

# Analysis of POE Trial Results

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A core System Dynamic Model of rural regions was developed by 22SISTEMA as part of the POLIRURAL project. The model consisted of 8 modules and contains almost 300 parameters. It was localized with appropriate modifications using local datasets for 11 of the 12 rural regions taking part in the project. Interactive versions of the regionally localized models were made available online with the help of AVINET. These online versions were intended for use by the Foresight teams in each region, to explore the impact of different policy options on regional performance indicators, as a contribution to their regional Foresight exercise. These interactive, online-versions of the core model are referred to as the Policy Options Explorer or POE. This document summarizes the feedback from the project partners on the model, the POE, lessons learned and suggestions for further work.

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## Preparation and Organization

### Background

The regional teams were expected to explore the range of policy issues given priority in their ongoing Foresight exercise, using the techniques outlined in D1.8.

The use of the POE (Policy Options Explorer) was not intended as a substitute for this task which is an important and necessary step for developing the action plan.

The regional teams were asked to use the online POE tool as part of their exploration of one or two selected policy options, with a view to providing constructive feedback on the model, the tool, and its use in support of a key Foresight process.

### Trial Set Up

Given the experimental nature of the underlying a SD model of rural areas, and the use of the POE tool, the regional teams were asked to use the tool to explore a limited number of policy issues and use this experience as the basis for provision of feedback intended to improve both the model and the tool.

With this in mind, the regional teams were required to:

- Obtain regional data to populate the core SDM (about 300 parameters)
- Identify one or two policy issues to be explored using the online POE
- Identify about 10 of input variables to 'parameterize' different policy options
- Identify about 10 output variables to reflect the 'impact' of the different policy options
- An SoE or Statement of Expectations describing what they hoped to achieve using the POE
- A DoE or Design of Experiment document explaining how they intended to introduce the use of the POE tool to their stakeholders, use it and gathering feedback from those stakeholders on the use of SDM and the use of the tool.

When the POE was available, the regional teams were then asked to provide feedback on their use of the POE, under the following headings:

- Did they manage to follow the experimental plan (by comparison with the DoE)?
- Did use of the POE meet their expectations (by comparison with the SoE)?
- How easy or hard was it to understand the model (for them and their stakeholders)?
- How easy or hard it was to understand and use the POE?
- What results did they achieve or what insights did they gain?
- Suggestions for future improvements?

### Policy Issues Explored

Each region involved in the project followed their own agenda based on the needs of their region and the wishes of their local stakeholders. What follows is a brief description of the policy issues each region chose to explore using the locally adapted POE.

**Apulia, Italy:** Encourage the return of young people to the area, or the arrival of new entrants. They saw cooperation between LAGs as key to addressing this issue.

**Central Bohemia, Czech Republic:** Three issues. Support development using the SMART village approach. Support adoption of new technologies and infrastructure based on settlement structure. Use of quadruple helix model.

**Central Greece:** How to boost the attractiveness of the region for tourists, residents, and new entrants. How to improve VET.

**Flanders, Belgium:** Improve the system for balancing rural landscapes with the pressure of urbanization. How to address land management issues such as fragmentation, soil-sealing, water buffering, and biodiversity loss.

**Galilee, Israel:** The construction of broadband or G5 infrastructure for the region, for the development of industry, agriculture, health, education, and tourism.

**Gevgelija-Strumica, Republic of North Macedonia:** Improve economic prospects of young people in rural areas.

**Häme, Finland:** Support creation of new business and growth of existing businesses. Maintain population. Enhance community activity and vitality of rural areas.

**Mazowieckie, Poland:**

**Monaghan, Ireland:** The potential for development based on non-traditional entrant's including youth, women and families moving to or remaining in rural Monaghan.

**Ségobriga, Spain:** Provided no clear statement of policy challenges to be explored.

**Slovakia Region:** How to implement the new CAP at national level and have a more strategic discussion about the National strategic plan.

**Vidzeme, Latvia:** How to increase the level of civic participation and public involvement in the promotion of territorial development and implementation of initiatives. Support development of high value-added products and services within existing and new EU funds and EC priorities.

## Initial User Expectations

In advance of using the POE, each region was asked to describe how they expected the POE to help them in the overall Foresight process. Although the overall understanding of the system and what it is intended for, seems OK. It is surprising to note that some of the users expected it to provide 'predictions' or estimate realistic 'targets' for impact variables. It seems very unreasonable to expect the model or any of its regional variants to provide predictions. On the other hand we did hope that it might exhibit some of the complex non-linear phenomena that characterize complex socio-economic systems. The expectation of the SDM designers was that it would help users gain a better understanding of the dynamics of change in rural regions. In particular it was hoped that it would help them understand the role of feedback loops and the evolution of policy impacts over time, and thereby enrich their discussions on which policy options to adopt. A summary of the initial expectations of each user group is provided below.

**Apulia, Italy:** No statement of initial expectations provided.

**Central Bohemia, Czech Republic:** The POE should support evidence-based decision-making. It should enable the comparison of data collected within each region of Europe. The POE should visualise

entered data and help to predict future development in the fields of interest. Users should be able to identify what trends will affect regional development, resilience, and quality of life. They should be able to compare the results of their SDM experiments with results of neighbouring regions, the capital and other regions of Europe.

**Central Greece:** The POE should predict future developments in fields of interest such as agriculture and tourism. It should allow policy makers identify trends that will affect regional development.

**Flanders, Belgium:** The POE should provide insights into the complex agricultural land use system in Flanders. For example in terms of how land use has changed over the years, in terms of who it will change in the future, the drivers of those changes, the impact of those changes, the conflicts that have arisen.

**Galilee, Israel:** The POE should support a decision by the central government to upgrade the digital infrastructure of Galilee with analysis which is complementary to other forms of analysis which have been undertaken to support their decision.

**Gevgelija-Strumica, Republic of North Macedonia:** Insights into the possible impacts of different policy measures over time. It is hoped that the use of SDM to model policy impact will help policy makers understand the need for good data to support policy related decision making and take measures to ensure the future availability of relevant data.

**Häme, Finland:** There is growing interest among stakeholders in systems thinking and the use of data-driven tools for simulation to support decision making. The POE should confirm the general feeling of stakeholders that has emerged in public talks.

**Mazowieckie, Poland:**

**Monaghan, Ireland:** The POE should simulate the evolution of trends related to the policy challenges being explored.

**Ségobriga, Spain:** No initial statement of expectations provided.

**Slovakia Region:** No expectation provided, just the expression of an intention to “present it as an innovative tool that can be useful for policy makers especially taking into account the limited personal capacities they have.”

**Vidzeme, Latvia:** The POE should help to illuminating the causal chains which link the policy options and the impact values. It should help to identify realistic targets to be achieved. It should help the users to identify important trends and motivate deeper discussions on the dynamics of development and the policy choices to be made, even if the data and the model is somehow incomplete.

## Execution

Feedback was obtained for 11 of the 12 regional teams. About half of the regions seemed to really understand what they were asked to do. All provided useful feedback and impressions.

Our goal was to obtain POE user feedback on at least two levels. On the level of feedback on the model, the ease with which it could be understood and its adequacy for the task at hand. In many cases the ‘intervention logic’ implicit in the choices made was highly questionable. The choice of policy

options to explore, as well as the choice of input and output parameters reflected how much each regional team understood the functioning of the rural economy and society. In many cases the choices of policy-impact parameters seemed ill suited to the issues being explored. This was to some extent a reflection of shortcomings of the underlying model. It was also a reflection of users' understanding of how economies and societies work, as well as how growth and development actually happens.

We also wanted feedback on the tool itself, and the ease with which it could be used.

## Stakeholder Involvement in the POE Trials

Each region organized its POE 'trials' differently. This seemed to depend on the level of confidence each team had in the tool and in its readiness for use by policy makers or by the general public. In some cases, the testing of the tool was limited to attending the training and its use by an internal team. In one case the tool and the principles on which it was based was presented to a large audience as part of a bigger process focused on the development of the vision. In other cases the tool was used by several groups of stakeholders.

What follows is an attempt to briefly summarize the variety of different approaches taken. This is perfectly in line with what was requested of the regional teams. These were given freedom to carry out these tests in the way they saw best and were asked to simply provide a short description of their 'design of experiment' in advance of their use of the tool, and to comment later on whether and to what extent this worked out as planned.

- **Apulia, Italy:** 15 stakeholders tested the POE, mainly from academia.
- **Central Bohemia, Czech Republic:** The POE was shared with all members of the stakeholder panel and relevant experts were asked for more detailed analysis of the model.
- **Central Greece:** The POE was tested by about 38 stakeholders, in 3 separate trials, with 10 from academia and 20 local stakeholders.
- **Flanders, Belgium:** No testing was carried out. But 2 from VITO attended the training
- **Galilee, Israel:** 3 from MIGAL attended the training. No trials have yet been scheduled with the stakeholders. They plan to do this later on.
- **Gevgelija-Strumica, Republic of North Macedonia:** 8 policy makers took part in the training.
- **Häme, Finland:** 2 stakeholders attended training. Links to the POE sent to other stakeholders. HAMK shared the application link and ID/Password with the stakeholders and urge them to test the application. 1 stakeholder commented the application.
- **Mazowieckie, Poland:**
- **Monaghan, Ireland:** 7 of 33 stakeholders from the regional user panel completed a feedback survey.
- **Ségobriga, Spain:** 5 internal and 7 external stakeholders took part in POE trials.
- **Slovakia Region:** 75 stakeholders were involved in the trial as part of a physical meeting.
- **Vidzeme, Latvia:** 80 attended an SDM seminar. 25 stakeholders took part in the training, most of them policy makers.

## Trial Results

## Insights Gained

These were of two kinds. Insights concerning the SDM model and the POE tool. The general feedback and insights gained are paraphrased as follows.

**Apulia, Italy:** Thanks to the model it was possible to identify some elements that can be obtained by local policies and direct us to the drafting and completion of the Action Plan. Despite the lack of data, the model helped stakeholders to understand some dynamics such as the growth of the elderly population and the decline of the youth population. This supported a discussion on measures to encourage return of young people to the Apulian area based on remote workers, a trend which has increased following the current Covid-19 pandemic crisis.

**Central Bohemia, Czech Republic:** No insights to report.

**Central Greece:** The POE tool was used to get insights in how certain policy changes can influence tourism and agriculture. The impression is that such a tool could be beneficial in planning as it provides a different way of focusing on elements of the Action Plan and the impact of the planned measures.

**Flanders, Belgium:** Based on the training, we saw that there is certainly value in the POE, to get insights into how policy changes can influence land-use in Flanders. We noticed that when certain control parameters are changed unrealistic results are obtained. This may be related to the input data used to calibrate the model, missing data, or model assumptions made which do not reflect the reality. So, there is still a need to fine tune the model before it can really be put to use.

**Galilee, Israel:** We learned how to operate the POE in the most fundamental way. We understood the difference between the current and comparison trends, and how to configure the model.

**Gevgelija-Strumica, Republic of North Macedonia:** We learned basic concepts of SDM, got an idea of the kind of results it could provide and how it might find its place in the Macedonian system for policy development and implementation. Policy makers who took part in the trials understood even for abstract measures, empirically based models that can assist in the evaluation of policy options. Nevertheless, much more training is required.

**Häme, Finland:** The POE trials opened our eyes, raised many questions, and sparked our curiosity. It started a discussion on the how often policy decisions are made based on data and or the results of simulation. It works well as an introduction to SDM and rural development. Especially as it stresses the need for a holistic approach to planning. It made us aware of the role of feedback loops, the huge number of variables and their interactions. It revealed the complexity of rural development.

**Mazowieckie, Poland:**

**Monaghan, Ireland:** See detailed report ...

**Ségobriga, Spain:** In the stakeholders meeting, not so much attention was paid to the values of the results offered by the model, but it served to exchange reflections and aspirations of the stakeholders about the territory, in relation to the different issues that the different variables represent (tourism, broadband, agriculture, institutional support). In our conversations with the stakeholders, they reflected on the difficulty of making long-term forecasts, due to the changing environment in which we live in recent times where external factors condition the entire scenario of prices and availability of raw materials (COVID, War in Ukraine). Use of the POE reinforced the importance of supporting entrepreneurship in the territory. They concluded that this is something that will have to be promoted to a greater extent in the Action Plan. They came to a better understanding of the importance of training for entrepreneurship as well as for acquiring skills that allow population to get the best

possible performance from broadband, taking into account that broadband which in a few years (2-3 years) will be a reality throughout the territory.

**Slovakia Region:** Participants in the POE trials learned that new innovative tools are being developed and used for supporting the rural policies design. This was highly appreciated.

**Vidzeme, Latvia:** We explored how population dynamics would influence the business and employment landscape. This involved simulating the potential number of enterprises and employees per economic sector. We found that the model had many shortcomings. These along with suggestions for improvements are provided further on.

## User Experience

A small number of users (Monaghan and VIDZEME) dug deep in their use of the tool and provided a detailed reports on the work they carried out, as well as on feedback from the users. Others such as Segobriga, have though hard about the model and provided well considered feedback. What follows is a summary of the most important points provided by the regional teams.

**Apulia, Italy:** After some initial difficulties, we became familiar with the software and understood how to use it. The impression is that the tool could be beneficial in planning. However this requires users to possess technologies skills that not everyone has.

**Central Bohemia, Czech Republic:** All users appreciated the POE being available free of charge. But even from an experts' point of view, the whole system appears complicated, and difficult to understand, especially without a manual and further instructions.

**Central Greece:** The general feedback from stakeholders was neutral to positive. Stakeholders found the use of SDM to be an interesting and potentially valuable new approach. All appreciated the availability of the model free of charge. They found the model and the POE to be complex and hard to understand. Without descriptive guidelines it is difficult to adjust the model according to the preferences of each end user. The complexity of input parameters was an issue. We discussed the timeliness and complexity of the input data on which the model is set. When it comes to comparing different regions, it is crucial to have the same or similar input data. This fact is essential for further modelling and comparison of regions.

**Flanders, Belgium:** We found the SDM exercise to be very useful. The tool itself was easy to understand. However the model was not explained in the POE interface, giving a feeling of a black box, and a lack of context for informed use of the tool.

**Galilee, Israel:** The PoliRural working crew at MIGAL has no expertise in modelling. A far more extensive and thorough training is required for a better comprehension of the SDM baseline model. The model was not detailed enough for our purposes. More dependent and independent variables dealing with 5G antennas and broadband, would have helped.

**Gevgelija-Strumica, Republic of North Macedonia:** In general, the general SDM concept and tool were easy to understand. From a technical point of view, the tool was easy to use. Improvements should be made to the interface and guidelines provided.

**Häme, Finland:** The application technically was easy to use. The algorithm, variables and data need more explanations to enhance credibility and trust on the model and the POE.

**Mazowieckie, Poland:**

**Monaghan, Ireland:** The stakeholders found the Monaghan model and the related experiments to be a potentially valuable new approach. However, the tool was complex and not easy to understand. It needs more refinement. One stakeholder commented “I can understand that a tool like this would be beneficial in planning. However I think that it is a tool that requires an analyst for interpreting the results. It is one thing to look at a graph and see line changes for a given scenario but evaluating the impact can only be done after the fact, with hindsight.” Another said that “it would be very hard for an individual to use the system. It needs a research background to both set up and interpret the queries.” Many of the results of experiments with policy options were surprising and were non-intuitive. For example, they found that maximizing the impact of the AKIS input valuable, could actually lead to reductions in rural population. Other surprising result of the use of the model included the result that increasing the investment in entrepreneurship didn't appear to affect related output indicators such as population. Nevertheless, this led to some productive conversations. For example, “improving AKIS leading to more efficient farming, may result in bigger more efficient farms, but less families in the region.” There were many comments on how to improve the user interface. These are provided further on.

**Ségobriga, Spain:** The reliability of the model depends on the quality of the starting data. In many cases the data we used was not from official sources. Often it was not 100% in line with the definition of the requested indicator. Stakeholders commented that they did not understand the value of the percentage of 3% included in variables such as “Visitors ratio objective.” It would have been easier for stakeholders to understand the model, if the variables, descriptions, and KPIs had been named and explained in Spanish. The logical connections between the variables and the KPIs of the model also need to be examined and may be questioned. It would be good to have the possibility of new variables or KPIs for the POE. There is still a long way to go to refine both the model and the tool. Nevertheless, we are optimistic and feel that this approach has a promising future.

**Slovakia Region:** Participants did not work with the model since the scope of the Slovak experiment is very limited. It did not have much impact on their perception of the challenges, or on decision making with respect to policy options or policy mixes. We found it useful, but very limited due to the lack of data. With sufficient data it could be a very useful tool supporting the Ministry of Agriculture and Rural Development as well as researchers in their work.

**Vidzeme, Latvia:** The users found it useful and easy to use when compared with existing systems which are either spreadsheet based or rely on professional business intelligence tools, which require an expert to run the simulations and interpret the results. The system was fairly easy to understand but some parameters such as “time to achieve common shared knowledge” lacked descriptions and guidelines on what they mean and how to choose a particular value. The overall impression is that this could be a very useful tool for planning experts. but it took some time to get a handle on what it does and how to use it effectively. Much more support is needed to help users interpret the results. It did not have much impact on the perception of challenges or decision making with respect to policy options or policy mixes. Users highlighted the need for long term training on the use of the POE in order to fully understand how this model can be used for policy making and policy evaluation.

It looks easy to use and could bring value to planning experts, but it should be explored and understood in more depth. It probably needs to be more adapted to the regional reality and

potential needs of the stakeholders. Some of the participants specifically pointed out the opportunities to use such tools for expanding the field of thinking, creating vision, generating ideas – as a brainstorming tool. Two participants of the seminar denied the usefulness of such a tool by saying either it is too complicated and is a burden, or that all needs and solutions are already known, so there is no need for such a tool.

## Data Availability

Even though the regional teams were required to choose 5 to 10 input parameters to model policy options, and 5 to 10 output parameters to model impact, they nevertheless had to provide data for the 300 parameters needed to run the model. The availability and quality of data was therefore a major concern. The feedback from users on data related issues is summarized as follows.

**Apulia, Italy:** The current model, due to the lack of data, is unable to provide a clear idea of the Apulian situation in every area. Very often the available data were too few or inadequate. One reason for this is that data gathering in Italy is slow, especially in the agricultural context. Some of the data required for the model were ‘interpreted’ based on subjective knowledge. To improve upon this data would have to be acquired for a fee from the FADN or Farm Accountancy Data Network.

**Central Bohemia, Czech Republic:** The SDM requires long time series data from different sources to work properly. Such data is often unavailable on the regional level, and sometimes even on the national level. Some important data simply does not exist, and it is not comparable with data from other regions across Europe. Other issues relate to data formats. The POE experiment used mainly data obtained by the Czech Statistical Office. Data from other sources such as the IAEI or Institute of Agricultural Economics and Information, could also be used. But data from such sources are not collected regularly or in long-time series and in formats that are often different from the Czech Statistical Office. Missing data is a major challenge for the whole Central Bohemian Region as the biggest and most populated region in the Czech Republic. Lack of data could bear on the specific settlement structure with more than 1000 villages. A related issue in the use of such data and SD models and POE tools at the level of small villages is insufficient human capital working in municipalities, as well as the lack of experts able to use such data and interpret results of modelling.

**Central Greece:** The SDM requires selected long time series data from different sources to work properly. Unfortunately, this kind of data is often unavailable, not only at regional level but also at national level.

**Flanders, Belgium:** Good quality data is key. The data we needed for the model was not always available. Ideally such data gaps should be taken into consideration when building the SDM.

**Galilee, Israel:** The model and the POE in its current form, does not provide a coherent working tool. We are well aware that the tool as it is provided needs long-running time series. This is a fundamental challenge for analysing the development and impact trends of 5G and broadband in Galilee, as the availability of such data is limited.

**Gevgelija-Strumica, Republic of North Macedonia:** A detailed discussion of the availability of data and compromises made was provided by the partners. Data collection required a joint effort by AGFT and GGP. Data was sourced from many institutions. It was incomplete. It differed in both coverage and resolution. As a general rule, it was only available at national level. Data for SDM modules dealing Rural Attractiveness and Rural Retention Capacity, were based entirely on the opinion of members of

the regional stakeholder group. This suggests that important elements of regional dynamics were not captured by the SDM.

**Häme, Finland:** Some of the required data was easy to obtain through national institutions. Nevertheless some data sets were fragmented or even impossible to find. The requests for data on natural capital, accessibility, rural attractiveness, and rural retention were hard to satisfy. In these cases data was created based inevitably biased, subjective assessment.

**Mazowieckie, Poland:**

**Monaghan, Ireland:** Data was missing for many years. Some data sets only had data from the national census of 2011 and 2016, with no data for the other years. In some cases the gaps were filled in by 'interpolation' in other cases by 'interpretation' being based on figures or neighbouring counties. Finding data related to Quality of Life, Rural Attractiveness and Natural Capital was especially challenging.

**Ségobriga, Spain:** Our view is that the model cannot provide meaningful insight unless it is based on complete series of data, at the appropriate scale. It was especially difficult to obtain data at municipal level. Some of the requested parameters were very hard or even impossible to obtain given the resources of time and labour available in the project. Basic data on birth rates, fertility rate and life expectancy was simply not available at municipal level. The same for parameters such as "average lifetime for a business", "Remote workers" and "Unskilled workers." Data for indicators such as the 'number of farms' or the 'average farm area' were only available for single year out of the 20 required. Data for parameters such as 'retirement substitution' and 'time with no changes to be expelled from the market', were provided based on the opinion of experts. In principle annual data for parameters such as 'farm income' should be available via the FADN or Farm Accountancy Data Network, was not available at local or even regional level. Some parameters such as 'natural capital and 'effect of agriculture on Natural Capital' were simply too difficult to understand. Requests for tourism related parameters such as 'potential visitors,' 'normal attraction ratio' or 'rural attractiveness' do not correspond to statistics that might be collected. These terms also require explanation.

**Slovakia Region:** The majority of the requested data sets are not available. The responsible Ministry of Agriculture and rural development was contacted in this regard as well as the Statistical Office with no new inputs provided. Lack of data was highlighted as a major issue negatively affecting the development of rural regions. Without the relevant data of adequate quality data, it is very difficult to measure the impact of policy options and use this to drive policy selection.

**Vidzeme, Latvia:** At best the model only partly reflects the selected policy challenges. In most cases this is due to a lack of data at regional level and the need to infer regional or local data from data aggregated at national level. The parameters of the model should be explained better. The model documentation suggests that some parameters are just combinations of other parameters. These combinations are hard to follow. They do not help the user to understand where the data is coming from, how they are calculated and how they might be used to explore policy options. More explicit information is needed on the links between variables of the model, explaining how the parameters are interacting. It might have been better to enable the exploration of smaller, "nested" models, separately covering thematic areas such as 'entrepreneurship' or 'land use.' Alternatively, some means for quickly and iteratively executing the model might help to better understand the causal relationships between control variables and KPIs. Many phenomena of interest, such as the movement of workers from urban to rural areas, are recent and no data is currently being collected on them.

These are not covered by normal employment statistics, yet they represent a big portion of newcomers to the region. Issues such as 'quality of life' are complex and multi-dimensional in nature, cannot be modelled in a meaningful way with a single parameter and require a more nuanced approach. The same holds for parameters such as 'natural capital' which is only partly covered by data on protected areas. For these reasons and for other reasons related to changes to the definition of territorial boundaries, the current model as it stands does not give an appropriate picture of the main policy challenges. To do so requires the collection of additional data, and the inclusion of new parameters in the POE.

## The Underlying Model

**Apulia, Italy:** The model for Apulia was clear and comprehensible. initial difficulties arose related to the collection of data and understanding some of the required parameters. Lack of data means that the analysis based on the POE is less complete. The tool will not allow us to make exact predictions. It may allow us to understand which parameters have the most significant influence on policy outcomes. It is therefore possible that the POE can help policymakers make policy decisions.

**Central Bohemia, Czech Republic: Users of the POE drew attention to** positive trends caused by COVID-19, which are not captured by the model, but which will have a significant effect on the behaviour of inhabitants of the region. These trends include WFH (Work from Home) which has reduced the commutes of people from the Central Bohemian Region to work in the capital city. This has had positive impact on the environment and also on the economies of local towns and municipalities. On the other hand, WFH requires adequate internet connection. It also suggests that the pandemic could have a positive impact on attracting young people to education in agriculture, supporting new entrants to agriculture and boost innovation in the sector. This we figured out on our own. It would have been nice to see elements of such dynamics reflected in the model.

### **Central Greece:**

**Flanders, Belgium:** It was to be expected that Adapting and calibrating the baseline SDM was a challenge for the Flanders pilot. Many of the assumptions made in the baseline model are not valid for the Flanders pilot area. The Flemish countryside is highly urbanized. It has a very fragmented landscape with strong links between rural and urban areas. Because of this, the dynamics that we need to model are different from those that characterize a fully rural area. For this reason it was not possible to calibrate the SDM baseline model to the Flanders pilot area. Instead, we used a model which focused on agricultural land use, with a view to exploring policy options for aligning the use of landscapes with the demands of urbanization.

**Galilee, Israel:** We faced difficulties in coherently understanding the interrelations between the variables. We therefore had difficulties understanding the model itself. Only 6 model parameters were related to the introduction of 5G antennas and broadband. These were not sufficient for our purposes and so, we were not able to calibrate the model to the Galilee pilot objectives, and therefore were not provided with a tool adequate for our needs.

**Gevgelija-Strumica, Republic of North Macedonia:** Meetings were held with 22SISTEMA to understand how different variables in the model are interconnected. Considering the complexity of the SDM model and the available time allocated within the project, it was a major challenge to understand the model and the method for using the POE. The model requires credible, high-quality

data from relevant stakeholders. But obtaining adequate and appropriate data was not possible. Macedonia has not conducted a census in the last 20 years. For experienced policy developers the model may be understandable, and the POE tool is to some extent easy for use. But extensive training and awareness of the use of such tools is required to embed such practices in the policy process. The current conditions for adoption of such tools and related policy practices are not favourable. This is due to the constantly changing political environment where each new minister brings their own approach and where there is no continuity with the past.

**Häme, Finland:** The model itself seems logical and understandable. But some of the variables and the related data are not understandable. For example terms such as 'natural capital,' 'accessibility,' 'rural attractiveness' and 'rural retention.' These are not well defined and in practice rely entirely on subjective (biased) assessment. To be more useful, modifications or adaptations to the model are needed. For example HÄME is interested in dynamics of young adults, those who are less than 40 years old. As it stands, the model works with age groups 0-5, 6 - 15, 16 – 20, 21 - 65 and > 65. A new group needs to be added, for example young adults 21-40 years old. We adapted our approach out of necessity, but the model did not address our real need.

**Mazowieckie, Poland:**

**Monaghan, Ireland:** Some of the variables such as Social Capital and Natural Capital took some time to understand and appreciate, and then we had to find suitable data sources.

**Ségobriga, Spain:** We experienced many difficulties understanding the model. It was at first not clear how our policy 'options' or 'scenarios' could be compared to the 'baseline.' Then we had difficulty understanding how the 'baseline' would be modified by the choice of policy options. It has also been difficult for us to understand how the 'baseline' could be modified by the different scenarios we defined. It was difficult for us to understand which variables can be modified to reflect different policy scenarios and which ones measure the impact of those policy choices. In our experiments, each variable was modified to see how each element influenced the others. Finally, the values of all the variables were raised to the maximum to see how the model behaved. The results did not correspond to common sense. This raised questions as to the validity of the model. The response of the model seems to rely on a series of hypotheses. But there is no indication of what those hypotheses are. We need to know this to be able to explain to stakeholders what is going on in the model. We need to discuss these with the stakeholders or users to be sure that everyone accepts them and believes them to be reasonable. In particular there is a need to explain the link between the Natural Capital module and factors such as climate change or the European strategy for Biodiversity. More work is needed to understand and explain parameters such as 'new-comers' or 'remote workers' and how they relate to other parameters of the model.

**Slovakia Region:** The model seems simple but limited due to the significant lack of data.

**Vidzeme, Latvia:** The first draft models made in the Stella environment didn't provide the expected interactivity and it was not possible to run the model and perform experiments. The POE provided an improved web-based model where we could run the model and experiment with various parameters. Doing this required a certain learning curve. We needed to adapt to the functionality of the model and faced several uncertainties. The weights and links between the data and the nature of the underlying assumptions were not clear. We would have liked to be able to see 'what makes the lines go up and down', when and how trends are taken into account. For example we would have liked to see what the role is of 'changes in legislation' or how 'global events' could be taken into account. Although we provided a lot of data, we got the feeling that the model only used a part

of the data provided, and that it did not provide a meaningful representation of regional reality. For example when we explored the impact of newcomers on the region, the results showed no difference despite adding a significant number of newcomers. This goes against any logic. It undermines the credibility of the tool and our faith in its use as a support for policy related decision making.

## Suggested Improvements

**Apulia, Italy:** It would be great to get written instructions and/or an introductory video explaining the system to the users. The POE has great potential as a support to policymakers. Continue to invest in improving this application. Meetings could be a starting point to raise awareness of the potential of SDM. But scientific papers would also be excellent. It means investing in dissemination.

**Central Bohemia, Czech Republic:** It is necessary to clarify the source of input data and prepare a detailed manual on how to work with the model, explaining for example, which functions are available and what outputs the model offers, especially for users who are not used to working with comparable models.

**Central Greece:** The SDM concept has significant potential as a tool to assist in planning for rural development. Especially as a tool that help understand how certain policy changes can impact the region. However, it requires more work to improve its useability. A 'help' tab would be useful. A detailed manual or set of videos is needed on how to use the POE. There is a need for more 'descriptive labels' for the input parameters. There is a need for clear indications of the allowable range of parameter values. There is a need for a better system for selecting 'input' and 'output' parameters. The set of parameters is very long and should be divided into categories. The data issue needs to be addressed as any credible model should be based on good quality data, available for many years.

**Flanders, Belgium:** The user gets a 'black box' feeling when using the POE. More model context should be provided to avoid this.

**Galilee, Israel:** Our advice is to invest more in training and 'mediating' the platform to make it accessible to a non-expert audience. As for any other product, the first encounter and impression and the confidence it creates in its future operation, is of crucial importance. We believe more investment should have been made on this aspect.

**Gevgelija-Strumica, Republic of North Macedonia:** Based on our experience using the POE within the Macedonian policy system, we observe that...

- Long term training is needed in order to fully understand how this model can be used for policy development and policy evaluation. Also, there is a need for the customised adaptation of the model for the specific characteristics of the region.
- Where technical capacity exists within the system to adopt approaches such as SDM and use tools such as the POE, those people have little or no impact on policy. This is a structural issue related to our system of governance.
- The usefulness of this approach is completely jeopardised by poor data or the lack of relevant data, as well as the inability of the national statistical office to support the rural development policy process. Of course, for the time being there is no clear rural development policy process.
- If SDM and tools such as the POE are to make a regular contribution to policy development and evaluation, they need to be simplified for key decision makers, that is they need to be made

accessible to and understandable by the key political figures that manage the policy development process.

**Häme, Finland:** More information is needed on the raw data provided and how it is used by the model. The variables need to be explained. In many cases it is not at all obvious what they mean. One example is the use of a variable called 'Community Climate.' The model should be supported by scientific analysis and references to scientific papers. Some factors could even be removed. For example 'primary sector workplaces' is a very small number and does not impact on anything.

**Mazowieckie, Poland:**

**Monaghan, Ireland:** The SDM approach has significant potential to assist in Rural Development planning. The system is challenging to use in its current format and more work is required to improve its usability. The system usability is low and not at all intuitive. It is important to remember that although a good number of the population is proficient with technology, many ordinary folks would not feel confident in utilising this tool. There is a need to

- Provide user support in terms of help tabs, user manuals or introductory videos.
- Improve the visual presentation of certain items. For example, the pop-up window on logon, it is not at all clear what to do when it appears. The blue and red 'compare' and 'current lines' are very confusing. Downloading graphs as PNG files is a bit awkward, JPEG would be better.
- Simplify the jargon. For example, terms such as 'baseline information,' 'current situation' and 'project outcomes' are not clear or easy to understand.
- Add a search bar to the variables. In other words, refine the selection method for input and output indicators. Group the 300 input indicators under thematic dropdown lists and provide some kind of a search engine to help users find relevant ones.
- Explain the parameters better, indicate their value ranges, and what parameter choices imply.
- Explain what each input setting does and what to consider when choosing them
- Help users understand the outputs of the model and what the 'graph lines' represent.

**Ségobriga, Spain:** The reliability of the model is directly related to the quality of the data that feeds it. For this reason, it is recommended to improve the base information, improving data collection methods, having complete series of data that allow trends to be established, in order to guarantee robustness and provide credibility to the model.

It would be very useful to include 'Info' or brief guidelines, to explain the objective of the POE, the meaning of each variable and reference values for the baseline scenario. It would also be of great interest to add information about how KPIs are influenced by the modification of each of the control variables, so that the person who uses the model can understand what variations can be expected on the KPIs when the control variables are modified. Some stakeholders could not participate in plenary meetings where a technician was available to explain how to use the tool, and they were forced to test the tool on their own. Some stakeholders are representatives of some groups or entities and wanted to show the tool to the members of their communities. It would be interesting to have this reference information as a guide, to resolve doubts and avoid misinterpretations of some variables.

There are many issues with the variables that need to be improved, to clarify their meaning and the values assignable to them. Many of the choices or designs require discussions as to their relevance, importance, and connection with other variables. In conversations with the developer of the core

model, we tried to clarify issues related to the parameters, their meaning and measurement. But questions remain and more arose in trying to use the POE interface.

A short list of some of those issues includes...

- The 'CAP Eco-schemes' parameter uses a scale between 0 and 5 where 0 means not implemented and 5 means fully implemented. The 'AKIS effect' parameter affects the entire agricultural model, but in our model, its influence is focused on the agriculture Jobs KPI. Stakeholders pointed out that input variables such as 'ECO-schemes' and the 'AKIS EFFECT' and KPIs such as 'Agricultural Jobs' were not relevant to the development of the Strategic Plan based on tourism. They commented that there was a need to include more specific variables related to tourism would have been of greater interest, such as, number of services, number of tourist companies, volume of private investment, nights spent by tourists...
- The parameter for 'institutional support' reflects 'additional institutional support relative to 2022' and takes values between 0 and 100%.
- The parameter for 'technical obsolescence time' reflects how a business stops making investments into a technology when it is no longer viable. It is affected by climate change, which shortens the obsolescence time. A value of '1' means that the business requires investments within one year to remain viable.
- The 'time to complete broadband campaign' is related to a % goal that is established by the 'broadband coverage' variable.
- The 'visitors ratio objective' is based on the 'potential visitor population,' which is defined in terms of natural capital, implying that the more 'natural capital' the higher the potential visitor population. Stakeholders commented that they miss environmental variables that allow assessing compliance with the Green Deal objectives, such as energy savings and decarbonization that would be achieved thanks to the implementation of a sustainable tourism plan.
- The 'cultural appeal' variable is derived from another variable in the system. So when the value of the 'cultural appeal' is modified, the cultural appeal itself is not altered, but rather the way in which it depends on 'shared knowledge.' It affects 'rural attractiveness' and 'newcomers' but we have observed that an increase in cultural appeal has no appreciable impact on jobs. In order to better understand what Cultural appeal refers to and its relationships with other variables and KPIs, it could be necessary to add a description of its concept In the Eco schemes variable.
- The 'housing accessibility' factor is an internal variable of the model, so it cannot be changed when the tool is used to define policy scenarios. It is only possible to modify the weight that "housing accessibility" has in the module "rural attractiveness" or "rural retention" for different age groups. It would have been very useful if the variable Housing accessibility could be modified when defining the scenarios, in the case of action plans that launch actions to promote access to housing, which is one of the great limitations in the arrival of newcomers in rural areas.
- In the 'time' variable to complete broadband campaign, the value cannot be increased by more than 15 years. Our vision is based on 2041, as the final reference year, so there was a gap between what we wanted and what the model allowed.
- In some cases, the model asks the user to select from 0-5. It does not give the possibility of entering a number between 0-5, but instead asks for a trend by drawing a graph. It is not clear why for some variables the model requests a number or percentage and for others choose a trend. It would be interesting to know why this is displayed like this and if it is the same for all models or depends on data availability

- It would be useful to define the two scenarios being compared in the graphs with a more descriptive and clearer name, because the names of “current” and “comparison” are not clear enough. In this sense, the idea that an Info section, clarifying concepts, would be very useful.

**Slovakia Region:** Include a number of young farmers into the tool. Figure out how more and better data could be included and how this tool could be used by relevant policy makers when designing the policies. It was recommended to do one more experiment dedicated only to policy makers from different ministries and policy levels and also researchers from the universities and specialised research centres dealing with agriculture and rural issues. But first the issue of data needs to be resolved to have a more broader impact.

**Vidzeme, Latvia:** A more detailed explanation of model variables is needed. Also an explanation on how composite variables are computed inside the model. There are equations in the list of variables, but they are obscure and don't clearly reflect the reasoning behind the model. There is a need for guidelines how relevant data can be obtained for input variables. There is a need for improvements to how variables are presented and searched. For example a 'mind-map' interface could be useful when choosing variables as inputs or as outputs and indicate what other variables it influences or is influenced by. Such a graph could be limited to 1 or 2 levels so as not to overwhelm the user by showing the full model. Improvements to the interface could include

- Reading the precise values from output charts by hovering over the lines.
- Editing input scales for input variables. Some of these are limited too much. For example investment is capped at €3M.
- Ability to add new (custom) model variables would be a big advantage but would require also writing of Stella models not only reading.

## Conclusions

### General Observations

The regional teams more or less followed their DoE for evaluating the model and the POE. Deviations from the original plans were justified on the basis of first user feedback, the confidence this gave them in the system and their impression of how well it was adapted to their needs.

Many teams appreciated the fact that it was available for free and compared it with systems that are available only for a fee or which can only be used with the help of dedicated experts.

Most (but not all) teams saw significant potential in the use of the model and the tool, as support for policy makers and for group work with stakeholders in collaborative policy processes.

All felt that the model and tool needs much more work before it can be considered a reliable tool to support the work of policy professionals in public administration, facilitators leading group work with stakeholder panels, or motivated members of the public interested in independent exploration of policy options.

The initial expectations of the users were generally in line with those of the developers. There was no expectation that the tool could provide 'quantitative predictions' of the impact of policy options on KPIs. On the other hand it was intended that the tool should be faithful to reality in that it provides 'qualitative predictions' to support the comparison of policy options. This meant that the model would have to be good enough to exhibit realistic qualitative responses to policy stimuli, to support a useful

comparison of policy options, an understanding of the trade-offs between different options, an understanding of the interaction between elements of a policy mix, and an understanding of how the system would respond to policy choices over a period of time. It is clear that this was very well understood by a small number of users, and they used the system in accordance with these intentions.

Nevertheless, some users expected that use of the tool would allow them to make quantitative predictions of how selected KPIs would be impacted by specific policy choices. Perhaps this may be possible one day, but for now it is far too much to expect of the model.

Some users expected that the POE would allow them to explore trends, identify patterns and discover drivers. This was not the intention when designing the tool. It is something that can easily be done by other means. But it is a reasonable request and may be included in a future version of the tool.

### Summary of Feedback from Users on the Tool and the Model

The most positive outcome of these experiments was that in some cases the use of the tool stimulated useful new thinking about rural regions and their tentative action plans. In these cases, it caused the users to engage in deeper conversations about specific aspects of their action plan. This is indeed what was intended. Arguably, such a result on its own, could have been obtained by other means at much less effort.

All users had difficulty acquiring data with which to 'regionalize' the model. In many cases, data was simply not available, not for any year and not at any level of resolution. In some cases data was only available for a single year out of twenty requested. In some cases data had to be made up based on 'expert' opinion. In other cases the requested data was ambiguous or of questionable relevance. The regional models were therefore built data for a large number of parameters, which varied greatly in quality, coverage, resolution, and reliability. These issues are nowhere visible in the model, undermining. A lack of transparency on the source and quality of data, makes the tool difficult to use, because it undermines confidence in the model, and therefore in the outputs of the tool.

Despite the very high level of interaction between the model developer and the regional teams, over a period approaching two years, at least 5 one-on-one meetings per team, in some cases many more, all users referred to a need for further training and support. The term "long term training" was used by several of the teams. Presumably this refers to a need for training that goes deeper and requires much more time than was anticipated and delivered within the project. Many teams specifically requested support via features such as

- Training videos and a 'help' button
- Material to explain the context of the tool and what it should be used for
- A detailed written manual on the model
- A detailed written manual on how to use the tool

Many teams had specific requests concerning the tool and its useability

- Less jargon and better labelling of graphs, lines, and other visual features
- Explanations of what the model parameters mean
- Indications of the allowable range of values
- The possibility of modifying allowable parameter ranges
- The possibility of selecting or changing the 'input' and 'output' parameters
- The improved presentation of the very large number of parameters. For example by grouping them into understandable categories, or by provision of a search function to help users to identify the parameters of interest in their exploration of policy related issues.
- A way to visualize the model and understand how the parameters are related.

These lists are not exhaustive. Arguably, they are a reflection of the fact that we had no discernible design process. More on this later on.

The most important feedback was in terms of the model itself. Some reported that the model felt that like a 'black box.' They found it impossible to understand what was going on behind the scenes, and therefore impossible to understand how to use it. This also sapped their confidence in the outputs provided by the POE. Several users reported that the outputs were non-intuitive and violated common sense, once again undermining their confidence in the output of the tool.

Some users took the time to delve deeply into the model, possibly referring back to deliverables D5.1-4. They reported many issues with the model, including questionable or non-intuitive outputs of their model explorations

- The definition of parameters and the values assigned to them,
- Links between parameters which often did not make sense,
- Clarity on the dependence or independence of parameters,
- Expected dependencies which were not reflected based on use,
- Internal parameters which users wanted to modify but were blocked by the system,
- Missing parameters needed to create a useful model.

Once again this is a result of the fact that there was no discernible design process, that the model was effectively untested before it was released. This is arguably the most important take-away from the entire 'POE trials' experience, the need to establish a structured design process, involving users at every step.

## Lessons for the Future

The first experience in using STELLA suggested that this is more of a teaching environment, allowing users to visualize and make simple models with simple interfaces, unsuited to big complex models, with poor support for collaboration and complex model building. To fulfil the needs of the project we implemented a model in STELLA and run it via an online interface developed in a separate environment. Working through this led to a better understanding of what building a model and related tool would entail. Future efforts, if they are to succeed, require a much more rigorous approach to both model building and tool development.

In product development, it is advisable to work through a process based on iterations of design, development, and testing, before the product is 'released' to a general user base. Testing should involve users and in any case people who are not the designers of the system, because they are heavily biased and easily become 'blind' to the shortcomings of the system. After a first release, the system may continue to evolve through successive releases, all of which are subject the same design process. It is essential to involve people with relevant expertise in the design process, not only expertise in engineering of the product, but domain specific expertise related to the application of the product.

One of the regional teams, in providing feedback on its POE trials, observed that it would have been better to start with small models, integrating them at a later stage when they reach a certain level of maturity. This is indeed what we set out to do at the start. We took the example of tourism and made a small model for tourism. We pointed out how this could be done on paper before being implanted in software. One of the regional teams actually used this approach, adapting the provided paper model, and clarifying the links and intervention logic by filling out the accompanying matrix. The tourism sector was chosen because we knew that this was of general interest for the development of

rural areas, and of specific interest to several of the regional teams. This approach was abandoned in favour of writing a big model in STELLA.

The 'paper model' approach is not very radical, but it is very effective. It is common in the early stages of a design project to work on paper with simple models. This is as true in making buildings, movies, and games, as it is for making software systems. This is an essential stage in most design processes. It is fast, low cost and provides a good way to clarify thinking about a complex subject. The approach is explained in some more detail in D5.5.

Any efforts to further develop the SDM and tools such as the POE should take on board the need for a good design process. This need exists at both the level of the model and the level of the tool. The model and the tool can be developed in parallel. An appropriate process for the development of models and tools which apply SDM to rural regions, should include the following phases:

- Brainstorm the overall purpose of the system, what it will be used for and by whom.
- Brainstorm the overall structure of the system, its modules and how they are connected.
- Define requirements for each module. In particular by identifying the kind of basic phenomena that the models are expected to reproduce.
- Iterate the design and testing of the modules, and check that it satisfies requirements
- Integrate the modules and check that the integrated system exhibits the expected behaviours
- Refine the tool, adding in all extra elements needed for release.

Key observations made by those who dug deeply into the model and the tool, trying to understand what was really going on, include the need for good ways to visualize the model, navigate the large number of model parameters and understand the links between them. One of the users conducted what can be called 'sensitivity analysis,' to understand how certain output parameters were affected by changes to input parameters. In doing so, they discovered many issues with the model where it violated common sense or failed to exhibit expected behaviours. This highlights a need to include in the model development process, the development of tools to help the modeller manage complexity and allow domain experts to check the model for its ability to reflect what is known about the development of rural regions.

It is clear from feedback that the choice and meaning of model parameters and their dependencies requires far more consideration than was given in the project. In particular it would be useful to distinguish between concepts which are well established and for which data is readily available and commonly understood, from concepts which are new or nascent or specific to user needs. The model building team also needs to be aware of the new and emerging measurement and accounting systems that are already being tested by governments, as a result of urgent need created by imminent crises related to the climate and energy, biodiversity, and natural resources. A key example is 'natural capital' for which a detailed, well developed and internationally accepted protocol already exists, and which is already being used by both companies, regions, and countries.

The issue of access to data requires special attention. Any scientist who uses data, takes great care to annotate the data noting the source, issues with quality and steps taken to compensate for this. The data issue needs close attention, as it is key to the overall reliability of the model and the credibility of the results obtained using the tool.

The development of the modules and system should be done with real data, so that data-related problems are well understood, and so that the system is developed to work with realistic, available data sets, based on concepts that are well known, understood, and accepted by policy professionals.