Social Innovation in Marginalised Rural Areas

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Innovative, Sustainable and Inclusive Bioeconomy

Work Programme: Topic ISIB-03-2015. Unlocking the growth potential of rural areas through enhanced governance and social innovation

Report D3.1

Categorisation of Marginalised Rural Areas (MRAs)

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**Acronyms**

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<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ANCs</td>
<td>Areas of Natural Constraints</td>
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<tr>
<td>AVHRR</td>
<td>Advanced Very High Resolution Radiometer</td>
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<td>CF</td>
<td>Cohesion Fund</td>
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<td>CORINE</td>
<td>Coordination of Information on the Environment</td>
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<td>CS</td>
<td>Case study</td>
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<td>EC</td>
<td>European Commission</td>
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<td>EEA</td>
<td>European Environment Agency</td>
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<td>ERDF</td>
<td>European Regional Development Fund</td>
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<td>ESF</td>
<td>European Social Fund</td>
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<td>ESPON</td>
<td>European Observation Network, Territorial Development and Cohesion</td>
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<td>EU</td>
<td>European Union</td>
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<td>GAA</td>
<td>Global Administrative Areas</td>
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<td>GST</td>
<td>Geographically Specific Territories</td>
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<td>LAU</td>
<td>Local Administrative Areas</td>
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<td>LFAs</td>
<td>Less Favoured Areas</td>
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<td>MRAs</td>
<td>Marginalised Rural Areas</td>
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<tr>
<td>NUTS</td>
<td>Nomenclature of Territorial Units for Statistics</td>
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<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<td>SI</td>
<td>Social Innovation</td>
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<tr>
<td>SRTM</td>
<td>Shuttle Radar Topography Mission</td>
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<td>USGS</td>
<td>United States Geological Survey</td>
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Executive Summary

The spatial focus of the SIMRA project is on Marginalised Rural Areas (MRAs): a term utilised in the Call for Proposals to which SIMRA was a response. However, the concept of MRAs per se has not previously been defined. There are many definitions of ‘rural’: operationalisation requires quantitative criteria which can be interpreted to identify a threshold dividing ‘rural’ from ‘urban’. These two categories are not fixed: they depend on the spatial resolution of the data used and can vary over time and space. Words with the root of ‘marginal’ have been used in numerous disciplines, often in highly contrasting ways. A key distinction can be drawn between ‘societal marginality’, which refers to people; and ‘spatial marginality’, which refers to places. With regard to the latter, the concept of handicaps is also relevant, especially as it is used in the Treaty of the Functioning of the European Union. However, such handicaps may also lead to opportunities in certain contexts. The concept of MRAs includes aspects of both societal and spatial marginality, which interact in many complex ways to create diverse types of marginalisation in rural areas.

Recent studies of Europe’s rural areas have aimed to use analyses of data of consistent spatial and temporal resolutions for variables of three types: physical geography, infrastructure (spatial marginality), and socio-economic (societal marginality). Data at a high spatial resolution are important for characterising the situation on the ground, where the social innovations that are the focus of SIMRA are likely to emerge. However, as few such data are available for the entire area of interest to SIMRA, the project created maps of individual characteristics that contribute to marginality or marginalisation – i.e., rural plus the variables of the three types – rather than one composite map. The data used are publicly available and cover the entire area of interest to SIMRA. They are mapped at the level of NUTS 3 administrative units (Europe) and regions (other countries). For each of these 1,689 units, the derived characteristics are summarised in a Table of Areas.

While Eurostat has developed criteria to identify rural areas, the area of interest for SIMRA includes countries to the south and east of the Mediterranean, and therefore the criteria of the Organisation for Economic Cooperation and Development (OECD) are used. Maps were produced of population density in predominantly and intermediate rural areas, allowing further mapping of changes from 2000 to 2010 and the creation of a rural-urban typology for all units.

With regard to measures of spatial marginality: 1) maps of mountains were produced using criteria that have been widely tested; mountainous units are those for which >50% of their area is mountainous according to these criteria; 2) aridity as a constraint on agricultural productivity was mapped; 3) islands were identified largely according to characteristics used by the European Commission, expanded to avoid excluding those which could be a focus for SI. The input datasets were all at high spatial resolution.

Characteristics linked to societal marginality were mainly available at lower spatial resolution (e.g., NUTS 2 or sometimes national). With regard to infrastructure, these include internet access from home and road access, and an index of road length with respect to the area of a unit (NUTS 3) to provide an indicator of connectivity. With regard to social and economic characteristics, the following were mapped: 1) gross domestic product per capita; 2) people at risk of poverty or social exclusion; 3) infant mortality; 4) early leavers from education and training. These provide contextual information for that contributes to the characterisation of MRAs.

The process of mapping has led to the establishment of a set of filters, or contextual information, for use in identifying likely MRAs and factors associated with marginalised people. These filters are incorporated in the Table of Areas, together with an indication of the level of detail of the underlying data. The thresholds for each filter recognise the limitations, and spatial and temporal resolution, of the underlying data and can be used to identify the characteristics of each unit, for interpretation in evaluating their relevance to social innovation in further stages of the SIMRA project.
1. Introduction

The spatial focus of the SIMRA project is on Marginalised Rural Areas (MRAs): a term utilised in the call for proposals to which the SIMRA was a response. The principal objective of Work Package 3 is on the provision of a holistic analysis and categorisation of existing examples of SIs in MRA in European, Associated and non-EU countries, with a special focus on the Mediterranean region. This is achieved by categorising types of MRA in the target region, and the drivers of marginalization and societal challenges that might specifically affect SI, which are used to contextualise examples of SIs in agriculture, forestry and rural development, and inform the development of hypotheses for diverging paths of SIs.

In this deliverable we provide a basis for identifying and exploring the complexity and variety of MRAs by developing an approach to their categorization and applying it to the area of interest to SIMRA. This is based on physical, environmental, social and economic aspects related to rural development. The approach taken was in four steps:

1) Exploration of the concepts on which the term ‘Marginalised Rural Area’ (MRA) is based, with a view to a precise definition where possible (Section 2).
2) Review of previous Europe-wide studies that inform the characterisation of MRAs (Section 3);
3) Critical evaluation of datasets to be used to characterize MRAs in the SIMRA project area (Europe and the countries surrounding the Mediterranean Sea) and present the criteria to be used for characterisation (Section 4);
4) Characterisation of MRAs to be used in further phases of the SIMRA project (Section 5).

Each of the component words of the term ‘Marginalised Rural Area’ (MRA) has a wide range of meanings and interpretations. However, the concept of MRA per se has not previously been defined in the literature. It comprises two elements – marginal(ised) and rural – and, as the first modifies the second, the discussion of definitions below starts with rural (Section 2.1), followed by a brief exploration of the uses and meanings of ‘margin’ and derived words/concepts (Section 2.2) and then their application in rural contexts (Section 2.3). This discussion draws on international and Europe-wide literature. It is recognized that national discussions and policies on comparable topics such as Inner Areas in Italy (e.g., Barca et al., 2014) and the New Regional Policy of Switzerland, following those deriving from the previous Federal Law on Investments in Mountain Regions (LIM) (Mayer et al., 2013), exist. However, these are beyond the scope of this deliverable.

Analysis of Europe’s rural areas uses data of consistent spatial and temporal resolutions for variables of three types: physical geography, infrastructure (spatial marginality), and socio-economic (societal marginality). Data at a high spatial resolution are important for characterising the types of areas that are the focus of SIMRA. However, there few datasets of relevance in that exist for the entire area of interest to SIMRA. Therefore, within SIMRA there is a need to derive spatial datasets and produce associated maps of the characteristics that contribute to marginality or marginalization.

Characteristics of MRA require to be identified, reviewed, categorized and contrasted, and represented at national regional or local levels with respect to their influence on social innovation. These areas face particular biophysical (e.g. mountainous, island, sparsely-populated and aridity) and societal challenges (e.g. depopulation, limited access to technological development, health and social exclusion). These can all be expected to affect the emergence of social innovation.

The outputs are designed to comprise new spatial datasets at resolutions compatible with the underlying information (e.g. 1km², NUTS 3, NUTS 2, and local authorities in North Africa and the eastern Mediterranean), enabling comparisons between such areas. The associated maps and a tabulation of the characteristics for the entire area of interest to SIMRA are to be used in subsequent analysis with respect to social innovation in Work Packages 2 to 7.

These new spatial datasets form an output which will be made available on a web-mapping facility linked to the SIMRA www site (www.simra-h2020.eu/). They provide a new contribution to the spatial representation of characteristics of MRAs, linking data from Eurostat, The World Bank and other sources of environmental and socio-economic information systems.
2. Concepts Underpinning the Characterisation of Marginalised Rural Areas

2.1. Rural

There are many definitions of ‘rural’ and, as van Eupen et al. (2012: 473) state, “it is not feasible to agree to a single definition for the term”, given the diversity of both situations and scientific perspectives across Europe. The simplest dichotomy is that what is not urban is rural, or ‘the countryside’; although the reality of urban-rural continua should be recognised, with urban areas and rural hinterlands overlapping and interlinking (Courtney et al., 2009).

To operationalise the concept of ‘rural’ requires quantitative criteria which can be interpreted in order to identify a threshold dividing urban from rural. At the global scale, such criteria are provided by the OECD (2011): they include population size, density, or context (e.g. in relation to nearby urban centres to which people commute, or health care delivery (Gessert et al., 2015).

Three further critical issues are: 1) the spatial scale of data analysis; 2) the possibility that specific locations or areas may be reclassified from one reference year to the next; 3) changes in classification (rural, urban, etc.) due to changes in the underlying criteria (e.g. when the population density of an area is below the ‘urban’ threshold at one census date and above it at the next). The first issue means that a particular location may be identified as rural or urban at one level of spatial resolution, but as the opposite at another level. The latter issues mean that the boundaries and spatial distribution of rural areas can change over time: ‘rural’ is not a static concept.

At the global level, a number of definitions of rural exist, including those of the United Nations Statistics Division, and the Organisation for Economic Cooperation and Development (OECD). The most widely used is that of the OECD (2011), which has classified administrative entities (“local units” – in Europe: Local Administrative Units (LAU2)/municipalities) of its member countries as rural if their population density is below 150 inhabitants/km². These local units are then aggregated into regions (Nomenclature of Territorial Units for Statistics 3 [NUTS 3] in Europe) which are classified as:

- predominantly rural: share of population living in rural local units >50%
- intermediate: share of population living in rural local units 15% to 50%
- predominantly urban: share of population living in rural local units: <15%

However, this approach creates problems for comparative analysis due to the very significant differences in the area of regions both between and within countries. With regard to NUTS 3 regions (‘small regions for specific diagnoses’, Eurostat, 2013; http://ec.europa.eu/eurostat/web/nuts/overview), two issues arise. First, the NUTS regulation (European Commission, 2003) defines minimum and maximum population thresholds (150,000 and 800,000 respectively) for the size of the NUTS 3 regions, and population densities across Europe vary greatly. Consequently, while the population of some NUTS 3 regions is over 3 million (Berlin [Germany], Attiki [Greece], Milano, Napoli, Roma [Italy], Barcelona, Madrid, [Spain]), the populations of other regions in Austria, Belgium, Germany, Greece, Spain, the United Kingdom, and island of Gozo [Malta] are less than 50,000. Comparably, the areas of NUTS 3 regions vary greatly, the largest being in the sparsely-populated areas of northern Europe: Norrbottens lan (Sweden: 106 km²), and Lappi (Finland: 99 km²) (Eurostat, 2013).

For Europe, since 2011, Eurostat has defined ‘rural’ using 1km² grid cells, with a two-stage process to, initially, identify the population in urban areas:

1) population density threshold (300 inhabitants/km²) calculated for 1 km² grid cells;
2) minimum size threshold (5,000 inhabitants) applied to grouped grid cells above the density threshold.

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1 see European Parliamentary Research Service: https://eppthinktank.eu/2012/11/28/4589/
2 https://unstats.un.org/unsd/demographic/sconcerns/densurb/densurbmethods.htm#D
3 Local Administrative Unit 2: see http://ec.europa.eu/eurostat/web/nuts/local-administrative-units
4 Except Japan and Korea, as their national population densities are > 300 inhabitants per km²
5 Except for NUTS 2 regions in Belgium, the Netherlands and Greece; spatial planning regions in Germany
The population living in rural areas is that living outside the urban areas, as identified through this process. To classify regions, two further stages are used:

1) NUTS 3 regions < 500 km² are grouped with one or more neighbours solely for classification purposes;
2) NUTS 3 regions are classified, based on the share of population in rural grid cells, as:
   - predominantly rural: > 50% of the total population in rural grid cells;
   - intermediate: 20-50% of the total population in rural grid cells;
   - predominantly urban: < 20%.

NUTS 3 regions are based on existing administrative entities. National governments can ask for the NUTS system to be revised to reflect changes at a national level (Eurostat, 2013), and three regular amendments were introduced between 2007 and 2015, as well as an extraordinary amendment which came into force in 2015 (http://ec.europa.eu/eurostat/web/nuts/history). Changes between 2013 and 2015 affected 185 NUTS 3 regions. Some such changes relate to recoding, and others include boundary changes or shifts (e.g. Poland, Netherlands, Germany, Finland and the UK), and new regions introduced, discontinued, split or merged (e.g. Poland, Germany, Ireland, France, Hungary). Such changes have led to an evolving record and representation of the socio-economic characteristics of the European area. The changes can be small in the division of European space into rural and urban, but have implications for consistency of data and use. Figure 1 shows the OECD urban-rural typology applied to EU Member States at the level of NUTS 3 regions.

![Figure 1. OECD urban–rural typology applied to European Union Member States at NUTS 3 level.](image-url)

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7 In addition, a region classified as predominantly rural becomes intermediate if it contains a city of more than 200,000 inhabitants representing at least 25% of the regional population; a region classified as intermediate becomes predominantly urban if it contains a city of more than 500,000 inhabitants representing at least 25% of the regional population: [Urban-rural_typology_update](http://ec.europa.eu/eurostat/statistics-explained/index.php/Urban-rural_typology_update)

A revision to the urban-rural typology has also been tested and introduced by the EU. This simplifies the typology into two levels (urban and rural), with a threshold of population density of 300 people per km², and a minimum population threshold of 5,000. Figure 2 compares the two typologies as applied to NUTS 3 level regions. Figure 2(a) shows the reallocation of NUTS regions to more urban, and Figure 2(b) the reallocation to more rural (Eurostat, 2011; http://ec.europa.eu/eurostat/statistics-explained/index.php/Urban-rural_typology).

Figure 2 (a). Areas reallocated to more urban when revised EU classification of urban-rural typology is compared to OECD classification, applied to Europe at the level of NUTS 3 regions (Source: Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php/Urban-rural_typology).

Figure 2 (b). Areas reallocated to more rural when revised EU classification of urban-rural typology is compared to OECD classification, applied to Europe at the level of NUTS 3 regions (Source: Eurostat, http://ec.europa.eu/eurostat/statistics-explained/index.php/Urban-rural_typology).

For SIMRA, the area of interest also includes the countries of the southern and eastern Mediterranean. So, for consistency, SIMRA retains the OECD approach, whilst recognizing the importance of translating between that and the contemporary EU classification of NUTS 3 regions for relevance to policy and stakeholder groups in the EU. Further discussion of ‘rural’ continues in Section 3.

2.2. ‘Marginal’ and its derivatives

There are many words with ‘margin’ as a root. This section discusses a number of these with regard to diverse literatures; the following section discusses their application in rural contexts.

The word ‘marginal’ has been used in numerous ways across different disciplines including economics, health, geography, politics, psychology, sociology, and the arts (Oxford English Dictionary, 2017). This plurality has led to an extensive literature on marginality and marginalisation. This literature will not be summarized here as this is beyond the scope of this document, which aims to categorise and define marginalised rural areas as spatial constructs. Nevertheless, it is recognized that various concepts relating to marginality and marginalisation (e.g., those relating to anthropology, culture, and politics) may be relevant with regard to the drivers of social innovations, as considered in other parts of the SIMRA project. Thus, the following section explores some key elements, especially in the contexts of economics, sociology, and geography, as these are the most relevant to the SIMRA project in the context of defining marginalized rural areas.
In economics, the earliest relevant work relating to the term ‘marginal’ was that of David Ricardo (1772-1823), a classical economist who was a contemporary of Adam Smith. Applied to rural land use, the extensive margin was the point at which land commands no rent. In Ricardo’s context, there were landlords who rented to farmers who employed workers at a subsistence wage; essentially, his model was one which showed the share of benefits from economic activity between rentiers (landowners), capitalistic farmers and workers. Land that commands rent is intra-marginal; land that commands no rent is not utilized and/or has been abandoned is (extra-) marginal. In a sense, the extensive margin can be interpreted as a line that ‘moves’ up and down the hill depending on the fortunes of farming, or at a later date in Britain, forestry. Above this line is the extra-marginal land.

This concept of marginal land was utilised in the UK into the 1970s (Ellison, 1953; Jenkins et al., 1974) and more widely (e.g. Strijker, 2005). In the context of SIMRA, its relevance is that it relates specifically to the characterisation of rural areas, which are discussed further in the following section. It is also a dynamic concept: the rent that land commands depends on many factors, such as the prices of the crops (or animals) grown on it and subsidies for their production, or possibilities to use the land for other productive purposes, such as forestry, or other uses. In more remote areas, these may include energy and technology-led developments (e.g. power stations, data centres), which provide new opportunities for employment. Thus, in this context, “marginalisation depends on the interaction of physical, environmental, social and economic aspects” (Strijker, 2005: 100).

In geography and sociology, ‘marginality’ has been used in many different ways and, as Déry et al. (2012: 6) noted, “When looking at the specific literature on marginality (authors who directly tried to define marginality, at least partially), a first striking observation is that geographers and sociologists are turning blind eyes to each other.” Robert Park (1928: 892) is identified as the first user of the concept in sociology, referring to immigrants as “cultural hybrid(s) on the margin of two cultures and two societies.” In 1966, Dickie-Clark introduced the term ‘marginal situation’, widening the use of the concept from individuals to groups, and showing its complex and multi-dimensional nature (Dennis, 2007).

Sixty years after Park’s paper, Billson (1988: 183) noted that “although marginality has historically played an important role in sociological thinking, the term’s lack of precision has led to confusion and disparate usage in recent years”. Thus, to provide greater clarity, from an analysis of the literature, she identified three main types of marginality: cultural, social role, and structural. A rare specific definition of marginality in the sociological context is that of Gatzweiler et al. (2011: ii) “an involuntary position and condition of an individual or group at the margins of social, political, economic, ecological, and biophysical systems, that prevent them from access to resources, assets, services, restraining freedom of choice, preventing the development of capabilities, and eventually causing extreme poverty.” Such uses continue, with for instance, von Jacobi et al. (2017: 3) stating that, for communities, groups, or individuals, “‘marginalisation’ tends to have a negative connotation” and commenting that, at the EU level, the term is used interchangeably with ‘disadvantage’, ‘inequality’, ‘worklessness’ and ‘poverty’ (ibid: 6). Important stigmas are attached to all of these (Paugam, 2005). Another related concept is social exclusion, where marginalisation would be a dimension of the exclusion process (Winlow and Hall, 2013).

Such types of marginality refer to people (individuals, groups, communities) and can be considered as ‘societal marginality’, as contrasted with ‘spatial marginality’, which refers to places (areas, regions) and is “usually linked to the geographic remoteness of an area from major economic centres (location) and refers to areas that are difficult to reach (access) in the absence of appropriate infrastructure and therefore isolated from mainstream development” (Gurung and Kollmair, 2005: 13). As this understanding of marginality concerns space, this is particularly the domain of geographers, although it overlaps with some uses of the concept in both economics and sociology, and other disciplines, particularly in the use of centre-periphery approaches (Cullen and Pretes, 2000), referred to by Leimgruber (2004) as ‘geometrical marginality’. As with social and economic marginality, spatial marginality is a relative concept: marginalised areas may be identified at all spatial scales, within both rural and urban areas, within countries, and up to the global scale (Gurung and Kollmair 2005; Déry et al., 2012).
In summary, as Turner (2010: 275) has noted, “the same words can easily be used by scholars to imply many different things. Economic, ecological, social, political, cultural and spatial marginalities may all have different values in different times and places”. In addition, different types of marginality operate at many scales, and may or may not overlap in a particular place or region. However, with the partial exception of the use of the concept to refer to the potential of land for growing crops or trees, most uses have not been developed or applied specifically in rural areas which, like any other territories, are spatial constructs.

2.3. Marginalisation and Marginality of Rural Areas

Limited reference has been made to the term ‘marginalised rural area’ (MRA) in published literature. Examples have been in relation to ICT for development (ICT4D: e.g. Wertlen, 2010) or the introduction of non-formal schools (e.g. Nair 2015) in developing countries. However, the term was not defined in these or any other examples. In such contexts, a MRA is a rural area containing communities, distant from urban centres, whose inhabitants have (very) low incomes and (very) limited access to infrastructure. High rates of migration to urban centres are often common. Such negative trends are also characteristic of ‘marginal rural areas’ in countries such as the Czech Republic and Slovakia (Málková, 2013). However, rural areas may also be characterised as marginal in terms of their agricultural potential (Strijker, 2005), a concept that aligns closely with the European Commission’s concept of ‘less-favoured areas’ (LFAs); since 2013, ‘Areas with natural or other specific constraints’ (ANCs). This concept is usually used to refer to the production of crops or animals, but is also applicable to silvicultural potential, i.e., the production of trees for energy and wood. Also, as noted above, such concepts of marginality and marginalisation are dynamic. For instance, as noted by Brouwer and Berkum (1996), “Marginalisation is a process of agricultural land to become less viable due to economic, social, political and environmental factors.” Particularly in mountain areas, such marginalised land may be abandoned and become (re)forested: a widespread phenomenon in the mountains of Europe (European Environment Agency, 2010b). Such spontaneously forested land, even though it may have value (e.g., for biodiversity, landscape) should be contrasted with land which has been actively planted for direct economic, social or environmental benefit.

Strijker (2005: 100) comments that “interdisciplinary analysis runs the risk of confusion about definitions”, which is true in this case. Words with the root of ‘marginal’ are used in different ways in relation to rural areas, and they overlap with other terms. For example, Bock (2016: 556) refers to “marginalisation or ‘peripheralisation’”; and Málková (2013) notes that ‘marginality’ and ‘peripherality’ may be considered as synonymous and as different. There is a considerable literature referring to peripheral rural areas (or regions) (e.g. Davies, 2010; O’Shaughnessy et al., 2011; and other examples referring to specific regions); their characteristics tend to be similar to those of marginal(ised) rural areas, although the word ‘peripheral’ tends to have a more explicitly spatial dimension.

A further related term is ‘handicap’. This is of particular relevance because of its use in the Consolidated version of the Treaty of the Functioning of the European Union (TFEU: European Union, 2012) which, in Article 174, refers to “regions which suffer from severe and permanent natural or demographic handicaps such as the northernmost regions with very low population density and island, cross-border and mountain regions.” These are the particular focus of the European Commission’s cohesion policy, which aims to reduce disparities in levels of social and economic development across the EU (European Commission, 2014). The EC Cohesion Policy Fund has 11 thematic objectives supporting growth between 2014 and 2020, supported by three mechanisms (the European Regional Development Fund, ERDF; the European Social Fund, ESF; and the Cohesion Fund, TCF). The 11 objectives cover topics such as research, technological development and innovation; enhancing access to information and communication technologies (ICT); protecting the environment and resource efficiency; sustainable transport; climate adaptation, risk prevention and management; promoting sustainable employment; and promoting social inclusion, combating poverty and discrimination.

In addition, Article 349 of the Treaty of Lisbon (European Union, 2007) states that similar measures should be taken for the Outermost Regions, given their “remoteness, insularity, small size, difficult topography, climate and economic dependence on a few products”. These characteristics are similar to those of the regions
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considered in Article 158 of the TFEU; they are also almost entirely rural and far from the principal markets for their products and services. All of these regions are defined initially in terms of their physical geography, and are also referred to as ‘geographically specific territories’ (GST: ESPON and University of Geneva, 2012a). Nevertheless, to some extent, the ‘handicaps’ of such territories can also be regarded as opportunities, as exemplified by the subtitle of the Green Paper on Territorial Cohesion: ‘Turning territorial diversity into strength’ (European Commission, 2008). These opportunities include attractive landscapes, high levels of biological and cultural diversity, and relative inaccessibility (cf. ‘wilderness’: Kuiters et al., 2013); these are fundamental reasons why, in some such regions, tourism is the mainstay of the economy; in others, it is becoming increasingly important (ESPON and University of Geneva, 2012a).

A related opportunity is the production of high-quality products, which can contribute to the sustainability of rural communities and economies both through export and local valorization, especially through tourism (Santini et al., 2013). In areas of coastal Europe, high-quality products may be from fishing and aquaculture. Within Europe, fishing provides employment for approximately 350,000 people, predominantly in rural areas. Some of these have a significant dependency on fishing in terms of the proportion of total employment. The European Commission (2016a) reports particularly high dependency on fishing-related employment in North West Spain, North-West Scotland and the Northern Isles, Southern Portugal, and areas of Croatia and Greece.

Apart from handicaps being (or becoming) opportunities, the characteristics of MRAs are brought together by Bock (2016: 556), who, citing Copus et al. (2011) states that “Rural marginalisation is often associated with geographical remoteness, primary sector dominance, insufficient infrastructure in terms of roads and public services, economic and demographic transition and population decline and, hence, rising unemployment, outmigration of economically active groups and ageing.” It is the combination of these characteristics that is crucial: for instance, dominance of the primary sector (or any sector) does not necessarily lead to marginalisation. While Bock notes that marginal areas are often to be found in GST or distant from urban centres, she states that the lack of access of resources previously ascribed to geographical ‘remoteness’ is now ascribed to lack of connectivity (social, political, or technological): a ‘relational remoteness’. Nevertheless, as she also notes, geographical remoteness, an element of spatial marginality, continues to imply real costs for improving connectivity. Similarly, Knickel and Kok (2003: 1) contrast “Concentration of production, income and employment at regional level” with “the marginalisation of less-favoured, mountainous areas and of regions that are more distant to processing industries and markets (polarization)”. Bock (2016: 557) concludes that rural marginalisation is “part and parcel of growing spatial disparity, and embedded in broader processes of social change”, and caused by four main factors: globalisation, mobility of capital and people, urbanisation, and the global financial crisis of 2008. In common with Strijker (2005), Bock (2016) concludes that marginalisation in rural areas results from the interaction of multiple problems, or factors. The relative emphasis given to these in any analysis is likely to derive not only from the perspective or discipline of the researcher, or research team, but also from the causal agency and the data available.
3. Categorising and Mapping Rural Areas

Going beyond the definition of rural presented in Section 2.1, and taking into consideration aspects of marginalisation/marginality discussed in Sections 2.2 and 2.3, this section presents the outcomes of recent studies that have aimed to categorise Europe’s rural areas, thus providing a foundation for the categorisation of MRAs in SIMRA (Sections 3 and 4). These studies have been driven particularly by the imperatives of European Commission’s cohesion, rural development, spatial development, and sustainable development policies and strategies (e.g. European Commission, 2014). Some have focused on the development of rural typologies (e.g. van Eupen et al., 2012), others on rural areas with respect to rural development, e.g. Camaioni et al. (2013: 297), who note that “rurality is naturally heterogeneous in its characteristics.” A description of the four studies of most relevance to the task for SIMRA follows.

The Foresight Analysis for Rural Areas of Europe (FARO-EU) project (www.faro-eu.org) was funded under FP6. The objective was to produce a typology that improved on “three aspects that have not been addressed adequately in previous typologies: (i) acknowledgement of broad geographic differences in Europe; (ii) use of statistical screening to identify the most appropriate indicators reflecting the territorial heterogeneity; and (iii) use of high spatial resolution datasets to identifying regional gradients and accommodate flexible spatial aggregation to suit a wide range of applications (van Eupen et al., 2012: 474).”

The work in the FARO-EU project required use of consistent datasets for key environmental and socio-economic variables at the highest available spatial resolution: in this case 1km². A critical challenge was that, while datasets for many environmental variables are available at this resolution, those for many relevant socio-economic variables were only available at NUTS 3 level. Consequently, two 1km² datasets were used: economic density and accessibility. The resulting rural typology classified Europe (i.e. the European member countries of the OECD) into nine classes (a 3x3 matrix) according to the combination of these two datasets within different environmental zones. These classes were aggregated into three rural types: peri-urban, rural, and deep rural. This classification was aggregated to the LAU2 level and then compared to the Urban-rural typology of the OECD (2007); each successive stage revealed a loss of detail, especially for heterogeneous regions. Following this study, two others developed and presented Europe-wide typologies at the NUTS 3 level. These are summarized below.

The first is that of Dijkstra and Poelman (2011), who compiled six existing regional typologies: an urban-rural typology including remoteness, and other typologies for metro, border, mountain, island, and sparsely-populated regions. For each, the goal was to provide “an analytical and descriptive lens on these types of territories. However, annual data availability below NUTS 3 (i.e. in greater detail) for all of Europe is extremely limited and does not allow for regular monitoring. These typologies are not intended for direct policy use” (ibid: 1).

The second study, funded through the ESPON 2013 Programme, considered European Development Opportunities for Rural Areas (EDORA: Copus et al., 2011; www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/EDORA/EDORA_Draft_Final_Report_Version_2.4_April_2010.pdf). The researchers proposed “an ‘analysis framework’ in the form of three typologies reflecting three important dimensions of differentiation among nonurban regions” (ibid: 15). This used the EU urban-rural typology mentioned above, and developed two others: a structural typology, considering “the transformations affecting the agrarian economy and society, and the increasing impact of global economic forces” (ibid: 18); and a performance typology, placing “regions on a continuum between “depletion” and “accumulation” of various kinds of capital (human, financial, fixed, and so on)” (ibid: 19). The study recognised that “These are very simple, broad-brush generalisations, at a macro-regional scale, which, of course, cannot “do justice” to the wealth of local (micro-scale) variation in rural areas across the ESPON space, or to the infinite number of possible combinations of drivers, opportunities and constraints” (ibid: vii).

The most recent project was Geographic Specificities and Development Potentials in Europe (GEOSPECS; www.geospecs.eu), funded through the ESPON 2013 Programme (ESPON and University of Geneva 2012a). Perth College, leader of SIMRA WP3 and lead author of this Deliverable was a partner in the GEOSPECS project.
This study focused on geographically specific territories (GSTs: border regions, coastal areas, islands, mountains, Outermost Regions, sparsely populated areas [SPAs]), with an analysis for all Europe, enabling comparison with parts of Europe that are not GSTs. Notably, these data were at the LAU2 level: for 125,049 administrative units across the ESPON space, including Turkey, but not Bosnia and Herzegovina and the Former Yugoslav Republic of Macedonia, for which such data are not available. The first stage of the analysis was to delineate the different types of territory: a process which revealed the considerable overlaps between islands, mountains and SPAs (Figure 2). These GSTs were defined as follows (ibid: III):

- mountains: altitude, terrain roughness and slope, building on definitions and analysis of Nordregio (2004) and European Environment Agency (2010b);
- islands: all territories that are physically disjoint from the European mainland or the main islands of the British Isles (UK and Ireland). Islands with a fixed connection to the mainland were recognised as a separate category;
- SPAs: divided into two types, delineated on the basis of population potentials and a threshold of 100,000 persons: 1) in relation to 50 km travel for commuting to urban centres (SPA per se); 2) ‘poorly connected areas’ (PCAs), based on population potential using 45-minute travel times along road networks.

At the LAU2 scale (or, in some cases, 1km², then scaled to LAU2) across Europe, only a few datasets were available for use in categorising these territories. From a socio-economic perspective, these included demographic trends, age structure, patterns of subsectoral employment, and accessibility by both road and air. A key methodological development was the use of population potentials (i.e. the number of persons that can be reached within a maximum generally accepted daily commuting or mobility area from each point in space) to define mobility. From an environmental perspective, the datasets included land use, protected areas and sunshine duration (ESPON and University of Geneva, 2012b).

Given the relatively small number of datasets available at the LAU2 level, only a small proportion of the potential quantitative analyses could be explored. Nevertheless, GEOSPECS provided a methodological framework and a database at the LAU2 level, which can be used for further multi-scalar analysis.

Figure 2 presents the classification of areas at LAU2 level, illustrating the combined characteristics underpinning the classification of these areas.

All four of these studies aimed to provide spatial analyses for the entire European area (defined in different ways), using consistent datasets. The variables used across all the studies can be grouped into three types:

- physical geography: e.g. mountains (defined in terms of altitude, terrain roughness and slope), contraints on primary production (e.g. aridity), and islands;
- infrastructure: e.g. distance from urban centres, accessibility by different modes of transport (e.g. roads);
- socio-economic: e.g. GDP per capita, population size and age structure, employment, economic land use.

The first type can be used to establish indicators of spatial marginality and is fixed, although the construction of a bridge can effectively turn an island into an extension of the mainland to which it is linked; a topic explored in GEOSPECS. The second type may change over time, resulting in significant changes in spatial marginality: for example, the construction of tunnels under the Alps through which high-speed trains link the Upper Rhone Valley in Switzerland to the Swiss Mittelland and Italian Piedmont. The third type, which can be used to establish indicators of societal marginality, also changes over time, and may be represented as trends or combined to create composite indicators (as in the EDORA project). All may be used to categorise different aspects of MRAs. At the same time, within each type, there are other indicators that were not considered in these studies; some of these are considered in the following section.

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Figure 2. Classification of Europe into geographically specific territories from ESPON GEOSPECS project, with key of classification elements (Source: GEOSPECS, 2011).
4. Approach to Identifying Marginalised Rural Areas

4.1. Characteristics of Marginalised Rural Areas

Rural areas are spatial constructs, and thus can be mapped using spatial data. As identified in the review of previous Europe-wide studies (Section 3), the use of data at a spatial resolution of NUTS 3 has significant drawbacks for characterising the situation on the ground, which is where the social innovations that are the focus of SIMRA are likely to emerge. However, as the experience of the projects reviewed showed, higher resolution datasets such as LAU 2 are limited in number and geographical extent. Therefore, the choice is a balance between the spatial resolution of the data required to characterise MRAs, the availability of such data across the entire area of interest to SIMRA, and the range in size of the spatial units used for different characteristics (e.g. from the smallest of LAU2 to the largest of NUTS 2 or national).

In order to achieve characterise marginalised rural areas for the area of interest to SIMRA, it was necessary to identify and evaluate the suitability of datasets that, as far as possible, were consistent across the entire region that SIMRA considers: not only Europe but also the countries to the east and south of the Mediterranean.

Therefore, the first stage of the process of categorisation was to identify the datasets of relevance to the requirements of SIMRA, defining the extent of areas which could be considered rural (including ‘intermediate rural’; OECD, 2011). These were then augmented by data which represent characteristics of marginality and marginalisation based on the literature in Section 2, and which can be expressed geographically. Given the complexities of defining these characteristics and obtaining a suitably high-resolution of spatial data, the approach is not to create a composite map of MRAs, but to create maps of individual characteristics that contribute to marginality or marginalisation. As discussed below, these maps are then used as the basis for a table against which to assess locations in which case studies of social innovations are situated, in order to evaluate the suitability of these case studies for use in further phases of the SIMRA project.

The core characteristics for defining marginalised rural areas within SIMRA and principal sources of data follow those set out in Section 3 above.

The process was to identify:

1) Rural area based upon OECD rules. This requires data on population density over the entire area of interest to SIMRA, and the population of cities. Principal data source: NASA Socio-economic Data and Applications Centre in collaboration with FAO (NASA, 2015); and the City Population database (www.citypopulation.de).

2) Areas which are marginal in terms of their physical geography (i.e. spatial marginality [Gurung and Kollmair, 2005]): a) mountainous – derived from global Shuttle Digital Elevation Model, following the process developed in ESPON GEOSPECS (University of Geneva, 2012a); b) limited connectivity as islands (European Commission, 1994; Eurostat, 2015); c) low agricultural potential due to aridity (Strijker, 2005); principal data source CGIAR (2008);

3) Areas which are marginal in terms of limited access to infrastructure, using indicators of access to the internet from home (principal data sources – Eurostat 2016; World Bank database); and accessibility by local road transport (principal data sources, OpenStreetmap);

4) Areas of marginalised populations (cf. societal marginality [Gurung and Kollmair, 2005]): inhabitants with (very) low incomes (as measured by GDP per capita); people at risk of poverty or social exclusion (as defined and surveyed by Eurostat, 2017; infant mortality, Eurostat and The World Bank; and, education and training (ISCED), Eurostat.

The core datasets were summarized by administrative units (NUTS 3 units; regional areas in southern and south-eastern Mediterranean countries) to provide a Table of Areas as a checklist of characteristics of marginalised rural areas for informing the selection of case studies of social innovation.

The approach taken recognizes that the definitions of rural and marginalised are contentious when expressed geographically, and that the overall objective is to enable consideration of factors influencing, stimulating or
inhibiting social innovation in MRAs. These data are for use as a portfolio of spatial data which represent the characteristics of MRAs rather than being combined into a single dataset. This avoids the risk of generating outputs of a geographic precision which is not supported by the accuracy or spatial resolution of all of the data which may be relevant. Furthermore, there may be no unique geographic location which is appropriate for representing the area of an SI. For example, a feature of particular place may be the focus of a SI (e.g. renewable energy facility, village linked to rural health care), but the people involved (creating, delivering or local beneficiaries) may be drawn from a wider geographic area.

Therefore, the approach taken is to enable information about relevant characteristics to be linked to examples of SI captured in subsequent activities within SIMRA. By using broad categories, which can be related to officially adopted criteria (e.g. OECD, EU, The World Bank), relationships can be identified between the analyses in SIMRA and relevant international and European public policies.

4.2. Data

To develop the table and maps of MRAs, publicly available data were used. Input data were sought which cover the entire area of SIMRA in a consistent manner, i.e. the European Union, other European states, and states to the south and east of the Mediterranean Sea. Reuse is made of data from the ESPON project, GEOSPECS. This should ensure maximum practical compatibility with a tested and accepted model and its outputs. An aim of this approach is to reduce the need for repeating data analysis where it has been undertaken already, or replace the approaches which have been approved and/or undertaken by relevant European agencies.

4.2.1. Use of administrative units in area of interest

The area of interest to SIMRA was defined as that of the European Union; non-Member States of Iceland, Norway, Switzerland and those of the Balkan region (principally the countries of the former Yugoslavia); eastern Mediterranean (Turkey, Syria, Lebanon, Israel, Jordan); and southern Mediterranean (Egypt, Libya, Tunisia, Algeria, Morocco). The southern extent was taken as the latitude of the border between Western Sahara and Morocco (c. 27° 40’ North).

As noted above, the administrative units for the European area are those of NUTS 3. For the other countries included, the highest level of regional level of administration below the national level has been selected, drawing on information from The World Bank and the Global Administrative Areas database (www.gadm.org/).

It should be noted that, for most variables, the data available for the eastern and southern Mediterranean countries are only at the national level. However, the database was compiled to enable a more refined approach to be adopted for characterising candidate case studies of social innovation, or innovation actions, if other data became available. An overview of the area and administrative units used is shown in Figure 3. A total of 1,689 NUTS 3 or local regions were identified for the area of interest to SIMRA.

To summarise all other spatial data relating to MRAs, and to characterise candidate case study areas, these spatial units are used as the basis of a Table of Areas. Each unit has a unique label. For units identified as NUTS 3, the label allocated by Eurostat is used. For those which do not have NUTS 3 status (i.e., eastern and southern Mediterranean and some Balkan states), a SIMRA project code has been allocated.
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Figure 3. Overview of the area of interest to SIMRA, showing the spatial units of the administrative database (southern extent is the line of latitude of the border between Western Sahara and Morocco: 27° 40’ North).

4.2.2. Population density

As noted above, the European Union rural-urban typology was updated in 2011. This provides an area which is broadly defined, recognising that, within EU Member States, definitions used vary widely to enable ‘policies-priorities-driven tools’ to aid targeting of area-specific development needs (https://epthinktank.eu/2012/11/28/4589/). The potential impact of the broader definition is to reduce the sensitivity of the rural class to the types of areas which might be considered marginalised.

For SIMRA, the definition of rural area used is that of the OECD (2011), as described in Section 2.1. A global dataset representing population density has been developed by the NASA Socio-economic Data and Applications Center, in collaboration with FAO. This provides a consistent dataset across the area of interest to SIMRA. This dataset provides estimates of population density for different years (e.g. 2000, 2015) and a projection for 2020, which is based on national censuses and population registers, adjusted to match United Nations country totals. The spatial resolution is 1km².

The data were downloaded, preprocessed and formatted for use with other input spatial datasets. The data were coded according to the thresholds specified by OECD (2011), with finer classes also used to reveal greater detail in the rural areas (Figure 4).

Data on population density are available, on a comparable basis for the area of interest to SIMRA, at a spatial resolution of 1km² for 2000 and 2010. These data were summarised for the NUTS 3 units and the
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administrative units of the south and eastern Mediterranean, and the differences calculated for the period between 2000 and 2010 (AppFig. 1; Table 1).

The data generated by SIMRA represent a first overview of changes in population density for Europe as a whole, at a spatial resolution of 1 km. The area of interest to SIMRA is approximately 11.5 million km², with a population of 219 million in 2010. Of this population, 26.5% live in areas with less than 150 people per km², down from 27.5% in 2000. That area represents 92.4% (10.7 million km²) of the area of study, slightly down from 92.9% of the study area in 2000.

These findings are broadly in line with those reported by the United Nations (2011) with a decline in population density in urban areas, in developed and developing countries. It is also in line with that reported by the OECD (2013) in consideration of emigration in the Baltic and East European countries. Similarly, the pattern is repeated by the European Environment Agency (2010a) for city regions for the period 2001 to 2004. However, these data appear to be available only as dot maps and are incomplete for the Eurostat area.

Outside urban centres, the pattern of change in population density between 2000 and 2010 shows notable increases in the Republic of Ireland, central and the east coast of Spain, Cyprus, central and western areas of Turkey, North Africa, the eastern Mediterranean. There is also evidence of increases around some capital cities and major urban areas (e.g. Oslo, Stockholm, Helsinki, Amsterdam, Madrid, Berne, Bucharest, Tirana, Luxembourg).

Decreases in population density outside urban centres are evident across most of the area of interest to SIMRA in Europe, notably in Hungary, central Germany, Romania, Bulgaria, eastern Portugal and the Baltic States, consistent with the reporting by OECD (2013).

The patterns in population reflect the changes at national levels in 2015, reported by Eurostat over a similar period, and continued to the present (2015; http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_and_population_change_statistics). Eurostat note that population growth within the EU Member States was highest for Luxembourg (2.33% in 2015), Austria, Germany, Malta and Sweden, with the greatest decreases in Lithuania (1.13%), Latvia (0.87%) and Croatia (0.82%). Figure 8 illustrates the spatial distribution of such changes in population, in terms of its density, across the area of interest to SIMRA.

In some areas, the reduction in population in rural areas has been sufficient to change the density to below the threshold used by the OECD (1994) to identify rural areas as communities with population densities below 150 inhabitants per km², and adopted by the European Commission. AppFig. 2 illustrates the change in spatial distribution of km squares with respect to this threshold.

Overall, the area with less than 150 people per km² has increased in 33 regions, including parts of central Germany, Hungary, Romania, Bulgaria, Serbia, eastern Greece, eastern Portugal, and northern Turkey.

In parts of other areas, the increase in population in rural areas has taken the density above the threshold. These include France, south-west Norway and south-west Sweden, Denmark, Switzerland, Austria, the United Kingdom, northern Italy, Spain, and north-west Africa. In these areas, it appears that population is clustering in towns. As these increase in size, the proportion of the area with a population density below the threshold is reduced.
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Figure 4. Map of areas classified as (a) Predominantly Rural and (b) Intermediate Rural overlaid on a representation of population density, 2010, for the SIMRA area of interest.
The values of population density were then used to create a classification according to the OECD definition of rural and transferred into the Table of Areas. For those areas not covered by Eurostat, population figures were obtained for urban centres from recent census reports from public databases through the City Population database (Birkhoff, 2017). These data were combined with those of population density and the presence of urban centres within identified areas, following the approach of the OECD (2011) to produce a consistent dataset of rural and intermediate rural areas at NUTS 3 and local regions across the area of interest to SIMRA (Figure 5). Table 1 summarises these areas for each of the three classes of the OECD Rural/Urban Typology.

Table 1. Summary of area of 1 km squares with a population density less than 150/km² for each of the three classes of rural/urban typology, in 2010.

<table>
<thead>
<tr>
<th>Classification Title</th>
<th>Sum of Rural area in unit (Count of km squares with pop density &lt; 150 / km²)</th>
<th>Total Area km²</th>
<th>Percentage Rural Squares of Total Area of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predominantly Rural</td>
<td>8,015,392</td>
<td>8,189,518</td>
<td>97.9</td>
</tr>
<tr>
<td>Intermediate Rural</td>
<td>2,160,641</td>
<td>2,533,648</td>
<td>85.3</td>
</tr>
<tr>
<td>Predominantly Urban</td>
<td>493,287</td>
<td>827,647</td>
<td>59.6</td>
</tr>
</tbody>
</table>

The areas of Predominantly Urban populations are concentrated around the major urban centres, generally national or regional capitals. In Europe, examples of such urban areas are notable in The Netherlands, Belgium and North West Germany, southern and south-east Spain, and the southern United Kingdom.

In North Africa and the Eastern Mediterranean, the largest concentrations of Predominantly Urban Areas represent central Morocco, the Nile Valley in Egypt, and areas of southern Syria. The impression of large geographic areas of urban populations is an artefact of: (i) the relatively large geographic areas covered by the administrative regions; (ii) the geographic distribution of the population focused on urban centres with populations greater than 500,000 people, and less than 15% of the population in a 1 km square with less than 150 people per km². That is, in such areas, the population is predominately urban rather than the geographic area being built up and highly populated.

The Rural/Urban typology classification for each region is recorded in the Table of Areas as one of the characteristics for informing interpretation of MRAs.
Figure 5. Map of areas across SIMRA area of interest, classified according to rural/urban typology (2010)
4.2.3. Mountains

The European Commission (2006) sets the provisions for support to European regions through various funds, such as the Cohesion Fund. This implements Article 174 of the Treaty of the Functioning of the European Union (TFEU: European Union, 2012), aiming to ‘reduce disparities between the levels of development of the various regions and the backwardness of the least favoured regions.’ It identifies actions required to aid areas with natural handicaps of which mountainous areas are one type. In this context, mountainous areas are to be defined by the national legislation of Member States (e.g., EEA 2010).

For SIMRA, the approach to mapping mountainous areas was that verified by the ESPON GEOSPECS project (ESPON and University of Geneva 2012a; www.geospecs.eu). Data for the area of continental Europe, North Africa and the eastern Mediterranean were from digital terrain models derived from the Shuttle Radar Topography Mission (SRTM), 90m spatial resolution. This is available for the Earth between latitude 60° North and 54° South. Therefore, it provides a continuous dataset for the SIMRA area, including all land south and east of the Mediterranean.

These data are provided in tiles at set intervals of latitude and longitude. All tiles covering the SIMRA area were downloaded, preprocessed and analysed following the rules set out by the GEOSPECS project.

Data for Iceland, Norway, Sweden and Finland were obtained from national databases to complete coverage for the area of interest to SIMRA, compiled and made available by ViewFinderPanoramas.org, and the Iceland Land Survey (www.lmi.is). These were all processed to the same spatial resolution (90m) for consistency in the derivation of intermediate datasets (e.g. slope and standard deviation of altitude).

The proportion of each NUTS 3 and local region which is classified as mountainous is calculated and provided in the Table of Areas. Following the guidance presented in the GEOSPECS project, a region has been classified as mountainous if over 50% of its area is classified as such. This is used as one of the overall filters in the characterisation of MRAs. The output classification of land classified as mountainous within the area of interest to SIMRA is shown in AppFig 3, and that of regions classified as mountainous in Figure 6.

As noted with respect to other characteristics, an effect of summarising and representing areas as mountainous at the level of NUTS 3 and local regions is to omit some areas which are otherwise understood to be mountainous. Examples include the UK (northwest Scotland, Wales), Ireland, and northern Sweden.

The representation of mountainous areas, as a specific category in a Geographic Information System (GIS) makes it possible to characterise candidate case studies of social innovation with respect to the degree of mountainousness.
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Figure 6. NUTS 3 and SIMRA regional areas coded to represent those with > 50% of their area occupied by mountains.
4.2.4. Aridity

As discussed in Section 2, there are complex relationships between agricultural potential and marginalisation. The physical geographic variables that characterize mountains (altitude, terrain roughness, slope) also limit agricultural productivity (i.e. consistent with Strijker, 2005) and, as mountains are considered as a category characterizing MRAs, it is not necessary to consider such relationships further. However, in the southern part of the area of interest to SIMRA, there is a further constraint to agricultural productivity: aridity.

The approach taken was to identify a surrogate for limiting productivity. For this, the CGIAR-CSI Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Climate Database were used (CGIAR, 2008). They provide global coverage of data related to evapotranspiration processes and rainfall deficit for potential vegetative growth, using the UNEP Global Aridity Index (UNEP, 1997). The spatial resolution is 1km². Further information on its derivation is available from CGIAR Consortium for Spatial information, Hijmans et al. (2005), Zomer et al. (2008).

These data were downloaded, preprocessed and formatted for use with other input spatial datasets. For illustration of the differences across the SIMRA area of interest, the SIMRA regions were coded by the mean value of aridity, shown in Figure 7. For consistency with international analysis of aridity, the data were coded according to the thresholds specified in the Global Aridity Index, summarised in Table 2.

<table>
<thead>
<tr>
<th>Aridity Value</th>
<th>Class Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.03</td>
<td>Hyper arid</td>
</tr>
<tr>
<td>0.03 to 0.2</td>
<td>Arid</td>
</tr>
<tr>
<td>0.2 to 0.5</td>
<td>Semi-arid</td>
</tr>
<tr>
<td>0.5 to 0.65</td>
<td>Dry Sub-humid</td>
</tr>
<tr>
<td>&gt;0.65</td>
<td>Humid</td>
</tr>
</tbody>
</table>

Table 2. Classification of Global Aridity Index, originally produced by UNEP (1997).

For SIMRA, the use of this characteristic is to represent areas of low agricultural potential, limited by aridity, so the class of semi-arid is also shown.

The compiled dataset was summarised by NUTS 3 unit and the administrative units of the south and eastern Mediterranean to provide the proportion of each unit comprised by each class. The proportion of the administrative units which is classified as semi-, arid or hyper-arid was then recorded in the Table of Areas.
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 677622.

Figure 7. Map of hyper-arid, arid and semi-arid areas based upon Global Potential Evapo-Transpiration (Global-PET) and Global Aridity Index (Global-Aridity) (Source: SIMRA, created from data from CGIAR, 2008; Trabucco and Zomer, 2009).
4.2.5. Islands

The European Commission (2006; 1994; Eurostat, 2013; Monfort, 2009) recognises that certain islands in Europe are areas with a natural handicap due to the limitations of key transport links. The classification of islands underpins their eligibility for certain funding, e.g. through the European Social Fund and the Cohesion Fund (European Commission, 2006). The classification used by the European Commission is based upon having:

- a minimum surface of 1 km²;
- a minimum distance between the island and the mainland of 1 km;
- a resident population of more than 50 inhabitants;
- no fixed link (bridge, tunnel, dyke) between the island and the mainland.

Figure 8 shows the distribution of island regions of the EU at the NUTS 3 level, classified according to population. Some such islands are nation states (e.g. Cyprus, Malta, Iceland), or a combination of State and region (e.g. Island of Ireland), coded by population size. Most are regions of EU Member States.

For SIMRA, some characteristics of islands as used by the European Commission are relaxed. No minimum population size is relevant to the validity of an area as a focus for social innovation (e.g. an island could be the site of a renewable energy installation, the source of a particular product, or eco-tourism), or consideration as marginal, or inhabitants as marginalised.

An analysis using OpenStreetmap was run to identify all NUTS 3 regions which contain islands, and those areas not covered by Eurostat data. This was supported by interpretation of aerial imagery of all regions, using Google Earth and Bing Maps, to identify any evidence of inhabited buildings. Where necessary, internet searches were carried out on specific islands for further information regarding their status. Ruins or other buildings of tourist interest were considered as uninhabited. The classification is shown in Figure 9. It includes NUTS 3 regions which have administrative links to smaller islands even if the region is dominated by areas of high population or a State capital (e.g. Copenhagen), island states (e.g. Cyprus, Republic of Ireland, Iceland,
Malta), and islands which comprise more than one region (e.g. Corsica, Sardinia, Crete, Sicily). The classification records the presence of:

- At least one island with no bridge or tunnel link
- No island without a bridge or tunnel link
- Only uninhabited islands with no bridge or tunnel link
- Area of an island, without a bridge or tunnel link to a smaller island.

Excluded from the classification are those NUTS 3 regions which have geographic features which may be characterised by restrictions of a similar nature to islands such those which have inter-tidal access (e.g. Lindisfarne, UK) or an isthmus (e.g. Juodkrante, Lithuania: access by bridge, or land via Kaliningrad, Russia).

The same calculation has been carried out for areas of relevance to SIMRA which are not represented in data from Eurostat (i.e. North Africa and Eastern Mediterranean). In these countries, administrative areas which have responsibility for islands have been included in the classification, providing consistency across the SIMRA area of interest (Figure 9).

Most regions with islands have at least one which is inhabited and has no link by bridge or tunnel to the mainland or another, larger island. However, many such areas also have islands which are linked by bridges or tunnels (e.g. in Denmark, Norway, northwest Scotland). The output of the classification also highlights a number of areas in which the only islands are uninhabited but which include historic sites or protected areas used for organised visits by tourists (e.g. southern Turkey, eastern Tunisia, southern Sardinia, south-eastern Iceland).

These data will be used to inform the characterisation of examples of social innovation, with interpretation of factors such as accessibility and remoteness. The classification of regions with islands is included in the Table of Areas to enable interpretation of potential challenges for communities due to being on an island. However, the use of such data in assessing candidate case study areas of social innovation will require checks to be made on the actual geographic circumstances of such examples.
Figure 9. Distribution of SIMRA regions in which there are islands, classified to represent accessibility by bridge or tunnel, evidence of habitation, and whether an area of a larger island.
4.2.6. Infrastructure

- Internet access

The President of the European Commission, Jean Claude Juncker, has set 10 Priorities under its agenda for jobs, growth, fairness and democratic change (https://ec.europa.eu/commission/priorities_en). One of those is the Digital Single Market, of which better access for consumers and business to online goods forms one of three policy pillars, alongside environment and economy and society (https://ec.europa.eu/digital-single-market/en/digital-single-market). To support monitoring of the implementation of the policy, Eurostat compiles a range of measures to monitor and inform decisions regarding the availability and uptake of internet infrastructure and use. For this, a Digital Economy and Society Index (DESI) has been developed; this composite index summarises indicators for use in tracking change in digital competitiveness in EU Member States, detailed in Table 3.

Table 3. The dimensions of the EU Digital Economy and Society Index (Source: European Commission, 2016b)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connectivity</td>
<td>Fixed broadband, mobile broadband, broadband speed, and affordability</td>
</tr>
<tr>
<td>Human capital</td>
<td>Basic skills and usage, advanced skills and development</td>
</tr>
<tr>
<td>Use of internet</td>
<td>Content, communication and transactions on line</td>
</tr>
<tr>
<td>Integration of digital technology</td>
<td>Business digitization and eCommerce</td>
</tr>
<tr>
<td>Digital public services</td>
<td>eGovernment</td>
</tr>
</tbody>
</table>

These data are used for exploring and monitoring change in national ‘digital scorecards’ (http://digital-agenda-data.eu/). The World Bank also compiles data to enable reporting on access and use of the internet for almost all nations. Figure 10 shows the values of the DESI for 2016 for each EU Member State and the average for the European Union (EU28).

![Figure 10. Digital Economy and Society Index (DESI) for 2016 (Source: European Commission, 2016).](image)

Figure 11 shows a map prepared with data from these two sources showing the distribution of households which have access to the internet at home. This covers European Union Member States and those for which Eurostat or the World Bank provide data, some of which is at yearly intervals. The exception is Kosovo, for which no nationally specific data are reported. The level of detail of data for North Africa and Eastern Mediterranean is national.
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under Grant Agreement No 677622.

Figure 11. Map of households that have internet access at home in 2014*, by NUTS 2 region and nation states (Sources: Eurostat, The World Bank for 2014; * Data for Serbia and Montenegro are for 2015).

The percentage of households with access to the internet, at NUTS 2 level, is recorded in the Table of Areas, with data at national levels recorded where there was no greater level of detail. However, where data are available they will be provided for use in the in-depth analysis of examples of social innovation in Work Package 4.
Road access

The European Observation Network for Territorial Development and Cohesion (ESPON) analysed accessibility as an indirect measure of the potential for activities and enterprises in regions to reach markets and activities in other regions (ESPON, 2009). It notes the importance of accessibility as a driver in the development of regions. The analysis considered air, rail and road transport, noting that roads tend to ‘shape contiguous spaces of higher accessibility’. Figure 12 shows the pattern of potential accessibility by road in Member States in 2006, by NUTS 3 units (ESPON, 2009), with highest levels of accessibility in a core area of Germany, Belgium, Luxembourg and The Netherlands, and extending to northeast France.

Figure 12. Potential accessibility by road for European Union countries, by NUTS 3 units, in 2006 (Source ESPON, 2009).
However, several factors limit the use of these data: (i) they do not extend across the entire area of interest to SIMRA; (ii) the significance of individual stretches of road may have local significance to a particular site or community greater than the classification would indicate; (iii) the effectiveness of accessibility may be mitigated by the quality of roads (e.g. road surface, geometry, terrain they traverse); (iv) the quality of a road of the same type or level may vary across the area of interest to SIMRA; (v) impacts of weather on road surface and usability (e.g. snow and ice, susceptibility to flooding).

To enable consideration of accessibility by road for examples of social innovation, a database of roads for the area of interest to SIMRA was created using the highest level of data available, enabling the accurate location of such examples with respect to the local road network. For this purpose, OpenStreetMap was used, as this has a standardised classification of highways: the types include motorways, trunk, primary, secondary and tertiary routes, tracks and pathways.

Data were downloaded from OpenStreetMap and converted in formats for use in ArcGIS. These were for all countries within the area of interest to SIMRA. A three-level classification was used to simplify the representation and interpretation of the road network as follows:

- Major roads – Motorways, trunk roads, primary roads;
- Intermediate roads – Secondary roads;
- Minor roads – tertiary roads, tracks, unclassified, residential, living street, cycleway, bridleway, footway, path, pedestrian, service.

To summarise infrastructure with respect to access by road, an index was derived of road length with respect to the area of NUTS 3 and local region (Forman, 1999; USEPA, 2011). This provides an indicator of connectivity within an area which can be augmented by analysis with respect to the type of road as well as total length. The higher the value of the indicator, the higher the internal connectivity of the area (i.e. greater density of roads).

Figure 13 shows the index derived for all roads, by NUTS 3 and local regions. Across the whole region, the pattern shows a lower ratio of roads to area (i.e. lower density of roads) in the northern and north-western areas (Finland, Sweden, Norway, Iceland, Ireland), and south eastern Europe, and south and eastern Mediterranean. The areas with the highest densities of roads are focused on Germany, France, southern UK and The Netherlands.

In several areas, there are differences in the density of roads at a regional level. For example, in North Africa, the coastal areas have a relatively high density of roads (e.g. coastal Morocco, Algeria, Tunisia), compared to those inland. Similarly, coastal areas of Portugal and Spain have road densities which are higher than areas of the inland, particularly in the south, a pattern which is also apparent for the index applied to major roads (AppFig. 4). AppFig. 5 shows maps of the index applied to all roads for areas to the western and eastern ends of the Mediterranean Sea, with NUTS 3 and regional administrative boundaries superimposed, and the road networks classified into major, intermediate and minor roads.

The values of the index are influenced by the size of NUTS 3 units, with differences in the size of units between countries having an impact on the index, exaggerating the differences at some borders (e.g. Czech Republic and Germany, Hungary and Romania).

These data and associated maps enable the interpretation of the locations or extent of candidate case studies in social innovation with respect to road infrastructure and accessibility. The interpretations expected are of:

1) the highest level of roads in the vicinity of the geographic focus of the social innovation (e.g. major road adjacent to the location of production site);
2) the level of roads across a geographic area of relevance (e.g. over 95% of minor roads in a catchment of community health care);
3) the density of roads or tracks present within the area of influence of a social innovation.

The databases of roads and administrative areas are stored in a Geographic Information System (GIS) for use with data provided on the candidate examples of social innovation, to inform their characterisation with respect to accessibility.
Figure 13. Classification of road density by NUTS 3 and regional boundaries based on road network for area of interest to SIMRA (Source: SIMRA, from OpenStreetmap [© OpenStreetMap contributors], Eurostat and Global Administrative Areas database).
4.2.7. Social and economic characteristics

As discussed in Section 2.4, marginalised populations have particular economic and social, sometimes including political, characteristics. Reducing disparities in such characteristics across Europe is the focus of public policies such as the Cohesion Policy (European Commission, 2014). Data on a number of characteristics of relevance are available for much of the SIMRA area of interest. For example, Eurostat publishes data on regional demographic statistics (e.g. infant mortality), participation in training and education, and regional poverty (e.g. people at risk of poverty or social exclusion). Typically, such data are reported in NUTS 2 spatial units which, for most of the SIMRA area of interest, are at too low a spatial resolution to provide characteristics directly relevant for candidate case studies of social innovation. However, such data provide supplementary information about the area of interest to SIMRA and the context within which social innovation takes place.

- **Gross Domestic Product per capita**

For SIMRA, the principal indicator of economic activity consistent with the principal physical characteristics of MRAs is Gross Domestic Product (GDP) per capita. These data were obtained from Eurostat for EU Member States and other countries covered in this database; for eastern and southern Mediterranean states, data were obtained from The World Bank.

As the series of data available at NUTS 3 level (for Europe) are published through to 2011, data for all countries within the SIMRA area were collated for the same year. As data from The World Bank are provided in US Dollars, these values were converted into Euros at the average exchange rate for 2011, as recorded by the World Bank. Figure 14 shows the distribution of GDP per capita for the SIMRA area of interest. No data were available at the level of NUTS 3 for countries in the Western Balkans. For this area, national data from the World Bank are used, except for Kosovo for which no nationally specific data are reported. The Gross Domestic Product per Capita by NUTS 3 region is recorded in the Table of Areas, with data at national levels recorded where there was no greater level of detail (e.g. eastern and southern Mediterranean).
Figure 14. Gross Domestic Product per Capita (Euros) for areas of interest to SIMRA (Sources: Eurostat, The World Bank).
• **People at risk of poverty or social exclusion**

The United Nations 2030 Agenda for Sustainable Development identifies ending poverty and hunger as the key objectives of Sustainable Development Goal 1, to ensure that ‘human beings can fulfil their potential in dignity and equality and in a healthy environment’ (United Nations, 2015). This global aim is reflected in the Europe 2020 Strategy of the European Union (European Commission, 2010), promoting social inclusion and reducing poverty.

To support the monitoring of progress towards this aim, Eurostat reports on ‘persons who are at risk of poverty or severely materially deprived or living in households with very low work intensity’ (Eurostat, 2017). For European Union Member States and those covered by Eurostat, data relating to this indicator are available at NUTS 2 or national levels (except for Kosovo). No equivalent data are available for North Africa or the Eastern Mediterranean. The definition of this indicator used by Eurostat (2017) is as follows.

People at risk of poverty are those with an equivalised disposable income below the risk-of-poverty threshold, which is set at 60% of the national median equivalised disposable income (after social transfers). Material deprivation covers indicators relating to economic strain and durables. Severely materially deprived persons have living conditions which are severely constrained by a lack of resources, not able to afford at least four out of nine following items:

1. to pay rent or utility bills,
2. keep home adequately warm,
3. face unexpected expenses,
4. eat meat, fish or a protein equivalent every second day,
5. a week holiday away from home,
6. a car,
7. a washing machine,
8. a colour TV,
9. a telephone.

People living in households with very low work intensity are those aged 0 to 59 living in households where the adults (aged 18 to 59) work less than 20% of their total work potential during the past year. Further information is available from the relevant dataset entry on the Eurostat database (http://ec.europa.eu/eurostat/web/products-datasets/-/tgs00107).

For SIMRA, this classification provides a broad geographic context to inform the characterisation of examples of social innovation, along with interpretation of factors such as accessibility and remoteness. A map of the geographic distribution of this indicator is shown in Figure 15. No data are reported for some of the Balkan states, and no equivalent is available for North Africa or the Eastern Mediterranean except for Turkey.

The percentage of people at risk of poverty or social exclusion, at NUTS 2 level, is recorded in the Table of Areas, with data at national levels recorded where no greater level of detail is available. Where no data are available, this is noted in the Table of Areas.
Figure 15. People at risk of poverty or social exclusion in northern section of area of interest to SIMRA (Source: Eurostat).
• Infant mortality

The Treaty of Lisbon, Article 184, notes the aim of reducing disparities between levels of development in different areas, with particular attention paid to rural areas, and those suffering from ‘severe and permanent or natural or demographic handicaps’ such as very low population density, islands and mountain regions. One disparity with significance with respect to sustainable development is that of human health, noted in the United Nations Sustainable Development Goal 3, of ensuring healthy lives and promoting well-being for all at all ages (United Nations, 2015).

Alexander et al. (2003) identify disadvantages that are faced by rural communities with respect to decreased access to hospitals, clinics, and healthcare workers with advanced technology or knowledge of its use. One of the three strategic objectives of the EU health policy is to support dynamic health systems, responding to challenges such as ageing populations, and the mobility of patients and health care professionals (European Parliament, 2017). Social innovation may provide one approach to reducing inequalities (Mason et al., 2015).

In reviews of trends in health within the European Union, Mladovsky et al. (2009) note that infant mortality has reduced to under 10 deaths per 1,000 in all Member States and (at the time) Candidate Countries except Romania and Bulgaria, Turkey and the Former Yugoslav Republic of Macedonia. Authors such as Reidpath and Allotey (2003) report the valuable role of infant mortality as an indicator of population health in general. This reflects structural factors affecting the wider population’s health having an impact on the mortality rate of infants.

For the SIMRA area of interest, data on infant mortality are available from Eurostat, at NUTS 2 level, and the World Bank, at country level, for North Africa, Eastern Mediterranean and some Balkan States. These data are shown in Figure 16, for 2013.
Figure 16. Infant Mortality (deaths of children under 1 year old per 1,000 in a year) as an indicator of health (Source: Eurostat and World Bank Data).
• Early leavers from education and training

The European Union Education and Training framework (ET 2020; European Commission, 2009) sets out the strategy for achieving the goals of the EU of addressing common challenges in relation to education and training. The four common objectives are:

• Making lifelong learning and mobility a reality
• Improving the quality and efficiency of education and training
• Promoting equity, social cohesion, and active citizenship
• Enhancing creativity and innovation, including entrepreneurship, at all levels of education and training.

The European Commission has identified seven indicators for tracking progress on education through to 2020. One of those, early leavers from education and training, is particularly associated with social exclusion, poverty, poor health and unemployment. The target for the EU is to reduce such early leaving by those aged 18 to 24 to less than 10% by 2020. Eurostat collate statistics to enable tracking of this target, at NUTS 2 level, for EU Member States, Switzerland, Norway, Iceland and Turkey, as shown in Figure 17. A few areas within EU Member States have no data available.

No equivalent data are available for other countries in the area of interest to SIMRA in North Africa and the Eastern Mediterranean, and some of the Balkan States. However, these data provide a characteristic of MRAs which can be used to inform the selection of case studies for social innovation.
Figure 17. Early leavers from education and training (percentage population aged 18 to 24 with at most a lower secondary education) as an indicator of level of education (Sources: Eurostat).
5. Characteristics and Table of Areas for Marginalised Rural Areas

As noted in Section 2, MRAs are characterised by a combination of physical geography, infrastructure and socio-economic criteria. A unique geographic definition of such areas for SIMRA (i.e., a single map) is not proposed because of the gaps in relevant data and inconsistencies in scale and levels of detail across the entire area of interest to SIMRA. Therefore, the characteristics derived in this Section are presented as either a set of filters or contextual information for use in identifying likely MRAs and aspects which are associated with marginalised people. These characteristics are listed in Table 4.

Table 4. Characteristics of MRAs: Physical and socio-economic (Spatial resolution: H: High; L: Low; Used as a filter of MRAs: Y: Yes; N: No; Not Applicable: N/A; *1 km square from data modelled by the provider).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Level of Detail</th>
<th>Use as a Filter</th>
<th>Threshold</th>
<th>Comment</th>
<th>N°. Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural/ Urban Typology</td>
<td>H and L</td>
<td>Y</td>
<td>Rural or Intermediate Rural in 2010</td>
<td>Expected to include almost all MRAs</td>
<td>Rural: 581</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intermed: 574</td>
</tr>
<tr>
<td>Increase in Area of Rural 1 km squares</td>
<td>H and L*</td>
<td>N</td>
<td>No explicit threshold</td>
<td>Increasing level of marginalization as area increases of population density below 150 people per km² between 2000 and 2010)</td>
<td>33 regions</td>
</tr>
<tr>
<td>Mountainous</td>
<td>H and L</td>
<td>Y</td>
<td>&gt;50% of area</td>
<td>Includes MRA</td>
<td>535</td>
</tr>
<tr>
<td>Aridity</td>
<td>H and L*</td>
<td>Y</td>
<td>&gt;50% of area in classes of Semi-arid and higher</td>
<td>Includes MRA</td>
<td>238</td>
</tr>
<tr>
<td>Islands</td>
<td>H and L</td>
<td>Y</td>
<td>If at least 1 island with no link by bridge or tunnel</td>
<td>Includes MRA</td>
<td>176</td>
</tr>
<tr>
<td>Roads</td>
<td>H and L</td>
<td>Y</td>
<td>Ratio of total road length to area</td>
<td>Proportion of road length to area of NUTS 3 or local region provides an indicator of local accessibility</td>
<td>N/A</td>
</tr>
<tr>
<td>Access to Internet</td>
<td>L</td>
<td>N</td>
<td>No explicit threshold</td>
<td>Comparatively low value may characterize marginalisation</td>
<td>N/A</td>
</tr>
<tr>
<td>GDP per Capita</td>
<td>L</td>
<td>N</td>
<td>No explicit threshold</td>
<td>Comparatively low value may characterize marginalisation</td>
<td>N/A</td>
</tr>
<tr>
<td>People at Risk of Poverty or Social Exclusion</td>
<td>L</td>
<td>N</td>
<td>No explicit threshold</td>
<td>Comparatively low value may characterize marginalisation</td>
<td>N/A</td>
</tr>
<tr>
<td>Infant Mortality</td>
<td>L</td>
<td>N</td>
<td>No explicit threshold</td>
<td>Comparatively low value may characterize marginalisation</td>
<td>N/A</td>
</tr>
<tr>
<td>Early Leavers from Education and Training</td>
<td>L</td>
<td>N</td>
<td>No explicit threshold</td>
<td>Comparatively low value may characterize marginalisation</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Filters are identified for at least one characteristic of MRAs from each of the types identified previously: physical geography, infrastructure and socio-economics. An indication is provided of the level of detail of the underlying data used in the derivation of each characteristic, labelled as ‘High’ and ‘Low’. In general, the physical geography input data are of a high spatial resolution (e.g. elevation data) and those of socio-economic data are at a low spatial resolution (e.g. data collected and reported at a NUTS 2 level).

The data on aridity and population density are noted as being at a spatial resolution of 1 km², each having been derived by the originating organisation for representation at that level of detail. In each case, these data have been summarised by the number of 1 km squares of particular class or value per NUTS 3 or local regional area. Therefore, the spatial resolution of the data as used in the Table of Areas is low, hence both labels are used in Table 4.

The threshold used for each filter provides a guide as to the level of each characteristic which could be associated with areas being marginal or people being marginalised. Use of these filters recognises the limitations of the underlying data and the spatial and temporal resolution of the representation of characteristics at NUTS 3 and local regions. For example, it is understood that the classification of a region as mountainous does not mean that the geographic centre of a social innovation activity is within the area of mountains, nor that all beneficiaries are living or working within the area of mountains. If required, the indicators of such characteristics can also be summarised by LAUs, for the area within the EU, or area covered by Eurostat (e.g. for data of relevance, where available, for the final set of case studies of social innovation selected).

The filtering approach enables the identification of the characteristics of an area and interpretation of those which might be of most relevance for understanding social innovation. However, for six characteristics, no threshold is provided. For each of these, the associated data are provided as relevant context for the consideration of examples of social innovation, but for which there is no basis in literature or empirical evidence as to what might constitute either a barrier or a stimulus to social innovation. Therefore, they act as a checklist of issues to be considered alongside more detailed analysis within the case studies.

Similarly, no threshold is provided for the increase in the area of rural 1 km squares (i.e. those for which there is less than 150 people per km²). However, this is linked to the OECD definition of the Rural Urban Typology. Thus, the data are provided to enable interpretation of the magnitude of change within each NUTS 3 and local region across the area of interest to SIMRA. This provides one factor for which temporal information has been obtained and can be used to consider the direction of change of characteristics of MRAs.

The data of the characteristics are prepared in formats for use in maps as backdrops to examples of social innovation, highlighting their distribution with respect to different characteristics of MRAs. The maps are available for closer inspection on the SIMRA WWW site, under the Resources tab. These maps will also be used to support dissemination through the SIMRA website using a web-mapping facility with an aim of providing a spatial context to the cartographic illustration of the database of examples of social innovation (Task 3.2). This facility will also enable information to be added and so support the presentation of other geographically specific information associated with the case studies and Innovation Actions (WP7).

The level of detail in the spatial databases of the physical characteristics (road access, island, mountainous land, land use, aridity) enable site, local or regional interpretation of some of the drivers to social innovation – whether positive and negative. Data on social and economic characteristics (population density, internet access, GDP, risk of poverty or social exclusion) enable interpretation of the regional contexts of possible drivers and barriers to social innovation. However, there may also be other drivers, such as land ownership, for which there are insufficient publicly available data, so that they cannot be mapped for the entire area of interest to SIMRA, but should still be considered in specific contexts.

An extract of the Table of Areas is shown in Table 5. This shows the format of a row per NUTS 3 or local region, and columns containing the values for each of the characteristics relating to marginalised rural areas.
This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 677622.

Table 5. Extract of the Table of Areas showing rows for project regions, information in the header row, and examples of characteristics.

The information on locations of examples of social innovation (Task 3.2) have been linked to the Table of Areas, thus at the level of NUTS 3 and local regions. This enables each example to be assessed with respect to the characteristics of MRAs and thus whether:

1) they are operational solely within MRA(s);
2) their activities are focused on MRAs but with actors drawn from outside MRAs (e.g. skilled employees or volunteers living in adjacent urban areas);
3) they are not focused or operating within MRAs.

The content of the dataset linking the Table of Areas with the examples of social innovation will require verification in Task 3.2, with gaps to be filled to address three issues anticipated to arise when linking examples of social innovation with geographic location:

1) a lack of geographic specificity regarding the focus or area of influence of examples of social innovation;
2) the geographic focus of a social innovation not being constant through time (i.e. scaling-out in which initial site of focus expands; the distribution of initial innovators may change as they leave or new innovators join);
3) examples of social innovation may be transboundary (e.g. in more than one municipality or region).

The Table of Areas enables comparisons to be made between social innovations across the area of interest to SIMRA. This underpins consideration and analysis of the database of examples of social innovation to be undertaken in Task 3.2. In particular, it provides a checklist of the topics which were not suitable for use as filters for MRAs, or for which data are only available at a coarse spatial scale (e.g. internet, health and education characteristics).

The Table of Areas is also implemented as a database supporting the spatial data, in ArcGIS. This enables:

1) the analysis of characteristics with respect to specific factors associated with examples of different types of social innovation;
2) the inclusion of additional data where they are available at higher spatial resolutions for areas within which social innovations selected for case studies are situated;
3) analysis and interpretation of examples of characteristics of MRAs with respect to the geography of examples of social innovation which are distributed across more than one NUTS 3 area or local region;
4) the communication and representation of characteristics of MRAs, and SI with respect to such characteristics.

This enables the spatial representation of the characteristics of MRAs to support analysis of the case studies of social innovation, the Innovation Actions in WPs5 and WP7 and policy analysis in WP6.
6. Re-Use and Access of Data and Outputs

All data obtained and used comply with the EC INSPIRE Directive (European Commission, 2007). The project outputs are coded with key words and metadata informed by guidelines from the EU Joint Research Centre (2013), and comply with the guidance in the Data Management Plan (D1.3). This is to increase the potential to locate the data and its reuse where relevant to other beneficiaries.

No ethical issues arise from the compilation or use of the outputs of this deliverable. No personal data are used in its creation, and no individual or groups of individuals can be identified from its contents. As noted above, the input data were obtained from a range of sources, all available for public access with no specific licence restrictions. There are no security issues arising.

7. Conclusions

No single definition exists for Marginalised Rural Areas. The approach presented provides working definitions of the characteristics of MRAs to support the aims of SIMRA. Relevant scientific, policy and technical literature have been used as a basis for defining rural, marginal and marginalised. Such literature includes evidence used in support of EU strategies (e.g. Health - Mladovsky et al., 2009), and the literature and scientific concepts, principles and underpinning of previous European studies (e.g. ESPON GEOSPECS and EORDA projects).

In combination, these definitions and concepts have been used to produce criteria for identifying the level and nature of marginality/marginalisation based on physical, environmental, social and economic aspects, at the level of NUTS 3 and local regions across the area of interest to SIMRA. The maps and underlying digital datasets present the distribution of those characteristics of MRAs which can be quantified and expressed spatially. Wherever possible, data have been sourced and used to enable consistent application across the entire area of interest to SIMRA. This includes the areas to the east and south of the Mediterranean and across the Balkan countries. However, for most of these areas there are limited data of an equivalent spatial resolution or collected over a contemporary timescale. For these areas, social and economic data collated and reported by Eurostat, or the equivalent digital infrastructure of the NUTS nomenclature, are rare and appropriate data have been obtained from The World Bank. Where appropriate, the content of the characteristics is classified and presented in greater detail than is used in the OECD rural/urban typology, enabling a more refined interpretation of individual areas.

The summary of characteristics of MRAs for the 1,689 regions within the area of interest to SIMRA illustrates a significant percentage with biophysical constraints due to aridity (14.1%), mountainousness (31.7%) or containing inhabited islands with no physical link (i.e. bridge or tunnel) (10.4%). These are not mutually exclusive, with several areas having significant geographic areas with combinations of two of the three constraints (e.g. mountainous and containing islands, e.g. Iceland, Norway, Corsica, Sicily), or high levels of aridity and mountainousness (e.g. North Africa, southern Europe). However, as explained, the use of the NUTS 3 and local regions as spatial units means that the characteristics are not distributed homogeneously across each area (e.g. areas classified as Predominantly Urban reflecting the urban concentration of the population rather than the nature of the land use across the wider area).

It is not anticipated that any one characteristic is uniquely responsible for an area being a MRA, so no combined map is provided. For some areas the principal limitation is one of gaps in data (e.g. indicators of education and social exclusion for the areas of North Africa and eastern Mediterranean). Across the entire area, the challenge would be of combining the spatial units by which the characteristics are represented and the resultant anomalies due to the aggregation of data in different geographical units (e.g. 1 km², NUTS 2, NUTS 3), albeit NUTS is a hierarchical system. This is a reflection of the Modifiable Areal Unit problem (Openshaw, 1983; Longley, 2017).

If data are available at higher spatial resolutions such as the Local Administrative Units level 2 (e.g. GEOSPECS, involving SIMRA partner Perth College; Streifeneder et al., 2007, at SIMRA partner EURAC) they can be incorporated into the spatial database and used for more targeted analysis of case studies of social innovation within SIMRA. For example, use could be made of data on population at LAU2 which are available for the EU
Member States and combined with those at spatial resolutions of 1km$^2$ and smaller (e.g. mountainous, aridity, islands, road infrastructure). This would improve the geographic precision with which a subset of characteristics of MRAs could be represented, but with data available to date that would not include the social or economic characteristics, and with inconsistencies across North Africa, the eastern Mediterranean, countries of the former Yugoslavia.

Changes in the distribution of population within the area of interest to SIMRA, between 2000 and 2010, is due to a combination of the depopulation of rural areas, inward migration, and the migration from cities to rural areas in some limited areas. Of the total population of approximately 219 million people, the net change in the area where the population is described as rural (i.e. < 150 people per km$^2$) increased slightly between 2000 and 2010, by 0.5%. Estimates of such changes for each region are recorded in the Table of Areas.

The Table of Areas and its spatial representation provide a source of data for comparing between examples of social innovation with respect to the set of characteristics of MRAs. This can be used as a 'checklist' of issues, with different combinations of two or more characteristics can be derived for any single area, and used for considering the nature of the marginality when consideration the selection of case studies of social innovation.

The relationship established between the Table of Areas and the database of examples of social innovation (WP3.2) enables searches to be based upon the characteristics of either MRAs or social innovation. In turn, this enables support for the identification and interpretation of contexts of different types of SI with respect to some of the barriers (e.g. mountainous, accessibility, aridity), pressures (e.g. depopulation, education and training) or stimuli for social innovation. For details of such interpretation see D3.3 and D5.1.
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Appendix. Additional Maps of Characteristics of Marginalised Rural Areas

AppFig. 1. Changes in population density between 2000 and 2010, summarised by NUTS 3 and local regions, for the SIMRA area of interest. (This map is available for closer inspection on the SIMRA WWW site, under Resources, at a resolution of 300 dpi).
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AppFig. 2. Map of changes in the percentage of 1km squares (< 150 people per km²; 2010) per NUTS 3 and local areas, for the SIMRA area of interest (This map is available for closer inspection on the SIMRA WWW site, under Resources, at a resolution of 300 dpi).
AppFig. 3. Classification of mountain areas across the area of interest to SIMRA. (This map is available for closer inspection on the SIMRA WWW site, under Resources, at a resolution of 300 dpi).
AppFig. 4. Classification of major road density by NUTS 3 and regional boundaries based on road network for area of interest to SIMRA (Source: SIMRA, from OpenStreetMap [© OpenStreetMap contributors], Eurostat and Global Administrative Areas database).
AppFig. 5. Classification of road networks, NUTS 3 and regional boundaries, and areas road density for the western Mediterranean (Source: SIMRA, from OpenStreetmap [© OpenStreetMap contributors], Eurostat and Global Administrative Areas database)