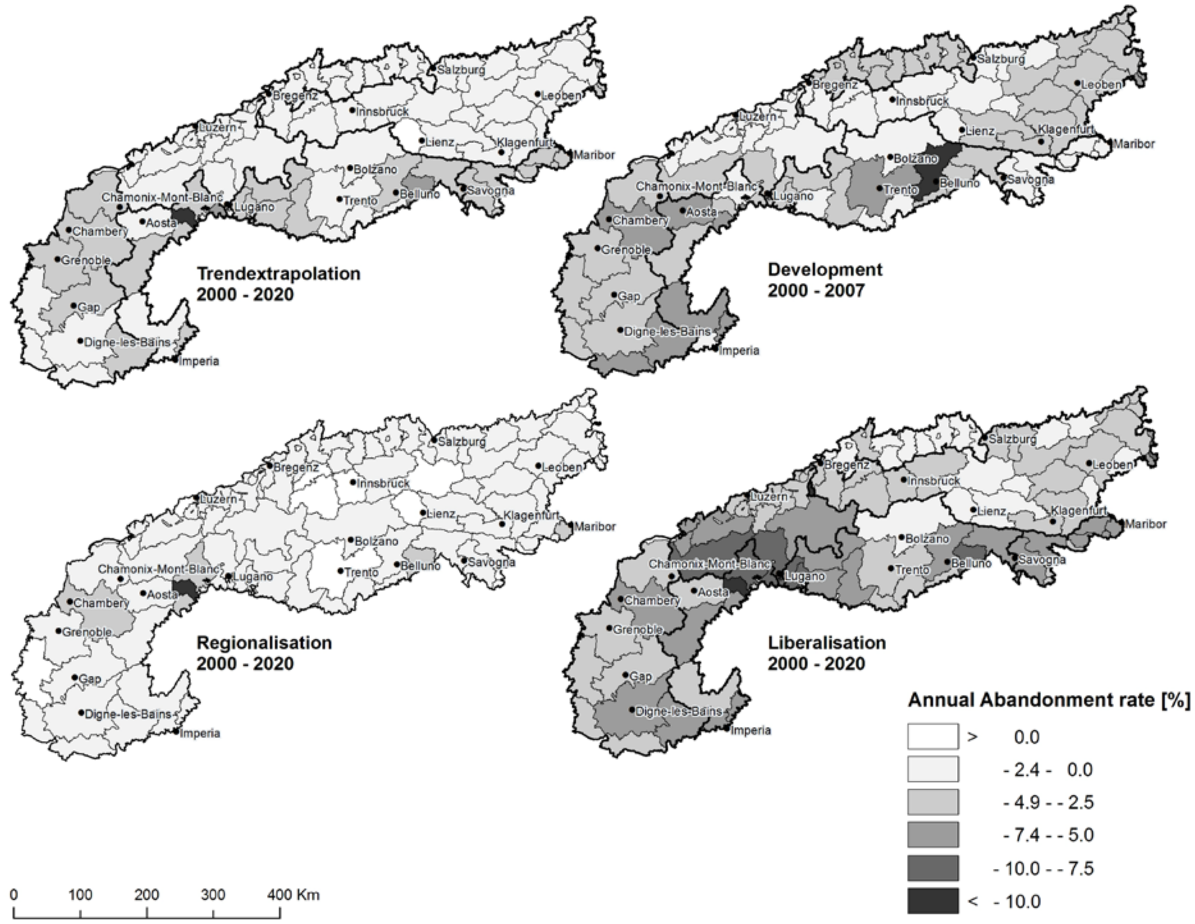


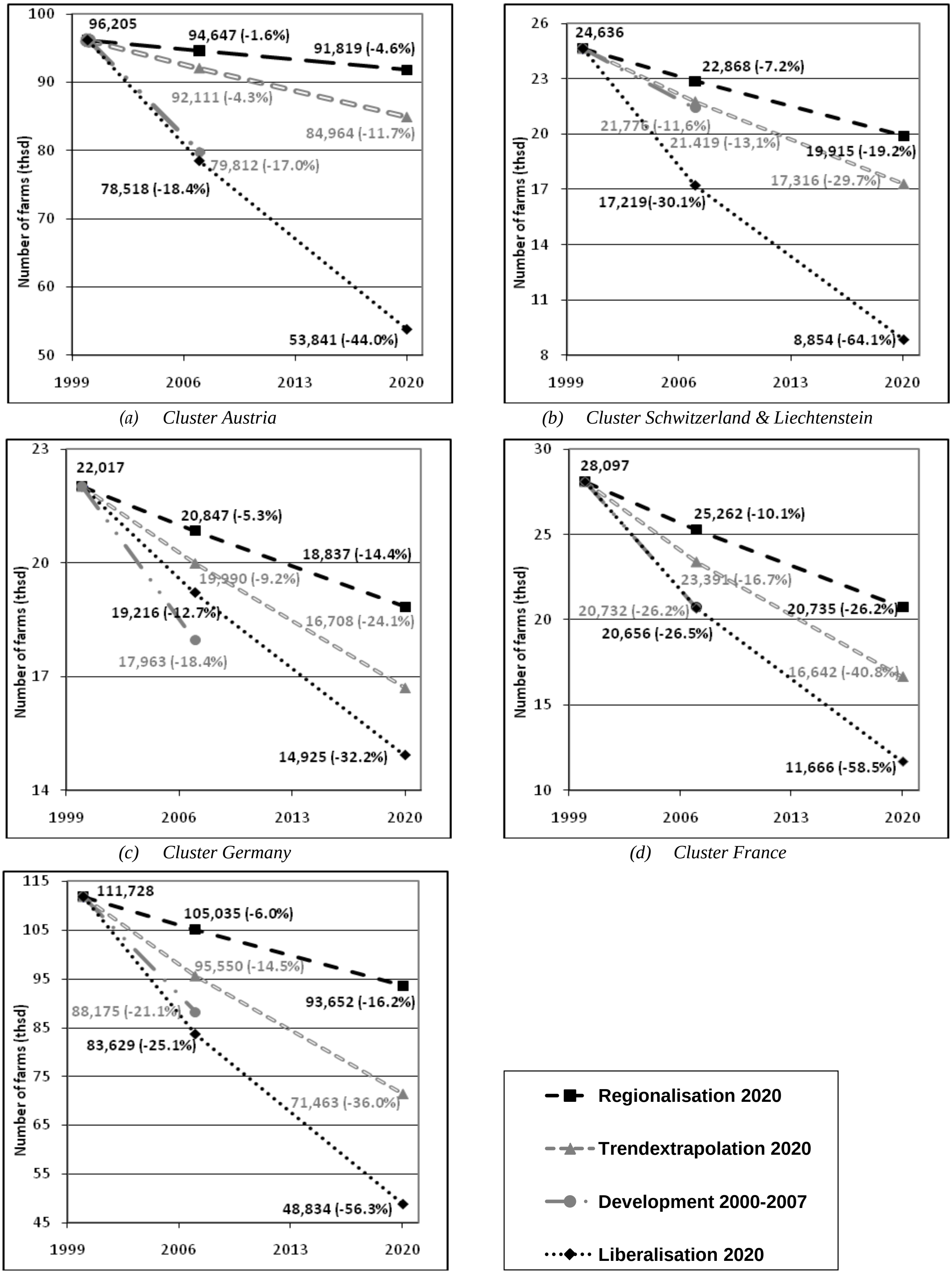
Figure 1: The annual farm abandonment rates in the period 2000-2020 for NUTS 3-regions based on Scenar 2020 scenarios (own representation).

Regionalisation scenario

Keeping current agricultural structures unchanged across the entire Alpine area was considered to be the ideal target from the outset. This approach looks at non-intensive farming as a way to enhance the qualities of mountain agriculture. The main features of this development scenario include: less livestock, preservation of farming as the main occupation or else switching to part-time farming, promotion of direct marketing practices and reallocation of funds to the second pillar of the CAP (rural areas).This regionalisation approach shows clearly once more that under the current market and socio-economic framework conditions a ‘renaissance of small-scale agriculture’ is not viable, neither politically nor economically. Keeping the number of farms unchanged, like in the Austrian cluster, or curbing declines like in other clusters is not feasible, as the current trend is diametrically opposed thereto. The dynamic adjustment and liberalisation trends imposed by the global agricultural market have already gained the upper hand in the Alps (Figure 1 & Figure 2).

Liberalisation scenario

This scenario sees the sharpest agro-structural change and the greatest differences between Alpine regions (Figure 1 & Figure 2). The actual development between 2000 and 2007 recorded higher farm abandonment rates only in Germany (Figure 1 & Figure 2). In this scenario, Austria and Germany stand out for their moderate abandonment rates compared to other Alpine areas. The number of farms in Switzerland drops remarkably. Farm abandonment is still high in the Italian and Slovenian Alps, where the trend continues. Also in France the number of farms is expected to decline sharply.



(a) Cluster Austria

(b) Cluster Schwitzerland & Liechtenstein

(c) Cluster Germany

(d) Cluster France

(e) Cluster Italy & Slovenia

Figure 2: Number of farms – Trends for the period 2000 – 2020 in national clusters according to the different scenarios, compared to the 2000 – 2007 development (own representation).

6 Discussion

The scientific community has questioned the validity of the farm abandonment rate as the unique indicator for the agro-structural change. For a more accurate analysis of the structural change Baur (1999) recommends combining indicators related both to factors of production and farm demographics so that changes in the number of farms can be investigated in relation to productive inputs and income distribution. Features like the size of the farm, the ownership structure and type of income (full or part-time farming) are considered in this case. As the model presented here determines farm abandonment rate by means of a variety of geographical, farm-related, demographic and socio-economic indicators, the consequences of the agro-structural change are related to the impact of these independent variables. Unfortunately, some additional indicators were only available at NUTS 2- or NUTS 3-level. Had they been also accessible for the municipal level, statements concerning the agro-structural change would have been more detailed and comprehensive.

However, rather than concentrating solely on farm abandonment, one could look also at the changes in the utilised agricultural area, as that would better highlight development patterns connected to the area rather than mere socio-economic changes.

Indicators used in the simulations were derived from the censuses of the period 1980 – 2000. The methodological decision to use census data collected every ten years at municipal level by the national statistical institutes prevented the integration of more recent data at NUTS 3-level, from Eurostat surveys for instance. Analyses at municipal level (LAU 2) allow a more detailed representation of site-specific differences.

The farm abandonment rates were estimated using a linear regression model, without taking into account any radical agricultural policy disruption, which, however, is likely to occur. Therefore, subjectively assessed multipliers were introduced, which represent an estimation of future trends in agricultural policy, the economy and the socio-economic environment. These multipliers help to describe how significant indicators might develop in the Scenar 2020 policy scenarios (chapter 4.4).

Undoubtedly, trends shown in the simulations depend on the qualitative assumptions of the authors. Independently of that, the standard deviation to mean value ratio (variation coefficient) plays a decisive role for adjusting the independent indicators to the scenarios. If the standard error to mean value ratio was for instance used instead of the variation coefficient, the scenario results would not have been so clearly differentiated. The differentiation between scenarios depends upon the definition of multipliers (Table 4) and the selection of the statistical measure (Equation 1).

Some open questions remain: how can one add objectivity to the methodological approach? How can the political measures assumed in the scenarios be transformed into indicator values (valuation) more objectively?

In this initial study, the substantive and methodological foundations of the model were developed, based on which, further refinements of the model can now be made. This paper has shown how the agro-structural change, a complex phenomenon which is dependent on many factors, can be analysed and visualised on a municipal level for the entire Alpine region. For the future it has to be assessed, whether other methodological approaches may help to forecast changes of the utilised agricultural area, or livestock density so that the agro-structural change can be analysed in a more detailed way.

7 Conclusion

For the first time, future trends of the agro-structural change in the Alps were forecasted for the municipal level using cross-regional models for five clusters. Regression analyses applied to municipal data bases allowed to fill the gaps left both by Scenar 2020, whose spatial scale was too small, and by the detailed farm-related studies (Agent based modelling) conducted at regional level. Based on the harmonised municipal data base of the EURAC project AGRALP, farm abandonment rates for each municipality and scenario were estimated until 2020 and aggregated at NUTS 3-level (Figure 1).

Results show which agro-structural changes can be expected in the Alps by 2020. Surprisingly, some of them are already visible today. For instance, the liberalisation scenario (Figure 2), which is marked by difficult framework conditions for the agricultural sector, foresees a sharp reduction in the number of farms. The trends revealed by this scenario closely match those already recorded in the Alpine regions (Development 2000-2007) of Italy, Southern Switzerland and France, to an extent that was not expected. Only partly they are contrary to the current development, as it is the case in the Alpine area of Central Switzerland and Western Austria (Figure 1 &Figure 2).

The next census of agricultural holdings 2010/2011 will show whether the estimates produced by the models differ from the actual trends and whether the observed congruence with the liberalisation scenario will be confirmed.

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