



GRANULAR

# Prototype Rural Diversity Compass

## D2.2

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# Table of contents

<b>1. Executive Summary .....</b>	<b>4</b>
<b>2. Introduction .....</b>	<b>5</b>
<b>3. Prototype Rural Diversity Compass .....</b>	<b>7</b>
<b>4. Characterization of Compass Components .....</b>	<b>9</b>
4.1 Residential Functionality .....	9
4.2 Productive Functionality .....	11
4.3 Environmental Functionality .....	14
4.4 Recreational Functionality .....	16
<b>5. Conclusions .....</b>	<b>18</b>
<b>Annex 1: Background information on Compass Components .....</b>	<b>22</b>
Housing.....	22
Demographic Trends .....	22
Commuting & Migration .....	23
Basic Services Delivery .....	24
Digital Transformation.....	24
Cohesion & Wellbeing .....	25
Labour & Employment .....	26
Resource Use & Ownership .....	27
Foodscapes .....	28
Diversified Economies .....	29
Economic Performances.....	30
Social & Technological Innovation.....	31
Natural Capital Stocks .....	31
Agri-Environmental Performances.....	32
Circular Resource Use.....	33
Climate Change Effects .....	33
Renewable Energy .....	34
Eco-System Services Profile .....	35
Rural Amenities .....	35
Recreational Infrastructures.....	36
Cultural Attractiveness & Heritage.....	36
Creative Tourism .....	37
Seasonality & Multilocality .....	38

<b>Annex 2: Additional Information on Compass Components .....</b>	<b>40</b>
A. Ecosystem service categories and indicators .....	40
B. Circular Economy Value Retention Model .....	41

## 1. Executive Summary

This document presents a prototype Rural Diversity Compass (from now on Compass). Its theoretical foundation has been elaborated in the GRANULAR deliverable D2.1, with prominent roles for multi-spatiality and multi-functionality. While paying attention to various EU rural policy notions, the Compass aspires to shed light on rural diversity by taking account of place-specific differentiation tendencies based on particular functionality dynamics. In doing so, it distinguishes residential-, productive-, environmental- and recreational functions. These four functionalities are characterised by 24 components, drawing attention to typical functional features and their interconnectedness in particular settings. Combining the 24 components reveals the place-specificity of particular functionalities, their relevance, balance, disbalance, trade-offs, etc.

The heart of this document describes the key features of the Compass by characterising its four principal functionalities and components. Frequently, it will be accompanied by references to the need for and significance of cross-referencing with other functionalities and their components. Hyperlinks are included that lead to additional data sources to substantiate their relevance further and to give a state-of-the art impression of relevant indicators, their availability and limitations.

The final part of this report returns to the multi-spatial lens from which the Compass departs, discussing its importance for understanding current differentiation tendencies. We emphasize that the EU's rural proofing aspirations require wider assessment criteria such as social-, spatial and climate justice to fully recognize how functionality dynamics impact rural areas in very different ways, resulting in hugely diverging rural profiles, problems and prospects. To take account of these differentiation tendencies, rural proofing strategies need more explicit incorporation of rural functionality balances and disbalances.

We end this report by recognizing the need and relevance to further test and validate the Compass throughout ongoing and forthcoming GRANULAR activity with respect to rural data-sourcing, -interpretation, -representation and -classification with the aspiration to contribute to more well-informed, participatory and inclusive rural policy-making processes at different scales and in different settings.


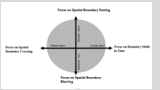

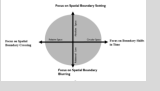

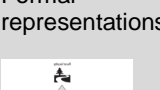
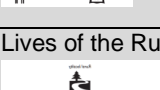
## 2. Introduction

This second GRANULAR WP2 report builds on the theoretical framework for analysing contemporary rural diversity as presented in its first deliverable. Its main objective is to launch a prototype Rural Diversity Compass based on the distinction of four key rural functionalities.

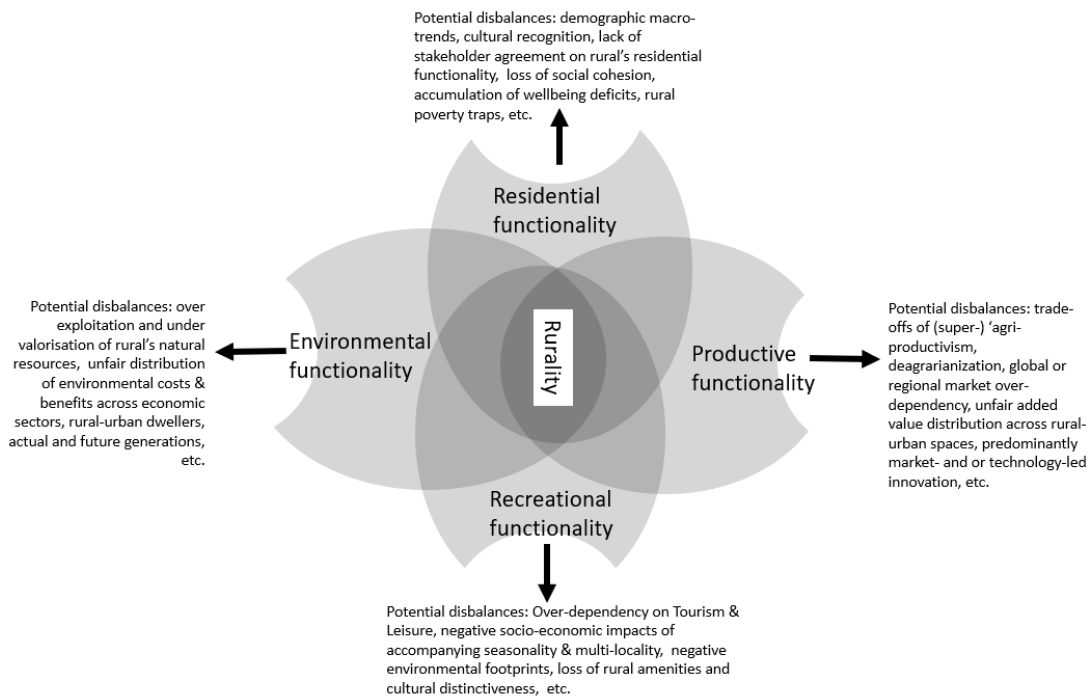
These functionalities are characterized by sets of components as further functional specifications and representations of critical drivers of contemporary rural differentiation tendencies. We will present these sets of components in the following while providing hyperlinks to relevant information sources and associated data, indicator availability, and discussions and challenges. Analytically, the prototype Rural Diversity Compass aims to stress that its various components become especially meaningful in their togetherness, interwovenness and interdependency. As substantiated in GRANULAR deliverable D2.1, rural functional (re-) balancing and (re-) integration are key aspects of rural resilience and rural policy proofing, with multi-spatiality and multifunctionality as critical analytical building blocks to characterize contemporary rural dynamics.

As a reminder, see the following synthesizing impressions of these two analytical cornerstones of D2.1:

**Table 1: GRANULAR's Multi-spatiality Approach**

<b>Absolute Space</b> 	The Rural as (Distinctive) Stocks of Resources (human, natural, material, immaterial)
<b>Relative Space</b> 	The Rural as Resource Flows, Mobility Patterns and/or Value Production and Distribution Chains that cross Rural-Urban boundaries
<b>Relational Space</b> 	The Rural as (co-) shaped by other than Spatial Proximity Relations (e.g. Digital, Social, Cultural, Organisational or Cognitive Relations)
<b>Circular Space</b> 	The Rural as part of Spatial-Temporal Resource Dynamics facing Planetary Ecological Boundaries and knowing Leisure-, Life-Cycle- and/or Life-Style-dependent Mobility Patterns
<b>Rural Localities</b> 	The rural as distinctive spatial practices linked to either production or consumption through actions, flows, transfers, and interactions that 'secrete' specific material expressions and societal reproduction mechanisms ('one of the productive permanences of capitalist spatiality')
<b>Formal representations</b> 	Formal framing of the rural within global capitalism and its accompanying commodification and exchange value processes. Formal representations are conceived, abstract and expressed through 'arcane signs, jargon, codifications and in things such as monuments, factors, housing, estates, workplaces, bureaucratic rules, etc.
<b>Lives of the Rural</b> 	Everyday lives of the rural are inevitably incoherent and fractured, with individual and social elements in their cognitive interpretations, reflections 'tumults and passions of space as directly lived' and therefore thought to be more or less supportive to, or conversely, subversive for other spatial facets of the rural.

**Figure 1: Rurality as Functionality Balances & Disbalances**



These analytical building blocks were summarised in the following design principles for Compass elaboration guidance:

- Recognise rural's multi-spatiality and make this the analytical starting point for characterizing contemporary rural differentiation processes by combining different rural boundary orientations with scholarly insights that emphasize the importance of rural's socio-economic, socio-political and socio-cultural dynamics as critical structuring elements and co-shapers of rural spatial architectures;
- Build on this multi-spatial thinking to characterize the place-specific rural functionalities, their interwovenness, (dis-) balances, representations and imaginations as increasingly reflected in emerging multi-layer rural classification approaches;
- Acknowledge the merits of EU's Rural Functional Areas approach (i.e. insights into rural service delivery and accessibility characteristics outside Urban Functional Areas) while recognizing its limitations such as understanding the interdependency of rural functionalities in rural areas;
- Embrace the EU's LTVRA's greater sensitivity to rural's inherent multifunctionality, but also notice that the LTVRA still needs to elaborate further and operationalize its principle action fields and guiding principles for rural policy-making;
- Emphasize that rural resilience - in addition to alternative concepts such as perseverance, adaptability, transformability, innovativeness, etc. - will manifest itself also in the place-specific capacity to (re-) balance and (re-) integrate functionalities to the benefit the rural and society at large;

- Build on emerging wellbeing frameworks as elaborated by the OECD<sup>1</sup> and EU's Social Survey Format<sup>2</sup> and further distinguish 'wellbeing from elsewhere' as a critical wellbeing dimension as it allows to take explicit account of different manifestations of or potential for rural-urban synergy as one of the key challenges for future rural governance and public policy making;
- Understand rural policy proofing, in addition to ongoing ex-ante efforts, as public policy responsiveness to; 1) contemporary rural differentiation tendencies; 2) place specificity of rural-urban synergy prospects and limitations and 3) functional (re-) balancing and (re-) integration efforts that may counteract rural wellbeing deficits and/or foster rural contributions to wellbeing elsewhere and wellbeing later;
- Translate these design lessons into a tool that: 1) allows the incorporation of novel and traditional data-sourcing methods originating from different scales (e.g. grid level, LAUs, NUTS levels); 2) sheds light on contemporary rural differentiation tendencies, drivers and outcomes and 3) may be helpful to orientate future multi-level rural governance and rural policy proofing efforts.

### 3. Prototype Rural Diversity Compass

These design lessons informed the prototype, as visualized in Figure 1. More generally, this prototype may be introduced as follows:

- It aims to shed light on the place-specificity of rural functionalities and their interaction patterns as an analytical point of departure to unravel contemporary rural differentiation tendencies;
- It presents a set of basic components to characterize rural functionalities and their interactions. These components know different disciplinary backgrounds and aim to take changes over time in rural functionality (dis-) balances explicitly into consideration. Thus, changes in time in relation to single functionality characteristics and performances, as well as their interdependencies and mutual interaction patterns. Together such changes over time will reveal the specificity of rural resilience concerns, rural policy challenges and, perhaps, identify potential leverages for rural governance and rural proofing progress;
- The prototype approaches rural policy proofing as a multi-level governance challenge. In addition to rural functional (dis-) balances, it relates rural proofing to social-, spatial- and climate justice as critical assessment criteria. Their interwovenness is emphasized in following scholarly definition of spatial justice: '*spatial justice may be described as the democratic progress of equitably distributing social and environmental benefits and burdens within and between groups, territories and generations*'<sup>3</sup>. It enables to link rural proofing with the responsibility of policymakers to assure a just distribution of resources and life opportunities as well as burdens and benefits of general policy measures. Procedural and distributive elements of different expressions of justice that can't be isolated from the place-specificity of contemporary rural differentiation tendencies, drivers and outcomes;

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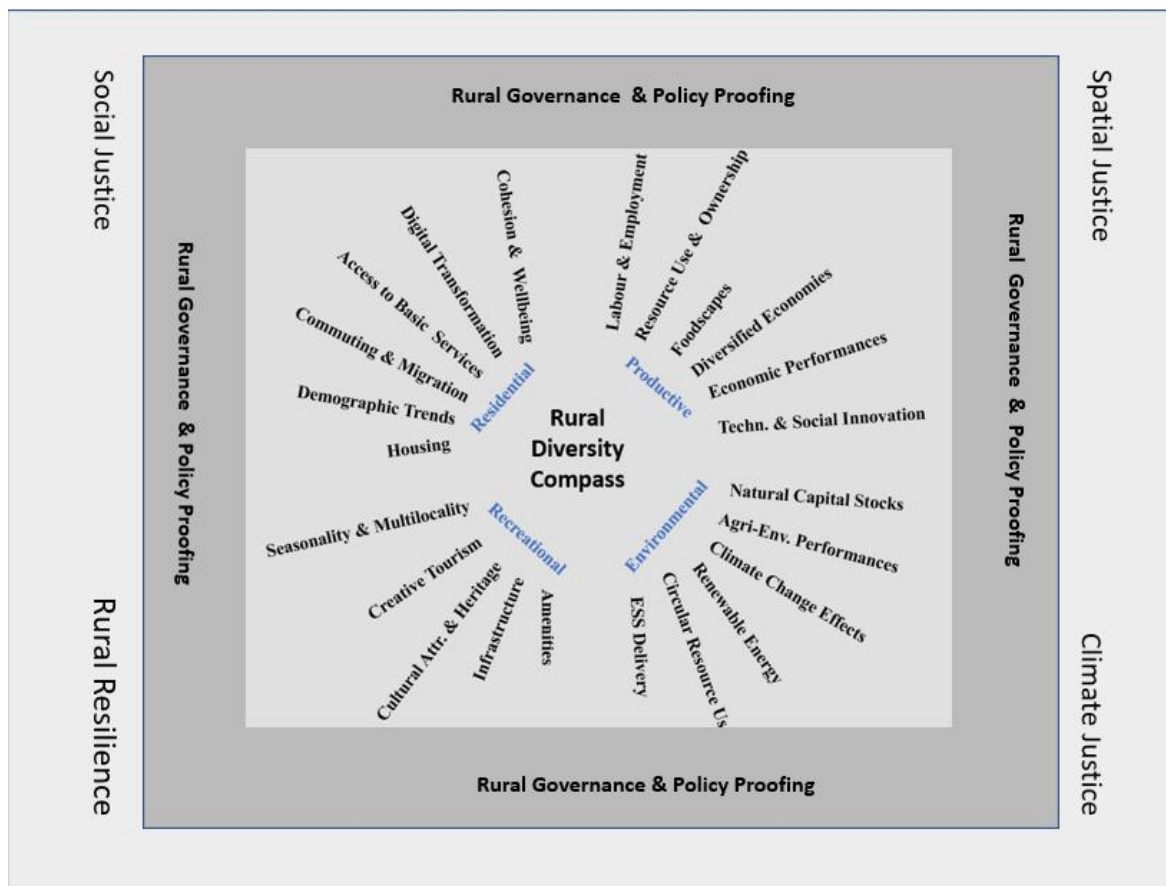
<sup>1</sup> OECD (2020), *Rural Well-being: Geography of Opportunities*, OECD Rural Studies, OECD Publishing, Paris, <https://doi.org/10.1787/d25cef80-en>.

<sup>2</sup> See [Europeansocialsurvey.org](https://europeansocialsurvey.org)

<sup>3</sup> See e.g. Madanipour et al (2022). The concept of spatial justice and the European Union's territorial cohesion, *European Planning Studies*, 30:5,807-824,DOI:10.1080/09654313.2021.1928040. (p. 813).

- It is foreseeable that insights in such place-specificities faces all kinds of data-availability limitations and challenges. For instance, information about rural functionality components and their representations are scale-sensitive. Sometimes, data gaps may reflect a limited significance of components in specific rural settings. Other times, data gaps may resonate lack of representations in terms of recognition, awareness and prioritizing of functionalities.
- Their analytical foundation in multi-spatiality, multi-functionality and multi-disciplinarity makes overall Compass components heterogeneous. Some components know a single functionality output orientation (e.g Housing and Demographic Trends), whereas others reflect functionality integration aspirations (e.g. Social Cohesion & Wellbeing). Hence, it will require complementary GRANULAR reflection on overall Compass components accompanying indicator dashboarding opportunities and limitations.

**Figure 2: Prototype Rural Diversity Compass**



After further introducing the components of the prototype Rural Diversity Compass (from now on Compass), we will return to its theoretical foundation in the concluding section.

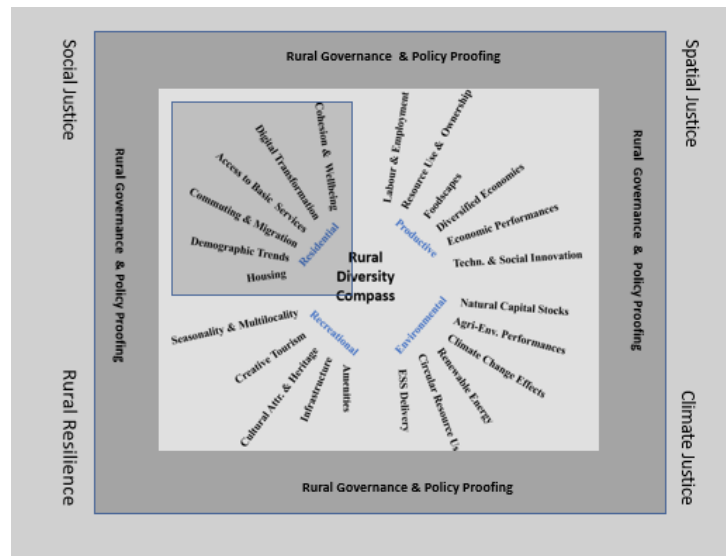
## 4. Characterization of Compass Components

In the following, we detail the four rural functionalities that constitute the backbone of our prototype Rural Diversity Compass (from now on Compass) by characterizing their basic components. For the sake of readability, explicit references to their mutual interwovenness will only be made occasionally. However, it should be noted that the Compass may become an instrument that gives direction primarily through cross-referencing its various components. The single components are briefly introduced, with hyperlinks to relevant literature and reports that provide additional information about issues as to their significance for rural dynamics and ongoing indicator-building efforts from multiple scholarly backgrounds.

### 4.1 Residential Functionality

This first Compass functionality focuses on the rural as residential space. It allows to distinguish a set of components that cover specific features, dynamics, needs and challenges of contemporary rural communities while simultaneously recognizing that these components may be to different degrees of significance to characterize and distinguish rural communities. For instance, Commuting and Migration may be differentiating to characterize rural communities. It is further pertinent to note that the components reflect various rural spatial boundary settings as introduced in D2.1. That is, these comprise a mixture of absolute (e.g. Demographic Trends), relative (e.g. Commuting & Migration) and relational (e.g. Digital Transformation) spatial lenses.

**Figure 3: Compass Quadrant With Residential Functionality Components**



- Housing:** The housing component refers to indicators such as percentage of owner-occupiers, social housing, absolute and relative rural housing prices, and the availability and -affordability of rural dwellings for different income categories. This may be extended with other available Eurostat housing indicators as population percentages living in overcrowded homes, housing cost overburden rate for different income groups, etc. Such rural housing indicators become particularly meaningful when cross-checking with other residential components as Basic Services and Social Cohesion & Wellbeing. In some settings rural housing prices might be a strong proxy for rural wellbeing, including affordability and accessibility of housing as a basic need. In other settings this might be different, for instance, when rising house prices are not just associated with good economic conditions, positive consumer confidence, and thus possibly wellbeing, but also unaffordability for many people in rural areas, and therefore with less positive wellbeing affects as loss of social cohesion.

- **Demographic Trends**: Demographic trends are a well-known and classical differentiation line to characterize rural dynamics and the place-specific outcomes of mega-trends as urbanisation, globalisation, digitalisation, neoliberalism, climate change, etc. The use of this component enables the distinction of areas with a growing and declining population as a proxy for socio-economic concerns, rural vitality issues, or, conversely, urbanisation pressures that may undermine typical rural features. Again, it requires cross-referencing with other Compass components to get a clear picture of the relevance of demographic change in relation to rural resilience and rural policy making. For instance, it is through insights in e.g. Migration & Commuting, Economic Performances, Cohesion & Wellbeing, Seasonality & Multi-Locality, that the Compass informs us about the processes of centralisation and peripheralization.
- **Commuting & Migration**: Commuting and Migration are relevant (co-) drivers of rural re-vitalization or marginalisation tendencies due their place specific impacts on rural communities and rural resource use. Meaningful indicators cover topics such as in- and outmigration distribution across age categories, educational and skill profiles, rural brain drain tendencies, newcomers, returnees, remittances, etc. Topics that entail multiple cross-referencing opportunities, both in terms of synergy prospects and trade-offs, as, for example, underpinned in literature on rural SME dynamics, social innovation and social cohesion. The component concentrates on proximate rural-urban interaction flows and their place-specific outcomes in terms of rural functionality dynamics (e.g. shifting balances between productive and residential functions). It may be covered through rural-urban commuting data-sources at different scales. Its significance, drivers and impact will manifest themselves particularly through cross-referencing with other Compass components such as public services, digital infrastructure, social cohesion and resilience, diversified economies, regional ecosystem profiles, etc.
- **Basic Services**: Basis Services are a component that puts the presence, accessibility and/or affordability of public service delivery in rural areas central stage. Special attention is paid to services as health, education and transport, but also drinkable water, waste and sewage management, communication and governmental services could be mentioned in relation to their accessibility and affordability for vulnerable social groups, for instance, rural elderly or young people depending on public transport facilities. This component may build on ongoing rural public services accessibility mapping exercises, for example as explored by the Joint Research Centre (JRC) and, where possible, to complement and refined with national, regional or local data. It is further important to note that basic services, as for instance defined within the foundational economy literature, may be provided by public as well as private actors. Cross-referencing with other Compass components, may provide insights into the key role of (the loss) of public services in those rural areas that face persistent 'accumulation of wellbeing deficits'. It may also reveal emerging based on novel public-private partnerships, digital services, social enterprises or other expressions of 'commoning' that go beyond exclusively public administration-led basic services delivery.
- **Digital Transformation**: The Digital Transformation component may be associated with all four functionalities as distinguished by the Compass. As access to digital services is increasingly considered as a critical human right and basic utility, we decided to interlink digital transformation to rural's residential functionality in the first place. Relevant indicators may be derived from European Digital Economy and Society Index (DESI). Their significance in relation to e.g. productive and recreational functionalities, will be manifest through cross-referencing with such components. To cover its major relevance for rural's residential's functionality, it is further interesting to build on emerging composite digital accessibility indicators.

French Portrea initiative, for instance, developed an e-administration vulnerability indicator that enables to estimate and compare non-take-up risks of paperless administrative procedures for particular territories. Its various dimensions include the relationship that individuals have with digital technologies and their uses in specific social situations and biographical events that expose certain population sections to new and/or recurring digital demands. Together these dimensions estimate the weight and number of people not using e-administrative rights. Thus, a composite indicator to assess and compare digital transformation processes, as particular expressions of relational spaces, may be certainly also of relevance for rural areas.

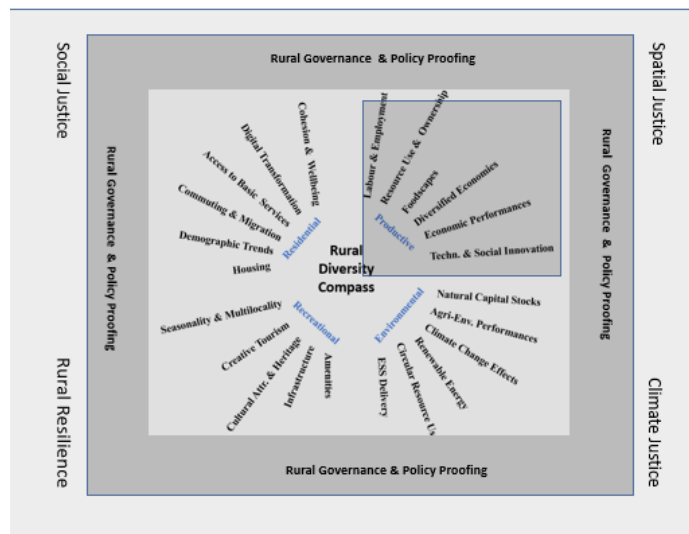
- **Cohesion & Wellbeing:** Cohesion and Wellbeing, as last residential component, joins two popular, but not easy to define or delineate policy notions. EU's social cohesion survey's covers issues as social exclusion, social tension, interpersonal trust, participation in society, sense of community, (un-) safety feelings and voluntary community engagement. The wellbeing notion aims to go beyond the various limitations of GDP doctrines. Emerging wellbeing assessment methods emphasize its multi-dimensionality. The wellbeing 'here and now' dimension encompasses topics as subjective wellbeing, household income, employment, educational level, health, safety, access to nature, housing and public service provision. The 'wellbeing from elsewhere' dimension enables us to take rural-urban synergy prospects explicitly into account, whereas the 'wellbeing later' dimension allows to concentrate at the implications of current behaviour for future generations. Especially in their togetherness these three broader wellbeing dimensions give an impression of the complexity of accompanying data requirements. The Compass makes explicit references to community-based wellbeing as a potential distinctive feature of rural's residential functionality. Its interwovenness with other wellbeing dimensions requires cross-referencing with all other Compass functionalities and their specific components.

## 4.2 Productive Functionality

A second Compass functionality concentrates on the rural as productive space. It addresses its traditional role as food provider, it allows to notice that this role now a days might be of different importance for rural economies and rural foodscapes might differ fundamentally, with respect to production orientations and other topics as rural land ownership, labour and employment characteristics, incorporation in and dependencies on global food chains, etc.

It further allows to recognize the significance of diversifying rural economies and the growing importance, similar to urban dynamics of service sectors in rural economies. Other productivity functionality components focus on rural's overall economic performances and innovation characteristics. Again, it is through their interrelations with other functionalities and their components that these are thought to become meaningful. For instance, potential relevance of non-monetary rural economic activity can't without detailed insights in rural's residential functionality characteristics and dynamics.

**Figure 4: Compass Quadrant with Productive Functionality Components**



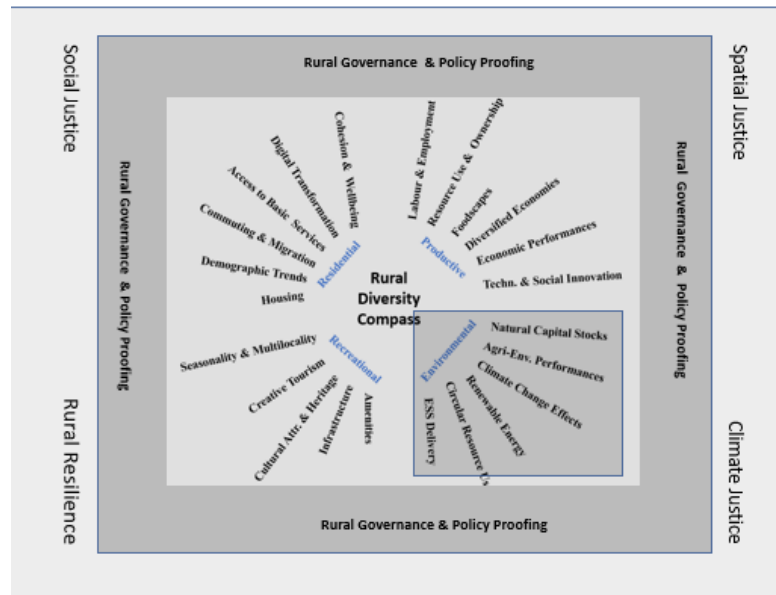
- Labour & Employment:** this component addresses rural employment characteristics, including differentiating topics as seasonality and temporality, lower versus higher skilled jobs, job availability per active person, self-employment rates and dependencies, significance of teleworking, unemployment rates across age-categories, gender and ethnicity aspects, labour migrant dependencies, labour quality aspects, etc. Cross-referencing may reveal, for instance, that especially rural areas dominated by agro-industrial activity or leisure and recreational activity face rural employment and labour conditions concerns. Or, more positively formulated, that cultural attractiveness may induce positive social phenomena as rural newcomers moving for quality of life reasons to rural areas and in that way contributing, directly or indirectly, to the creation of new rural jobs. Member states as the Netherlands, for instance, know more and more so-called 'Future Farmers', newcomers without agricultural backgrounds that initiate small-scale farming activities, often based on direct and close relationships with rural and urban consumers and multifunctional land resource use. Other relevant aspects of this labour & employment component comprise topics as share of population working in own community, role and significance of the informal economy, possible mismatches between rural vacancies and available skills (e.g. rural upskill requirements), the growing significance of remote working and the importance of remittances in rural livelihood strategies. All aspects that may be partly directly covered by this component, but may also reveal themselves especially through cross-referencing with other components such as Commuting and Migration and Social Cohesion and Wellbeing.
- Resource Use & Ownership:** The Resource Use and Ownership component of rural's productive functionality enables to focus on the presence of food and non-food crops, forestry, fishery, biomass and other expressions of productive rural resource use. Hyperlink references point at a broad array of indicators to characterize rural land resources in these terms. Their accuracy may vary across scale, notwithstanding a growing amount of fine-grid analysis opportunities. But even a fine-grained characterisation of rural land resources may give a poor impression of overall rural productive features unless considered in interaction with other, less or non- land-dependent economic activity as explored and characterized through other productive functionality components. Component references to ownership allow to interlink with societal phenomena as more or less concentrated rural land ownership. A concentration of rural land ownership in the hands of view may be especially, although certainly not exclusively, witnessed in eastern, and southern MS, including expressions of land grabbing. Again, insights in their place-specific social-economic and environmental outcomes and implications assumes cross-referencing with other Compass functionalities and components.

- **Foodscales**: The Foodscales component enables to incorporate a broad spectrum of food systemic actors, features and dynamics. Scale and intensity of food production, associated input dependencies (e.g energy, chemicals, fertilizers, fodder from elsewhere, etc.), food chain characteristics (e.g. export dependencies, alternative food networks, role and relevance of food quality labels), food related health problems, consumer behaviour, all are aspects of contemporary differentiating foodscales that may affect the rural and rurality in specific ways. Initiatives as the Food System Index (see hyperlink) start to synthesize to summarize this multi-faceted nature by joining info on food production, -trade, -consumption, -accessibility, -affordability and public health. A foodscape lens may be further 'territorialized' with the help of indicators that address the presence (or absence) of other gainful activities at farm-level. Cross-referencing allows to identify place-specific synergistic effects or, conversely, potential trade-offs of overall foodscape characteristics with other Compass components such as Amenities, Cultural Attractiveness and Heritage, Social Cohesion & Wellbeing and Creative Tourism.
- **Diversified Economies**: The Diversified Economies component takes societal significance of increasingly diversifying rural economies on board. It challenges stereotyping of rural economic activities and builds on scholarly and statistical efforts to cluster and compare rural economic dynamics across various economic sectors as, for instance, elaborated by European ESPON network and applied within EU's Long-Term Vision for Rural Areas. Comprehensive insights in diversifying rural economies may be further related to the production and distribution of added value and rural capacity to valorize endogenous resources. Again, cross-referencing, in this case with special attention for environmental and recreational components, may identify potential synergies and trade-offs with other rural functionalities.
- **Economic performances**: The Economic Performances component assesses and compares the rural in relation to (supra-) national, regional or urban economic performances. As such it can build on prevailing GDP-led data-sourcing, including EU-based comparative analysis of rural economic performances in relation to urban proximity or centrality versus rural peripherality features. The Compass aims to go beyond the limitations of urban proximity versus rural peripherality approaches by taken a much broader spectrum of potential drivers of differentiating rural economic performances into account, including their interwovenness and components with more indirect economic impacts, such as Commuting & Migration and Cultural attractiveness & Heritage, to mention just a few. Moreover, the Compass may extend meaningful cross-referencing to emerging policy topics as low-, no- or post-growth scenarios.
- **Technological & Social Innovation**: The Technological and Social Innovation component enables to focus on rural innovation features. Hence, it involves various topics as business-led, sector-led, chain-led and cross-sectoral innovation. All representing meaningful innovation expressions, all of relevance for EU's smart growth ambitions and all with their particular balances between technological versus social Innovation orientations. Innovation literature associates technological innovation often with triple Helix features (i.e. close collaboration between public-private and research partners), whereas social innovation is often associated with quadruple Helix approaches, characterized by more prominent and explicit roles for direct and active citizen-engagement. It recognizes that rural stakeholder participation, representation and inclusion in innovation networks may differ significantly in terms of cross-sectoral collaboration. Other Compass components may provide proxies for territorial ability to (re-) integrate and (re-) balance functionalities as promising innovation trajectories. Their multi-spatial understanding acknowledges the significance of translocal innovation networks that may interlink peripheral rural areas with distant urban centres and in that way confirm the relevance of cognitive proximity.

### 4.3 Environmental Functionality

The third Compass functionality focusses on the rural in its role of stocks and spaces of natural capital and eco-system services. It highlights that urban futures assume and depend on rural delivery of natural capital assets and provisioning of different types of eco-system services. Other environmental functionality components concentrate on rural land- and resource use features. Together the components allow to characterize rural environmental performances from multiple perspectives, with eye for their interaction with and dependencies on other functionalities and with Climate Change Effects and Circular Resource Use as increasingly key aspects of rural futures.

**Figure 5: Compass Quadrant with Environmental Functionality Components**



- **Natural Capital Stocks:** The Natural Capital stocks environmental functionality component concentrates on the rural as the source of location of stocks of natural capital assets and eco-system services (see also below). It acknowledges and addresses rural diversity in terms of available natural assets and the biophysical flows from those assets. National Capital Indicator Framework (NCIF) provides a large number of relevant indicators based on a holistic assessment. The same NCIF aligns with the asset categories of the System of Environmental Economic Accounting (SEEA), and the Common International Classification of Ecosystem Services (CICES): a method for classifying ecosystem services.
- **Agri-environmental performances:** The agri-environmental performances component is based on indicators as elaborated for the purpose of CAP monitoring and evaluation. Its principle objective is to provide insights to human-nature interactions, to be further specified through cross-referencing with other environmental functionality components such as Circularity and Regional Ecosystem Services. As a whole these components characterize the place specific outcomes, opportunities and limitations of agricultural activity in relation to societal ecosystem service concerns that go beyond food provisioning. In that way cross-referencing may also point at the significance of rural land use choices and rural as well as urban spatial planning strategies (see below).

**Circular Resource Use:** The Circular Resource Use component characterizes natural resource use of rural areas with a spatial-temporal focus. It addresses the need for adaptation of rural resource use for sustainability purposes, having more (e.g. Refuse) or less (e.g. Recycle) far-reaching societal implications. Such R-ladder inspired circularity thinking relates to societal concerns of rurality as

extractive space, landfill space, etc., or, more positively formulated, the rural as localities that may (re-) valorize waste flows of urban origins, contributing in different ways to bio-economies and/or fostering sustainable and healthy life-styles. As such Circularity progress might be associated with agro-ecological (i.e. a focus on social innovation) as well as agro-industrial (i.e. a focus on technological innovation) circular farming pathways and imaginations. Two contrasting trajectories that reflect different R-ladder orientations (see Annex 2B for a visual impression of the R10 framework), priorities, expectations and scale horizons. Agro-ecological circularity perspectives, for instance, prioritize the regional scale, whereas agri-industrial perspectives depart from national or supra-national circularity panoramas. As a component in its infancy, and therefore lacking broadly available and accepted sets of progress indicators, we propose to concentrate on inventorizing which indicators are being explored that may be relevant for rural circularity characteristics, performances, prospects or barriers. One of the key challenges concerns the notion of cascading: resource use efficiency based on consecutive resource circulation that contributes to improved efficiency over the entire material life-cycle.

- **Climate Change Effects:** The Climate Change component encompasses well-known rural indicator topics such as greenhouse gas emissions, drought- and flood risks and carbon sequestration performances. It may build on emerging Climate Change Dashboards with a broad array of indicators. At an EU-level the Copernicus Database may provide a good starting point to be complemented with place-specific climate risks and vulnerability analysis, climate change mitigation and adaptation progress by different expressions of carbon sequestration or other adaptations that may contribute to net zero-emissions in relation to soil, water and air. It may be desirable to sub-categorize this component in Climate Change Effects and Climate Change Adaptation and Mitigation. The first concentrating on pressures and hazards the second and third on possible mitigation and adaptation orientations and strategies. The latter two may be explored and characterized in multiple ways, including cross-referencing with other functionalities and components as Resource Use & Ownership, Foodscapes, Diversified Economies, Social Cohesion & Well-being and Circularity; this may shed light on differentiating mitigation and adaptation orientations, opportunities, capacities and barriers. It relates to the need for trend analysis that allows us to connect climate adaptation and mitigation progress in time with specific rural implications, both in terms of threats and opportunities.
- **Renewable Energy:** Renewable Energy is a more clearly delineated environmental functionality component which concentrates on rural contributions to progressing towards fossil fuel dependencies through, for example, solar-, wind-, thermal, hydro- or other renewable energy sources. As proxies for sustainable natural resource management, this component might be also perceived from a productive functionality lens. The particular nature, frequency, scale, as well as organisational aspects of renewable energy sourcing (e.g. public-, private- or community-led) provide multiple entrances for meaningful indicator development. Cross-referencing with other components as Foodscapes, Social Cohesion & Wellbeing, and Rural Amenities allows to identify their wider rural social-economic and social-cultural impacts.
- **Eco-system services (ES) Delivery :** The Eco-system services profile component concentrates on rural delivery of ecosystem services. The distribution of ES may have different spatial characteristics. ES scholars make a distinction between service providing areas (SPA) and service benefiting areas (SBA) with following categories: '*in situ*' (SPA and SBE are identical, '*omni directional*' (SBA extends SPA without directional bias), '*slope dependent*' (SPA lies downslope due to gravitational processes as for instance present in water systems) and '*directional*' (SBA are located behind SPA without slope dependencies)<sup>4</sup>. Insights to such spatialities of ES address numerous data-sourcing topics.

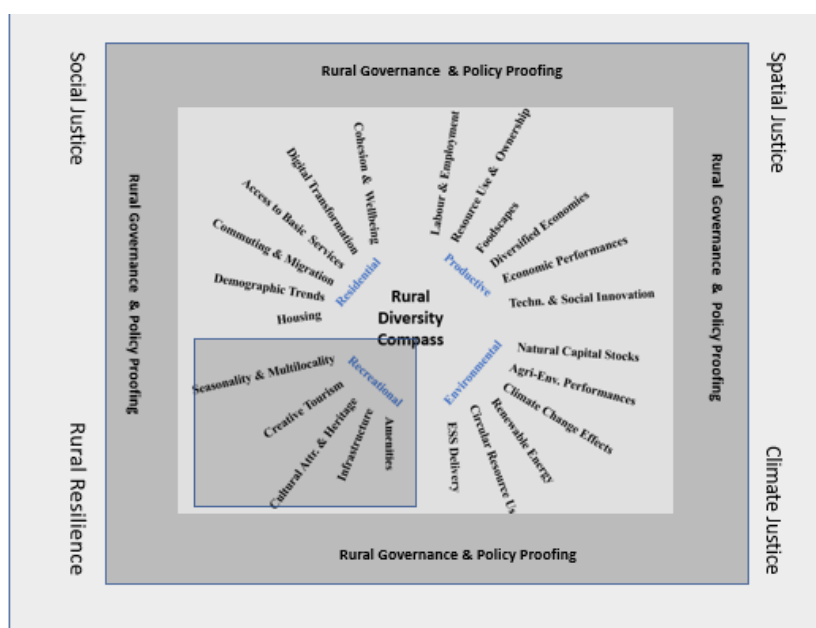
<sup>4</sup> See e.g. Antognelli, S.; Vizzari, M.; Schulp, C.J.E. Integrating Ecosystem and Urban Services in Policy-Making at the Local Scale: The SOFA Framework. *Sustainability* 2018, 10, 1017. <https://doi.org/10.3390/su10041017>

For example, these relate to scholarly debate on the pros and cons of differentiating ESS delivery profiles and strategies as part of rural and urban spatial planning choices and policy debate around the pros and cons of integrated versus segregated, multifunctional versus monofunctional and landsparing versus land sharing strategies. Such choices will impact on wider regional rural-urban interdependencies. Agro-industrial pathways based on function segregation and landsparing preferences, for instance, often go along with a loss of rural ability to provide other, sometimes characterized as ‘non-importable’ ESS as landscape values. Similarly, also urban spatial planning may affect regional ESS profiles. Urban planners, for instance, might seek to internalize ESS as part of their Green Cities and Climate Change adaptation ambitions. Or, conversely, opt for spatial planning that externalizes ESS to rural areas as part of sustainability ideas that start from Compact Cities concepts and associated societal benefits. In sum, rural-urban spatial planning choices, especially in peri-urban areas, might have major impacts on rural’s environmental functionality. High resolution data analysis of both rural and urban land use dynamics, also through cross-referencing with other Compass functionalities, will enable the identification of place-specific contributions to rural wellbeing, rural distinctiveness or, conversely, rural fragmentation or rural marginalization. Emerging insights in ES preferences of urban and rural dwellers are also of significance for this Compass component. Note further that ES categories as ‘*provisioning services*’ (with productive functionality) and ‘*cultural services*’ (with recreational functionality) are by definition multifunctional ES categories and therefore intrinsically related to other Compass functionalities.

#### 4.4 Recreational Functionality

This fourth Compass functionality explores leisure and recreation related as a specific field of rural spatial activity and representation. Its inclusion as a separate functionality enables to address the relevance of rural’s socio-cultural features and dynamics in various ways. In their togetherness these features and dynamics aim to shed light on rural’s the social-cultural component of rural resilience in relation to megatrends as globalization and digitalization, as both may undermine as well as strengthen the reproduction, transformation and valorisation of rurality and rural distinctiveness.

**Figure 6: Quadrant With Recreational Functionality Components**



- **Amenities:** Compass attention to rural recreational functionality acknowledges the relevance of place-specific rural amenities. The OECD distinguishes between the following types of rural amenities: i) almost intact nature, ii) human-nature interaction, and iii) man-made. It uses the following amenity classification: i) native forest, high mountains, desert wilderness; ii) farming landscapes, traditional ways of fishing, forest management for game and hiking; iii) historical monuments or artefacts, traditional crafts, village festivals, etc. Together, such indicator elaboration offers opportunities that may overlap with other recreational functionality components as introduced below. However, we propose to include rural amenities as a distinctive component of the Compass as it enables to characterize rural's recreational functionality in relation to other functionalities. Sometimes, such interrelations might be dominated by the natural or environmental functionality of rural areas. In other settings, productive and residential functions might be key conditions for leisure and recreational activity, as may be substantiated through cross-referencing with other Compass components.
- **Infrastructure:** The Infrastructures component concentrates on the specificity, density and quality of rural recreational and tourism infrastructure. It encompasses indicators for rural leisure and recreational activity such as walking, swimming, cycling, boating, sailing and fishing, as well as different types of overnight facilities (campsites, hotel beds, B&Bs, etc.). Insights to such infrastructural features give an indication of the socio-economic significance of rural tourism and leisure, as well as their accompanying rural-urban flows in terms of distance, proximity, cultural backgrounds, age categories, lifestyle preferences, etc. Meaningful socio-economic cross-referencing may be related to other functional components such as Basic Service delivery, Diversified Economies and Social Cohesion & Wellbeing. Cross-referencing with components such as Circularity, Renewable Energy and Natural Capital Stocks, could make a start with assessing associated environmental impacts. Given rather limited EU-level data availability, this Compass component seems to depend strongly on data sourcing at lower scales.
- **Cultural Attractiveness & Heritage:** The Cultural Attractiveness and Heritage component follows a regional cultural capital assets approach. It includes regional (e.g. architectural-, military-, industrial) expressions of cultural heritage that may attract tourism and leisure seekers to rural areas. This field points to the key role of wider regional cultural attractiveness and the significance of rural-urban synergy manifestations by means of globalizing tourism and leisure flows, e.g. reflected by popular Italian, French or Spanish tourist destinations. It deepens our insights into the backgrounds and drivers of co-evolving rural functionalities, as the role of cultural attractiveness goes beyond rural's recreational and leisure function and may manifest itself also through other Compass components as Social Cohesion and Wellbeing, Commuting and Migration and Diversified Economies. All may be considered as proxies for cultural attractiveness, although perhaps still without widely shared and accepted sets of indicators.
- **Creative Tourism:** The Creative Tourism component concentrates on the growing significance of the creative sector and its relationship to rural's recreational functionality. Rural creative tourism scholars underline that contemporary tourists show a growing desire to connect with the communities they visit. Unlike traditional cultural tourism, creative tourism provides visitors with learning experiences through immersion in rural communities. In that way creative tourism would fundamentally differ from, for example, previous Cultural Attractiveness & Heritage component. While the latter is primarily about built heritage, museums, monuments, landscapes, etc., creative tourism concentrates more on image, lifestyles, atmosphere, narratives, and media as other key aspects of territorial branding strategies. As argued, It provides alternative opportunities to create economic advantages, foster innovation and differentiate from other, at first sight, similar tourist destinations.

A focus on active value creation makes creative tourists co-producers of experiences that may be personalized in different terms such as cultural capital, knowledge, skills, emotions, tastes, etc. Rural environments may know local artisans and craftsmen that produce traditional items whose utility might have been increasingly lost from urban activities or replaced by industrial production items; they may offer tourists hands-on cultural experiences as active participants in the host community's cultures. Such a focus on cultural (proximity) relations us sheds further light on increasingly fluid rural-urban relations. Their exploration requires quantitative and qualitative data-sourcing, to be facilitated by cross-referencing with other recreational components and other rural functionality components (e.g. Foodscapes, Diversifying Economies, Eco-system Services delivery, etc.).

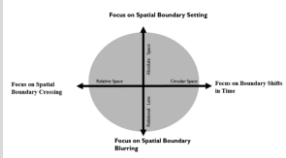
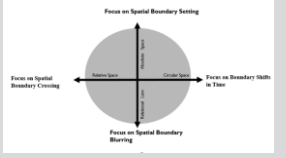
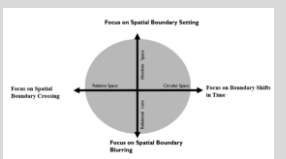
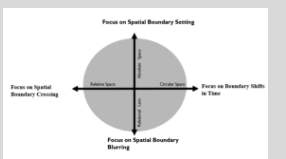
- **Seasonality & Multi-locality**: The Seasonality and Multi-locality component introduces a spatial temporal lens on rural leisure and tourism activities. It addresses topics as the place-specific impacts of seasonal fluctuations in rural leisure and tourism flows, the concentration of second homes in rural settings and the expansion of multi-locality lifestyles. As proxies for increasingly fluid spatial-temporal rural-urban relations, their place-specific impacts assume insights into their interaction with other rural functionalities. In rural settings with distinctive and typical food cultures, for instance, the temporality of recreational and leisure flows might support foodscapes that remain positively interwoven with wider ESS delivery and the preservation of typical rural amenities. Yet, same societal phenomena might also create problems in relation to rural service delivery, rural labour certainty and quality aspects and overall rural social cohesion and well-being performances due to tensions between (more) permanent and (more) temporal rural dwellers. Especially through combining relative (i.e. rural-urban flows) and relational (i.e. cultural proximity) understandings of contemporary rural, this component enables to deepen insights into the varying impacts of rural's recreational functions and their interaction with other functionalities. Note further that multi-locality may express itself also in residential patterns through seasonal employment and growing opportunities for working from home or life-style choices. It makes multi-locality indeed a rural phenomenon that may affect different functionalities.

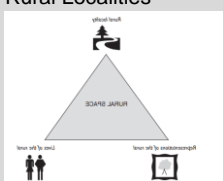
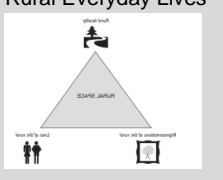
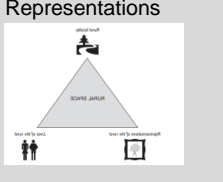
## 5. Conclusions

We will finish this report by returning to GRANULAR's multi-spatial understanding of contemporary rural dynamics. The overall set of components comprises multiple boundary orientations, which are tentatively summarized in Table 2, as components might sometimes be approached from different spatial lenses. Rural foodscapes, for instance, may be looked upon from absolute (e.g. land use characteristics), relative (e.g. food chain dynamics), relational (e.g. food cultures) and circular (e.g. temporal natural resource use characteristics) orientations.

Conversely, other components by definition assume a bounded (absolute) spatial approach, such as natural capital stocks, demographic trends, etc. Others primarily represent non-spatial relational rural lenses, such as Digital Infrastructure (i.e. virtual proximity), Cultural Attractiveness & Heritage, Tourism and Creative Sector (i.e. Cultural Proximity) and Technological and Social Innovation (i.e. Cognitive proximity)

**Table 2: Compass components as part of GRANULAR's multi-spatial theorizing**

	Spatial Lens	Analytical Focal Points	Representation in the prototype Rural Diversity Compass
Spatial Boundary orientations	<b>Absolute Space</b> 	The Rural as (Distinctive) Stocks of Resources (human, natural, material, immaterial)	<ul style="list-style-type: none"> <li>• Housing</li> <li>• Demography</li> <li>• Social Cohesion &amp; Wellbeing (its 'here and now' dimension)</li> <li>• Resource <u>Use</u></li> <li>• Labour &amp; Employment</li> <li>• Economic Performances (e.g. in terms of GDP and added value production)</li> <li>• Natural Capital Stocks</li> <li>• Recreational Infrastructure</li> <li>• Amenities</li> </ul>
	<b>Relative Space</b> 	The Rural as Resource Flows, Mobility Patterns and/or Value Production and Distribution Chains that cross Rural-Urban boundaries	<ul style="list-style-type: none"> <li>• Migration &amp; Commuting</li> <li>• Eco-System Service Delivery</li> <li>• Access to Basic Services</li> <li>• Resource <u>Ownership</u></li> <li>• Economic Performances (e.g. central-periphery aspects)</li> <li>• Cultural Attractiveness &amp; Heritage</li> <li>• Foodscapes (e.g. chain dependencies)</li> </ul>
	<b>Relational Space</b> 	The Rural as (co-) shaped by other than Spatial Proximity Relations (e.g. Digital, Social, Cultural, Organisational or Cognitive Relations)	<ul style="list-style-type: none"> <li>• Digital Transformation</li> <li>• Social &amp; Technological Innovation</li> <li>• Cultural Attractiveness &amp; Heritage</li> <li>• Diversifying Economies</li> </ul>
	<b>Circular Space</b> 	The Rural as part of Spatial-Temporal Resource Use Dynamics facing Planetary Ecological Boundaries and knowing Leisure-, Life-Cycle- and/or Life-Style-dependent Mobility Patterns	<ul style="list-style-type: none"> <li>• Circularity</li> <li>• Renewable Energy</li> <li>• Seasonality &amp; Multi-locality</li> <li>• Agri-environmental performances</li> </ul>

Structuring elements	<b>Rural Localities</b> 	The rural as distinctive spatial practices linked to either production or consumption within global capitalism and its accompanying commodification and exchange value processes	<ul style="list-style-type: none"> <li>Analytical focus on rural's <u>productive</u> functionality components, with eye for its interwovenness with other functionalities</li> </ul>
	<b>Rural Everyday Lives</b> 	Every days lives of the rural, inevitable incoherent and fractures, with individual and social elements in their cognitive interpretation and -in theory- a certain transformative capacity	<ul style="list-style-type: none"> <li>Analytical focus on rural <u>residential</u> functionality, with eye for its interwovenness with other functionalities.</li> </ul>
	<b>Formal Rural Representations</b> 	Formal framing of the rural, being synergistic or, conversely, contradictory with foregoing other structuring elements of rural spatial architectures	<ul style="list-style-type: none"> <li>Analytical focus on formal representation of rurality in terms of social-, spatial- and climate justice and rural resilience.</li> </ul>

Additionally to its various and complementary boundary setting orientations, the Compass further incorporates insights from Halfacree's 'totality of rural space triangle' (see D2.1). Latter's eye for the material aspects of rural spatial production is especially represented by its set of productive functionality components, as a socio-economic overview of place-specific responses to globalization forces and other macro-level phenomena as urban hierarchies, centrum-periphery dynamics, economic restructuring and social recomposition tendencies.

The structuring influences of 'everyday rural lives', as second structuring element of the (re-) production and transformation of rural space, appears primarily in the residential functionality. Directly through components such as Social Cohesion & Community Wellbeing that allow to incorporate topics such as social inclusiveness and rural wellbeing performances, perceptions and problems. Indirectly, through other components such as In- and Outmigration, Commuting, and Basic Service Delivery profiles. Hence, all may be perceived as proxy-indicators for rural life styles' (lack of) distinctiveness and (in-) attractiveness. Potential transformative capacity of 'every day rural lives' may be identified through cross-referencing with components such as Social & Technological Innovation, Climate Change Effects and Eco-system Services delivery profiles. The first enables to associate transformative capacity with the presence (or absence) of cross-sectoral and place-based cooperation and collaboration and specific innovation trajectories. The other two with sustainable resource use progress as another critical indication for rural's transformative capacity

Finally, the Compass allows to take the significance of formal spatial representations, such as Halfacree's third key structuring element of rural spatial architectures, explicitly on board. It does so by recognizing that concepts such as social justice, spatial justice, and climate justice might have formal representations that align differently and, consequently, vary in their support for the other two distinct structuring elements of rural spatial architectures. The same goes for rural resilience. Also this notion may know internal conflicts between the three structuring elements. For instance, current farmers upheaval in various parts of Europe points and discrepancies between its formal representation by policy makers and every day rural life experiences of concerned farmers.

Overall this theoretical foundation in multi-spatiality and multifunctionality will have to prove its potential to guide and ‘enlighten’ through further tests, checks and validation. Key questions as whether, where and when the Compass indeed becomes a helpful tool need to be further explored and scrutinized. As always, the proof of the pudding will be in its eating.

These further checks and tests are part of GRANULAR’s wider objectives and aspirations. In relation to concrete WPs objectives, these may be summarized as follows:

- WP3: Orientation for rural data-sourcing, data-mining and data-gap identification to improve and deepen available insights in rural dynamics;
- WP4: Incorporation opportunities into EU-level rural classification schemes;
- WP5: Application and translation into a rural proofing dashboard, rural proofing methodologies and multi-level rural governance recommendations;
- WP6: Facilitation, substantiation and learning tool for Living Labs and Replication Labs in relation to their specific stakeholder concerns, agendas, support needs and rural spatial architectures.
- WP7: Dissemination, sharing and discussion as analytical and learning tool for better understandings of contemporary rural diversity tendencies, drivers and outcomes.

## Annex 1: Background information on Compass Components

### Housing

- The State of Housing in Europe in 2021:  
[https://www.stateofhousing.eu/The\\_State\\_of\\_Housing\\_in\\_the\\_EU\\_2021.pdf](https://www.stateofhousing.eu/The_State_of_Housing_in_the_EU_2021.pdf)
- Eurostat Housing Price Statistics: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Housing\\_price\\_statistics\\_-\\_house\\_price\\_index](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Housing_price_statistics_-_house_price_index)
- Development of Smart Rural Village Indicators in Line With Industry 4.0  
<https://ieeexplore.ieee.org/document/9169887>
- Multi-locality as underestimated rural phenomenon:  
<https://www.tandfonline.com/doi/full/10.1080/21681376.2021.2025417>
- Multi-local living in the Global North and the Global South:  
[https://www.researchgate.net/profile/Cedric-Duchene-Lacroix/publication/301636594\\_Multilocal\\_living\\_in\\_the\\_Global\\_South\\_and\\_the\\_Global\\_North\\_Differences\\_Convergences\\_and\\_Universality\\_of\\_an\\_Underestimated\\_Phenomenon/links/571f3d480aefa648899b1e6/Multilocal-living-in-the-Global-South-and-the-Global-North-Differences-Convergences-and-Universality-of-an-Underestimated-Phenomenon.pdf](https://www.researchgate.net/profile/Cedric-Duchene-Lacroix/publication/301636594_Multilocal_living_in_the_Global_South_and_the_Global_North_Differences_Convergences_and_Universality_of_an_Underestimated_Phenomenon/links/571f3d480aefa648899b1e6/Multilocal-living-in-the-Global-South-and-the-Global-North-Differences-Convergences-and-Universality-of-an-Underestimated-Phenomenon.pdf)
- The life-style of the new generation as an indicator of a multi-local every life:  
<https://www.tandfonline.com/doi/full/10.1080/23800127.2017.1322778>
- The logic of multi-local living arrangements:  
<https://onlinelibrary.wiley.com/doi/full/10.1111/tesg.12159>
- New forms of multi-local working in the Helsinki Region:  
<https://www.tandfonline.com/doi/full/10.1080/09654313.2018.1504896>
- Far away and yet so close: urban–rural linkages in the context of multilocal work arrangements  
<https://www.tandfonline.com/doi/full/10.1080/21681376.2022.2042370>
- Multi-locality Arrangements in German Statistics:  
<https://onlinelibrary.wiley.com/doi/full/10.1111/tesg.12160>

### Demographic Trends

- EUROSTAT regional demographic data:  
<https://ec.europa.eu/eurostat/web/rural-development/data>
- Insights from demography: a long-term vision for rural areas:  
[https://population-europe.eu/files/documents/pb27\\_development\\_of\\_rural\\_areas\\_web\\_0.pdf](https://population-europe.eu/files/documents/pb27_development_of_rural_areas_web_0.pdf)
- What depopulation means for Europe:  
<https://www.europeangeneration.eu/single-post/what-depopulation-means-for-europe>
- ESPON report on shrinking rural regions:  
<https://www.espon.eu/sites/default/files/attachments/ESPON%20Policy%20Brief%20on%20Shrinking%20Rural%20Regions.pdf>
- UN- Population Indicators:  
[https://www.un.org/en/development/desa/population/publications/pdf/policy/WPP2013/Chapters/f\\_Definitions%20of%20Population%20Indicators.pdf](https://www.un.org/en/development/desa/population/publications/pdf/policy/WPP2013/Chapters/f_Definitions%20of%20Population%20Indicators.pdf)
- Rethinking the OECD's New Rural Demography:  
<https://www.ncl.ac.uk/media/wwwnclacuk/centreforruraleconomy/files/discussion-paper-26.pdf>
- Policies for depopulation and service delivery in rural regions: <https://www.oecd.org/regional/rural-development/rural-service-delivery.htm>
- IMPACT OF DEMOCRATIC CHANGE IN EUROPE:  
<https://rural-interfaces.eu/news-or-events/impact-of-demographic-change-in-europe/>

- MANAGING POPULATION DECLINE IN EUROPE'S URBAN AND RURAL AREAS:  
<https://www.neimed.nl/nl/managing-population-decline-europes-urban-and-rural-areas>
- The Impacts of Population Change on Rural Society and Economy:  
<https://www.routledgehandbooks.com/doi/10.4324/9781315753041.ch7>
- Research on rural ageing: Where have we got to and where are we going in Europe?:  
<https://www.sciencedirect.com/science/article/pii/S0743016712000101>
- European Rural Demographic Strategies: Foreshadowing Post-Lisbon Rural Development Policy?  
<https://www.mdpi.com/2673-4060/3/4/53>
- An alternative policy approach to rural development in regions facing population decline:  
<https://www.tandfonline.com/doi/full/10.1080/09654313.2017.1361596>

## Commuting & Migration

- Main place of work and commuting time – statistics: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Main\\_place\\_of\\_work\\_and\\_commuting\\_time\\_-\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Main_place_of_work_and_commuting_time_-_statistics)
- Trends in commuting time of European workers: A cross-country analysis  
<https://www.sciencedirect.com/science/article/pii/S0967070X21003693>
- Rural commuting: Its relevance to rural and urban labour markets  
<https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=d71f920dcc8768a021ffbea0e2de9495340eca35>
- Commuting and the Rural-Urban Hierarchy: <https://www.sciencedirect.com/science/article/pii/S074301679190009H>
- Commuting and Wellbeing: A critical overview of the Literature:  
<https://www.tandfonline.com/doi/full/10.1080/01441647.2019.1649317>
- When and How does Commuting to Cities influence rural employment growth?  
[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3031041](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3031041)
- The effects of commuting on individuals and communities: A brief overview of the literature:  
<https://www.umdsmartgrowth.org/wp-content/uploads/2022/02/Lit-Review-For-Website.pdf>
- The Migration-Commuting Nexus in Rural England. A Longitudinal Analysis:  
<https://www.sciencedirect.com/science/article/pii/S0743016715300048>
- Workplace choice, commuting costs, and wage taxation in urban and adjacent rural regions:  
<https://link.springer.com/article/10.1007/s00168-020-01003-4>
- “We’re in this all together”: community impacts of long-distance labour commuting:  
<https://www.tandfonline.com/doi/full/10.1080/10371656.2015.1060717>
- Economic linkages between urban and rural regions – what’s in it for the rural?:  
<https://www.tandfonline.com/doi/full/10.1080/00343404.2017.1339868>
- Commuting and self-employment in Western Europe:  
<https://www.sciencedirect.com/science/article/pii/S0966692320303823>
- Women and migration in rural Europe, labour markets, representations and policies:  
<https://books.google.nl/books?hl=en&lr=&id=s7LtCwAAQBAJ&oi=fnd&pg=PP1&dq=rural+commuting+in+Europe&ots=E1XCYgVTJq&sig=H9I6ML1BQ6bWUIH4zTluFdduTyk#v=onepage&q=rural%20commuting%20in%20Europe&f=false>
- EU report Migration in Rural Areas:  
[https://ec.europa.eu/migrant-integration/library-document/migration-eu-rural-areas\\_en](https://ec.europa.eu/migrant-integration/library-document/migration-eu-rural-areas_en)
- UN Report on Global Migration Indicators:  
<https://publications.iom.int/books/global-migration-indicators-2021>
- Roles of Local and Newcomer Entrepreneurs in Rural Development: A Comparative Meta-analytic Study  
<https://www.tandfonline.com/doi/full/10.1080/00343401003792500>
- Selective belonging: how rural newcomer families with children become stayers  
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## Annex 2: Additional Information on Compass Components

### A. Ecosystem service categories and indicators

Service	Indicator	Service	Indicator
<b>Provisioning</b>		13. Soil formation and regeneration	e.g. bio-turbation
Food	Annual production (kg/ha)	14. Pollination	Number & impact of pollination species
Water	Total amount (m <sup>3</sup> /ha)	15. Biological regulation	Number & impact of pest-control species
Fiber & Fuel & other raw materials	Total biomass (kg/ha)	<b>Habitat or supporting</b>	
Genetic materials	Total gene bank value (e.g. number of species)	16. Nursery habitat	Number of transient species & individuals
Biochemical products and medicinal resources	Total amount of useful substances that can be extracted (kg/ha)	17. Genepool protection	Natural biodiversity, habitat integrity
Ornamental species and/or resources	Total Biomass (kg/ha)	<b>Cultural &amp; Amenity</b>	
<b>Regulating</b>		18. Aesthetic appreciation of natural scenery	Number/area of landscape features with stated appreciation
Air quality regulation	Leaf area index, NOx-fixation, etc.	19. Recreational opportunities	Number/area of landscape & wildlife features with stated recreational value
Climate regulation	Greenhouse gas balance (C-sequestration)	20. Inspiration for culture, art and design	Number/area of landscape features or species with inspirational value
Natural hazard mitigation	Water-storage (buffer) capacity in m <sup>3</sup>	21. Spiritual & religious inspiration	Presence of landscape features or species with spiritual value
Water regulation	Water retention capacity in soils or at surface	22. Education & science opportunities	Presence of features with special educational and scientific value/interest
Waste treatment	Denitrification (kg N/ha/yr), immobilization in plants and soil		
Erosion protection	Vegetation cover root-matrix		

## B. Circular Economy Value Retention Model

