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AGRICULTURAL LAND ABANDONMENT IN THE EU WITHIN 2015-2030

In the period 2015-2030 about 11% (more than 20 million ha) of agricultural land in the EU are under high potential risk of abandonment due to factors, related to biophysical land suitability, farm structure and agricultural viability, population and regional specifics. The risk for around 800 thousand ha (0.4%), located in Southern and Eastern Romania, Southwestern France, Southern and central Spain, Portugal, Cyprus, Poland, Latvia and Estonia, is particularly severe.

Economic factor and market instruments (including the EU Common Agricultural Policy) could largely mitigate those potential risks in a number, mostly Eastern countries and regions – Estonia, Latvia, Romania, Cyprus. The incremental abandonment within 2015-2030 is nevertheless projected to reach 4.2 million ha net (about 280 thousand ha per year on average) of agricultural land, bringing the total abandoned land to 5.6 million ha by 2030, the equivalent of 3% of total agricultural land. This would be an alarming trend, considering that the decrease in agricultural land over the same period of time is estimated to be three times smaller, around 1%.

Amongst EU Member States, Spain (in particular North / Northwest) and Poland (where the largest single loss at NUTS 3 level is projected for the Chelmsko-zamojski region – 85 thousand ha) are likely to face by far the greatest agricultural land abandonment in both absolute and relative terms. The two countries will account for 1/3 of EU total loss and Spain will be the only EU country to miss more than 1 million ha.

In absolute terms, France (South / Southeast), the United Kingdom, Germany (Western parts) and Italy (especially Sardinia) complement Spain and Poland in the group of the largest agricultural land abandonment in the EU, altogether responsible for more than 70% of losses. Owing to the large total agricultural land, the relative shrinkage will be less pronounced in Germany and especially – France, both countries standing below the 3% EU average. In relative terms, the Netherlands (notably South Limburg), Northern Portugal, Finland, Greece (particularly Korinthia and Lefkada island) and especially Slovakia (4.6% loss) are expected to be above the 3% EU average.

Arable land is projected to account for the largest share of abandoned land, followed by pastures and permanent crops. This is proportional to the prevailing breakdown of agricultural land by types, where arable land is the largest group, while the permanent crops are the smallest one. Permanent crops will account for a significant, albeit not dominant share in abandonment in Southern Europe – Greece, Italy, Spain and Portugal.

The bulk of abandoned agricultural land (4.8 million ha gross) is likely to remain unused within 2015-2030 because of negligible re-cultivation of once-abandoned land. Less than 600 thousand ha are only projected to convert into forests and natural areas, while the conversion into build-up area will be minimal – just 18 thousand ha.

1. Context

In the majority of EU Member States, a considerable loss of UAA was recorded in the last decades not only due to urban expansion and afforestation, but also to farmland abandonment. Between 2015 and 2030 this trend is expected to continue and the UAA is estimated to shrink by around 1%, mainly due to conversion into artificial areas, forest and natural vegetated areas.

Agricultural land abandonment became important already in the 1950s and it is still a topical issue. It can be defined in different ways[1] according to the approach. The most common definition refers to land that was previously used for crop or pasture/livestock grazing production, but does not have farming functions anymore (i.e. a total cessation of agricultural activities) and has not been converted into forest or artificial areas either. Many factors are involved in this complex and multi-dimensional phenomenon. Agricultural land abandonment can be triggered by primary drivers related to low productivity, remoteness or mountainous regions, or

[1] See, for instance, definition of abandoned agricultural land in Hart et al. (2013) referred to actual abandonment, semi-abandonment or hidden abandonment and transitional abandonment or Pointereau et al. (2008).

unfavourable soil or climate conditions for agriculture. Secondary drivers such as rural depopulation, detrimental regional socio-economic factors, policies or farm structure can further accentuate land abandonment (Van der Zanden et al., 2017).

Agricultural land abandonment has empirically shown to contribute to several positive and negative impacts, with trade-offs largely depending on the specific context (Van der Zanden et al., 2017; Hart et al., 2013). The diverse impacts of abandonment need to be addressed via a broader set of policy instruments to alleviate the negative effects or even – reverse the trends in the early stages of the process. In this context, for years the EU Common Agricultural Policy (CAP) has been providing financial support to farmers for the management of natural resources, biodiversity, sustainable farming, maintaining valuable landscape and helping rural areas to remain attractive, while responding to the public demand for sustainable agriculture in Europe (European Commission, 2009).

2. Data and methods

The following analysis provides an overview of agricultural land abandonment trends in the EU. In particular, the likely territorial patterns of land abandonment within the period 2015-2030 are analysed. The resulting outcome is an agricultural land abandonment indicator at national, regional (NUTS 3) and grid level for all EU Member States, which represents the share of abandoned agricultural land into the total agricultural land.

The modelling framework[2] takes on board the main elements that drive an abandonment process:

- Non-market related: biophysical, agro-economic, demographic and geographic factors by regions. The integration of these endogenous components makes possible to build a European potential risk map of agricultural land abandonment at fine resolution (100 square metres pixel) throughout the simulation period (2015-2030).
- Market-related: Agricultural land demands projected up to 2030 from the 2016 CAPRI baseline projections[3] integrating the main policy, macro-economic and market assumptions. The measures of the latest 2014-2020 CAP reform are also covered.

The allocation of agricultural production systems is simulated according to the land claims specified at regional level by CAPRI. Along with the regional expectations of agricultural production systems, the LUISA Territorial Modelling Platform also endogenously simulates the areas of abandonment in accordance to the potential risk map while taking into account the market-related factors, the competition for land among agricultural activities and with other land uses (urban, industry, forest, etc.) at the same time. Consequently, the locations that are most likely to undergo abandonment processes of arable land, pastoral land and/or permanent cropland are identified. Throughout the simulation period (2015-2030) the abandoned agricultural land may either not change, or it may convert into other types of land use/cover in the subsequent time-step, depending on the land use/ cover utility optimisation, demography, accessibility, as well as other factors that are incorporated in the LUISA Platform.

The risk map of agricultural land abandonment is built by aggregating a set of factors (Table 1), and adapting several methods (Benayas et al., 2007; Pointereau et al., 2008; Confalonieri, et al., 2014; Terres et al., 2015; Lasanta et al., 2016), into three groups: 1) biophysical land suitability for general agricultural activities; 2) farm structure and agricultural viability, and 3) population and regional context.

Table 1: Main factors that drive agricultural land abandonment[4]

Biophysical land suitability	**Farm structure and agricultural viability**	**Population and regional context**
Length of growing period	Age of farmers	Low population density
Soil Organic matter	Farmer qualification	Remote areas
Soil texture	Farm size	
Root depth	Rent paid	
Soil pH	Rented UAA	
Salinity and sodic	Farm income	
Precipitation	Farm investment	
Soil drainage	Farm scheme (subsidies)	
Slope		

Each criterion corresponds to a spatial thematic layer or statistical information at NUTS 2/3 level from different European data sources. In the first group,

[2] In Jacobs-Crisioni et al. (2017) are described the technical improvements, scenario assumptions, data sets and models that are included in the LUISA Territorial Reference Scenario 2017.
[3] 2016 CAPRI baseline was provided by the EC-JRC Directorate Sustainable Resource, Economics of Agriculture Unit (JRC.D.04).
[4] The rationale behind the selection of these driving factors and the cut-off values to be classified as severe natural conditions can be found in Eliasson et al., 2010; Confalonieri, et al., 2014; European Union, 2013.

soil, climate and terrain criteria[5] are used for classifying land according to its suitability for generic agricultural activity. Severe natural conditions are in line with the EU Regulation No 1305/2013 (European Union, 2013; Eliasson et al., 2010), Annex III "Biophysical criteria for delimitation of areas facing natural constraints", in order to be eligible for payments. In the second group, structural farm and agriculture information is used to reflect the stability, viability and performance for preventing farmland abandonment at regional (mostly NUTS 3) level. This information is mainly gathered from FADN[6] (Farm Accountancy Data Network) and EUROSTAT-FSS (Farm Structure Survey)[7]. The last group of population and regional factors is particularly dependent on the dynamic character of the LUISA modelling method at grid level. Two main variables are used to identify places where agricultural abandonment is more likely to occur – very low population density areas and remote areas. Areas with population density below 50 inhabitants / km2 are considered as very low density areas (Terres et al., 2015). For each cell, the modelling mechanism counts the allocated residents within the surrounding kernel of (approximately) 1 km^2. Remote areas are identified those which are more than 60 minutes driving away from the closest city or town (Dijkstra L. and Poelman H., 2014).

Plotting together the three maps (one for each of the above groups allows building a comprehensive potential risk map of agricultural land abandonment in the EU within 2015-2030[8]. The spatial aggregation is made by using a weighted linear addition (WLA). There biophysical factors have been assigned the highest weights following the assumption that abandonment could be initially triggered by primary drivers related to remote and mountain regions, as well as unfavourable soil and climate conditions for agriculture.

3. Results

3.1. European potential risk map of agricultural land abandonment

Figure 1 aggregates the potential risk of agricultural land abandonment in 2030, while Figure 2 displays it at grid level. The risk is estimated only for areas where the land use is agriculture, i.e. arable farming (including rice), livestock grazing, mixed crop-livestock and permanent crops.

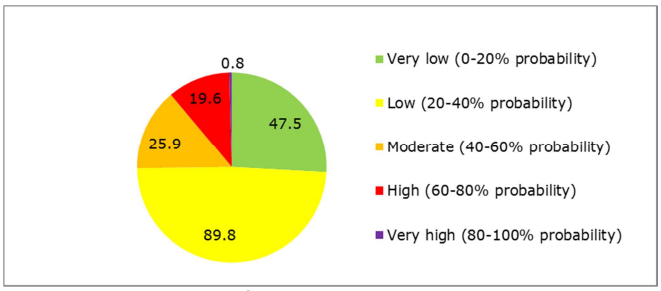

Figure 1: Potential risk of agricultural land abandonment in the EU in 2030, million ha

In 2030 the very large majority of EU agricultural land is projected to be under very low (around 1/4 of all) and low (about 1/2, being the largest category) risk of abandonment. From the remaining 1/4, more than half (14% of all) is estimated to be under moderate risk of abandonment. This, however, still leaves around 11% of EU's agricultural land under high (19.6 million ha, 10.7%) and very high (800,000 ha, 0.4%) potential risk of abandonment respectively, primarily in Romania, Estonia, Latvia, Poland, Cyprus, Spain, Portugal, France, Ireland and Denmark. Altogether, those findings mean that although the potential risk of agricultural land abandonment is relatively modest at EU level, it may be quite severe in some EU Member States and in particular (as shown in Figure 2) in some of their regions, e.g. Southern and Eastern Romania, Southern and central Spain, Southwestern France, etc.

[5] The spatial information related to these criteria are mainly gathered from IIASA (International Institute for Applied Systems Analysis), FAO (Food and Agricultural Organization of the United Nations), SINFO project (Soil Information System for the MARS Crop Yield Forecasting System), ESDB (European Soil Data base), EFSA (European Food Safety Authority, Spatial Data Version 1.1) and HWSD (Harmonized World Soil Database).
[6] The *Farm Accountancy Data Network* (FADN) is an instrument to evaluate the income of agricultural holdings and the impacts of the EU CAP. The concept of the FADN was launched in 1965, when Council Regulation 79/65 established the legal basis for the organization of the network. It consists of an annual survey carried out by the EU Member States. The services responsible in the EU for the operation of the FADN 3/94 collect every year accountancy data from a sample of the agricultural holdings in the EU. Derived from national surveys, the FADN is the only source of microeconomic data that is harmonized, i.e. the bookkeeping principles are the same in all countries.
[7] *Farm Structure Survey* (FSS) covers all agricultural holdings with an UAA of at least one hectare or using market production as a threshold. The main purpose of FSS is to obtain reliable data, at regular timing intervals (two / three years), on the structure of agricultural holdings in the EU, in particular about land use, livestock and labour force. It was conducted for the first time in 1966-67. Approximately every ten years the FSS is performed in the form of agricultural census at more detailed geographical levels. The EU Member States transmit individual (micro) data to Eurostat, where these are stored in the Eurofarm database. The legal basis for the FSS is regulation (EC) No1166/2008 of 19 November 2008.
[8] In five-year time-steps

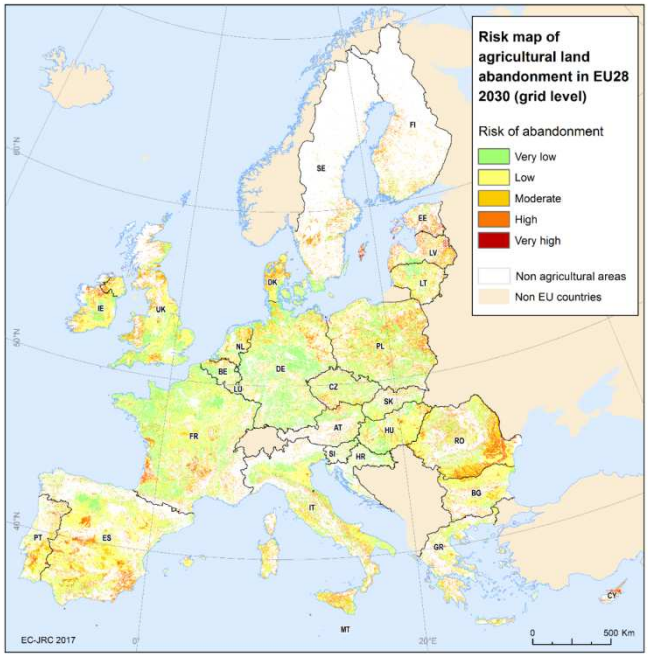

Figure 2: Estimated potential risk of agricultural land abandonment in 2030 at grid level (100-metres resolution) in the EU

The land abandonment risk in various regions is driven by different factors. The biophysical component is the leading one in large parts of Austria, Poland, Greece, Spain, Estonia and Latvia, northern parts of Sweden, Finland, Italy, Ireland and the United Kingdom, as well as in the southern parts of France and Bulgaria. It is mainly due to mountain ranges, such as the Apennines, Pyrenees, Alps, Dolomites, Carpathians, French Central Massif, Iberian and Cantabrian mountains which provide unfavourable terrain and climate conditions. Considerable abandonment risk due to climate limitations is mostly found in the Mediterranean countries where soils suffer from drought (Greece, Italy, Spain), but also in the United Kingdom and Scandinavia (due to acidic and waterlogged soils). In the inner part of Spain, the middle and northern areas of Sweden, Finland and Ireland, the northern and eastern parts of Romania, and partially in the Baltic States, Hungary and Cyprus, the elevated agricultural abandonment risk is mainly associated with remoteness and low population densities. Economic and structural farm factors are likely to be the primary cause for the increased agricultural abandonment risk in many regions of Spain; the north of France, Greece and Italy; the central and northern parts of Sweden and Finland; Eastern Bulgaria, as well as in the Baltic States and Hungary.

3.2. Projected agricultural land abandonment within 2015-2030

In the period 2015-2030 the incremental agricultural land abandonment in EU-28 is projected to reach around 4.2 million ha i.e. about 280 thousand ha per year on average. This will bring the total abandoned agricultural land to roughly 5.6 million ha, equal to approximately 3%[9] of the total agricultural land (183.6 million ha) in 2030. This would be an alarming trend, considering that the decrease of EU agricultural land over the same period of time is estimated to about 1% only, i.e. a difference by factor of three. Arable land is by far the dominant type of agricultural land in the EU and consequently, it will also account for the largest share of abandonment. More than 70% of the total EU abandonment in 2030 will be arable land (4 million ha), followed by pastoral land with more than 20% (1.2 million ha) and permanent crops with approximately 7% (400 thousand ha). Almost a quarter (≈1.38 million ha) of all agricultural abandonment in the EU will most likely occur in mountainous areas[10] where arable land would be again the most affected agriculture system (974 thousand ha, i.e. 70% of all mountainous abandonment) due to, among others, natural handicaps and challenging mechanisation.

Figure 3 presents the absolute (in thousand hectares) and relative (as share of total UAA) agricultural land abandonment between 2015 and 2030 per EU Member States, while Figure 4 shows a detailed map of the projected agricultural land abandonment (in black colour) in the EU over the same period of time. Figure 3 and Figure 4 reveal that Spain and Poland are likely to face both the greatest absolute and relative (about 1/3 of all EU) agricultural land abandonment, Spain being the only EU country under threat to lose more than 1 million ha (around 20% of all EU losses). Since the two countries were also amongst the ones with the highest potential risk of land abandonment (Figure 2), this means that various economic and market instruments are likely to have little impact on the agricultural land abandonment.

On the other hand, economic and market factors may largely mitigate the high potential risk in Estonia, Latvia, Romania and Cyprus. In terms of absolute

[9] This estimate is close to other similar projections, e.g. Lasanta et al. (2016), where the farmland abandonment under the most likely scenario ranges 3-4% by 2030. In a more extreme scenario, with lack of public support (e.g. CAP) for extensive farming and tough global competition among agricultural commodities, the rate of farmland abandonment may reach 7%.

[10] Mountain areas have been spatially identified using the Less-Favoured Areas (LFA) classification map, corresponding to the class named "Totally mountain/hill areas" from the Spatial Dataset 2000-2006 based on GISCO Communes - Version 2.4.

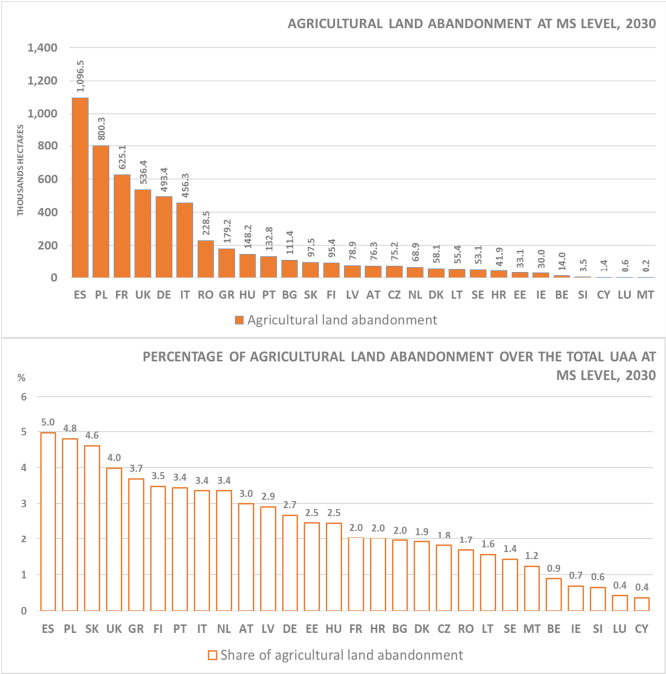

Figure 3: Absolute (top) and relative (bottom) agricultural land abandonment between 2015 and 2030 by EU Member States

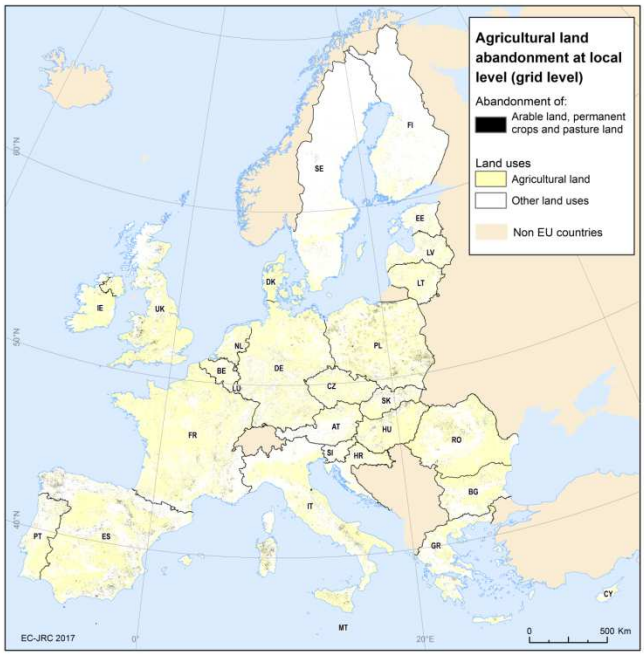

Figure 4: Estimated agricultural land abandonment in 2030 at grid level (100^2 metres) resolution

figures, France, the United Kingdom, Germany and Italy complement Spain and Poland in the group of the largest agricultural land abandonment[11], altogether responsible for more than 70% of all EU losses. Owing to the vast total agricultural land, the relative shrinkage will be less pronounced in Germany and specifically in France, both countries being projected to rank below the average EU forecast of 3%. Conversely, due to relatively smaller total agricultural land, the Netherlands, Portugal, Finland, Greece and especially Slovakia (4.6% loss) are expected to be above the 3% EU average. With regard to the agricultural land abandonment at fine grid level (Figure 4) spatial patterns can be distinguished across Spain and Poland, Northern Portugal, South-eastern France, Southern Apennines, the Italian islands of Sardinia and Sicily, North-eastern Hungary, Central Romania, etc.

The diversity of landscapes and hence, the spatial patterns of agricultural production and land abandonment vary considerably among EU Member States – Figure 5. At least 80% of the expected abandonment will consist of arable land in Bulgaria, Cyprus, Denmark, Finland, Hungary, Lithuania and Slovakia. Over half of the abandonment is likely to be pastures in Ireland, the United Kingdom, the Netherlands and especially – Luxembourg, where the rate will exceed 90%. Permanent crops will account for a significant, albeit not dominant share in agricultural land abandonment in Southern Europe – Greece, Italy, Spain and Portugal.

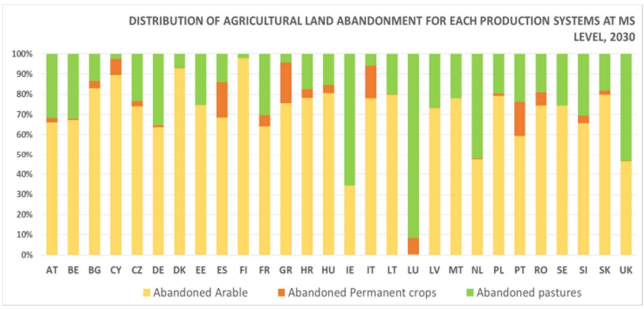

Figure 5: Breakdown of agricultural land abandonment per EU Member States within 2015-2030

Looking at regional level, Figure 6 presents the projected abandoned agricultural land as share of total agricultural land at NUTS 3 level in the EU within the period 2015-2030. It confirms that Spain is expected to face the biggest challenges in the EU, especially in its North / Northwest, where Lugo (ES112) will be affected the most, with almost 80 thousand ha of abandoned land. Other regions in Southern Europe, which are likely to see significant land abandonment, are identified in Northern Portugal[12], South-eastern France[13], Sardinia[14] in Italy,

[11] The next one (seventh) in descending order, Romania, is to lose two times less land than the sixth, Italy.

[12] With the highest absolute loss of more than 27 thousand ha expected in Terras de Trás-os-Montes (PT11E).

[13] The largest loss of about 33 thousand ha is, however, projected for Aveyron (FR622) in Southern France.

[14] Projected about 48 thousand ha for Sassari (ITG25) and 35 thousand ha – for Nuoro (ITG26)

and Greece – Korinthia (EL652) on the Peloponnese peninsula and the island of Lefkada (EL624). In Central and Northern Europe, substantial agricultural land abandonment is projected for Northern Hungary (Nógrád County, HU313), South-eastern Poland, where the largest absolute EU-wide loss of more than 85 thousand ha at NUTS 3 is computed for the Chelmsko-zamojski region (PL312) in Lublin Voivodeship[15], few NUTS 3 in Western Germany, as well as in the central and far-North parts of the United Kingdom. Single regions in Western Austria (Insbruck, AT332) and Southern Netherlands (South Limburg, NL423) are also expected to undergo a significant (more than 30%) agricultural land abandonment, which trend is not likely to spread onto the surrounding regions.

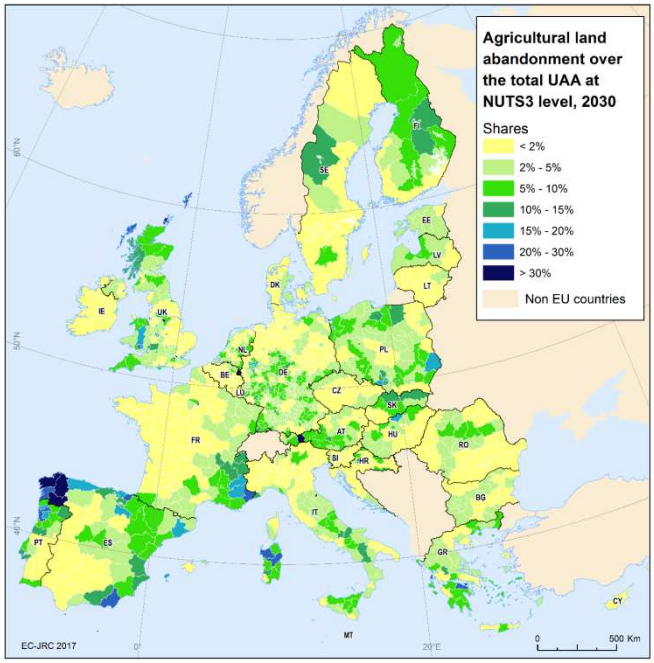

Figure 6: Shares of agricultural land abandonment with regard to the total agricultural land aggregated at NUTS 3 level in 2030

3.3. Conversion dynamics of land abandonment

On the next step, the analysis of the likely evolution of agricultural land abandonment is further refined by looking at the conversion dynamics of abandonment (Figure 7) by applying the method of land-use/cover flows[16], which focuses on aggregated land conversions "from" or "to" abandoned agricultural land. Figure 7 clearly reveals that the conversion from agricultural land into abandoned land will be by far the most frequent transformation, reaching about 5 million ha or 2.7% of the total agricultural land. The opposite transformation, i.e. abandoned land converting into various types of agricultural land, will amount to 200 thousand ha (0.11% of abandoned land) only. This leaves a net conversion of about 4.8 million ha as loss of agriculture land. The transformation of abandoned land into forest and natural areas is projected to be much larger and hence, the net balance will be far better – almost 600 thousand ha, equal to more than 10% of recuperation. The creation of new built-up areas is likely to be much less important, recovering just 18 thousand ha (about 0.3%) of abandoned agricultural land in the EU between 2015 and 2030.

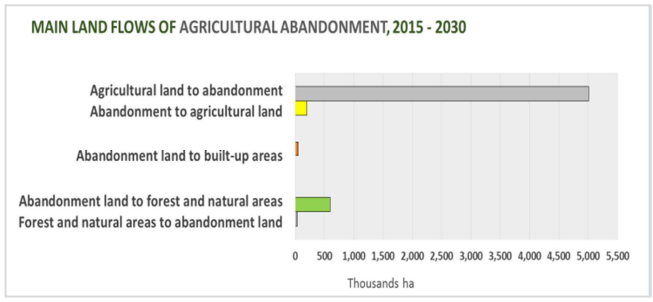

Figure 7: Conversion dynamics of agricultural land abandonment in the EU within 2015-2030

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[15] Another region where significant loss of almost 53 thousand ha is projected is the Olsztynski one (PL622) of the Warmian-Masurian Voivodeship in Southern Poland.

[16] The approach of land-use/cover flows is based on the methodology presented by the European Environmental Agency for 'Land Accounts for Europe' (EEA, 2006). It was adapted to the LUISA framework (for a detailed description of the method see Barbosa et al., 2015).

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