iSQAPER
Interactive Soil Quality Assessment

Deliverable 7.3. Report on scenarios of future farm and soil management systems

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Report on scenarios of future farm and soil management systems

Deliverable 7.3 of WP7

iSQAPER

Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience

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June 2019

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Executive summary

WP7 up-scales the effect of agricultural management practices and assesses the soil environmental footprint at the level of Europe and China. Task 3 develops scenarios of future farm and soil management systems for improved productivity and enhanced soil quality. This is carried out by a multi-actor approach. First, developing the critical thresholds of soil quality indicators at the continental scale and establishing threshold values in the variables of the continental-scale datasets. Second, identifying socio-economic barriers and opportunities to proposed management practices.

The analytical process is facilitated by a genuine multi-actor approach, encouraging co-production of knowledge and co-innovation. First, a workshop is designed to provide participatory space for all partners and relevant multi-actors to find appropriate involvement in the co-production of knowledge aimed at creating a common foundation on concepts to develop the environmental footprint scenarios. Second, a survey in the case studies provided information about the likelihood of implementing the soil management practices at the local and regional level. The scenario workshop was conducted with representatives of the iSQAPER project partners and a wide-range of multi-actors. The workshop took place in Madrid on February 2019. The facilitators of the workshop were from the UPM team, supported by the coordinator team (WU), the policy team (IEEP) and key actors of the science teams (FIBL). The major value and achievement of the scenario workshop was a common understanding and knowledge base for all actors on key elements of environmental footprint that could emerge from iSQAPER. Further, following the discussions during the scenario workshop, a basis for developing future scenarios was created. These scenarios will be applied in Task 7.4.

The definition of scenarios and the likelihood of implementing the agricultural management practices in the case studies lead to the following conclusions:

- WP7 provides an understanding of the potential effects at the spatial level is useful for scenario design.
- It provides information about concrete measures to achieve the effects demands to go beyond current policies.
- The model can be applied to obtain expected changes of soil ecosystem services under different policy scenarios
- WP7 analyses the effect of planning linked to current policies and new policy scenarios.
- Three scenarios are defined in a multi-actor approach:
- SC1: Expected: similar intensity as before
- SC2: Regional targets: same as SC1, but acting where it is needed most
- SC3: Towards 2050: duplicate intensity of SC1
- The scenarios are defined by estimating the change in the implementation of AMPs, based on a multi-actor approach, that include experts in the case studies, and a wide range of actors outside the case studies.
- The degree of implementation may vary locally.
- The results will be upscaled to the entire region and presented in D7.4.

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1 Introduction

1.1 Integration of Task WP7.3 in iSQAPER

The main objective of WP7 is to upscale the effect of agricultural management practices on representative farming systems to evaluate the soil environmental footprint in Europe and China. This objective is achieved through the application of an upscaling model that relies on work developed in WPs 2 to 8 (see Figure 1).WP2 provides the spatial frame of reference through the identification of detailed agro-climatic zones. WP3 describes how soil type, climatic zone, topography and crop and land management interact to affect indicators of soil quality. These two WPs provide the input for the analysis of farming systems and soil quality indicators performed on Task 7.1 (see Deliverable 7.1).

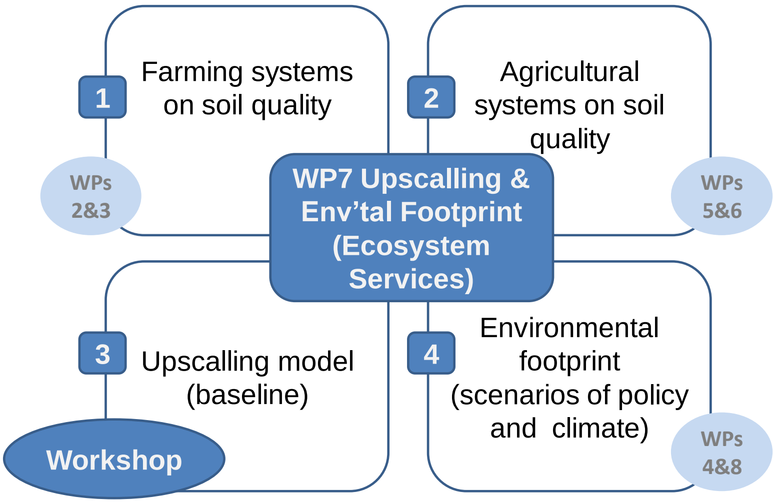


Figure 1. Approach to evaluate the environmental footprint in WP7

1.2 Objectives

This Deliverable 7.3 is framed into WP7 titled Upscaling of practices and assessing soil environmental footprint at the level of Europe and China.

Soil quality is important to maintain the water and nutrient retention function of the soil, biodiversity, production and yield stability. The knowledge of these processes at the local level is provided in WPs 3 to 6. At the wilder geographical level, WP7 upscales the local knowledge, building a model that is based in empirical results and geographically explicit dataset at the continental level in Europe and China (Bai et al., 2018; Bünemann et al, 2018).

The basis for iSQAPER scaling model is defined in Deliverable 7.1. The model is based on a geospatial database of soil quality indicators (SQI) and agricultural management practices (AMP) and on the relationships between AMP and SQI is defined in Deliverable 7.2.

Based on the information provided by SQAPP (WP4) and the perception of stakeholders at the local and regional levels, D7.3 develops scenarios of future farm and soil management systems for improved productivity and enhanced soil quality. The Lead partner is the UPM, collaborating with WU, MEDES, BothEnds, Case Study Site partners. In addition, D7.3 identifies barriers and opportunities to proposed scenarios, these barriers are then used as critical thresholds at the larger scale in D7.4. The work is carried out in a multi-actor framework. The linkages of the work in WP7 are summarised in Figure 2.

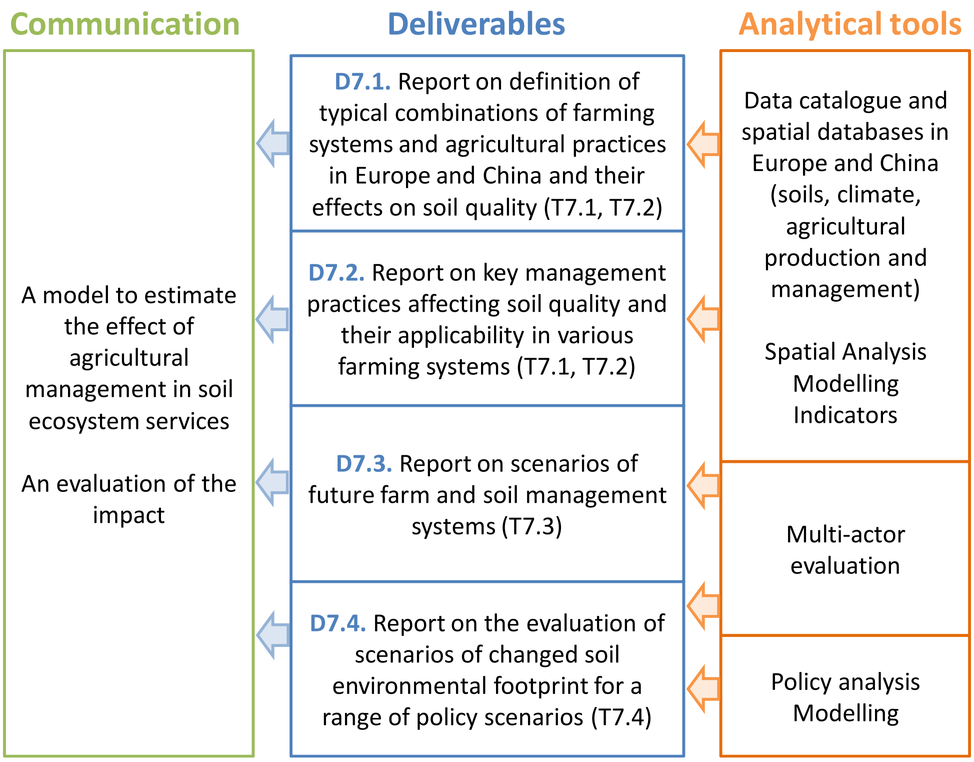


Figure 2. Analytical tools, Deliverables and support to iSQAPER communication supported by WP7

Following this introduction, Section 2 presents and overview of the conceptual approach of the multi-actor approach. Section 3 presents the scenario workshop. Section 4 presents the results of the policy analysis with the project teams. Section 5 discusses limitations of the analysis and describes future work. In Task 7.4 soil environmental footprint will be evaluated under a range of policy scenarios. Section 6 presents the conclusions.

2 The approach to co-design scenarios for the upscaling of the effect of agricultural management practices in iSQAPER

2.1 Stakeholder participation in a multi-actor approach in iSQAPER

The multi-actor approach means that knowledge focuses on real problems or opportunities that end users of the iSQAPER knowledge (e.g., farmers, scientists, policy analysists, and others that need a solution) are facing. In the iSQAPER project the multi-actor approach is also included in the structure of the project team, since partners with complementary types of knowledge join forces in the project activities from beginning to end. As a result, "multi-actor approach projects are able to develop innovative solutions which are more ready to be applied in practice and cover real needs. Moreover, those benefiting directly from the results of the projects will be more motivated to use them, because they were involved in generating them. They helped to build the project, bringing in their ideas and views so they feel a co-ownership of the solutions generated"

(https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_brochure_multi-actor_projects_2017_en_web.pdf).

This conceptual approach of the multi-stakeholder approach in iSQAPER aims to guide the knowledge needed to achieve the scenario definition and how the how the multi-stakeholders will be involved in the knowledge development. The key objectives of the approach in iSQAPER – empower, inform, engage and consult – are summarised in Figure 3.

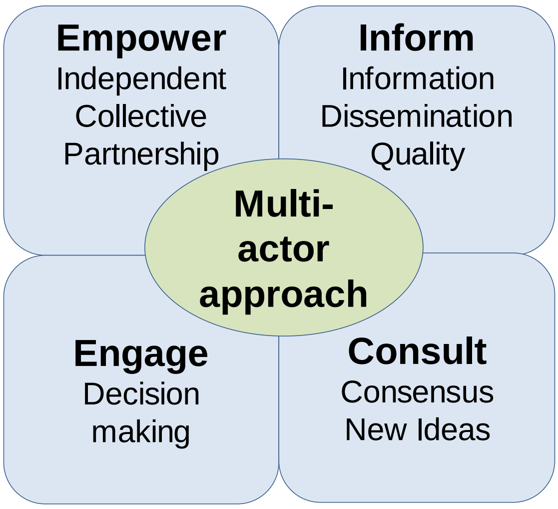


Figure 3. Key objectives of the stakeholder participation in the iSQAPER multi-actor approach

The iSQAPER multi-actor process of creating scenarios, links soil health challenges at the farm level and scientific knowledge, aiming to produce knowledge relevant to different actors. The process is summarised in Figure 4.

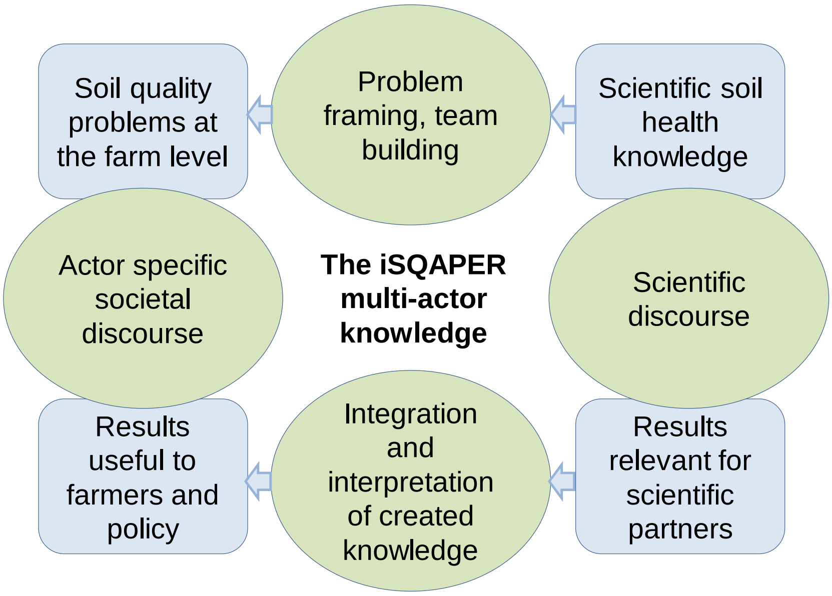


Figure 4. Linking actors to produce useful results in iSQAPER

Timing of the activities are defined in four steps (Figure 5):

Step 1: Learning from each other in the project team: Brainstorming to think further about the future scenarios and the different actor/stakeholder groups to co-create a common understanding of future scenarios.

Step 2: Work further on selection of the stakeholders and stakeholder engagement and familiarising stakeholders' previous to the workshop.

Step 3: Multi-stakeholder workshop. Lead exercises, making it the knowledge more likely to be used by each stakeholder.

Step 4: Policy analysis with the project teams.

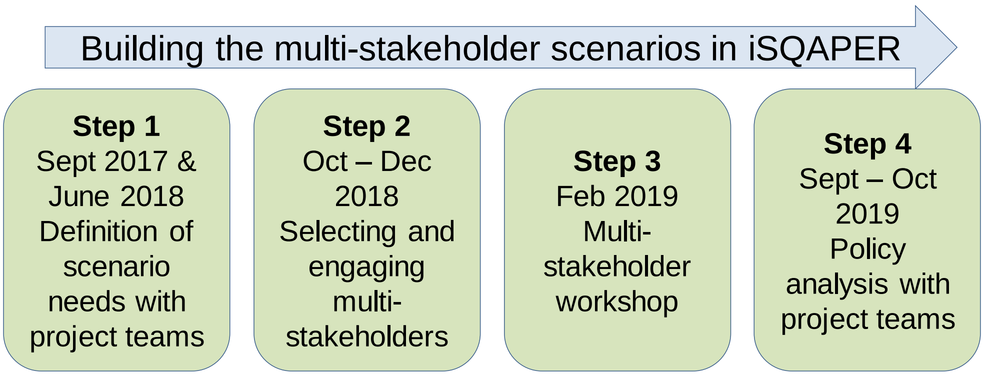


Figure 5. Building the multi-stakeholder scenarios in iSQAPER

2.2 The process

Designing the scenario includes some key considerations relating to the participants, the content and the timing.

Selecting participants: Who?

iSQPAPER identifies broad groups of actors for definition of the scenarios. The knowledge ultimately contributed by the multi-actor group inevitably reflects the particular group selected and the process of knowledge exchange/co-creation. To ensure objective knowledge, we engaged with the stakeholder teams, as shown in Figure 5.

The process: How?

How various actors were involved was defined by the objectives of WP 7. Awareness that people have different subjectivities ('mind sets') was crucial in the workshop design. Therefore, we developed an agenda that includes content relevant to different actors.

Producing knowledge: What?

The types of knowledge contributed by different actors were integrated in the multi-actor interactive process. Different forms of knowledge were considered, including practical, scientific, and policy knowledge.

Timing of the interactions: When?

The timing of interactions with stakeholders to produce the iSQAPER scenarios was defined by the timing of the development of SQAPP for demonstration in WP4, and model development for upscalling in WP7.

3 Multi-actor workshop

3.1 Workshop content and participants

A workshop was designed building form the roles and expectations of the different actors. The success of the scenario workshop is linked to the willingness of the multi actors to deliver expert and tacit knowledge. Since the work is transdisciplinary, the interaction of the stakeholders was also guided by transdisciplinary team, allowing for flexible interactions during the workshop, structuring the interactions in the onset and allowing for changes in the second part of the day. Figure 6 shows some images from the workshop and Figures 7 and 8 present the two tier-agenda. Table 1 includes the participants.

Figure 6. A view of the multi-actor workshop

Time	Subject	Presenter
9.00 – 9.30	Arrival and welcome – coffee and introductions of all participants, Ana Iglesias, UPM	
9:30 – 10:00	**Objectives: modelling the environmental footprint of agricultural management practices in Europe and China**	Luis Garrote, UPM
10:00 – 10:30	**Links to policy**	Catherine Bowyer, IEEP
10:30 – 10:45	**Discussion on the policy scenarios**	Catherine Bowyer, IEEP
10:45 – 11:30	**The science behind the model: Effect of soil management practices on soil indicators**	Paul Mäder, FIBL
11:30 – 12:00	**Links to SQAPP (mobile app to test soil quality)**	Luuk Fleskens, WRU

Figure 7. Scenario workshop agenda: Communication

Time	Subject	Presenter
13:00 – 14:00	Detailed model estimates	Luis Garrote, UPM
14:00 – 15:00	**Incorporating new ideas for the assessment of environmental footprint (Food production, Water, Soil carbon, and soil biodiversity?)**	All
15:00 – 16:00	**Incorporating new ideas for the assessment of scenarios (Climate change, implementation of policies)**	All
16:00 – 17:00	Feedback and open discussion	Luis Garrote, UPM
17:00	Closure	
17:00	Site visit, walking	All participants
19.00	Dinner, tapas	All participants

Figure 8. Scenario workshop agenda: Co-design of scenarios

Table 1. Workshop participants

Name	Organisation	Name	Organisation
Alicia Morugan Coronado	UMH	Luis Garrote	UPM
Amaya Sanchez	WWF	Luuk Fleskens	WU
Ana Iglesias	UPM	María Alonso	UPM
Antonio Nuño de la Rosa Róspide	UPM	Mario de la Fuente	Technological Platform
Catherine Bowyer	IEEP, GB	Matjaž Glavan	INI-LJ
David Santillan	UPM	Miguel Quemada	UPM- AMPs
Esteban Henao	UPM	Nathalie van Haren	Bothends
Fernado Teixiera	UEVORA	Pablo Resco	COAG
Fuensanta Garcia	UMH	Paul Maeder	FIBL
Ignacio Atance	FEGA	Paul Wolvekamp	Bothends
Ivanka Puigdueta	UPM	Vicente Sotés	UPM
Javier Alvarez	CHT	Zoltan Tóth	GEORIKON
Jorge Mataix Solera	UMH	Aina Calafat	SEAE

3.2 Conclusions of the workshop

The multi-actor discussion lead to the following conclusions:

1. The upscaling model developed in WP7 provides a comprehensive approach to evaluate the impact of change in agricultural management practices at the local level.
2. The ecosystem services evaluated are useful to agricultural and environmental policy at the regional level.
3. Farmers decisions on the adoption of innovative agricultural management practices benefit from the information on the impact on agricultural productivity.
4. Climate change policy at the regional and continental scales could be linked to the changes in agricultural management practices.
5. Key future scenarios useful to policy may include business as usual and a high ambition scenario.
6. A scenario based on regional goals could be more difficult to formulate by also desirable, if possible.
7. Even if the agricultural management practices are varied in each region, there are four practices that are relevant to soil health and ecosystem services that may be interesting to include in the scenarios. Those are: (a) incorporation of organic matter to decrease the input of chemical fertilisers and improve soil organic matter content, structure and water retention capacity; (b) reduced tillage to improve soil structure and erosion; (c) rotation of crops including the use of leguminous to improve biodiversity and soil nitrogen, and avoid excessive use of chemical fertilisers; and (d) organic production.

These conclusions were the basis of the scenario design carried out by the project teams and described in the next section.

4 Multi-actor case study and policy teams

4.1 Definition of scenarios

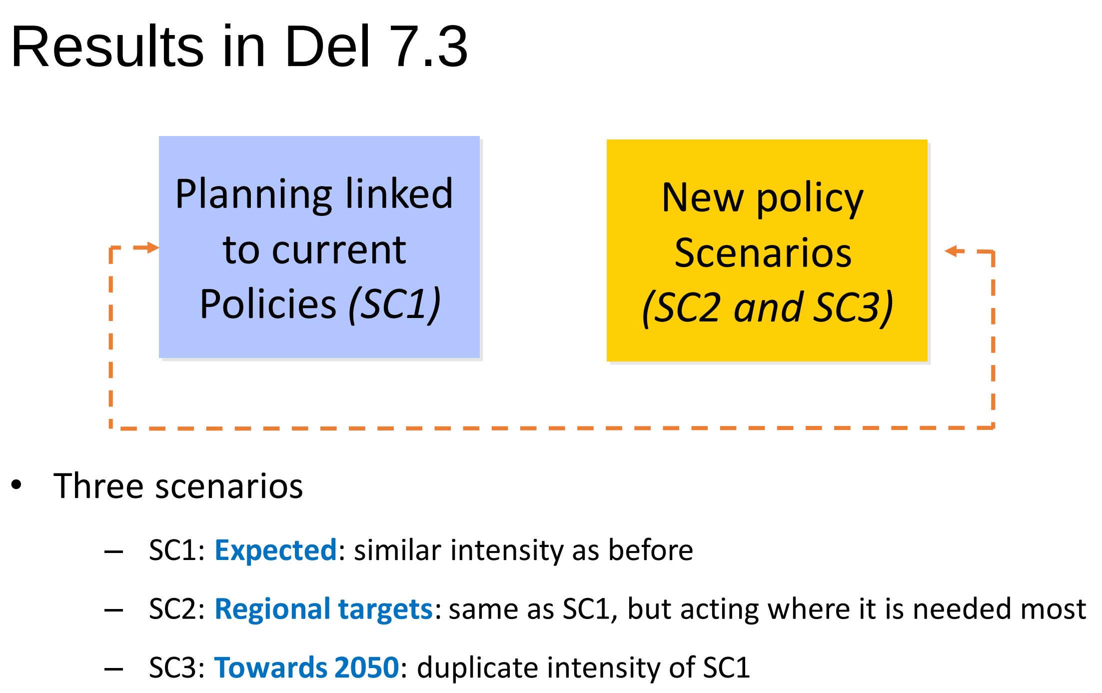
Based on the conclusions of the workshop (Section 3.2) and an ongoing consultation with the experts in the case studies and the IEEP policy teams (Figure 5), the flowing scenarios are defined (Figure 9):

Expected: The Expected scenario maintains the observed tendency in the implementation of beneficial agricultural management practices.

Regional Targets: This scenario assumes the same rate of implementation of agricultural management practices, but considers that policy efforts are focused on areas where soil threats are more active and soil quality indicators are poorer. The emphasis, therefore, is place on targeting the regions that where the practices would be more beneficial.

Towards 2050: This scenario assumes an intensification on the rate of implementation of agricultural management practices as a result of public policies.

Policy portfolios for each scenario include the selective implementation of certain combinations of management practices. The results for individual farming systems are grouped together to account for subgrid variability. The results for different agricultural management practices are combined to produce the effect of each policy scenario. Results of different soil quality indicators are then combined to produce descriptions of improvement of soil environmental footprint. Soil Environmental foot print scenarios are then analysed in terms of improvements with respect to the current situation.



- **Scenario 1 – Expected**. Based on current societal trends and policies
- **Scenario 2 – Regional targets**. Targeting policy intervention to the most degraded soils
- **Scenario 3 – Towards 2050**. Towards the goal of carbon neutral agriculture by 2050. High level implementation

Figure 9. Definition of scenarios

4.2 Likelihood of changes in the AMPs in the future

The likelihood of changes in the AMPs in the future are defined in the main agro-climatic regions in Europe and China, established in D7.2 and D7.3 (Figures 9 and 10). In each region, each case study evaluated the likelihood of implementing the four agricultural management practices: (a) addition of organic matter: (b) reduced tillage; 8c) crop rotation including leguminous; and (d) organic production. Table 1 summarises the results of the stakeholder consultation in the case studies.

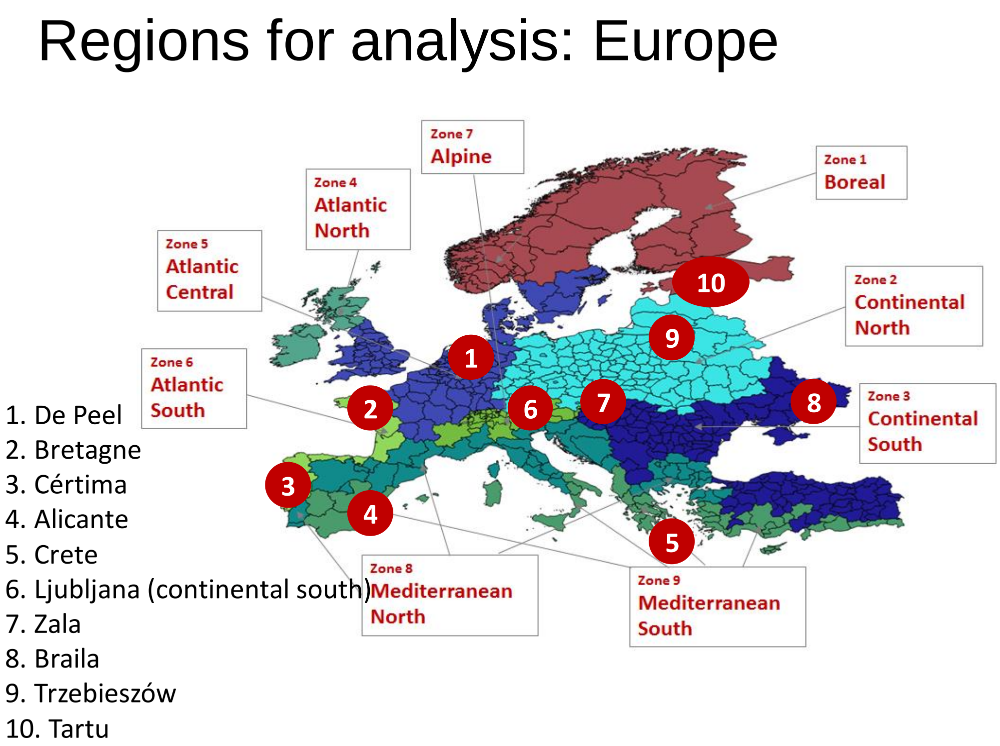
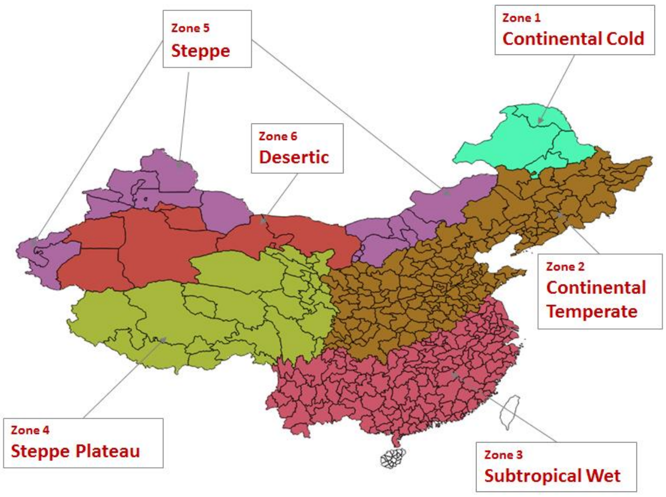


Figure 10. Agro-climatic regions and representative case studies for scenario development in Europe

Regions for analysis: China



11. Qiyang
12. Sichuan
13. Zhifanggou
14. Gongzhuling

Figure 11. Agro-climatic regions and representative case studies for scenario development in Europe

Table 2. Likelihood of changes in the selected agricultural management practices in the case studies

Case study	Likelihood of changes in the selected agricultural management practices			
	Addition of organic Mater	Reduced Tillage	Crop rotation including leguminous	Organic production
1. De Peel All sandy soils, different farms	++	same	++	+
1. De Peel Arable, vegetable, dairy	All the same	Some arable farmers some reduced tillage	All the same, they find a clear benefit, less subsidy driven	Dairy will do less organic than the rest
2. Bretagne	+	+	+	++
3. Cértima, Baixo Mondevo Vineyard, fruit	+ low	++	same	+
3. Cértima, Baixo Mondevo Cereals, maize and rice	++ from animals or swer (key issue, very strict rules)	same	++	+

Case study	Likelihood of changes in the selected agricultural management practices			
	Addition of organic Mater	Reduced Tillage	Crop rotation including leguminous	Organic production
3. Cértima, Baixo Mondevo Vegetables	+	same	++	++
4. Alicante Optimal: what needs to be done	++ Soils very poor, require OM additions	+ Keep a minimum tillage, not avoid altogether, to keep structure	+	++
4. Alicante What the farmers will do	+ becoming expensive	same	+ Cooperatives are promoting this	+++ (more than 10%)Market driven, image of the farm
5. Crete Subsidised	same	++	same	+++
5. Crete Non subsidised	+++ Because there are many animals and manure available	same	same	+
6. Ljubljana Transition country, for everywhere in the country	+++	Depends on the soil +, some soils in the area need tillage	++ 3-4 crop rotation with legumes	++ With the new subsidy payment
7. Zala arable	+++	+	+	+
7. Zala alfalfa	+++	same	same	same
8. Braila All study area, SE Romania	Not likely to increase a lot	++ because low structure in the soil	+++ subsidies	neutral
8. Braila The rest of Romania, rest od CS region	Not likely to increase a lot	Depends on soil type because of the clay content, the most clay, the less low tillage	+++ subsidies	same
9. Trzebieszów What the soil needs	+++		++ provides better improvement	

Case study	Likelihood of changes in the selected agricultural management practices			
	Addition of organic Mater	Reduced Tillage	Crop rotation including leguminous	Organic production
9. Trzebieszów What the farmers will do	+++ OM available and need to improve it	Same, farmers do not like it very much	+ supported by the government	++ Farmers consider it important, market opportunity
10. Tartu Cereal	++ in the form of cover crops	+++	Already forced by the subsidies	Not enough subsidies, may b a short term problem, already 20% ++
10. Tartu Mixed farms	++ from manure	++	Already forced by the subsidies	Same as for cereal farming +
11. Qiyang (subtropical) Upland soils	+++	+	+	same
11. Qiyang (subtropical) Low land soils	++	same	++	same
12. Sichuan Paddy rice	++	+++	+	same
13. Zhifanggou	+	+	+	+
14. Gongzhuling Maize, upland	+	+++	++	+

Comments:

CS1. De Peel. It is not representative for the entire Atlantic region. In other parts of the region, the soils have larger clay content and therefore they will implement more reduced tillage.

CS4. Alicante. Organic matter needs to be applied continuously for more than 15 years in order to have an effect. Organic matter is becoming really expensive

CS5. Crete. The changes are relevant to only olives and grapevine, some very small percentage of vegetables. Organic farming also very likely to increase in other crops.

CS9. Trzebieszów. Organic production is linked to breweries. An important agricultural management practice not considered is liming to deal with sandy acidic soils. Organic farming, organic matter will be adopted in entire region.

CS10. Tartu. This case study is not entirely representative of the agro-climatic region because of the farm economic strucuture, but some aspects are similar to other Nordic countries.

5 Gaps in knowledge and further work

5.1 Gaps in knowledge

The analysis presented in D7.3 has made use of available knowledge and data to define the future management scenarios to define the environment footprint. However, available knowledge and data is far from complete, and the multi actor process necessarily involves filling these gaps with ad-hoc decisions.

The multi-actor approach included different scientific disciplines, the social sciences, practitioners, environmentalists and policy developers, providing information to the project and interested in using the information for different purposes. They provided input with different questions in mind. The need to synthetise the information provided is a great challenge.

The information used to define scenarios and the likelihood of implementing the agricultural management practices, can only describe a pattern and changes at the regional level; only if the local data are available the scenarios can be further defined.

General questions that need to be considered in multi-actor evaluations include the following:

- what are the best criteria for selecting the actors?
- how do the key individual criteria and information can be used for scenario building?
- are we uncovering new relevant information or covering up the lack of representativeness of the wide range of actors?
- how do we move beyond the information provided by the multi-actors to the conceptual scenarios to be applied in a model?

All of these questions can only be addressed through an ongoing process of stakeholder consultation evolving over time.

5.2 Further work

This scenario analysis will be used to define the ecosystem services and a SQI under policy scenarios (Deliverable 7.4).

Policy scenarios will be defined with WP8. Policy portfolios will include the selective implementation of certain combinations of management practices.

Results for individual farming systems will be grouped together to account for subgrid variability.

Results for different agricultural management practices will be combined to produce the effect of each policy scenario.

Results of different soil quality indicators will be combined to produce descriptions of improvement of soil environmental footprint,

Soil Environmental foot print scenarios will be analysed.

6 Conclusions

The definition of scenarios and the likelihood of implementing the agricultural management practices in the case studies lead to the following conclusions:

- WP7 provides an understanding of the potential effects at the spatial level is useful for scenario design.
- It provides information about concrete measures to achieve the effects demands to go beyond current policies.
- The model can be applied to obtain expected changes of soil ecosystem services under different policy scenarios
- WP7 analyses the effect of planning linked to current policies and new policy scenarios.
- Three scenarios are defined in a multi-actor approach:
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- The degree of implementation may vary locally.
- The results will be upscaled to the entire region and presented in D7.4.

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