

D5.1 Polirural Model (ed.1)

| | |
|-----------------------------|--|
| Project Acronym: | PoliRural |
| Project title: | Future Oriented Collaborative Policy Development for Rural Areas and People |
| Grant Agreement No. | 818496 |
| Website: | www.polirural.eu |
| Contact: | info@polirural.eu |
| Version: | 1.3 |
| Date: | 7 April 2021 |
| Responsible Partner: | 22SISTEMA |
| Contributing | CKA, KAJO, 21C, VITO, SMART & LEAN, VIDZEME PLANNING REGION |
| Reviewers: | Version 0.1: Virpi Oksman - JIIP Maria Eugenia García de Garayo – TRAGSA Version 1.0: Virpi Oksman – JIIP Maria Eugenia García de Garayo – TRAGSA |
| Dissemination Level: | Public |
| | Confidential - only consortium members and European Commission |
| Keywords: | System dynamics, model, modules, drivers |

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 818496

Revision History

| Revision | Date | Author | Organization | Description |
|----------|------------|--|---------------------------|--|
| 0.1 | 25/11/2019 | Maria Eugenia García de Garayo | TRAGSA | Change in an image |
| 0.2 | 25/11/2019 | Pavel Kogut | 21C | Minor changes in the text (grammar and content) |
| 0.3 | 25/11/2019 | Tuula Löytty | Smart & Lean | New image 19 |
| 0.4 | 25/09/2020 | Ruth McAreavey Susanne Von Muenchhausen | REA – European Commission | General review and comments |
| 1.0 | 23/02/2021 | Antoni Oliva | 22SISTEMA | Major review after comments from REA |
| 1.1 | 01/03/2021 | Virpi Oksman | JIIP | Minor changes in the text clarifying content |
| 1.2 | 02/03/2021 | Maria Eugenia García de Garayo | TRAGSA | Minor changes in the text clarifying content |
| 1.3 | 07/04/2021 | Antoni Oilva | 22SISTEMA | Document updated as per the internal reviewers' comments |

Responsibility for the information and views set out in this publication lies entirely with the authors.

Every effort has been made to ensure that all statements and information contained herein are accurate, however the PoliRural Project Partners accept no liability for any error or omission.

Table of Contents

| | |
|---|-----------|
| List of Tables..... | 4 |
| List of Figures..... | 4 |
| Executive Summary..... | 5 |
| 1 Introduction | 7 |
| 2 Model Building Process..... | 8 |
| 2.1 Literature review..... | 8 |
| 2.1.1 Findings from D1.1..... | 8 |
| 2.1.2 SD Literature Research | 8 |
| 2.1.3 Flander’s Bibliography | 10 |
| 2.2 Identification of the main dynamics and system borders | 11 |
| 2.3 Design of a provisional structure of sub-systems | 13 |
| 3 Description of Polirural Model 1..... | 16 |
| 3.1 Main Dynamics..... | 16 |
| 3.2 Structure..... | 18 |
| 3.3 Description of modules..... | 19 |
| 3.3.1 POPULATION..... | 19 |
| 3.3.2 EMPLOYMENT..... | 19 |
| 3.3.3 AGRICULTURE | 21 |
| 3.3.4 EDUCATION..... | 22 |
| 3.3.5 NATURAL CAPITAL | 23 |
| 3.3.6 QUALITY OF LIFE | 24 |
| 4 Conclusion | 26 |
| Annex 1 POLIRURAL MODEL VERSION 1 | 28 |
| Annex 2 INPUTS FROM TEXT MINING FOR MODELLING..... | 32 |
| Annex 3 – Responses to the monitors’ comments..... | 41 |

List of Tables

| | |
|---|----|
| Table 1 Text Mining tasks and information levels..... | 13 |
|---|----|

List of Figures

| | |
|---|----|
| Figure 1 Causal loop diagram of 'Self-help capacity' and 'Capacity to take initiatives' in Kopainsky and Rieder (2004)..... | 9 |
| Figure 2 'Capacity to take initiatives' in stock and flows diagram, by Kopainsky and Rieder (2004) | 9 |
| Figure 3 Influence diagram for the rural population and emigration in Fars Province (Mohammadhashem, 2014)..... | 10 |
| Figure 4 Causal Loop Diagram (CLD) of dynamics involving population | 11 |
| Figure 5 CLD of Social Capital dynamics | 12 |
| Figure 6 CLD of Natural Capital dynamics | 12 |
| Figure 7 CLD of Knowledge dynamics | 13 |
| Figure 8 Provisional Sub-system's Structure | 14 |
| Figure 9 Population Dynamics Scheme | 16 |
| Figure 10 Stocks and flows relating Social Innovation | 17 |
| Figure 11 Natural Capital as a stock | 17 |
| Figure 12 Workforce specialization as an indicator of Knowledge | 18 |
| Figure 13 Modules structure | 18 |
| Figure 14 Urban Population Aging Chain | 19 |
| Figure 15 Structure of employment gap | 20 |
| Figure 16 Labour supply disarrangement scheme | 20 |
| Figure 17 Intensive Farming Ratio relating land and jobs in agriculture | 21 |
| Figure 18 AKIS, Eco-Schemes and Farm to Fork effects on services and industry jobs | 22 |
| Figure 19 Stocks and relations defining workforce specialization | 22 |
| Figure 20 Workforce Specialization and AKIS success | 23 |
| Figure 21 Natural Capital main structure | 23 |
| Figure 22 Accessibility structure around mobility infrastructures stock | 24 |
| Figure 23 Local entrepreneurship | 25 |
| Figure 24 Ideas to evolve in 'migration net ratio' variables (Tuula Löytty) | 27 |
| Figure 25 POPULATION module | 28 |
| Figure 26 EMPLOYMENT module | 28 |
| Figure 27 AGRICULTURE module..... | 29 |
| Figure 28 EDUCATION module | 30 |
| Figure 29 NATURAL CAPITAL module..... | 30 |
| Figure 30 QUALITY OF LIFE module | 31 |

Executive Summary

The Deliverable 5.1 is the first version of the System Dynamics Model (SDM). As it is written in the Work Package description SDM will combine *“quantitative and qualitative techniques to explore the future directory, interdependencies and impact of different policies, endogenous and exogenous factors for the 12 participating study areas until 2040. This will be done collaboratively and iteratively, with foresight and system dynamics practitioners working side by side with regional stakeholders over a period of time to explore, model and validate regional futures”*.

According to the description above, the first version of the SDM initiates the way by proposing a framework or template to be worked in depth with the pilots.

The first version has been designed taking into account the different pieces of the PoliRural project, especially the technical ones (Text Mining and Innovation Hub) and the pilots, ultimately responsible for the application of the outputs. As stated in chapter 2 the process to design the first version of the SDM starts from the definition of rural attractiveness worked out in the consortium (*D 1.1 Envisioning More Attractive Rural Places and Professions*):

“Rural attractiveness is sustainable rural communities with access to high quality public services, a thriving and diverse local economy where agriculture related activities are complemented by sustainable tourism and other forms of employment in a working countryside, and an attractive, ecologically rich and accessible countryside in which the environment and biodiversity are conserved and enhanced”

The design included a revision of the general literature of rural development, as well as System Dynamics literature in this area. As it will be discussed, no models were found to tackle the issue in a way that could be of profit for the project.

Nevertheless, some references were taken to build parts of the model, referring specific local dynamics. A first analysis of the Flanders pilot area was also taken as an example. The complete literature review and process of construction can be found on chapter 2.

The model as such has suffered major modifications after review by the REA, as explained in chapter 3. It is still a first simplified version of the model, to be developed in next editions (2, 3 & 4).

The main dynamics considered have been POPULATION, SOCIAL INNOVATION, NATURAL CAPITAL and KNOWLEDGE. From these four main topics it is possible to unfold most of the issues concerning rural development, as explained in the chapter.

There is also a structure of the information poured into the model. Depending on the nature of the information a different layer will be affected. This is especially relevant for the output coming out from Text Mining analysis. This way information can be ordered in the following layers and their correspondence in the structure of the model:

- LAYER 1 MEGATRENDS – considered as exogenous variables
- LAYER 2 TRENDS AT REGIONAL LEVEL – local effects of exogenous variables
- LAYER 3 POLICY OPTIONS – endogenous variables (explained in the model)
- LAYER 4 POLICY IMPLEMENTATIONS AND PROGRAMMING – scenarios

The resulting model is divided in six modules:

-
- POPULATION
 - EMPLOYMENT
 - AGRICULTURE
 - EDUCATION
 - NATURAL CAPITAL
 - QUALITY OF LIFE

The Conclusion chapter contains specific aspects of the model to be improved, in terms both of the structure and the interface (including a revision of the terms used). It also contains a reflexion on the need for simplicity for the local agents to understand the scope and usefulness of the SDM. In this sense the challenge PoliRural SDM faces is to combine simplicity and specificity. SDM ed.1 is the first step in that direction.

Finally, next steps are explained considering the relation with the pilots but also with the other technical pieces, and a foresight for the evolution of the model in the versions 2, 3 and 4.

1 Introduction

PoliRural objective number 3 is to *“explore the future trajectory of rural development in regions using a hybrid foresight approach (quantitative plus qualitative), taking into account both historic and current situation”*.

In particular there are 3 sub-objectives deriving from this general one:

- 3.1: Build conceptual models of rural ecosystems using quantitative and qualitative methods.
- 3.2: Translate the concept into computer model – interactive simulator – which makes it easy for decision makers to understand the interrelationships involved in policy change.
- 3.3: Advance a combined approach (system dynamics plus scenario modelling) as a new viable method for advancing rural policy objectives.

Deliverable 5.1. is the first iteration in the path towards the final objective. A first version of the System Dynamics Model (SDM) that is going to evolve until the final version at the end of the project.

Having said this, the initial version of the model had also some other objectives, responding to the logic of the whole project and the relation with the other parts involved, technical as well as territorial. These objectives are summed up below:

- Understand Text Mining added value to the process and start defining with TM team the products we can expect from them.
- Introduce the concepts and examples of System Dynamic Modelling to the pilots and give them the approach to the information and knowledge we need from them to build the models.
- Analyse the detailed complexity of the model and start thinking ways to simplify the use and interaction with it by the final user.
- Consider the different levels of information coming into the model and setting up the specifications to integrate each level to its correspondent application.
- Start testing the model's publication software both by the builder and the final user.

2 Model Building Process

The model building process has followed several phases including: (i) literature review; (ii) identification of the main dynamics and system borders; (iii) design of a provisional structure of sub-systems; and (iv) system's design. This process has given a conceptual and structural background for the first attempt of the system.

2.1 Literature review

The aim of this first approach has been identifying dynamics and issues shared by the pilot areas in a European context. The review included theoretical and academic literature, specialized System Dynamics literature and bibliography of a pilot area.

2.1.1 Findings from D1.1

Main source of information for the academic literature has been *Deliverable 1.1 Envisioning More Attractive Rural Places & Professions*, which has an exhaustive overview of the rural development facts and trends. The overview was completed with a workshop with pilots and a query to build the foundation for this vision work.

Some of the inputs taken from D1.1 include new forms of entrepreneurship in agriculture, tourism, social innovation and public services; new forms of networking and cooperation; and the importance of promoting the involvement of young people, women as well as new entrants.

An output from the overview included lists of tags identified as being important concepts in the field for rural development. Some of these tags are listed below.

AGRICULTURE – PERIURBAN AGRICULTURE - FARMERS – YOUNG FARMERS – TOURISM – ECOTOURISM - URBANISATION - COUNTERURBANISATION – MIGRATION – NEW ENTRANTS HURDLESS – SOCIAL INNOVATION – GENDER – ENTREPRENEURSHIP – DIVERSITY – MULTIFUNCTIONALITY - RURAL ATTRACTIVENESS – ASSET-BASED RURAL COMMUNITY DEVELOPMENT – STATIC CAPITAL - TERRITORIAL CAPITAL – RURAL EMPLOYMENT – LOCAL SUSTAINABILITY - FOOD SYSTEMS – SHORT FOOD CHAINS

2.1.2 SD Literature Research

With this approach a first delimitation of the field of word was settled, giving way to the System Dynamics literature review. The main source for this review has been the Bibliography provided by the System Dynamics Society, which contains more than 12.000 references coming from SD technical publications as well as procedures from international SD conferences.

From this review some important dynamics were found to be relevant and have been somehow reflected in the model's first version:

- 'Self-help capacity' and 'capacity to take initiatives' concepts, used as a simile to entrepreneurship, taken from Kopainsky and Rieder (2004)¹.

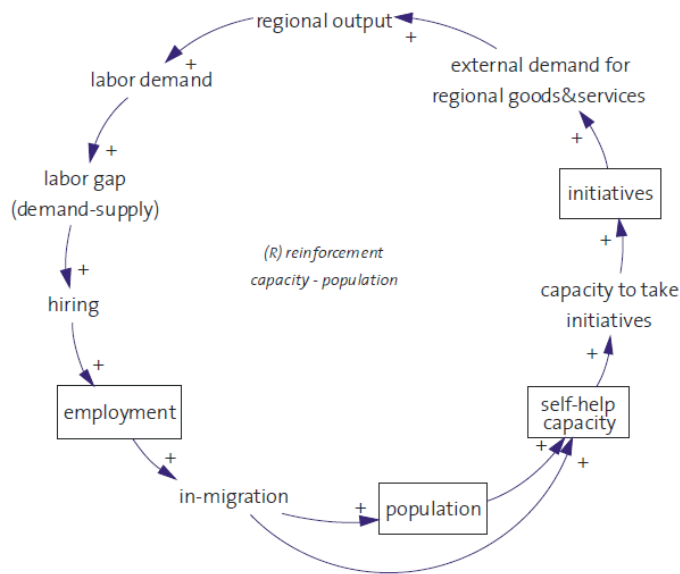


Figure 1 Causal loop diagram of 'Self-help capacity' and 'Capacity to take initiatives' in Kopainsky and Rieder (2004)

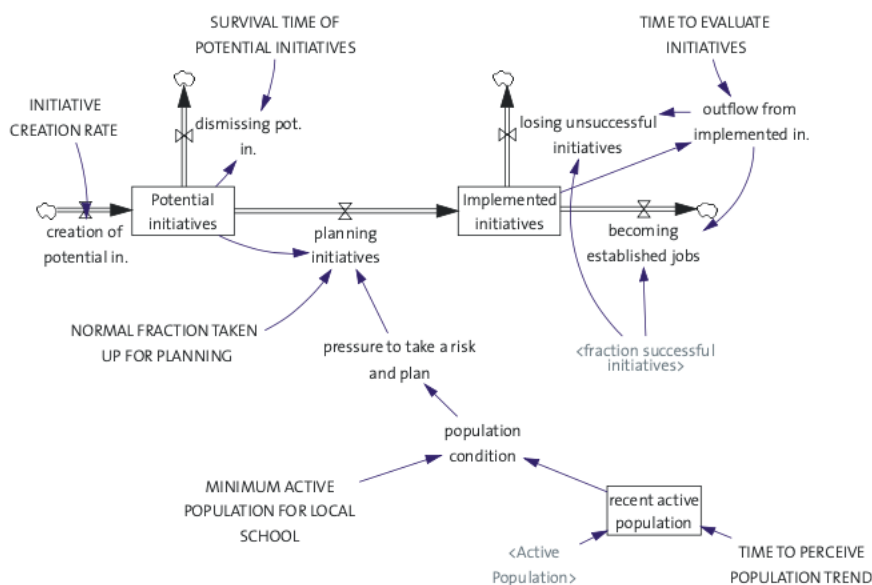


Figure 2 'Capacity to take initiatives' in stock and flows diagram, by Kopainsky and Rieder (2004)

¹ Birgit Kopainsky and Peter Rieder (2004). Processes and determinants of rural development in Switzerland. 22nd International System Dynamics Conference, Oxford, UK.

- Rural population and migration as consequence of different living costs and wages between rural and urban areas, taken from Mohammadhashem (2014)²

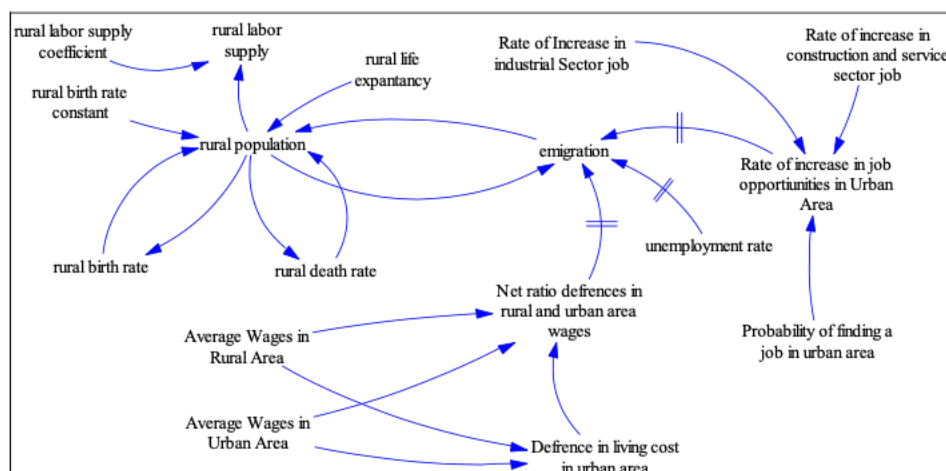


Figure 3 Influence diagram for the rural population and emigration in Fars Province (Mohammadhashem, 2014)

- Some ideas about the role of the model in the decision-making process and also about the group model building process were taken from Tian Shi and Roderic Gill (2005)³.

It is important to conclude that there were no models that could be used in the project, even introducing substantial modifications. Apart from the quotations above, the references were found either too old or too far from European reality to be of significance for the project, and they were not considering in any case all the rural dimensions PoliRural considers. It was clear from this point that the model should be built from scratch.

2.1.3 Flander's Bibliography

Last step in the literature review consisted in analysing the bibliography provided by a pilot area. The area analysed was Flanders, and it was based on the document *INPUTS FROM TEXT MINING FOR MODELLING* (Annex 2) provided to the text mining team and containing a detailed background knowledge of the region.

Flanders' literature review helped fixing the steps needed to undertake the modelling:

- First characterization of the area
- Issues to be addressed
- Technical and behavioural parameters

² Moosavihaghighi Mohammadhashem (2014). A System Dynamics Investigation of Employment and Production in the Fars Province Agricultural Sector. Proceedings of the 32nd International Conference of the System Dynamics Society, Delft, The Netherlands.

³ Tian Shi and Roderic Gill (2005). Developing effective policies for the sustainable developmet of ecological agriculture in China: the case study of Jinshan County with a systems dynamics model. *Ecological Economics* 53 (2005) 223 – 246.

The document also contained clues to identify semantic structures leading to one or another section.

Considering all the knowledge gathered through the literature review, the main dynamics and the system border were fixed.

2.2 Identification of the main dynamics and system borders

The complementary sources reviewed were enough to have a first approximation of the main dynamics taking part in rural development, specially focusing on the issues and challenges ahead.

When developing the main dynamics, the rest of issues unfold so that the whole map of the rural reality can be reflected. The dynamics considered at this stage were Population, Social Innovation, Natural Capital and Knowledge. These were considered the most important, given the level of detail needed to build a template model for twelve regions. The choice was made confronting literature review with the dynamics identified at a preliminary level in the pilot regions (new dynamics can be introduced to deepen in certain aspects when information from pilots grows). They are detailed below.

- POPULATION

Population dynamics are closely linked to variables such as jobs, income, education or services. It allows also talking about concepts like newcomers or rural attractiveness differentiation for age groups. Population dynamics close many of the loops built, giving sense to the structure, as shown in the figure below.

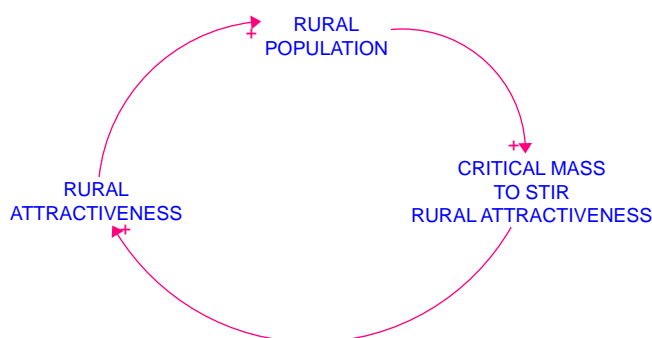


Figure 4 Causal Loop Diagram (CLD) of dynamics involving population

- SOCIAL INNOVATION

Social capital is defined as the networks of relationships among people who live and work in a particular society, enabling that society to function effectively. The term not only refers to life-sustaining relationships (provision of food, shelter or clothing, as well as care for the young, old, and infirm) but also incorporates intangible concepts such as community wealth, sense of belonging.

Social capital is enriched by the knowledge shared by the community, which in its turn reinforces the sense of community, belonging and identity. This dynamic is important by the way it affects many of the areas of the project (Knowledge, Employment,

Natural Capital...). The value is also increased for the fact of being an endogenous dynamic, though delayed in time and with a need of existing elements.

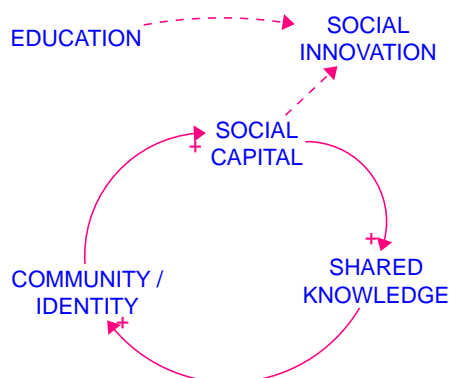


Figure 5 CLD of Social Capital dynamics

- NATURAL CAPITAL

The need to preserve or increase natural capital and ecosystem services is central in the design of any development policy, especially in rural areas. The dynamic is a simple one, but affecting many other like social capital, knowledge or rural employment.

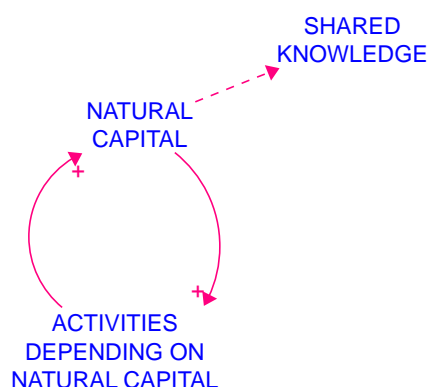


Figure 6 CLD of Natural Capital dynamics

- KNOWLEDGE

The application of Knowledge into the development strategy provides the territory with lasting dynamics and a more adaptive capacity for future challenges. As an example, PAC reform has various instruments to introduce knowledge into the agricultural sector (e.g., AKIS). The base dynamic is again very simple, but with big implications in several modules of the model. Main variable in the model to approximate knowledge is workforce specialization, as shown in the description of the model (chapter 3).

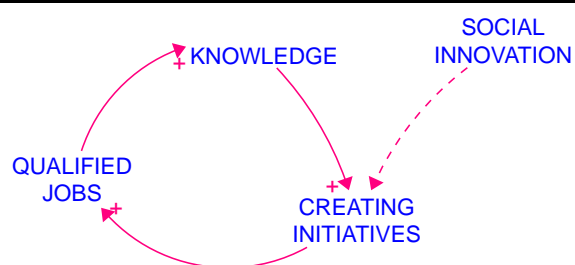


Figure 7 CLD of Knowledge dynamics

Taking these four dynamics as a departure point it is possible to unfold most of the issues identified in the literature review.

Besides identifying main dynamics, a first approach to the system limits was needed. In this sense, a working document by member of the consortium Patrick Crehan (CKA) gathering the notes of a meeting with members of the consortium Tommaso Sabbatini and Denis Kolokol (KAJO), and Runar Bergheim (AVINET) was key to a first classification of **text mining outputs** as **information levels** for the system dynamics model. So, what is a Task for text mining team is translated as an information level for the model:

| TASK | NAME (TEXT MINING) | INFORMATION LEVEL | TRANSLATION IN THE MODEL |
|------|---|------------------------------|--|
| 1 | Global Mega-trends and high level drivers of change | EXOGENOUS VARIABLES | Not described in the model, but affecting the dynamics |
| 2 | Relevant trends at regional level | EXOGENOUS VARIABLE'S EFFECTS | How exogenous variables are impacting in the system |
| 3 | Policy Options | MAIN DYNAMICS | Dynamic structure |
| 4 | Policy Options (Implementation and Programming) | SCENARIOS | Scenarios construction and analysis |

Table 1 Text Mining tasks and information levels

2.3 Design of a provisional structure of sub-systems

Once the main dynamics have been identified and system's borders established, a first approach to sub-system structure has been put in place. The structure is going to be the base for the first version of the model. Figure 3 shows this initial structure with the main dynamics limiting the area where the rest of dynamics unfold.

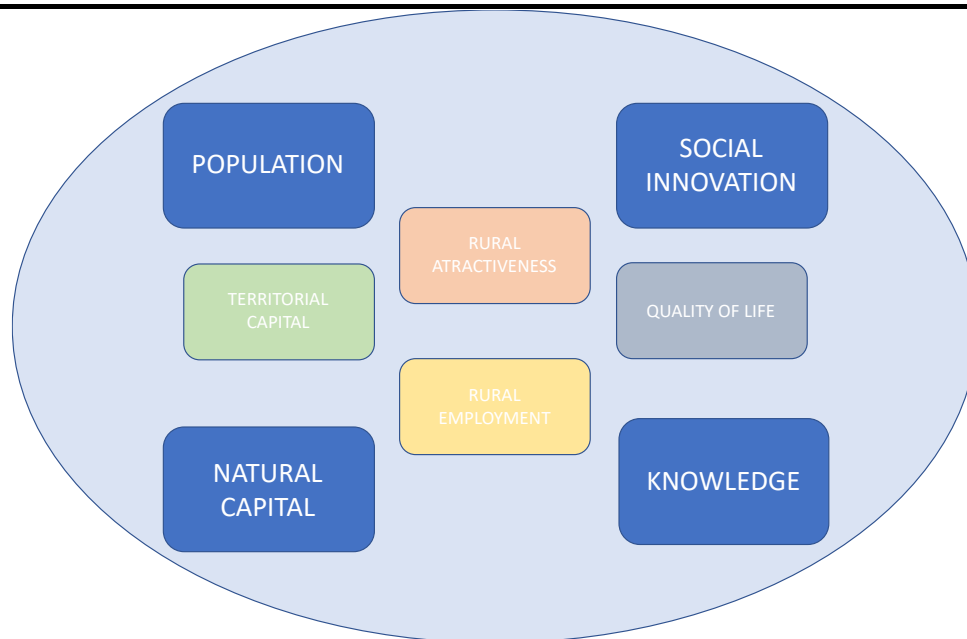


Figure 8 Provisional Sub-system's Structure

Main dynamics are described in 2.2, the rest of sub-systems describe secondary dynamics (not in terms of importance, but rather cause and consequence of the former ones).

- **RURAL ATTRACTIVENESS**

It involves all the dynamics causing people to leave or move to rural areas, but also to invest, to visit, etc. It is not a module, but rather a concept mobilizing variables from all the modules. Thus, rural attractiveness will be responsible of closing many of the loops defined.

- **TERRITORIAL CAPITAL**

This is a concept often quoted in the literature, gathering a number of issues related to the territory and its management: natural and ecological values, culture, social innovation and governance. Territorial capital is a key component of the rural attractiveness.

- **RURAL EMPLOYMENT**

Employment is the base for a stable rural population, and therefore, is going to play a key role in the model. A big part of the rural employment will be defined by the agricultural model, but secondary and tertiary sectors are increasingly opening opportunities for rural development. The dynamics involving old and new approaches to rural employment will be reflected in this sub-system.

- **QUALITY OF LIFE**

This sub-system has a high degree of interaction with the rest: it may affect for good (accessibility for people and business) or for bad (landscape impact, possibilities of spreading urbanisation) the rest of sub-systems, especially territorial capital, population and attractiveness. We will consider here accessibility to services but also less tangible variables such as social capital.

Although been described individually, the system has to be thought as a whole, so the interactions are a constitutive part of the system, and sub-systems description just a mean to understand the system reflecting the rural reality.

Once the main dynamics, the borders of the system, and a first approach to the sub-systems involved, the model can be built. Next chapter explains the first version of the PoliRural System Dynamics Model, after the steps described so far.

3 Description of Polirural Model 1

To describe the model, find first the main dynamics involved and the modules explaining them; then the structure of modules and finally a description of the 9 modules built.

3.1 Main Dynamics

Main Dynamics are the ones described above, POPULATION, SOCIAL INNOVATION, NATURAL CAPITAL and KNOWLEDGE. Now it is about explaining how they are treated and reflected in the model.

- **POPULATION**

Population is described as an aging chain, this is a flow from birth to death with several stages or stocks, in this case five stages as explained later on. The key to the population system is the net migration, considered in the different stages. The regulation of this flow is in the base of the population dynamic and it is responsible of many of the issues related to rural development.

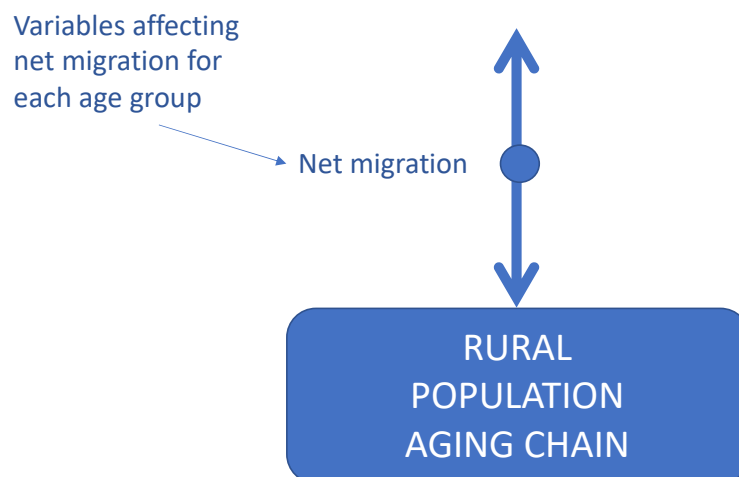


Figure 9 Population Dynamics Scheme

- **SOCIAL INNOVATION**

Social Innovation is considered a composite variable, made up of Social Capital and Workforce Specialization. At its turn Social Innovation is responsible of creating new initiatives, so an entrepreneurship indicator. This capacity of creating new initiatives will affect some of the main development loops in the model, and so it will affect economic dynamization.

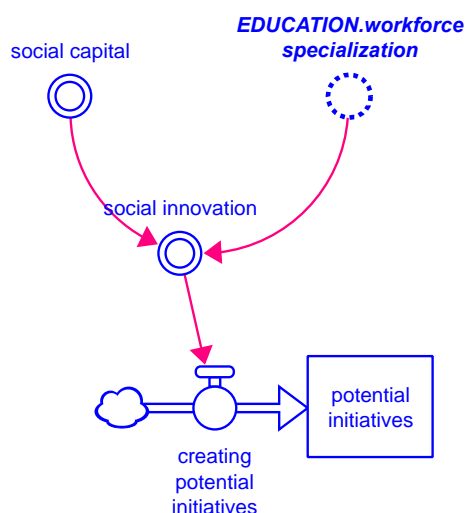


Figure 10 Stocks and flows relating Social Innovation

- NATURAL CAPITAL

Natural Capital is considered a stock in the model. In terms of the modelling exercise this means considering Natural Capital as something that can be accumulated over time, and with the capacity to grow or shrink, depending on a number of factors. There are three productive sectors linked to the stock of natural capital: agriculture, other primary activities and tourism. The activities related to the stock will be responsible for its maintenance in the long term. Natural capital can be reinforced via a shared knowledge loop and is also responsible of the definitions of both rural attractiveness and quality of life.

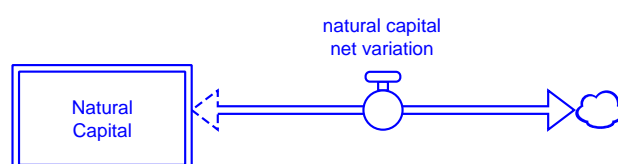


Figure 11 Natural Capital as a stock

- KNOWLEDGE

Knowledge is translated into an aging chain of education levels, after school period. The different levels flow to specialized workers, and they define the composite indicator 'workforce specialization'. This is the main variable in the knowledge dynamic, and it is responsible of two important loops: the effect of the Agriculture Knowledge Innovation Systems (AKIS) (a new element introduced by the CAP reform) in the creation of new jobs; and the capacity of the social system to create new initiatives (entrepreneurship level), as explained in SOCIAL INNOVATION.

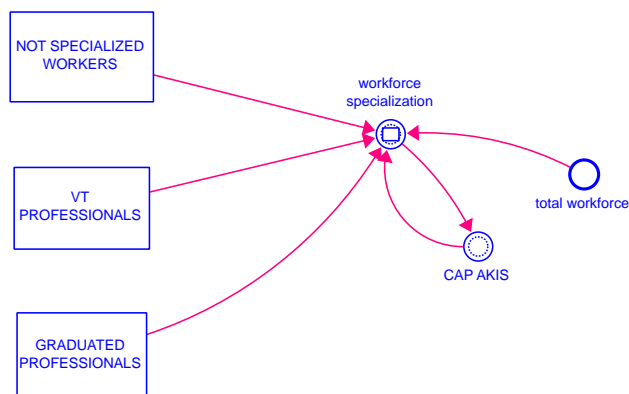


Figure 12 Workforce specialization as an indicator of Knowledge

3.2 Structure

To reflect the main dynamics as well as the secondaries a system with six modules has been built. The modules are the following: POPULATION, EMPLOYMENT, AGRICULTURE, EDUCATION, NATURAL CAPITAL and QUALITY OF LIFE.

In the figure below you can see the interaction of the six modules. Whenever a variable defined in a module is used in some other module an arrow is linking them.

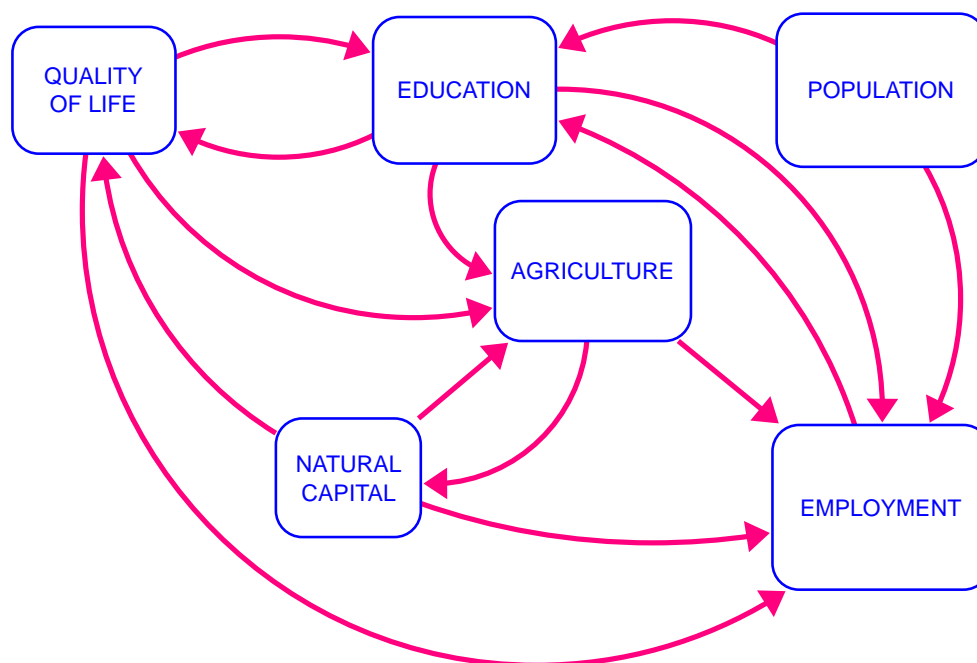


Figure 13 Modules structure

3.3 Description of modules

3.3.1 POPULATION

In the base of the population module there is an aging chain structure. The basic stocks or stages in the chain are INFANTS, SCHOOL AGE, POST SCHOOL, WORKING AGE and ELDERLY. In every stock there are inflows and outflows considering net migration (in or out of the system) and deaths. Figure 14 represents Population aging chain (the cloud symbol represents the flow is either coming from or going out of the system).

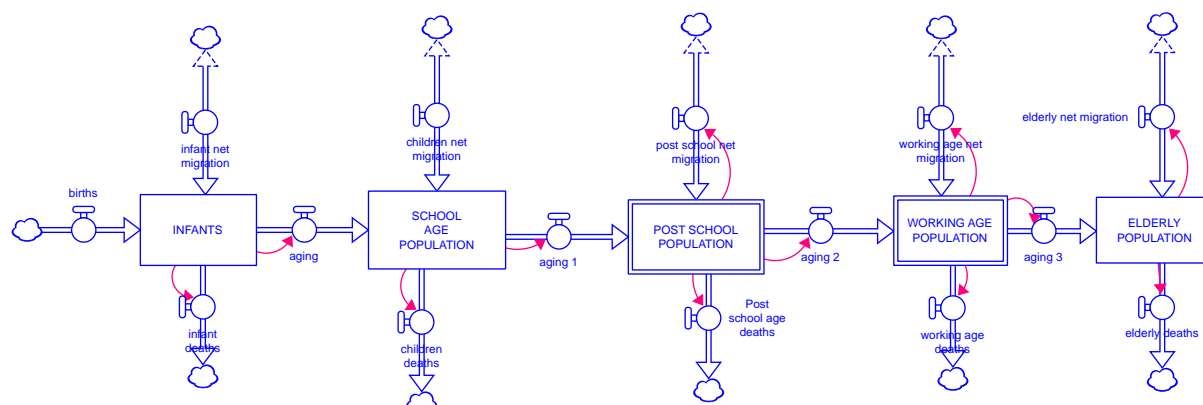


Figure 14 Population Aging Chain

The key driver of the population module lays in the net migration flows. Net migration flows represent the total flow coming in or out the rural areas. The regulation of these flows will allow all the issues concerning rural attractiveness to be reflected, following local patterns of behaviour.

The division in several groups of age will allow each group to be given different criteria to consider staying or moving rural.

3.3.2 EMPLOYMENT

Employment module main components are four stocks representing jobs in agriculture, rest of primary sector, industry and services. The reason to split primary sector in two is to be able to deepen with some detail in the agricultural model (in the agriculture module, see point 3.3.3). Every stock is affected by creation and destruction ratios.

The sum of the four stocks results in total regional employment. From this value it is possible to define one of the main influences in the net migration ratio, which is the positive or negative employment gap. The gap is obtained by comparing total regional employment and effective workforce, as in the image below.

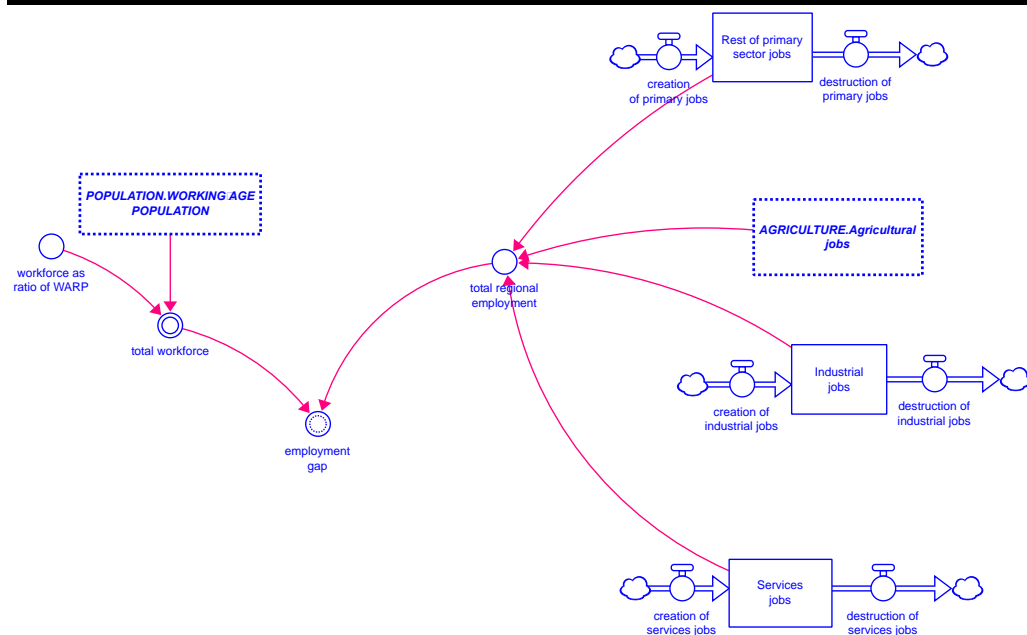


Figure 15 Structure of employment gap

The need for simplification makes this module to act indeed as a simplification of the local economy. The assumption here introduced is that jobs are an indicator of the economic activity. For more profitability and revenue, more jobs will be created.

There is also a link with the EDUCATION module, through ‘workforce specialization’. The link addresses the idea of disarrangement between workforce specialization and what the employment market is demanding. See below the scheme of the labour supply disarrangement.

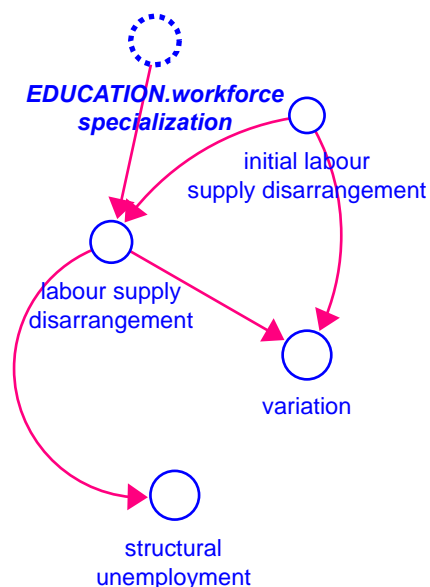


Figure 16 Labour supply disarrangement scheme

3.3.3 AGRICULTURE

Agriculture model revolves around two stocks: agricultural land and agricultural jobs. The link between the two is the variable Labour intensity of agriculture, that gives a relation in person per ha of agriculture land. The Labour intensity of agriculture will be lower in extensive properties with an intensive use of machinery. The ratio will represent a mean indicator of the agricultural regional model. The image below shows the two stocks linked through the intensive farming ratio.

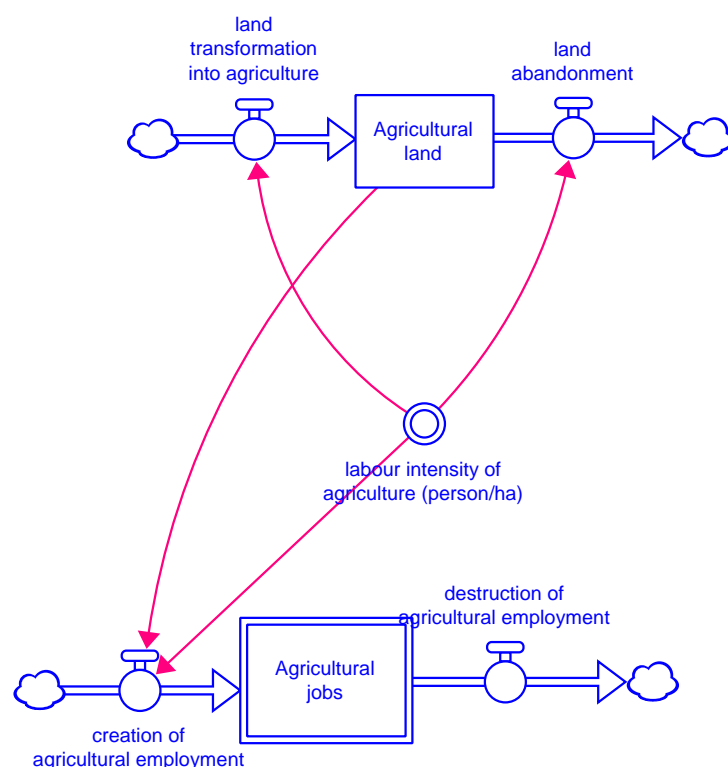


Figure 17 Intensive Farming Ratio relating land and jobs in agriculture

The structure also reflects some of the ideas gathered in the literature review, like the substitution of retired farmers or land access as a farming attraction factor. They are linked to other modules through the variables 'social capital' for the farmers substitution and 'social innovation' for land access.

Some of the Common Agricultural Policy (CAP) reform related points are also introduced in the model: *Agriculture Knowledge Innovation Systems (AKIS)*, *Eco-Schemes* and *Farm to Fork* strategy. They are considered to have effect on services and industry, and they are linked through the variables called 'related agricultural jobs effect on services' and 'related agricultural jobs effect on industry' respectively, as shown below.

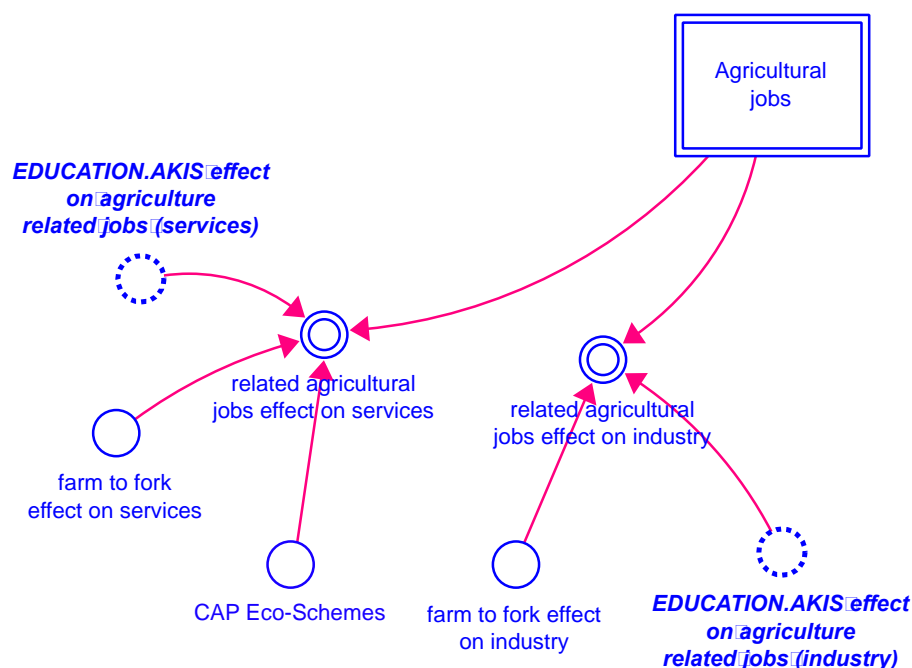


Figure 18 AKIS, Eco-Schemes and Farm to Fork effects on services and industry jobs

3.3.4 EDUCATION

The education module is based in a triple aging chain considering not specialized workers, Vocational Training Students and professionals, and University students and professionals. The variable that considers the proportion of specialized workers versus unskilled workers, is workforce specialization, and it will have effects in the Quality of Life module, defining social innovation ratio; and in the Employment module, modifying the labour supply disarrangement, as explained in 3.3.2. See below definition of workforce specialization coming from the three stocks of workers.

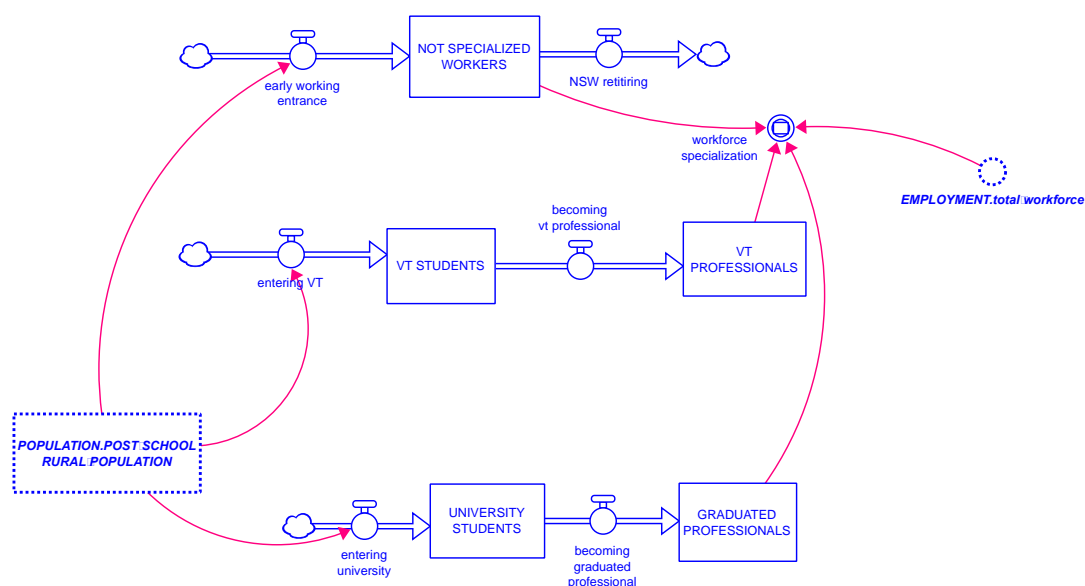


Figure 19 Stocks and relations defining workforce specialization

The fraction of students attending VT or University Centres will be affected by the accessibility of the centres, a variable defined in Quality of Life module, and depending on the mobility infrastructures.

There is a circular loop affecting workforce specialization and AKIS. It is considered that a certain level of specialization will help the AKIS to cope, but at the same time the success of AKIS will stir workforce specialization. The image below illustrates this.

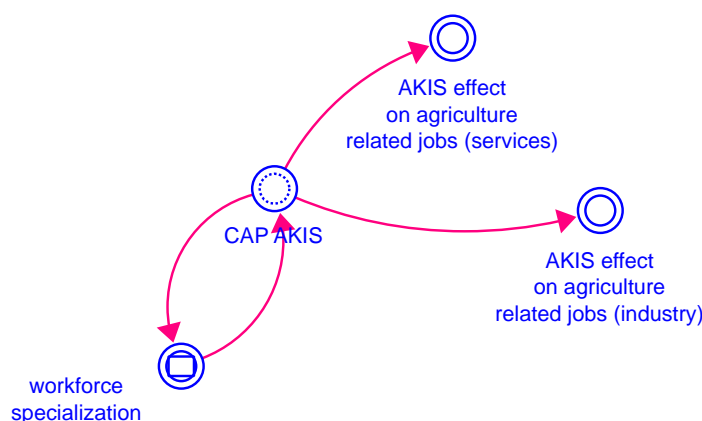


Figure 20 Workforce Specialization and AKIS success

3.3.5 NATURAL CAPITAL

Natural Capital is a very simple module containing the Natural Capital stock, with a bi-flow for the net variation. Some of the factors affecting the Net Variation are the proportion of natural land and the intensive farming ratio. The stock is responsible for the activity in the tourist sector and primary sector.

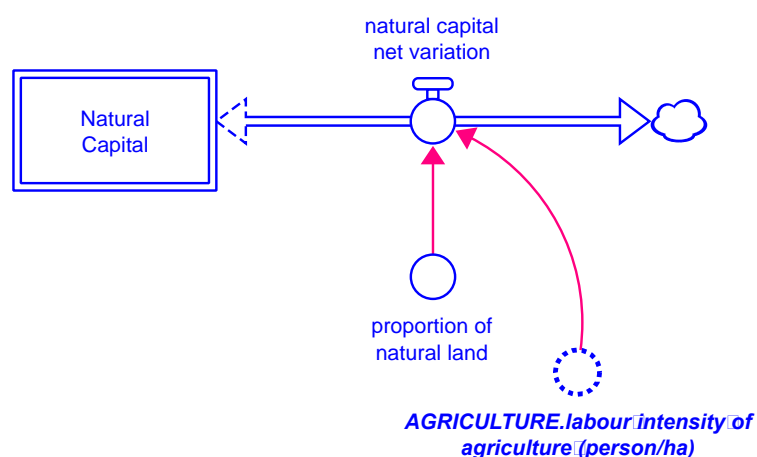


Figure 21 Natural Capital main structure

The stock of natural capital is also present in quality of life module. The assumption is that a high value of natural capital will trigger shared knowledge, and all the consequences deriving from there, in terms of social capital, cultural appeal or identity.

3.3.6 QUALITY OF LIFE

This module has two differentiated parts. The first one is based in infrastructures, giving access to services both presential and remote. Infrastructures are considered a stock that can be feed via constructing new infrastructures and it also depletes over time. See in the next figure the accessibility structure around mobility infrastructures stock.

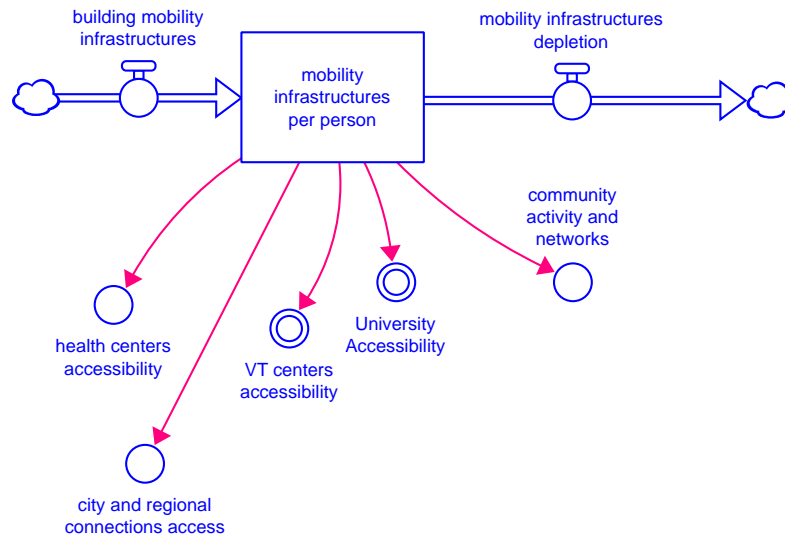


Figure 22 Accessibility structure around mobility infrastructures stock

The other part is about community and social capital. The main loop there is the one relating shared knowledge and community activity. They activate each other, so the more community activity, the more shared knowledge and vice versa.

From this loop it derives the dynamic of creating and planning initiatives i.e., local entrepreneurship. This dynamic begins in social innovation, a variable combining social capital and workforce specialization, and from there goes to creating the stock of potential initiatives, to the end of creating stablished jobs, as shown below.

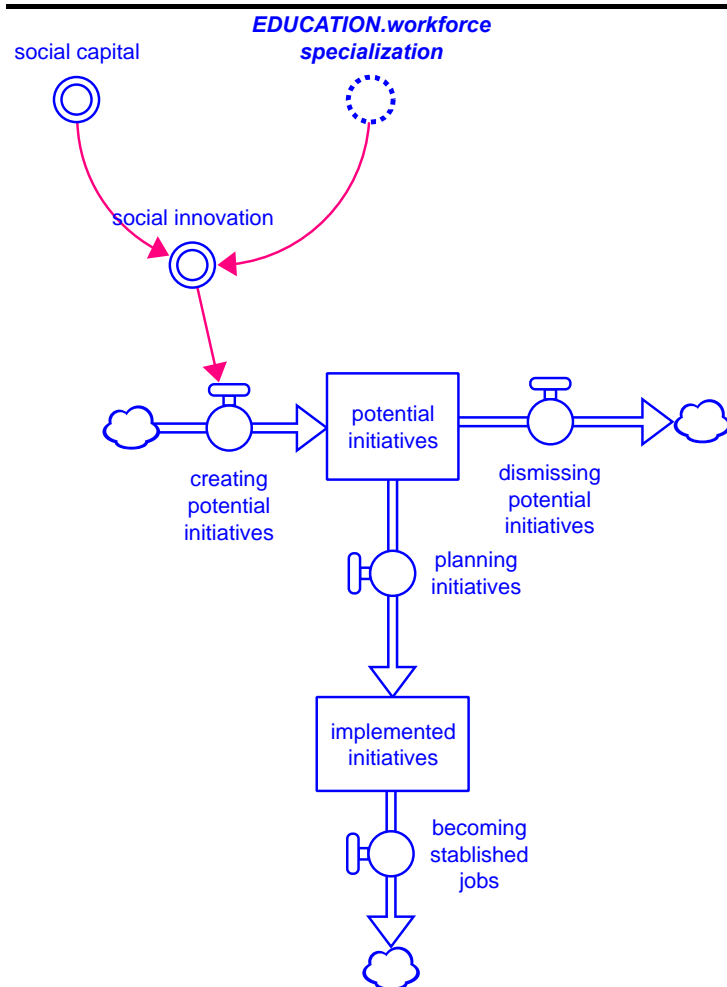


Figure 23 Local entrepreneurship

4 Conclusion

The aim of the first version of the model is to build a framework for the pilots to understand the approach of SDM and to think in their own specificities, starting from the general model drawn. After the review by the REA (September 2020) the model has been completely rebuilt, putting together the basis model, the knowledge acquired since the beginning of the project and the comments by the REA. In this sense the second version of the first edition of the model here presented, is again a good point of departure.

Some considerations on the main points discussed with the REA and addressed in the deliverable:

- The report point of departure is the definition of Rural Attractiveness worked on WP1 and specified in D1.1. At the same time, a bibliographical review was needed to see the approaches researchers and practitioners have given to the issue. Edition 1 takes into account in first place Rural Attractiveness definition, and then it takes some ideas and dynamics from the bibliographical review.
- Agriculture had a predominant role in the first version of the model, but it was changed soon after edition 1 was presented for the wider concept of rural employment. This allows to introduce new sources of employment in the rural areas, as well as concepts such as entrepreneurship and social innovation.
- Population dynamics is central to any rural development model. Decreasing population will be an issue in most of the rural areas, but not in all. The way Population module is presented allows rural areas to consider it an issue only if it is relevant.
- Infrastructures module contains now variables defining social capital. The concept has been developed in more detail.
- Territorial capital has been included in the more generic stock of Natural Capital, but the structure reflects relations with the social capital and the community too, tackling thus the principal ideas of the territorial capital concept.

After several consultations with some pilot areas, some improvements were proposed to advance to the new version. Some of them were about the language used. The idea is to get as close as possible to the terms used in local statistics and data. These appreciations will be considered for the following versions of the model, as a part of the work with the pilot areas.

It has to be noted that it is not only a question of language. In this sense the framework has both to be improved with the pilot areas and also adapted to their local realities. The following example can help to understand these ideas and the work initiated. It is a reflection about the migration net ratio, expressed as WILL TO MOVE or WILL TO STAY in the first version of the model. After a first web meeting the concept was considered too strong and closed to incorporate all the ideas involved in this kind of decision. The following image elaborated by consortium partner Tuula Löytty (Smart & Lean) collects some of these ideas and will be the base for the evolution of the modules POST SCHOOL WILL and WORKING AGE AND ELDERLY WILL.

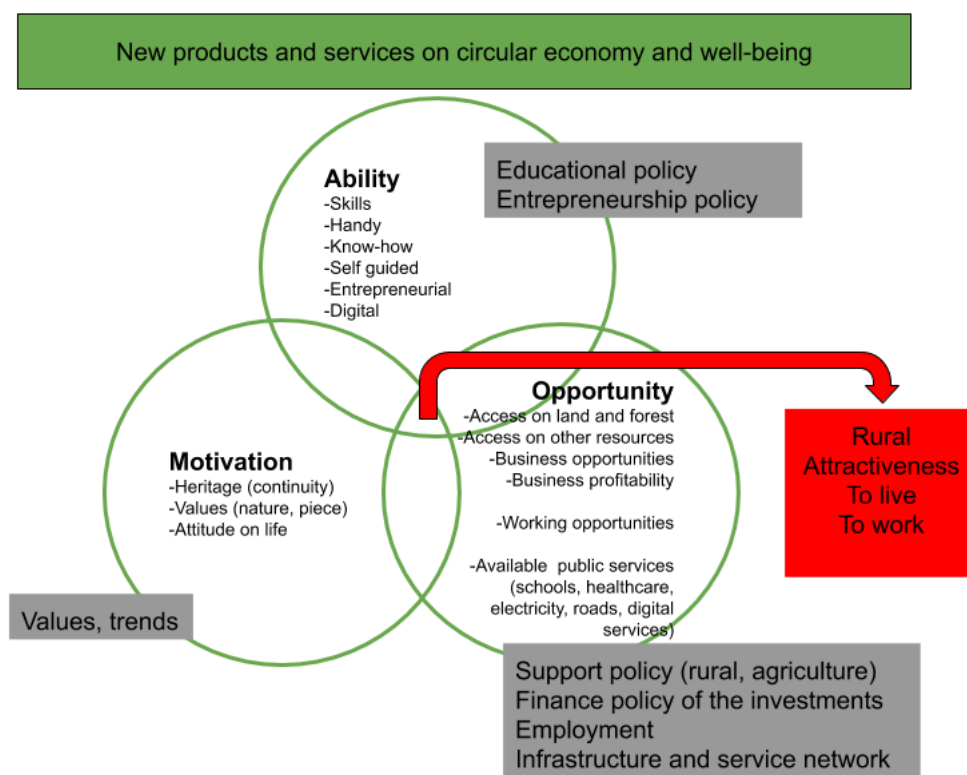


Figure 24 Ideas to evolve in 'migration net ratio' variables (Tuula Löytty)

The initial complexity of the model has also been an issue discussed with partners. In this sense, the exercise of publishing an example model⁴ (just for training purposes) served also to show to what extent a simplification can be worked out and whether it is enough to be useful for policy makers or not. The successive versions of the model will have to take into account this issue. The final goal would be finding a balance between possible and feasible, but also presented in such way that is easy to use by policy makers.

The work done so far is important because it opens the way for next developments. Following versions of the model will be based in the framework here presented but now with the collaboration of the pilots. The advances of the foresight and text mining work packages will also give more inputs to work with. Version 2 of the model will include improvements and specificities coming from both sides.

⁴ The example model can be consulted in the ISEE Exchange web
<https://exchange.iseesystems.com/public/antoni/polirural-webinar/index.html#page1>

Annex 1 POLIRURAL MODEL VERSION 1

The model has been designed with STELLA ARCHITECT software version 1.9.2. Below an image of the six modules described in the text.

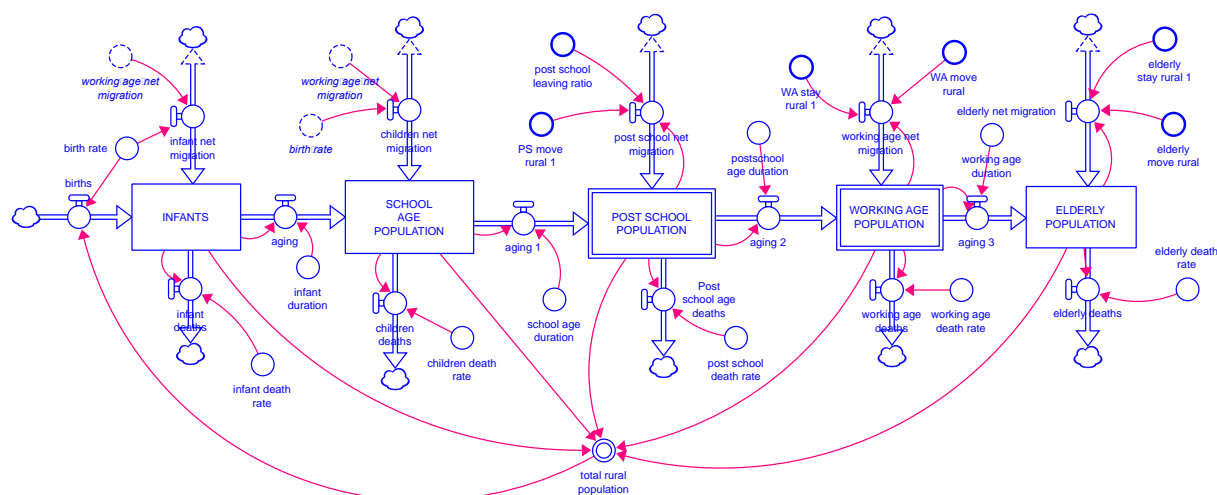


Figure 25 POPULATION module

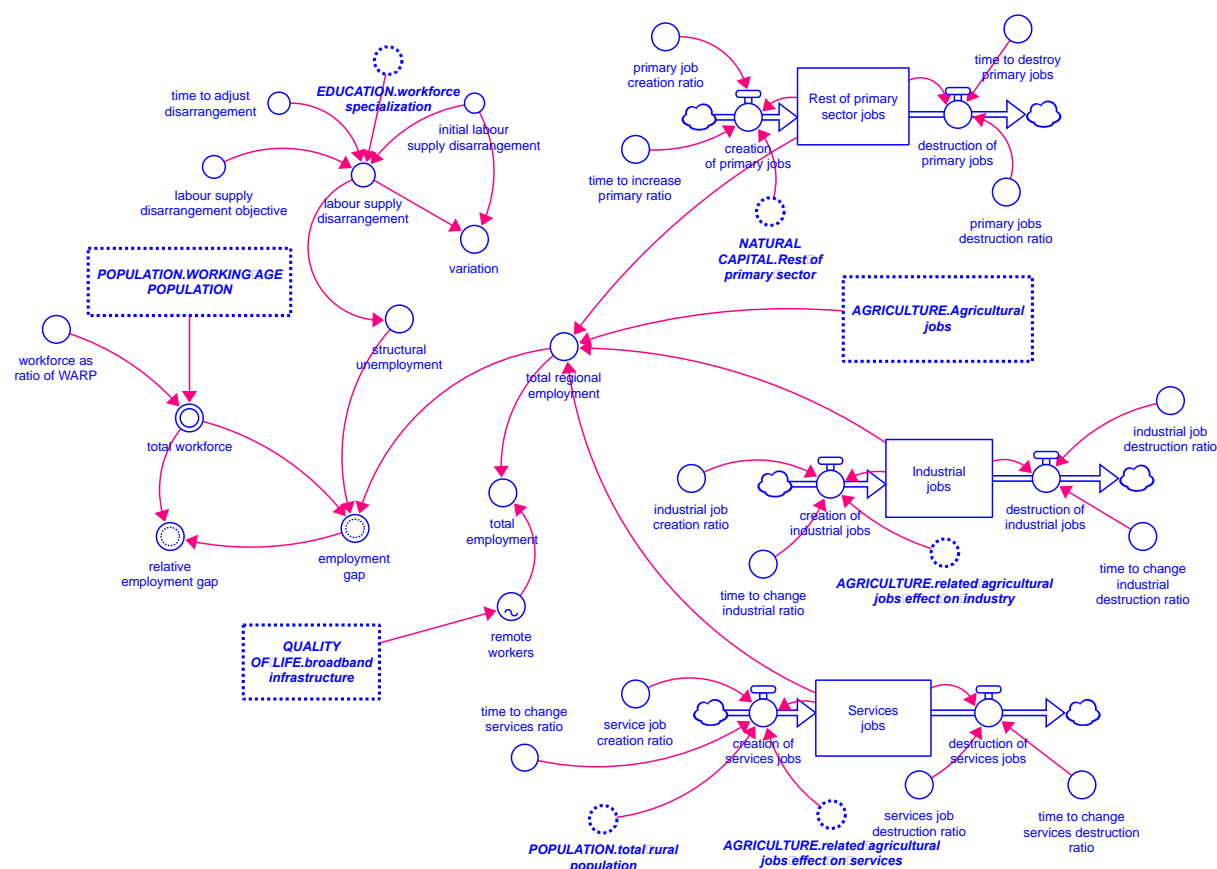


Figure 26 EMPLOYMENT module

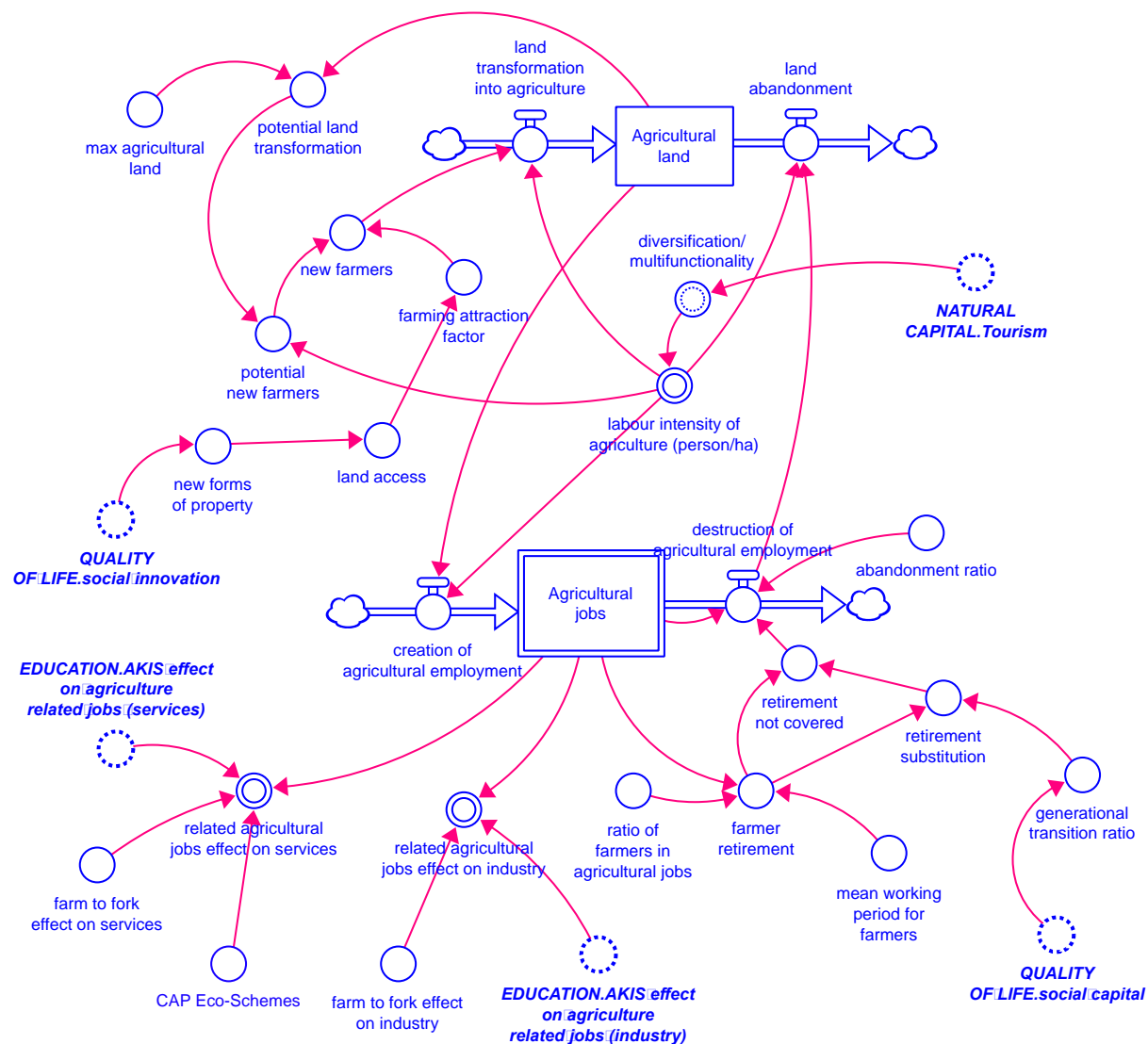


Figure 27 AGRICULTURE module

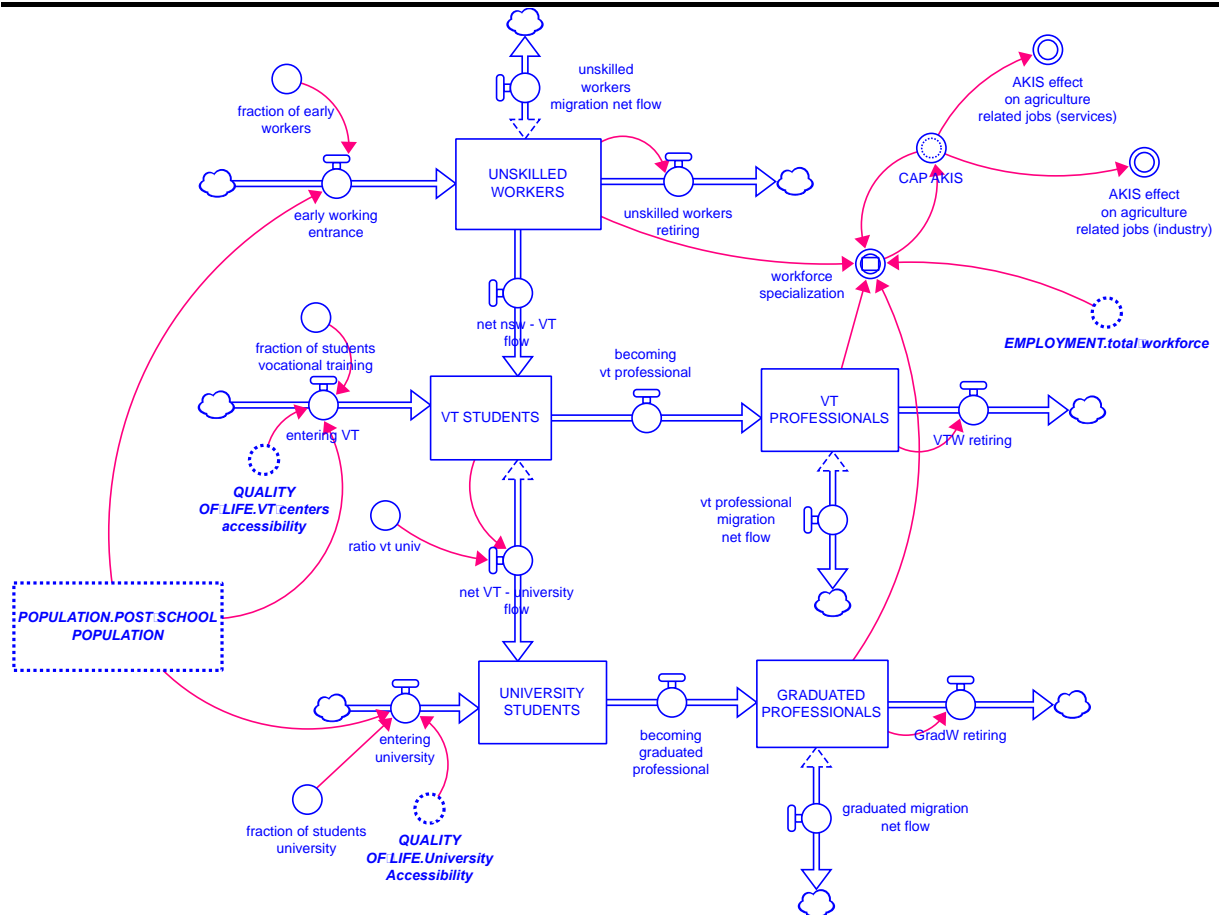


Figure 28 EDUCATION module

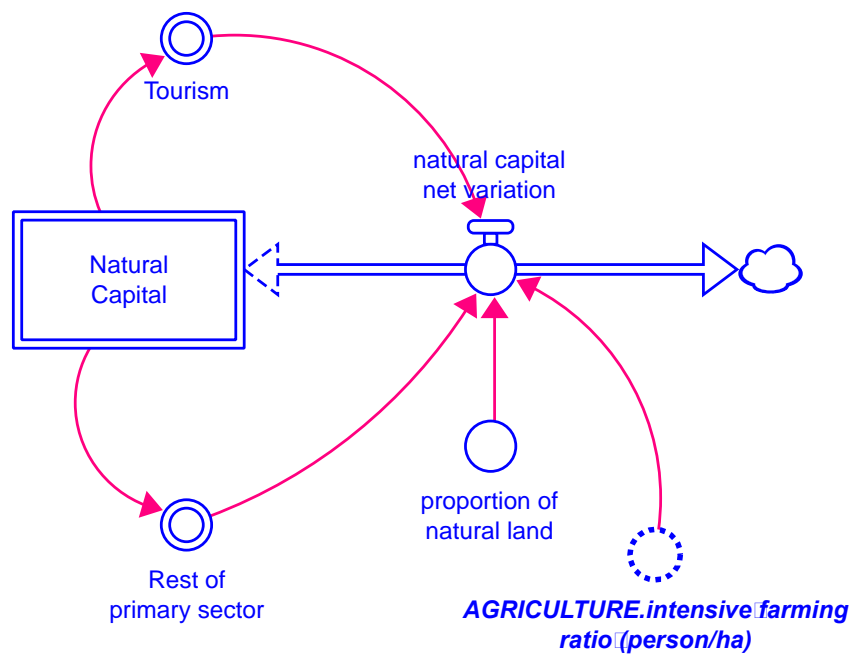


Figure 29 NATURAL CAPITAL module

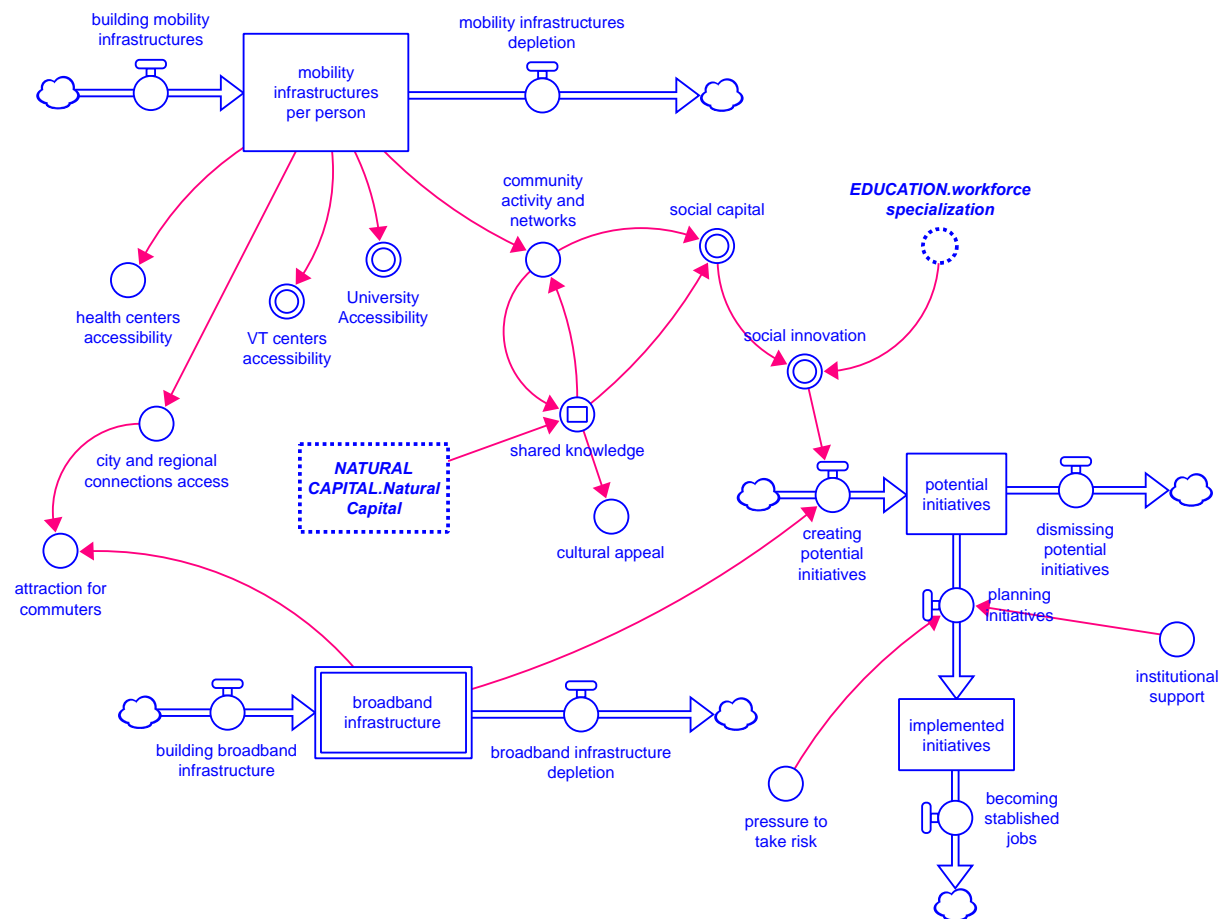


Figure 30 QUALITY OF LIFE module

Annex 2 INPUTS FROM TEXT MINING FOR MODELLING

1. INTRODUCTION

The objective of this document is to start defining the products coming from text mining (TM) that may allow the design of system dynamics (SD) models.

It is important to understand the normal course of action when modelling with local agents or communities, so that everyone may see the global reach and the challenges ahead.

The objective of SD is firstly helping to understand the current situation as a trend or behaviour over time, produced by the interactions of a given structure. The model tries to identify the structure, so that passed and current realities are explained. Once the model is defined and agreed, policy exploration can be built driven by sensitivity analysis and scenario design.

The extent to which direct human intervention (via field work, interviews, workshops, etc.) may be replaced or supported is something to be adjusted by the ongoing process of the project.

When dealing with local communities the preliminary step will be gathering all the information (coming from literature, expert sources, workshops, etc.) needed to answer the following general questions:

Which are the main discourses and narratives?

Which are the local drivers or most rapid trends?

Major conflicts and problematic indicators?

What are the main capitals, thresholds and risks?

What is the institutional context (involved in the specific narrative)?

This will lead us to identify trends or behaviours over time, and then the firsts Causal Loops Diagrams previous to the models.

From this approach, find a procedure proposal including information sources needed and outputs expected from TM to start designing models for the pilot areas.

2. INPUTS EXPECTED FROM TEXT MINING TO BUILD SD MODELS

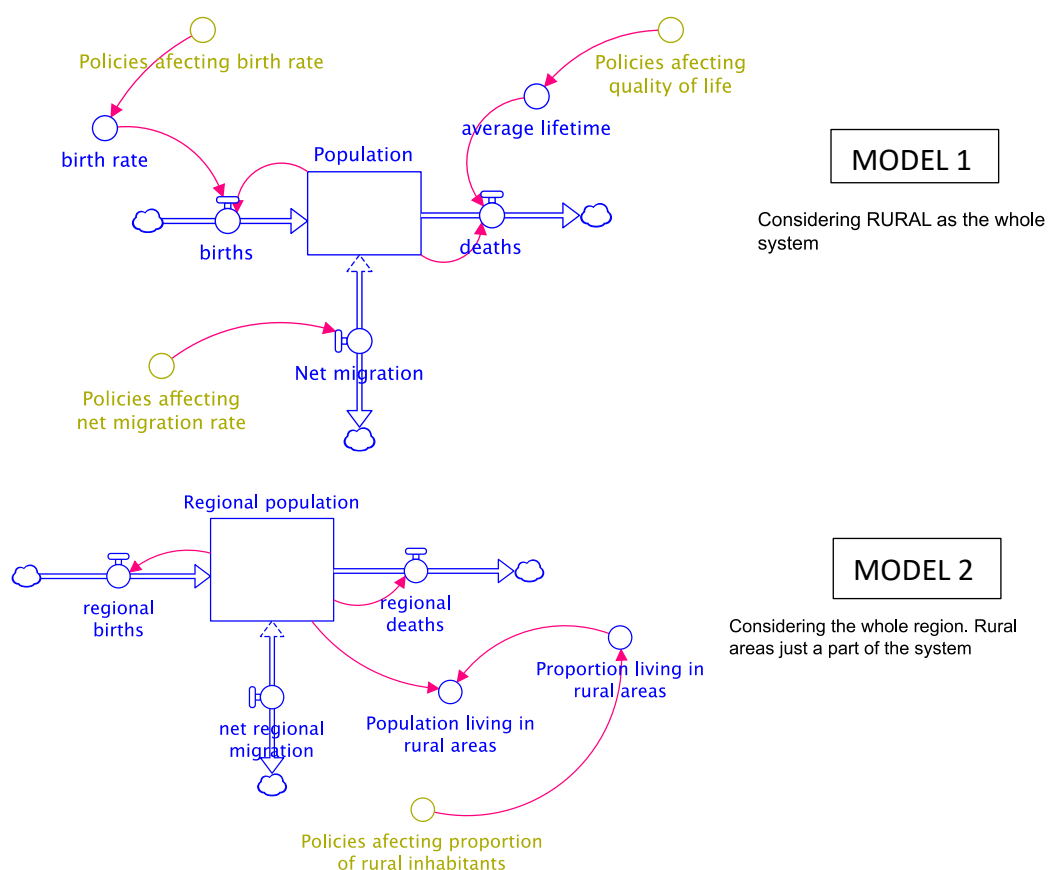
The inputs expected are divided in three categories:

- First characterization of the area
- Issues to be addressed
- Technical and behavioural parameters

Find an explanation below, including SOURCES and EXPECTED RESULTS for every case.

a) First characterization of the area

The first characterization is a general framework to approach the pilot area. Depending on this first idea the model will take a different form. One of the clearest features will come from the settlement model. The case of Flanders has to be understood and analyzed as an urban region with a rural population very much intertwined (then model 2 will be applied). The approach of the population module will adapt to this foundational feature e.g. as reflected in the simplified population modules below.



SOURCES

The documents needed to identify this first general characterization are very general documents or sources. In the case of Flanders, the [Factsheet on 2014-2020 Rural Development Programme of Flanders \(Belgium\)](#) is a good example.

Find in the extract below some key indicators of the urban nature of the area and a proposal of indications to find them (marked in green).

1. SITUATION AND KEY CHALLENGES

Flanders is the northern region of Belgium. It covers an area of 13 521 km² and counts approximately 6.35 million inhabitants. The region has a very high population density (475 inhabitants per km²) which is more than four times the average density of the European Union.

Only 7% of the area is rural and 2.5% of the population lives in the rural area. The Flemish countryside is highly urbanised. It has a very fragmented landscape with strong links between countryside and cities. From the geographical, functional and cultural points of view, rural and urban areas are increasingly interlinked.

These are general, often introductory documents or chapters of a more specific subject. Some other links giving answer to the general characterization are [Wikipedia definition of agriculture in Flanders](#) and [Prospects and challenges for agricultural diversification in a peri-urban region \(Flanders – Belgium\)](#) in chapter number 2 intitled *The rural area and agriculture in the Flemish region*.

The Flemish countryside is highly urbanized. It is not only characterized by a high population density and a highly fragmented landscape, quite often the relationship between the countryside and the urban environment is also very strong. The countryside and the urban environment are becoming increasingly intertwined in a geographical, practical and cultural way. The present communication and transport facilities favour economic, social and cultural interaction. As a result, differences are shrinking: the urban environment is an attraction pole for employment, services, education and entertainment. But city dwellers rely on the surrounding countryside for ecosystem services, such as a green area, calmness and recreation. As far as food production, water resources, energy and biodiversity are concerned, rural areas provide important services to the whole society, including the urban environment. Because of the strong linkage between the countryside and the urban environment, dynamics in the rural area are partially determined by the urban environment.

Some other sources include text like this:

Flanders can be portrayed as a peri-urban area, in which agriculture is still a significant economic sector.

In these texts we are searching for structures like

<name(s) of the region or synonyms like the XXX region, landscape, countryside... >

IS, HAS, IS CHARACTERIZED BY, PRESENTS, CAN BE PORTRAYED AS...

Titles are also a clue, like in the case of *The rural area and agriculture in the Flemish region*.

.... IN (THE) <XXX name of the region>

KEY INTRODUCTORY WORDS like Description, Introduction

Figures and numbers are another source of quantified information of the first characterization, with a structure similar to

FIGURE of the region/area/population/...

EXPECTED RESULTS

What we expect from this first analysis is a **literal definition of the region**, that is going to allow us to work on a typified approach to the modelling exercise.

The definition may be completed both with a quantitative analysis coming from the texts (figures included in the text) but also a quantitative analysis of the text itself.

QUESTIONS

To study the possibility for the pilot areas to give some kind of hierarchy of the sources, so that the results could be analysed differently. This could be a valid hierarchy for the sources:

- 1 General introductory text
- 2 Specific (addressing one topic or keyword: agriculture, landscape, population, infrastructures...)
- 3 Super specific (addressing subtopic levels: organic agriculture, commuting, climatic change effect on agriculture...)

Considering 2 and 3 types may also include some introductory chapters (type 1).

b) Issues to be addressed

Once we have a first characterization of the region, we need to fix the boundaries of the modelling exercise, finding the issues to be addressed. These are the main discourses, narratives, trends and changes and also local drivers affecting them.

The issues will come from some of the following topics:

- Population dynamics
- Natural resources and cultural heritage
- Land use
- Territorial structure
- Governance
- Knowledge and R+D+i
- Socio – economic system
- Institutional framework and policies

To help identify the topics find below a proposed list of terms relating each of the topics. This list can be updated as a work in process.

THESAURUS

- **POPULATION DYNAMICS:** depopulation, aging, young, immigration, rural population, urban population, average lifetime, birth rate
- **NATURAL RESOURCES AND CULTURAL HERITAGE:** natural resources management, water use, landscape, biodiversity, natural risks, conservation of the heritage, community implication, environmental quality, waste management.
- **LAND USE:** intensity in the use of land, transformation trends (urban to rural; natural to not natural; protected land; urban uses and planning), territorial polarization, land use normative, forest management, agriculture, agricultural activity.
- **TERRITORIAL STRUCTURE:** urban development, urban sprawl, urbanization, urban fringe, peri-urban areas, horsification, gardenification, rural development, coastal areas, inland areas, polarities and networks, mobility and transport infrastructures, territorial equilibrium, insertion in superior territorial units (region, state).
- **GOVERNANCE:** shared views, identity, strategies, integrated management, corporate participation, public participation, policies, opinion diversity, common entrepreneurship (common initiatives), social cohesion, quality of life, politics about, housing policies, population dynamics.
- **KNOWLEDGE AND R+D+i:** knowledge management, shared knowledge, knowledge generation, agrarian training, information flows, information culture, literacy, generation of patents, doctorates, technology acquisition, skilled labour, advanced start-ups and spin-off, R+D expenditure, higher education diploma, higher secondary diploma, higher secondary vocational diploma
- **SOCIO-ECONOMIC SYSTEM:** structure of the competitiveness for the different sectors (exogenous, endogenous; long term, short term), income polarity,

profitability, environmental externalities of the economic activity, structure of the family and public income and expenditure, labour market, environment principles and rules of the local economy, prices, incomes, outsource, labour migrants, agricultural sector, industrial sector, specialised services, tertiarization

- INSTITUTIONAL FRAMEWORK AND POLICIES: decision making process, strategic and planning mechanisms, leadership, legal framework, provision of public services, objectives, goals, strategic goals, strategies, measures, policies, priority aspects, policy recommendations

SOURCES

Main source documents will be type 2 and 3 studying topics or subtopics affecting the region.

Find below examples of text excerpts coming from the sources provided. You can find on green general rules to identify the issues to be addressed.

The **fall from 42.282** farm managers in 1999 to **29.394** in 2009 coincided with an **increase in the average** age of farm managers from 46.2 years to 49.5 years. Moreover, there is only a small number of **young managers**: in 2009 only 2.3 % of Flemish businesses had a manager aged under 30, and 7.9 % were older than 65 (LARA, 2011).

The context of Flemish urbanisation causes cities to grow beyond their boundaries to form **urban regions** with a city centre, an agglomeration and a suburb. These urban regions are very large compared with other countries. As a result, **the majority of** the Flemish population in the **highly** urbanised Flemish region actually lives outside the city centres (Boudry et al., 2003).

Increasing urbanisation not only **results in** potentially less available open space; a **growing demand** also results in higher land prices.

In Flanders, **climate change** is expected **to manifest** itself primarily in a marked temperature rise with an increase in frequency of extremely hot summer days and in high precipitation variability, with an increase mainly in winter precipitation.

Under a high **climate change scenario**, harvest losses of up to **30 %** are likely due to drought stress for shallow-rooted summer crops such as sugar beet, grown in sandy soil.

Potential consequences in the field of animal production are **higher** wind chill temperatures, **leading to** production losses, new illnesses and plagues, lower energy demand for heating and higher energy demand for cooling (Gobin et al., 2008).

While direct water consumption (total water consumption excluding cooling water) **may have decreased** considerably in Flanders over the past decade (-10 % in 2009 compared with 2000; MIRA, 2012), pressure on water resources remains high. With a **value of** approx. **32 %** in 2007 (EEA, 2009), the Belgian Water Exploitation Index (WEI, actual water consumption

expressed as a percentage of water availability) exceeds the 20 % threshold, which is considered as alarming (Alcamo et al., 2000).

In Flanders, too, numerous claims are putting pressure on the limited available space. Typical local elements of such pressure are the growing demand for construction and industrial sites, 'horsification' and 'gardenification' (Bomans et al., 2009; Bomans & Gulinck, 2008).

One of the causes of the successor problem in agriculture is the fact that lower prices and falling incomes often force farmers and/or their partners to take on extra work outside the business. Only 13.8 % of Flemish farm managers aged over 50 have a potential successor.

Moreover, certain tasks are outsourced, either to contractors for specialised operations that require expensive machinery, or to labour migrants from Eastern Europe (mainly Poland, Romania and Bulgaria) for seasonal work for which local workers are hard to find. Furthermore, an increasingly greater portion of income is earned outside the business.

Thus, 54% of agricultural households derive income from non-agricultural activities. A positive aspect of human capital is that starters in the agricultural sector are relatively well trained: 18% hold a higher education diploma, 28% a higher secondary diploma in agriculture, 12% a higher secondary vocational diploma in agriculture, and 33% an installation certificate.

The decrease in the number of farmers, although increasingly better trained, goes hand in hand with scale enlargement, specialisation, high capital intensity, and small profit margins. This puts continuous pressure on business management: business managers are required to manage increasingly bigger units and are ever more dependent on uncertain markets (and therefore income) and capital markets to finance their business. Poverty and cash flow problems are therefore still considerable, but also difficult to estimate. In 2009, 254 farmers applied for aid from the non-profit association Farmers at a crossroads. However, farmers identify administrative burden as one of their main professional problems, which also generates a great amount of stress. No data are available on social capital, e.g. degree of integration in social life (e.g. membership of associations).

General rules for the identification can be summarized as follows:

WORDS FROM THESAURUS

VERBS (or VERBAL FORMS) INDICATING INCREASE, DECREASE, DEPENDENCE: increase, manifest, grow, lead to, decrease, put pressure, identify

ADVERBS OR OTHER FORMS INDICATING GROWTH OR DECLINE: fall from, the majority of, highly, increasingly

FIGURES OR QUANTIFICATION FORMS: the majority, threshold, greater, better, bigger

Social networks may also be a source rather adding quantitative aspects to the identification than as identification source itself.

Additionally, social networks might work as identifiers of new issues arising (in the case of Flanders: Mercosur negotiations, specific climate change consequences...)

EXPECTED RESULTS

The final result expected is a **list of issues to be addressed** with any kind of quantification coming from figures from the text but also a quantitative analysis of the text itself and the quantitative inputs from social networks.

c) Technical and behavioural parameters

This is the last and most accurate analysis, with the idea of giving clues for the structure of the model, once the issues to be addressed have been identified.

SOURCES

Documents type 2 and 3, and specifically around the words identified in section b (Issues to be addressed).

The job here is to identify this text excerpts that could be easily translated into model pieces. Find below some examples found in the sources provided. Marked in fuchsia key words to identify the excerpts.

The number of starting farm businesses in Flanders **has fallen** under 200 per year. In order to keep the agricultural sector viable, more beginning farmers **are needed**. The **reasons for the low number** of beginning farmers are **multiple**: an insufficient number of economically viable businesses to take over, an insecure and low income, legal uncertainty, increasing social demands, a less favourable image...

The countryside **is facing a rapid evolution due to changes in the Flemish agricultural sector** (**fewer but larger** agricultural businesses, diversification, part-time farming, changing views on landscape and buildings ...).

As in other regions, agricultural activity in Flanders **has changed considerably**, with the **main trends determining** its development in the second half of the twentieth century: intensification, specialisation and concentration.

The research results show that active diversification (being processing at the farm, alternative markets and tourism) distinctly **occurs more as** the distance to the city **decreases** (Figure 10). In other words, active diversification activities **increase as** one **approaches** the city. On the other hand, environmental measures and the maintenance of hedges and trees **occurs more frequently further away** from the city.

The rule to identify is not so clear in these cases, but it has to do with either verbs (verb forms), nouns or expressions giving the idea of causality. Every excerpt of text is linked to an identified issue.

... ARE NEEDED; THE REASONS FOR...; DUE TO...; TRENDS DETERMINING...

...OCCURS MORE AS... DECREASES; ...INCREASE AS... APPROACHES...; OCCURS MORE FREQUENTLY FURTHER AWAY

EXPECTED RESULTS

The results here are dynamics in the form of pieces of text that can be easily translated into models. The dynamics are linked to the issues previously identified, and more than one dynamic may be linked to every issue.

Annex 3 – Responses to the monitors’ comments

| Comment made by the monitors | Explanation |
|--|---|
| The conceptual understanding differs from the understanding in the WP1 reports, which gives evidence of a fragmentation of the project’s tasks and hampered impact of the scientific coordination. | The report point of departure is the definition of Rural Attractiveness worked on WP1 and specified in D1.1. At the same time, a bibliographical review was needed to see the approaches researchers and practitioners have given to the issue. Edition 1 takes into account in first place Rural Attractiveness definition, and then it takes some ideas and dynamics from the bibliographical review. |
| The presentation of the Agricultural Model as central to rural development (page 10) is fundamentally different to WP1’ understanding of the role of agriculture in PoliRural. (...) Where is entrepreneurship, social innovation? | Agriculture had a predominant role in the first version of the model, but it was changed soon after edition 1 was presented for the wider concept of rural employment. This allows to introduce new sources of employment in the rural areas, as well as concepts such as entrepreneurship and social innovation. Now they have been added to ed.1. |
| Decreasing population is not always the rural development problem – e.g. is this really the case for rural Belgium? | Population dynamics is central to any rural development model. Decreasing population will be an issue in most of the rural areas, but certainly not in all. In the case of Belgium, the main dynamic is related to the competition for land, between the different uses, but rural population it is also something to consider. |
| Modules do not sufficiently take account of social capital and forms of community activity that are at the heart of many rural development activities. Infrastructures and quality of life – as mentioned in many of the modules as depicted 28- 36, conceptual clarity would be useful – is this community infrastructure? How is quality of life understood? (to some degree this is answered in fig. 26, but yet very generic terms are used e.g. social capital and it is not clear how this might be measured). | INFRASTRUCTURES / QUALITY OF LIFE module (Figure 26) contains the concept of social capital, as an input to the ‘quality of life’ variable. The concept has been developed in more detail in the following models, but a special attention will be given to this aspect. Measuring this kind of variables is always problematic. Finding proxies for them is something to be worked out with pilots. |
| Territorial capital – what of ecosystem services? Public goods? | TERRITORIAL CAPITAL module contained the variable ‘natural land ecological value’. As this was a first approach, future development in this direction will be made. |