



European
Commission

JRC SCIENTIFIC AND POLICY REPORTS

Assessing the risk of farmland abandonment in the EU

Final report

JM TERRES – L NISINI – E ANGUIANO

2013



Report EUR 25783 EN

Joint
Research
Centre

European Commission
Joint Research Centre
Institute for Environment and Sustainability

Contact information

JM TERRES

Address: Joint Research Centre, Via Enrico Fermi 2749, TP 266, 21027 Ispra (VA), Italy

E-mail: jean-michel.terres@jrc.ec.europa.eu

Tel.: +39 0332 78 9000

<http://mars.jrc.ec.europa.eu/>

<http://www.jrc.ec.europa.eu/>

This publication is a Reference Report by the Joint Research Centre of the European Commission.

Legal Notice

Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

Europe Direct is a service to help you find answers to your questions about the European Union
Freephone number (*): 00 800 6 7 8 9 10 11

(*): Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server <http://europa.eu/>.

JRC78131

EUR 25783 EN

ISBN 978-92-79-28281-2 (pdf)

ISSN 1831-9424 (online)

doi: 10.2788/81337

Luxembourg: Publications Office of the European Union, 2013

© European Union, 2013

Reproduction is authorised provided the source is acknowledged

Front page picture: courtesy of SOLAGRO

Printed in Italy

Acknowledgement

This report was prepared by JM Terres with the support of L Nisini and A Wania from the MARS unit of the Institute for Environment and Sustainability, Joint Research Centre (JRC), European Commission.

Some parts of this report such as the identification and definition of relevant drivers of land abandonment and the establishment of the supporting expert panel are based on previous worked carried-out by E Anguiano who initiated this study (unfortunately for us ☺) but moved to DG AGRI before the end of the project.

Contributions in terms of suggestions and feedbacks have been gratefully received from M Ambar, A Buckwell, A Coppola, E Corbelle, K Hart, H Kallstrom, A Gocht, P Pointereau, D Strijker, L Vranken, A Zobena, as members of the expert panel set-up by the JRC for this study.

Data from the Farm Accountancy Data Network have been kindly and swiftly provided by DG AGRI.L3 unit (micro-economic analysis) under a signed agreement between DG AGRI and JRC [ARES(2012)105995]. Many thanks to T Vard and J Lazzaoui for their advices and suggestions on the use of FADN data.

The authors would like to express their sincere gratitude to L. Visek from DG AGRI.G1 for his guidance and the good working relationships which took place along this project.

List of Abbreviations

AA	Administrative Arrangement
AEI	Agri-Environmental Indicators
AEM	Agri-Environmental Measure
CAP	Common Agricultural Policy
CI	Composite Index
CLC	Corine Land Cover
DG AGRI	Directorate General for Agriculture and Rural Development
DG ENV	Directorate General for Environment
DG ESTAT	Directorate General for Eurostat
EEA	European Environment Agency
EC	European Commission
ESU	European Size Unit
EU	European Union
FA	Factor Analysis
FADN	Farm Accountancy Data Network
FAO	Food and Agriculture Organisation (United Nations)
FAS	FARM Advisory Service
FLA	Farmland Abandonment
FSS	Farm Structure Survey
GDP	Gross Domestic Product
IRENA	Indicator Reporting on the Integration of Environmental Concerns into Agricultural policy
JRC	Joint Research Centre
LAU2	Local Administrative Unit (level2)
LFA	Less Favoured Area
MoU	Memorandum of Understanding
MS	Member State
NUTS	Nomenclature des Unités Territoriales Statistique
OECD	Organisation for Economic Co-operation and Development
PCA	Principal Components Analysis
PDO	Protected Designation of Origin
PGI	Protected Geographical Indications
RD	Rural Development
RDP / RDM	Rural Development Programme / Rural Development Measure
FT	Farm type
UAA	Utilised Agricultural Area

AT	Austria	ES	Spain	MT	Malta
BE	Belgium	FI	Finland	NL	Netherland
BG	Bulgaria	FR	France	PL	Poland
CY	Cyprus	HU	Hungary	PT	Portugal
CZ	Czech Republic	IE	Ireland	RO	Romania
DE	Germany	IT	Italy	SE	Sweden
DK	Denmark	LT	Lithuania	SI	Slovenia
EE	Estonia	LU	Luxemburg	SK	Slovakia
EL	Greece	LV	Latvia	UK	United Kingdom

SUMMARY

An expert panel of 12 European scientists in fields related to land abandonment (bio-physical / land suitability, farm structure, farm economics, land market, regional development, socio and economic factors in rural areas) and representative for the EU27 Member States were tasked to identify main drivers of farmland abandonment in Europe. Two sets of criteria for assessing the risk of farmland abandonment have been suggested as follow:

For low farm stability and viability

This was estimated through drivers on ‘low farm income’ (D2), ‘lack of investments on the farm’ (D3), ‘farm-holder’s age’ (D4), ‘farm manager qualifications’ (D5), ‘low farm size’ (D8), ‘commitments taken by farmers in specific management scheme’ (D9).

For negative regional context

This was estimated through indicators on ‘weak land market’ (D1), ‘low population density and remoteness’ from market opportunities and services (D7).

Each of these drivers was calculated individually; an assessment was done to provide relevance and robustness of results, corresponding maps were produced.

The results suggested a first group of useful drivers (policy relevance, analytical soundness, data availability and robustness) composed of: ‘weak land market’ (D1), ‘low farm income’ (D2), ‘low density population and remoteness’ (D7).

The second group of drivers with ‘lack of investments on the farm’ (D3) and ‘farm-holder’s age’ (D4) were policy relevant but reliability was lower when using European datasets.

The third group of drivers (‘farm manager qualifications’ (D5), ‘low farm size’ (D8), and ‘commitments taken by farmers in specific management scheme’ (D9)) showed some deficiencies in analytical soundness and/or data reliability. They were not further used in the analysis.

In order to produce a risk indicator of ‘farmland abandonment’, **composite indices** (gathering several drivers into one value) were developed based on the normalised values of the individual drivers. The normalisation procedure was performed at two different levels: (a) EU27 level as an attempt to elaborate a risk index covering EU27 in an homogeneous manner; and (b) MS level. In the latter case, the assumption is made that one cannot compare, in absolute value, situations from MS having heterogeneous economic and structural developments of their agricultural sector (e.g. regions in new MS versus western European regions). Drivers were accordingly normalised for each MS separately.

For the composite indices, further analysis was done at NUTS2 level to found-out in those flagged with a higher risk of farmland abandonment the most occurring farm-types. It results that the higher risk occurs in areas with high proportions of permanent crops (in Mediterranean countries) or permanent grasslands (livestock farming systems).

Table of Contents

Summary.....	3
1 Introduction.....	7
2 Background and policy context	8
2.1 Development of agri-environmental indicators.....	8
2.2 The indicator on Farm Land Abandonment (FLA).....	9
3 Literature review: Characterisation of farmland abandonment	10
3.1 Scene setting.....	10
3.2 Risk of farmland abandonment: driving forces.....	11
4 Coordination of the expert panel for the risk of farm Land Abandonment indicator	17
4.1 Description of the expert panel	17
4.2 Proposed definition of ‘Farmland abandonment’	20
4.3 Indicators review	21
4.4 Methodological factsheets for each selected criterion	22
5 Review process for European datasets to assess farmland abandonment.....	23
5.1 Farm Accountancy Data Network (FADN)	23
5.2 Farm Structure Survey (FSS)	26
5.3 Geo-spatial datasets.....	27
6 Methodological development, data analysis and results.....	29
6.1 Methodology for individual drivers	29
6.2 Data analysis and results (including maps).....	29
D1: Weak Land Market	29
D2: Low Farm Income.....	35
D3: Low investment level in the farm	41
D4: Age of farm holder (>65 years)	45
D5: Low farmer qualification	48
D6: Previous trend of Farmland abandonment	51
D7: Remoteness / low population density	51
D8: Low farm size	57
D9: Farm enrolment in Specific Schemes	64
6.3 Methodology combining drivers into a Composite index.....	67
6.4 Composite index results	71

Normalisation at EU level.....	72
Normalisation at national level	77
7 Discussion.....	83
8 Conclusions.....	84
References.....	86
ANNEXE A: Drivers factsheets (drafted by the expert panel).....	90
ANNEXE B: FACTSHEET AEI14 ‘Risk of Farmland Abandonment’	114
ANNEXE C: List of Excel tables with results for each driver	125
ANNEXE D: Technical note on the feasibility of downscaling the Land Abandonment Analysis from level 2 to level 3 in the NUTS system.....	126

1 INTRODUCTION

This report is the final deliverable of the Administrative Arrangement #AGRI-2011-0295 between DG Agriculture and Rural Development (DG AGRI) and the Joint Research Centre (JRC). Under this arrangement, DG AGRI entrusts the JRC with the execution of a research project entitled **“Study on farmland abandonment”**.

The purpose of this Administrative Arrangement (“AA”) is to provide technical assistance to ensure progress in the conceptual and methodological improvements of the indicator “Risk of Farmland Abandonment (FLA)” through carrying-out various tasks related to literature review, experts consultations, data collection and processing, data analysis, mapping and reporting.

The final report incorporates all deliverables of the study, including:

- The description of the updated methodology applied and related difficulties encountered;
- The full results derived from the finalised methodology;
- An ad-hoc technical report on the feasibility of downscaling the analysis from NUTS2 to NUTS3 level
- Conclusions for the establishment of the indicator ‘Risk of Farmland Abandonment’.

2 BACKGROUND AND POLICY CONTEXT

2.1 DEVELOPMENT OF AGRI-ENVIRONMENTAL INDICATORS

The Cardiff European Council (June 1998) endorsed the principle that the environmental dimension should be integrated in all Community policies. It also stressed the importance of developing appropriate environmental indicators to assess the impact of different economic sectors – including agriculture – on the environment, and to monitor progress in integrating environmental concerns.

The Helsinki European Council (December 1999) adopted the strategy for integrating the environmental dimension into the CAP. The strategy sets environmental integration objectives for water, land use and soil, climate change and air quality, as well as landscape and biodiversity, affirming that the preservation of natural resources is an essential element for the long-term sustainability of agriculture. In its conclusions, the Council requested a regular reporting on progress in integration, based on agri-environmental indicators.

The Göteborg European Council (June 2001) endorsed the conclusions of the Agriculture Council (April 2001) on environmental integration and sustainable development in the CAP, inviting the Commission to regularly monitor and evaluate the Council's integration strategy, and calling upon the Commission to continue its efforts to further improve the set of agri-environmental indicators and to define the statistical needs for these indicators.

In response to the Council's requests, the Commission issued two Communications. The second Communication [COM(2006)508] "Statistical Information Needed for Indicators to Monitor the Integration of Environmental Concerns into the CAP" elaborated further on the indicator concept and identified potential data sources and information needed to make the indicators operational.

In December 2006, the "Agriculture and Fisheries Council" adopted Council conclusions that welcomed the progress made through the IRENA operation and gave a broad mandate to the Commission for continuing the work on the indicators along the lines proposed in COM(2006)508, in close cooperation with the relevant institutions of the Member States.

The primary aim of the system of agri-environmental indicators is to help fulfilling the Commission's information needs:

- for the assessment of the impact of the agricultural policy decisions on the environment, so as to identify shortcomings in current measures and needs for new policy initiatives and, where appropriate, to improve the targeting and tailoring of the measures to local conditions,
- concerning agri-environmental trends that may impact on natural resources and have implications for the environment and for other EU policy fields and
- for the evaluation of the efficacy of the integration strategy, with a view to adjust and deepen it if necessary.

As a follow-up, a Memorandum of Understanding (MoU) for Agri-Environment Indicators (AEIs) was signed by DG AGRI, DG ENV, DG ESTAT, JRC and the EEA with the aim of establishing the basis for cooperation amongst the partners to develop, consolidate and maintain a coherent

system of indicators. A comprehensive assessment of the work carried out will be undertaken every three years, coordinated by ESTAT.

The partners to the Memorandum of Understanding have agreed to pool a number of skills and resources, contributing to:

- (i) consolidating the selected set of 28 agri-environmental indicators listed in COM(2006)508 and extending their coverage to the new Member States;
- (ii) Correcting the existing weaknesses that currently restrict the usefulness of certain indicators;
- (iii) Establishing a permanent and stable arrangement needed for the management and long-term functioning of this indicator system.

2.2 THE INDICATOR ON FARM LAND ABANDONMENT (FLA)

Various concerns have been raised that reductions in EU support to agriculture and reforms of trade policy will lead to widespread land abandonment across the EU with negative environmental and social consequences. In fact, this case was made strongly during the 2003 reform process where, as noted by the European Commission¹ some Member States considered that full decoupling of support from production could lead to several risks such as the abandonment of production, the lack of raw material supply for processing industries, or to social and environmental problems in areas with few economic alternatives.

Moreover, the change of political system in central and eastern European countries from 1990 onward triggered the process of land privatization with the dismantling of collective farms. This may have led to land abandonment as (i) property rights were not always well established and (ii) many cases of co-ownership or unknown owner, leading to non-functioning land market. All these resulted often in high fragmentation and small size of agricultural plots and holdings, not allowing profitable and commercial farming to develop.

These changes in political situations raised the risk of Farm Land Abandonment and triggered its inclusion in the list of 28 agri-environmental indicators to be developed under the Memorandum of Understanding for Agri-Environment Indicators by DG AGRI, DG ENV, DG ESTAT, JRC and the EEA.

One should remind that the indicator on the risk of land abandonment has replaced the indicator on marginalisation developed during the IRENA operation. Thus, the approach has changed even if farmland abandonment is a phenomenon commonly associated with marginalisation as a potential outcome (Baldock et al, 1996 and Bethe et al, 1995).

¹ See CAP Health Check proposals http://ec.europa.eu/agriculture/healthcheck/prop_en.pdf

3 LITERATURE REVIEW: CHARACTERISATION OF FARMLAND ABANDONMENT

3.1 SCENE SETTING

Land abandonment has long been a contentious issue within Europe (for example see Pointereau et al, 2008; Brouwer et al, 1997; Baudry 1991). In part, as noted by Keenleyside and Tucker (2010) and others, this is because it has proved difficult to define, measure and study. For example, Moravec and Zemeckis (2007) note that there is no single definition of the terms “land abandonment” or “abandoned land”, with different interpretations between each legal or scientific text. The lack of consistent measurement across the EU means the current extent of abandonment is not known (Pointereau *et al*, 2008). However, whilst the exact extent may not be documented, it is clear that substantial areas of the EU have been affected by agricultural abandonment, however defined. This is largely a result of declines in the viability of extensive (low input) and small-scale agriculture systems (Baudry, 1991; Pinto Correia, 1993).

As summarized by the FAO, the reasons for abandonment of land are multidimensional and can be differentiated as follows: natural constraints, land degradation, socio-economic factors, demographic structure, and institutional framework (FAO, 2006, p2). Whatever the cause, abandonment is of concern to policy makers and others because of its negative social, economic and environmental associations (Moravec and Zemeckis, 2007). For example, in southern Europe a major environmental concern is the fire risk associated with abandoned land. In more northern and central parts of Europe, loss of farmland biodiversity is seen as a key environmental concern (see for example Baudry, 1991). More broadly, land abandonment is intimately linked with the wider issue of rural depopulation, whereas in Eastern Europe, widespread abandonment was associated with the transition process (Keenleyside *et al* 2005).

Whilst land abandonment is often viewed negatively, it is not always clear that land abandonment is detrimental. For example, in terms of nature conservation, Keenleyside and Tucker (2010) note: “In many circumstances abandonment may be damaging as it will threaten a range of semi-natural habitats and associated species of nature conservation importance, many of which are concentrated in Natura 2000 sites and other High Nature Value (HNV) farmland. But in some locations, abandonment could be highly beneficial, particularly in highly fragmented landscapes and where it could provide the opportunity for significant large-scale restoration of non-agricultural habitats (e.g. re-wilding).” (Keenleyside and Tucker 2010 p1)

As related by Renwick et al (2011), there is a fear that agricultural and trade reforms will reduce the economic viability of farming in Europe and lead to further abandonment of the more marginal agricultural areas. A number of studies have attempted to analyse the issue of land use under a range of future scenarios. The results of these studies suggest that there is likely to be significant levels of farmland abandonment in Europe over the next 20 to 30 years. In general, the highest projected levels of abandonment are simulated for scenarios that anticipate high levels of global competition in agriculture, and low levels of CAP support for extensive farming. However, still significant abandonment is also projected under scenarios with reduced global competitiveness, high levels of support for agriculture and the environment and strong regulations. Consequently, this is likely to call for some policy response.

Existing model projections are constrained by available data and uncertainty over future socio-economic developments and policy decisions (Renwick et al, 2011). The models are also deterministic and assume that land owners take decisions primarily on the basis of economic signals with little time lag. In reality it is clear that landowners will often continue uneconomic farming (by supplementing incomes in other ways) for a variety of social and cultural reasons (Renwick and Revoredo-Giha, 2008). On the other hand, some factors not directly included in the scenarios may result in underestimation of abandonment such as the effects of on-going natural constraints, rural depopulation and climate change.

3.2 *RISK OF FARMLAND ABANDONMENT: DRIVING FORCES*

Once the preliminary definition is established, the objective is to evaluate the risk of farmland abandonment. The methodology is not based on reporting on past or current situations but on the probability of occurrence. The objective is to analyse the leading causes more than getting a picture of the farmland already abandoned. Methodologies based on e.g. the UAA decrease have shown their limitations (see JRC report EUR 23411EN-2008) when the estimate of the risk of FLA was based on the continuation of an observed trend. Nevertheless, outcomes of this report could be useful to validate the final set of driving forces. To carry out a risk assessment exercise, the main determinants of the farmland abandonment must be identified. In addition, related indicators must be built to assess trends and provide an early warning.

As land abandonment is a complex multi-dimensional process with interlinked economic, environmental, social aspects, the task to find out a simple and realistic method to elaborate a set of indicators addressing the risk of farmland abandonment is not straightforward. Moreover, much of the political significance of change in land use derives from local context and there is no clear-cut division among factors which could affect FLA; as it rather depends on the result of their interactions (Coppola, 2004; Bethe and Bolsius, 1995). Consequently, it is proposed to consult a group of experts on this topic with the objective to identify the weight and the thresholds to be given to the sub-indicators.

The issue of FLA carries a different weight and different drivers in individual countries and also within each country. In Western Europe, the problem tends to be minor, or even negligible; while in southern and Eastern Europe it is more important (Moravec and Zemeckis, 2007). It should be acknowledged that the phenomenon of farm land abandonment can evolve rather quickly, especially in the new EU Member States. For instance, their integration in the EU has brought important changes in the socio-economic situation of their rural areas through the implementation of EU policies such as agriculture, but also the regional, structural and social instruments. On top of these, there are some global drivers influencing food, biomass (energy or other) and land demands which may change the current picture of land-use very quickly.

But even if the scale of the phenomenon (size, proportion) varies between regions and countries, potentially influencing the definition of the land abandonment or the political importance given to the issue, examples have shown that land abandonment can occur everywhere even in areas with good yield potential, and even in a satisfying general economic situation (Strijker, 2005).

The literature review shows recurrent determinants of farmland abandonment which we can classify into three blocks:

(i) Block1: Poor environmental / biophysical suitability for agricultural activity

DG AGRI proposed to use the set of bio-physical criteria established by the JRC² to support the delimitation of areas with significant natural constraints (new delimitation) as a starting platform for the designation of areas at risk of farmland abandonment before refining the picture with socio-economic indicators.

Compared to the current LFA scheme (art.19 of the Council Regulation No 1257/1999), it offers the advantage to be methodologically consistent at the EU scale (current art.19 entails differences at MS level in the indicators used for LFA delimitation, high variability of LFA coverage between countries, etc.) and it addresses only the environmental and biophysical aspects (while art.19 includes also socio economic factors) which will give more flexibility in the risk assessment.

It must be stressed that, in June 2009, the Council recognised the biophysical criteria proposed by the Commission for future LFA designation and Member States were invited to carry out simulations and apply the appropriate fine-tuning in order to refine the new delimitation of intermediate LFAs. Moreover, the Commission tabled in Oct. 2011 the legal proposal for Rural Development policy (2014-2020 period) which includes the list of bio-physical criteria for newly delimiting areas with natural constraints. This exercise is on-going and final results will serve to improve the indicator.

(ii) Block2: low farm stability and viability

The main determinant regarding the farm viability is its economic situation. Farmland is typically abandoned as an economic resource when it ceases to generate an income. Although this is not a sole cause, and although it can be triggered by a number of factors (described in/by the other indicators), there is a strong link and farm income plays a prominent role in the farmer's strategy regarding land use. According to the FADN report 2008³, holding's income is measured by estimating the Farm Net Value Added (FNVA), which represents the remuneration of all production factors (land, capital and labour). It is obtained by deducting total intermediate consumption (farm-specific costs and overheads) and depreciation from farm receipts (total output and public support). Thus, it represents the **economic performance of the farms** from which, for instance, wages, rents and interests still need to be paid and own labour and capital need to be remunerated. When expressed per annual work unit (AWU) it takes into account differences in the labour force to be remunerated per holding.

The IRENA indicator on Marginalisation considers that farming generates low profitability in areas where 40% of holdings have a Farm Net Value Added per Annual Work Unit (FNVA/AWU) that is below 50% of the average FNVA/AWU of the region. However, in the agricultural sector, the rule of profit maximisation is not always true and it cannot be made

² Definition and justification of criteria: <http://agrienv.jrc.ec.europa.eu/lfa.htm>

³ http://ec.europa.eu/agriculture/rca/pdf/report_2008.pdf

reference only to strictly economic variables to explain Farmland abandonment (Coppola, 2004). Schmitt (1997, quoted by Strikjer, 2005) reminds also that farmers will only leave agriculture when their income becomes very low since there are many reasons for this as e.g. the strong preference for being a farmer or the lack of gainful alternatives for their land, machines, buildings, and labour.

The **share of CAP subsidies in the income** may be an indicator of instability considering that the holding can largely depend on EU support to maintain its activity. Even if premiums are based on a long term agreement, the assessment of the risk of farmland abandonment could be biased if a high share of farm income is based on subsidies. Some policy instruments ensure that farmers receiving public support will be less prone to abandon land when they carry a commitment on the land (e.g. farmers committed for at least five years in the agri-environmental measures etc.). This was also confirmed by Renwick et al. (2011) through modelling various policy scenarii.

Investments on the farm could additionally be a relevant indicator of the farm dynamism, its adaptation capacity and forward-looking strategy. New investments are a signal of a medium/long term strategy and can be a proxy of the willingness to continue farm activity, while low level of investment might be indicating a farming activity in decline.

Less intensive use (Standard Gross Margin/UAA)⁴ of the land is one step toward marginalisation which may lead to farmland abandonment, as identified by Baldock et al (1996). However, extensive holding management is a farming system that can be economically viable. Thus, this sub-indicator should be understood in this context as the decrease of farming intensity, which will lead generally to a lower competitiveness and profits.

The agricultural sector is characterized by household farms and the productive activity is highly influenced by the life cycle of the farmer and of his/her family. Some studies (Kristensen et al., 2004) highlighted the relationship between **farmer's age** and landscape changes. In particular, other factors being constant, farmland extensification and abandonment are more likely to occur when the farmer is old and close to retirement. The number of farmers nearing **retiring age** may reflect the expected transition of the land and its structure in a period of 10 years (Baldock et al, 1996). Additionally, the proxy can become more significant if the information about **succession** is known (percentage successor farmers). Potter and Lobley (1996) identified a direct effect in farm management. The investment indicator could, in this regard, be a proxy in succession probability. Moreover, if the holding has a low economic viability and inappropriate structure, the succession possibility will be low. That would be especially true if there are other working opportunities in the area. **Alternative employment opportunities** in other sectors, as well as **low proportion of full-time farms** are factors which increase the probability of abandonment (Rickebusch et al, 2007). Trends in these issues will indicate a change in the farming activity and in land use. There could be areas with a well-established and stable system where farmers could be part-time employed in other sector. For instance, in its analysis of marginalization in Denmark, Bethe and Bolsius (1995) stressed that part-time was often a necessity although this criterion was given a low weight.

⁴ The Standard Gross Margin (SGM) is the difference between the standardised monetary value of gross production and the standardised monetary value of certain costs.

Training, information and advice are important to be able to adapt to changing socio-economic circumstances (Baldock et al, 1996). According to Dellapasqua (2010 – personal communication), the risk of land abandonment decreases with the increase in the level of education/training and use of advisory services. Equally, the literature suggests that to maintain and/or achieve a sustainable land use that is adapted to the specific regional conditions, a thorough training of agricultural advisors is particularly required (Mishra et al, 2010). The advisory training should incorporate the promotion of appropriate environmentally friendly farming techniques. In some examples (e.g. Ireland), MS have introduced educational voluntary schemes with the stated objective of protecting against land abandonment. Farmers' training levels are highly variable between Member States. Many farmers do not have the skills necessary to take advantage of the potential of the new environment for innovation, provision of environmental services, diversification, and development of local services or bio-energy production. These shortcomings can increase the risk of land abandonment. An effective advisory system could lead to better farming strategies and higher managerial skills. In other words, it could contribute to the farm stability and its development on the mid and long term.

Farm “physical” structure can also be a handicap in farm viability. As it has been mentioned before, it can constitute an obstacle to succession, especially in new EU MS. At the farm level, **small parcels, far** (distance) from the farm are more likely to be abandoned than those well **accessible** and large plots, due to high transportation and labour costs. Farmers of small or medium size parcels of land are more likely to have difficulties to access to certain production inputs, formal credit and other institutional services required to increase competitiveness. Extreme **fragmentation** of the holding is also an indication of an inappropriate farm structure related to higher cost management. Low parcel size could also reduce the capacity of adaptation.

Finally, the **land tenure** could influence the investment and holding dynamism if a long-term perspective is not ensured. A large proportion of tenant-farmed agricultural area can indicate a tendency of instability; however this should be seen in a regional/national context as property laws and local usage varied a lot from MS to MS and play a strong role.

(iii) Block3: negative drivers from regional context

At regional level, an imbalanced economic development between sectors (agriculture, industry, services) may be source of transfer of labour forces. Risk of farmland abandonment may increase when the **agriculture income** is substantially below that of the rest of the economy (regional income). This tendency would be reinforced with the increase of opportunities outside the agricultural sector. Therefore, the evolution of the **employment structure** (% of people employed in the agricultural sector) could be a good proxy. A relative low value added per agricultural worker is a strong incentive to leave agriculture for a better job, which seems to be geographically not too far away. This should be seen in combination with the re-structuring process of the remaining farms, i.e. if the remaining farms are not increasing their size, there is a risk of land abandonment. While proximity of urban centres makes it possible to combine farm-work with a second job (so continuation of farming through part-time work), a long distance leads to higher risk of land abandonment (Terluin et al., 2010).

External factors such as labels for quality products could have positive effect on the stability of farming activity. If Baldock et al (1996) stated that **Protected Designation of Origin (PDO)**

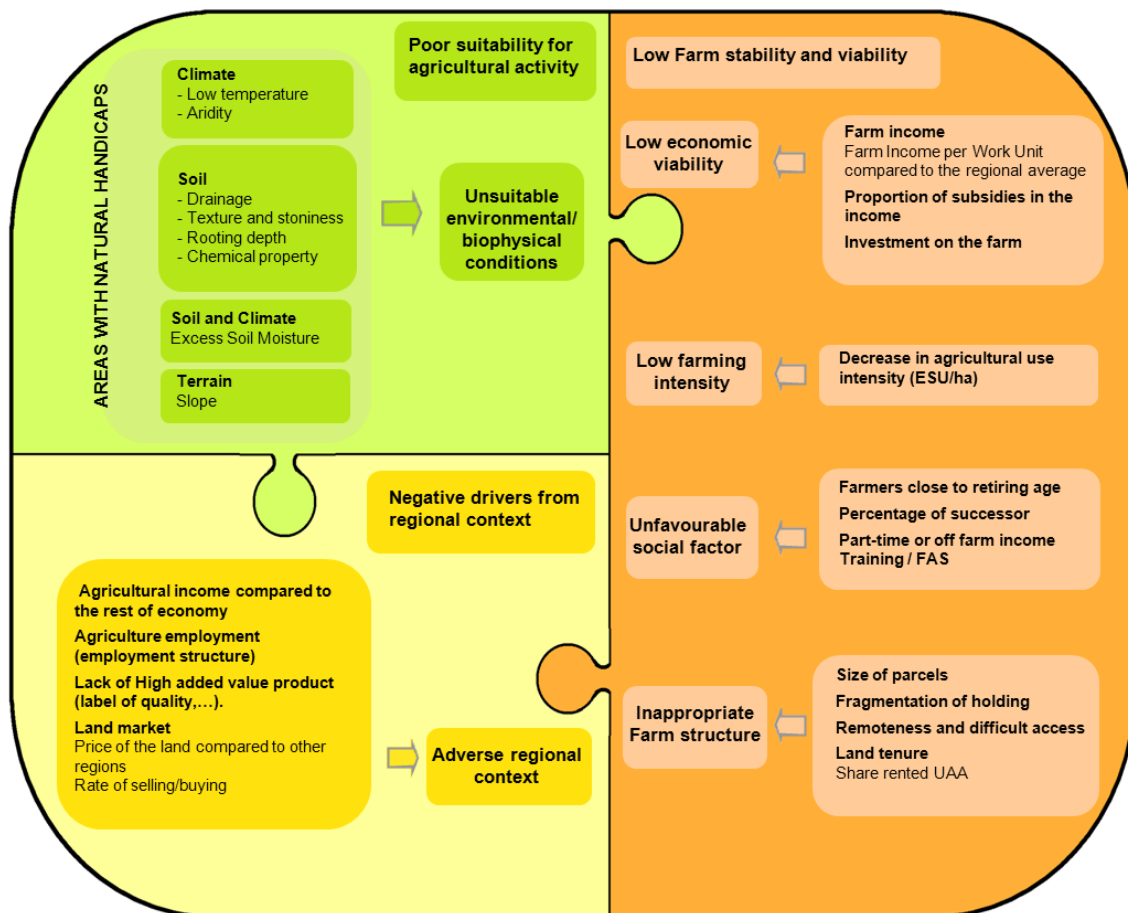
allows producers to increase their income, the study on the Evaluation of the CAP policy on PDO and Protected Geographical Indications (PGI) stressed that the selling price can be better but sometimes production costs are also higher (London Economics, 2008). Nevertheless, producers of PDO/PGI located in remote areas see greater benefits of the scheme in terms of visibility, profitability and reputation of their business and small producers of PDO/PGI see a greater impact of the scheme in terms of the stability of their business. Some PDO/PGI products require specific farming practices linked to land-use management and therefore a link can be established between labelled products and the maintenance of specific (traditional) landscapes (Gauttier, 2006; Paracchini et al, 2011). Production of such products may be a key element to prevent land abandonment. Furthermore, production of high value added products stimulate development of collective marketing initiatives in developing communication with consumers. Conversely, Marescotti (2003) showed that (i) PGI/PDO products could be the result rather than the cause of the development of rural areas and (ii) the presence of PDO products can limit in some ways the intensification of the farm system.

However, the lack of recognised **labels** generally indicates a lower promotion of the agricultural product, less market opportunity and less farm stability.

In the IRENA operation, the **price of the land** was considered as a good additional indicator of marginalisation, as it expresses the demand for land. In case of marginalisation process the demand for land is low, usually corresponding to a lower land or rent price. Unfortunately, due to the inappropriate scale of the available data, it was difficult to draw concrete conclusions. However, the prices of land and, in a broader sense, the **land market** are of the utmost importance for the problem of farmland abandonment. Caian and Swinnen (2009) found that land transactions leading to an increase in land sales and rental prices, typically signals a high demand for agricultural land and hence a lower risk of land abandonment. Transition period in the new MS was accompanied by major changes in agricultural structure in most of these countries, generally involving the break-up of large collective or state farms and the privatization of land. The resulting smaller units typically faced considerable challenges including lack of equipment, limited access to capital, scarcity of advice and technical support, difficulties with markets and low levels of government support (Keenleyside et al, 2005). The FAO (2006) stressed that the transition countries face difficulties regarding land ownership (registration), insufficiently defined property rights, and the lack of operational land markets. This prevents the reconstitution of viable farming units through land consolidation. In Latvia, the land privatisation has caused a number of problems to land use and land management, given the large number of small farms. In Bulgaria, the law resulted in forced co-ownership (Vranken et al, 2004) as it imposes a minimum plot size of 0.3 ha. Because of the absence of any type of land market during this phase, parcels remained fragmented and led to a massive co-ownership situation. The forced co-ownership of many land parcels in Bulgaria creates imperfect property rights on land, inefficient land allocation among farm structures, and farmland abandonment. Vranken (2004) found that a higher percentage of plots are left uncultivated when co-owned and undividable by law. Even if there are obviously other specific determinants of farmland abandonment in new Member States (political and economic transformation, loss of export markets, reduction of domestic support and subsidy

arrangements, the dismantling of agro-food systems etc.) land property and land market are recognised to be important drivers.

Figure 1: Main determinants of farmland abandonment and inter-linkages



It is important to bear in mind that the three blocks described above are part of a global framework that can influence the process of land abandonment. Food demand, economic growth, international trade and policies drive the demand of agricultural products (Bush, 2006) and have an impact on farmland use.

Finally, and in a longer run, climate change pressures may lead to further marginalisation of agriculture or even to the abandonment of agricultural land in some parts of the EU (Commission staff working document accompanying the white paper ‘Adapting to climate change: Towards a European framework for action’, 2009⁵).

⁵ http://ec.europa.eu/agriculture/climate_change/workdoc2009_en.pdf

4 COORDINATION OF THE EXPERT PANEL FOR THE RISK OF FARM LAND ABANDONMENT INDICATOR

4.1 DESCRIPTION OF THE EXPERT PANEL

The selection process to constitute the expert panel has mainly considered three criteria:

- Importance of the expert’s literature references (in the light of their experience and state of the art in their respective countries) or known experience in the field from previous works.
- The expertise provided by the panel should cover all thematic components related to land abandonment. These are bio-physical characteristics and suitability of land, farm structure, farm economic, social factors, land market, regional development.
- The experts should come from a range of MS representing the various geographical / economical / farming conditions present in EU27

Based on these three sets of criteria, we have selected a number of experts. The following list presents the experts (with information on their background related to farm land abandonment) that have agreed to actively contribute to the study.

Expert	Organisation and background
Ambar Margarida	Educational background in “Agronomic Engineering” and is currently studying on “Territorial Management and Urbanism”. Her professional experience has been on land development for over 20 years as part of the technical staff in organisations under the Portuguese Ministry of Agriculture. As part of her regular work, she has been involved in several projects such as land consolidation, implementation of irrigation schemes and landscape development, frequently related to the execution of big public infrastructures (e.g. Alqueva dam). She was responsible for the national land consolidation service for over one year until the Ministry was reorganized. She was the Portuguese project manager for FARLAND project and is now part of the FACTS! Project Portuguese team. She has also been internationally involved in several <i>fora</i> , either in land-related networks or cooperating with other public bodies and also provided training on land issues in Macedonia and Ukraine. In particular, she has been involved in the creation of policy instruments related to land abandonment such as land banks, either in Portugal and in Lithuania, and she was the main person organising an international workshop about land abandonment that was promoted by the FARLAND Network in 2009, with the support of FAO - Regional Office for Europe and Central Asia and had participants from more than 20 countries.

Buckwell Alan	<p>Country Land & Business Association, UK; then Institute for European Environmental Policy – London UK.</p> <p>Previously Professor of Agricultural Economics at Wye College (now Imperial College London, Wye Campus). Throughout his career, his main interest has been the nature and effects of the Common Agricultural Policy. He has advised the agricultural committees of both houses of the UK Parliament, and also the European Parliament. In 1995/6 he was seconded to the think tank within the Agricultural Directorate of the European Commission. Main professional activity is to provide economic evaluation and ensure research input in policy design across agricultural, land use, environmental, forestry and water policy and other issues.</p> <p>From 1993-1996 he was President of the European Association of Agricultural Economists, and is President elect of the UK Agricultural Economics Society 2004/05. His role has been helping seek a more economically rational agricultural policy for the benefit of citizens, food consumers and producers. He challenges the CAP to devise better ways than in the past to deal with the trio of problems: market failures, missing markets, and market imperfections.</p>
Coppola Adele	<p>University di Napoli - Facoltà di Agraria, Italy.</p> <p>PhD degree in Agricultural Economics and Policy. Associate Professor at the Department of Agricultural Economics and Policy, University of Naples Federico II. Main fields of the research are: planning problems and regional economics and policy; policy evaluation and public investment analysis; analysis of farm typologies in the Italian agriculture. Analysis of farm typologies has focused on identification of socio-economic factors explaining development patterns and farm persistence. Main economic and social factors which can affect land abandonment at macro, meso and micro level have been studied with a special focus on factors acting at the farm level. The role of agricultural policy in influencing both the path of land use and the speed of land abandonment processes has been analyzed.</p>
Corbelle Eduardo	<p>University of Santiago de Compostela</p> <p>PhD in forestry by the University of Santiago de Compostela (ES). Specialized in monitoring and statistical modelling of land use changes using geographic information systems and remote data. Among recently published work is Corbelle & Crecente (2012) "Multi-scale assessment and spatial modelling of agricultural land abandonment in a European peripheral region: Galicia (Spain), 1956-2004". Land use policy, 29 (3), 493-501.</p>
Hart Kaley	<p>Institute for European Environmental Policy, London, UK (since Oct 2007). Senior Fellow and Head of the Agriculture and Land Management programme, specialised in European policies which impact on the rural environment and has a good understanding of the implementation and impacts of these policies in different parts of the EU, including the implications for farmland abandonment, particularly in relation to HNV farming systems. She is actively involved in the debates surrounding the future of the CAP and work to develop a longer term rationale for agricultural policy, including developing a suite of policy measures that are oriented towards the delivery of public goods. She has also advised on the development of agri-environment schemes to promote HNV farming in Serbia and Macedonia which have involved addressing the very immediate threats of land abandonment and in some cases needing to reintroduce extensive grazing to areas that have already been abandoned. Prior she was a Research Assistant at Kings College and Wye College, University of London.</p>

Kallstrom Helena	<p>Swedish University of Agricultural Studies, Department of Urban and Rural Development, Uppsala, Sweden.</p> <p>MSc in agronomy, researcher and PhD in Environmental Communication (2008)</p> <p>”Between comfort and solitude” concerns social conditions at farms in sparsely populated regions of Sweden, where farmland are continuously abandoned. She has also studied social sustainability at farms for Swedish Board of Agriculture and for The Federation of Swedish Farmers. Also works with qualitative methods in the research fields of rural sociology, anthropology and communication.”</p>
Gocht Alex	<p>Johann Heinrich von Thünen-Institut, Federal Research Institute for Rural Areas, Forestry and Fisheries, Germany, research fellow since 2004.</p> <p>Studied at the Imperial College of the London University and worked for several years at the Institute of Farm Economics in Braunschweig developing a tool to stratify FADN data into farm groups for the modelling system FARMIS, a farm group model for the German agricultural sector and selected EU Member States. Since then, he has worked with the EU-wide modelling system CAPRI and is responsible for the inclusion of a layer of farm groups based on FADN in the model. Completed his PhD in 2009 at the University of Bonn about methods of economic farm modelling and extended the farm group layer in CAPRI by including Farm Structural Survey (FSS) data in combination with FADN. He has further specialized in the quantitative analysis of agricultural and environmental policies in particular related to land use changes.</p>
Moravec Jiri	<p>Institute for Structural Policy (IREAS), Praha, Czech Republic.</p> <p>Ph.D., lecturer Faculty of Environment, Purkyne University, Czech Republic.</p> <p>Contributor to the 6th Framework Programme project on Cross compliance and Land Abandonment.</p>
Pointereau Philippe	<p>Solagro, France. Agronomist from the ESA Purpan, leading the Agro-Environment department of SOLAGRO and co-ordinates the European research projects (BioBio, Biocore, Quessa) and studies with the IES/JRC, EEA and IEEP. His research interests cover the agro-ecology and the environmental assessment of farming systems. He developed the diagnostic system DIALECTE used by advisors at farm scale. He led the projects on Farmland abandonment and identification of High Nature Value (HNV) farmland in Europe under IES/JRC. He works with the French ministry of Agriculture on the evolution of the French agriculture and land use.</p>
Strijker Dirk	<p>University of Groningen, Cultural Geography, The Netherlands</p> <p>Professor in Rural Development (the Mansholt-chair) since 2005, and vice-chair of the department of Cultural Geography at Faculty of Spatial Sciences of Groningen University, The Netherlands. Has a Master degree in Agricultural Economics from Groningen University and a Ph.D. in Economics from the University of Amsterdam for a thesis on the influence of the EU agricultural policy on the spatial patterns of agricultural production. He publishes on the economic and spatial aspects of agriculture and agricultural policy, on land use and land abandonment, and on the relations between agriculture, nature and rural development.</p>

Vranken Liesbet	<p>Division of Agricultural and Food Economics, Department of Earth and Environmental Sciences, KULeuven Belgium.</p> <p>Professor in Bio-Economics and Policy, head of the Research Group Society-Environment Interactions within the Division of Agricultural and Food Economics has a Master in Agricultural Sciences and a Phd in Economics, both from the Catholic University of Leuven. She is a specialist in studying land markets issues and agricultural reforms. She is well trained in quantitative skills and in analyzing economic data which led the publication of her work in international journals and dissemination among international organisations (EU Commission, World Bank, FAO). She has been involved in various projects on land-related issues, including projects for the EU Phare-ACE program, for the FAO and the World Bank. She was a member of the core team which produced the recent study on “Review of the transitional restrictions maintained by new Member States with regard to the acquisition of agricultural real estate” for DGMARKT, and co-author of the main report. Currently, Liesbet Vranken is participating in the FP7 project ‘Factor Markets’ in which she is doing research on the key developments and institutional framework of land markets in Europe.</p>
Zobena Aija	<p>University of Latvia (LU), Faculty of Social Science, Latvia</p> <p>PhD in Sociology (1992), professor, Head of the department of Sociology, senior researcher at the Advanced Social and Political Research Institute (ASPRI) of the LU. Areas of expertise: Regional and rural development, social policy, social cohesion. Involved in project “Social Partnership for Anticipating Change in the Labour Market”, leading partner ITC ILO (2011)</p>

4.2 PROPOSED DEFINITION OF ‘FARMLAND ABANDONMENT’

The expert panel coordinated by the JRC proposed the following definition: ‘*Farmland abandonment is a cessation of management which leads to undesirable changes in biodiversity and ecosystem services*’.

Originally, FLA was seen as a loss of Utilized Agricultural Area (UAA) that has not been converted into artificial zone or afforested (tree plantation). The non-agricultural land is no longer farmed for economic, social or other reasons (no alternative use) and is not included anymore in the crop rotation system. Depending on the environmental conditions, this abandoned farmland will gradually be covered by scrubs and trees. This concept represents the **measurement** of the phenomenon, not the **risk**; therefore the definition has to be changed to reflect the exact scope of the AEI 14 ‘Risk of land abandonment’.

Moreover, as the indicator will be used to assess the integration of environmental concerns into the CAP, it was necessary to steer the definition towards potential threats for the environment, which in this case, are linked to loss of biodiversity and ecosystem services.

The purpose of the indicator was clarified as it should address the risk of farmland abandonment (probability of occurrence), not the consequences of FLA or the extent to which FLA actually happens.

Additional conceptual information was reported by the experts:

- Ecosystem services refer to the collection of four sets of services which are based on biodiversity, or life on earth. These services are the provisioning services (food, forest

products, fuel etc.), regulating services (for water, climate etc.), supporting services (soil formation, nutrient recycling etc.) and cultural services (aesthetic, spiritual etc.).

- For abandonment to be of concern there must be some undesirable changes (usually loss) of at least one of these services which is not outweighed by any gain in other services. Not all loss of Utilized Agricultural Area will be associated with undesirable changes in these services, so not all loss of UAA will necessarily mean ‘abandoned’.
- Cultural and social dimensions (encompassing for instance the loss of employment) were proposed to be included in the definition (undesirable changes) but, since the objective has an environmental dimension, only reference to ecosystem services was kept. Nevertheless, social and cultural aspects could potentially be used as drivers for farmland abandonment.
- The issue of soil sealing was discussed but this will be assessed by the indicator on land use change (AEI9) of the Memorandum of Understanding (MoU) for Agri-Environment Indicators. AEI9 will focus on the percentage of the total area that has changed to artificial surfaces compared to a reference period. It is therefore not necessary to cover the soil sealing issue under the FLA indicator.
- A first agreement on the time scale was reached: a period of 5 to 10 years for identifying FLA is proposed in order to discard short term market influences on land-use. Also this period should be in line with data availability and policy intervention frame.

4.3 INDICATORS REVIEW

From the initial list established from the literature review, the expert panel suggested most relevant factors and indicated priorities. This process includes the compromise between desirability and availability of data for the whole EU.

List of selected drivers:

Block2 “Low farm stability and viability”

- ✓ Farm income
- ✓ Low investment in the farm
- ✓ Age of farm holder (> 65 years)
- ✓ Low farmer qualification
- ✓ Remoteness and difficult access (this would better fit in the “adverse regional context” block)
- ✓ Low size of the farm compared to average of same farm type
- ✓ Farm enrolment in specific schemes

Block3 “Adverse regional context”

- ✓ Weak land market
- ✓ Previous trend of FLA (to be postponed when time series of farmland abandonment data will become available)

List of excluded drivers:

- ✓ Opportunity outside the agriculture (better captured by remoteness, population density, unemployment)
- ✓ High value added products (as the lack of PDO/PGI products may simply be due to intensive and profitable agriculture, not needing to add value to raw products).

4.4 METHODOLOGICAL FACTSHEETS FOR EACH SELECTED CRITERION

Experts have compiled a factsheet for each driver including definition, effect on the risk, calculation options and references. Factsheets were circulated for comments and approval from the panel.

List of prepared factsheet and author:

Criteria	Expert in charge
Land market	Liesbet Vranken
Farm income / regional average	Allan Buckwell
Investment in the farm	Adele Coppola
Average age on the farm	Adele Coppola
Previous farmland abandonment trend	Hans Wytrzens / P Pointereau
Remoteness and difficult access	Helena Nordstrom Kallstrom
Size of parcels, farm/average in farm-type	Margarida Ambar
Opportunities outside the agricultural sector	Dirk Strijker
High value added product	Aija Zobena
Farmer qualification	DG AGRI (G1)
Farm commitment / Specific schemes (AEM ...)	DG AGRI (G1)

The full analysis on drivers carried-out by the experts is available in ANNEXE A.

5 REVIEW PROCESS FOR EUROPEAN DATASETS TO ASSESS FARMLAND ABANDONMENT

Regarding data, there are no other options for the duration of the Administrative Arrangement than using existing sources (FADN, FSS, administrative data on the CAP, pan-European geo-spatial datasets) as there will be no time (and resources) to develop or collect new datasets.

5.1 FARM ACCOUNTANCY DATA NETWORK (FADN)

The Farm Accountancy Data Network (FADN) consists of an annual survey carried out by the Member States of the EU, which collect accountancy data every year from a sample of agricultural holdings. The main objective of FADN is the evaluation of the income of agricultural holdings and the analysis of economic impacts of the CAP. DG AGRI is responsible for managing FADN at EU level.

Derived from national surveys, the FADN is the only source of micro-economic data that is harmonised (i.e. the bookkeeping principles are the same in all countries), which combines data on farm structure, input use and economic variables. The combination of such different variables in one data set is a key factor for linking different issues in agri-economic analysis. Holdings are selected to take part of the survey on the basis of sampling plans established at the level of each region in the Union. The survey does not cover all agricultural holdings in the Union but only those which due to their size could be considered commercial. The methodology applied aims to provide representative data along three dimensions: region, economic size and type of farming. The rules of the FADN are specified under EU regulations, but the data are collected by Member State organizations.

The aim of the network is to gather accountancy data from farms for the determination of incomes and business analysis of agricultural holdings. Currently, the annual sample covers more than 80.000 holdings (commercial farms above 1 ha). They represent a population of about 6.400.000 farms in the 27 Member States, which cover approximately 90% of the total utilized agricultural area (UAA) and account for about 90% of the total agricultural production of the Union. The information collected, for each sample farm, concerns approximately 1000 variables and is transmitted by Liaison Agencies.

The FADN database only includes ‘commercial’ farms beyond a certain economic threshold⁶, which varies from one country to another according to the agricultural structure (the minimum size is currently 1 Economic Size Unit (ESU = a standard Gross Margin of €1200 in Bulgaria and 16 in Belgium, Netherlands, Germany and the United Kingdom). The threshold on the minimum size farm may lead to a certain under-representation of the smallest farms, which in the case of FLA may be an important issue. In addition, FADN is only statistically representative at NUTS 0, 1 and 2 levels. However, there are no other datasets available with such relevant variables at EU level.

⁶ There is a constant review of where to draw the line about what is a commercial farm. In principle it is one which provides most of the income for the farmer and his family. The line is drawn according to local circumstances.

An FADN data user agreement has been signed between DG AGRI and the JRC. Anonymous individual holding data selected by the JRC have been extracted and swiftly sent by DG AGRI.L3.

The following variables were requested and provided at holding level (however anonymously)

Table 1: FADN variables available for the study

Code	DESCRIPTION	Comment
A1	Region	
A18	Organisational form	
A2	Sub-region	
A24	Country	
A27	Econ.size in EUR	Calculated by DG AGRI (cf Typology Regulation)
A28	General TF	Calculated by DG AGRI (cf Typology Regulation)
A29	Principal TF	Calculated by DG AGRI (cf Typology Regulation)
A3	Farm Number	
A39	Less favoured Area	The Netherlands do not provide data on LFA classification (use of code 4) and LFA payments. They consider LFA not significant for the country. In Germany all the LFA farms have been classified under code 2 (LFA-Other than Mountain). This should not be the case any more for 2007 and following accounting years.
A41	Altitude zone	
A45	Environmental constraints Area (EC no 1257/1999 and 1698/2005)	e.g.: the majority of the UAA of the farm is located in a 'Natura 2000' area or in an area linked to the Directive 2000/60/EC (water).
F86	rent paid for land	
J112	Grant and subsidies tot. on animal and prod.	
SE005	Economic size	in ESU
SE025	Total Utilised Agricultural Area	area in ha
SE030	Rented U.A.A.	area in ha - In FR the share of rented area is high because farmers belonging to partnership may rent their own land to the company
SE035	Cereals	area in ha
SE065	Other permanent crops	area in ha
SE071	Forage crops	area in ha
SE110	Yield of wheat	in q/ha - global ratio
SE120	Stocking density	in LU/ha of forage area - global ratio. Please note that mountain area or other pasture outside the UAA of the holding are not taken into account in the denominator. Therefore the farms with few own forage area, but using a lot common land will have a high stocking density. The stocking density SE120 should therefore be interpreted with caution. It is possible to approach the use of common land through the variable A42 (Days of grazing outside UAA).
SE125	Milk yield	in kg/cow - global ratio
SE131	Total output	

SE135	Total output crops & crop production	
SE206	Total output livestock & livestock products	
SE375	Rent paid	Including the rent for buildings, quotas... See SE030.
SE425	Farm Net Value Added /AWU	Global ratio
SE408	VAT on investments	It was considered preferable, for the purposes of calculating income, to treat this amount separately from the overall VAT balance. It is generally a large amount and has no connection with the year's production. If it were taken into account in the VAT balance, it would distort the balance of subsidies and taxes on current operations.
SE516	Gross Investment on fixed assets	= Purchases – Sales of fixed assets + breeding livestock change of valuation
SE521	Net Investment	
G94IG	Agricultural land + buildings IG	
G95IG	Agricultural land IG	Optional information
G96IG	Permanent crops IG	
G97IG	Land improvements IG	Optional
G99IG	Acq.costs, quotas, oth. right IG	Optional information – Be cautions when comparing MS because if the quotas is attached to land, its value is recorded under G95
G100IG	Forest (inc. stand. timber) IG	
G101IG	Mach. + equipment IG	
G103IG		Investments before subsidy
SE622	LFA subsidies	
SYS02	Farms represented	
SYS03	Sample farms	
SYS04	Exchange rate	
YEAR	Year	
SE415	Farm Net Value Added	
SE420	Family Farm Income	This indicator is calculated for the whole farms including those without family labour
SE425D	AWU	FNVA/AWU denominator (= SE010)
SE425N	Farm Net Value Added	FNVA/AWU numerator (= SE415 where SE010 > 0)
SE430	Family Farm Income / FWU	This global ratio can be > 0 whereas SE420 < 0 because it is calculated taking into account only the farms with FWU > 0
SE430D	FWU	FFI/FWU denominator (= SE015)
SE430N	Family Farm Income	FFI/FWU numerator (= SE420 where SE015 > 0)

The geographic reference (Administrative unit) of the provided data can vary from MS to MS. Details are given in the table below.

Table 2: level of FADN data availability and processing by MS

MS	Admin level	Data processed	MS	Admin level	Data processed
AT	NUTS3	NUTS2	IT	NUTS3	NUTS2
BE	NUTS3	NUTS2	LT	NUTS3	NUTS0
BG	NUTS3	NUTS2	LU	NUTS0	NUTS0
CY	NUTS0	NUTS0	LV	NUTS3	NUTS0
CZ	NUTS3	NUTS2	MT	NUTS3	NUTS0
DE	NUTS3	NUTS1	NL	NUTS3	NUTS2
DK	NUTS3	NUTS2	PL	NUTS3	NUTS2
EE	NUTS3	NUTS0	PT	NUTS3	NUTS2
ES	NUTS3	NUTS2	RO	NUTS3	NUTS2
FI	NUTS3	NUTS2	SE	NUTS3	NUTS2
FR	NUTS3	NUTS2	SI	NUTS3	NUTS0
GR	NUTS3	NUTS2	SK	NUTS3	NUTS2
HU	NUTS3	NUTS2	UK	NUTS3	NUTS1
IE	NUTS3	NUTS2			

‘Admin level’ refers to the lowest geographic administrative unit reference given in the FADN dataset for each holding. The table shows that this level can vary from MS to MS.

‘Data processed’ refers to the level of processing and reporting selected for the analysis. This level is a compromise between data availability, representativeness and targeted objective of reporting at NUTS2 level as stated in the specifications of this study.

In the case of DE and UK, despite data were provided with reference at NUTS3 level, it was agreed with DG AGRIL3 to process and report results at NUTS1 level to ensure representativeness of the sample.

For some MS (CY, EE, LT, LU, LV, MT, SI), data are processed at NUTS0 level because intermediate NUTS level 1 and 2 do not exist (they are geographically identical to NUTS0).

5.2 FARM STRUCTURE SURVEY (FSS)

The purpose of the FSS is to obtain reliable data, at regular intervals, on the structure of agricultural holdings in the European Union in order to: Assess the agricultural situation across the EU; monitor trends and transitions in the structure of European farms (agricultural holdings); manage, evaluate and design the CAP in its environmental, economic and social aspects. FSS data is also used in other policy areas such as environment, regional development and climate change.

FSS statistics provide harmonized data on agricultural holdings in the EU, including: Number of agricultural holdings, land use and area (crops), livestock, farm labour force (including age,

gender and relationship to the holder), economic size of the holdings, type of activity, other gainful activity on the farm, system of farming, machinery.

Two types of surveys are available:

- (i) Every ten years, a full scope survey is carried out in the form of an agricultural census (The Agricultural Census 2010 is currently being carried out in the EU Member States and will be available for use in 2013);
- (ii) Every 2 or 3 years, between the censuses, sample surveys are carried out and results are available only at NUTS2 or NUTS3 level, depending on MS (the last sample survey was carried out in 2007).

Survey results are representative only at NUTS2 level, which means that the variability of FLA within NUTS2 is lost. Consequently we aimed at census data so that the maximum spatial details can be kept. However, while the last census was done in 2010/2011 (depending on MS), data will only be available in 2013. Therefore the last census data currently available for this study are from 2000. It is then proposed to use this dataset (FSS 2000, depending on MS) to test the indicators and have a first assessment of the method and the results. An update will always be possible once FSS data for the 2010 census will be released.

DG ESTAT is responsible for managing FSS at EU level.

Despite several attempts to ESTAT to access micro-data (however anonymised), it was not possible to receive them. Consequently ESTAT has proposed to process those data according to the definition of the drivers and thresholds identified by the literature review and the panel of experts and to send the result only to the JRC.

Consequently, the following processing was requested to ESTAT:

Percentage of farms with holders over 65 years of age by lowest geographical breakdown available	Results delivered in June 2011
Percentage of farms with UAA below 50% of the NUTS3 average holding UAA, by NUTS3 / LAU1 / LAU2 (lowest geographical breakdown available) and by farm-type.	Results delivered in December 2011
Percentage of farms with a UAA under 50% of the NUTS2 average holding UAA, by NUTS3 and by farm-type.	Not delivered as of Nov 2012

5.3 GEO-SPATIAL DATASETS

In order to complete the analysis based on accountancy and statistical datasets, additional geo-spatial data are needed to compute spatially explicit indicators of remoteness and low densely populated regions. The following data need to be mobilised:

- For Travel time: EuroRegionalMap road network, Communes database (GISCO)
- For Population density: SIRE database (2001, Eurostat) for population per commune and Corine Land-Cover (EEA) for the spatialisation
- Identification of urban centres: the Urban Audit 2007 cities (source: DG REGIO)

- The Urban Morphological Zones derived from CORINE Land Cover 2000 and the disaggregated map of population density (source: EEA).
- The administrative boundaries from the EuroBoundaryMap (EBM 2001 Census) database (scale: 1/100 000). Source: ©EuroGeographics.
- EuroRegionalMap (ERM v2.2) database (scale:1/250 000) by ©EuroGeographics
- The agricultural area used at LAU2 level for driver D7 was derived from CORINE Land-Cover 2006 (source: EEA) (<http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster-2>)

6 METHODOLOGICAL DEVELOPMENT, DATA ANALYSIS AND RESULTS

6.1 METHODOLOGY FOR INDIVIDUAL DRIVERS

This section describes the refined methodology taking into consideration some known data limitations, feedbacks from the expert meetings held at the JRC on 23-24th January 2012 and 13-14 September 2012, and also based on the JRC's experience gained during the analysis.

In a first stage, economic drivers (D1, D2, D3) were computed to flag NUTS2 with “40% of the regional sample of observations below a certain threshold valued” (e.g. NUTS2 with 40% of their holdings with an income below the regional average farm income). However, the outcome was not satisfactory as it was providing information on the regional distribution of the observations rather than meaningful economic difficulties in these regions. A new methodology has therefore been applied to compute the weighted average estimator for each NUTS2 in EU27. The calculation of the weighted average considered each holding with its weight. Weighting factors are available from FADN variable SYS02; they are the ratio of the number of farms in a cluster in the whole population to the number of farms included in the same cluster in the sample. A cluster is a group of farms belonging to the same farm-type, same economic size within a region (or group of regions).

Results are presented using 5 quintiles, having 20% of the distribution in each class. In doing so, there is not anymore absolute threshold for identifying a risk, but NUTS2 regions belonging to the fifth quintile are with a higher risk in relative terms. This approach was also chosen as it would allow the computation of the composite risk index (combining individual drivers) presented in section 6.3 of this report.

6.2 DATA ANALYSIS AND RESULTS (INCLUDING MAPS)

D1: Weak Land Market

Rationale:

Increase in land sales and rental prices are generally linked to a high incidence of land transactions which typically signals a high demand for agricultural land and hence a lower risk of land abandonment. A weak land market has a negative effect on FLA.

Assessment and methodological improvement applied:

A regional average was done at NUTS2 level, except for DE, UK (NUTS1) and for CY, EE, LT, LU, LV, MT, SI (NUTS0). Aggregation at NUTS2 level means that all the holdings belonging to a NUTS2 are considered in the analysis of this NUTS2.

The FADN parameters ‘Rent paid, including rent for building, quotas ...’ (var. SE375) and ‘Rented UAA’ (var. SE30) are used in a ratio to provide proxy information on the rental price of agricultural land. The weighted average is calculated for the 3 years (2006-2008) for each holding

in the database. Each holding of the FADN sample was considered with its weight; the weighting factor is represented by the FADN variable SYS02.

Some special cases were identified in the dataset. Based on information provided by DG AGRIL3, they have been handled as follows:

- The rented area is positive but the rent paid is 0: Member States often justify this case when the land is available for free (i.e. a family member is owner of the land). Rent considered = 0.
- There is no land rented (SE030 = 0) but some rent is paid (SE375 > 0). Then “no data” is attributed. These are cases of renting buildings or milk quotas.

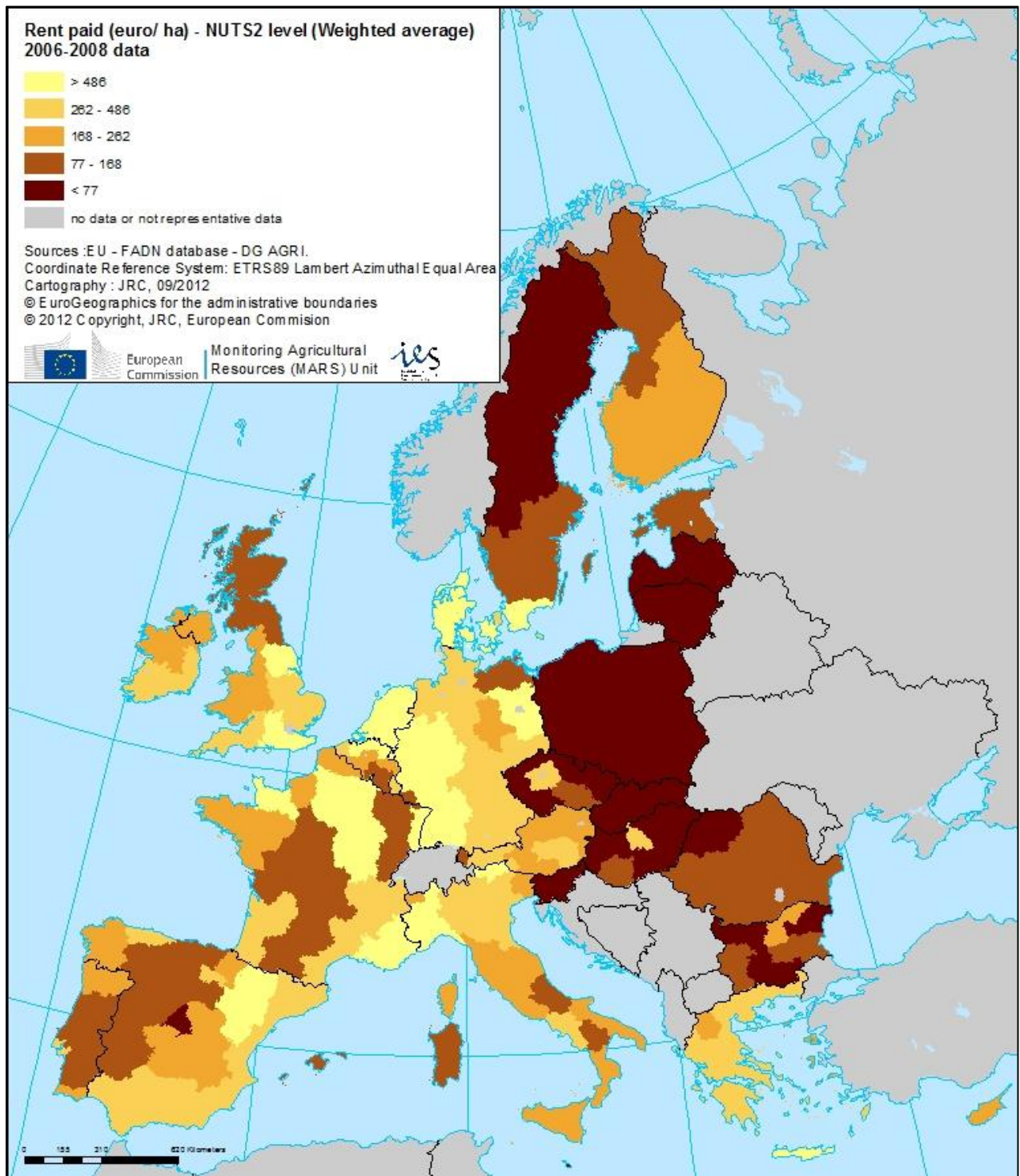
Data screening showed that some MS or regions (Portugal, southern Spain, southern Italy, southern Greece, Romania) have a large percentage of records with an average rent equal to “zero” in the database (leading to high standard deviation) - Figure 3. This could be interpreted as a sign of low demand for land, hence possibly entailing land abandonment or, as suggested by AGRIL3 officers responsible for FADN data, that farmers are renting land without payment (e.g. the owner is a family member). In the latter case, this could lead to biased conclusions.

Indeed, A Coppola (one of the members of the expert panel) suggested that when the land tenure model is mainly the ownership (in Italy for instance), results could be biased: other conditions being constant, the probability of land being abandoned is likely to be lower when the land is owned than when it is rented (consequently the share of rented / owned land has to be taken into consideration).

Results:

The main result is presented in Figure 2. Figure 4 shows the share of rented land to the total agricultural area (UAA). Results are classified in quintiles (20% of data in each of the 5 classes).

Figure 2: Weighted average value of the rent per ha (euro ha⁻¹) paid by holding (NUTS2 level) - quintiles



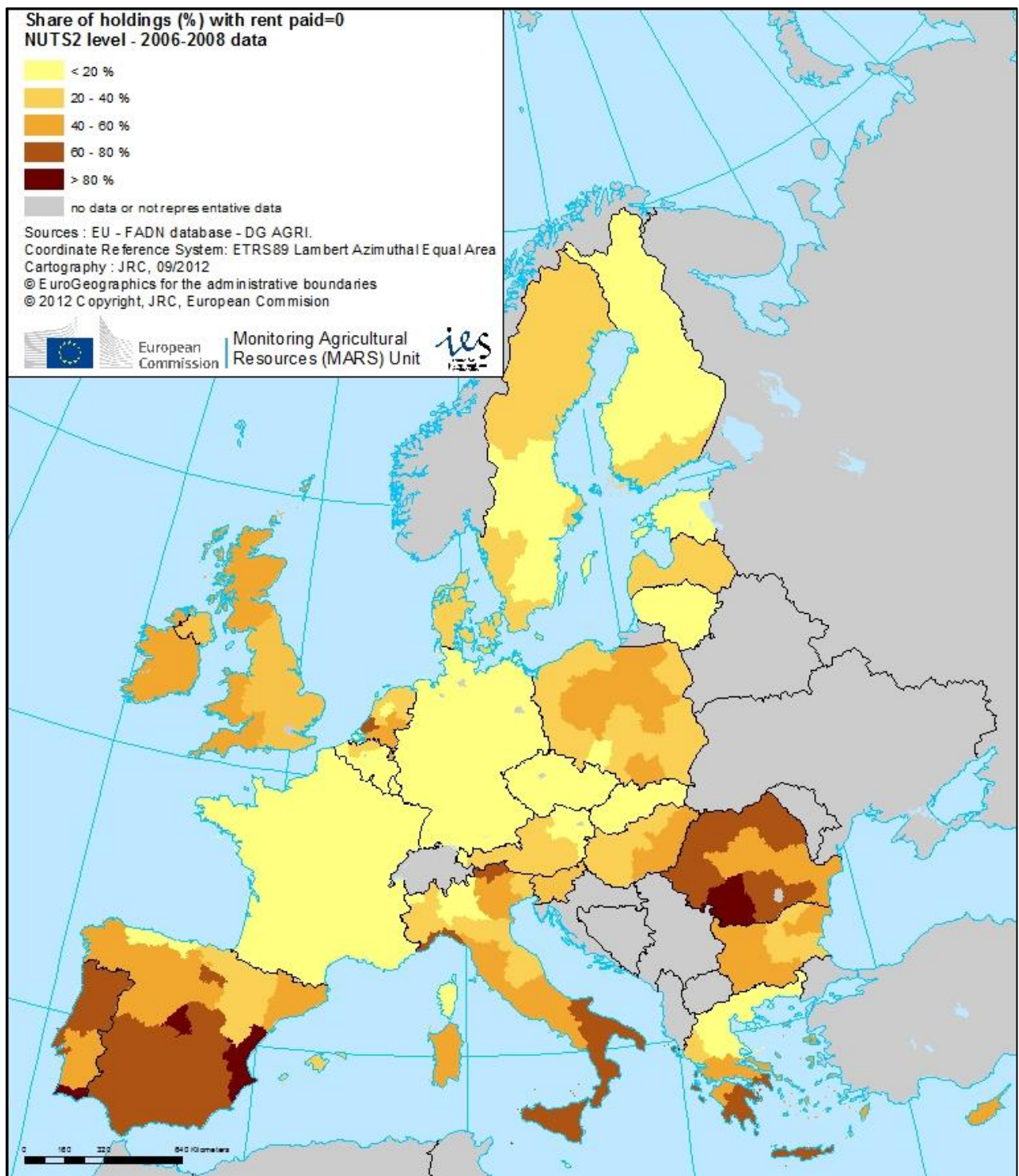
Central European countries such as Poland, Slovakia, part of the Czech Republic, part of Hungary, Slovenia and part of Bulgaria have very low renting prices. A similar situation is encountered in the Baltic States and in northern Sweden.

To a lower extent, low paid rent occurred also in Portugal, western Spain, some central and western French regions, in Scotland and in Romania.

The information provided by the share of holdings renting land but not paying a rent (Figure 3) may increase the risk in central and northern Portugal, south-western Spain, Basilicata region in Italy and several regions in Romania if the rationale provided by A Coppola is followed. Indeed, in these regions, the paid rent by holding actually paying something (non-zero rent) is low (Figure 2) and at the same time there is a large share of holdings renting land (60% and above) but not paying for it.

Some results with NUTS2 regions having a high average rent paid by ha have been questioned (e.g. Aragon in Spain). A possible explanation is that limited areas of 'good' agricultural land are rented (at a high price) in a region where the share of the overall rented land is low (e.g. arable land in a region dominated by permanent grassland). In this case, a more meaningful ratio would be the rent paid / total UAA (rather than rented UAA). However, it seemed more logical in first instance to consider only the rented UAA to assess the level of the land rental market.

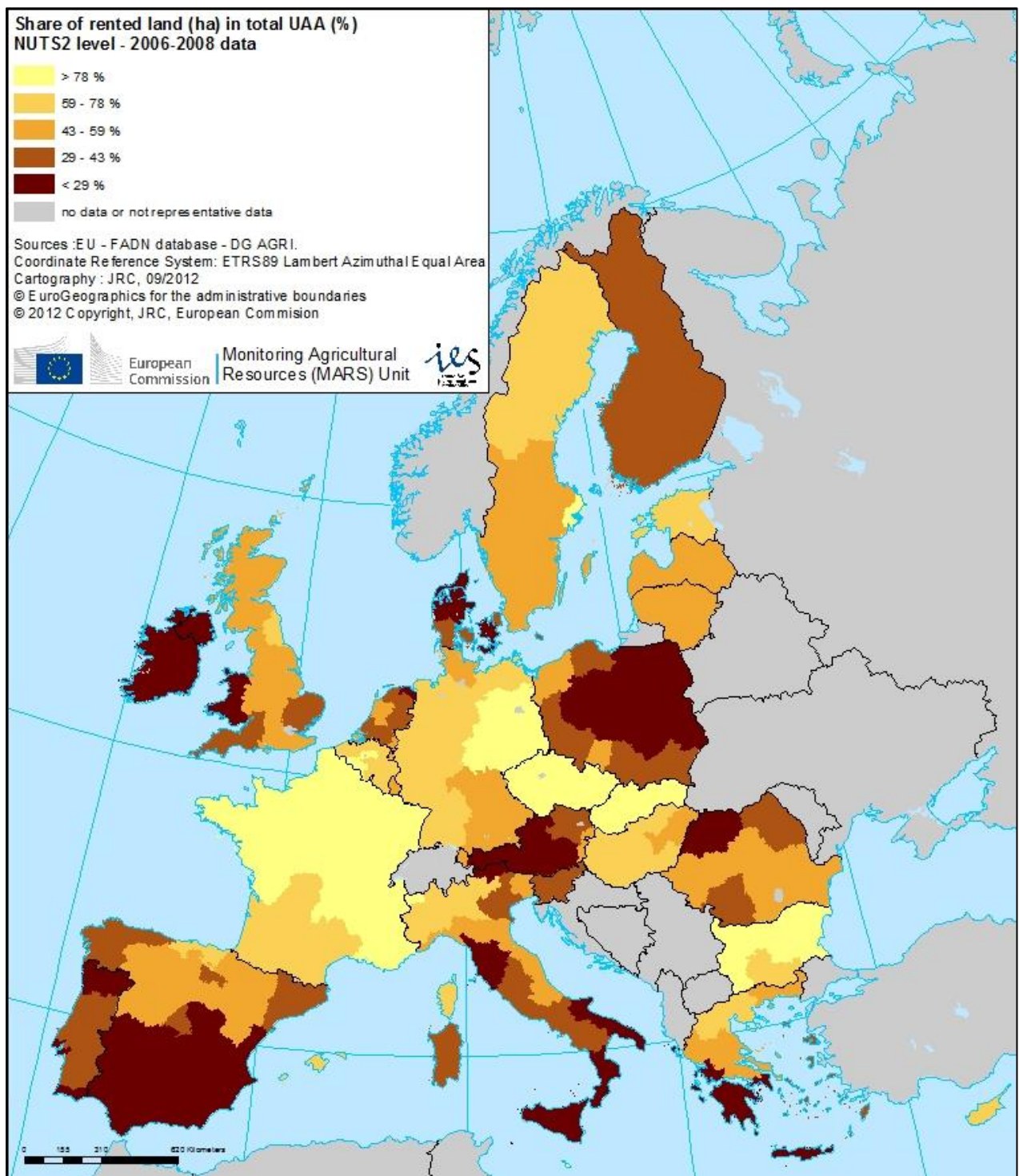
Figure 3: Percentage of holdings with rented land but no rent paid (NUTS2 level).



It was therefore recommended to process the data considering only ‘non-zero’ values as paid rent.

Figure 4 shows the share of rented land in the total UAA at NUTS2 level.

Figure 4: Share of rented land in the total UAA (NUTS2) - quintiles



Based on this and before a final assessment from the experts, it is suggested to give a medium confidence level to this driver.

Suggestion for improvement:

The FADN parameters used to calculate this driver was ‘Paid rent, including rent for building, quotas ...’ (var. SE375), as this was the only one available for the period 2006-2008. This

includes also buildings, milk quotas etc..., and therefore goes beyond the only rental price of the land.

For the future it would be preferable to use FADN variable F86 (rent paid for the land) as only the land is considered. This variable was collected only from 2009 onward.

A second possible improvement could be the use of land price in selling transactions as this would give a relevant base to assess the land market. A strong land market typically signals a high demand for agricultural land and hence a lower risk of land abandonment. Data on land market at European level are not available / known to us; an inventory may be needed to gather data from each MS.

D2: Low Farm Income

Rationale:

Farmland is typically abandoned as an economic resource when it ceases to generate an income. Although this is not a sole cause, and although it can be triggered by a number of factors (described in/by the other indicators), there is a powerful link. Low farm income has a negative effect on FLA.

Assessment and methodological improvement applied:

The farm net value added (FNVA) is used as income indicator. The FNVA measures the amount available for the remuneration of the fixed factors of production (work, land and capital). As such it is the most comparable indicator between MS because its measure is not different whether factors of production are external or family factors. It is usually expressed per farm or per annual working unit. The FADN working variable used for this driver is the Farm Net Value Added expressed per Agricultural Working Unit: FNVA/AWU⁷ (SE425).

The concept of 'Total Income of Agricultural Households' may also be relevant to assess the overall income available for the household. It may indicate (at least on the short term) the income resources available to the household (including e.g. external income from the partner). However, with a medium to long term perspective and with the objective to assess the ability of agricultural activity to provide enough economic resources, the Farm Net Value Added variable is preferable; acknowledging that calculation on FNVA may indicate a higher risk.

Moreover, the EU's efforts to collect the 'Total Income of Agricultural Households' variable were abandoned in 2002. In the future, the sub-indicator could be weighed by the proportion of other gainful activities (*FSS variable: Other gainful activity of holder-manager*). However 2 major issues would arise: (i) availability of FSS public data below the NUTS2 level and (ii) no

⁷ http://ec.europa.eu/agriculture/rica/pdf/hc0102_income.pdf

possibility so far in European datasets to link holdings data from FSS censuses to FADN holdings.

In a first attempt the methodology applied identified regions where more than 40% of the sample had a farm income below the regional average. Results were not satisfactory as these were only a measure of the distribution of farm incomes within a region, but not providing relevant information on low income leading to potential land abandonment.

Moreover, as the farming economic context is still very heterogeneous between Member States, a unique European threshold value for the income would not make sense (different economic and structural situations are present in Member States, in particular incomes are still very disparate – e.g. a low agricultural income in the Netherlands could still be a high value for Bulgaria). There is indeed a ratio of 1 to 15 amongst EU27 MS between the minimum and maximum national agricultural income (see Table 3).

Therefore, the proposed methodology for the Driver D2 on ‘Low Farm income’ will compare the farm income to the national general income (all sectors) in order to identify differences between the income in the agricultural sector and the average national income. It assumes that when differences are large, agriculture may not be economically sustainable anymore, leading to people leaving the farming sector for possible opportunities in other sectors.

The national income rather than the European one should be considered as it is felt that farmers may quit agriculture to move preferably to a different sector in their own country rather than emigrating to another country. Consequently, this driver is already subject to a normalisation at country level.

Table 3: Weighted average farm income by annual working unit from FADN (var. FNWA/AWU).

MS	Average farm Income	Coef. of Variation	MS	Average farm Income	Coef. of Variation
AT	25323	0.89	IE	21053	3.04
BE	40732	0.82	IT	17919	1.59
BG	2712	2.17	LT	7416	1.41
CY	5807	3.22	LU	33888	1.01
CZ	12578	1.01	LV	6310	1.95
DE	32045	0.87	MT	13425	1.25
DK	39578	1.19	NL	42937	1.32
EE	9209	1.42	PL	5077	1.38
ES	20107	1.41	PT	6872	1.74
FI	24184	1.36	RO	3614	2.06
FR	29191	0.94	SE	28724	1.30
GR	12502	1.05	SI	3441	2.65
HU	12433	2.91	SK	7991	1.81
			UK	41430	2.36

The procedure calculates the weighted average farm income per annual working unit and compares it to the Gross Domestic Product (GDP) per capita at market prices - Euro per

inhabitant⁸. The national GDP is a proxy for the national income. In the analysis, the GDP per capita for the period 2006-2008 is used.

Note: In the present assessment, Farm income by annual working unit is compared to the national income per capita. It would be more appropriate to compare either farm income per annual working unit to GDP per active population; or farm household income to national household income. However, data were not all available for these comparisons; and in the next step, the methodology will normalise anyway the income values for the calculation of the risk, therefore the issue of the unit is secondary, what matters is the variation of the ratio between NUTS2 regions.

Results:

The statistical analysis of the income variable is presented in Table 4 in terms of weighted average and variability. The coefficient of variation shows that the distribution of values is quite large, in particular in MS such as Cyprus, Ireland, Hungary, Slovenia and UK.

Table 4: statistical analysis of the distribution of D2 (ratio average income / national GDP) at national level

MS	Number of Holdings	Standard Deviation	Average Agri. Income / GDP	Coef. of Variation
AT	2328	0.68	0.77	0.89
BE	1314	1.07	1.30	0.82
BG	2263	1.37	0.63	2.17
CY	588	0.90	0.29	3.15
CZ	1785	0.97	0.97	1.00
DE	9588	0.95	1.10	0.87
DK	4194	1.13	0.95	1.19
EE	567	1.11	0.80	1.38
ES	11113	1.21	0.86	1.40
FI	1045	0.98	0.72	1.37
FR	8944	0.93	0.99	0.94
GR	4311	0.66	0.63	1.04
HU	2279	3.68	1.27	2.90
IE	1392	1.53	0.50	3.06
IT	19756	1.10	0.69	1.59
LT	1826	1.21	0.87	1.38
LU	501	0.45	0.44	1.03
LV	1518	1.35	0.73	1.84
MT	446	1.26	1.01	1.24
NL	1720	1.63	1.24	1.31
PL	14862	0.85	0.62	1.36
PT	3815	0.75	0.43	1.72
RO	2025	1.16	0.58	2.02
SE	1193	1.03	0.79	1.30
SI	933	0.52	0.20	2.62
SK	646	1.46	0.77	1.90
UK	3621	3.08	1.31	2.36

⁸ Source: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/data/database - GDP and main components - Current prices (nama_gdp_c)

Results are presented in Figure 5.

The higher risk appears on the first quintile (ratio < 0.58), identifying the whole of Ireland, most of Portugal, southern France (Languedoc-Roussillon in particular), central and southern Italy, the whole of Slovenia, mountain areas in western Austria, central and southern Greece, the whole of Cyprus, western Bulgaria, eastern Romania, central Slovakia, central / eastern and southern Poland, and some areas in northern Sweden and eastern Finland.

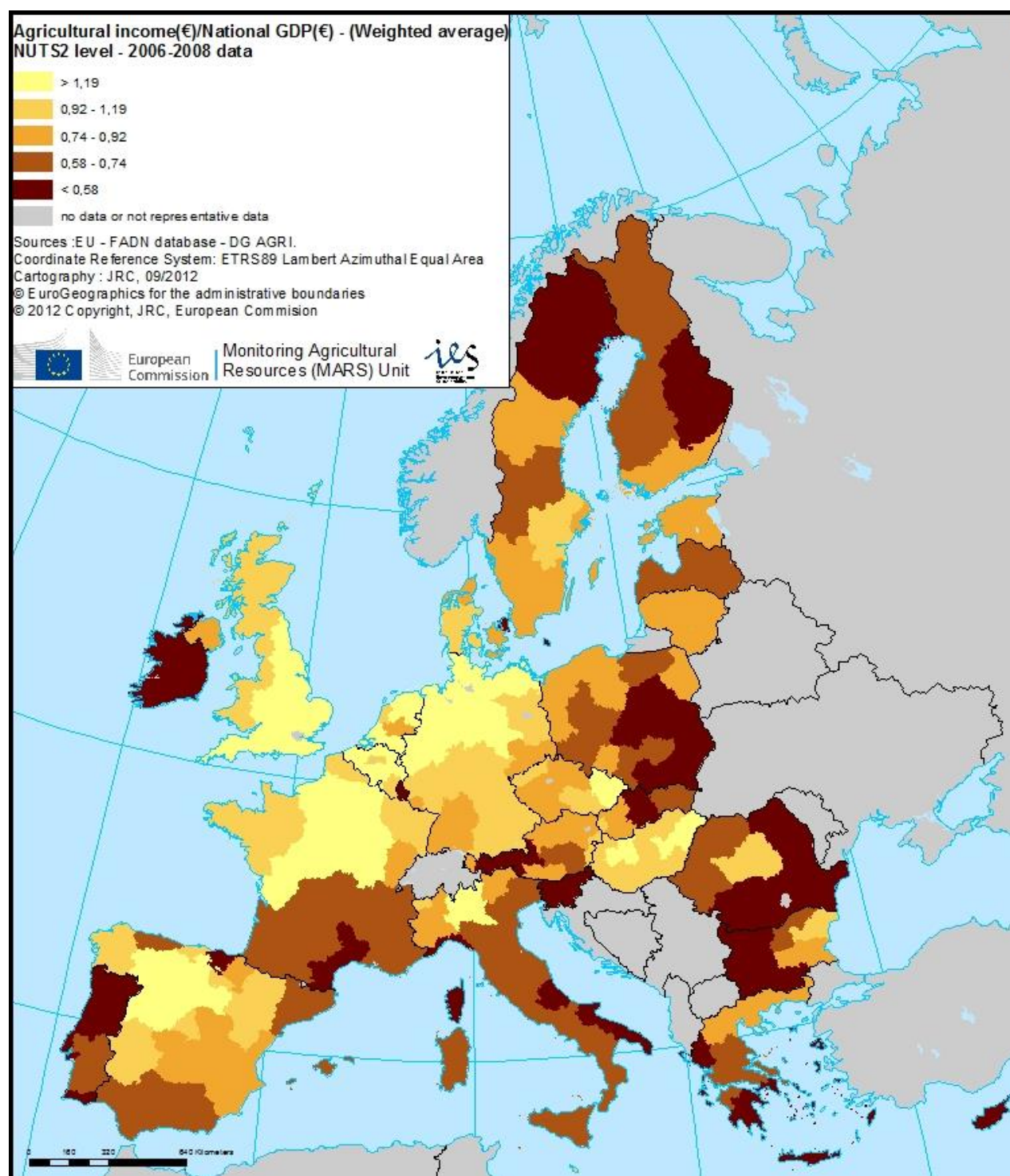
Interestingly, the lower quintile threshold (0.58) corresponds more or less to the level used to define relative poverty⁹ (0.6 of national GDP per capita; meaning that the average agricultural income in the regions identified in this quintile is below the national relative poverty threshold).

Caution should be taken in interpreting these results as suggested by the expert-panel. Different situations in MS may have different underpinning explanations. Indeed, the results are based on farm income only, while the total household income may change the picture. Ability to pull income from diversification activities (tourism, external income for part-time work, external income of the partner etc) may matter to ensure the survival of rural families. However, this information is not available in the FADN database.

For example, the situation in western Austrian mountains with low agricultural income may be overcome by external additional income brought by farm tourism.

⁹ Relative poverty is measured as the percentage of population with income less than some fixed proportion of median income. There are several other different income inequality metrics, for example the Gini coefficient or the Theil Index. As such these poverty statistics measure inequality rather than material deprivation or hardship. Relative poverty measures are used as official poverty rates in several developed countries. The main poverty line used in the OECD and the European Union is based on "economic distance", a level of income set at 60% of the median household income.

Figure 5: Ratio of 'agricultural income / national GDP' (NUTS2 level) - quintiles



Completeness, robustness and relevance of data are satisfactory, suggesting good confidence levels for this driver.

Further analysis was done for NUTS2 with a ratio 'income per annual working unit / GDP per cap' below 0.58 (first quintile = 20% of NUTS2 most at risk) to find out which farm-types were most affected (using the FADN dataset - var. A28).

The distribution of farm-types (as share of NUTS2 affected farms) is shown in Table 5 for the NUTS2 of the first quintile for driver D2.

Table 5: Percentage of the number of farms in NUTS2 at risk classified by farm-type [NUTS2 with ratio 'income AWU / GDP per cap' < 0.58]

NUTS	Farm-type (%)							
	1	2	3	4	5	6	7	8
AT32	0	0	0	100	0	0	0	0
AT33	0	0	2	96	0	2	0	0
BG31	8	10	3	40	17	2	2	18
BG41	9	27	3	28	3	17	8	5
BG42	24	19	4	28	3	12	2	8
CY00	19	3	60	7	1	8	0	2
DK01	83	2	0	0	2	0	0	14
ES21	8	2	9	77	4	1	0	0
ES70	0	12	50	6	0	18	13	0
FI13	15	5	5	63	1	1	0	11
FR81	6	4	71	13	0	5	0	1
FR83	2	9	66	14	1	7	0	1
GR21	7	3	17	25	5	23	8	14
GR22	0	0	72	1	0	19	1	8
GR25	2	2	80	1	1	12	2	2
GR30	9	12	35	4	2	30	0	7
GR41	7	0	77	3	0	4	2	7
GR42	1	5	90	0	0	4	0	0
GR43	1	5	76	3	0	14	0	2
IE01	1	0	0	97	0	0	0	2
IE02	3	0	0	94	0	0	0	3

NUTS	Farm-type (%)							
	1	2	3	4	5	6	7	8
ITC3	11	36	27	3	0	19	2	2
ITF1	12	0	56	4	0	19	5	3
ITF4	11	1	76	2	0	9	0	1
LU00	3	0	14	67	1	0	2	13
PL11	14	2	6	14	6	12	22	25
PL12	10	4	10	16	3	9	26	23
PL21	11	3	7	12	2	16	20	29
PL31	14	1	8	6	2	24	16	30
PL32	16	2	1	8	2	21	19	31
PT11	4	3	46	11	0	18	8	10
PT15	0	4	57	34	0	5	0	0
PT16	14	2	21	32	4	11	5	11
PT17	13	29	17	6	1	30	2	2
PT30	22	16	13	0	0	49	0	0
RO21	12	0	1	20	3	16	24	24
RO22	23	1	2	19	3	25	9	18
RO31	16	1	3	22	4	18	18	17
RO41	23	2	1	16	3	14	15	26
SE33	41	0	0	39	1	0	0	19
SI0	5	1	10	50	0	10	12	12
SK03	27	0	0	44	1	1	3	25
TOTAL*	12	3	23	20	2	14	11	15

With Farm-types

- | | |
|--------------------------------|-------------------------|
| 1 Specialist Field crops | 5 Specialist Granivore |
| 2 Specialist Horticulture | 6 Mixed cropping |
| 3 Specialist Permanent crops | 7 Mixed livestock |
| 4 Specialist Grazing livestock | 8 Mixed crops-livestock |

23% of the holdings in NUTS2 regions at risk are of type 3 (FT3=Specialist Permanent crops). It is followed by FT4 (Specialist grazing livestock) which represents 20%. FT3 holds the biggest share in UAA. 'Specialist Permanent crops' farms are most frequent in NUTS2 located in southern Europe (Spain, Greece, Italy, Portugal, Cyprus). Most of these farms are probably cultivating olive (olives groves). While 'Specialist Grazing livestock' farms are mostly present in Ireland and in central Europe (Austria, Slovakia, Slovenia).

These results bring forward the potential risk of farmland abandonment from farm-types using large shares of land (livestock grazing system), often in an extensive manner. This is also the case for extensively managed olive groves in Mediterranean countries.

D3: Low investment level in the farm

Rationale:

Investment behaviour reflects farm dynamism, its adaptation capacity and expectations for the future. New investments are a signal of a medium/long term strategy and can be a proxy for the willingness to continue farming activity. Low investment level has a negative effect on FLA.

Assessment and methodological improvement applied:

The FADN variable G103IG “Total investments before deduction of subsidies” covering investments for agricultural land, building, rights, forest, machinery and circulating capital, is used for the calculation instead of FADN variable SE521 (Net Investment = Gross Investment – Depreciation) which was previously envisaged. Variable SE521 was not adequate due to the depreciation term that can hinder some annual investments if important depreciation occurs, for investments made in previous years.

In order to assess whether a single holding has NOT invested in the period 2006-2008, a ‘constant’ sample of holdings for each country was originally created (sample of holdings observed in each of the three years with no investment). However, the procedure for establishing the constant sample was very restrictive when used at regional level as 35% of FADN regions had less than 15 holdings fulfilling the condition, and therefore could not be used due to lack of representativeness. Consequently, it was decided to calculate the weighted average level of investments for the period 2006-2008, using as a proxy for the indicator ‘holdings with low level of investments’ instead of using ‘holdings with no investments’.

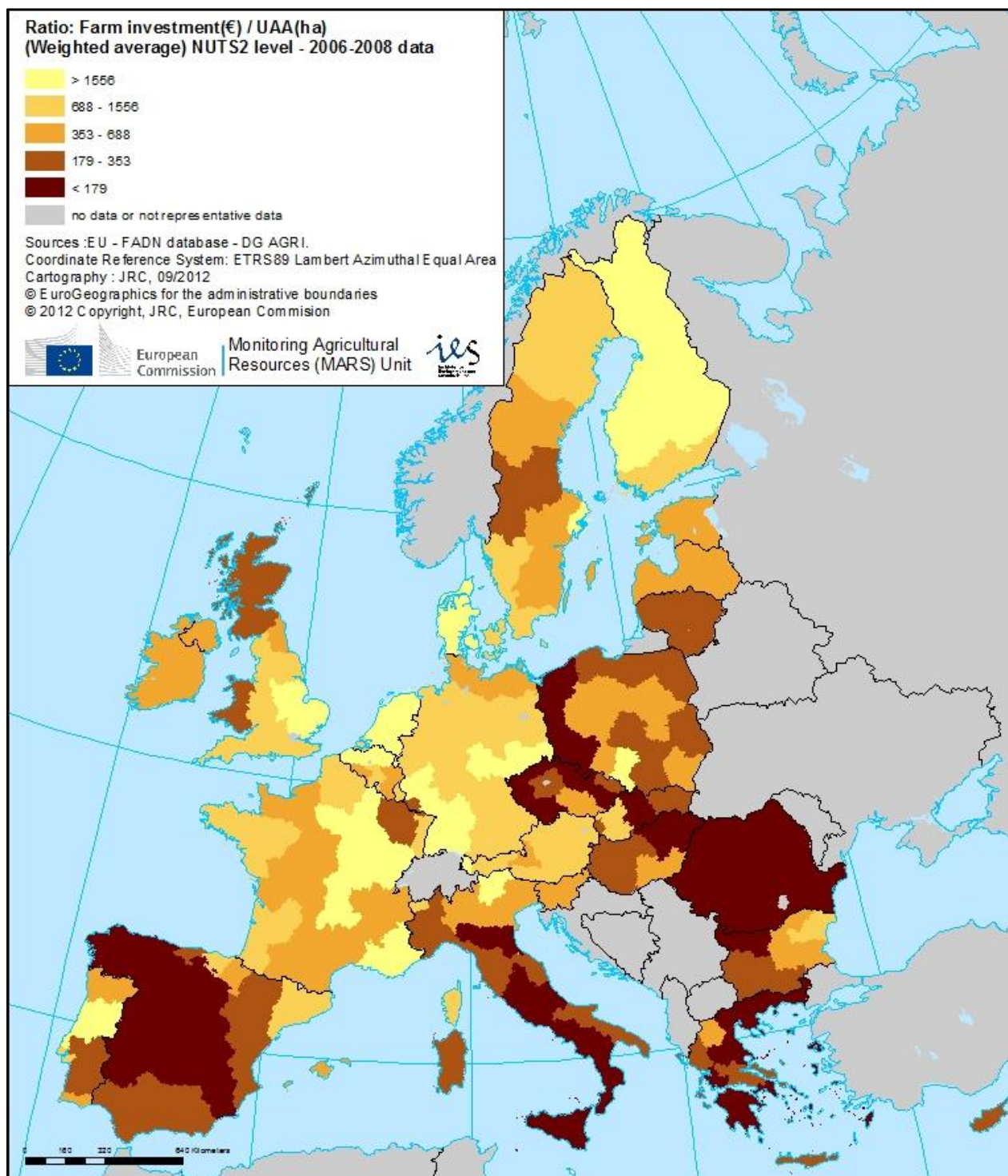
Given the structural differences occurring amongst different farming systems, the expert panel has recommended to normalize the amount of investment per holding by the physical size of the holding, as small farms will have often lower investments (in absolute terms) than large size farms. The correction has been made by dividing the investment variable by the UAA of the holding (G103IG/SE025), which provides in the end the amount of investment per hectares of UAA.

It was also suggested to test the economic size as a normalization variable. The investment per holding was accordingly divided by the economic size of the holding (dividing the investment variable by the economic size of the holding - G103IG/A27). This provides the amount of investment per euro of economic size (FADN variable A27 being the economic size).

Results:

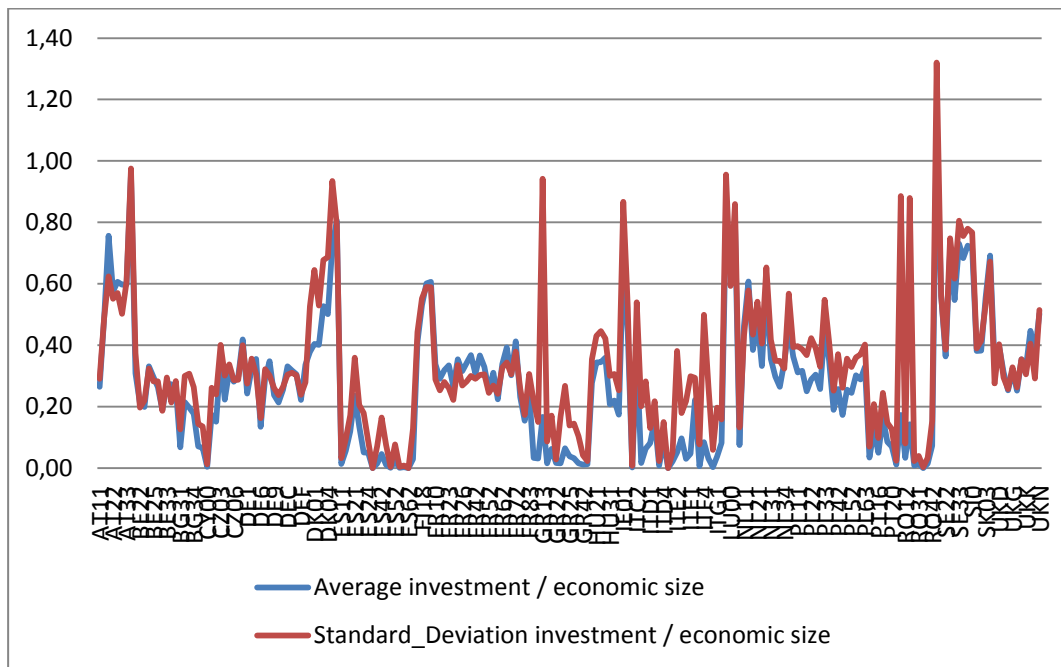
Results are shown in Figure 6. Regions with lower investment ratios are found in Spain (except north-east), in central and southern Italy, in most of Greece, in the whole of Romania, in several Czech regions and in western Poland.

Figure 6: Average level of investment per holding (normalised by physical size) (NUTS2 level) - quintiles



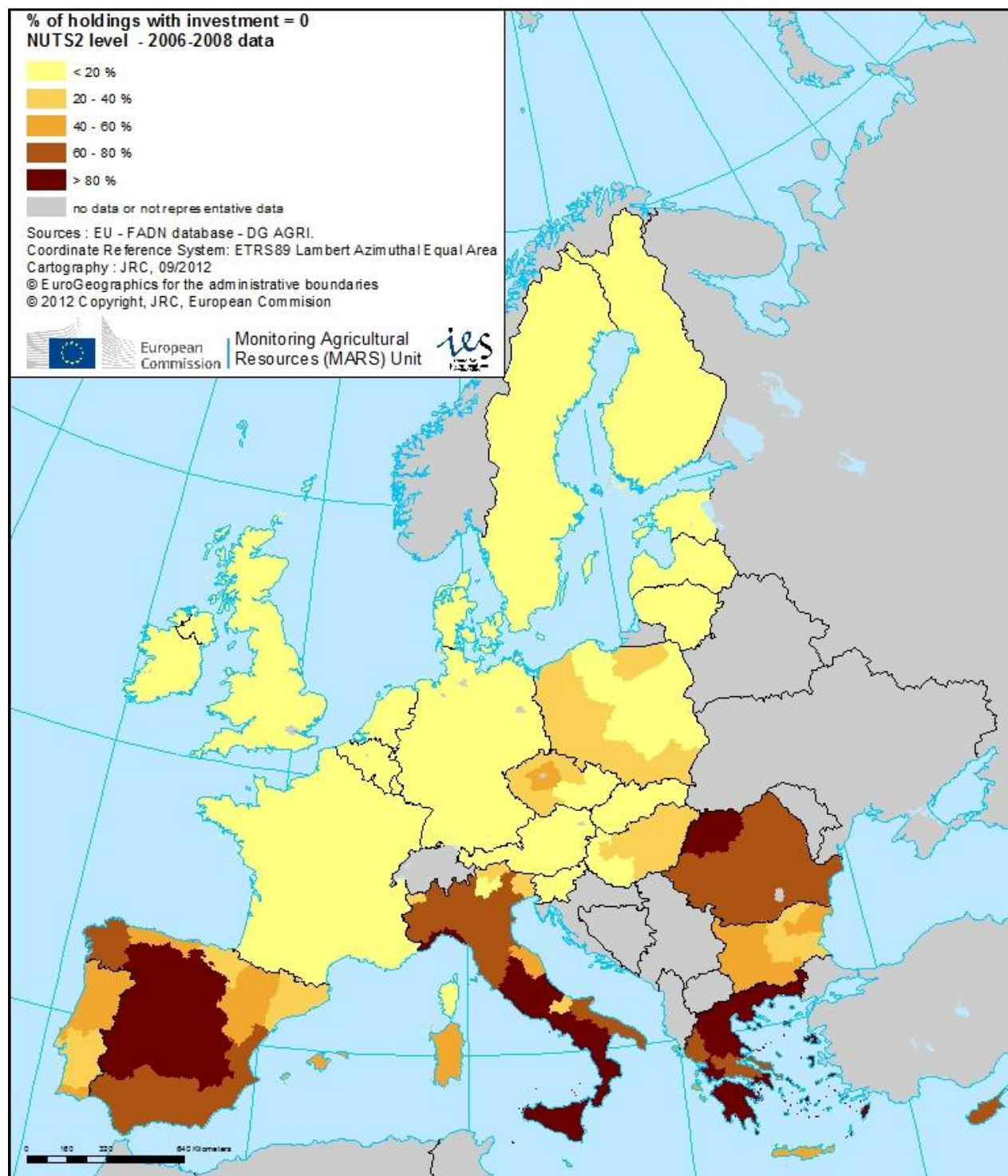
The analysis of the distribution of the results shows large variations (standard deviation higher than the average) - Figure 7. This applies in particular to the following regions: Antwerp (Belgium), North and East Bulgaria, Central Bohemia (Czech Republic), Baden, Hamburg and Essen (Germany), Denmark, Aquitaine, Rhone-Alpes and Mediterranean regions (France), Hungary, Ireland and Eastern and Western regions in the Netherlands.

Figure 7: Farm investment normalised by economic size: average and standard deviation by NUTS2



The number of NUTS2 with 'zero' values is high in some regions (see Figure 8). For example areas in Spain, Italy, Greece, Cyprus and Romania have more than 60% of the holdings with no investment during the period 2006-2008. The Farm Land abandonment expert-panel suggested to clarify this point as data reliability could be challenged.

Figure 8: Share of holdings (%) at NUTS2 level with no investment (=0) during period the 2006-2008



Upon our request for verification, AGRIL3 has confirmed some reporting difficulties in the FADN database for the investment parameter for some (Mediterranean) countries. Explanations provided by these MS mention that the financing of investment comes from "family loans". Many farmers consider those as private and do not report them in the farm accounts. Consequently debts and investments are missing for these farms. This is a known issue in the FADN database.

Moreover, some Italian experts have been consulted and mentioned some changes of definition for this FADN parameter during the period 2006-2008 in Italy, acknowledging some possible data deficiencies.

The expert-panel has also mentioned some possible effects from Rural Development measures implementation (linked to investment) as 2006 was the first year of the new programming period. However, the no-investment situation only occurs in the five MS mentioned above. It should be checked whether these MS encountered more difficulties than others in implementing RDP measures in 2006.

When assessing the ratio between farm investments and their economic size (investment / ESU), some countries such as the Baltic States have a high ratio. After checking data validity with AGRI.L3, the given explanations are:

- some farms may use common land, therefore appearing smaller in physical and economic size than what they are in reality,
- some relatively small farms may develop contract work for other farmers, then buying larger materials than they would need for their own farm.

Despite these possible reasons, data suggest that investments in the Baltic States are very high in the period 2006-2008. A comparison with Eurostat data on “Gross fixed capital formation” also shows that Latvia and Lithuania (no data for Estonia) have made important investments in the agricultural sector in the last 10 years.

The difficulties for reporting on investments for some Mediterranean countries and data variability in some countries suggest a medium confidence level for this driver.

D4: Age of farm holder (>65 years)

Rationale:

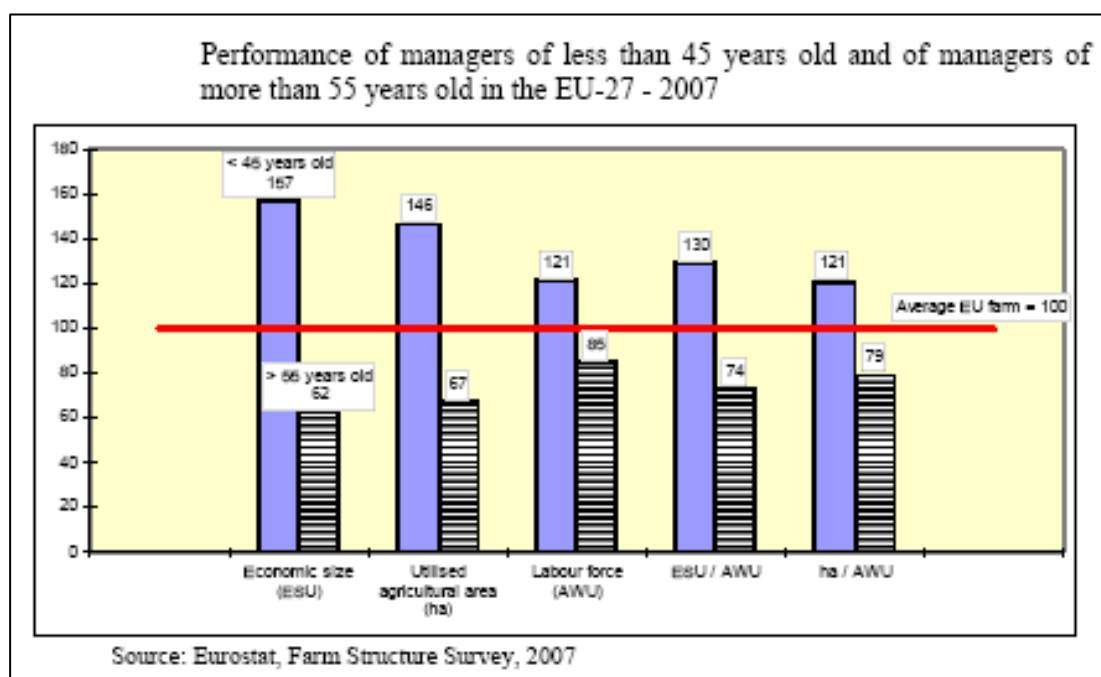
Farmland abandonment is more likely to occur when the farmer is old and close to retirement. A high share of old farmers in a region has a negative effect on FLA.

Assessment and methodological improvement applied:

Farmers' age is generally acknowledged in literature references as an important driver for land abandonment. The information published in ‘Situation and prospects for EU agriculture and rural areas - December 2010’¹⁰ does confirm the structural difference in farming between young and old farmers in the EU. Younger farmers being always above the EU average (older farmers being always below) for parameters on economic size, UAA and labour force (see Figure 9).

¹⁰ http://ec.europa.eu/agriculture/publi/situation-and-prospects/2010_en.pdf

Figure 9: Performance of farm managers' age classes below 45 years and above 55 years



The IRENA methodology was used as starting point for this indicator: Regions with a high share of farmers close to retirement were defined by more than 40% of holdings managed by farmers aged 55 years and older). However, the limit for the age has been discussed since 55 years old is considered for the early retirement scheme under the RD regulation. Nevertheless, it seems to be too low since many regions of some MS would be concerned (e.g. Portugal). Another point was that at the age of 55, it is very difficult to change sector or labour. Therefore, the farmer will probably stay.

The first calculation of this indicator raised concerns for biases due to:

- Data resolution: the administrative level at which the calculation is made matters as large administrative unit levels - NUTS3 and above - loses the internal variation due to averaging a larger population,
- Data interpretation: some experts raised some doubts for their countries as results could be the consequence of specific institutional country-related situations such as the pension scheme, tax system, farm transmission scheme, etc. rather than the real situation of actual farm holders.

In order to reduce these biases, data on 'age of the farm-holders being a natural person' (FSS 2007 data) were downloaded directly from the ESTAT website at NUTS2 level (ensuring consistency in spatial scale, as only few countries have data available at NUTS3 level). For Germany and UK, NUTS1 data were used due to missing data at NUTS2 level.

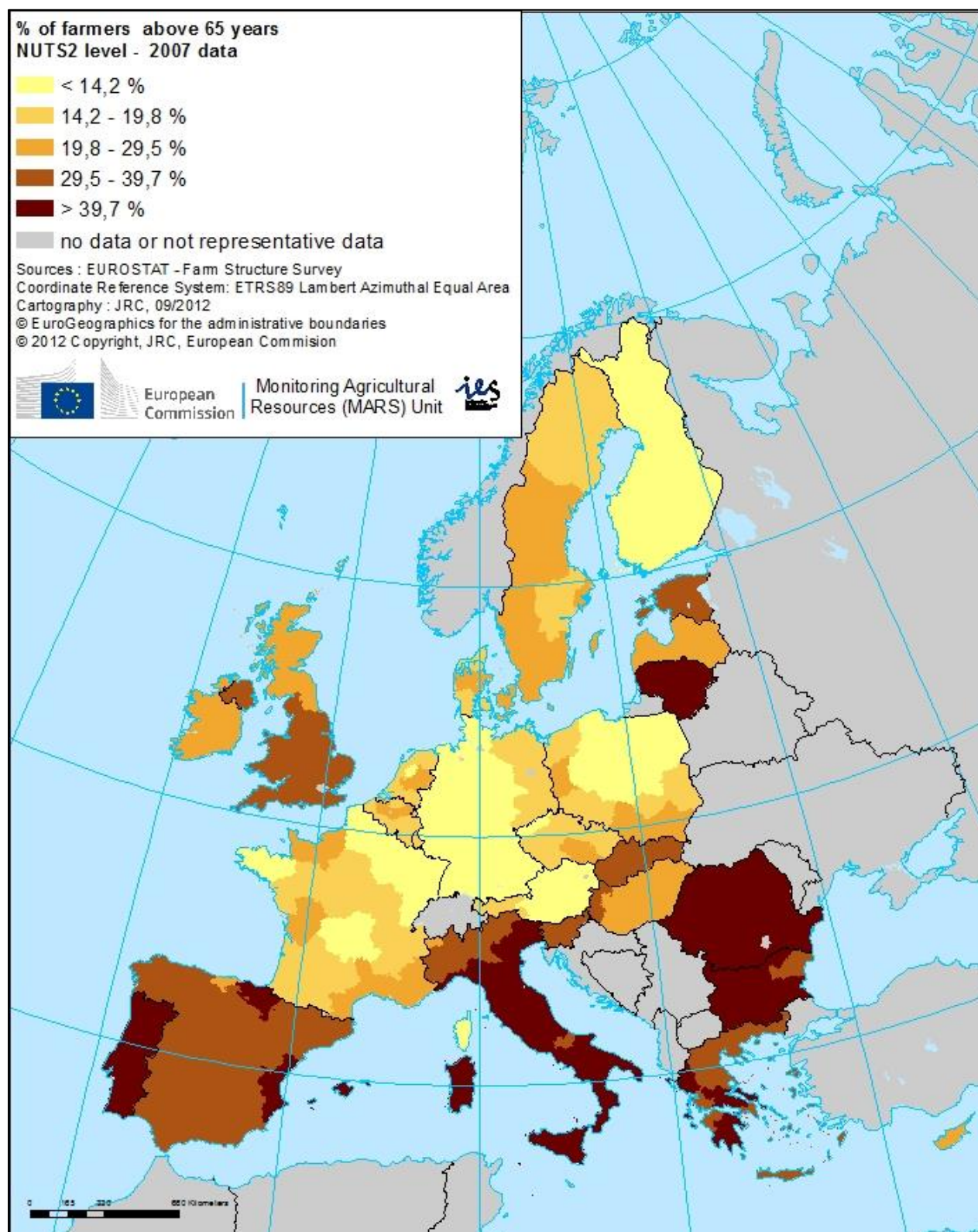
The share of farm holders above 65 years in the total number of farm holders has been calculated in order to have a proxy for the distribution of the farmers' age population. This proxy was used to possibly lower the potential bias mentioned by the experts related to specific institutional country-related situations.

Results:

Figure 10 shows the EU map for the share of farm holders older than 65 years.

The share is very high (>40%) in Portugal, most of Italy, southern Greece, Bulgaria, Romania and Lithuania. It is also high in England, Wales and Northern Ireland. However, a member of the expert panel raised doubts on the validity of results for UK, arguing that in this MS, farm owners (older) and farm managers (younger) are often different; This is different from the general assumption that farm owners and holders are the same person.

Figure 10: Share of 'farm holders aged more than 65 years (NUTS2 level) - quintiles



Despite farmers' age is acknowledged in many literature references as an important driver for land abandonment, pan-European data heterogeneity, different institutional and structural situations in MS, and the impossibility to verify the variability of aggregated data (as we did not have access to FSS micro-data), it is suggested to assign a medium level of confidence to this driver.

D5: Low farmer qualification

Rationale: Education/training and use of advisory services can be assumed as a proxy for the professionalism of the farm, and willingness to invest in terms of human capital and knowledge with a sufficient time horizon. An inverse correlation exists between the level of education/training and the use of advisory services and risk of land abandonment. Low farmer qualification has a negative effect on FLA.

Assessment and methodological improvement applied:

Data on farmers' training level were downloaded from Eurostat's public website. Data at NUTS2 and NUTS3 levels were used (no access to more detailed data), depending on their availability in MS. The mapping was done at NUTS2 level for comparability purposes and because not all NUTS3 within a given NUTS2 may have data. The last available dataset (2005) was used.

Table 6: Variability in the educational / training level data

MS	NUTS level	MS	NUTS level	MS	NUTS level
AT	2	FI	3	MT	0
BE	3	FR	3	NL	3
BG	3	GR	3	PL	3
CY	0	HU	3	PT	3
CZ	3	IE	3	RO	3
DE	2	IT	3	SI	3
DK	3	LT	3	SE	3
EE	3	LU	0	SK	3
ES	3	LV	3	UK	3

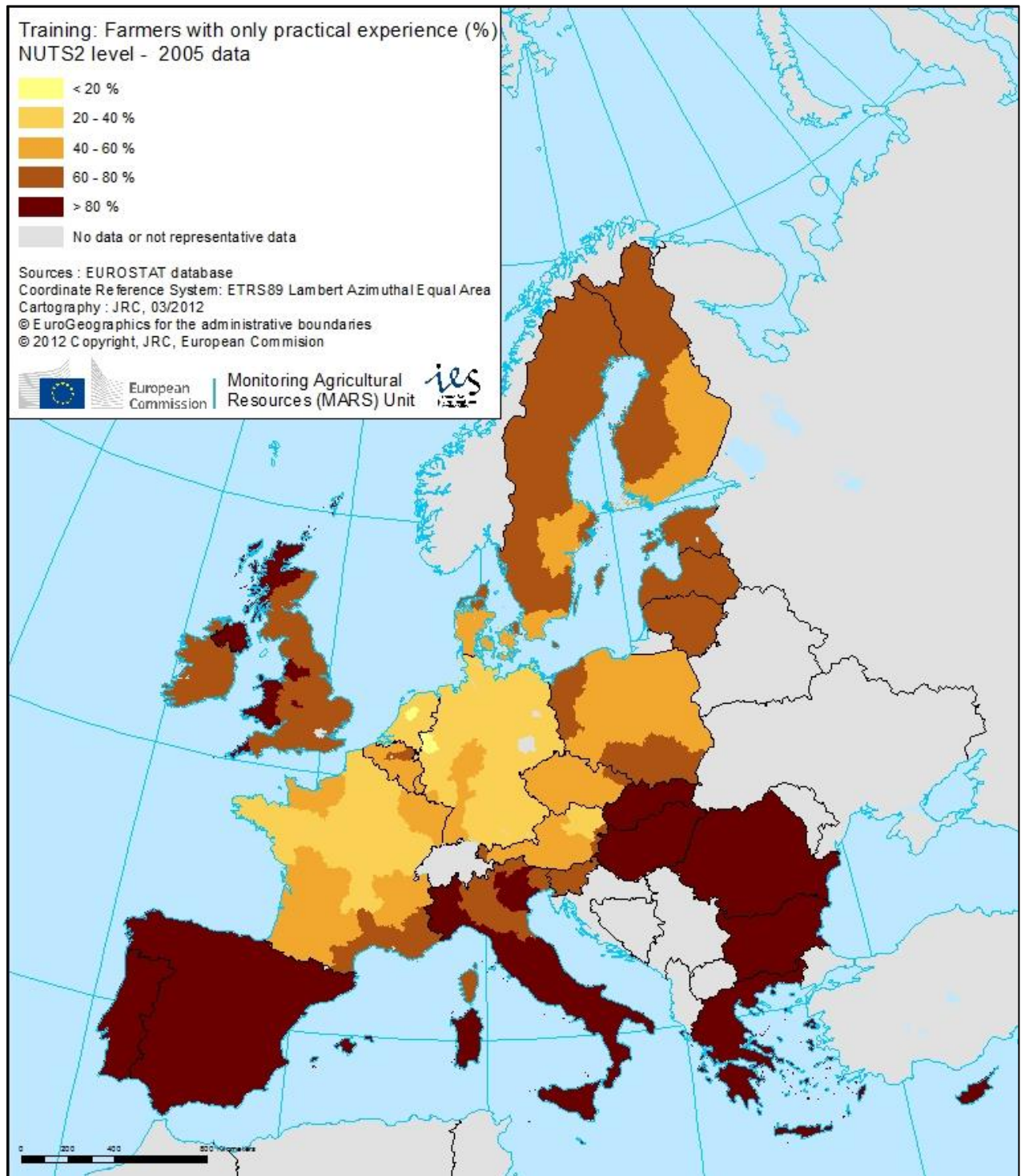
FSS parameter values for farmers' training level were: "practical experience only", "basic agricultural training", and "full agricultural training". Percentages for each category were calculated (from the total number of managers having answered the question in the survey).

Results:

The EU map on the parameter 'farmers with practical experience only' is shown in Figure 11. Mediterranean (Portugal, Spain, most of Italy, Greece, Cyprus) and some central European countries (Slovakia, Hungary, Romania and Bulgaria) have more than 80% of respondent-farmers with "practical experience only", meaning that very few of them have followed agricultural education courses. To a lower extent (60-80%), there is also a majority of respondents with only practical experience training in UK, Ireland and in the Baltic States.

The expert panel questioned the validity of the FSS data for this parameter and therefore suggested a low confidence level for this driver.

Figure 11: Share (percentage) of farmers with practical experience in 2005 – NUTS2 level



D6: Previous trend of Farmland abandonment

Previous trend of farmland abandonment was suggested by the expert panel as a possible driver. The rationale is that regions facing the phenomenon are more fragile, and therefore prone to further land abandonment.

Farmland abandonment trend assessment was suggested to be made from time series analysis by estimating the loss of agricultural land (UAA) which has not been converted into forest or into artificial areas between two points in time (Pointereau et al, 2008). This non-utilised agricultural land is no longer farmed for economic, social or other reasons, and is not included in the crop rotation system.

To be relevant and accurate, the calculation needs to be done at local level (LAU2) in order to avoid compensation effects occurring in larger units, especially when urbanisation or afforestation rates are important.

Therefore the driver requires the use of UAA data from Farm Structure Survey at LAU2 level from at least two censuses. This brings two major difficulties:

- Community FSS data at LAU2 level are confidential and our project did not succeed in receiving these dataset from ESTAT;
- FSS census 2010 is not yet available (foreseen for end of 2012 – early 2013).

Given these data limitations, it was not possible to calculate driver D6.

Moreover, a part from the data availability issue, another weakness of this driver is its lack of sensitivity for changes in agricultural policies and in new economic and structural situations.

D7: Remoteness / low population density

Rationale:

Farm land abandonment is likely to occur for farms with remote and difficult access. The accessibility provides information on the location of an area with respect to opportunities, activities or assets existing in other areas. High remoteness and low population density have a negative effect on FLA.

Assessment and methodological improvement applied:

Several layers of geographical datasets were used. They consist in:

- *Low population density:* A grid layer containing population density was used to classify the EU-27 LAU2 into 6 classes. This dataset is based on the OECD methodology to build LAU2 typology (urban or rural) (Reference: <http://www.eea.europa.eu/data-and-maps/figures/population-density-2>). The population density information has been broken down into several classes in order to identify very low densely populated areas only.

- *Remoteness*: A layer containing the travel time by road network to urban centres was selected as indicator of remoteness. One of the advantages of this indicator is the availability of data at LAU2 level for each European country (except for Bulgaria).

A GIS network analysis was used to compute travel time needed from each European commune (origins = LAU2 from which the travel time is computed) to reach the closest city centre (destinations = city of at least 50.000 inhabitants) in order to access a wide range of services and opportunities such as schools, hospitals, banks, wholesale agricultural products markets, etc.

The expert panel has suggested thresholds for both criteria: less than 50 inhabitants per km², more than 60 minutes of travel time to the closest urban centre. A new dataset was created, combining the population density and the remoteness data, providing both characteristics for each LAU2 in EU27 (Figure 14) for the most relevant classes: population density below 50 inhabitants; and travel distance above 60 minutes. The underlying hypothesis, suggested by a member of the expert panel, is that at less than 30 minutes traveling to an urban centre and that above a population density of more than 150 inhabitants per km², there is no major risk of land being abandoned.

Results:

The expert panel agreed on the usefulness and relevance of these criteria, especially for the remoteness.

The following maps (Figure 12, Figure 13) display respectively the results of the low population density and remoteness at various threshold levels. There is obviously a clear relation between the two datasets.

The map on the combination of both criteria (Figure 14) identifies remote and scarcely populated areas in Spain and Portugal, southern France, Italy, Greece, in mountain regions of Romania and Austria. Additional areas are found in northern Poland, in the Baltic and Nordic States, in Wales and Scotland and in Ireland.

The availability and completeness of data at LAU2 level for all MS is very good. The expert panel has already acknowledged the usefulness of this driver. Consequently, a high relevance is proposed.

Figure 12: Population density (inhabitants per km2) at LAU2 level

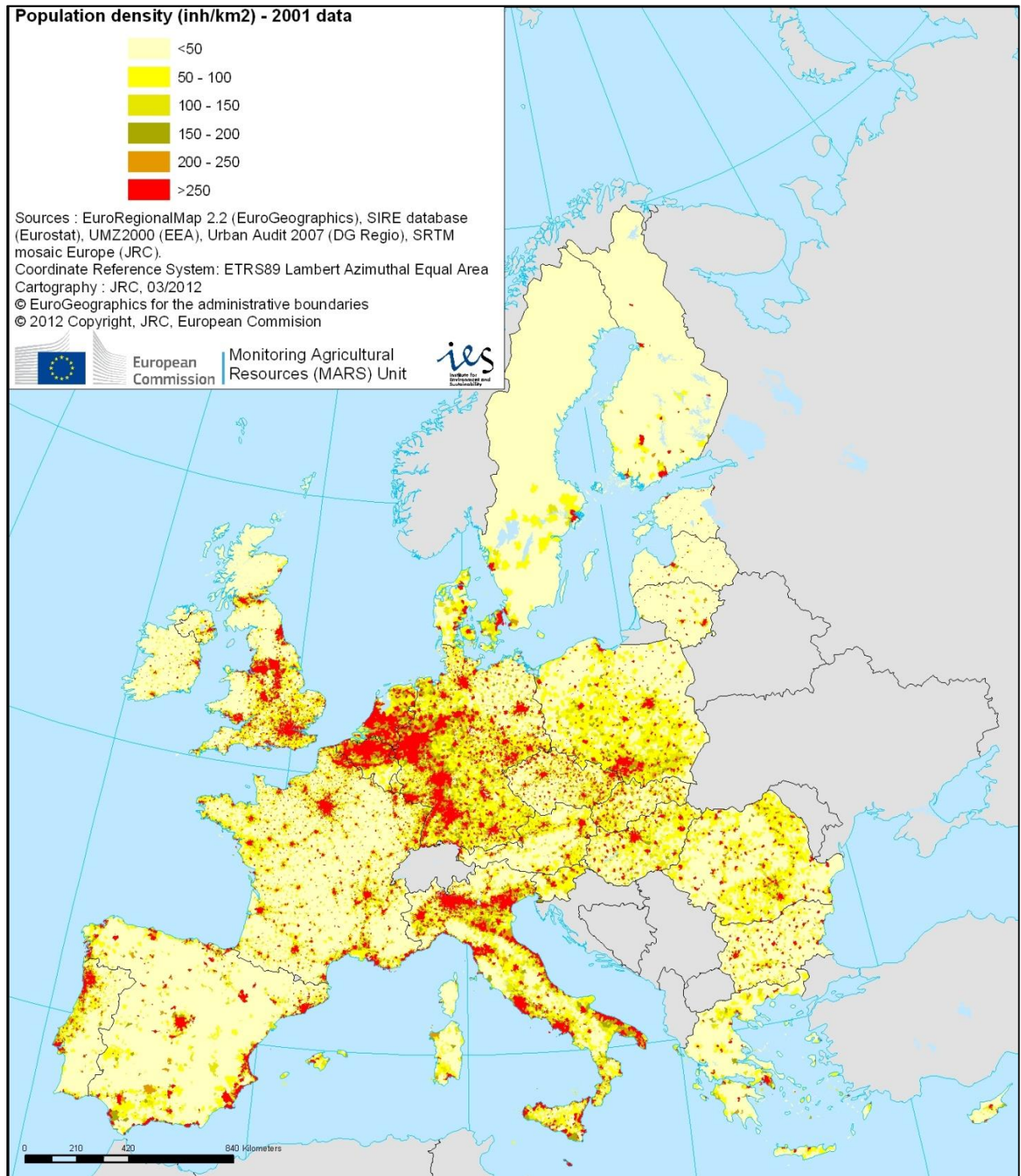


Figure 13: Travel time to the closest urban centre at LAU2 level

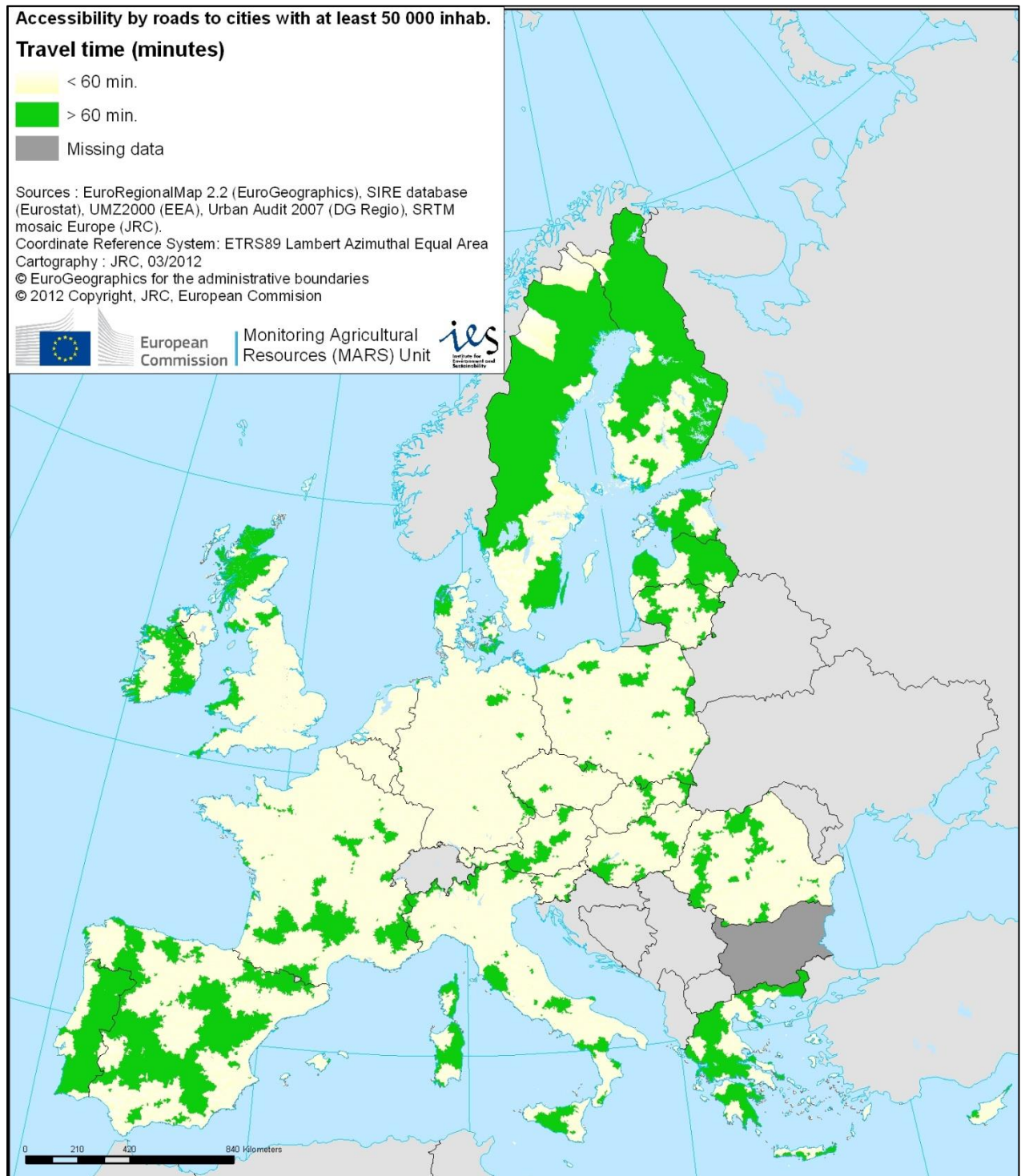
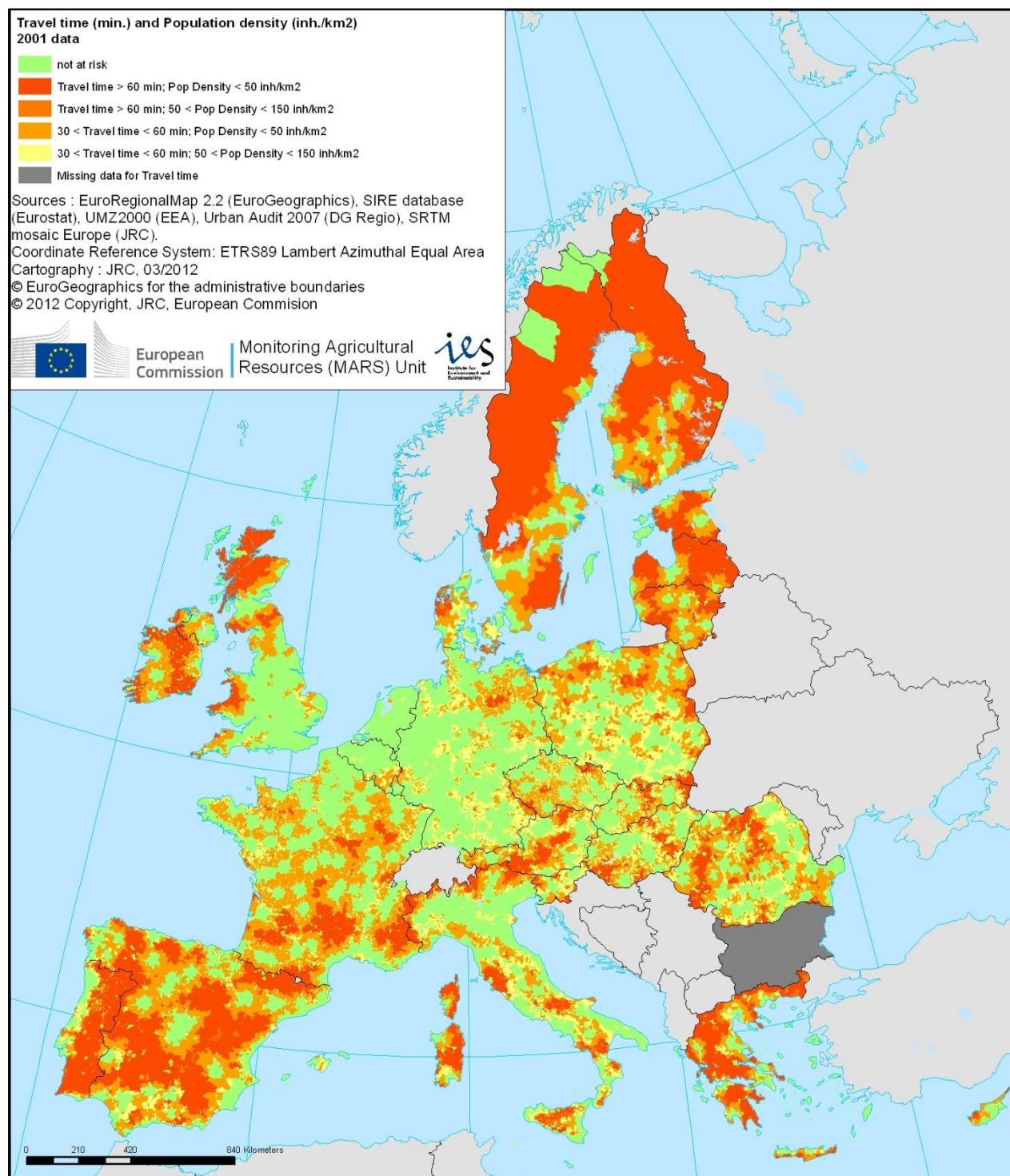


Figure 14: Travel time to major urban centres combined with population density at LAU2 level



For the purpose of identifying farmland at risk of abandonment, it is therefore necessary to identify agricultural land within regions of low population density and remote from an urban centre.

LAU2 matching the thresholds were identified. The corresponding agricultural area¹¹ of those LAU2 was determined by overlaying the Corine Land Cover (CLC) 2006 dataset (due to missing CLC data for Greece in 2006, CLC 2000 was used instead).

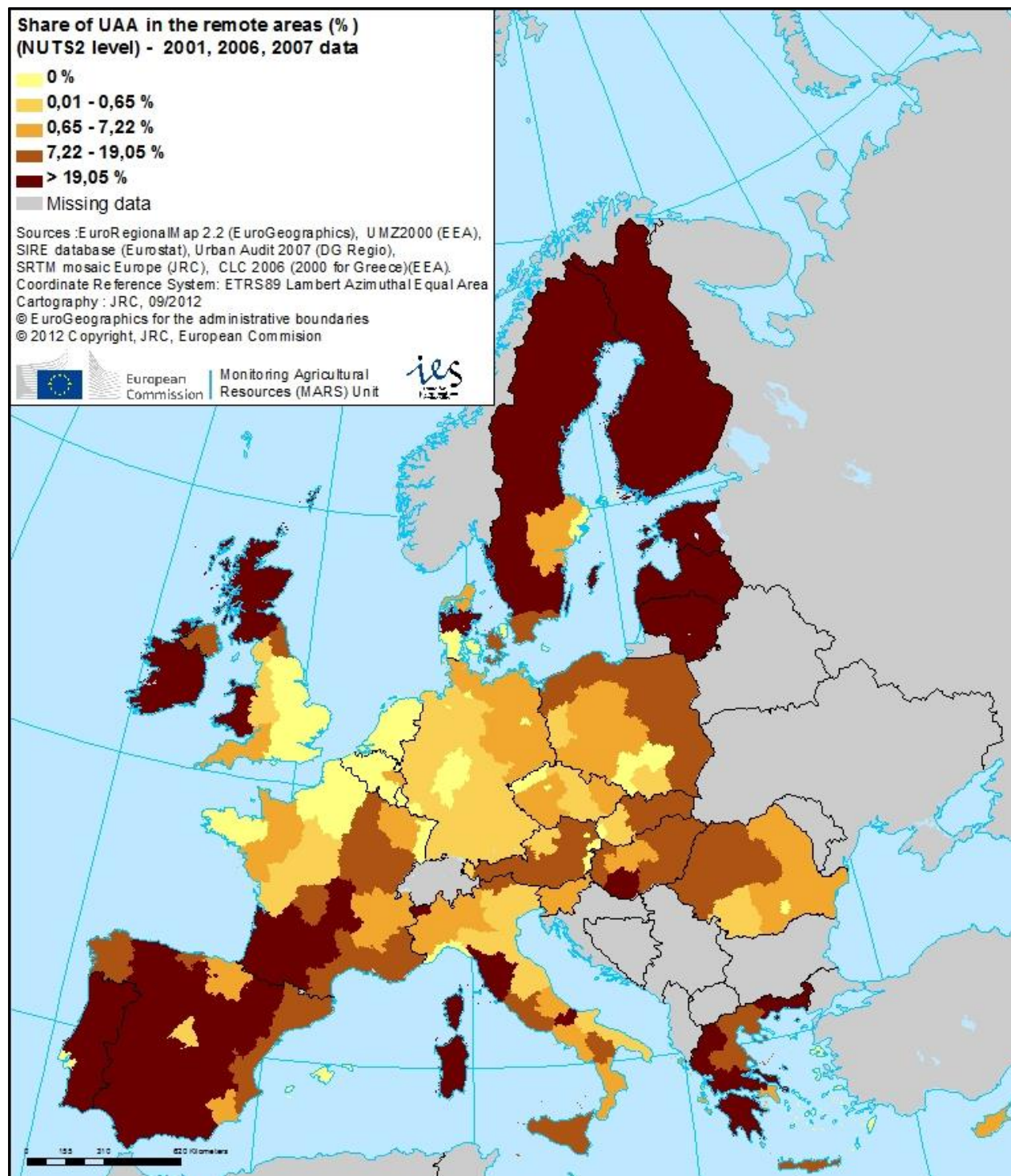
¹¹ Caveat: Corine Land Cover (CLC) does not provide official data on agricultural areas. As CLC is derived from a photo-interpretation of satellite images, there can be large differences with official agricultural statistics.

The share of agricultural area in scarcely populated and remote LAU2 was calculated, by reporting the agricultural areas at risk to the total agricultural areas at NUTS2 level (NUTS1 for DE, UK; NUTS0 for CY, EE, LT, LU, LV, MT, SI).

Regions with a higher share of agricultural land in remote and scarcely populated areas occur in Portugal, Spain, south-west France and Corsica, Tuscany / Molise and Sardinia in Italy, most of Greece, the Baltic States, Scotland and Wales in the UK, and Ireland (Figure 15, results are shown in quintile classes). In these regions, more than 19% of the agricultural land is in low populated areas and remote from cities.

However, CLC is the only Europe-wide land cover information available at LAU2 level.

Figure 15: Share of UAA in LAU2 with low population density (< 50 inhabitants/km²) and remote from urban centre (travel time > 60 min) at NUTS2 level. Results are shown in quintiles.



D8: Low farm size

Rationale:

The size of a farm refers to its Utilized Agricultural Area (UAA). In general, larger farms can benefit from lower production costs, are more suitable for most of the competitive agricultural practices (use of machinery or a better efficiency in the use of inputs), they are more frequently

related to innovation and usually more competitive and viable in economic terms. Moreover, fragmentation has a general negative effect on the farm output and it can simply be stated that, the more fragmented farms are, the more significant is the negative impact on their economical results. Low farm size has a negative effect on FLA.

Assessment and methodological improvement applied:

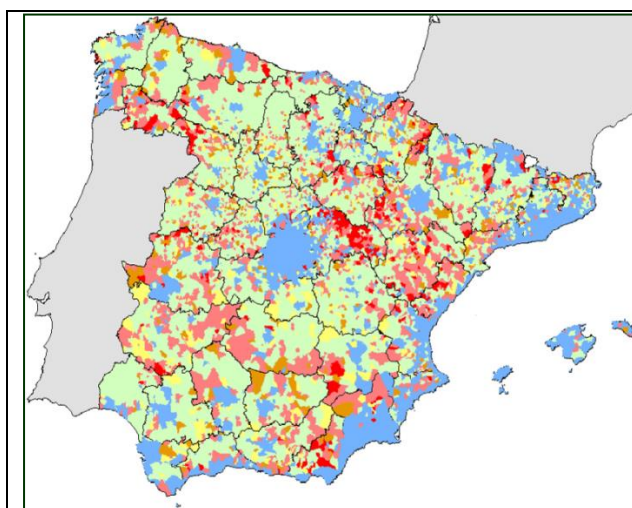
The farm physical size (ha UAA) of each individual holding from FSS is compared to half the regional average farm size (ha UAA) within the same farm type.

The construction of this driver requires the input data to be individual (number of farms under a certain size). The only possible dataset to be used is an exhaustive FSS census. As of October 2012, the last available FSS census data are from 2000. The availability of FSS census 2010 is foreseen only for the end of 2012, early 2013.

Because it was impossible to access ESTAT FSS micro-data (even anonymously) some calculations were done by ESTAT and results were provided to the JRC. For the comparison to the regional average farm size the JRC requested two geographical levels (NUTS3, NUTS2). Due to a lack of resources ESTAT has only provided the results for the comparison to the NUTS3 average farm size.

An important parameter is the level of aggregation for calculating the share of farm size below a certain threshold. Indeed, if the aggregation level is too large (NUTS3 and above), it could mask the existence of farms having a small size but that are concentrated spatially in few locations (LAU2). When all farms in a NUTS3 or NUTS2 are considered, their share is not significant and the phenomenon will not be depicted.

Figure 16 and Figure 17 illustrate the effect of the size of the administrative unit on the aggregation of results (here the UAA evolution between two censuses aggregated at LAU2 and NUTS3 levels).

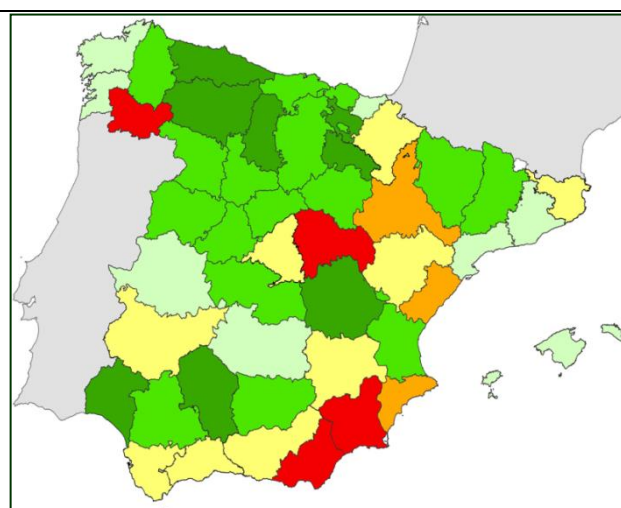


UAA evolution (in %)

- -100% to -50%
- -50% to -10%
- -10% to -5%
- -5% to 0%

- Rural areas with UAA increase
- Urban areas

Figure 16: UAA evolution between 2 census at LAU2 level



UAA evolution (% of UAA 89)

- < -10%
- -10% to -5%
- -5% to 0%
- 0 to 5%
- 5% - 20%
- > 20%

Figure 17: UAA evolution between 2 census at NUTS3 level

Results:

The data were provided to us for the lowest possible geographic reference level respecting the constraints of sampling (NUTS3 or LAU1 or LAU2; depending on the MS) and farm types representativeness. The geographic reference level and census years are provided in the table below.

Table 7: Geographic (administrative) reference level and reference year for the calculation of the share of holdings with UAA below the regional average farm size.

MS	Administrative reference level	Year
AT	LAU2	2000
BE	LAU2	2000, 2003
BG	NUTS3	2003
CY	NUTS3 not available	
CZ	No census	
DE	NUTS3 not available	
DK	LAU 1	2000
EE	No census	
EL	LAU1	2000
ES	LAU2	2000
FI	LAU2	2000, 2003
FR	LAU1	2000
HU	NUTS3	2000

MS	Administrative reference level	Year
IE	LAU2	2000
IT	LAU2	2000
LT	NUTS3	2003
LU	LAU2	2000, 2003
LV	NUTS3	2000
MT	No census	
NL	LAU2	2000, 2003
PL	NUTS3	2003
PT	LAU2	2000
RO	NUTS3	2003
SI	NUTS3 not available	
SE	LAU2	2000, 2003
SK	NUTS3	2001
UK	LAI1	2000, 2003

It should be noted that at NUTS3 level data are missing for six Member States, namely Cyprus, Czech Republic, Germany, Estonia, Malta and Slovenia.

The previous analysis made for the “Income” Driver (D2) showed that holdings with particularly low income are from type “grazing livestock” or type “permanent crops” (see section D2, Table 5). These two farm-types have therefore been used to target the analysis for Driver D8. The share of holdings with a UAA below half the regional (NUTS 3) average by farm type is shown in Figure 18 for “grazing livestock” and Figure 19 for “permanent crops”.

The expert panel finds the results little relevant since some areas might be identified because the farm type in question is rare (compared to other farm types present in the surrounding) in a specific area and with a size below the average regional farm type size. However, this is not enough to be a factor of land abandonment. Indeed, the map for “grazing livestock” identifies for example some productive cereal growing areas in France or in the UK, only because there are few (small) grazing livestock farms in these regions. These areas are not at risk of land abandonment.

For countries such as Slovakia, Hungary and Romania, the distribution of farm size may show co-existence of few very large farms and many small farms resulting in a large share of farms below the regional average. As we have only received the results of the calculation from ESTAT, the JRC cannot carry out further statistical verifications on the distribution of farms.

Moreover, some additional information would be necessary to know how much area (ha UAA) is associated to the number of farms identified and how many farms are concerned in order to aggregate the results to a higher administrative level (NUTS2, NUTS1). This is not possible with the data provided by ESTAT.

Indeed, in a test and trial phase it is desirable to test statistically different calculation methods and thresholds and different aggregation levels. This is possible only if access is given to raw data. Consequently with the limitations for accessing data defined by ESTAT, it is not possible to fully assess the relevance of this indicator.

Further to this issue, difficulties were encountered with the LAU2 identification codes which change for some countries between 2000 and 2003. Consequently, the maps may have some ‘no data’ areas because it was not possible to link statistical database records to the geographic data layer.

Figure 18: Share of grazing livestock holdings (percentage) with UAA below half the NUTS3 average of grazing livestock farms.

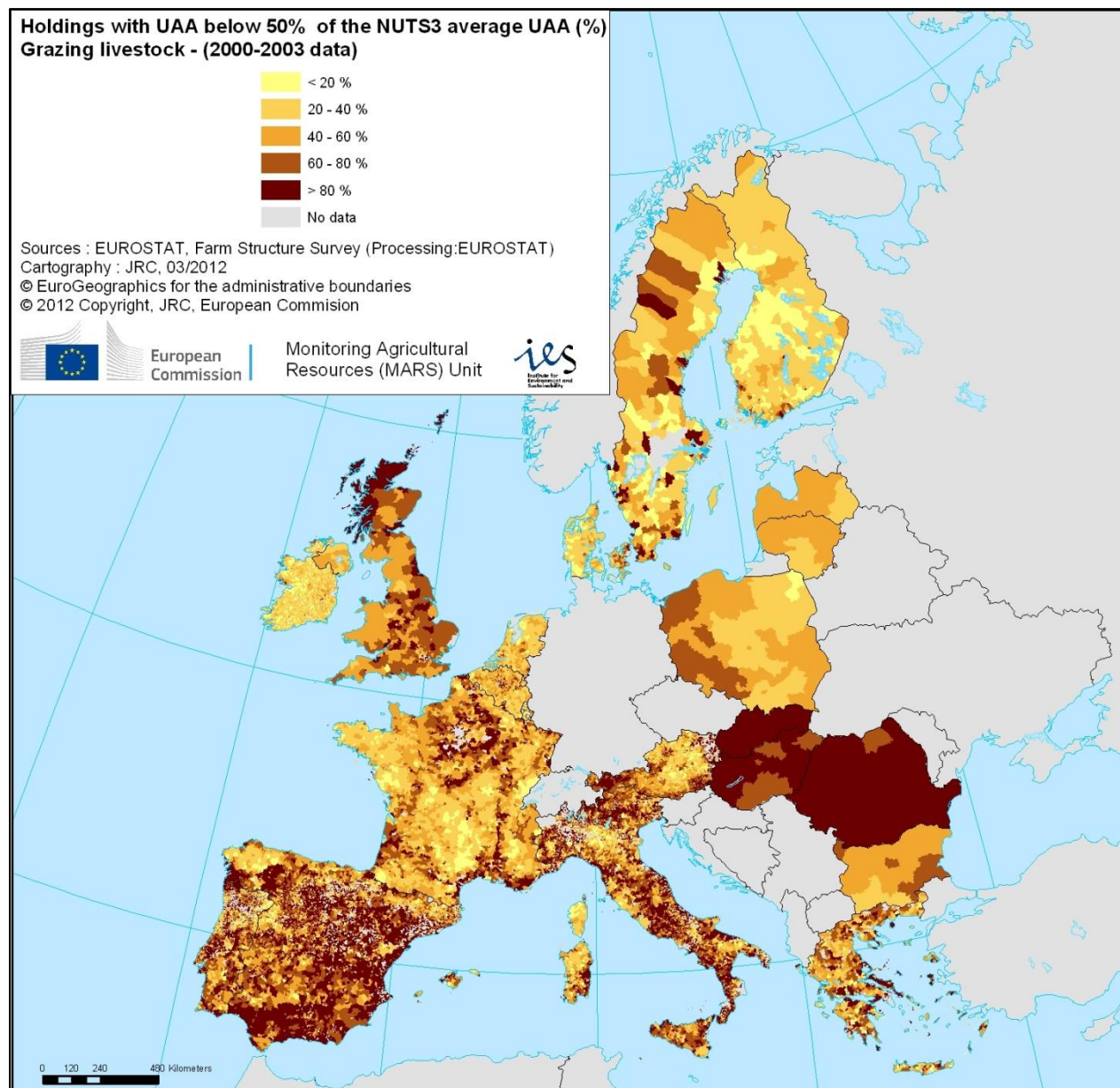
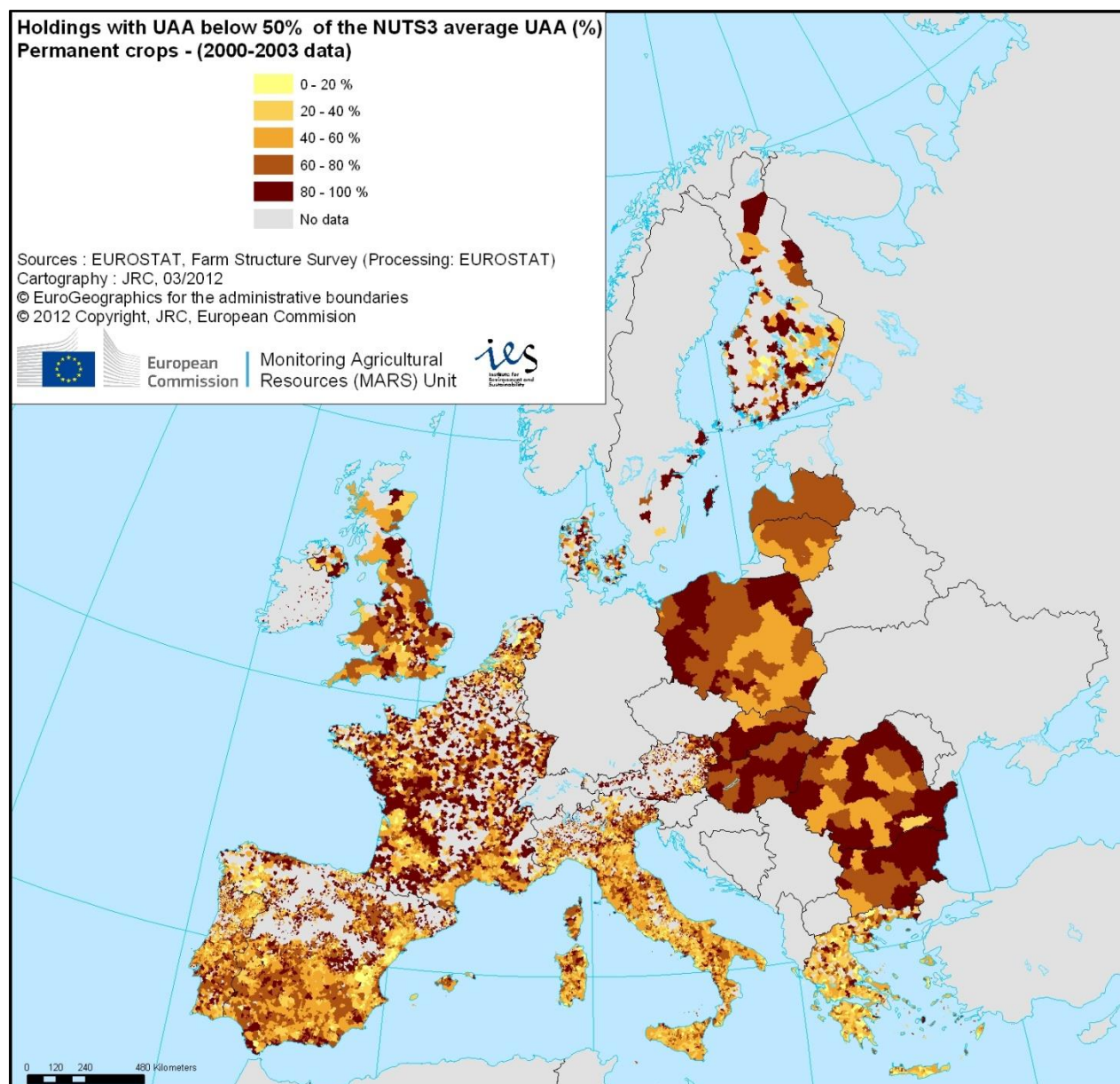


Figure 19: Share of “permanent crops” holdings (percentage) with UAA below half the NUTS3 average of “permanent crops” farms.



The comparison with the NUTS2 average farm size has not been done as results have not been provided by ESTAT.

Issues previously reported, particularly the impossibility to carry out further statistical analysis on the data, but also the experts’ advice on the results obtained until now suggest a low confidence level for this driver.

Further considerations:

Additional relevant information on farm size has been found on “Situation and prospects for EU agriculture and rural areas - December 2010” (http://ec.europa.eu/agriculture/publi/situation-and-prospects/2010_en.pdf), however only at national level.

The average farm size varies from more than 50 ha in five Member States (Czech Republic, Denmark, Luxembourg, the United Kingdom and France) to less than 5 ha in four others (Malta,

Romania, Cyprus and Greece, see figure below). Differences are even larger when considering the economic size of the farms (potential gross value added), that takes into account the potential economic productivity of the area used (see figure below).

Figure 20: Average farm size (ha), economic size (Gross Value Added in euro)

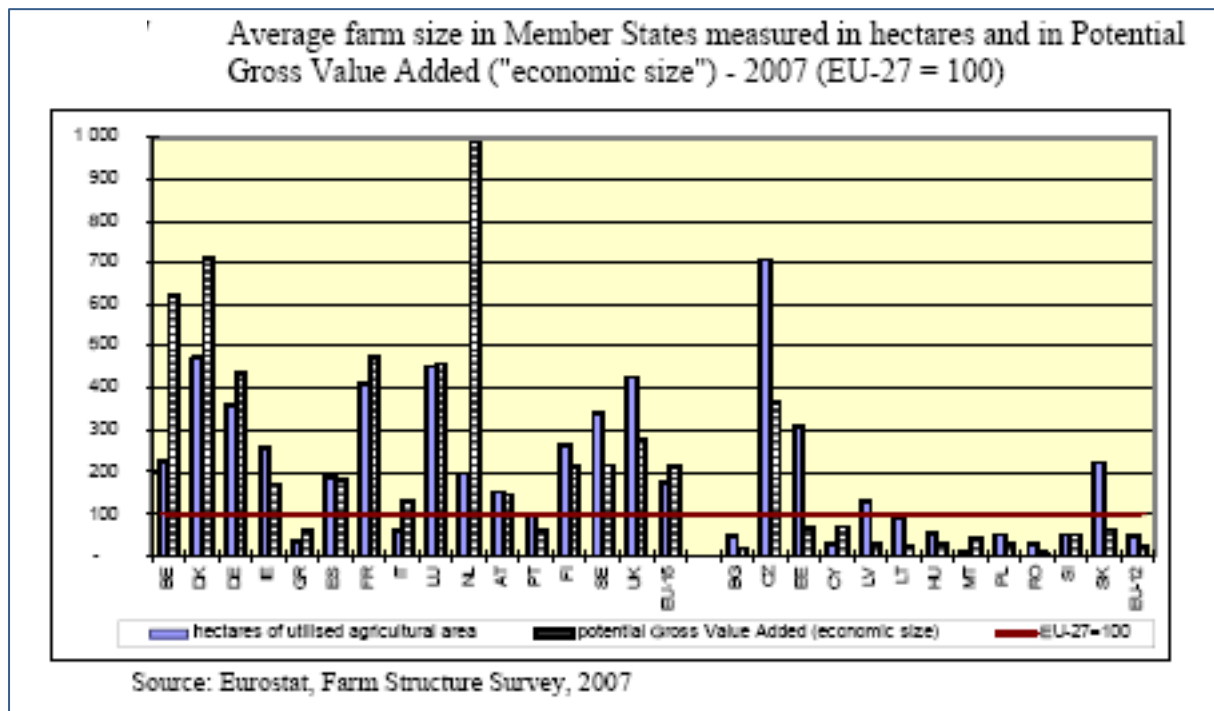
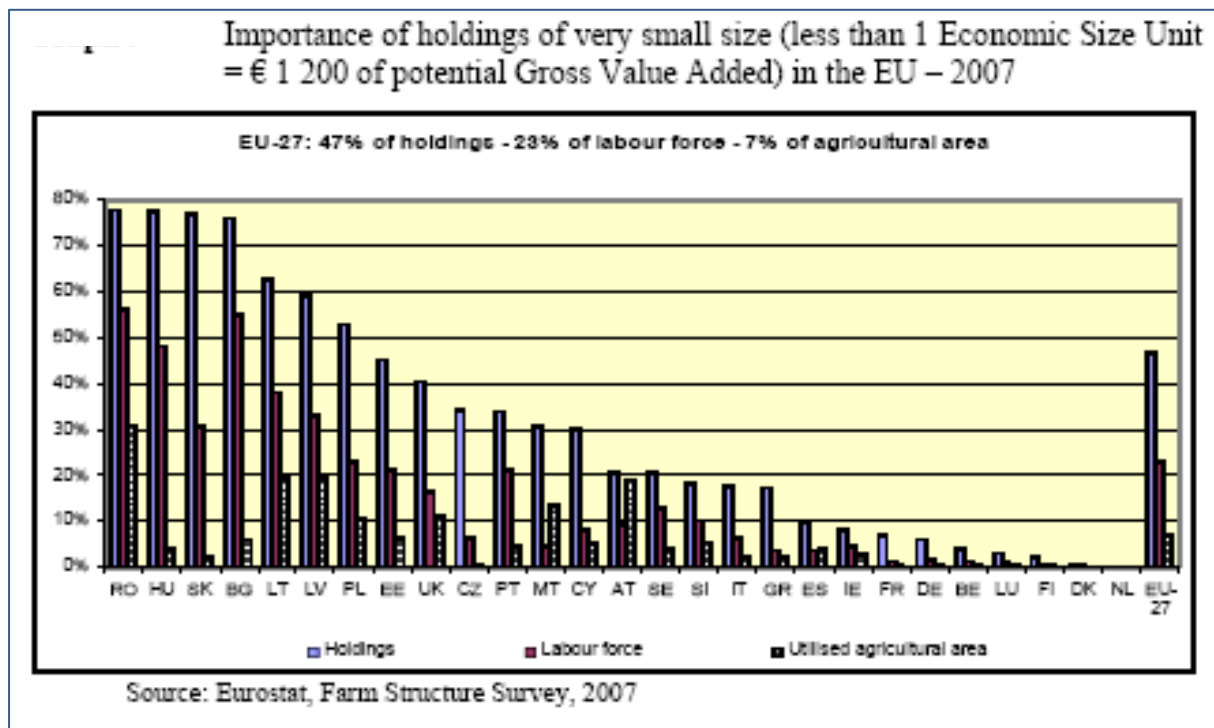


Figure 21: Share of very small holdings (< 1 ESU) by MS



D9: Farm enrolment in Specific Schemes

Rationale: The risk of land abandonment is lower in the case of presence of payments linked to a commitment to continue farming, or to manage the land in a prescribed manner. High farm enrolment in a specific scheme has a positive effect (reduces FLA).

Assessment and methodological improvement applied:

The principal scheme to avoid land abandonment is the support to farmers in Areas with Natural Constraints (ex-LFA). Therefore, it seemed logical to identify areas supported by this scheme. However, a first attempt has been made with data on payments for Less Favored Areas (LFA) but too many problems and caveats occurred, e.g.:

- The rationale can easily be challenged as high payment level does not mean high risk of land abandonment (similarly for low payment and low risk level). Indeed, the level of payment is not always directly linked to the cost incurred and income foregone of farming in areas with natural handicaps; it can also be linked to the budgetary availability of the MS for the second pillar of the CAP and to its Rural Development policy priorities.
- The number of holdings receiving payments is not a useful information either as there is no specific commitment to be fulfilled to receive payment apart from continuing farming for five years. The LFA scheme is well known as being an easy way for MS to distribute pillar2 budget. Moreover, not all farms are eligible to the scheme within a Less Favored Area, eligibility criteria are applied targeting specific farms, there again according to Rural Development policy priorities of the MS.

Instead, it was suggested to use the Agri-Environment Measure (AEM) scheme. The rationale being that real commitments for specific land management practices are at stake and the AEM scheme operates on a voluntary basis for farmers. In areas where a large share of farmers uptake AEM, it is expected that the risk of farmland abandonment would be low.

However, a low level AEM uptake cannot be a proxy for a risk of abandonment (for e.g. in intensive agriculture areas, there might be a low uptake of AE measure but there is no risk of land abandonment), while the opposite can be accepted (a high level of AEM could be a sign of low risk of abandonment, as farmers are committed for some time – five years at least – to farm their land according to AEM specifications). This caveat already suggests a limited relevance level for this driver.

The representative from DG AGRI suggested using AEM data on “organic farming” (as AEMs can cover a whole bunch of measures, reaching from putting in place hedges, buffer stripes, or mowing grassland at specific dates to longer crop rotation or fertilizer use reduction, etc.). Data are usually available only at Rural Development programme level (i.e. national level for AT, BG, CZ, CY, DK, EE, EL, FI, FR, HU, LT, LU, LV, MT, NL, PL, PT, RO, SI, SK, SE and regional level for BE, DE, ES, IT, UK). Data on organic farming are also collected in FSS and therefore a regional breakdown at NUTS2 level is available and would fulfill the requirement to provide results at NUTS2 level.

The FSS Eurostat public database (organic farming: number of farms, areas with different crops for 2007 has been used at NUTS2 level; NUTS1 for DE; NUTS0 for CY, LT, LV, LU, MT).

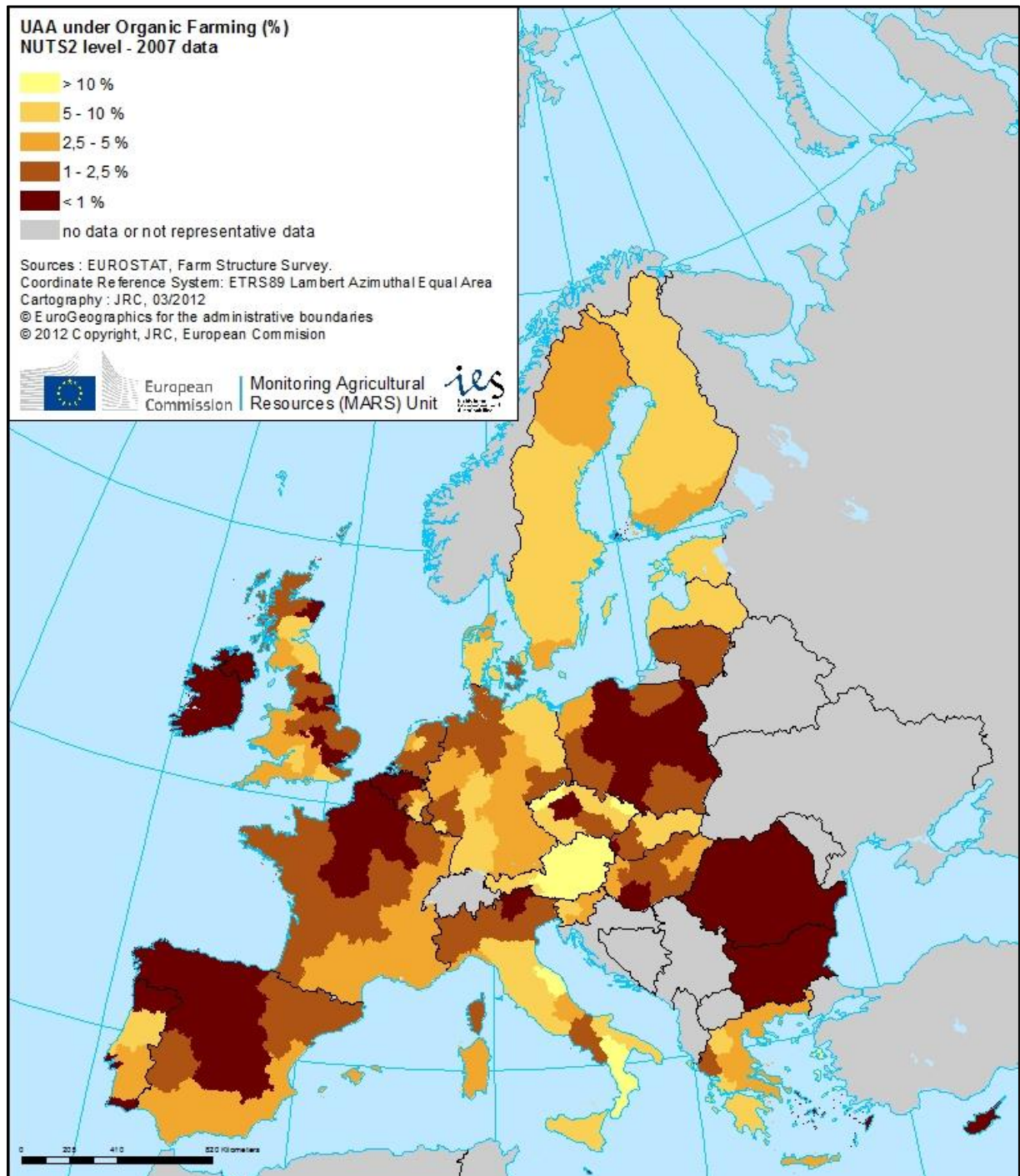
Results:

Figure 22 below shows the share of (certified) organic farming in the total UAA at NUTS2 level. For most of the regions, the share of organic farming is rather low (below 10% of the UAA). Only in countries such as Italy, Austria and the Czech Republic, some regions can have a share higher than 10%.

Even with data on organic farming, as anticipated it is difficult to raise robust conclusions as the share of land which is under the scheme is maximum 10% of the UAA. What would be the situation on the remaining 90% of the agricultural land? They are not under organic farming but not at risk of land abandonment either as they can be under very intensive management.

Given all these limitations, a low relevance is given to this driver in the final assessment of the risk of farm land abandonment.

Figure 22: Share of UAA (percentage) in organic farming (certified).



6.3 METHODOLOGY COMBINING DRIVERS INTO A COMPOSITE INDEX

So far, the analysis has been carried-out on single drivers identified during the literature review and suggested by the expert panel. A possible way forward to gather the information from all relevant drivers into a final risk indicator of Farmland Abandonment is to integrate the meaningful drivers into a composite index. This is possible through an empirical framework for building composite indicators, following a methodology proposed by the OECD (2008).

The framework will be tested first at European level aiming to build a European risk indicator. However, we can anticipate that the risk indicator will also need to be calculated at national level as the farming economical context and farm structures are still very heterogeneous amongst Member States. Consequently, the relevant drivers will be integrated into a Composite Index, based on their normalised values at (i) European level and (ii) national level.

Theoretical aspects

Following the OECD handbook on the construction of a composite indicator, the methodology follows different steps:

- *Data selection.* Drivers should be selected on the basis of their analytical soundness, measurability, country coverage, relevance to the phenomenon being measured and relationship to each other.
- *Normalisation.* Drivers should be normalised to render them comparable. Attention needs to be paid to extreme values as they may influence subsequent steps in the process of building a composite index.
- *Weighting and aggregation.* Indicators should be aggregated and weighted according to the underlying theoretical framework.
- *Robustness and sensitivity.* Analysis should be undertaken to assess the robustness of the composite indicator in terms of, e.g. the normalisation scheme, the choice of weights and the aggregation method.
- *Links to other variables.* Attempts should be made to correlate the composite index with other published indicators.

Data selection

The composite index will be build using the individual drivers found relevant and robust in the statistical analysis carried out in section 6.2. Three categories were used:

- Drivers are relevant, meaningful and robust. These are: D2 ‘Farm Income’ and D7 ‘remoteness / population density’. This first set of data is complete, consistent, and available at high resolution (single holdings or LAU2 level).
- Drivers are relevant but less robust due to data deficiencies. These are D1 ‘Rent paid’, D3 ‘Low investments’ and D4 ‘Farm holders’ age’.

- Drivers with important caveats, weak or incomplete data: These are D5 ‘Low farmer qualification’, D8 ‘Low farm size’, D9 ‘Farm enrolment in specific scheme’.

The composite index will be tested on 2 sets of drivers: (i) the meaningful and robust set i.e. D2 ‘Farm Income’, D7 ‘Remoteness / Population density’, complemented by D1 ‘Rent paid’ as data availability and representativeness is good but expert’s opinion is still required for the issue of data variability; and (ii) on the same set complemented by drivers D3 ‘Low investments’ and D4 ‘Farm managers’ age’ whose analytical soundness and/or data reliability is less robust.

Data processing

Imputation of missing data

In FADN dataset as in FSS, missing data may occur. Several methods are available for the estimation (imputation) of missing data: mean imputation, hot deck imputation and regression imputation.

However, these methods can only be reliably applied when the correlation between the variables is high. Its verification revealed that was not the case and it was decided to not apply imputation procedures on missing data which could produce distorted estimates.

Outlier detection

Extreme values (outliers) in the dataset of each indicator can reflect false or anomalous information and may influence the elaboration of a composite index. Various outlier detection methods have been applied (Skewness, Kurtosis, Interquartile Range) spotting some very high values (anomalous?) for the indicators D1 ‘Rent paid’ and D3 ‘Low investments’ (applies for example to NL33 ‘South Holland’ for both drivers).

Several approaches to outlier management were tested (e.g. *winsoritation*: replacing the highest value with the second highest value) but none brought significant improvements. Consequently, the analysis was done on all data, including potential outliers.

Data normalisation

Normalisation is required prior to any data aggregation as datasets used to build individual drivers are in different measurement units and have different ranges of variation.

Amongst the various normalisation methods available (Freudenberg, 2003; Jacobs et al., 2004): the ‘*Min-Max*’ method was chosen to have an identical range of values between zero and one. This is achieved by subtracting from each observation the global minimum and by dividing the result by the data range of the whole dataset.

Each value of the q indicator for a NUTS (N) of the country c , X_{qc}^N is transformed in:

$$I_{qc}^N = \left[\frac{X_{qc}^N - \min(X_{qc}^N)}{\max(X_{qc}^N) - \min(X_{qc}^N)} \right] \quad (\text{eq.1})$$

or

$$I_{qc}^N = 1 - \left[\frac{X_{qc}^N - \min(X_{qc}^N)}{\max(X_{qc}^N) - \min(X_{qc}^N)} \right] \quad (\text{eq.2})$$

where $\min(X_{qc}^N)$ and $\max(X_{qc}^N)$ are respectively: (i) the minimum and the maximum value of X_{qc}^N for EU27 countries together; (ii) the minimum and the maximum value of X_{qc}^N across all NUTS in country c.

Equation (1) can be applied to normalize variables showing a positive relation with farmland abandonment, whereas Equation (2) is applied to variables showing a negative relation to farmland abandonment. The drivers' relation to land abandonment (shown in Table 8) was identified according to expert's opinion. A negative relation means that a low value of a driver (e.g. income) means a high risk of land abandonment.

If the equation (1) is used for the normalization, I_{qc}^N have values lying between 0 (laggard, $X_{qc}^N = \min(X_{qc}^N)$), and 1 (leader, $X_{qc}^N = \max(X_{qc}^N)$).

When equation (2) is used for the normalization, the normalised indicators I_{qc}^N have values lying between 0 (laggard, $X_{qc}^N = \max(X_{qc}^N)$), and 1 (leader, $X_{qc}^N = \min(X_{qc}^N)$).

Table 8: Indicators used in the evaluation of the risk of Farmland Abandonment and relation with the risk

Indicator	Effect on risk of Farmland abandonment	Variables involved in the normalisation process
D1: weak land market	negative	Rent paid per hectare
D2: low farm income	negative	Farm Income per AWU / National GDP per cap
D3: low farm investment	negative	Farm investment per hectare of UAA
D4: Farmers' age	positive	Share of farmers above 65 years
D7: Population density, Remoteness	positive	Share UAA in remote rural areas

Normalisation was done at two levels: (i) considering all EU27 observations together to identify the minimum, maximum and data range; and (ii) applying the same normalisation procedure within each country separately (minimum, maximum and range of observation values at MS level). The first level is an attempt to elaborate a risk composite index covering all MS (EU27) together; while the second attempt builds a risk composite index for each country. In this latter case, the assumption is made that one cannot compare, in absolute value, economic results from MS having heterogeneous economic and structural developments of the agricultural sector. Otherwise, we may find many regions being at risk in the new MS and very few for western European regions.

Weighting and aggregation

Several methodologies are available for weighting individual indicators into a composite one. Some are derived from statistical models, such as principal component / factor analysis, or from participatory methods like budget allocation processes in which experts are asked to allocate a

“budget” of e.g. 100 points to the indicators set, based on their experience and subjective judgment of the relative importance of the respective indicators.

The Principal Components Analysis (PCA), and more specifically the Factor Analysis (FA), groups together individual indicators which are collinear to form a composite indicator that captures as much as possible of the information common to individual indicators. Each factor (usually estimated using PCA) reveals the set of indicators with which it has the strongest association. The idea of PCA/FA is to account for the highest possible variation in the indicator set using the smallest possible number of factors.

There are several assumptions in the PCA; one of these is the inter-correlation among the indicators. Strong inter-correlations are not mathematically required, but applying the PCA to a correlation matrix with only low inter-correlations will require nearly as many factors as there are original variables, thereby defeating the data reduction purposes of factor analysis. On the other hand, too high inter-correlations may indicate a multi-collinearity problem and collinear terms should be combined or otherwise eliminated prior to factor analysis.

Then, the first step of the PCA procedure is to check the partial correlation among the indicators. In this study the Kaiser-Meyer-Olkin (KMO) test is used. KMO varies from 0 to 1. KMO should be at least 0.6 to proceed with factor analysis (Kaiser & Rice, 1974), though realistically it should exceed 0.8 if the results of the PCA are to be reliable. If not, it is advisable to drop the individual indicators with the lowest individual KMO values, until the overall KMO rises above 0.6.

In our case, the KMO test is lower than 0.6, which means a weak correlation among the indicators. Consequently, it is not appropriate to use the PCA for weighting the indicators. For this reason and in the absence of further guidance from the expert panel on the relative weight which could be given to each indicator, an equal weight is assigned to all of them.

The Composite Index (CI) will be established using a linear aggregation summing the normalised individual indicators:

$$CI_c^N = \sum_{q=1}^Q w_q I_{qc}^N$$

with the sum of weights of each indicator $\sum_q w_q = 1$ and $0 \leq w_q \leq 1$, for each indicator $q = 1, \dots, Q$.

CI_c^N has a range between zero (minimum risk) and one (maximum risk) [0, 1] for each NUTS.

The Composite Indicator is calculated for each NUTS2 in each country for the two normalisation levels.

Robustness and sensitivity

Composite Index development involves stages where judgements have to be made, e.g. on the selection of individual indicators, the choice of aggregation model, the weighting factors, etc.

All these choices are the *bones* of the composite index and, together with the information provided by the numbers themselves, they shape the communicated message.

Since the quality of a model depends also on the soundness of its assumptions, it is important to provide an evaluation of the confidence in the model, assessing its uncertainties (through a sensitivity analysis¹²) associated with the modelling process and the choices made.

It is important to evaluate the sensitivity of the model to different weighting schemes and/or different aggregation methods. For this reason, experts' feedback is important.

Links to other variables - validation

Given the rather theoretical process to build the Composite Index, it is crucial to verify the results and to confront them with other independent variables. Unfortunately, there are so far no datasets on farmland abandoned available at EU27 level.

Nevertheless, several alternatives for cross-checking the results do exist, they might consist in:

- The use of Land-Use models. However, their calibration and underlying assumptions are very complex and often questionable for providing a realistic estimate of land being abandoned.
- The use of agricultural economic models which may provide information at regional level (NUTS2) on agricultural land not anymore economically suitable for production. Similarly to the previous bullet, some assumptions used in these models (e.g. the land supply function) are not easily validated. Anyhow, the economy is not the only driver to be taken into account in the case of farmland abandonment. The literature review has inventoried also bio-physical and sociological drivers which are not integrated so far in available agricultural economic models in Europe.
- The use of ESTAT Farm Structure Survey data on trends of UAA at LAU2 level between two censuses (2000 and 2010 for example). This would require (i) to have access to these datasets at LAU2 level, and (ii) to have auxiliary data on the rate of urbanisation and afforestation at LAU2 level as well.
- The feedbacks from national experts, knowing well the situation in terms of risk of farmland abandonment in their home country.

6.4 COMPOSITE INDEX RESULTS

The data selection process has identified two sets of candidate drivers to be used to build the composite indicator, namely:

- A first set with relevant drivers and robust data: D1, D2, D7;
- A second set with relevant drivers but less robust data: D3, D4.

The data processing, and in particular the normalisation procedure has identified two levels of computation:

- A normalisation of the parameters at EU27 level;

¹² Sensitivity analysis is the study of how the variation in the output can be apportioned, qualitatively or quantitatively, to different sources of variation in the assumptions, and how the given composite indicator depends upon the information fed into it.

- A normalisation of the parameters done at national level.

Therefore, the combination of data selection and normalisation procedures results in four scenarios for the elaboration of the composite indicator:

Composite indicator with drivers D1, D2, D7	• Normalised with min and max at EU27 level	S1
	• Normalised in each MS with min and max of the MS	S2
Composite indicator with drivers D1,D2, D3, D4, D7	• Normalised with min and max at EU27 level	S3
	• Normalised in each MS with min and max of the MS	S4

In the following maps of composite indices, Bulgaria has no result because of missing data for Driver D7 ‘travel time to urban centre’. Consequently, it was not conceptually sound to combine only two drivers for scenarios S1 and S2 in the case of Bulgaria, while other countries had three or to combine four drivers for scenarios S3 and S4 while other countries had five.

The resulting maps for each scenario of the composite index display a ranking of NUTS2 regions from the lower risk (yellow) to the higher risk (dark brown). NUTS2 regions are classified using quintile intervals (20% of observations in each of the five classes) for the scenarios S1 and S3. Upon request of a DG AGRI representative, all classes with lower risk (80% of the observations in the first four quintiles) are shown with the same colour (yellow) while the last 20% of observations with higher risk are further divided in two subclasses (80% - 90%) and (90% - 100%).

For scenarios S2 and S4, NUTS2 regions are simply classified using five classes, starting from a Composite index value of 0.5 (medium) up to a value of 1 (very high risk). A subset of MS (Spain, France, Italy, Sweden and Slovakia) has been selected for display purposes and is shown in the report for Scenario4, however the analysis has been made for all MS and all Scenarios.

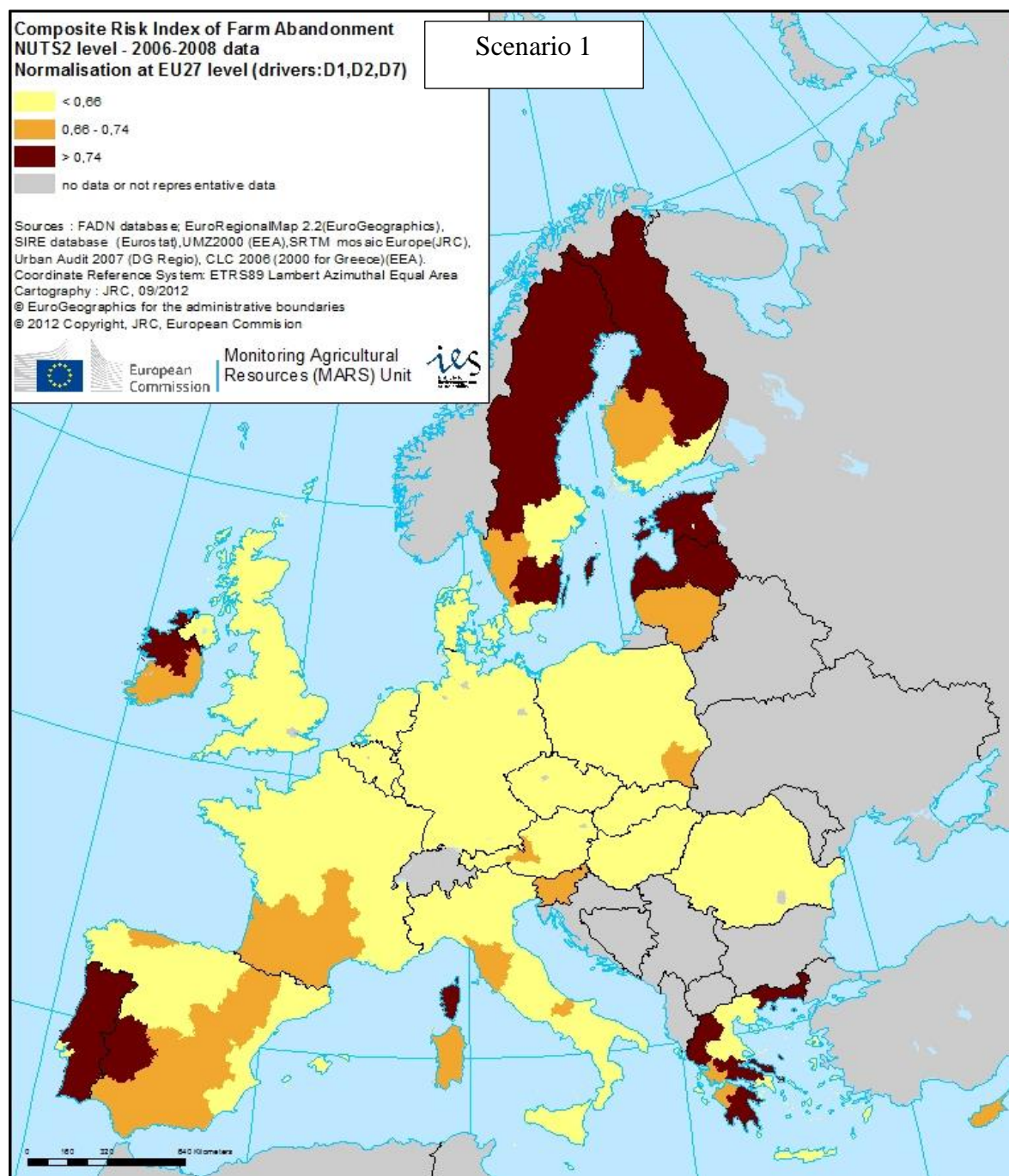
A further analysis was carried-out to identify farm-types in the NUTS2 flagged with the higher risk of Farmland Abandonment (the upper most 20% quintile and/or the higher composite index value [> 0.7]). Micro level FADN data were used to retrieve holdings farm types and agricultural areas at stakes within the flagged NUTS2. This is potentially interesting information for policy assessment and for designing necessary response measures to tackle the risk of farmland abandonment.

Normalisation at EU level

Scenario1

Figure 23 shows the EU map of the composite risk index for scenario1.

Figure 23: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D7, normalised at EU27 level. Quintile 0-80% (yellow), 80% - 90% (light brown) and 90% - 100% (dark brown).



Based on the three most relevant and complete drivers and using a normalisation procedure on the EU27 dataset, regions with the higher risk of farmland abandonment are found in Portugal, Extremadura (Spain), Corsica (France), part of Peloponnese / part of Macedonia (Greece), Latvia, Estonia, northern Finland, northern Sweden, and in Connacht and Donegal in Ireland.

Smaland and Ostergotland regions in southern Sweden are surprisingly identified as being at risk. Data show that the contribution of driver D7 (share of agricultural land in remote areas) to the composite index is important. This result needs to be confirmed by Swedish experts.

Table 9 shows the distribution of the eight farm types in the NUTS2 regions identified in scenario1. Among the NUTS2 with higher risk of farm land abandonment under scenario1, the most frequent farm-type is FT4 (Specialist Grazing livestock) with 35%.

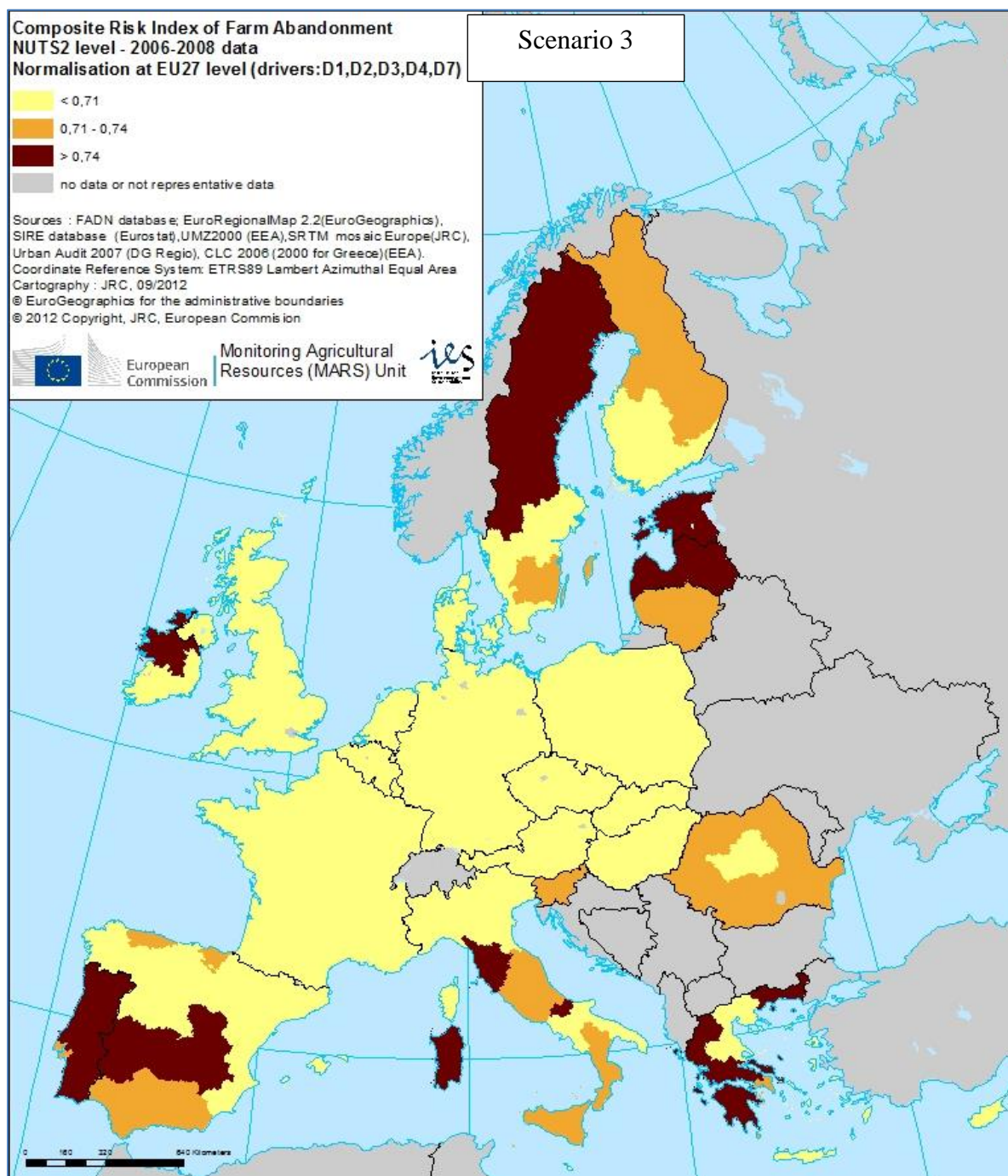
Table 9: distribution (%) of farm-types in NUTS2 regions with higher risk of land abandonment under Scenario1

NUTS2	Farm-Type							
	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	8 (%)
AT32	0	0	0	97	1	0	1	1
CY00	24	3	46	13	2	8	0	4
EE00	34	4	1	35	3	4	1	18
ES12	0	0	0	100	0	0	0	0
ES24	33	0	22	15	16	7	1	6
ES42	16	9	39	11	2	20	0	3
ES43	30	1	12	34	2	4	3	14
ES61	28	22	20	16	4	4	2	4
FI13	12	7	2	68	2	2	0	7
FI19	26	9	1	44	6	1	1	14
FI1A	16	4	0	72	2	0	1	5
FR61	21	3	34	20	1	7	3	10
FR62	31	1	12	37	3	5	1	9
FR72	12	0	0	76	0	0	5	6
FR81	9	7	59	20	0	4	0	1
FR83	3	5	53	31	3	2	2	1
GR11	82	0	9	7	0	2	0	1
GR13	51	0	13	28	1	3	0	4
GR21	7	2	9	55	3	6	2	16
GR23	9	0	35	21	0	18	5	12
GR24	31	0	26	17	0	11	2	12
GR25	3	6	58	3	0	24	1	5
IE01	4	0	0	91	0	0	0	5
IE02	6	0	0	88	0	0	0	5
ITE1	22	9	36	14	2	11	3	4
ITF2	24	0	18	23	9	15	4	6
ITG2	17	5	12	52	5	5	1	3
LT00	46	2	2	19	1	7	4	19
LV00	32	2	3	36	4	4	4	16
PL32	24	3	3	15	5	12	11	27
PT11	1	8	35	40	0	6	3	7
PT15	0	11	63	18	0	9	0	0
PT16	12	4	13	54	3	3	3	8
PT18	28	3	24	27	1	5	2	11
SE31	8	0	0	69	6	0	1	15
SE32	22	1	0	41	12	1	1	22
SE33	16	0	0	67	1	0	1	15
SE21	4	0	0	83	11	0	2	0
SE23	7	2	0	80	7	0	0	5
SI0	5	1	10	59	0	5	5	13
TOTAL	21	5	18	35	3	6	2	9

Scenario3

Figure 24 shows the EU map of the composite risk index for scenario3.

Figure 24: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised at EU27 level. Quintile 0-80% (yellow), 80% - 90% (light brown), 90% - 100% (dark brown).



Based on the five relevant and acceptable drivers, and using a normalisation procedure on the EU27 dataset, most regions that have been identified at risk under Scenario1 are confirmed under Scenario3. Limited differences occur in Italy with Tuscany, Molise and Sardinia identified as areas with a higher risk of farmland abandonment. Also in Spain, the area with the higher risk is extended to Castilla-La-Mancha.

It may be surprising to see Tuscany as a region with a higher risk of farmland abandonment in Italy. Data screening for Tuscany shows the three economic drivers (D1, D2, D3) with low values, compared to southern Italian regions. In contrast, ‘farmers’ age’ and ‘remoteness’ are relatively high, identifying consequently Tuscany with a higher risk of land abandonment. The unexpected low value for D2 ‘farm income’ might be due to the presence of other sources of income outside agriculture (e.g. diversification activities such as farm tourism) not included in the farm income. Information on the household income would be relevant for this point.

Our recommendations for this point are: (1) to verify and check Italian FADN data consistency with Italian FADN representatives; (2) to set different weighting factors on each driver in order to calibrate the model to better fit national conditions, as it seems that drivers 4 and 7 should have a lower weight in Italy at least. However, this last point would require extensive experts’ consultation to reach a robust weighting system.

The analysis of NUTS2 with a higher risk under Scenario3 provides the distribution of farm-types shown in Table 10. Among the identified NUTS2 with a higher risk of farmland abandonment under Scenario3, the most frequent farm-type is FT4 (Specialist Grazing livestock) with around 30%.

Table 10: percentage distribution of farm-types in NUTS2 regions identified with a higher risk of land abandonment under Scenario3

Farm-Type NUTS	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	8 (%)
EE00	34	4	1	35	3	4	1	18
ES12	0	0	0	100	0	0	0	0
ES21	14	4	4	72	4	1	0	2
ES42	16	9	39	11	2	20	0	3
ES43	30	1	12	34	2	4	3	14
ES61	28	22	20	16	4	4	2	4
FI13	12	7	2	68	2	2	0	7
FI1A	16	4	0	72	2	0	1	5
GR11	82	0	9	7	0	2	0	1
GR13	51	0	13	28	1	3	0	4
GR21	7	2	9	55	3	6	2	16
GR22	0	2	66	9	0	11	5	8
GR23	9	0	35	21	0	18	5	12
GR24	31	0	26	17	0	11	2	12
GR25	3	6	58	3	0	24	1	5
GR30	10	19	34	6	3	18	0	11
IE01	4	0	0	91	0	0	0	5
ITE1	22	9	36	14	2	11	3	4
ITE2	34	1	17	19	4	13	3	9
ITE3	42	1	21	14	3	12	2	5
ITE4	24	9	23	27	1	9	2	4
ITF1	24	2	35	19	2	10	4	4
ITF2	24	0	18	23	9	15	4	6
ITF5	31	1	25	28	1	7	2	5
ITF6	22	1	55	7	0	9	1	5

ITG1	16	12	38	19	1	8	1	5
ITG2	17	5	12	52	5	5	1	3
LT00	46	2	2	19	1	7	4	19
LV00	32	2	3	36	4	4	4	16
PT11	1	8	35	40	0	6	3	7
PT15	0	11	63	18	0	9	0	0
PT16	12	4	13	54	3	3	3	8
PT17	26	34	12	4	2	20	1	2
PT18	28	3	24	27	1	5	2	11
PT30	4	44	23	0	4	26	0	0
RO11	21	7	7	27	7	7	11	15
RO21	20	5	7	19	3	12	14	21
RO22	36	7	11	13	7	7	5	15
RO31	36	5	5	9	12	8	11	14
RO41	26	5	9	18	5	6	9	23
RO42	33	3	5	19	8	11	7	15
SE21	8	0	0	69	6	0	1	15
SE31	16	0	0	67	1	0	1	15
SE32	4	0	0	83	11	0	2	0
SE33	7	2	0	80	7	0	0	5
SI0	5	1	10	59	0	5	5	13
TOTAL	23	6	20	30	2	8	3	8

Normalisation at national level

The normalisation procedure was also done at MS level as it was felt that farmland abandonment is a phenomenon very much linked to national economic, structural and political conditions. Maps are presented for a subset of MS (Spain, France, Italy, Poland, Slovakia) and for scenario4 (all relevant drivers) for practical reasons. However, all MS have been processed under scenarios S2 and S4 and are available in the auxiliary results files sent to DG AGRI.

Regions with a higher risk of farmland abandonment are shown in dark brown in the following maps.

Scenario2

Results and maps of the composite index build with drivers D1, D2, D7 for all individual MS are not shown here since some more complete results are presented under scenario4 below. However, all results of scenario2 are available in the provided excel files.

Scenario4

This scenario uses all relevant drivers (D1, D2, D3, D4, D7) normalised at MS level. Results are shown for a subset of MS, however results for all MS are available in the provided excel files.

Figure 25: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised for Spain.

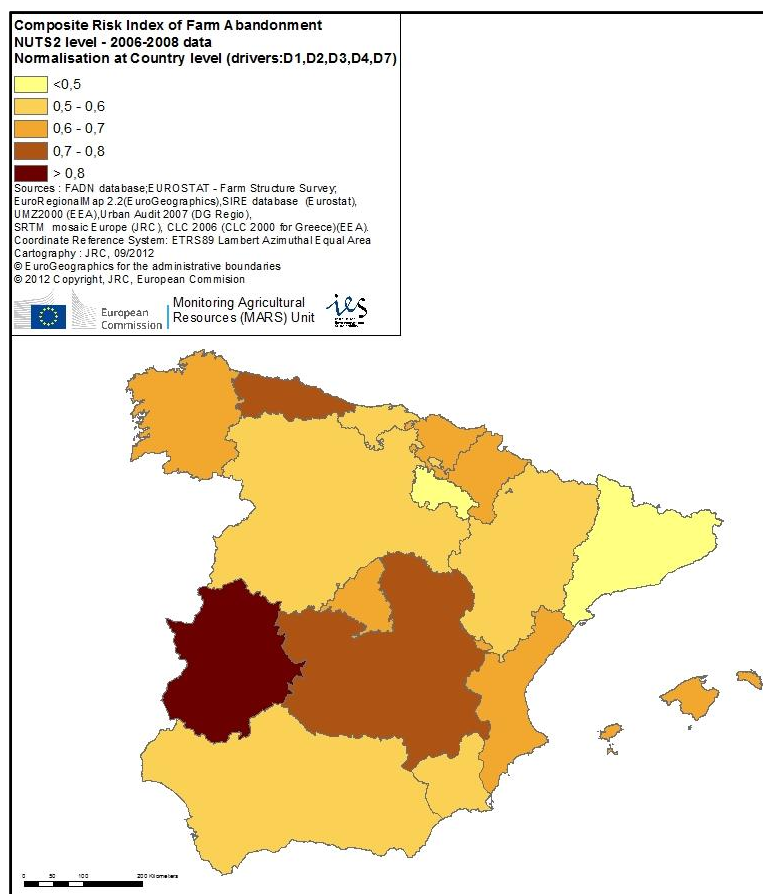


Table 11: Farm-type results on Spanish NUTS2 with higher risk of land abandonment under scenario4

Farm-types NUTS2	FT1 %	FT2 %	FT3 %	FT4 %	FT5 %	FT6 %	FT7 %	FT8 %
ES12	0	0	0	100	0	0	0	0
ES42	16	9	39	11	2	20	0	3
ES43	30	1	12	34	2	4	3	14
TOTAL	18	5	24	31	2	12	1	6

Figure 26: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised for France.

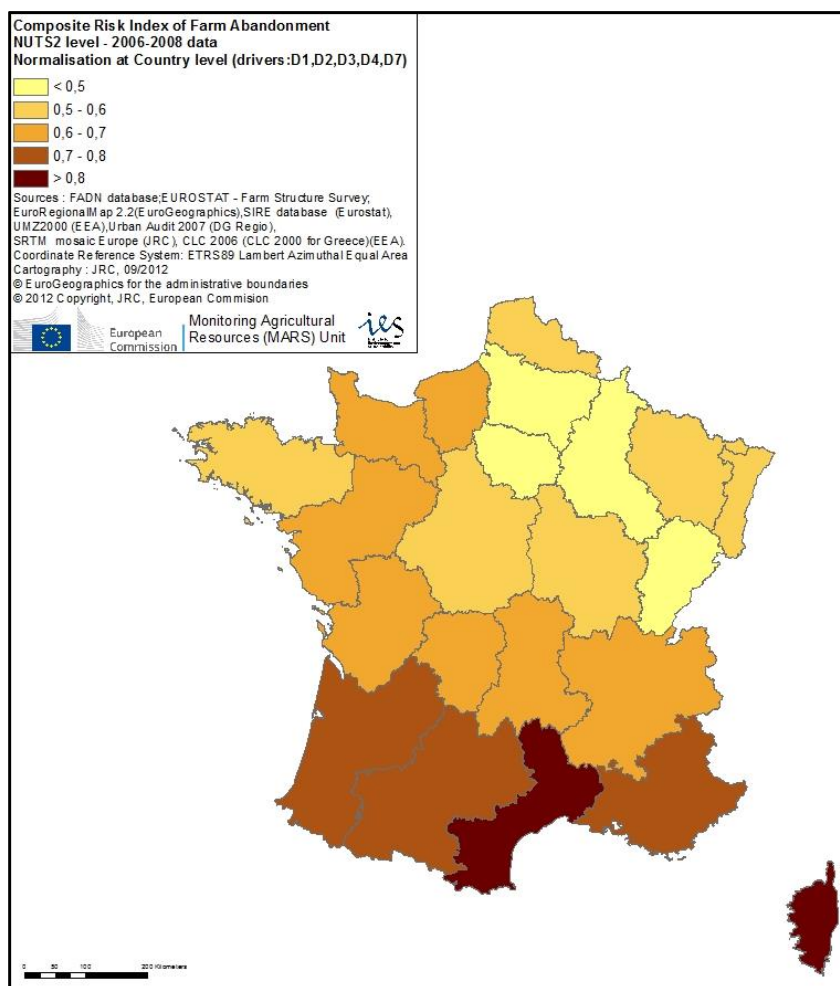


Table 12: Farm-type results on French NUTS2 with higher risk of land abandonment under scenario4

Farm-types NUTS2	FT1 %	FT2 %	FT3 %	FT4 %	FT5 %	FT6 %	FT7 %	FT8 %
FR61	21	3	34	20	1	7	3	10
FR62	31	1	12	37	3	5	1	9
FR81	9	7	59	20	0	4	0	1
FR82	11	34	41	9	0	5	0	1
FR83	3	5	53	31	3	2	2	1
TOTAL	17	10	37	23	1	5	2	5

Figure 27: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised for Italy.

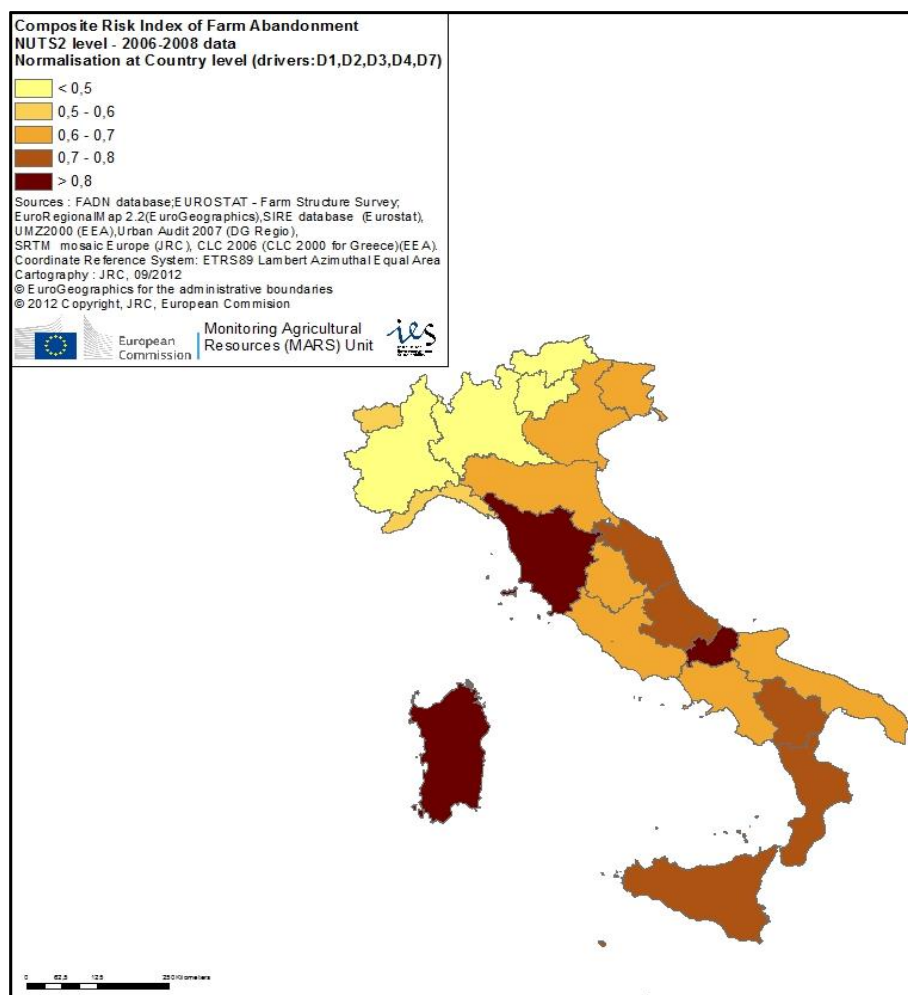


Table 13: Farm-type results on Italian NUTS2 with higher risk of land abandonment under scenario4

Farm-types NUTS2	FT1 %	FT2 %	FT3 %	FT4 %	FT5 %	FT6 %	FT7 %	FT8 %
ITE1	22	9	36	14	2	11	3	4
ITE3	42	1	21	14	3	12	2	5
ITF1	24	2	35	19	2	10	4	4
ITF2	24	0	18	23	9	15	4	6
ITF5	31	1	25	28	1	7	2	5
ITF6	22	1	55	7	0	9	1	5
ITG1	16	12	38	19	1	8	1	5
ITG2	17	5	12	52	5	5	1	3
TOTAL	24	5	30	23	2	9	2	5

Figure 28: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised for Poland.

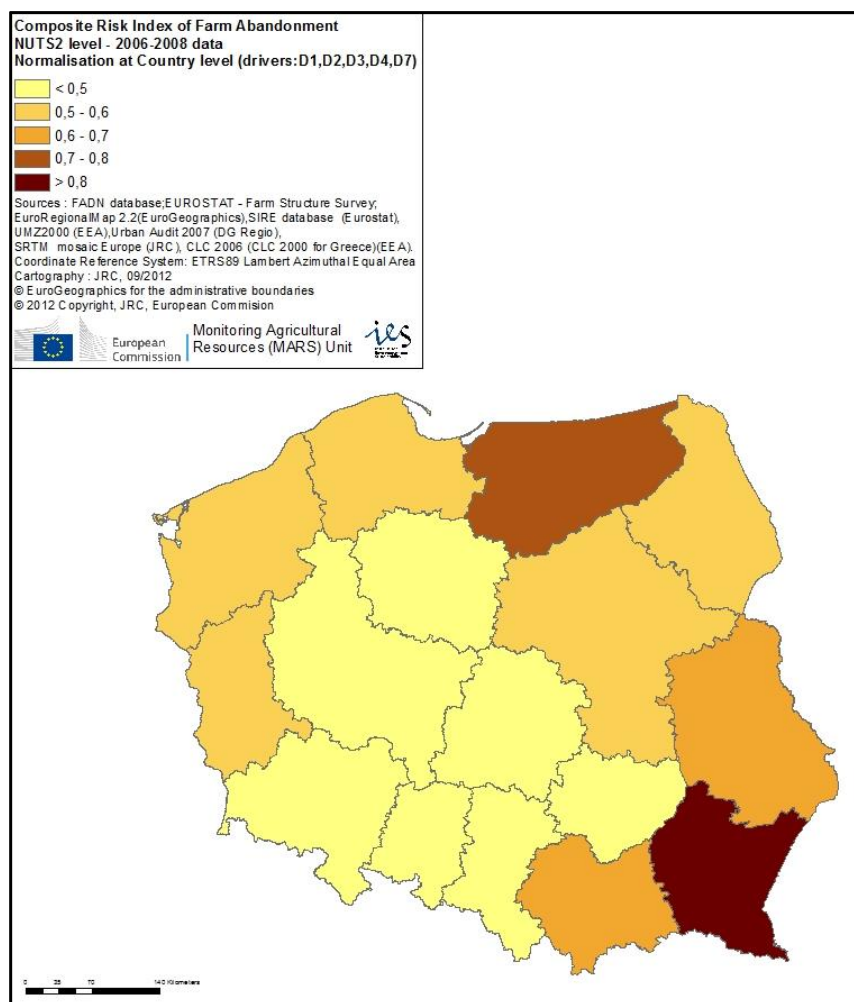


Table 14: Farm-type results on Polish NUTS2 with higher risk of land abandonment under scenario4

Farm-types NUTS2	FT1 %	FT2 %	FT3 %	FT4 %	FT5 %	FT6 %	FT7 %	FT8 %
PL32	24	3	3	15	5	12	11	27
PL62	23	1	1	33	8	4	10	20
TOTAL	23	2	2	26	7	7	10	23

Figure 29: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised for Slovakia.

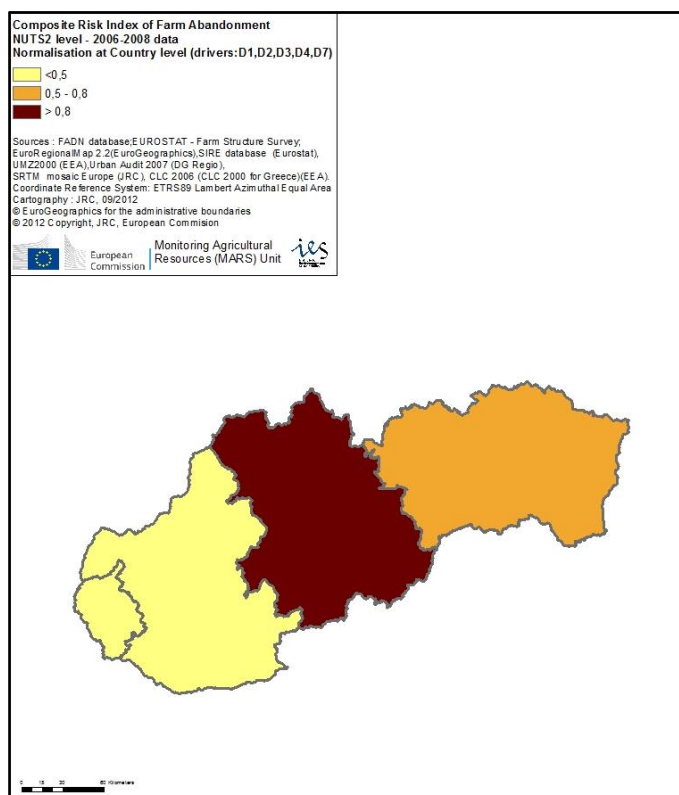


Table 15: Farm-type results on Slovak NUTS2 with higher risk of land abandonment under scenario4

Farm-types NUTS2	FT1 %	FT2 %	FT3 %	FT4 %	FT5 %	FT6 %	FT7 %	FT8 %
SK03	18	0	0	48	1	1	3	29
SK04	38	0	0	30	0	4	1	27
TOTAL	30	0	0	37	1	2	2	28

7 DISCUSSION

Based on the composite indices, a farm-type analysis was done on the NUTS2 flagged with higher risk of farmland abandonment. It indicates that the four scenarios converge in identifying regions and holdings farm-types in NUTS2 with higher risk.

At EU27 level, these NUTS2 regions are located in Portugal, Spain (Extremadura and Castilla-la-Mancha), Italy (Tuscany, Molise and Sardinia), Greece (Peloponnese and part of Macedonia), Latvia, Estonia, northern Finland and Sweden, and in Ireland (Donegal and Connacht). The most frequent farm-types identified in these regions are ‘Specialist Permanent crops’ and ‘Specialist Permanent grazing livestock’.

At MS level, similar patterns are found, but with more discrimination within the country. For the farm-type analysis, FT1 ‘specialist field crop’ can also be found in addition to the above mentioned farm-types, especially in central European countries.

In an agri-environmental context, taking into account the agreed definition by the experts (*Farmland abandonment is a cessation of management which leads to undesirable changes in biodiversity and ecosystem services*), the likely impacts of farmland abandonment from farm with permanent grazing livestock and permanent crops may be negative for maintaining the landscape and for biodiversity depending on extensively managed agricultural land (typically occurring on semi-natural grassland and/or High Nature Value farmland). Abandonment of this land may be negative for biodiversity conservation because vegetation succession leads to species-poor and more homogeneous vegetation types. In most places in Europe, the final succession stage will be forest. Vegetation succession also results in a structural change from an open to a closed landscape, which in turn has an impact on fauna-friendly habitats.

Other environmental effects of abandonment include the loss of small scale mosaics of land use and their characteristic species, also those of forest edge habitats. Furthermore, it may reduce genetic diversity in both wild species and in local breeds of livestock or varieties of crops (which are often well adapted to semi-natural habitats), and increase fire risk in forests where grazing areas act as firebreaks.

Whilst land abandonment is often viewed negatively, it is not always clear that it is detrimental. For example, in terms of nature conservation, Keenleyside and Tucker (2010) note: “In many circumstances abandonment may be damaging as it will threaten a range of semi-natural habitats and associated species of importance for nature conservation. But in some locations, abandonment could be beneficial, particularly in highly fragmented landscapes and where it could provide opportunity for significant large-scale restoration of non-agricultural habitats (e.g. re-wilding)”.

One of the members of the expert panel also stated that most farmland in Europe is privately owned. So when the owner decides it is not worth the effort to farm it, he does not (usually) abandon ownership even if he stops actively farming. Land always has potential future options use for hunting, recreation, reversion to natural woodland etc. Therefore such land has still some value. The ecosystem approach is potentially valuable because it defines a broader concept of land use, and so land can be used for alternatives purposes.

8 CONCLUSIONS

Manifold causes exist for farmland abandonment in Europe, depending on the area and the period under consideration. It is a complex process which can have a wide range of drivers, varying from MS to MS and sometimes within a single country. Indeed, the agricultural situation differs from region to region, as a consequence of natural conditions, historic developments and the economic and demographic context. In most cases, a combination of different factors leads to farmland abandonment. It is therefore very challenging to design a unique method for a European assessment, encompassing all possible drivers and causes.

In this study, an expert panel has identified nine drivers which have been first calculated individually. An assessment was done providing relevance and robustness of the results for each of them.

Second, a combine indicator of ‘risk of farmland abandonment’ has been developed through a composite index (gathering several drivers into one value). It was built based on Principal Component Analysis carried-out on the normalised values of the individual drivers. The normalisation procedure was made at two different levels: (a) EU27 level as an attempt to elaborate a risk composite index covering EU27 in an homogeneous manner, and (b) MS level.

Results and maps are presented at NUTS2 level for all individual drivers and for the composite index.

However, NUTS2 regions often hold diverse agro-economic conditions, not impacting on farmland abandonment uniformly the whole area. Analyzing data at coarse level (NUTS2) may overlook actual land abandonment occurring in smaller regions. This might happen when the variability of individual drivers is high with an average value masking very different situations. Consequently, an approach was tested to further downscale the results from NUTS2 to NUTS3 administrative regions using the more detailed data on ‘remoteness / population density’ (see ANNEXE E).

The main difficulties encountered in this study were related on one hand to data resolution and availability, and to the other hand to the validation procedure.

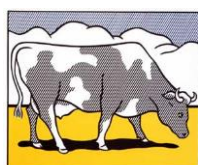
Data related issues

- Resolution of the input data:
 - The scientific literature widely agrees that farm land abandonment is a local specific phenomenon, requiring availability of local data to estimate its risk. When the assessment objective is the European level, lack of accessibility to local data is clearly an issue.
 - Whether from FADN or from FSS, the resolution of input data available in European databases varies from MS to MS, going from NUTS3 in the best case, to NUTS0 in the worst. This heterogeneity of input data is a source of difficulty and inaccuracy in the aggregation process to build comparable and homogeneous pan-European drivers of farmland abandonment at NUTS2 level.
- Unavailability of some data: FSS micro-data.

Despite that these data exist and are available in Eurostat, it was not possible for our project to have access to them. This situation is linked to MS' decision to limit the access to FSS data below NUTS3 level. This has resulted in an incomplete processing for driver D8 related to farm size, and no possibility to build driver D6 for the trend of loss of UAA.

- Other type of difficulties was encountered with the identification codes of administrative units which change regularly in time (MS redefining some of their administrative units). Consequently NUTS codes are not consistent in time and space, requiring important manual fixing / visual screening to find correspondences between tabular and geographic datasets. This is a very time and resources consuming process and not all codes can be fixed, resulting in some gaps in the datasets.

The geographic level of available agricultural data to compile agri-environmental indicators can be illustrated by the following:



At detailed scale (LAU2)
A good picture of reality



Local level NUTS3
Cubism/patterns of reality



Regional / National level (NUTS2, 1, 0)
Abstract painting

Validation process – Method benchmarking

- The lack of European or national datasets measuring the actual farmland abandonment prevents any benchmarking of the proposed methodology. The OECD methodology used to build the composite index for the risk of farmland abandonment in this study would require to be validated against measured data of farmland abandonment. Moreover, such measurements could also be used to establish the weighting system to be applied to the drivers composing the index.

By managing a large part of the European Union's territory, agriculture ensures food production, manages some important natural resources (incl. a wide range of valuable habitats) and supports socio-economic development of rural areas. The continuation of appropriate agricultural land management is essential to ensure these primary functions. This is why avoidance of farmland abandonment is an important rationale for the CAP. Consequently, an improved knowledge of the farmland abandonment phenomenon is necessary. This study contributes at assessing its risk; however validation through some measurements of its occurrence is still needed.

REFERENCES

- Baldock D., Beaufoy G., F. Brouwer and F Godeschalk (1996). Farming at the Margins. Abandonment or redeployment of Agricultural Land in Europe; Institute for European Environmental Policy (IEEP) and Agricultural Economics Research Institute (LEI-DLO); London-The Hague.
- Barbero Martín A. (1993). El abandono de tierras agrícolas en Europa. Montes, nº33 (1993). 7pp.
- Baudry, J. (1991). Ecological consequences of grazing extensification and farmland abandonment: Role of interactions between environment, society and techniques. INRA, SAD. 1991. Options méditerranéennes n°15, 1991. 13-14 p.
- Bethe F., and Bolsius, E. (Eds.) (1995). Marginalisation of agricultural land in Europe. National Spatial Planning Agency. The Hague, Copenhagen, Bonn.
- Brouwer F., Baldock D., Godeschalck F. and Beaufoy G. (1997). Marginalisation of agricultural land in Europe, Paper presented at the international conference 'Livestock systems in European rural development', held in Nafplio, Greece. 23rd-25th January 1997.
- Brouwer F. and Lowe P. (editors) (1998). CAP and the Rural Environment in Transition. A Panorama of national perspectives; Wageningen Perspectives; Wageningen Pers), 356pp
- Busch G. (2006). Future European agricultural landscapes - What can we learn from existing quantitative land use scenario studies? Agriculture, Ecosystems and Environment 114 (2006) 121-140
- Busmanis P., Zobena A., Grinfelde I., Dzalbe I. (2000). Privatisation and soil in Latvia. Sustainable Agriculture in Central and Eastern European Countries (CEESA). Humboldt University of Berlin. Project under FP5. 72-121.
- Ciaian, P. and J.F.M. Swinnen (2009), "Credit Market Imperfections and the Distribution of Policy Rents", American Journal of Agricultural Economics, 91(4): 1124-1139.
- Chassany J.P. (1999). [Processus de déprise agricole et enjeux socio-économiques](#), Ingénieries, n° sp "Boisements naturels des espaces agricoles en déprise", 1999, pp 81-89
- Coppola A. (2004). An economic perspective on land abandonment processes. Working Paper n. 1/2004. Università degli Studi di Napoli.
- Cooper T., Baldock D., Rayment M., Kuhmonen T., Terluin I., Swales V., Poux X., Zakeossian D. and Farmer M. (2006). An evaluation of the less favoured area measure in the 25 member states of the European Union. Institute for European Environmental Policy. 262 pp.
- Corbelle Rico E., Crecente Maseda R. (2009). Evolución histórica de la Superficie Agrícola Utilizada en Galicia (1962-2006). Integración de fuentes estadísticas y cartográficas. Economía Agraria y Recursos Naturales, volumen 9, número 2. 13pp.

- Dellapasqua C. (2010). Personal communication from the Commission from the Commission of 21 December 2006, Employment in rural areas: closing the jobs gap [COM(2006) 857 final - Not published in the Official Journal].
- DESERTLINKS project (FP5), Desertification Indicators System for Mediterranean Europe. Land Abandonment (Costas Kosmas), LA indicator (F. Lopez-Bermudez, University of Murcia)
- FAO, European commission on Agriculture (2006). The Role of Agriculture and Rural Development in Revitalizing Abandoned/Depopulated Areas. 34th Session, Riga, Latvia, 7 June 2006. 15pp.
- FAO (2006) Agriculture and the environment: changing pressures, solutions and trade-offs. FAO Rome.
- Freudenberg M. (2003), Composite indicators of country performance: a critical assessment, OECD, Paris.
- Gauttier, M. (2006) Appellations d'Origine Contrôlée et Paysages, INAO, France, pp.75. Available at http://agriculture.gouv.fr/IMG/pdf/inaoetpaysage_0207.pdf
- Gellrich M., Baur P., Koch P., Zimmermann N. E. (2006). Agricultural land abandonment and natural forest re-growth in Swiss mountains: A spatially explicit economic analysis, *Agriculture, Agriculture, Ecosystems and Environment* 118 (2007) 93–108
- Jacobs R., Smith P. and Goddard M. (2004), Measuring performance: an examination of composite performance indicators, Centre for Health Economics, Technical Paper Series 29.
- Kaiser H.F. and J. Rice,(1974), Little jiffy, mark IV, *Educational and Psychological Measurement* 34, 111-117.
- Keenleyside C., Veen P., Baldock D. and Zdanowicz A. (2005). Background document from the Seminar on Land Abandonment and biodiversity in the New Member States and candidate countries in Relation to the EU Common Agricultural Policy held in Sigulda, Latvia, on October 7-8 2004. 64pp
- Keenleyside, C and Tucker, G M (2010) Farmland Abandonment in the EU: an Assessment of Trends and Prospects. Report prepared for WWF. Institute for European Environmental Policy, London.
- Klijn J. A. (2002). Driving forces behind landscape transformation in Europe, from a conceptual approach to policy options. Proceeding of the Frontis Workshop on The Future of the European Cultural Landscape. 9-12 June. Wageningen, The Netherlands.
- Konečný M. (2004). EU Enlargement and Agriculture: Risks and Opportunities. Friends of the Earth Europe, 86pp
- Kristensen L.S. Thenail C., Kristensen S.P. (2004). "Landscape changes in agrarian landscape in the 1990s: the interaction between farmers and the farmed landscape. A case study from Jutland, Denmark", *Journal of Environmental Management*, 71

- London Economics (2008). Evaluation of the CAP policy on protected Designation of Origin (PDO) and Protected Geographical Indications (PGI). Final report - 286pp
- MacDonald D. Crabtree J. R., Wiesingern G., Dax T., Stamou N., Fleury P., Gutierrez Lazpita J. and Gibon A. (2000). Agricultural abandonment in mountain areas of Europe: Environmental consequences and policy response. *Journal of Environmental Management* n°69, pp47-69
- Marescotti A. (2003). Typical products and rural development: Who benefits from PDO/PGI recognition? . 83rd EAAE SEMINAR Food Quality Products in the Advent of the 21st Century: Production, Demand and Public Policy 4th-7th Septmeber, 2003 - Chania, Greece
- Mishra A.K. et al., (2010). Determinants of farm exit: a comparison between Europe and the US, paper presented at the 114th EAAE Seminar, Berlin, April 15-16, 2010.
- Moravec J., Zemeckis R., (2007). Cross compliance and land abandonment. Deliverable D17 of the CC Network Project, SSPE-CT-2005-022727. 6-16 p.
- Mottet A. (2005). Transformation des systèmes d'élevage depuis 1950 et conséquences pour la dynamique des paysages dans les Pyrénées. Contribution à l'étude du phénomène d'abandon des terres agricoles en montagne à partir de l'exemple de quatre communes de Hautes Pyrénées. Thèse pour le doctorat de Sciences Agronomiques. Institut National Polytechnique de Toulouse.
- OECD, 2008. Handbook on constructing composite indicators: Methodology and user guide – ISBN 978-92-64-04345-9
- Paracchini M.L., Pinto Correia T., Ramos I., Capitani C. (2011). Progress in indicators to assess rural landscape valuation: how and what is measured at different levels of governance. *Landscape Research*. Accepted for publication
- Pinto Correia T. (1993). Land abandonment: changes in the land use patterns around the Mediterranean Basin. Zaragoza. CIHEAM-IAMZ pp. 97–112.
- Pointereau P., Coulon F., Girard P., Lambotte M., Stuczynski T., Sánchez Ortega V., Del Rio A. (2008). Analysis of Farmland Abandonment and the Extent and Location of Agricultural Areas that are Actually Abandoned or are in Risk to be Abandoned, EUR 23411EN – 2008, Institute for Environment and Sustainability, JRC.
- Potter C. and Lobley M. (1992). Ageing and succession on family farms: the impact on decision-making and land use. *Sociologia Ruralis* 32 n.2/3, 317-334
- Potter C. and Lobley M. (1996). Unbroken Threads? Succession and its Effects on Family Farms-in Britain. *European Society for European sociology Sociologia Ruralis* 36 n.3, 286-306
- Renwick A. and Revoredo C. (2008). Measuring cross-subsidisation of the Single Payment Scheme in England. Paper prepared for the 109th EAAE Seminar, Viterbo, Italy, November 20-21st 2008.
- Renwick A., Jansson T., Verburg P-H., Revoredo-Giha C., Britz W., Gocht A. and McCracken D. (2011). Policy Reform and Agricultural Land Abandonment. 85th Annual Conference, April 18-20, 2011, Warwick University, Coventry, UK 108772, Agricultural Economics Society.

- Rickebusch S., Gellrich M., Heike Lischke H., Guisan A., Zimmermann N. (2007). Combining probabilistic land-use change and tree population dynamics modelling to simulate responses in mountain forests. *Ecological modelling* 209, 157-168.
- Silber R., Kloyber E., Wytrzens H.K. (2006). Determinants of agricultural abandonment in rural areas of Upper Austria. In: Czech University of Agriculture Prag (Hrsg.), Proceedings 93rd seminar of the EAAE - Impacts of Decoupling and Cross Compliance on Agriculture in the Enlarged EU, 93rd EAAE Seminar - Impacts of Decoupling and Cross Compliance on Agriculture in the Enlarged EU, 22.-23. September 2006, Prag; ISBN: 80-213-1522-9
- Silber R., Wytrzens H.K. (2005). Knowledge of land use changes as a prerequisite of rural development - some methodical considerations on land abandonment
In: Svatoš M., Boháčková, I.: Agrarian Prospects XIV, 20.-21. September 2005, Prag; Czech University of Agriculture, The Faculty of Economics and Management, Part II, 1053-1059; Czech University of Agriculture, Prag, Prag; ISBN 80-213-1372-2
- Silber R., Wytrzens H.K. (2005). Modelling the Probability of Land Abandonment at Parcel Level. In: Forgács C., Greif F., Hoppichler J., Palkovics M., Varga G., Vogel St. Agriculture in Central Europe - Potentials and Risks. 47th Georgikon Scientific Conference, 15th. ÖGA Annual Meeting, 29.-30. September 2005, Keszthely, Ungarn, 63-63; Eigenverlag der Universität Veszprém, Keszthely; ISBN 963 9096 99 7
- Sluiter R., De Jong S.M. (2008), Monitoring land abandonment in the Mediterranean region: An example of the Peyne area, Languedoc, France, *Nederlandse Geografische Studies* (376), pp. 85-92.
- Strijker D. (2005). Marginal lands in Europe—causes of decline. *Basic and Applied Ecology* 6 (2005) pp 99-106
- Terluin I., Godeschalk F.E., von Meyer H., Post J.H., Strijke D. (1995). Agricultural income in less favoured areas of the EC: A regional approach. *Journal of Rural studies*. Volume 11, Issue 2, April 1995, Pages 217-228.
- Terluin, I, Strijker D., Munch W. (2010). Economic dynamics in rural regions. In A. Oskam, G. Meester & H. Silvis, EU policy for agriculture, food and rural areas. Wageningen: Wageningen Academic Publishers, 2010, Chapter 18 (pp. 309-323)
- Vranken L., Noev, N., Swinnen, J.F.M. (2004). Fragmentation, abandonment, and co-ownership: Transition problems of the Bulgarian land market. *Quarterly Journal of International Agriculture*, Volume 43, Issue 4, 2004. Pages 391-408.
- Weber, N. and al. (2000). New Forests for Europe: Afforestation at the Turn of the Century, Proceedings of the Scientific Symposium February 16th –17th, 2000, European Forest Institute.

ANNEXE A: DRIVERS FACTSHEETS (DRAFTED BY THE EXPERT PANEL)

Key Criteria for an indicator on the risk of farmland abandonment		
N°: 1	Title: The Land Market	Expert: Liesbet Vranken
<p>The development of a well-functioning land market is of importance for the problem of land abandonment. Land transactions can play an important role for the development of a viable agricultural sector and this for several reasons. First, they provide land access to those who are productive but own little or no land. Second, they allow the exchange of land as the off-farm economy develops. Third, they facilitate the use of land as collateral to access credit markets (Deininger and Feder, 2001).</p> <p>The form of these land transactions matters. The most straightforward distinction is between the sale of land and renting of land. Theoretically, the sale of land is often considered the superior form compared to land rental. The arguments supporting the optimality of land sales are that (a) land sales transfer full rights to the new user; (b) they are more likely to increase access to credit as owned land can be used for collateral purposes, and (c) they provide optimal incentives for investment by providing permanent security of rights (Binswanger et al., 1995).</p> <p>However, these conclusions rely on a number of simplifying assumptions which are not always consistent with reality, and especially not with reality in transition and developing countries. This view is summarized in the following quotes from a World Bank Policy Research Report on Land Policies: “However, transaction costs..., risk and portfolio considerations, limited access to credit markets, and the immobility of land all imply that the actual performance of land sales markets may be far from the theoretical ideal”.</p> <p>Land sales markets typically function imperfectly, especially in poor countries. First, imperfections in input, product, credit, and insurance markets all affect the functioning of land sales markets. Second, transaction costs (notary and other fees, access to information, lack of parcel boundary definition) in land sales can be high. These factors make it expensive and difficult for efficient producers to buy land; they also reduce the attraction for less efficient producers to sell their land. Third, families hold on to land for reasons of prestige, lifestyle value, and tradition. As a consequence, rural land sales markets are often thin and rigid (Ciaian and Swinnen, 2008) and may even be limited to distress sales. In such circumstances, land rental markets can go a long way toward bringing the operational distribution of holdings closer to the optimum, given existing constraints (Deininger, 2003).</p>		
.	Definition of the criteria	
<p>Development of the land sales and land rental market</p> <p>If demand for agricultural land is high, the risk on farm land abandonment will be lower. High demand for agricultural land might be caused by two factors.</p> <p>First, if the probability that agricultural land is changed into artificial surfaces (residential or industrial land) is high, then the demand for agricultural land will be high as well. Especially in semi-urban the pressure to change agriculture land into residential land will be substantial. This then typically results in a remarkable difference in price evolution by plot size. Small parcels of agricultural real estate are often purchased to convert the land for other purposes, notably for more lucrative non-agricultural use, and this is incorporated in the price (Ciaian and Swinnen, 2009).</p> <p>A high demand for agricultural land can also be due to the willingness of farmers to expand their agricultural area or may also be caused by new entrants into the agricultural sector who demand land to start up their business. High <u>incidence of agricultural land sales transactions</u> would be an indicator</p>		

of a high demand for agricultural land and this would typically result in a higher agricultural land sales price.

However, the lack of agricultural land sales transactions does not necessarily implicate that demand for agricultural land is low. Land owners may hold on to their land for non-productive reasons so that the supply of agricultural land for sales is low resulting in non-linear relation between the amount of agricultural land for sales and the selling price (Trivelli, 1997; Karafotakis et. al, 2006). In such situations, well functioning land rental markets will be crucial to avoid land abandonment. Renting land is a very widespread form of agricultural land transaction in many developed countries, including the US and several EU-15 countries as well as the 12 new EU Member States (EU-12), where sometimes more than half of all agricultural land is rented by farms. Although there are large differences among countries. Among the EU-15 member states, we observe substantial variations in the proportions of land rented. For example, in Belgium, where tenants are highly protected by the land rental policy, almost 70% of the cultivated land area is rented, while in Italy, where the policy aims at stimulating owner-cultivation, only 26% of the cultivated land is rented. Land renting is also very prominent in the EU-12, but with even larger variations among countries. In the Slovak and Czech Republics, around 90% of the cultivated land area is rented. In Hungary, Estonia and Lithuania, between 50% and 60% of the cultivated area is rented. In Latvia and Poland, the figures fall to around 25%. The share of rented land in the total utilised land is lowest in Poland, mostly for historical reasons – albeit the average number hides major regional variations (Swinnen and Vranken, 2009). Therefore, one should not only consider the incidence of land sales, but also the incidence of land rentals and the magnitude of the land rental prices and this especially in regions where the share of rented land is high.

Given the immobile character of land, one has to take into account differences in the cost of living when comparing land prices among regions.

Land market constraints

Factors that impede the functioning of land markets and hence impede transfer of land to the most efficient user will affect the risk of farm land abandonment. Factors that constrain the functioning of land market are land sales and land rental price regulation, such as maximum and minimum lands sales and rental prices, tax regulations and quantitative regulations for the sale, purchase and use of agricultural land. These factors will affect both the supply and demand of land and the importance of rental relative to sales markets. If for example supply of agricultural land on the sales market is small and certain regulations result in sticky and rigid rental markets, the risk of land abandonment increases. Therefore, land sales and land rental market regulations may be an important driver of land abandonment.

In addition, credit market imperfections, property rights imperfections and transaction costs (Stanley et al., 2007) will also affect the functioning of land markets and affect the risk of land abandonment.

Capital market imperfections may constrain the efficiency of land sales markets in several ways. First, where capital markets work imperfectly, land purchases typically have to be financed out of own savings. Second, where financial markets do not work well, or where confidence in money as a repository of value is low, land may be used to store wealth and may be acquired for speculative purposes. Third, land may be purchased or held on to as a hedge against inflation, or as an investment asset in the absence of alternative investments or hedging options. Fourth, with constrained access to credit, investments in land ties up much needed capital in land, and prevents farmers from using these savings for investments in technology, equipment, or quality inputs. These factors mean that the sale price for land will typically be higher than the productive value of land so that farmers who will be inclined to expand their agricultural area will be less likely to do so.

During the 1990s credit market imperfections were widespread across all Central and Eastern European New Member States (NMS) of the EU. These problems have been mitigated substantially where credit from banks and other rural financial institutions, and contracts with agribusinesses have reduced credit constraints for farms. However in many poorer transition countries these constraints

remain very important. Furthermore, the introduction of CAP measures also relaxed the credit constraints in most EU-12 (Ciaian et al, 2010).

Further, it is well known that property rights imperfections as well as transaction costs related to the identification and delineation of land plots, the enforcement of land rights, etc., are significant constraints on the development of land markets. In fact, the NMS of the EU are well-known examples of how these factors affected land markets.

Property rights for most of the land in the NMS of the EU were privatised in the 1990s. While these land reform processes have largely been finalised, this does not necessarily mean that all the land reforms have been completed and that all the issues concerning property rights have been resolved. There are several cases in which problems with property rights and transaction costs continue to influence land markets.

In several new EU Member States the privatization process is still unfinished. A substantive share of agricultural land is still owned by the state and may be subject to future privatisation and restitution. The current decision-making and the uncertainty about the future ownership has an effect on the (lack of) transactions associated with this land and its use.

Other problems follow from co-ownership of land and the difficulty of unknown owners. In many NMS, land ownership registration was poorly maintained, if at all, and in many areas a process of land consolidation occurred, wiping out old boundaries and relocating natural identification points (such as old roads and small rivers). The loss of information on registration and boundaries resulted in a large number of unknown owners in some transition countries (Dale & Baldwin, 2000). In addition, unsettled land inheritance within families during the socialist regime gave rise to widespread fragmentation in land ownership and a high number of co-owners per plot of land.

Fragmentation of land is often cited as a constraint on the functioning of land markets – or on their ability to lead to consolidation of farm land. However, evidence suggests that labour market constraints may be a more fundamental cause of fragmentation, and that a combination of improved off-farm employment, retirement, and rental markets can address the major land consolidation problems (Rozelle and Swinnen, 2004).

Several studies document that the land markets in the transition countries, even among the most advanced such as those in Central Europe, were characterised by the existence of substantial transaction costs in rural land markets, hindering land exchanges in the years leading up to EU accession (Dale & Baldwin, 2000; Lerman et al., 2004). Transaction costs include those related to bargaining costs, the enforcement of withdrawal rights, asymmetric information, co-ownership and unknown owners, and unclear boundaries. Uncertainty and high costs in the identification of land property rights may lead to soaring transaction costs and constraints on land transactions in general.

2. Effect on the risk of Farmland Abandonment

A high incidence of land transactions, which in general leads to an increase in land sales and rental prices, typically signals a high demand for agricultural land and hence a lower risk of land abandonment.

The better the land market functions, the less likely agricultural land will be abandoned *ceteris paribus*. Hence, removal of land market constraints will decrease the likelihood of farm land abandonment. The removal of policies or practices that favour large scale farming organizations in the NMS of the EU might cause that some of these large scale farms cease their activities. In the short run, this might lead to an increase of farm land abandonment while in the long run, when more efficient farming organization emerge and expand, it will decrease the likelihood of farm land abandonment.

3. Calculation options

- Land sales and land rental prices are collected by Eurostat, but unfortunately often only at country level while disaggregated data would be most valuable. Moreover, to compare prices among countries the cost of living and/or agricultural productivity or income in a specific country or region should be taken into account.
- To my knowledge, information on constraints in the land market is collected in ad hoc surveys and not in a systematic way. However, screening of the different databases (FADN, FSS, etc) should be done.

5. References

- Binswanger, H., K. Deininger and G. Feder (1995), "Agricultural Land Relations in the Developing World", *American Journal of Agricultural Economics*, Vol. 75, No. 5, pp. 1242–48.
- Ciaian, P. and J.F.M. Swinnen (2009), "Credit Market Imperfections and the Distribution of Policy Rents", *American Journal of Agricultural Economics*, 91(4): 1124-1139.
- Ciaian, P., D. Kancs and J.F.M. Swinnen (2010), *EU Land Markets and the Common Agricultural Policy*. CEPS, Brussels.
- Deininger, K., 2003, *Land Policies for Growth and Poverty Reduction*. A World Bank Policy Research Report, World Bank and Oxford University Press. (pp. 92-94)
- Dale, P. and R. Baldwin, 2000, "Emerging Land Markets in Central and Eastern Europe", in Csaki and Lerman (eds.): *Structural Change in the Farming Sectors in Central and Eastern Europe*, *WB Technical Paper*, No 465.
- Deininger, Klaus and Gershon Feder, 2001, "Land Institutions and Land Markets" in: Gardner, B. and G.C. Rausser (eds.), *Handbook of Agricultural Economics*, Elsevier Science, Amsterdam.
- Karafotakis E., Mylonakis J. and K. Kountouris, 2006, "Price assessment of Agricultural Land in Greece", *International Research Journal of Finance and Economics*, Issue 6.
- Lerman, Z. and C. Csaki , G. Feder, 2004, *Agriculture in Transition: Land Policies and Evolving Farm Structures in Post Soviet Countries* , Lanham, MD (USA): Lexington Books
- Rozelle, S. & Swinnen, J. (2004). Success and Failure of Reforms: Insights from Transition Agriculture. *Journal of Economic Literature*, 42 (2), pp. 404-456.
- Swinnen J., Ciaian P., Kancs A. (2008), "Study on the functioning of land markets in the EU member states under the influence of measures applied under the Common Agricultural Policy" , Final report, Center of European Policy Studies(CEPS), Brussels.
- Swinnen, J.F.M. and L. Vranken (2009), "Land & EU Accession. Review of the Transitional Restrictions by New Member States on the Acquisition of Agricultural Real Estate", Brussels: CEPS Publications, 89pp.
- Swinnen, J., Vranken, L., Stanlely, V., 2006, "Emerging Challenges of Land Markets. A Review of the Available Evidence for the Europe and Central Asia Region", *Chief Economist's Regional Working Paper Series Infrastructure Department (ECSIE)*, Vol. 1, No 4.
- Trivelli Carolina, 1997, "Agricultural Land Prices", Paper Prepared for FAO's Land Tenure Service, Sustainable Development Department, Food and Agriculture Organization of the United Nations.

Key Criteria for an indicator on the risk of farmland abandonment

Nº: 2 | Title: Farm income / Regional average | Expert: Allan Buckwell

Preliminary remarks

Which farm income concept is relevant for assessing risk of farmland abandonment?

The choice is wide! The figure on the next page summarises the set of income concepts produced by the Farm Accountancy Data Network. This is the obvious data to use as it is the only harmonized micro-economic data set in the EU. It is highly detailed and the methodology defining the selection of the representative sample of farms, the variables collected for each farm, the analysis and the results presented have been debated and agreed over 45 years! These rules of the FADN are specified under EU regulations, but the data collected by Member State organizations.

The FADN sample is about 80,000 farms across the EU 25 (incorporating Romania and Bulgaria is underway) from the population of about 5 million commercial farms (6.4m for the EU27). It covers only commercial farms generally above 1 hectare. There is a constant review of where to draw the line about what is a commercial farm. In principle it is one which provides most of the income for the farmer and his family. The line is drawn according to local circumstances, so this minimum size is currently 1 Economic Size Unit (ESU = a standard Gross Margin of €1200) in Bulgaria and 16 in Belgium, Netherlands, Germany and the UK.

From the figure the choices of farm income concept are:

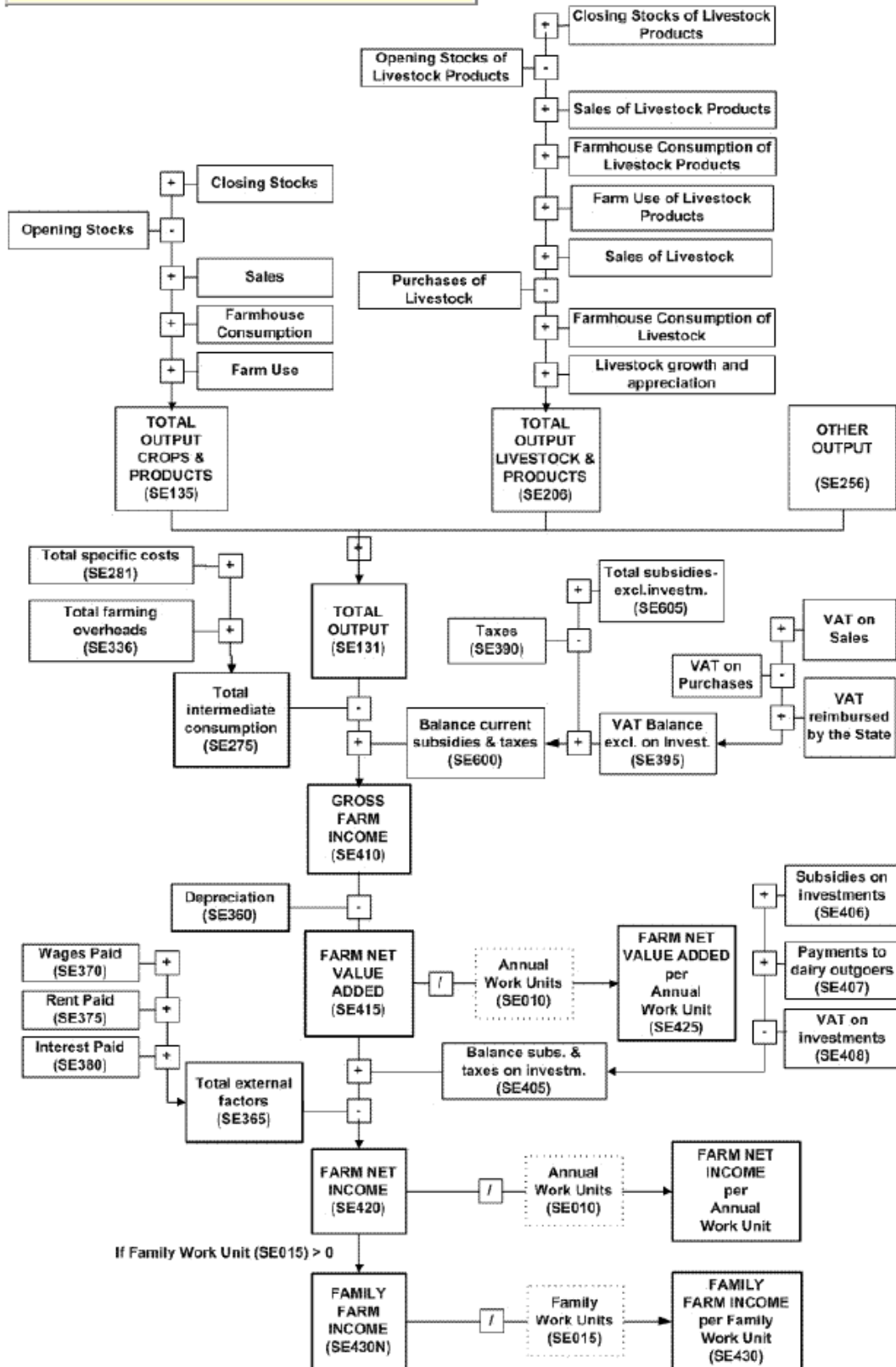
- Gross Farm Income
- Farm Net Value Added and Farm NVA per annual work unit(AWU)
- Farm Net Income and FNI per AWU
- Family Farm Income and FFI per family work unit

The foregoing discussion suggests the last of these measures is the nearest to the relevant concept for our purposes.

But this concept is deficient because it does not contain the broader non-farm income which can keep farmers going indefinitely. This is why the concept of Total Income of Agricultural Households is more relevant, but the EU's efforts to collect this data were abandoned in 2002. (The references listed tell the story.)

How therefore should we measure Farm Income for our indicator and combine it with other indicators?

FADN Standard Results : income indicators



It is an interesting mental exercise to imagine that we could get individual farm data (eg for all applicants of the Single Payments under the CAP), and then, based on their region and mix of land use, use some survey statistics to suggest what their income levels are and then to assess which have incomes so low that they might be in the box – ‘at risk of abandonment’. Suppose we could do this, and that the location of the farm could be mapped along with the other variables we think are relevant to identifying that ‘the land might be abandoned’ and if it was abandoned it could be a serious loss of

specified ecosystem services', is this what the perfect indicator looks like? Is this the yardstick against which we (mentally) compare the rather cruder estimates which is all the available data will provide us with?

If the ultimate concern about abandonment is the loss of ecosystem services then many or most of these are likely to be mapped. So zones with certain environmental characteristics may be mapped. For some other purposes we take average characteristics of, say, 10 Km squares. To map farm income would be a rather crude exercise – it would have to be based on the predominant farming types in the zones (or Km squares) with an indicated income per hectare for that type (or mix) of farming. So the analytical technique is to try and map each of our criteria, overlay the maps and see where the densest concatenation of causal factors is and estimate their extent. Is this where we are going

1. Definition of the criteria

Family Farm Income as defined in the Farm Accountancy Data Network (FADN).

This is the gross income from sales of crops and livestock and their products, plus change in stocks less farming overhead costs, specific costs and variable costs, adjusted for taxes and subsidies,

less depreciation, wages paid, rent and interest paid and adjusted for taxes and subsidies on investment.

and expressed either in total or per family work units.

The detailed specification of all these variables is found in the **FADN, A to Z of the methodology (11th February 2010)**.

The biggest difficulty with this as our measure of risk of farmland abandonment is that it does not contain sufficient information on the total income of the agricultural household.

2. Effect on the risk of Farmland Abandonment

See above discussion.

The relationship is expected to be negative, the higher the farming income level the lower the risk of abandonment – but we can expect the relationship to be shifted up significantly (higher risk) for older farmers (or populations of farmers) who do not have willing farming successors.

3. Calculation options

The farming income levels for specified farm types (LFA extensive grazing, Dairy, Mixed, Lowland Grazing, etc) can be indexed and compared across Member States

They can be expressed as indices compared to general income levels for each Member State

They can be shown in more detail in absolute €/farm and per hectare by regions for many MS

5. References

The Farm Accountancy Data Network link is http://ec.europa.eu/agriculture/rca/index_en.cfm

The arguments on Total Income of Agricultural households can be found in Berkeley Hill (2010) The costly mistake of measuring the wrong thing – the CAP and income indicators, follow the link at the end of the following article:

<http://www.reformthecap.eu/blog/much-money-little-evidence>

Hill, B. (2008) "Presidential Address: Some Economics of Public Statistics". Journal of Agricultural Economics. Vol. 59, No 3. 387-420.

Key Criteria for an indicator on the risk of farmland abandonment		
N°: 3	Title: Investment in the farm	Expert: Adele Coppola
1.	Definition of the criteria	
<p>The relationship between investments and the risk of farmland abandonment can be considered from two different points of view.</p> <ol style="list-style-type: none"> 1. We can be interested to investment as level and type of fixed (and tangible) assets in the farm. Fixed assets refer to capital stock and are the sum of the value of agricultural land (that includes the value of irrigation facilities, land improvements, plantations and farm buildings), of machinery and equipment, and of breeding livestock. Capital inputs that compose the fixed assets can be more or less easily converted to cash and that can influence the decision to dismiss them when farm activity is not more profitable. In some cases they are not readily marketable or they can have recovery prices that are substantially lower than the buying prices. That especially occurs when the input is highly specialized, such as some dairy equipment or specialized crop machinery. Microeconomic theory suggests that a capital input will continue to be used as far as its marginal productivity value is higher than the recovery price. Then we can expect that the risk of abandonment is lower the more specialized is the capital input, and the lower is its recovery price. The criteria can more easily applied to the farm as a whole than to the single land plot. In fact, investments specifically referred to land plots mostly include irrigation facilities and plantations whose value is incorporated in the land value and is taken into account by the land market (see Liesbet Vranken work). 2. A second approach looks at whether or not new investments have been undertaken in the last years. Investment behaviour is the fruit of many different factors but, other factors being constant, it reflects expectations about the future. Then, new investments are a signal of a medium/long term strategy and can be a proxy of the willingness to continue farm activity. This criteria can be applied both to the farm as a whole and to the single land plot, depending on the availability of information on the type of investments (e.g. machineries vs plantations). 		
2.	Effect on the risk of Farmland Abandonment	
<p>We expect that the higher is the amount of investments and the more specialized the capital inputs are, the lower is the risk of farmland abandonment. Moreover, if new investments have been undertaken, the risk of farmland abandonment is lower.</p> <p>For our objective, fixed assets (point 1) should be considered apart from land, whose influence is considered when the land market is taken into account.</p>		
3.	Calculation options	
<p>Economic and financial data such as assets and depreciation are included in the European Farm Accountancy data Network (FADN) that cover a sample of farms that can be considered “commercial”, that is “large enough to provide a main activity for the farmer and a level of income sufficient to support his or her family. In practical terms, in order to be classified as commercial, a farm must exceed a minimum economic size”. Only aggregated results for groups of farms or for farms within regions and Member States are published, while individual data can be used by the European Commission for study and policy analysis aims.</p> <p>FADN don’t include information neither on the single type of asset, nor on the difference between the acquisition cost and the recovery price. Then the operative use of the level of investment criteria to assess the risk of farm abandonment needs to set a threshold or a reference level. That could be solved by estimating an average level of investment per hectare according to different farm typology. The use of the criteria of new investment can be easier: FADN records gross and net investments and</p>		

data are yearly, then the yearly difference of net investments.

Both calculation options refer to the farm level. To apply them to a region level, a more detailed study on the relationship between farm typologies and investment behaviour is required.

5. References

European Commission, *Community Committee for the Farm Accountancy Data Network (FADN)*, RI/CC 882 Rev.8.1, Brussels, 12 April 2007

De Stefano F. (1985), *Principi di politica agraria*, il Mulino, Bologna

Key Criteria for an indicator on the risk of farmland abandonment		
N°: 4	Title: Average age on the farm	Expert: Adele Coppola
1.	Definition of the criteria	
<p>The agricultural sector is characterized by household farms and the productive activity is highly influenced by the life cycle of the farmer and of his/her family.</p> <p>Some studies highlighted the relationship between farmer's age and landscape changes. In particular, other factors being constant, farmland extensification and abandonment are more likely to occur when the farmer is old and close to retirement. As a fact, elderly farmers try to reduce their working time on the farm and the scale of operations. That is true when farmer doesn't have a successor. The presence or absence of a successor can have an important influence in land use decisions and the absence of successors reduces the incentive to expand farm capacity and to intensify land use.</p> <p>The criteria of the average age can consider the age of the farmer or the age of the farmer family as a whole. In the last case this criteria is able to catch the effect both of the farmer age and of the presence/absence of a successor, but detailed information on the number of family members and on their age is needed.</p>		
2.	Effect on the risk of Farmland Abandonment	
<p>We expect age to have a positive effect on the risk of farmland abandonment, but other factors can affect this relationship: production system, presence/absence of successors, farm size, etc.</p>		
3.	Calculation options	
<p>Information on the famers' age is included in the FSS (comprehensive survey are carried out every 10 years and intermediate sample surveys are carried out every 3 years) and in the FADN data (annual data). These dataset give information on the family labour, too, that can be useful to understand whether there is a deeper involvement of family members in the farm activity. These data can be directly used in an individual farm model to assess the risk of land abandonment. When the risk is assessed at regional level, the share of farmers more than 65 years old can be an operative option, but it should be crossed with information on land use and farm typology.</p>		
5.	References	
<p>Potter C., M. Lobley (1992), "Ageing and succession on family. The impact on decision making and land use", <i>Sociologia Ruralis</i>, Vol. 32, n. 2/3</p> <p>Kristensen L.S. Thenail C., S.P. Kristensen (2004), "Landscape changes in agrarian landscape in the 1990s: the interaction between farmers and the farmed landscape. A case study from Jutland, Denmark", <i>Journal of Environmental Management</i>, 71</p>		

Key Criteria for an indicator on the risk of farmland abandonment		
N°: 5	Title: Farmer qualification (education, training, farm advisory services)	Expert: DG AGRI (G1)
1. Definition of the criteria		
<p>Training, diffusion of knowledge activities and advisory services can cover issues under both the agricultural and forestry competitiveness and the land management and environment objectives. The evolution and specialization of agriculture and forestry require an appropriate level of technical and economic training, including expertise in new information technologies, as well as adequate awareness in the fields of product quality, results of research and sustainable management of natural resources, including cross-compliance requirements and the application of production practices compatible with the maintenance and enhancement of the landscape and the protection of the environment.</p> <p>It can be said that there is an inverse correlation between level of education/training and use of advisory services and risk of land abandonment: the risk of land being abandoned decreases with the increase in the level of education/training and use of advisory services.</p>		
2. Effect on the risk of Farmland Abandonment		
<p>Evaluations indicate that, among others, training and advisory services have been effective in creating employment. Rural development policies have played an important role in preventing depopulation and land abandonment and in creating and maintaining jobs. Equally, the literature suggests that to maintain and/or achieve a sustainable land use that is adapted to the specific regional conditions, a thorough training of agricultural advisors is particularly required. The advisory training should incorporate the promotion of appropriate environmentally friendly farming techniques. In some instances, e.g. Ireland, MS have introduced educational voluntary schemes with the stated objective of protecting against land abandonment.</p> <p>Education/training and use of advisory services, besides contributing to farm profitability, can be assumed as a proxy for the professionalism of the farm, and willingness to invest in terms of human capital and knowledge with a sufficient time horizon.</p> <p>Farmers' training levels are highly variable between Member States. Many farmers do not have the skills necessary to take advantage of the potential of the new environment for innovation, provision of environmental services, diversification, and development of local services or bio-energy production. These shortcomings can increase the risk of land abandonment.</p>		
3. Calculation options		
<p><u>Variables:</u></p> <p>- Education: Max level of education in the household: 1= None and primary; 2= Lower Secondary; 3= Upper secondary; 4= Post-secondary; 5= Degree;6= PhD.</p> <p>- Training: 1 if a member of the household has undertaken a professional training course, 0 otherwise.</p> <p>- Advisory services 1 if the holding is assisted by a farm advisory, 0 otherwise.</p>		
5. References		

- Mishra A.K. et al., Determinants of farm exit: a comparison between Europe and the US, paper presented at the 114th EAAE Seminar, Berlin, April 15-16, 2010.
- Communication from the Commission of 21 December 2006, Employment in rural areas: closing the jobs gap [[COM\(2006\) 857](#) final - Not published in the Official Journal].
- IHDP, 7th International Science Conference on the Human Dimension of Global Environmental Change, 26-30 April 2009, Bonn, Germany.

Horst Korn et al.(Eds.), Report of the International Workshop “Opportunities of EU Agricultural Policy Instruments for Biodiversity Conservation and Integrated Rural Development in Protected Areas of the New Member States”, 2005.

Key Criteria for an indicator on the risk of farmland abandonment		
N°:6	Title: Previous trend of Farmland abandonment	Expert: SOLAGRO – Philippe Pointereau
1.	Definition of the criteria	
	<p>The recent farmland abandonment is the UAA loss observed between the last two FSS censuses, that has not been converted into artificial areas. This non-utilised agricultural land is no longer farmed for economic, social or other reasons, and is not included in the crop rotation system.</p> <p>Tree plantation is not considered as a part of farmland abandonment. If the data are available, this flow must be excluded of the surface of abandoned farmland.</p>	
2.	Effect on the risk of farmland abandonment	
	<p>The hypothesis of this indicator on the risk of farmland abandonment, is to consider that a recent farmland abandonment in a specific territory is expected to be maintained in the next period.</p> <p>The main weakness of this indicator suggests that agricultural policies and agricultural markets do not change. For example the trend of farmland loss in the new Member States as changed in most of these countries as Poland, Bulgaria or in Baltic countries. This situation is due to the CAP implementation. Greece has also recovered during the period 2003-2007 most of the UAA lost during the period 1993-2003. The reason of this change is not known. In France, wine crisis can affected the surface of vineyards during a specific period with low wine prices and high financial supports to destroy the vineyard.</p> <p>Generally the abandoned regions are the target of some specific policy as LFA, or agri-environmental payments. These payments are expected to affect positively the economical situation of the farms and reduce the farmland abandonment.</p> <p>The strength of this indicator is to locate the areas with physical and climatic constraints where no real economical options exist for the farms.</p> <p>This indicator can be crosschecked with other indicators as farm incomes.</p>	
3.	Calculation options	
	<p>The principal difficulty is to reveal three opposing processes : the conversion of farmland to artificial surfaces, the afforestation on agricultural lands and the farmland abandonment.</p> <p>The main option is to calculate the loss of the UAA observed between the last two FSS censuses in the rural areas, considering that the loss of UAA in the urban areas can be mainly affected to soil sealing. The urban areas are the municipalities with a population density over 150 inhabitants per km² or an increase of the population of more than 10% between the two last population censuses (this ratio must be adapted to the length of period between the two censuses). As some farmland is also converted in artificial uses in rural areas, only the medium, high and very high level of UAA decrease is considered as farmland abandonment.</p> <p>The decrease is considered as low when the loss of UAA at the municipalities level is under 100ha/year or 0,6%/year. This threshold can be adapted to the condition of each Member States taking into account the average size of the municipality.</p> <p>This flow includes also the properties purchased to develop private hunting grounds or for leisure and also artificial afforestation. If relevant data are available, these two flows which are not farmland abandoned, must be excluded.</p>	
4.	References	

Pointereau. P. and Al.,2008. *Analysis of farmland abandonment and extent and location of agricultural areas that are actually abandoned or are in risk to be abandoned.* JRC/IES

Key Criteria for an indicator on the risk of farmland abandonment		
Nº: 7	Title: Remoteness and difficult access	Expert: Helena Nordström Källström
1.	Definition of the criteria	
<p>Remoteness and difficult access can be seen as an indicator on the risk of farmland abandonment in more than one aspect.</p> <p>On the one hand, remoteness and difficult access could be factual and measurable distances to service, agricultural infrastructure and other farmers as well as long distances and small blocks within farms.</p> <p>On the other hand, there could also be a subjective dimension of remoteness and difficult access. The subjective perception of remoteness and difficult access is related to expectations on the situation and also comparison to other farmers and farm areas within countries in a local context and/or within EU in a regional context.</p> <p>Remoteness and difficult access in both aspects often creates a negative spiral when distance grows as farmers abandon their land and by that cause higher risk for further FLA.</p>		
2.	Effect on the risk of Farmland Abandonment	
<p>When farms are influenced by remoteness and difficult access, in any aspect, farm land abandonment is likely to occur. When distance grows farmers are more likely to give in (1).</p> <p>But there could also be reactions against this on local level, based on for example a strong farming identity, which will act in the opposite direction. Due to for example alternative work possibilities FLA could be postponed to the next generation shift which highlights the importance of demography statistics on a local level.</p>		
3.	Calculation options	
<p>For this indicator most usable is of course the measurement of physical distance with different data sets on national and EU level. These calculations could for example consist of data on: Distance to city centres, available roads and distance to other centres for service for citizens (2). Distance to agricultural infrastructure, such as retailers and agricultural supply (No known source of data) Distance to other farms and/or farmers (National and EU data on farms registered within CAP) (3; for Swedish conditions this has for example been analysed in relation to possible spreading of diseases on farm animals) Difficult access and distances within farms (such as distance to blocks) (National and EU data on farms registered within CAP).</p> <p>For the future, different types of surveys should be developed and carried out to measure subjective perceptions of remoteness and difficult access</p>		
5.	References	
<p>(1) Nordström Källström, H. 2008. Between comfort and solitude – the social conditions at Swedish farms. Acta Universitatis agriculturae Sueciae 2008:74. Swedish university for agricultural sciences, Uppsala</p> <p>(2) Jonard, F., M. Lambotte, F. Ramos, J.M. Terres and C. Bamps. 2009. Delimitations of rural</p>		

areas in Europe using criteria of population density, remoteness and land cover. JRC Scientific and technical reports EUR 23757 EN. Ispra.

- (3) Petterson, L. and L. Widell. 2010. Den produktionsekonomiska betydelsen av kontrollprogram för salmonella hos nötkreatur. RA10:2. Jordbruksverket, Jönköping.

Key Criteria for an indicator on the risk of farmland abandonment

Nº: 8	Title: Size of parcels, size of farm / average in the same sector	Expert: Margarida Ambar
------------------	--	--------------------------------

Previous considerations

- When talking about the “size of a farm”, we can consider the economical size (expressed in European Size Units or in Euros) or the “physical” size (expressed in hectares). For the sake of the criteria “size of the farm” to establish the FLA indicator, it seems logical to consider the “physical” size since economical aspects related to FLA are taken in consideration in relation to other proposed criteria.

- When we refer to the “physical size” or the area of a farm /parcel, we can consider the total area or we can segregate the utilized agricultural area (UAA), unutilized agricultural land or other land of the farm / parcel. Since “the measurement of farmland abandonment is based on the loss, between two periods of time, of UAA which has not been developed (sealed) or afforested”, it seems logical to consider the UAA when we refer to the size of the farm / parcel.

- When we use the term “farm”, we propose to consider it as synonymous of an “agricultural holding”, that is to say a single unit technically and economically, which has single management and which undertakes agricultural activities, either as primary or secondary activity (refer to Regulation (EC) No 1166/2008 of the European Parliament and of the Council, of 19 November 2008).

- We have to keep in mind that as we’re considering the size of a farm / parcel, we are not taking in consideration if this refers to one single piece of land or if it includes two or more separated parcels. So, we’re not taking in consideration (physical) fragmentation, which can be a significant constrain in the farm management with major impact in its output. Fragmentation has a general negative effect on the farm output and it can simply be stated that, the more fragmented farms are, the more significant is the negative impact on their economical results and, therefore, the risk of FLA is higher. In general, two farms with the same size but where one of them is more fragmented than the other, means that the parcels of the second one are smaller (at least, some of them). On the other hand, we can say that the smaller the farm is (and smaller the parcels are), the more significant is the negative impact of fragmentation.

Complementary to fragmentation and stressing its negative effects, there’s another aspect that could be considered, which is the distance between parcels of a farm and the distance of the parcels to the headquarters of the holding.

- The concept of “parcel” can vary accordingly to the context, to the MS,... Commission Regulation (EC) No. 1122/2009 defines “agricultural parcel” as a continuous area of land, declared by one farmer, which does not cover more than one single crop group (defined in the same Reg.), but MS may lay down additional criteria for further delimitation of an agricultural parcel. Therefore, in practice, each MS has the possibility to choose the most appropriate definition of agricultural parcel for their context. So the records are not generically comparable throughout EU. For instance, according to CODED, the term “parcel” for UN Geographic Information Systems means a single cadastral unit or land property and, within agricultural context, means a continuous plot of land as defined in the land register.

When setting up an Integrated Administration and Control System (IACS) to manage CAP aid, each MS had to establish an identification system for agricultural parcels (LPIS) in order to spatially represent the activities of farmers on their lands. Especially at the beginning, LPIS didn’t take in consideration cadastral systems or land administration systems, focusing on the farmer: these systems were cheap and easy to build and maintain. Since then, they have been developed because the requirements imposed by the CAP have evolved.

LPIS has been defined to operate at reference parcel level such as cadastral parcel or production block (Commission Regulation (EC) No 796/2004 of 21 April 2004). So, the MS have implemented

their LPIS in different ways but they mainly record agricultural land use information declared by farmers, rather than land tenure information. The main reasons for this are that land records weren't (and still aren't in many cases) readily available for the majority of countries and that these land records and related administrations are complex.

However, future trends are that IACS-like data will be included within cadastral systems. The information managed under the IACS is directly related to a multipurpose cadastre since the information in these systems has evolved from a subsidy purpose to a broader land management context because of the introduction of the CAP's second pillar, Rural Development. "Future needs, in this context, will be more complex to an extent that land Administration System may not be neglected any further." (Inan & Cete, 2007).

CRITERIA SPECIFIC

- The increase in the size of farms generally brings benefits from reductions in production costs as the usage levels of some inputs increase. Seeds, fertilizers, irrigation and labour are the major inputs that are essential to any crop and have significant contribution to the total cost of production. The unit price of seeds, fertilizers, pesticides and irrigation differ significantly with the size of farms, according to an inverse relation: buying larger quantities of such inputs reduces their unit price, representing an advantage for bigger farms (Rahman and Takeda, 2007). On the other hand, these bigger farms allow and compensate the use of machinery, thus reducing costs with labour.

- Farmers of small or medium size parcel of land are more likely to have difficulties to access to certain production inputs, formal credit and other institutional services required for improved practices. It may happen that, as a result, farmers continue with traditional practices, which lead to low productivity. Farmers of larger farms have more possibilities to have such a cash flow that allows them to invest with their own money or have easier access to the credit market, thus having the chance of benefiting from opportunity costs (Rahman and Takeda, 2007).

- The relationship between farm size and technical efficiency isn't linear: there seems to be an U-shape relationship since, for farms up to 1.000-2.000 ha, efficiency falls when size rises and, beyond this size, it rises again (Helfand and Levine, 2004).

- Other gainful activities are not related to its size and can have a most significant positive impact in the farm outcome.

- In the case of the production of high value added products, there are particular market relations and some of the statements mentioned above have different logics (see respective factsheet).

- . Particularly related to the last two points and in spite of what was stated before, "research is emerging that supports the economic feasibility of small farms." "In many cases, modest and small size farms can take better advantage of emerging opportunities than larger farms that produce much more and are depending on other businesses to market and distribute their products..." "Smaller farms can be more vertically integrated and capture the profits from each level of marketing, processing and even distributing their products. Technological improvements have increased small farmers ability to find just the right size of equipment for the area they are farming (e.g. drip irrigation)." "These emergent adaptative farms tend to be more labour intensive and may produce a wider range of products than conventional farms." (Sorte et al., 2009). Nevertheless, these appear as specific cases, not the rule.

- Depending on existing conditions, intensification of agricultural activities in small farms can be an effective means to overcome the restrictions created by this constrain.

- The shape of the parcel is a factor that has some relation with the size of the parcel: if the shape isn't a regular one, it disturbs more the farm management, the smaller the parcel is.

- Constrains to forms of more intensive agriculture due to EU regulations meant to preserve natural values, create the necessity of extensive systems, more space, bigger farms. Besides, some kinds of

farms require large areas in order to be eligible for CAP funding: intensive dairy farms, for instance, may require the increase of their managed area to keep stocking rates down (nitrate pollution). The other way around, there's a minimum size (and width) under which parcels are not eligible for aid. This parameter is established per MS.

- . Changes in parcels' size frequently interfere on landscape and / or other natural values (when, for instance, parcels are limited by hedges or stone walls and these have a role in the ecosystem). This is particularly sensitive in landscape protected areas or in places where the landscape is determinant for tourism.

-It's good that we underline that the factor "size" isn't enough to determine if a certain farm / parcel is able to provide good economical outputs and, therefore, if it isn't at risk of being abandoned. This depends on several other factors such as the type of crop, the quality of the soil, etc.

1. Definition of the criteria

To this concern, the size of a farm / parcel refers to its Utilized Agricultural Area (UAA) – the total area taken up by arable land, permanent grassland, permanent crops and kitchen gardens. Therefore, it does not concern to the total area of the farm / parcel: the non-utilized and other land (e.g. forest, shrub lands) are not considered.

Farm is understood here as an agricultural holding – a single unit technically and economically, which has single management and which undertakes agricultural activities, either as primary or secondary activity (so it may also provide other supplementary, non-agricultural, products and services). This means that a farm may include different types of land tenure (land can be owned, rented, share-farmed, etc.). Besides, one single farm may consist of more than one parcel (fragmentation) and these can distance themselves more or less significantly.

Parcel is considered here to be a continuous area of land, declared by one farmer, which does not cover more than one single crop group. So, this relates to the land use (not to the ownership) and is coherent with the concept of farm presented above, besides being supported by the type of available data.

2. Effect on the risk of Farmland Abandonment

In very general terms, we can say that:

Larger farms can benefit from lower production costs.

Larger farms allow better farming techniques.

Larger farms are more suitable for most of the competitive agricultural practices, like the use of machinery or a better efficiency in the use of inputs, for instance.

Larger farms are more frequently related to innovation.

Larger farms are more frequently competitive and viable in economical terms.

So, in principle, the bigger the farm / parcel is, the less likely it will be abandoned. Exceptions for some small farms with intensive agricultural systems and those with profitable OGA.

3. Calculation options

Data sources:

- farm structure surveys (FSS);

- farmers' area declarations for CAP aid.

Calculations:

- farms' average size, at municipal level;

- average number of parcels per farm, at municipal level.

5. References

Rahman, Shaik Moksadur; Takeda, Jun (2007). "Measuring the costs of Production Based on Sizes of Farm Operation: a Study on Rice Farmers in Jessore District of Bangladesh". *American Journal of Applied Sciences* 4 (5): 274-283.

Helfand, Steven M.; Levine, Edward S. (2004). "Farm size and the determinants of productive efficiency in the Brazilian Center-West". *Agricultural Economics* 31. Elsevier. 241-249.

Corbelle Rico, Eduardo; Crecente Maseda, Rafael (2009). "Evolución histórica de la Superficie Agrícola Utilizada en Galicia (1962-2006). Integración de fuentes estadísticas y cartográficas". *Economía Agraria y Recursos Naturales* (ISSN: 1578-0732), 9: 2: 181-192.

FAO (2002). "Land Tenure and Rural Development". *FAO Land Tenure Studies* 3. Rome

Inan, Halil Ibrahim; Cete, Mehmet (2007). "Evaluation of Land parcel Identification Systems". *Strategic Integration of Surveying Services*. FIG Working Week, China.

Sorte, Bruce; Crop, Mary; Kaiser, Clive; Mills, Randall (2009). *Minimum Parcel Size for Viable Adaptative Farms in Umatilla County: an Economic Analysis*. Oregon State University

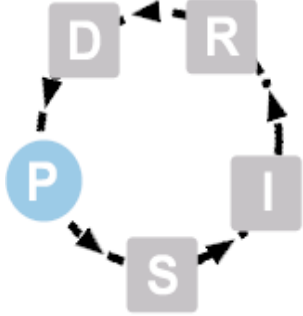
Key Criteria for an indicator on the risk of farmland abandonment		
N°: 9	Title: Farm commitment / Specific Schemes (AEM,...)	Expert: DG AGRI (G1)
1. Definition of the criteria		
<p>Farmland is typically abandoned as an economic resource when it ceases to generate an income. Although this is not a sole cause, and although it can be triggered by a number of factors (described in/by the other indicators), there is a powerful link.</p> <p>The EU rural development policy therefore offers a set of measures which prevent a loss of income. There are measures which directly address land which is at risk of marginalization (e.g. areas with natural handicaps, areas with low productivity/additional costs, etc.), as well as measures that land managers can take up as voluntary commitments.</p> <p>In the former category, the current rural development framework offers payments for areas with natural handicaps which explicitly combat land abandonment. Beneficiaries of these payments are committed to continue farming on the paid for areas for at least five years after the first payment. Arguably, Natura 2000 payments and payments linked to Directive 2000/60/EC fall into the same category, as the income loss and additional cost are paid to farmers.</p> <p>The latter group of measures includes mainly agri-environmental commitments which have to be maintained for at least 5 years. One could also include investments (directly or indirectly related to land) into this category, as their durability is at least five years.</p>		
2. Effect on the risk of Farmland Abandonment		
<p>As explained in the first point, the listed measures either maintain farm's income (i.e. a farmer is not losing money because of land's intrinsic features), or they have a positive effect on farm's income.</p>		
3. Calculation options		
<p>It can be argued that the risk of land abandonment is zero or close to zero in the case of presence of a payment which is linked to a commitment to continue farming, or to manage the land in a prescribed manner.</p>		
5. References		
<p>D. MacDonald <i>et al</i> (2000): Agricultural abandonment in mountain areas of Europe: environmental consequences and policy response, p 47-69 Journal of Environmental Management 59 (2000), Academic Press</p> <p>Irena operation: Irena indicator fact sheet</p> <p>COUNCIL REGULATION (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) (O.J. L 277, 21.10.2005, p. 1)</p>		

Key Criteria for an indicator on the risk of farmland abandonment		
N°: 10	Title: Opportunities outside the agricultural sector	Expert: Dirk Strijker
1.	Definition of the criteria	
	<p>There are various ways to approach this. One is in terms of the share of the non-agricultural sector in the region, either in value added or in employment. The level of unemployment is another aspect of opportunity.</p> <p>Opportunity has also a perspective of distance, so the question can be raised to which geographical entity (region, country) the share in value added or employment should be related. As distance is important, distance to a major city can also be a relevant indicator.</p> <p>There can be considerable differences between the income and the employment approach, because labour productivity tends to be relatively low in the more traditional regions of the EU. Share of agriculture in value added can then be quite low, combined with a high share in employment.</p> <p>A. The value added approach could be measured as Share of Agriculture in Gross Domestic Product / GRP (basic indicator of EU)(Gross Value Added agr., fish./GDP)</p> <p>B. The employment approach could be measured as ‘Share of agriculture in employed civilian working population’ (basic indicator of EU)</p> <p>C. The relative value added per agricultural worker can be derived from the first two indicators.</p> <p>D. Unemployment rate: % of civilian working population (basic indicator of EU)</p> <p>E. Distance</p>	
2.	Effect on the risk of Farmland Abandonment	
	<p>A. Value added A high share of agriculture in the regional GDP/GRP implies indirectly that there are not many alternative income sources in the region. So, the costs of terminating agriculture are relatively high: reduced risk of land abandonment</p> <p>B. Employment A high share of agriculture in the regional employment has the same indirect implication</p> <p>C. A relative low value added per agricultural worker is a strong incentive to leave agriculture for a better job, which seems to be geographically not too far away. There is a risk of land abandonment, although this risk is smaller when the remaining farms are in a rapid modernization process (1): they will most probably absorb the land. So, if the remaining farms are NOT increasing their size, there is serious risk of land abandonment.</p> <p>D. A high unemployment rate indicates low opportunities outside agriculture</p> <p>E. A short distance makes it possible to combine farmwork with work outside the farm (so continuation of agricultural land use through part-time farming), a long distance leads to more risk of land abandonment.</p>	
3.	Calculation options	
	<p>See 1. Data on GDP available at NUTS-3 level, Employment for Agriculture, Fishing and GVA for Agriculture, Fishing available at NUTS-3 level, Unemployment on NUTS-3 level. Distance is more complicated. it could be operationalized as inside or outside a circle around main centres (capital, other major cities).</p>	
5.	References	

(1) Terluin, I, D. Strijker & W. Munch, Economic dynamics in rural regions. In A. Oskam, G. Meester & H. Silvis, EU policy for agriculture, food and rural areas. Wageningen: Wageningen Academic Publishers, 2010, Chapter 18 (pp. 309-323)

Key Criteria for an indicator on the risk of farmland abandonment		
Nº: 11	Title: High value added products	Expert: Aija Zobena
1.	Definition of the criteria	
<p>Production of high value added products – production of PGI-PDO products, labelled products (organic, regional and other food labels). Producers try to acquire untraditional market niches by using different food labels and traditional production methods, often linking a high quality product with other products and services, e.g. rural tourism.</p> <p>Production of high value added products usually could be connected with:</p> <ul style="list-style-type: none"> - return to traditional production technologies, - turn from intensive to more extensive land use practices, - increase of use of local resources, - reduction of labour input in some cases (f.e., conversion from intensive dairy farming to beef cattle breeding in some regions in Latvia); - increased input of manual work in other cases (conversion from industrial to artisan food processing) . <p>There is a link between labelled products and the maintenance of specific (traditional) landscapes. Production of some such products may be a key element to prevent land abandonment. Production of high value added products stimulate development of collective marketing initiatives in developing communication with consumers.</p>		
2.	Effect on the risk of Farmland Abandonment	
<p>Production of high value added products have several positive effects on rural development, particularly:</p> <ul style="list-style-type: none"> - the viability of farms and food processing enterprises, - the fight against poverty in marginal areas, - the preservation of biodiversity and traditional knowledge systems, - as well as in fairness of trade issues. <p>At the same time some studies come to conclusion that the presence of, f.e., PGI-PDO products could be the result rather than the cause of the development of rural areas (1) and the presence of PDO products limit in some ways the intensification of the farm system (2).</p>		
3.	Calculation options	
<p>“Landscape appreciation” indicator addresses the presence of labeled products (3).</p>		
5.	References	
<p>(1)Marescotti A. Typical products and rural development: Who benefits from PDO/PGI recognition? . 83rd EAAE SEMINAR Food Quality Products in the Advent of the 21st Century: Production, Demand and Public Policy 4th-7th Septmeber, 2003 - Chania, Greece</p> <p>(2)Pointereau P., Paracchini M.L. et al. Identification of High Nature Value farmland in France through statistical information and farm practice surveys. European Commission Joint Research Centre Institute for Environment and Sustainability, 2007</p> <p>(3) Paracchini M.L., Capitani C. COM(2006)508 – Implementation methodology of the “Landscape State and Diversity” indicator.</p>		

ANNEXE B: FACTSHEET AEI14 ‘RISK OF FARMLAND ABANDONMENT’

<p><u>Indicator Definition</u></p> <p>Farmland abandonment is a cessation of management which leads to undesirable changes in biodiversity and ecosystem services.</p> <p><u>Main indicator, supporting indicators</u></p> <p>Main indicator:</p> <p>The risk of farmland abandonment is estimated through statistical analysis of key drivers (see supporting indicators) combined into a composite index indicator.</p> <p>Supporting indicators (drivers for farmland abandonment):</p> <ul style="list-style-type: none"> • Weak land market • Low farm income • Lack of investment in the farm • High share of farm holders over the age of 65 years • High share of farm holders with low qualification • Remoteness and low population density • Low farm size • Low share of farms committed to specific schemes linked to continue farming <p><u>Links with other indicators</u></p> <ul style="list-style-type: none"> • AEI 01 Agri-environmental commitments • AEI 03 Farmers’ training level and use of environmental advisory services • AEI 04 Area under organic farming • AEI 10.1 Cropping patterns • AEI 10.2 Livestock patterns • AEI 12 Intensification / Extensification • AEI 23 High Nature Value Farmland • AEI 28 Landscape – State and diversity 	
---	---

Key messages

1. Farmland abandonment due to economic, structural, social or difficult regional factors is estimated to have a higher risk in southern Member States (Portugal, Spain, Italy, Greece, Romania). In northern Europe, the risk is higher in the Baltic States, northern Finland and Sweden and in north-western Ireland.
2. NUTS2 regions with a higher risk of farmland abandonment also have a higher share (around 30%) of holdings with farm-type ‘grazing livestock’.
3. Difficulties in the indicator compilation arise from data availability and resolution. Farmland abandonment appraisal requires to access data at very fine scale in order to assess the distribution of situations within a NUTS2 region (avoiding regional averaging which masks specific situations). This was not possible with the Farm Structure Survey (FSS) dataset available to the European Commission Joint research Centre. Moreover, it was found that official European datasets (FSS, Farm Accountancy Data Network) do not hold the same level of geographic reporting amongst all Member States; thus creating time consuming processing and preventing building comparable outputs for all MS.

Factual results

Introduction

Farmland abandonment is commonly understood as the cessation of agricultural activity on a given surface of land. This process has been observed in many regions of Europe at different periods. Farmland abandonment bears significant environmental consequences and is often associated with social and economic problems in rural areas. Therefore, risk of farmland abandonment is a process driven by a combination of social, economic, political and environmental factors.

Policy relevance and context

Food security is one of the major challenges of the future given the outlook of increasing global demand faced with uncertainties of supply linked to unpredictable economic and political, climatic and biological developments. The European Union has a justified strategic interest to keep its agricultural production potential in view of the short and long term needs such as food, feed, fibre and biomass production. Moreover, the environmental effects of farmland abandonment may imply loss of landscape and biodiversity, and increased vulnerability to natural disasters.

As shown by Renwick et al (2011), there is a fear that agricultural and trade reforms will reduce the economic viability of farming in Europe and lead to further abandonment of more marginal agricultural areas. The reasons for and consequences of farmland abandonment are very diverse across the EU while at the same time they can be potentially very serious. For this reason, farmland abandonment has attracted considerable attention from policy makers, at national and EU level.

Farmland abandonment has a biophysical and a socio-economic dimension. Increasingly policy makers have made an effort at the EU level to bring these two dimensions closer to each other. This is reflected - for example - in the way that the Common Agricultural Policy (CAP) has progressively included more environmental requirements attached to the necessary management of agricultural land.

To avoid land abandonment, the CAP offers two main instruments with the objective of keeping farming in place and thereby contributing to maintaining the production capacity of European agriculture: (a) **decoupled direct payments** with their link to cross-compliance requirements and (b) the **Area with Natural Constraints** (ANC) payments.

- Decoupled direct payments contribute to stabilizing and enhancing farm income. Besides this role, direct payments, in combination with **cross-compliance**, underpin the respect of basic requirements for agricultural activities. Cross compliance consists of mandatory requirements related to the environment, food safety, animal health and welfare (**Statutory Management Requirements** (SMR)). Furthermore, it includes the requirement to keep land **in Good Agricultural and Environmental Conditions** (GAEC). If a farmer does not respect these basic requirements on all his land, his direct payments are reduced or entirely cancelled. Linking direct payments to basic agricultural land management requirements helps to protect natural resources and maintain the capacity to produce, also on marginal land which might be at risk of abandonment.
- Compensatory payments in Area with Natural Constraints help maintain farming activity in areas which, due to adverse natural conditions, are less profitable. This concerns in particular marginal areas or mountainous areas where the ANC payments contribute to avoiding land abandonment and, thereby, negative effects for the environment and/or the attractiveness of the rural areas in question.

Agri-environmental context

By managing a large part of the European Union's territory, agriculture preserves farm resources, biodiversity, and a wide range of valuable habitats. Many of these habitats and related species have a direct interdependence with agriculture. Agriculture is also the first to benefit from biological diversity. However, the maintenance of a number of ecosystems that have emerged from agricultural cultivation depends on the continuation of appropriate land management practices.

Whilst land abandonment is often viewed negatively, it is not always clear that land abandonment is detrimental. For example, in terms of nature conservation, Keenleyside and Tucker (2010) note: "In many circumstances abandonment may be damaging as it will threaten a range of semi-natural habitats and associated species of nature conservation importance, many of which are concentrated in Natura 2000 sites and other High Nature Value (HNV) farmland. But in some locations, abandonment could be highly beneficial, particularly in highly fragmented landscapes and where it could provide the opportunity for significant large-scale restoration of non-agricultural habitats (e.g. re-wilding)." (Keenleyside and Tucker 2010 p1)

Assessment

In the analysis that follows, results are presented by NUTS2 region as (i) this is the reporting unit required by the COM(2006) 508 on Agri-Environmental Indicators and (ii) because of the resolution available of inputs data (FADN and FSS). However, it is acknowledged that NUTS2 regions often hold diverse agro-economic conditions and that farmland abandonment is a local phenomenon, not impacting the whole NUTS2 area in a similar manner.

Driver D1 – Weak land market

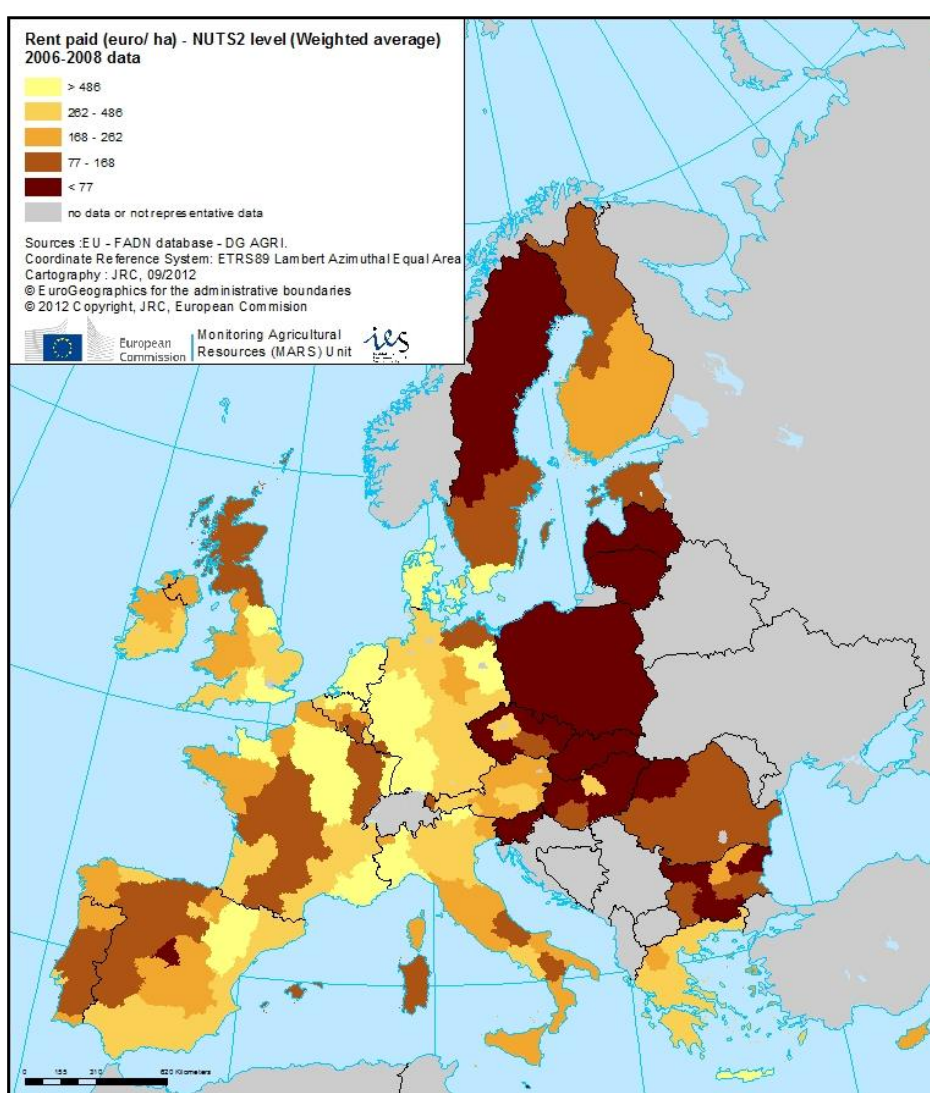
High land sales and rental prices are generally linked to a high demand for agricultural land and hence a lower risk of land abandonment.

The FADN parameters ‘Rent paid, including rent for building, quotas’ and ‘Rented UAA’ are used in a ratio to provide proxy information on the rental price of agricultural land. The average is calculated for the 3 years (2006-2008) for each holding in the database.

Central European countries such as Poland, Slovakia, part of the Czech Republic, part of Hungary, Slovenia and part of Bulgaria have very low renting prices. A similar situation is encountered in the Baltic States and in northern Sweden.

This can be seen as a sign of a low demand for land, hence possibly leading to land abandonment.

Figure 30: Weighted average value of the rent per ha (euro / ha) paid by holding (NUTS2 level)



Driver D2 - Low Farm Income

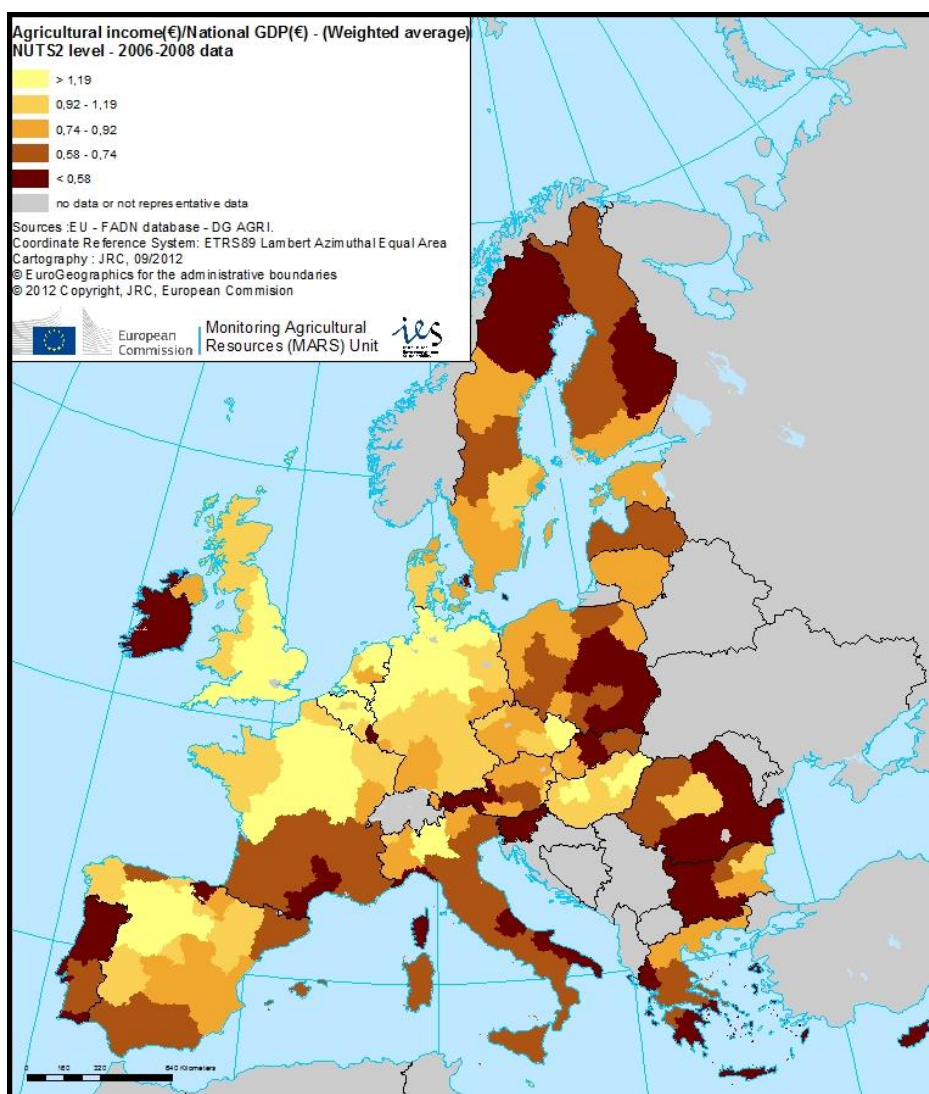
Farmland is at higher risk of abandonment as an economic resource when it ceases to generate a sufficient income.

FADN variable 'Farm Net Value Added' expressed per Agricultural Working Unit (FNVA/AWU) is used.

As the farming economical context is still very heterogeneous between Member States, a unique European threshold value for the farm income does not make sense (different economic and structural situations are present in Member States, in particular incomes are still very disparate – e.g. a low agricultural income in the Netherlands could still be a high value for Bulgaria. There is a ratio of 1 to 15 in EU27 between the minimum and maximum regional agricultural income). Therefore, the methodology for Driver D2 on 'Farm income' compares the farm income to the national general income (all sectors) in order to identify differences; assuming that when differences are large, agriculture may not be economically sustainable anymore, leading to people leaving the farming sector for possible opportunities in other sectors.

The weighted average farm income per annual working unit is calculated and compared to the Gross Domestic Product (GDP) per capita at market prices - Euro per inhabitant" (Source: Eurostat http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/data/database - GDP and main components - Current prices (nama_gdp_c). The national GDP is a proxy for the national income. In the analysis, the GDP per capita for the period 2006-2008 is used.

Figure 31: Ratio of 'agricultural income / national GDP' (NUTS2 level)



The higher risk appears on the first quintile (ratio < 0.58), identifying the whole of Ireland, most of Portugal, southern France (Languedoc-Roussillon in particular), central and southern Italy, the whole of Slovenia, mountain areas in western Austria, central and southern Greece, the whole of Cyprus, western Bulgaria, eastern Romania, central Slovakia, central / eastern and southern Poland, and some areas in northern Sweden and eastern Finland.

Caution should be taken in interpreting these results as different situations in MS may have different underpinning explanations. Indeed, the results are based on farm income only, while the total household

income may change the picture. Ability to pull income from diversification activities (tourism, external income for part-time work, external income of the partner ...) may matter to ensure the survival of rural families; however these data are not available in the dataset.

Driver D3 – Low investment in the farm

Investment behaviour reflects farm dynamism, its adaptation capacity and expectations about the future. New investments are a signal of a medium/long term strategy and can be a proxy of the willingness to continue farming activity.

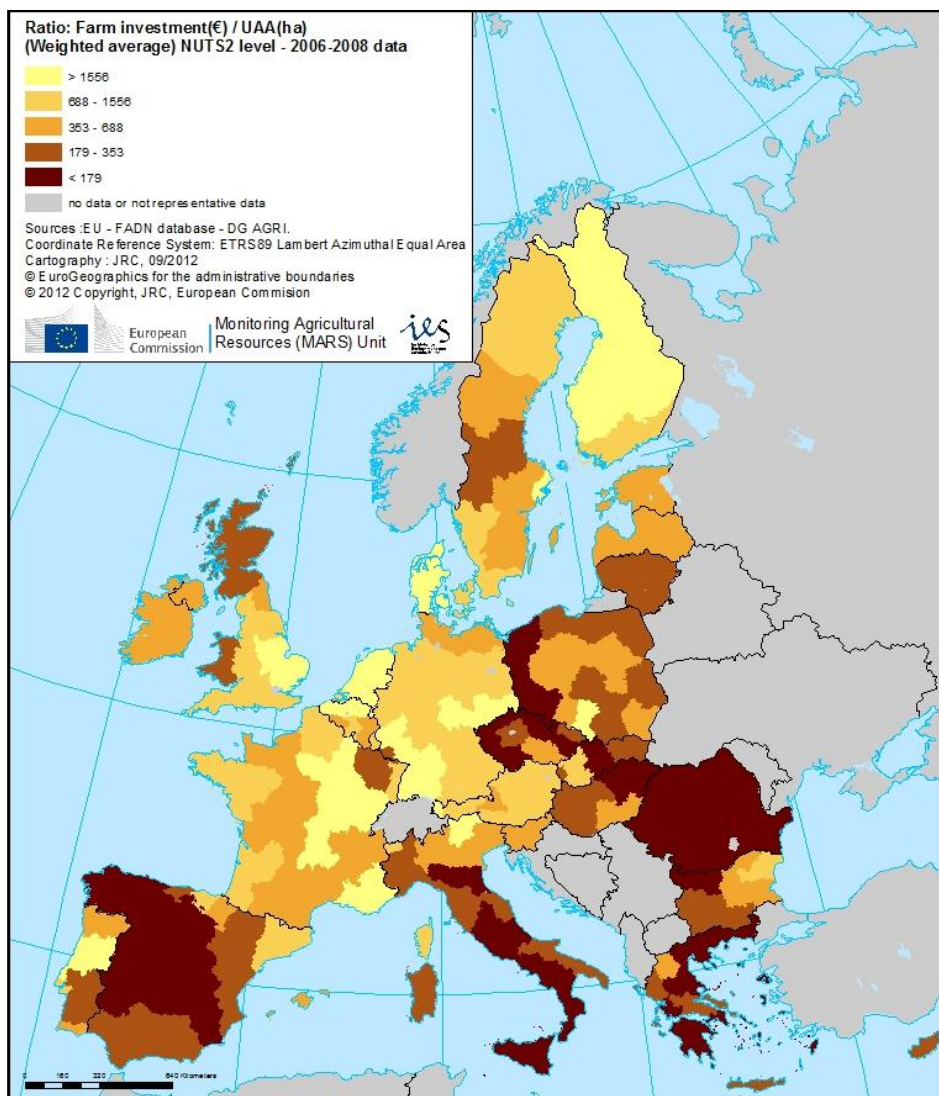
In view of removing the bias as small farms have often lower investments (in absolute terms) than large farms, the amount of investment per holding was normalized by its physical size. FADN variables 'Total investments before deduction of subsidies' is divided by the holding size.

Regions with the lower investment ratio are found in Spain (except north-east), in central and southern Italy, in most of Greece, the whole of Romania, in several Czechs regions and in western Poland.

The investment parameter in FADN database can have reliability weakness for some (Mediterranean) countries. Explanations provided by these MS refer to investment made with 'family loans'. Many farmers considering those as private and do not report them in the farm accounts; consequently debts and investments are missing for these farms. This is a known issue in FADN database.

Moreover, some Italian experts have mentioned some changes of definition for this parameter during the period 2006-2008 in Italy, acknowledging some possible data deficiencies.

Figure 32: Average level of investment per holding (normalised by physical size) (NUTS2 level)



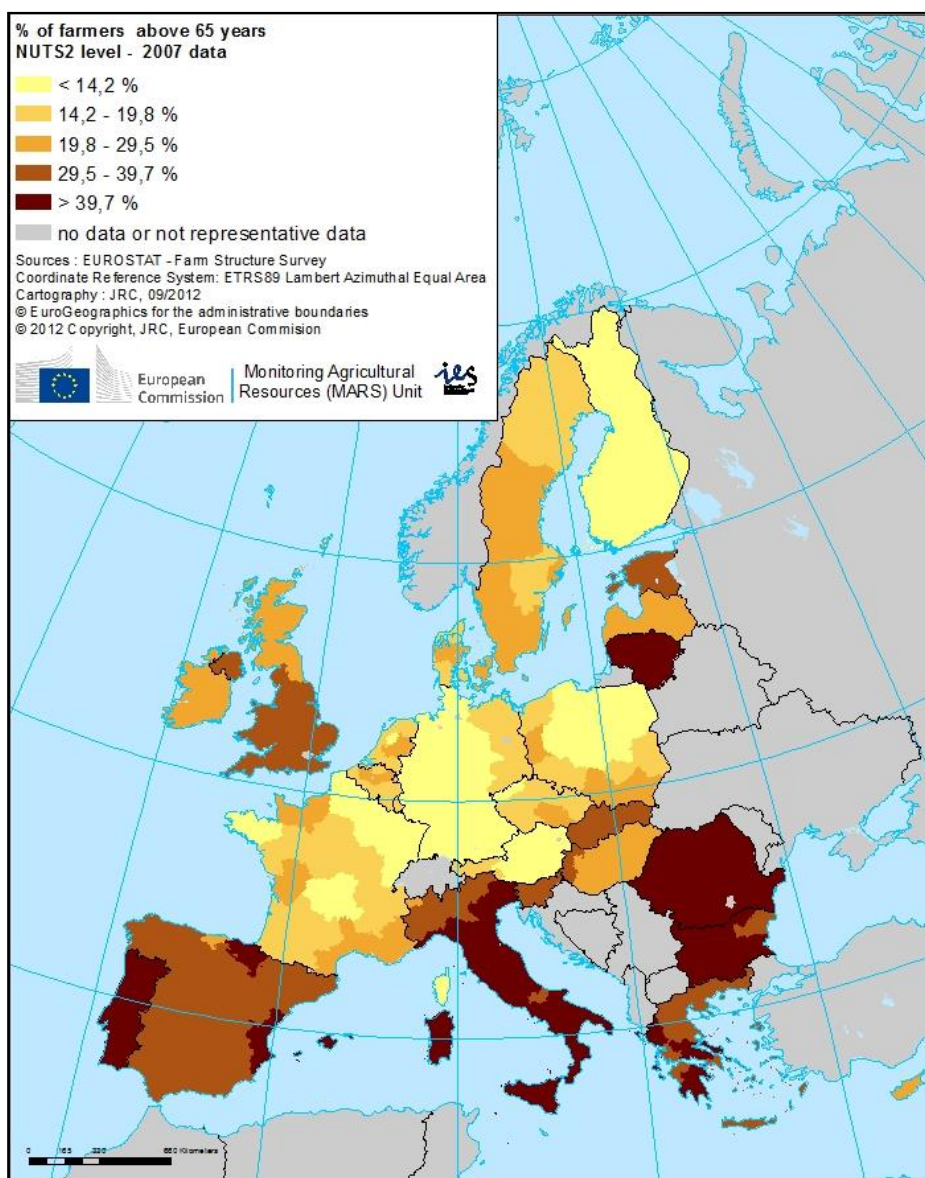
Driver D4 – Age of farm holder

Farmland abandonment is more likely to occur when farmer population is old / close to retirement.

The ratio between farm holders above 65 years and the total number of farm holders has been calculated (Figure 10) in order to have a proxy for the distribution of the farmers' age population.

There is an unfavourable age ratio in Portugal, most of Italy, southern Greece, Bulgaria, Romania and Lithuania with 40% or more of the farm holders' population above 65 years old.

Figure 33: Share of 'farm holders aged more than 65 years (NUTS2 level)



Driver D7 – Remoteness / Low population density

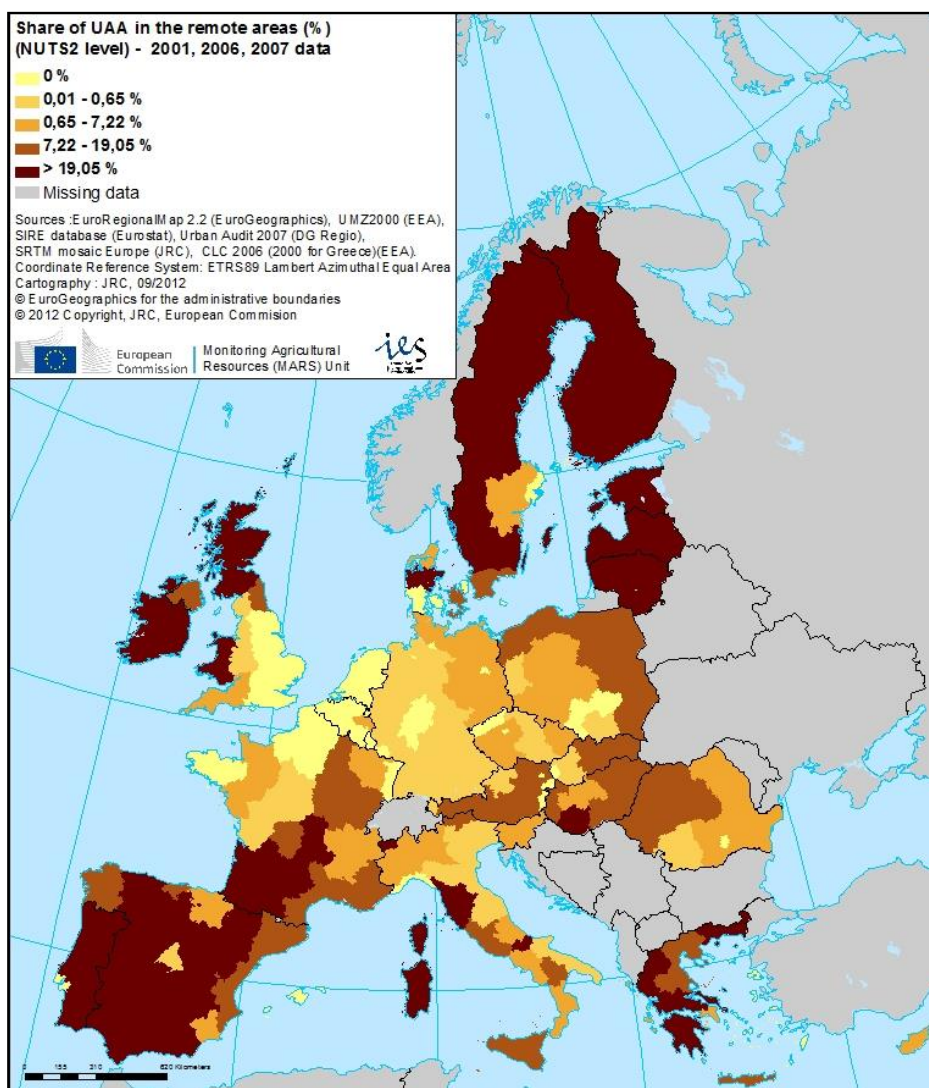
Farmland abandonment is likely to occur in remote areas with insufficient access to basic services (healthcare, school, and other services) and fewer marketing opportunities.

Low population density: A geographic layer containing population density grid was used to classify the EU-27 LAU2 based on the OECD methodology to build LAU2 typology (urban or rural) (Reference: <http://www.eea.europa.eu/data-and-maps/figures/population-density-2>). The population density information had been broken down into several classes; very low densely populated areas (< 50 inhabitants/km²) were identified.

Remoteness: The travel time by road network to urban centres was selected as an indicator of remoteness. Travel time was computed for each LAU2 to reach the closest urban centre (at least 50.000 inhabitants). Threshold of more than 1 hour travelling time was applied to identify remote LAU2.

Agricultural area in remote and scarcely populated areas was estimated by overlaying Corine Land Cover (CLC) 2006 dataset (for Greece CLC 2006 is missing, CLC 2000 was used instead) to the geographic layer of remoteness/ low population density. The share of this area compared to the total agricultural areas at NUTS2 level (NUTS1 for DE, UK; NUTS0 for CY, EE, LT, LU, LV, MT, SI) is shown in Figure 34. Regions with the higher share of agricultural land (more than 19%) in remote and scarcely populated areas occur in Portugal, Spain, south-west and Corsica in France, Tuscany / Molise and Sardinia in Italy, most of Greece, the Nordic Baltic States, Scotland and Wales, and Ireland.

Figure 34: Share of UAA in LAU2 with low population density (< 50 inhabitants/km²) and remote from urban centre (travel time > 60 min) at NUTS2 level.



Composite index

The combination of single drivers into a composite index of risk of Farmland Abandonment is done through an empirical framework for building composite indicator, following a methodology proposed by the OECD (2008).

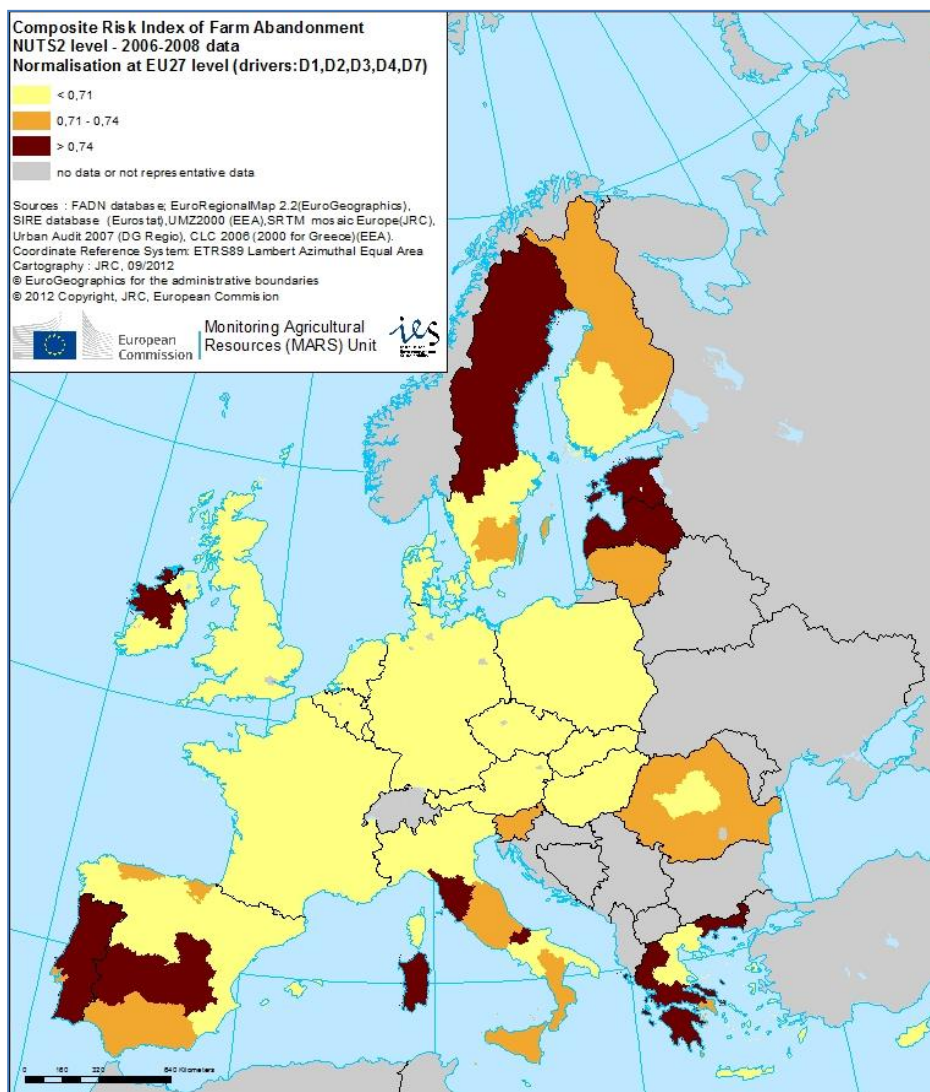
The framework will be tested at European and at national levels based on their normalised values.

(a) normalisation of the drivers at EU27 level

Figure 35 shows a ranking of NUTS2 regions from the lower to the higher risk using 20% quintile interval, combining the drivers with the highest data robustness and analytical soundness. These regions are found in Portugal, central Spain, Tuscany, Molise and Sardinia in Italy, part of Peloponnese / part of Macedonia in Greece, Latvia, Estonia, northern Sweden, and in Connacht and Donegal in Ireland.

Figure 35: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised at

EU27 level. Map with 20% quintile

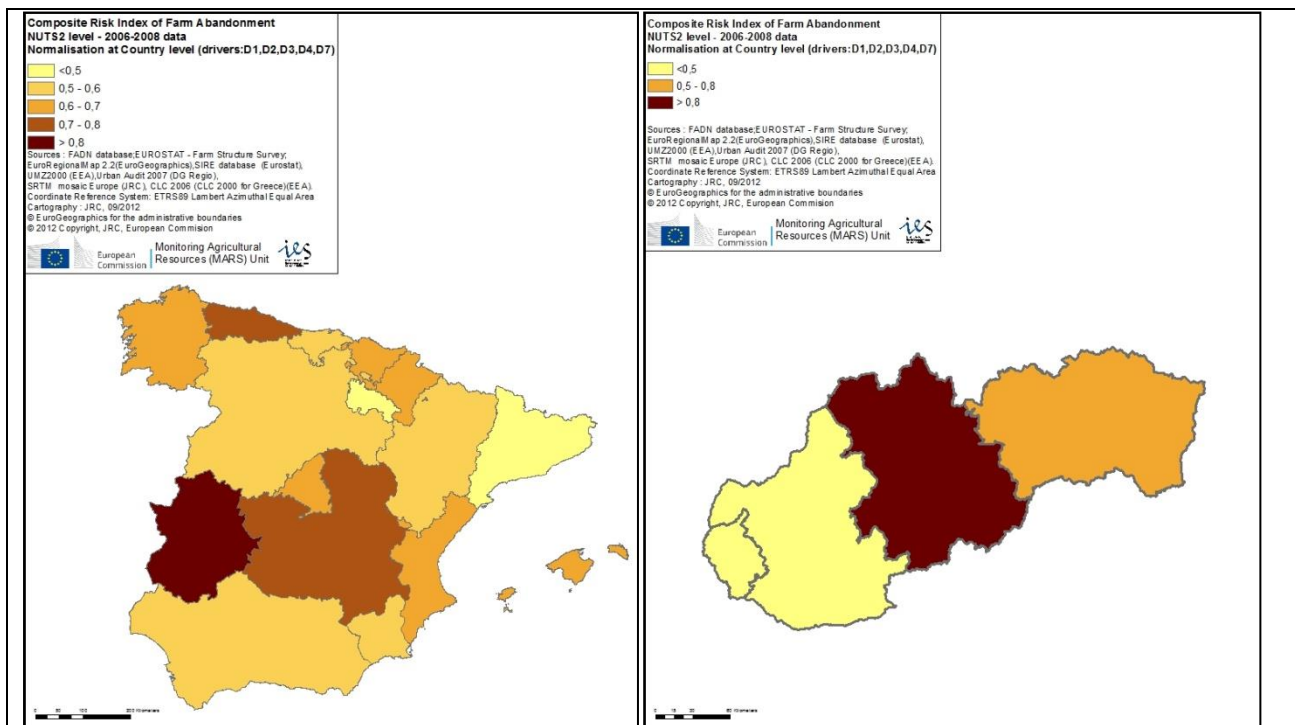


Surprisingly, Tuscany in Italy is identified under this scenario as a region with a higher risk of farmland abandonment. Data screening on the components of the composite index shows the three economic drivers (D1, D2, D3) with low values, comparable to southern Italian regions; but 'farmers' age' and 'remoteness' are relatively high, identifying consequently Tuscany with a higher risk of land abandonment. The unexpected low value for D2 'farm income' might be due to the presence of others source of income outside agriculture (e.g. diversification activities such as farm tourism) not included in the farm income. Information on the household income would be relevant for this point. Moreover, Italian experts have confirmed FADN data consistency issues in 2006-2007. It may also indicate the need to set different weighting factors on each driver in order to calibrate the model to better fit national conditions, as it looks like drivers 4 and 7 may need a lower weight, in Italy at least. However, this last point would require extensive experts' consultation to reach a robust weighting system. A downscaling procedure from NUTS2 to NUTS3 level has also shown that it is only NUTS3 'Grosseto' with a high risk, demonstrating the usefulness of having detailed scale data for assessing the risk of farmland abandonment.

b) normalisation of the drivers at MS level

The normalisation procedure was also done at MS level as farm land abandonment is a phenomenon very much linked to national economic, structural and political conditions. Maps are presented for two MS (Spain and Slovakia).

Figure 36: Composite indicator of the risk of farmland abandonment based on drivers D1, D2, D3, D4, D7, normalised for Spain(left) and Slovakia (right).



The Spanish regions identified with the higher risk are 'Extremadura', 'Castilla la Mancha' and 'Asturias'; and 'Stredné Slovensko' in Slovakia.

Data used and methodology

FADN: data source for drivers D1, D2, D3.

Farm Accountancy Data Network (FADN) is a European system of sample surveys conducted every year to collect structural and accountancy data on farms, with the aim of evaluating the impact of the Common Agricultural Policy. It covers only farms above a minimum size. In 2006 FADN farms represented 43% of the farm population in the Farm Structure Survey (EUROSTAT), but 93% of Utilised Agricultural Area and 94% of Livestock Units. The rules applied aim to provide representative data from three dimensions: region, economic size and type of farming. FADN is the only source of micro-economic data that is harmonised, i.e. applies the same book-keeping principles in every EU country. For further information on FADN: <http://ec.europa.eu/agriculture/rca/index.cfm>

FSS: data source for drivers D4.

The purpose of the Farm Structure Survey is to obtain reliable data, at regular intervals, on the structure of agricultural holdings in the European Union. It provides harmonized data on a number of agricultural holdings, land use and area (crops), livestock, farm labour force (including age, gender, education), economic size of the holdings, type of activity, other gainful activity on the farm, system of farming, machinery.

Further information on FSS:

http://epp.eurostat.ec.europa.eu/portal/page/portal/farm_structure_survey/introduction

Spatial geodata-sets:

Data source for driver D7.

. For Travel time: EuroRegionalMap road network, Communes database (GISCO),

. For Population density: SIRE database (2001, Eurostat) for population per commune and Corine Land-Cover for the spatialisation

Identification of urban centres: the Urban Audit 2007 cities (source: DG REGIO)

The Urban Morphological Zones derived from CORINE Land Cover 2000 and the disaggregated map of population density (source: EEA).

. For agricultural areas: Corine Land Cover (CLC) 2006 dataset (EEA: <http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster>)

Data for mapping all drivers: The administrative boundaries from the EuroBoundaryMap (EBM 2001 Census) database (scale: 1/100 000). Source: ©EuroGeographics., EuroRegionalMap (ERM v2.2) database (scale:1/250 000) by ©EuroGeographics

Coverage

EU27

Methodology

An expert panel of 12 European scientists in fields related to land abandonment (bio-physical / land suitability, farm structure, farm economics, land market, regional development, socio and economic factors in rural areas) and with a good geographic representativeness of EU27 Member States were tasked to identify the main drivers of farmland abandonment in Europe.

Two sets of criteria for the risk of farmland abandonment have been suggested as follows:

. For low farm stability and viability

This is estimated through drivers on '**low farm income**' (D2), '**low investments on the farm**' (D3), '**farm-holder's age**' (D4), '**farm manager qualifications**' (D5), '**low farm size**' (D8), '**farm enrolments in specific management scheme**' (D9).

. For negative regional context

This is estimated through indicators on '**weak land market**' (D1), '**low density population and remoteness**' from market opportunities and major services (D7).

Each of these drivers has been calculated individually; an assessment has been done providing relevance and robustness of the results, maps have been produced.

The results suggest a first group of powerful drivers (policy relevant, analytically sound, data available and robust) composed of: 'weak land market' (D1), 'low farm income' (D2), 'low density population and remoteness' (D7).

The second group of drivers with 'low investments on the farm' (D3) and 'farm-holder's age' (D4) are policy relevant but some issues were found on data when using European datasets.

The third group of drivers ('farm manager qualifications' (D5), 'low farm size' (D8), and 'farm enrolments in specific management scheme' (D9)) have deficiencies in analytical soundness and/or data reliability. They were not used further in the analysis.

In order to produce a single indicator of 'risk of farmland abandonment', **composite indices** (gathering several drivers into one value) have been developed based on Principal Component Analysis carried-out on the normalised values of the individual drivers. The normalisation procedure has been made at 2 different levels: (a) EU27 level as an attempt to elaborate a risk composite index covering EU27 in an

homogeneous manner; and (b) MS level. In the latter case, the assumption is made that one cannot compare, in absolute value, situations from MS having heterogeneous economic and structural developments of the agricultural sector. Otherwise, we may find regions in many new MS being at risk and very few for western European regions. Therefore, drivers are normalised for each MS separately.

Quality and availability of data

- Resolution of the input data:

The scientific literature widely agrees that farm land abandonment is a local specific phenomenon, requiring availability of local data to estimate its risk. When the assessment objective is the European level, lack of accessibility to local data is clearly an issue.

Whether from FADN or from FSS, the resolution of input data available in European databases varies from MS to MS, going from NUTS3 in the best case, to NUTS0 in the worst. This heterogeneity of input data is a source of difficulty and inaccuracy in the aggregation process to build comparable and homogeneous pan-European drivers of farmland abandonment at NUTS2 level.

- Unavailability of some data: mainly FSS micro-data. Despite these data exist and are available in Eurostat, it was not possible for our project to have access to them. This situation is linked to MS' decision limiting access to FSS micro-data. This has resulted in an incomplete processing for driver D8 related to farm size, and no possibility to build driver D6 for the trend of loss of UAA.
- Moreover, difficulties were encountered with the identification codes of administrative units which change occasionally in time (MS redefining some of their administrative units). Consequently NUTS codes are not consistent in time and space, requiring important manual fixing / visual screening to find correspondences between tabular and geographic datasets. This is a very time and resources consuming process and not all codes can be fixed, resulting into some gaps in the datasets.

References/more reading:

Keenleyside, C and Tucker, G M (2010) Farmland Abandonment in the EU: an Assessment of Trends and Prospects. Report prepared for WWF. Institute for European Environmental Policy, London

Renwick A., Jansson T., Verburg P-H., Revoredo-Giha C., Britz W., Gocht A. and McCracken D. (2011). Policy Reform and Agricultural Land Abandonment. 85th Annual Conference, April 18-20, 2011, Warwick University, Coventry, UK 108772, Agricultural Economics Society.

ANNEXE C: LIST OF EXCEL TABLES WITH RESULTS FOR EACH DRIVER

Driver	Excel file name
D1	D1_Weak_Land_Market
D2	D2_Low_Farm_Income
D3	D3_Low_Investment_in_the_farm
D4	D4_Age_of_farm_holder
D5	D5_Low_Farmer_Qualification
D6	N/A
D7	D7_Remoteness__low_population_density
D8	D8_Low_Size_of_the_farms
D9	D9_Farm_enrolment_in_Specific_Schemes
Composite Index	Composite_Index
Downscaling	Downscaling_NUTS3

ANNEXE D: TECHNICAL NOTE ON THE FEASIBILITY OF DOWNSCALING THE LAND ABANDONMENT ANALYSIS FROM LEVEL 2 TO LEVEL 3 IN THE NUTS SYSTEM

Introduction and concept

One of the deliverable of the Administrative Arrangement #AGRI-2011-0295 between DG Agriculture and Rural Development (DG AGRI) and the Joint Research Centre (JRC) is to explore options for downscaling the results from NUTS2 to NUTS3.

In general terms, the aim of downscaling is to transform estimates at low resolution to a more detailed resolution through the use of mathematical or statistical models. This is applied when results that are too coarse (in terms of spatial resolution) for the purpose and do not reflect the whole variability of the spatial phenomenon to assess. Consequently, the output obtained at the coarse resolution needs to be reprocessed in order to get 'proxy' estimates at more detailed scale.

Downscaling methods were developed to deal with this problem. There is a wide documentation on downscaling techniques. Initially they were used for climate projections (spatial and temporal); then they were applied to other environmental domains.

There are two main forms of downscaling techniques: one is dynamical downscaling, where output of a coarse model is used to drive a regional, numerical model in higher spatial resolution (but with a smaller extend), which therefore is able to simulate local conditions in greater detail. The other form is statistical downscaling, where a statistical relationship is established from observations between large scale variables (like atmospheric surface pressure) and a local variable (like the wind speed at a particular site).

Other classifications can be found in literature. They classified downscaling methods into four categories (e.g. regression methods, weather pattern-based approaches, stochastic weather generators), but these approaches have so far been used mainly for climate studies.

Methodology applied for the farmland abandonment - Results

The aim is to estimate the percentage of UAA at risk of abandonment at NUTS3 level from the results obtained at NUTS2 level (low spatial resolution). In this study, not a full downscaling is applied.

The farmland abandonment analysis produced a measure of risk of land abandonment based on the information obtained from individual drivers.

First, all NUTS2 with the highest risk scores in scenario3 (Composite Index > 0.71 , corresponds to the last 20% of the observations) were selected. Scenario3 was chosen because it provides a European wide assessment of the risk of farmland abandonment using all relevant drivers (D1, D2, D3, D4, D7).

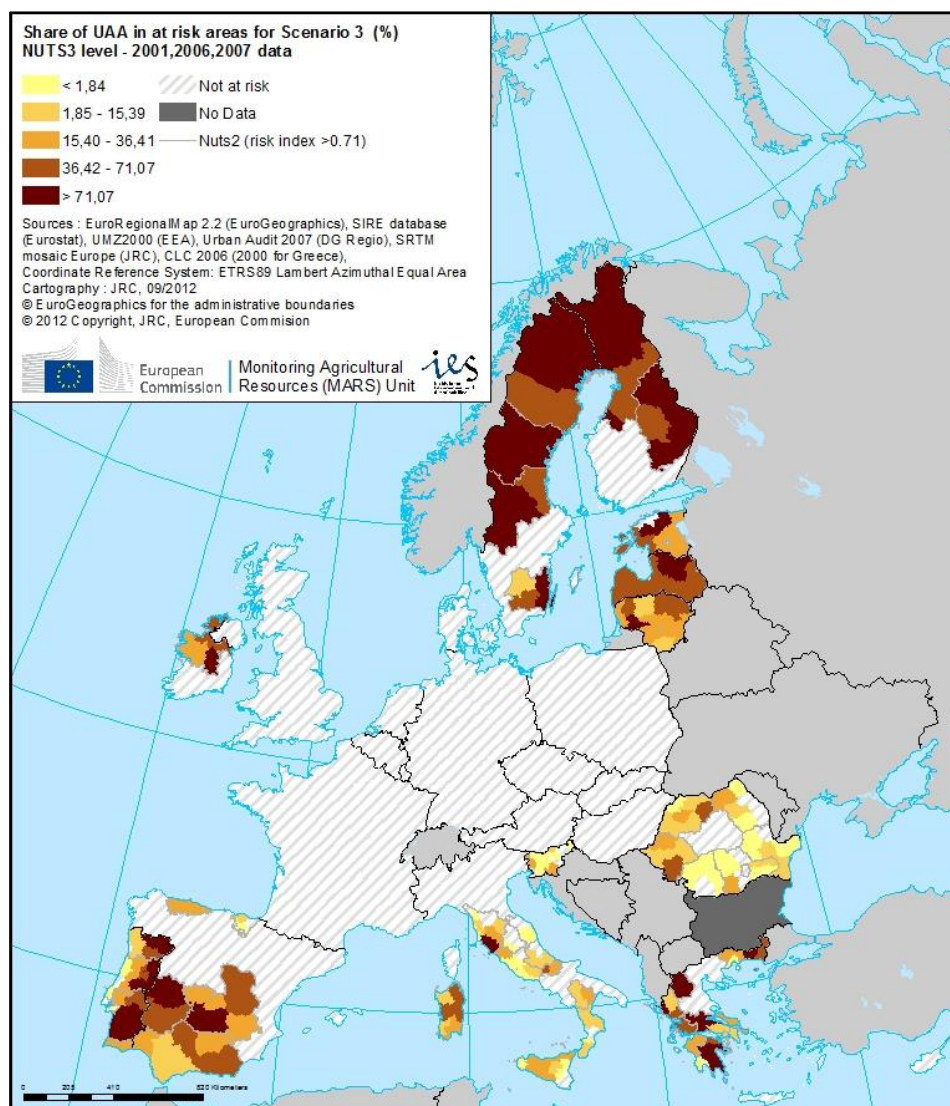
Second, within the selected NUTS2, the agricultural land in remote and with low population density area has been identified. This is done in the Geographical Information System (GIS) with the combined use of CORINE land cover layer (resolution 100m) and the remote / low population' layer (at LAU2 level). The result of this operation is the characterization of CORINE agricultural land with the attribute 'remoteness / low population density' (resolution 100m). This information can then be re-aggregated at NUTS3 level and the percentage of agricultural area in

‘remote and low populated area’ in the total agricultural area can be calculated (ratio UAA at risk / UAA total at NUTS3 level).

Figure 37 shows the results of the downscaling in quintiles. NUTS3 with a higher risk of farmland abandonment occur in eastern Portugal, west and central Spain (Caceres, Ciudad Real), Tuscany (Grosseto), south and western Greece, in some areas in the Baltic States, in northern Scandinavian countries and in central Ireland.

This example shows the influence of data resolution on the results. However, the methodology applied here is only a proxy. An exhaustive and comprehensive downscaling procedure would require using covariates available at higher spatial resolution and correlated with the parameters to be downscaled. In this way, it would be possible to apply statistical downscaling to regionalize the composite index.

Figure 37: Downscaled share of UAA at NUTS3 based on NUTS2 from scenario 3



European Commission
EUR 25783 – Joint Research Centre – Institute for Environment and Sustainability

Title: Assessing the risk of farmland abandonment in the EU

Author(s): JM TERRES, L NISINI, E ANGUIANO

Luxembourg: Publications Office of the European Union

2013 – 134 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424 (online)

ISBN 978-92-79-28281-2 (pdf)

doi: 10.2788/81337

Abstract

An expert panel of European scientists in fields related to land abandonment (bio-physical / land suitability, farm structure, farm economics, land market, regional development, socio and economic factors in rural areas) were tasked to identify main drivers of farmland abandonment in Europe. Two sets of criteria for assessing the risk have been suggested:

Low farm stability and viability was estimated through drivers on 'low farm income' (D2), 'lack of investments on the farm' (D3), 'farmer's age' (D4), 'farm manager qualifications' (D5), 'low farm size' (D8), 'commitments taken by farmers in specific management scheme' (D9).

Negative regional context was estimated through indicators on 'weak land market' (D1), 'low population density and remoteness' from market opportunities and services (D7).

Each of these drivers was calculated individually; an assessment was done to provide relevance and robustness of results, corresponding maps were produced.

The results suggested a first group of powerful drivers (policy relevance, analytical soundness, data availability and robustness) composed of: 'weak land market' (D1), 'low farm income' (D2), 'low density population and remoteness' (D7).

The second group of drivers with 'lack of investments on the farm' (D3) and 'farmer's age' (D4) were policy relevant but reliability was lower when using European datasets.

The third group of drivers ('farm manager qualifications' (D5), 'low farm size' (D8), and 'commitments taken by farmers in specific management scheme' (D9)) showed some deficiencies in analytical soundness and/or data reliability. They were not further used in the analysis.

In order to produce a risk indicator of 'farmland abandonment', composite indices were developed based on the normalised values of the individual drivers. The normalisation procedure was performed at two different levels: (a) EU27 level as an attempt to elaborate a risk index covering EU27 in an homogeneous manner; and (b) MS level.

For the composite indices, further analysis was done at NUTS2 level to relate those flagged with higher risk to the holding's farm-types. It results that extensive and traditional farming systems with high proportions of permanent crops or permanent grasslands are the most frequent farm-types found in NUTS2 at risk.

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

