SNOWMAN NETWORK

Knowledge for sustainable soils

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SAS-STRAT

Sustainable Agriculture and Soil: comparative study of strategies for managing the integrated quality of agricultural soils in different regions of Europe / Belgium, France, Netherlands

Final Scientific Report (final version)

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1 Abstract

SAS-STRAT project aims at identifying, describing and analysing conditions and means for a sustainable management of cultivated soils in Europe, that takes into account a variety of current or potential qualities of these soils, including and beside agricultural production.

The project relies on 3 cases studies in France, Belgium and the Netherlands:

- The French case study focuses on the territory of the watershed of the Austreberthe, entirely included in the department of Seine-Maritime in the Normandy region. This watershed extends to whole or part of 31 municipalities with approximately 38,000 inhabitants and covers an area of 214 km^2. Due to strong urbanisation of valley bottoms, development of crop agriculture, a marked relief and silty soil compacting due to rain, this territory is submitted to devastating mudflows and sometimes overflows of rivers that can be rapid and significant. Farmers are regularly pointed out as the cause of flooding problems but are also victims of the agricultural policy that leads to change the type of crops and intensification of cultures. This ambiguous situation, which makes the farmer both responsible and concerned at first order, makes farmers and their organisation indispensable partners for managing runoff problems.
- The Belgian case study focuses on transition pathways of soil management in the new context of individual and collective and public policies developing “conservation agriculture” (CA). The case is addressed through a multi-level transition perspective that focuses the analysis on Greenotec ASBL (non-for-profit association) in Belgium. Greenotec is the unique association in the Walloon region leading the transition towards zero tillage. It has settled experimental platforms and a frame of extension. Greenotec has built a network of more than 200 farmers that are on the pathway of conservation agriculture transition. More recently, Greenotec has set up contract with local municipalities that are confronted with mud floods to connect floods issue with cropping practices. Greenotec has also a tradition of cooperation with researchers but not yet with socio-economist scientists.
- The Dutch case study focuses on new impulses to increase sustainability of dairy farming in the Beemster polder, with special attention to sustainable soil management of the underlying grassland and arable lands. The polder ‘the Beemster’ is located in the province of North Holland. It was dried during the period 1609 through 1612 and is included in the UNESCO World Heritage sites. CONO dairy farmers cooperative has a factory in the polder since early 1900, which notably produces the Beemster cheese. “Ben & Jerry’s” ice-cream company and CONO use a score for environmental impact of dairy production to underpin their sustainability program Caring Dairy. This score is now tested within a broad group of participating dairy farmers. Although only 30% of the CONO farmers are located in the Beemster, CONO can be seen as an innovative case. CONO is leading in sustainable dairy production in the Netherlands. Main characteristic of the new system was that it is a visual method of scoring the quality. With the visual method farmers get better knowledge of their soil, which CONO is willing to reward when they achieve better scores on ‘happy planet’.

The transversal analysis of these case studies focused on three themes:

- Sustainable soil quality management as an issue of transition in socio-technical systems: trouble in the “regime” (mainstream practices) and self-locking effects on current practice
- Integrated soil quality management is a multi-stakeholder and multi-level strategy for taking in charge soil quality as a common good shared within a heterogeneous network of actors
- The role of technical and scientific tools as a support for facilitating transition and complexity management: the role of “intermediary objects” supporting exchanges and negotiation between various expert and non-expert actors and the specific contribution of actors in a position of scientific and technical mediation.

This transversal analysis and the proposed recommendations were developed in cooperation with stakeholders, who contribute with their own expertise on integrated soil quality. This was made possible notably through an Integration workshop (Paris, 17th-18th June 2013) that gathered stakeholders from the studied cases, the SAS-STRAT research team and other stakeholders.

2 Objectives and method

SAS-STRAT project aims at identifying, describing and analysing conditions and means for a sustainable management of cultivated soils in Europe, that takes into account a variety of current or potential qualities of these soils, including and beside agricultural production.

The project is developed by Mutadis (coordinator), ADEPRINA (France), Sol et Civilisation (France), the University of Liège (ULg, Belgium) and Boerenverstand (Netherlands).

The project relies on 3 cases studies in France, Belgium and the Netherlands

This research is developed in strong cooperation with stakeholders, who contribute with their own expertise on integrated soil quality.

2.1 Objectives

SAS-STRAT aims at identifying, describing and analysing conditions and means for a sustainable management of cultivated soils in Europe, that takes into account a variety of current or potential qualities of these soils, including and beside agricultural production.

The objectives of the research project are to:

- Explore what are the different qualities that constitute the integrated agricultural soil quality (e.g. support for economical activities and income generation, including agriculture; land planning; property as a place where to exert its individual freedom and as a patrimony to hand down; environmental compartment and object of ecosystem services transactions; vector of chemical quality of our environment and health, etc.)
- Describe regional governance approaches experimented in Belgium, France and the Netherlands in the European context to improve the integrated quality of agricultural soil (case studies)
- Analyse the conditions for an integration of new soil challenges (biodiversity, climate change, ecosystemic, cultural, identity and social… services) in agricultural soil
- Establish a community of stakeholders involved in integrated quality of soil, at local, regional, national and European level (Belgium, France, Netherlands, EU), and a first group of researchers-experts involved on integrated soil quality
- Analyse with stakeholders the lessons learnt from the case studies investigated, consider the value of these experiences for the wider community, and develop in cooperation with stakeholders recommendations for the development of integrated approach, combining regional and local initiatives, national and EU policy
- Analyse the contribution of cooperative research methodologies to address soil complexity, and provide recommendations to sustainable management of soil quality

In order to do so, the research developed within SAS-STRAT:

- Sets up a common methodological framework to implement cooperative research methodologies along the same objectives in the three countries (work package 3 – WP3)
- Prepares and analyses case studies in three regional countries to obtain feedback on the multidimensionality of soil quality as experienced in three different contexts, and hindrances and positive factors in the development of integrated management of agricultural soil. (WP 4, 5, and 6)
- Structures an exchange of experiences between the three countries, with a direct involvement of stakeholders met during the case studies‘ interviews; complement the case studies with a European meeting of co-expertise, soliciting the expertise of scientists (including from the "SNOWMAN community") and the expertise of specialists and professionals involved in the case studies, with a view to reach through dialogue shared proposals or recommendations (WP7)

- Disseminates the results in the research community through scientific publications (WP2)

2.2 Method

The project has developed in 3 phases:

- Development of a common methodological framework ensuring intercomparability of the 3 case studies (WP3)
- Development of the 3 case studies (WP4, 5 and 6)
- Integration of the lessons learnt from the 3 case studies and recommendations (WP7). This was notably done through a participatory Integration Workshop to be organised in Paris on 17th-18th June 2013.

Each case study has been developed by a different research team according to its own method. A common methodological framework has been developed in order to ensure mutual understanding of methodologies and a common ground of minimal common issues to be addressed. However, this does not constitute a unified methodological approach (which would have required additional resources). In order to reinforce mutual understanding and facilitate transversal analysis of the case studies, cross-fertilisation field seminars were organised in the territories concerned by each case study. These seminars included presentation and discussion of the case with the stakeholders followed by a working meeting of the whole SAS-STRAT team.

The French case study was developed according to the method of patrimonial audit method developed by H. Ollagnon (Ollagnon, 2006) which constitutes a cooperative research tool involving stakeholders in the investigation of the quality of a problem – here the integrated quality of soil -, considered as a complex and multi-stakeholder issue). The patrimonial audit investigates a common strategic issue with the stakeholder group and aims to produce a co-expertise of this strategic issue shared by the group. The stakeholders are interviewed in a semi-directive way and the outcomes are presented, discussed and validated by the interviewed group.

The Belgian case study is developed in the conceptual framework of « *Sustainability Transition Studies* », and more precisely the multi-level perspective set out by Geels (2002) and Geels and Schot (2007). Here, transitional processes are interpreted as being the dynamics of inter-action between the three analytical levels defined by Geels and Schot (2007) as follows:

1) *Niches of innovation*: spaces where radical new approaches emerge to then mature and progress while remaining more or less protected from the pressure of selection exerted by the *regime*.
2) *Socio-technical regimes*: sets of norms, standards, beliefs, regulations, and cognitive routines, which direct the trajectories of practices within a given sphere. The stability of a *regime* is founded on the strong inter-dependence of these various components. This engenders a degree of irreversibility making the *regime* more or less resistant to change.
3) *Socio-technical landscape*: the environment considered to be exogenous in relation to the *regime.* It encompasses macro-economies, large-scale models of cultural representations, and macro-political trends and developments.

The Dutch case study is developed through a pragmatic methodology giving account of the development of tools and methods to support the improvement of sustainability of dairy farming in the framework of the quality policy of the Dutch dairy cooperative CONO. The team involved in the development of the case study is also directly involved in the case itself as an advisor of CONO and co-developer of tools for assessing and discussing soil quality.

The Integration workshop was organised in Paris on 17th and 18th June 2013 and 21 actors from France, Belgium, the Nethelrlands and Switzerland (see list of participants in annex 8), including stakeholders from the French and Dutch case (stakeholders from the Belgian case were invited but did not come), external stakeholders from France and Switzerland, members of the SAS-STRAT Steering Committee and the SAS-STRAT research team.

The programme of the seminar (see annex 9) included 4 sessions:

- Session 1: Presentation of the results of the case studies (and discussion with participants).

- Session 2: Lessons learnt from the case studies (and disussion with the participants).
- Session 3: Strategic diagnosis of the stakes and challenges for integrated soil quality management in Europe (see annex 12).
- Session 4 : Recommendations - how to create conditions for actors' practices to take into account integrated soil quality.

The final version of the transversal analysis of the case studies (see section 8) was then produced incorporating stakeholders' input. This transversal analysis is developed according to 3 key themes identified by the research team:

- Sustainable soil quality management, a problem of transition in socio-technical systems: trouble within the regime and self-locking effects on current practice
- Taking complexity into account in soil quality management
- Contributions of scientific and technical tools to soil quality management

Finally, recommendations (see section 9) were developed on the basis of the transversal analysis and of the discussions with the participants of the integration workshop.

3 Background of the research

Since the late 1990s, research on soil has been considerably developing in Europe. The international conference on soil sciences held in Montpellier in 1998 was a major milestone to recognize soil as a natural element as important as water and air. Its importance is related to the fact that soil is a support to many activities essential to human life (for a long time, it was even considered only from a food perspective), but also it is a system in itself, on which topical questions today (biodiversity, climate change...) are dependent.

3.1 Soil quality is a multi-faceted issue

Karlen et al. (1997) define soil quality as ' the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation' (Schuman. 1997. Soil quality: A concept, definition, and framework for evaluation. Soil Sci. Soc. Amer. J. 61:4-10). This definition and its discussion have underpinned the research developments in the first decade of the 21st century. It reflects the acknowledgment of the research and policy community that soil is a multi-faceted question. In the policy field, the memorandum for the draft soil directive as of 2006 explains that Soil is “essentially a non-renewable resource and a very dynamic system which performs many functions and delivers services vital to human activities and ecosystems survival. Information available suggests that, over recent decades, there has been a significant increase of soil degradation processes, and there is evidence that they will further increase if no action is taken.” The proposal has the objective of “establishing a common strategy for the protection and sustainable use of soil based on the principles of integration of soil concerns into other policies, preservation of soil functions within the context of sustainable use, prevention of threats to soil and mitigation of their effects, as well as restoration of degraded soils to a level of functionality consistent at least with the current and approved future use.”

There are a number of understandings for soils: physical and biological substrate, environment, support to fauna and flora, place of human living, encompassing a wide range of economic, cultural and social uses and values, to name but a few. Although the multi-dimensionality of soil is now widely recognized, soil research has been mainly focussing on physics and biology. Research on soil quality management in the field of humanities is still limited. This may be explained by the fact that soil is seldom an issue in itself for social and political sciences, but only a related object to other issues (urbanisation, agriculture, protection of the environment). The emergence of the concept of eco-systemic services has given further strength to the recognition of the multiple qualities and functions of soil. Soil cannot be reduced to one dimension.

Research has thus helped identify potential conflicts of use or value, which threaten the sustainable management of soils and the need for mediation (Doussan, 2002; Citeau, Bispo, Bardy, King, 1998). Under the French research program GESSOL, research currently conducted by the University Paul Cézanne Aix-Marseille-3 stresses that soil remains in France a fragmented legal object, despite the draft EU directive. In this respect soil is strongly associated with complexity and the policy and research developments clearly show the need of a better integration of the various uses and functions related to soil.

3.2 Soil quality and complexity

Soil is a complex element: it has intrinsic qualities (physical, chemical, biological), but is an environment that is both natural and human. It is difficult to separate fully the qualities of each other - like a growing number of objects that are situated between humanity and nature (Latour, 2006). Soil tightly integrates physical, chemical and biological qualities, and social and human qualities. Like for any other complex issue, the complexity of soils can not be reduced by a clinical examination that would separate from each other the different qualities and soil functions and would not take into account their interdependence and interactions deep (Simon, 1969; Latour, 2006; Ollagnon, 2006).

3.3 Agricultural soil: an outstanding case for soil complexity and integration

Soil complexity is particularly obvious as regards agricultural soil. This type of soil currently faces a number of challenges related to complexity and lack of integration.

Among new developments impacting agricultural soil in Europe conservation agriculture with new approaches, e.g. non-ploughing, by producing change reveal the complexity of soil management. These approaches build on the quality of the soil and the different functions of cover plants (soil protection, improvement of biodiversity, and soil structure, carbon storage...). They improve the biological quality of soil, can prevent from erosion while they often need to increase the use of pesticides. They also provoke changes in the relations among farmers, as well as in the relations between farmers and other stakeholders (local and central authorities, experts, industry...) (Triomphe B, et al., 2007). The impacts of these changes for soil quality only begin to be assessed, often from a single perspective, while there is a clear interaction between soil quality, agronomic technology, food industry, pesticides industry, regulation, etc.

Most recently, biodiversity and climate change have started to consider soil as a key element in coping strategies (Hurni, Giger, and Konrad, 2006). Agricultural soils are one of the prior fields of action given the importance of their impact on both these issues. What are the relations between climate change, biodiversity and soil quality? Is biodiversity a driver for a better integration of the different functions and values of soil? What about climate change? How to ensure that the consideration of these new concerns enhances integration of the various soil services, rather than they spoil it? Are there examples of good strategies in this respect?

What is the quality of agricultural soil? How to maintain, and improve this quality? What can be the complementary contribution of EU and national policy and of regional and local practices? The EU and the member states often regulate on a normative basis, for example fixing targets for pollutants, or for biodiversity, and defining normative ways to reach these targets. These objectives are regularly challenged by stakeholders at local level. Farmers in the Netherlands have for instance argued that they can meet the target for ammonia emission with other methods than the ones authorised by regulation (Sonneveld et al., 2008), and they have obtained a regime of exception, at least for a limited time. In France, the hexagonal rural development program (Programme de développement rural hexagonal) proposed a bottom up approach, giving rooms for negotiation between stakeholders at local level to find appropriate ways to meet national and European targets (e.g. Natura 2000), taking into account the particular assets and limits of the local territory. These developments reflect the fact that in the face of complexity integration is best achieved at local level.

In this respect the management of soil is strongly related to local governance. In a 2008 paper “Toward robust regions: rural-urban transitions in the metropolitan landscape”, Han Wiskerke reminds that the supply of goods and services has become less and less regional in the past decades, and therefore more and more disconnected from the place where they are purchased and consumed (Wiskerke, 2008). He reports a wide variety of rural and regional development initiatives in Europe that try to connect various players and stakeholders, to embed good and services in the region, building on its natural and social capital. We can argue in continuation, that soil is a major issue to reconnect local actors and the different activities and values – existing and potential – present in their community. The connection and integration at local level can be a major path to sustainability. During three years the implementation of activities generating impacts and risks for humans and nature in nine European territories, the TRUSTNET IN ACTION (TIA) European co-operative research project (2003-2006) has underlined the need for inclusive multilevel governance experimentation as a means to restore the conditions for local actors to initiate and drive sustainable development, while traditional governmental policies confronted with complexity demonstrate little efficiency as regards environment protection and may increase the vulnerability of human activities at territorial level.

The recognition of complexity is a first step to sustainability. The second and no less important step is the capacity to address this complexity by developing strategies that take into account the variety of uses and values of soil and their interactions.

3.4 A need for a multidisciplinary and pluralist approach

The proposed research aims at:

- Describing current strategies developed at regional level to cope with the need for a greater integration of soil uses and functions (understood as total soil quality)
- Analysing the conditions and means for such an integration
- Analysing their relations to national and European levels of governance
- Proposing recommendations to policy makers and practitioners

In this respect, it is important to develop a multidisciplinary and pluralist approach that can account both the issues related to the intrinsic qualities of the soil, its social qualities, and people's skills (in the meaning of relationships between the soil and the people), by observing them in their entirety and complexity. As a number of environmental or complex issues, it can be assumed that sustainable soil management needs to establish a dialogue between policy-makers, the research community and stakeholders, not only to enrich knowledge but also to make sure science and policy orientations are line with social concerns, and take into account existing natural and human contexts. A specificity of this research is thus to combine a multidisciplinary perspective with a co-operative methodology. The co-operative methodology will contribute the quality of the research as well as the practicability of the results for it will bring territorial experience and local expertise in the project. The expected result is to produce a global and dynamic picture of the conditions and means for the total quality of soil. It will bring a specific understanding of the horizontal interactions that are operated at territorial level (between categories of local actors). It will also bring understanding of the vertical interactions between local actors and communities and the three majors spheres of decision that are impacting the territory, namely the public sphere (public authorities and policies at national and European levels), the private sphere (industry, business) and the scientific and technological sphere (public and private research).

4 Common methodological framework and reflexive analysis on the implementation of cooperative research

4.1 Objectives

There are several challenges proposed in SNOWMAN call 3 to address the complexity of soil management in the perspective of sustainable management. This encompasses: widening the community of researchers involved on soil beyond the community of researchers on pollutants and contamination; encourage pluridisciplinarity; include the participation of stakeholders.

In this respect, there is a need to implement cooperative research methodologies that are able to meet these challenges in the context of soil quality, building on the previous experience of the research team members. By experimenting, we mean implementing these methodologies in this field, and in retrospect analysing in a reflexive way the capacity and limits of these research methodologies, and the possible adaptations, and developments requested.

The 3rd work package of SAS-STRAT was dedicated to methodology and pursued the following objectives:

- The definition of a methodological framework to conduct case studies in the three countries according to the cooperative methodologies of each national team, with common objectives
- The development of a reflexive analysis of the implementation of cooperative research methodologies in the field of soil quality, and recommendations to further use of these methodologies in this field

4.2 Short description of the content of the methodological framework

The interdisciplinary reflections carried out by SAS-STRAT research team have led to develop a common methodological framework structured into five parts that are briefly developed hereunder.

4.2.1 Common hypothesis and assumptions

In order to move from a description of the multiple dimensions of soil to an analysis of the conditions for an integrated management of soil, the research team considers a cooperative research methodology is most needed. Integration needs to engage experts and stakeholders because they are directly engaged in soil management, they have knowledge about a particular dimension (e.g. related to soil contamination, to an agricultural practice, or to land value…), and they contribute to build a holistic understanding of soil quality, with the different dimensions, and their relations.

4.2.2 Common grid of analysis

Each of the cases represents a situation in which integrated management of soil quality is explicitly accomplished. It is approached as a complex and multi-stakeholders issue and in a dynamic perspective of improvement of this management. Each case:

- Puts at stake a great number of dimensions related to soils,
- Represents situations in which an explicit integrated management of the soil quality is pursued in the concerned territories,
- Involves a co-evolution learning process for a better soil quality management,
- Involves a great number of stakeholders concerned with the future of soils and their management,
- Involves actors willing to improve their practice of integrated soil quality management.

A common grid of analysis (see annex 1) was developed and included into deliverable D3-1: Methodological framework: issues and cooperative research methodology to address integrated soil quality (2nd May 2012)

4.2.3 Common principles

The actors interviewed in the three case studies are considered as co-expert of their situation. The process led to a co-expertise process based on scientific expertise, pragmatic expertise...

Each team uses common guidelines and requirements on which type of actors are to be met for each case study. In all cases we seek for a strategic representation rather than a statistical representation, i.e. we seek to meet key actors who in their institutional or effective position have a great ability to influence the situation

For each considered case, the research team responsible for the case study interviews each actor asking a same strategic question – such as "conditions and means for a better integrated sustainable management of soil quality" (to be specified for each territory).

Ethical rules are defined in order to secure the meeting and communication with the actors.

The different research teams will pay particular attention to the historical trajectory of soil management in the considered cases.

The practitioners-researchers will not only observe the knowledge, practices and capacities of the actors, but they also facilitate the evolution of the system to improve sustainable management of soil quality.

4.2.4 Common questions to be tackled

During the interviews, each actor will express elements regarding his/her analysis of the situation following four topics:

- Identification of the qualities at stake and the problems met
- Diagnosis of current actions, particularly individual actions, collective actions (regulations) and the "mode of action of the actors together"
- Anticipation of evolutions and problems (or projects), especially if public policies regarding soil management were to be strengthened
- Proposals for actions, particularly in terms of governance.

4.2.5 Cross-fertilisation between the different methods

While this cross-fertilisation between the different methods of research teams were not originally planned, the three research teams have wanted to go further in integrating their different methods. At first, the research teams wanted to incorporate element of each specific methodology in data collection. A common grid for the interviews was developed.

Before the final seminar, summary reports for each national case was written by taking the framework of the common grid of analysis which has allowed easy identification of cross-cutting lessons to different cases.

4.3 Key elements of reflexive analysis of the implementation of cooperatives methodologies applied to soil quality

The research team had to address the following questions:

- Capacity of these methodologies to describe the various dimensions of soil quality;
- Capacity of these methodologies to achieve with researchers and stakeholders an integrated view of soil quality;

For both these capacities, the analysis outlines

- Particular sensitive aspects or difficulties in achieving this description/integration;

- Possible adaptations or development requested to fit to the specificities of soil complexity".

First, the research team would underline that these are relevant questions, and it is difficult to address these keys issues in the contract that is ours. It is impossible to make exhaustive responses. Also, this part of the report aims to outline possible answers, not so much from the point of view of cooperative research in general but by focusing on lessons for the Snowman network.

Work on soil quality raises fundamental questions. It is difficult to address these issues without precaution for scientists as by private actors. Firstly, soil is a private property, which is not the case of water, air or biodiversity. Secondly, "soil quality" is a general concept that must be declined in each specific context. It involves a clinical approach to the question of the relevant entity, which varies greatly according to soil conditions, territories, country, history...

4.3.1 Do stakeholders feel concerned?

To initiate collaborative research, a key point is to ensure that stakeholders are concerned about the quality of soil, and are sufficiently concerned to participate in such a process. It is difficult to fully answer this issue, however some indicators are in line with a real concernment. In the three territories, the issue of "managing soil quality" was seen as a relevant issue but stakeholders replaced the soil issues in relation to their problems. Moreover, such a cooperative research was relevant for public actors also. There is a real interest to resort to this type of research to better define public policy on such complex issues.

4.3.2 Emergence of an integrated view of soil quality?

This is not a universal definition of soil quality that emerges from this collaborative research, but elements of processes that allow each territory, in agreement with scientists and with the government, to define its soil quality.

4.3.3 What were the difficulties encountered in the implementation of cooperative research?

A first difficulty in the SAS-STRAT methodology was the fact that each case study has been developed by a different research team with its own method. Although common elements (through the common methodological framework) were incorporated in each case study, this common methodological framework represented an adjustment of each team's own method rather than a unified framework of data collection and analysis (which would have required more resources to develop).

Secondly, in this case and to bring a real added value, the cooperative research should not only aim to collect the expertise of local actors, but should also investigate possible convergence with other forms of expertise.

4.3.4 What are the lessons learnt for further development of cooperative research in the field of soil quality?

Progress on the issue of agricultural soil quality management, involving multiple stakeholders, is necessarily germination process in each territory as at European level, which requires time.

So, to progress at the same time at these different levels, knowing that the action is based on the involvement of multiple stakeholders, assist actors at local level and at European level is necessary.

Different topics to deepen the reflection with multi stakeholders were discussed during our research, such as develop tools to better visualize and manage "together" the "total soil quality" (the VSA score, developed by the Dutch team, could be one of them), developing new modes of governance of soil quality, based on the strong commitment of stakeholders (in particular, explore the concepts of "common", "common good", "common management") or developing policies and tools for supporting transition processes in farmers' practices and helping to lift socio-technical locks that hinder this transition.

The Integration workshop (Paris, 17th-18th June 2103) organized it the participation of stakeholders (from and outside of the case studies) and public authorities has shown that exchanges of experience

on the basis of case studies and of their transversal analysis at a European or transnational level is a useful tool for developing a common ground between practitioners, market actors, experts and policy makers. In particular, the fact that this exercise was not directly connected to a decision-making process facilitated the discussion and cooperation and helped all types of stakeholders.

5 French case study – water and soil quality management and struggle against erosion in the watershed of Austreberthe (Normandy)

5.1 Context of the case study

The watershed of Austreberthe extends to whole or part of 31 municipalities with approximately 38,000 inhabitants and covers an area of 214 km^2 entirely included in the department of Seine Maritime.

The watershed of the Austreberthe has two streams. The Austreberthe River has a length of 18 km and its only tributary, the Saffimbec, runs for 3 kilometres. The Austreberthe rooted in Sainte Austreberthe (altitude: 85 meters) and flows into the Seine from Duclair, situated downstream Rouen. The maintenance of these two rivers is provided by the Syndicat Intercommunal des Rivières d'Austreberthe et de Saffimbec (SIRAS).

Land mapping shows a strong urbanisation of valley bottoms, development of crop agriculture, a marked relief and silty soil compacting due to rain. This encourages large water flows in the dry valleys. These flows cause devastating mudflows and sometimes overflows of rivers that can be rapid and significant.

These phenomena are further amplified by the circular shape of the watershed that favours rapid and simultaneous concentration of water in the river.

The watershed of Austreberthe has always suffered from three types of flooding: floods caused by overflow of the river, floods caused by a rise of water tables, flood caused by water runoff.

Floods are related to the fact that the rainfall during the last decade of the 20th century, was very important, but also to the transformation of the territory (changing farming practices, urbanisation...), knowing that the soil in this territory has particular characteristics that renders it waterproof after a few rainfalls if it is not covered by cultures (capping phenomenon).

Since 1983, 100% of the municipalities in the watershed have been subject of a declaration of natural disaster.

The catchment area of the territory is Austreberthe sensitive to flooding and erosion. This area has a number of drinking water wells and 18 km of river that are sensitive to pollution. Problems related to runoff have, in many cases, a direct impact on agriculture, which results in damage to crops and / or consequent loss of production.

Potential impacts are:

- Emergence of gully erosion in the slope axis or at sharp slope changes, inducing:
    - Regular filling works (representing additional costs)
    - Sometimes significant difficulties to exploit plots (bypass gullies);
    - Loss of production...
- Non-arable areas because of regular flooding;
- Submersion of cultures;
- Erosion causing loss of silt on the upper areas and filling of lower areas inducing differentiation of land.

Farmers are regularly pointed out as the cause of flooding problems but are also victims of the agricultural policy that leads to change the type of crops and intensification of cultures.

Land transfer rates related to sheet erosion on slopes is ranging from 7 to 10 t / ha / year, which is considerable.

This ambiguous situation, which makes the farmer both responsible and concerned at first order, makes farmers and their organisation indispensable partners for managing runoff problems.

Whether for the evolution of cultural practices across watersheds or for the realisation of landscaping or facilities, farmers must be involved in various projects.

The case study focuses on the efforts of territorial actors to address erosion issues, including agricultural soil quality issues with all concerned stakeholders, notably farmers. Public actors concerned with erosion notably include the Association of catchment basin of the Austreberthe and the Saffimbec ("Syndicat Mixte de Bassin Versant de l'Austreberthe et du Saffimbec" - SMBVAS[1]) and the AREAS (Regional Association for Soils Study and Improvement in Haute-Normandie - Association Régionale pour l'Étude et l'Amélioration des Sols de Haute-Normandie)[2]. The AREAS is a non-for-profit organisation, created in 1985, which works on streaming, erosion and phytosanitary products flows, mainly in rural areas, but also in urban areas. Its missions are to:

- provide technical advices to contracting authorities;
- participate to information transfer (training courses, field visits);
- experiment solutions against streaming and erosion;
- study the hydrological state of the different catchment basins of the region;
- study the composition of the streaming waters.

The AREAS works in the entire region of Haute-Normandie, which is composed of two departments: Seine-Maritime and Eure. Seine-Maritime is the most concerned department as concerns streaming and erosion, and is also the most productive agricultural area in France, due to the depth of the silt in its soils (5 to 10 meters). Violent floods in December 1999 and 2000 have mobilized the population of the department; as a consequence, catchment basins organisations have been created. According to the AREAS, catchment basins are indeed the relevant local territories for working on streaming and erosion.

5.2 Method for the case study

The research investigates the conditions and means of a comprehensive and sustainable management of soil quality, encompassing a variety of soil functions in the considered territory of the case study. The research was developed through several stages:

- Identification of one territory with particular challenges as regards soil quality;
- Establishment of a bibliography (see annex 2)
- For the case, identification of the main stakeholders (see list of interviewees in annex 4) involved and concerned on the different qualities and functions of soil (e. g. agriculture, water management, land planning, biodiversity, climate change…)
- Establishment of a contract between the team of auditors and both of the AREAS and the SMBVAS (cf. contract in annex 3).
- Conduct of interviews with a pluralistic group of about 25 to 30 stakeholders and with soil sciences researchers, on the basis of a cooperative research methodology (here on the basis of the patrimonial audit method developed by H. Ollagnon (Ollagnon, 2006), which constitutes a cooperative research tool involving stakeholders in the investigation of the quality of a problem – here the integrated quality of soil -, considered as a complex and multi-stakeholder issue); The patrimonial audit investigates a common strategic issue with the stakeholder group. The stakeholders are interviewed in semi-directive way and the interviews were guided by the common grid of analysis of SAS-STRAT developed in WP3.

[1] http://www.smbvas.fr/index.php

[2] http://www.areas.asso.fr

[2] http://www.areas.asso.fr

- Presentation of draft case study outcomes to the stakeholders: all the interviewed stakeholders had been invited to a meeting for an oral presentation of the results by the researchers (18th March 2013). Eighteen people were present.
- Preparation of a case study report outlining:
    - the main issues and challenges related to soil quality in the territories considered, the different understanding of soil quality by researchers and stakeholders
    - the diagnosis of the actions that have been undertaken so far in order to solve these problems: what is the current management strategy for soil and what are its results in terms of qualities?
    - forecasting: reporting stakeholders' analysis on the likely evolution of the situation in terms of issues at stakes, threats and assets
    - action: stakeholders' objectives and propositions, in terms of strategy and actions, to address the issue of comprehensive and sustainable soil quality.

5.3 Outcomes of the case study

5.3.1 Identification of the situation, concerned stakeholders and problems

The first question asked to the interviewed stakeholders during the patrimonial audit aimed to see what "dimensions" or "qualities" they associate to the management of soil quality. The first reality showed by the interviews of the stakeholders is the fact that most of the soils are loamy soils, a composition promoting slaking, and by this way considerably accelerating the process of runoff. But other aspects of "soil quality" emerge. The stakeholders describe soils in terms of **surface**, **profile**, as a **filter**, an **interface** between the outside and the bedrock and as a **moving material**.

The patrimonial audit also reveals five different categories of stakeholders, which one having a different relationship to soils. These five categories of stakeholders are:

- the local elected representatives
- the farmers
- the representatives of national, regional and departmental administrations
- the associations
- the experts and scientists

For all of them, soils is a wealth for the territory but it is subject to trends of degradation: industrialization of agriculture, increasing urbanisation. These threats take place at all levels: global (markets), Europe & State (policies), watershed (water management), landscape mosaic, farms & agricultural parcels

A key problem identified is the consequences of horizontal as vertical soil movements (runoffs, soil erosion, flooding and mudslides, impacts on water quality). On other aspects, interviewed stakeholders identify rather emerging tensions than acute problems: loss of soil productivity due to erosion (but is it a problem for farmers?); artificialisation of land; soils plays less their role of filter (ploughing of grasslands); the loss of "the identity of Normandy".

So, the strategic core of the issue is: can the farming world and society meet in a global management of the territory and of soil quality as a global & regional common resource?

5.3.2 Diagnosis of the current system of action

Flooding, runoff, become a concern and a major issue for public authorities in Normandy in the 1980s. In 1990, following extensive erosion and, the Prefect demands the creation of watersheds associations for all the Seine-Maritime, including the SMBVAS (Syndicat Mixte du Bassin Versant de l'Austreberthe et du Saffimbec) partner of this research-intervention.

The SMBVAS as a key role in the struggle against runoffs. But, it is seen as treating the symptom rather than the cause of problems and action of SMBVAS on the symptoms make them less visible.

Soils are also a key issue for local players, which translate into a myriad of activities. People outside the world of faring find some awareness among farmers; they receive some individual efforts. But they also find that “these actions are struggling to have a “system effect”, a “global effect” on the erosion and runoff” and for farmers, a better management of soil quality is difficult to consider under current conditions. It’s difficult for them to reconcile dominant economic logic and management of soil.

Overall, **actors of “intermediate territorial level” seem more pro-active but they struggle to mobilise other levels (individual, national, European level).**

So, interviewees noted a multitude of actions, but non-complex actions in response to a multi-stakeholders and complex problem. Soil quality issues are addressed in a non-complex way, which generates various negative systemic effects (for example, individually, with fewer inputs, a farmer is likely to receive “double penalty”: less yields and a lower price for his crop). **For actors, those systemic effects discredit or will eventually discredit the decision-making process and those who have taken the initiative.**

Interviewees also felt that the system of action is at a pivotal moment: with **the desire to move from risk reduction towards prevention,** and, for actors met, there will be no sustainable improvement of runoff management without managing all dimensions related to soils even if they confirm that there is no comprehensive and concerted approach to soil quality. So, there is a lack of capacity to act as a whole, and it’s becoming prejudicial for action. This is even more true that many actors agree on the fact that there is a satisfactory level of knowledge of these phenomena (including a scientific point of view) and range of actions to implement, but neither the “whole voluntary" nor the “whole regulation” or the “whole economic” seem satisfactory.

So, in partial conclusion of the “diagnosis section”, the “soil quality” remains a “weak signal” difficult to integrate into the daily practices of each institution, public or private, of each individual. However, because of the “circulating nature” of the phenomena, their “transappropriativity” (i.e. the fact that they cross the usual categories of public and private appropriation, like private property, public mandates…), the accumulation of "micro-decisions" (i.e. decisions of individual actors in the framework of their own activity) is causing “macro-phenomena”. Changing these “micro-decisions”, requires for each actor to implement “burdensome strategies”, in a context where many actions are carried out but without any real shared strategy at the basin level. So, **we find an asymmetry between the importance of issues related to runoff and weak signals perceived by each actor.**

5.3.3 Prospect: evolution of the situation, problems and response

To take a positive step, it seems necessary to reconcile different spatial horizons (as “territorial” horizon and “sectorial” horizon (market, economic sectors…), also local / national / European and global levels) and different temporal horizons (crisis management, longer time of great changes in agriculture & urbanisation, time of democracy & institutions…).

According to the stakeholders the **probable scenario** is that current trends (industrialisation of agriculture, urbanisation) will persist. For some actors, this leads to tougher regulations, competition on land and land degradation, and on the issue of runoff and flooding, a good level of management.

The **negative scenario** is for the territory the occurrence of a big flood, pollution affecting water quality, decrease of agricultural activity, loss of soil fertility. For erosion control, the negative scenario is for the stakeholders to go further without leaving the “only volunteers” or “everything regulated” logics. But, acting only with volunteers raises questions of efficiency; acting only with regulations leads to anticipation by stakeholders of non-productive effects, so these stakeholders dissociate from the action, the risk of destabilization of institutions and the break of the trust between stakeholders, who act more and more in an administrative way.

The **positive scenario** is unclear for stakeholders but they insist on a strong change in farming practices (not based on coercion) with better environmental impact and still economically viable farms and innovative urbanisation that integrates further storm water management.

In terms of action, the prospect reveals the stake that consists in answering that question: do the stakeholders wait for the next flood to take the positive step they speak about, or do they create an innovative and positive project out of crisis?

5.3.4 Modes of soil quality management to set up according to the stakeholders

The interviewed actors describe a desirable management mode that is not clearly defined but some characteristics are sketched out: defining with all the parties involved what is expected for soil, at the territory level; acting simultaneously at different levels; a new role for elected representatives (facilitator of the engagement of multiple private owners alongside public authorities, for better coordinated management of water and soil)

Those requirements are then translated into priority axes. Firstly, protect soil, in term of quantity, (prevent the artificialisation of lands…) but also in term of quality (redevelop a more suitable agronomy). Secondly, act together rather than wait for enormous efforts of the few or focussing on few issues. Finally, do not forget the major technical measures as maintenance of structures, floodplains, etc.

5.3.5 Key lessons from the French case study

Problems related to the improvement of soil quality can be classified in three categories:

- The mono-stakeholder problems, considered as non-complex problems (e.g. agricultural practices of each farmer), the conventional ways reach limits in influencing individual actors.
- The bi- or oligo-stakeholders problems, where the reduction of complexity is negotiated (e.g. construction of hydraulic & retaining structures by SMBVAS). This approach is necessary but also limited, because understanding of quality is not appropriated by all actors.
- The inherently complex and multi-stakeholders problems (important number of stakeholders, dealing with complex issues – e.g. management of the causes of runoffs). Complex and multi-stakeholders action does not exist… but could exist. This requires the establishment of forum, languages, know-how for meeting, to meet, communicate and negotiate. In the case studied, such places do not exist; they are latent but not actual.

In terms of recommendations, public soil quality policies (notably a possible European Directive on soil quality) can simultaneously achieve three major requirements. First, it is obvious that such public policies should include global norms, universal standards, but it is clear from this work that it should not stop here. Secondly, and paradoxically, these policies as an “external driver” could contribute to the emergence of “self-organized” communities of actors in the territories; these communities would manage soil quality. What conditions can allow the emergence of such communities? At the European level, a Soil Directive may facilitate to identify these communities, their practices and know-how… and also their limitations. Rather than imposing soil qualities from outside, it can enhance the ability of actors in rural territories to define "soil qualities" they wish to manage. It could strengthen the capacity of these communities, by helping them to invest in “facilitation functions”. Finally, soil quality policies should enable the meeting between these two modes of knowledge and action, which are complementary. It could strengthen these communities to be open to outside concerns to manage “Soil Quality” as a global and regional common good (and not only a local common good). But it can also contribute to fostering local applicability of global public policy on soil.

6 Belgian case study – transition pathways of soil management in the context of the development of conservation agriculture in Wallonia: the case of Greenotec association

6.1 Context of the case study

Conservation agriculture is an agricultural model that aims to maintain soil fertility and prevent soil erosion through the application of principles such as minimal soil disturbance (reduced tillage), permanent soil cover and crop rotation. For farmers, reduced tillage techniques are first a solution for technical or economic problems: they permit the cultivation of very stony or clayey soil and they allow fuel and labour saving. Simultaneously, conservation agriculture meets current societal and political concerns about soil quality: its abilities to maintain soil fertility and prevent soil erosion allow conservation agriculture to be considered as a tool for the preservation of soil quality.

The Belgian case study focuses on transition pathways of soil management in the new context of individual and collective and public policies developing “conservation agriculture” (CA). The case is addressed through a multi-level transition perspective that focuses the analysis on Greenotec ASBL (non-for-profit association) in Belgium. Greenotec is the only association in the Walloon region leading the transition towards zero tillage. It has settled experimental platforms and a frame of extension. Greenotec has built a network of more than 200 farmers that are on the pathway of conservation agriculture transition. More recently, Greenotec has set up contract with local municipalities that are confronted with mud floods to connect floods issue with cropping practices. Greenotec has also a tradition of cooperation with researchers but not yet with socio-economist scientists.

In the Walloon region (South of Belgium), our investigation area, several farmers experienced reduced tillage in the early 1980's. Since then, conservation agriculture has expanded and, nowadays, the Walloon agricultural surface under reduced tillage is estimated to be between 15 and 20% for winter wheat crops and less than 10% for other crops (Greenotec 2012). Reduced tillage techniques are developing mainly in Hesbaye (crops region) and in the Condroz (mixted region).

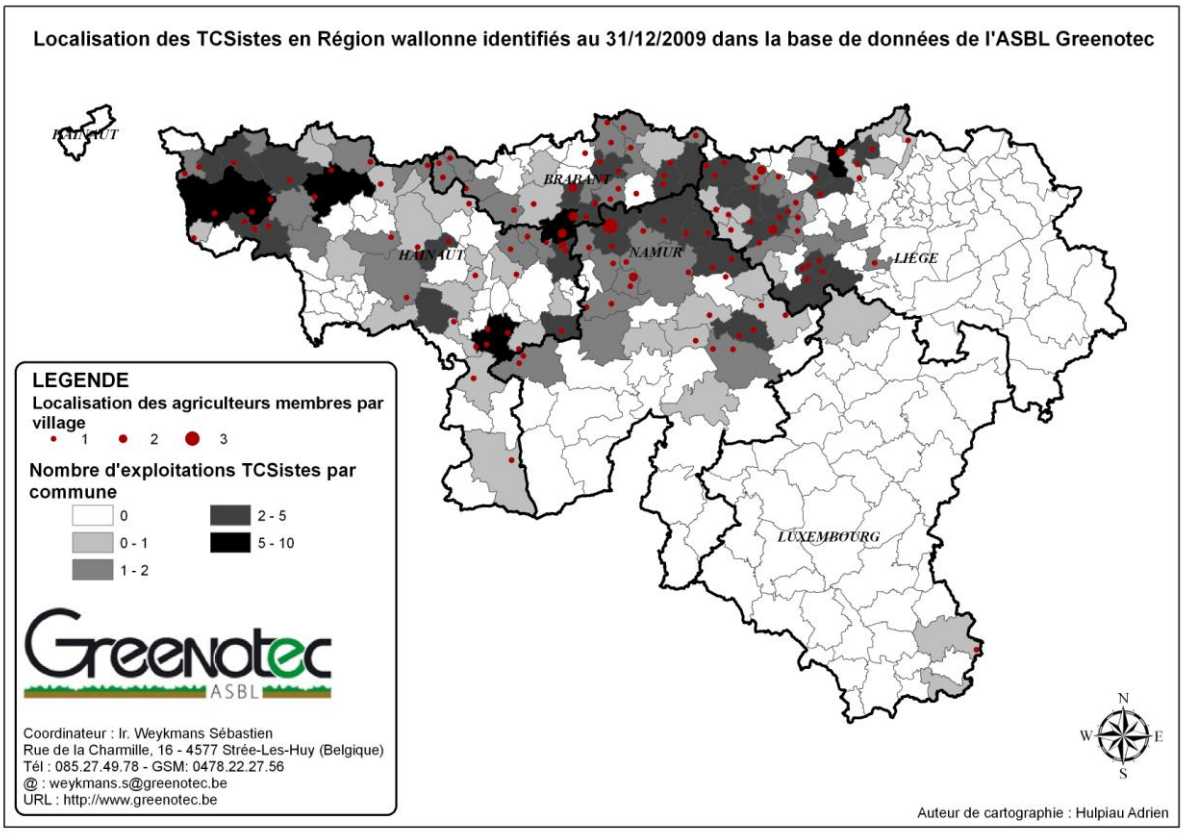

Figure 1 – Map of farmers applying simplified cropping techniques and of Greenotec members in the Walloon region

6.2 Method and theoretical framework for the case study

Among the various schools of thought emerging from the « *Sustainability Transition Studies* », we are positioning our analysis within the multi-level perspective set out by Geels (2002) and Geels and Schot (2007). Here, transitional processes are interpreted as being the dynamics of inter-action between the three analytical levels defined by Geels and Schot (2007) as follows:

4) *Niches of innovation*: spaces where radical new approaches emerge to then mature and progress while remaining more or less protected from the pressure of selection exerted by the *regime*.

5) *Socio-technical regimes*: sets of norms, standards, beliefs, regulations, and cognitive routines, which direct the trajectories of practices within a given sphere. The stability of a *regime* is founded on the strong inter-dependence of these various components. This engenders a degree of irreversibility making the *regime* more or less resistant to change.

6) *Socio-technical landscape*: the environment considered to be exogenous in relation to the *regime.* It encompasses macro-economies, large-scale models of cultural representations, and macro-political trends and developments.

Within the context of our analysis, ploughing is considered to be one of the components of the *regime* of modern-day agricultural production. As emphasized by Goulet and Vinck, ploughing can be considered an institution insofar as it is both an externalized normative framework (i.e. is beyond the control of individuals) and one internalized by individuals, which directs the trajectory of farming practices.

> Farmer's connection with plowing is a robust one. Working the land in this way remains a practice deeply anchored in the professional norms of farmers and in the recommendations of prescriber organizations (Chambers of Agriculture, cooperatives). [...] It is so embedded in beliefs and conventions, partly upheld by legal frameworks and standardized operational

procedures, that one can legitimately speak of plowing as an institution[3] (Goulet and Vinck 2012, 205).

On the basis of this observation, we posit that conservation agriculture in the Walloon region of Belgium is an emergent *niche* of innovation marking a break with ploughing – an institution of the *regime* of conventional agriculture[4]. The emergence of this *niche* is facilitated by several components of the *socio-technical landscape* that are bringing pressure to bear on the agricultural *regime*. These include the energy crises that focused attention on the costs of ploughing (fuel), the liberalization of agricultural markets that raised the problem of European agriculture competitiveness and of climate-related concerns, the issue of soil quality management now high on the political agenda (draft European framework directive on soil protection), the recognition of conservation agriculture by the FAO, as well as the more far-reaching issues of sustainable development associated with the evolution of the CAP.

Some of the criticisms levelled at the *Sustainability Transition Studies* (Shove *et al.* 2010, Smith *et al.* 2005, Berkhout *et al.* 2004) point at the difficulty of this theoretical corpus being able to characterize the way in which the development of a radical innovation within a *niche* can affect a *regime*. To describe the process whereby links between the *niche* and the *regime* can be created, Grin and van Staveren (2007) proposed the notion of *anchoring* according to which *niche* experimentation becomes anchored in the *regime*. We demonstrated how the case of conservation agriculture inverts this notion of *anchoring* and how the notion of *insularization* is more appropriated to describe the relations between *niche* and *regime*. Contrary to the process of *anchoring*, the founding principle of conservation agriculture is disengagement, a shift away from what has historically constituted an absolute must for the modernization of agriculture, i.e. ploughing. In connection with this, Goulet and Vinck (2012) developed the concept of *innovation by removal*[5], placing at the heart of the transitional process towards conservation agriculture the analysis of mechanisms of detachment from the institution that is ploughing. Through our analysis, we will be positioning innovation by removal within a process that we have qualified as insularization in relation to the dominant agricultural regime. The notion of insularization arose from a twofold observation. Firstly, conservation agriculture is a niche that seems to emerge within the regime of conventional agriculture and not on its fringe. Secondly, farmers' trajectories show that the mechanism whereby farmers detach from ploughing can extend to other dimensions of agricultural practices. This process of insularization thus stems from socio-technical transformations associated with transitional detachment from the regime of conventional agriculture which opens up new spheres of learning and practices – the island detaching itself from the continent – while drawing some of its normative techniques and models from conventional agriculture – the continent. The metaphor of the insularization addresses the question of the relationship between niches and regime by inverting to notion of "anchoring".

The point that interests us here is not the result of the insularization process but well the mechanisms through which conservation agriculture is built up as a niche in relation to the dominant agricultural regime. We will evidence how different practices of reduced tillage imply diverse reconfiguration in farmers' practices and representations systems. These transformations might be superficial or systemic; they might affect a part or the entire system.

Following our multi-level analytical framework, we have conducted our fieldwork investigations on five levels:

1 On farmers' practices and trajectories: through farmers' interviews and farm observations, we try to understand individual transitions;

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[3] Original citation : « …le lien qui attache l'agriculteur au labour est robuste ; en effet, le labour constitue une pratique encore profondément ancrée dans les normes professionnelles des agriculteurs et dans les recommandations des organismes prescripteurs (Chambres d'agriculture, coopératives). [...] Il est alors légitime de parler du labour comme d'une institution […] une prégnance de croyances et de conventions, soutenues en partie par des cadres juridiques et par des procédures opérationnelles standardisées » (Goulet and Vinck 2012, 205).

[4] It is to be noted here that our hypothesis pertains to the specific case of conservation agriculture in the Walloon Region. In other contexts, the development of conservation agriculture is or has been such that it cannot in fact be considered as a *niche* marking a break with the dominant agricultural *regime.*

[5] In French: « innovation par retrait »

2 on collective learning processes: through observation during field trips, workshops and seminars organised around conservation agriculture, we address the issue of learning and of the articulation between individual transition and a collective model of transition;

3 on Greenotec activities: through observation of Greenotec meetings and activities and interviews with the leaders of the association, we aim to understand how is built a collective model around conservation agriculture;

4 On Walloon institutions related to soil management and conservation agriculture: through the investigation of different departments of the public administration, GISER (in charge of integrated soil, flooding and erosion management) and NITRAWAL (in charge of nitrate pollution prevention), we reach to understand the role played by the public institutions and their articulation with conservation agriculture;

5 on research centres related to soil management and conservation agriculture: through semi-structured interviews with scientists, we reached to understand the role played by scientific research in soil quality management and conservation agriculture.

The initial step in field investigation was to set up a collaboration framework with Greenotec, identified as being a central actor in conservation agriculture in the Walloon region. We first met Greenotec president and coordinator to present the SAS-STRAT project and to establish a convention of collaboration (see annex 6). Our project was welcomed by Greenotec and later, the convention has been accepted by the steering committee of the association.

Between September 2012 and September 2013, we conducted semi-structured interviews and participants' observations with the identified stakeholders, and in March 2013 we organized a multi-stakeholder seminar within the SAS-STRAT. The seminar and the field trip offered the possibility for all these different people to meet and exchange around conservation agriculture and soil quality. For us, it offered a wealth of lessons learnt, opportunity and data collection for our understanding of the transition process to conservation agriculture and its articulation with soil conservation issues.

6.3 Outcomes of the case study

The analysis of farmers' transition to conservation agricultural evidences the following sequential process: 1) destabilization of the regime, 2) learning and experimentation, 3) radical change in the understanding of soil, 4) transformation of cover crops functions as well as fertilization principles, pesticides use, vision of agriculture, etc.

The way the regime is destabilized is case-dependent: observed farmers have entered a process of learning and experimentation of no-till or reduced tillage techniques for a variety of reasons: technical problems (soil compaction, difficulties to plough), a need to save time and workforce (e.g. one farmer working on a surface of several hundred hectares), a wish to save money (e.g. by lowering fuel use), soil erosion problems…

The study showed that the transformation of soil conception (from a "soil as a substrate" to a "living soil") is a tipping-point in the transition process because of its implications in terms of irreversibility and sustainability in the transition. For farmers who have developed a holistic and functional conception of soil quality, soil quality is no longer considered only a matter of soil structure that can be achieved through adapted techniques: it becomes a matter of preserving and improving living organisms and processes in the soil through diversified practices. One of these practices is the requalification of some principles of fertilization: some farmers reduce their fertilizer use since they increase organic matter rates, especially with cover crops and by interfering with the soil as little as possible, and continuously. This practice is associated with the practice of diversified cover crops: the role of nitrogen-fixing intermediate crops can be extended by assigning numerous other functions to them, and particularly soil organisms feeding and soil decompaction. The intensive use of pesticides can also be called into question by farmers regarding their potentially negative impact on soil life and biodiversity. Finally, the transition to conservation agriculture can lead farmers to consider other alternative models such as organic farming and integrated pest management that might nourish their conservation agriculture practices with other sustainable techniques and representations. Regarding all these potential transformations, we can say that the switch from a "soil as a substrate" to a "living soil" increases the irreversibility of the transition: while reduced tillage in its technical dimension is quite easily reversible,

the “living soil” conception induces a reconfiguration of the whole cultivation system and its foundations.

Consequently, farmers implement farming practices which allow sustainable soil management but also a broader agroecological farming system within the conventional agricultural system. This transition leads not only to adaptive changes at the fringe of the system: it induces a deep and systemic transformation of conventional agricultural practices. In order to preserve the living processes in the soil, farmers might reduce their use of fertilizers (thanks to the increase of organic matter in their soil, a consequence of no-tillage), of pesticides and herbicides (by the means of “low-volume pulverisation”, resistant varieties or better observations of parasites and diseases). Usually, we can also observe the transformation of the function of cover crops. Cover crops are obligatory by the law to prevent nitrate surplus. In CA, they become a way to provide organic matter to improve soil fertility.

As evidence in this research, for most of the farmers, soil degradation issue doesn’t precede the transition to conservation agriculture: it arises from the transformation of their practices and from a learning and experimentation process. The transition to conservation agriculture plays therefore a crucial role in soil quality management as it allows to the emergence of soil quality concerns among farmers.

7 Dutch case study – tools and process for integrating soil quality management in the sustainability policy of CONO dairy farmers cooperative

7.1 Context of the case study

7.1.1 National context

Because of its size and density, the Netherlands has considered soil as a key element of policy making quite early, notably in the environmental field. A soil protection act was voted in 1986, and several other regulations were passed since then. This regulation aims at preventing and managing in the first place soil pollution and contamination. Erosion and surface runoff are other important threats to soil in the Netherlands, and led to different policy developments, notably to prevent the side effects of the development of a more intensive agriculture from the 1970s.

While Dutch regulation has set limits to different soil pollutants including from farming, initiatives were taken at the level of provinces, notably by farmers' organisations, to self regulate. Pilot actions were also carried out in local farms to reach environmental goals through other ways than the ones prescribed by central government (Sonneveld et al., 2008).

These experiences have shown the limits of segmented regulation at central or local level to integrate the different dimensions of soil quality, and the value of innovation at local level in this respect, building on farmers' knowledge of their land and soil, as well as on connections between farmers and other stakeholders (local and central administration, industry, researchers, policy makers…).

Lessons can be learnt from current experiences at local level notably to understand their capacity to produce a better integration in practice of total soil quality, including the different uses and functions of soil (farming being only one of them).

7.1.2 Case study in the Beemster polder

The Dutch case study focuses on new impulses to increase sustainability of dairy farming in the Beemster polder, with special attention to sustainable soil management of the underlying grassland and arable lands.

The polder 'the Beemster' is located in the province of North Holland. It was dried during the period 1609 through 1612 and is included in the UNESCO World Heritage sites (see historical map of the area below). The typical squared shape of the parcels and the grid of canals paralleling the grid of roads, which have been preserved intact, is one of the reasons that it is listed as a world heritage.

Figure 2 – historical map of the polder "the Beemster"

CONO dairy farmers cooperative (www.cono.nl) has a factory in the polder since early 1900, which notably produces the Beemster cheese. In 2006 they adapted the sustainability program of Ben&Jerry's ice-cream company. Within the program of Ben&Jerry's, sustainable dairy farming was described as 'happy people, happy cow and happy planet'. In December 2010 CONO launched an integral score for the 'happy planet'. All 550 farmers that deliver their milk to CONO have been scored on nitrogen (N), phosphate (P) and carbon (C) on the nutrient balances. Although only 30% of the CONO farmers are located in the Beemster, CONO can be seen as an innovative case. CONO is leading in sustainable dairy production in the Netherlands. Since then, they have also been looking for a better and more farmer friendly method of scoring soil quality. The main characteristic of the new system was that it uses a visual method for scoring soil quality. With the visual method, farmers get better knowledge of their soil, and CONO is willing to reward them when they achieve better scores on 'happy planet'. In the Beemster area soil consist mainly of clay soils. Often the land is used for short-term profit crops like bulbs or tulips. These crops gain a lot of cash in one year but are devastating for soil quality.

"Ben & Jerry's" ice-cream company and CONO use a score for environmental impact of dairy production (developed by Frank Verhoeven) to underpin their sustainability program Caring Dairy. This score is now tested within a broad group of participating dairy farmers. The criteria for scoring sustainability are in debate at the moment, but a general agreement was made between stakeholders, government and scientists. Several instruments where brought together in one score for "happy planet" (air quality, Water quality, Soil quality, Impact on climate change, Biodiversity and Footprint)

The data needed for this score can also be used for a certificate and good results can be rewarded in a way that dairy farmers are stimulated to lower levels of nitrogen and phosphate surpluses and improve their soil quality. The province of Drenthe and Utrecht are using the score and searching for new ways of stimulating soil quality by measuring "farmers data" and rewarding "best practices".

7.2 Method for the case study

The case study takes the form of qualitative and technical research in the form of interviews and data collection of 25 to 30 individuals on the basis of the methodology defined in WP3. The case study focuses on the territory of the Beemster polder, while taking into account the relations to province and central government, and experts.

This case study is carried out under the form of interviews and expert meetings with farmers and relevant stakeholders (see before). Data analysis is carried out and several examples and best practices are written down and discussed. In the end, a description of sustainable soil management in relation to dairy farming is given; a list of measurements, potential scores (range of results) and the potential use for government regulation and/or ecosystem services is to be written down. Five dairy farmers were selected as 'best practice' farmers and compared with five conventional dairy farmers. From these ten farmers the questionnaire (see annex 7) is taken.

To measure the quality of the soil belonging to the dairy farms, it is important to look at the Organic Matter (OM) content of the soil as one of the key-indicators. Research done by Sonneveld et al. (2008) showed that within the exact same type of soil (in theory), OM content differed by more than 4% due to differences in management of the farmer (in practice). Factors like the amount of applied fertilizer, the quality of the organic manure, land use, ploughing, water management, etc. affect the quality of the soil throughout the years. An optimal OM content is needed to lower inputs and to improve the amount and quality of the grasslands and fodder crops on a long term. In the used "cycle approach" the aim is to improve the quality of the soil, the crops (mainly grasslands), storage of the harvested feed and the manure quality. As a result farmers can successfully lower their inputs of concentrates and their use of artificial fertilizer. Farmers' knowledge combined with scientific knowledge is effectively used to improve the nutrient cycle (efficiency) on dairy farms.

In order to assess the quality of soils – including OM content – with the farmers, Dr. ir. Marthijn Sonneveld (Wageningen University, chair of land evaluation) has introduced the VSA score within CONO/Beemster. This score is an easy to access and cheap tool to evaluate integrated sustainable soil management in productive agriculture (grasslands and arable land). The tool was invented in New Zealand (Sheppard) and worked out for the FAO. For the CONO cheese factory the method seems to be a attractive way to address sustainable soil-and land management, for building more learning

capacity of the farmers and even for rewarding more sustainable soil management use of their farmers (on the long term). The VSA score helps to:

- Stimulate the discussion about sustainable soil management among the stakeholders (on the spot).
- Involve other stakeholders (society, governments, civilians) by scoring sustainable soil management
- Make sustainable soil management accountable

7.3 Outcomes of the case study

7.3.1 Development of the Visual Soil Assessment scoring method used in the framework of the Dutch case study

The objective of a Visual Soil Assessment (VSA) is to give a grade to the soil by watching and feeling it. A good soil quality is very important for the sustainability of a land (high yield and no reduction of the soil quality). Different soil properties (e.g. soil structure, rooting pattern) reflect the soil conditions as result of the land management. By carrying out the VSA, a score on farm scale will be given based on scores of those soil properties. The higher the score is, the better the soil quality is.

7.3.1.1 Why VSA?

Land managers need a reliable, quick and easy tool to assess the soil quality. They can do the assessment by themselves, just by looking to the soil and give a score to the soil quality indicators. Based on their VSA score, they can make the right decisions that lead to more sustainable land management.

The VSA method is developed in New Zealand by Graham Shepherd and implemented by the Food and Agricultural Organization (FAO). As example the field guide for pastureland is included in this folder.

7.3.1.2 Example of VSA in the Beemster

Where to carry out the assessment in the field? It is important to perform the VSA at random locations in the field. Each unique combination of soil type and land use will form a stratum, and each stratum on a farm will be assessed. For this test we used the land from a Beemster farmer, the farmers parcels are shown in Figure 3.

Figure 3 - Overview of parcels from the Beemster farmer

7.3.1.3 Visual scoring

At each site, a score can be given to each criterion (2 is for good conditions, 1 for moderate conditions and 0 for poor conditions). On the scorecard, weights are assigned to the criteria based on the

accuracy and importance of the criterion. The VSA score for a sampling location is calculated by summing the individual scores of the criteria. In the example below, the VSA score of site number 10 of this farm is 18 out of 44. After conversation with the farmer sometimes it seems that something special happened in the parcel, for example filling up a ditch or the construction of gas pipes. Figure 4 shows the result of the VSA score that has been made on the Beemster farm during the excursion.

VSA-Score card

Landowner:	3. de Moel-Kooij	
Site number:	10	
Location GPS:	118586	504417
Property details:	Wo	moerige laag op of tussen niet gerijpte klei
Soil type:	Moerige eerdgrond	
Land Use:	Maïs	
Date:	19-6-2012	
Field status for each criterion		
Texture:	Heavy Loam	
Moisture condition:	Moist	
Surface Ponding:	No	
Cracks:	No	
Environment:	vanaf 40 cm grijs, gerijpt en vlekken	
History:	Al 6-7 jaar Maïs, daarvoor grasland	

Criterion	Visual Score	Weighting	Total
Soil structure	0.5	3	1.5
Soil porosity	0.5	3	1.5
Soil pH		2	0
Earthworms	0	2	0
Number and collor of soil mottles	1	3	3
Root development	1	3	3
Surface cover	1	2	2
Tillage pan	1	3	3
Soil colour	2	2	4
Total			18

Figure 4 - Result of VSA-score card on a Beemster farm

When the entire farm has been sampled, a final VSA score is given based on the VSA scores at site level. It is an indication for the management of the field and can be used to compare it with different farmers in the neighbourhood. The resulting VSA scores given to 10 farmers from the Beemster polder is shown in Table 1. The maximum score that can be achieved is 44.

Farm number	Total VSA score
1	35
2	34
3	34
4	34
5	32
6	36
7	33
8	27
9	35

10	36

Table 1 - VSA score for ten farms in the Beemster

VSA scores can be compared with each other to see where the soil quality is better, and if this has to do with management. For example: the comparison between continuous grassland and a field where maize is grown for 7 years. Graphically the VSA score can be shown in an octagram that gives a quick overview. In Figure 5 below, the octagram of the Beemster farm is shown. One can notice that grassland and maize are given separate graphs.

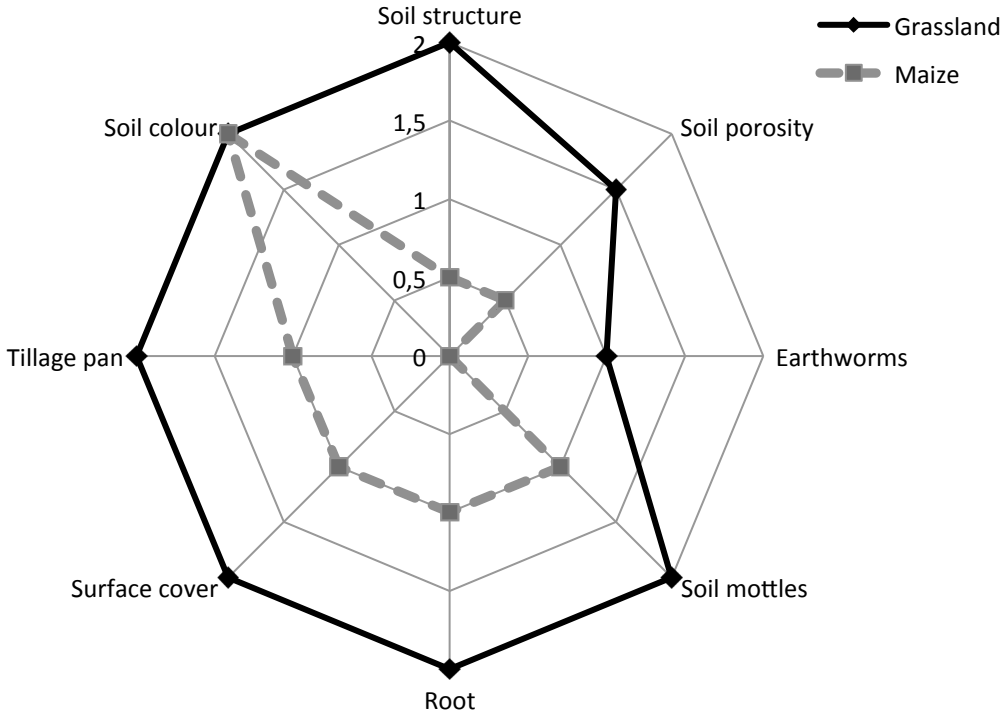

Figure 5 - Octagram of the VSA score

7.3.2 Case study

The research team responsible for the Dutch case study has analysed the social network related to soil quality in the Beemster area with special focus on dairy farming and the role of co-operative CONO cheese makers. The results of this work are exposed below.

7.3.2.1 What are the characteristics and unique qualities of this specific soil?

The Beemster region has a 400 years history that has a direct impact on its present landscape and spatial organisation: fields, farms, roads, canals, villages and towns. It also has a consequence on the actor network involved in agricultural issues (such as soil quality): for instance, the water board and the local/regional/national authorities play an important role in land management.

7.3.2.2 What is the evolving social network related to this soil?

The research team has carried out a mapping of the actors who, through their representatives, are involved in the management and preservation or development of this specific soil. The considered categories of actors considered are the following:

- Elected and administrative representatives of the territory Beemster Polder (Waterschappen)
- Soil scientists (among them members of the SNOWMAN network in the concerned country)

- Soil-Land owners (e.g. Farmers, Nature organisations, Fondsen, Pachters)
- Farmer organisations (LTO, Agrarische natuurvereniging Waterland en Dijken)
- Actively involved regional citizens (e.g. Heemkunde kring)
- Representatives of sustainability organisations (Unesco, Stiching Natuur en Milieu)
- Policy makers at different levels (e.g. European Commission civil servants dealing with the CAP)

The result of the mapping of actors carried out by the research team for the Dutch case study is summarised in Table 2 below.

Actor	Relation with soil quality issues	Perspective - interest & policy
Average farmer	Owner of the land, shareowner of the CONO co-operative	Not willing to improve soil quality, but willing to take extra steps when rewarded.
Innovative farmers involved in (national) networks	Owner of the land, shareowner of the CONO co-operative	Large involvement in policy making, networking, pro-active.
CONO cheese co-operative	Strong relation with farmers	Distinctive on sustainability
LTO (Dutch Federation of Agriculture and Horticulture) – national	Represents large part of the farmers community	Large involvement in policy-making, networking, guarding farmer's interest.
LTO – local	Represents large part of the farmers community, at the local level	Guarding local farmer's interest
Water, land en dijken (environmental co-operative)	Operate in the area	Collective that focuses on maintaining the landscape with farmers
Government – EU	Responsible for the CAP	Promote sustainable soil management
National government (agricultural ministry)	Dutch legislation	Policy making
Province of North Holland		
Water board (Hoogheemraad schap Hollands Noorderkwartier)	Water level & quality management	In charge of the water quality
Water company	Water quality	In charge of concrete water management
Beemster world heritage (UNESCO)	Beemster is protected by UNESCO	In charge
Advisors feed companies	Regular farm visits	
Other advisors	Incidental farm visits	
Local action groups		Depends on group's interest

Table 2 – Analysis of the networks of actor linked to the Beemster soil

The research team managed to get a complete overview of all the actors involved in relation to the soil management (step 1). Three sources of influence on soil quality management were identified in this network of actors:

1. Economy and industry: Farmers, Feeding, bulb sector[6], Dairy sector, CONO, breeding industries, multinational firms (fertilizer, feed, etc.).
2. Government: Water boards, local municipalities, provinces, national government, EU.
3. Society, Science and Culture: World heritage rules, environmental organisations, Science, Consumers, Citizens, Education, schools, farmer culture.

7.3.2.3 Quality of the Beemster soil

Beemster soil is particularly beloved by Beemster farmers, not only because it is their 'main production tool' or part of their patrimony and familial heritage, but especially for its qualities: "I think it is one of the best soils of the Netherlands" (farmer). The quality of Beemster soil is also identified as a resource by external bulb growers, whose actions affect the long-term quality of the soil.

As regards fertility, the Beemster soil has a relatively high Organic Matter level (around 9-10%), certainly for two reasons: the first would be that the drying and farming of this soil 'only' dates back to 1612; the second would be linked to the nature of the (peat) soils surrounding the Beemster polder. These peat soils result from the natural filling of old deltas and marine marshes, between 6000 and 5000 Before Present, and still have an OM level higher than 80% (usually 89-90%). Clayey soils 'dry well' and have a good structure (compared to peat soils that are always very wet and less suitable for agriculture).

The Beemster soil has been conserved by relatively extensive dairy farming practices (e.g. pastures). On those clayey soils, intensive cattle breeding, intensive crops (like bulbs, maize, etc.) and intensive crop rotations would result in a rapid OM (and Soil Organic Carbon - SOC) decline, a soil compaction, more water thus agricultural substances and soil run-off and therefore a growing equipment and operation costs for farmers with lower crop yields.

The research team has identified three key issues related to soil quality in the Beemster case:

- Current rules and regulations that accompany the soil on different levels (e.g. Non tillage rules)
- Societal debate
- Experimenting and developing innovations with the soil

In the Beemster case, the sustainability programme developed by the CONO cooperative improves three types of qualities:

- Soil quality itself
- The quality of the relation of farmers with their soil
- The quality of relations within the networks of actors related to soil management

7.3.2.4 The CONO cooperative

The CONO cooperative has to be understood in the global transformation of the global milk market. The liberalisation of the milk production will lead to the end of milk quota and the probability of price decrease.

1. CONO is a competitive actor on the milk market. Therefore, it constantly has to innovate because of the hard competition with much bigger dairy companies. According to our understanding of the factory, CONO has a double vulnerability:

[6] Especially in this region (because of the soil quality) there are a lot of possibilities for dairy farmers to gain short-term profit by sub renting the land for bulbs.

a. As a front runner, it must constantly innovate because of the concurrence, and the competition on differentiation (and his economical added value) It ask a constant work of actualisation

b. The brand 'Beemster' is ambiguous (e.g. for foreign consumers): the quality attached to the brand is based on the reputation of the Beemster World Heritage while the strategy of CONO is not focused on the Beemster area. We see more Beemster as an opportunity to give some added reputation to the handcraft quality.

2. CONO cooperative as a collective dynamic has a real ability to develop a better use of resources.

   a. The collective organisation is led by the farmer board, there is a citizen advisor board… there is a whole network of cooperation with the Wageningen University.

   b. The cooperative plays a double role: on one hand, it tries to make progress in the qualification of his cheese product and on the other hand, it tries to re-distribute the added value along the food chain (4000 euros/dairy farmer).

7.3.2.5 CONO's "Caring Dairy" programme as an example of development of cycle approaches in agriculture and soil quality management

In The Netherlands, Dairy farmers are one of the main users of the agriculture soils. Figure 6 shows a simplified picture of a dairy farming system. It makes clear how cows, manure, the land and roughage are connected. This picture (or better; the system thinking) was earlier described as a novelty by Stuiver et al. (2003) and can be seen as the start of a transition towards a more ecological and sustainable way of producing in The Netherlands.

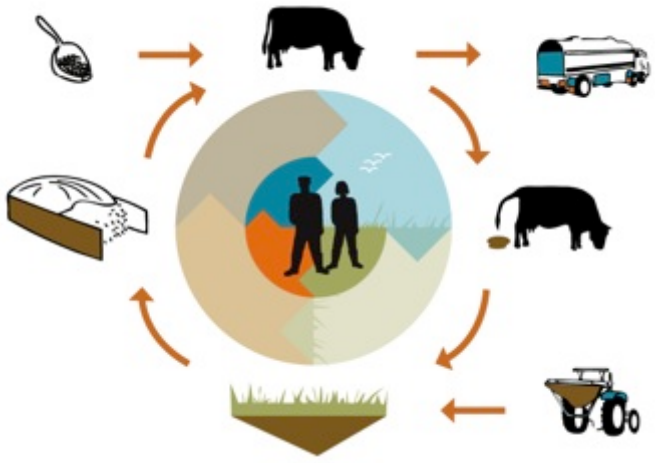

Figure 6: Simplified visualization of the dairy farm system

The cycle approach is based on the optimal use of the farmers' own resources such as pasture, fodder, soil, forage, manure and minimal use of external inputs like fertilizer and concentrates. This approach is put central by CONO cheese makers in their sustainability programme. CONO is a cooperative owned by its members (the farmers). Their sustainability programme Caring Dairy is focused on the sustainability of the whole chain from cow to cheese. In December 2010, the CONO Cycle Compass was launched as part of Caring Dairy (Calker, 2005). This allows members of CONO to be scored on sustainability aspects and constitutes a new way of scoring and rewarding for the management of the soil under the farm.

The cycle approach is a symbol for optimized resources and supplies (sunlight, organic matter, minerals, labour, water, energy, landscape, experience, knowledge, etc.) and using as selective as possible external input, realizing an income over the long term and with respect for natural systems. (Hoes et al, 2010). Worldwide, the need to focus on the cycle approach is growing. In 2011, a report from the leading McKinsey & Company titled "towards the circular economy".

Less input of concentrates and fertilizers and higher utilization of their own food, their own land and cow manure lead to cost savings and environmental benefits. The entrepreneur uses the resources of nature, such as manure, soil, water on his land or self-produced grass to ensure that soil fertility is

maintained. It is scientifically increasingly possible (Oenema et al, 2011, Aarts et al, 2007, Dijkstra et al, 2010) to describe the cycle approach and monitor the results on the mineral balance.

Ultimately, the management of the farm has a great influence on both the final soil and the leaking of nutrients into ground and surface water and on the emissions of greenhouse gases (De Boer et al, 2012). There is much variation among dairy farmers in business, craftsmanship and environmental performance in practice. The cycle approach embraces variations in the management of the business. This approach is not a set of rules and regulations such as organic agriculture. It describes a goal now and in the future with less input and a maximum output achieved with minimal losses to the environment and climate. The soil plays a key role.

CONO wants targeted farmers with sustainable performance and reward good management practices. This poses the question of how the entrepreneur can have insight into sustainable soil in such a way that can also be rewarded. Business figures, such as the phosphate efficiency indicate that in the year the soil is functioning properly, but it still gives insufficient image of how sustainable is the soil management of the farmer. Besides, recycling figures for N, P and C will also include an assessment whether the farmers now and in the future enables the soil to maintain. Soil quality is not just a concept that relates to the chemical state of the soil, but also on the biological and the physical state. This makes it necessary to achieve better overall score and instruments.

Since 2008, CONO cheese makers have developed the Caring Dairy workshop programme where the affiliated farmers can attend workshops and create action plans. With the “Cow Compass” and “Recycle Compass” scores launched in December 2010, CONO assesses the quality of farmers’ practices as regards cow health and well being and preservation of nature and the environment. The scores in conjunction with the workshops provide the knowledge to farm in a more sustainable manner. The Recycle-Compass score of CONO is a uniform scoring method to evaluate how farms succeed in closing their production cycle. The more the circuit is closed, the lower the losses to the environment and climate, all in conjunction with an attractive landscape and biodiversity. Within the Recycle Compass the mineral balance (the supply of concentrates and fertilizer on the farm minus the discharge of milk and meat) plays an important role.

Furthermore, CONO presented a strategy whereby farmers can earn additional bonuses if they have a low phosphate surplus on their business reality. CONO cheese makers has used Recycled Compass for several years now but want to take the next step and will reward the efficient use of phosphate. This is because the world supply phosphate slowly runs out and the dairy industry will be less dependent on external inputs of phosphate, and phosphate will be more reusable. Efficient use of phosphate (by e.g. less concentrate and fertilizer imports) means in many cases economically better farmers. The farmers are also here to earn money. But the choice of reducing the phosphate surplus is also motivated by the available calculation and data collection that is reliable enough for a reward. This is in contrast to the emission of greenhouse gases that is subject to much scientific debate (e.g. on the question: how do you calculate CO2 capture it?). Every dairy farmer who is a member of CONO gets the opportunity to participate in a performance trajectory. For these participants, the mineral balance is accurately drawn. It is also a concrete improvement agreed as a P2O5 fertilizer use <8 kg P2O5/ha in 2013 and <4 kg P2O5/ha in 2015. To participate in such a process the farmer receives an additional premium of 0.0025 euros per kg milk (about 1500 euros extra on an average dairy farm). It is a redistribution of the milk, which CONO tries to create more incentives for sustainable business. Like the grazing premiums or discounts at too high a cell and count in the milk. The choice of phosphate was developed in consultation with the advisory board of the Caring Dairy program consisting of Wageningen University, the Netherlands Society for Nature and Environment, Solidaridad and WWF (see www.caringdairy.nl).

8 Transversal analysis of the case studies

This section presents the transversal analysis of the case studies conducted by the SAS-STRAT research team. This transversal analysis was discussed and refined with stakeholders during the SA-STRAT Integration workshop (Paris, 17th-18th June 2013). After a short presentation of the method for the transversal analysis, the 3 themes are developed hereunder. These themes correspond to a central element in the method of each case study:

- Sustainable soil quality management, a problem of transition in socio-technical systems: trouble within the regime and self-locking effects on current practice
- Taking complexity into account in soil quality management
- Contributions of scientific and technical tools to soil quality management

8.1 Method

The transversal analysis was developed through a 4-step process:

1. Choice of 3 themes for transversal analysis by the whole SAS-STRAT research team.
2. Production of a draft transversal analysis of the 3 case studies by the SAS-STRAT research team
3. Organisation of an Integration workshop (Paris, 17th-18th March 2013) with 21 actors from France, Belgium, the Netherlands and Switzerland to discuss the case studies and their transversal analysis
4. Production of the final version of the transversal analysis.

The Integration workshop (Paris, 17th-18th June 2013)

This workshop, organised in Paris on 17th and 18th June, gathered 21 actors from France, Belgium, the Nethelrlands and Switzerland (see list of participants in annex 8), including stakeholders from the French and Dutch case (stakeholders from the Belgian case were invited but did not come), external stakeholders from France and Switzerland, members of the SAS-STRAT Steering Committee and the SAS-STRAT research team.

A system of French-Dutch simultaneous translation was made available in order to facilitate communication between stakeholders. This was appreciated by all participants for the quality and finesse of reflection and analysis that was made possible (this is a point that may seem marginal but which proved important).

The programme of the seminar (see annex 9) was designed in order to facilitate the progressive emergence of a "common understanding" between the multiple stakeholders. This gradual process of co-expertise was developed as follows:

- Session 1: Presentation of the results of the case studies. This session aimed to present synthetically participants how the integrated management of agricultural soils is the context of the 3 SAS-STRAT case studies. In order to enrich the information basis and the discussion, 2 additional cases from Switzerland and France were presented by stakeholders (see annexes 10 and 11):
  - Switzerland : "Public policies for Facilitating Transition Towards Sustainable soil management in the Swiss canton of Berne"
  - France : "Supporting the transition of farmers to conservation agriculture : the experience of the Association for Sustainable Agriculture (Association pour une Agriculture Durable – APAD)"
- Session 2: Lessons learnt from the case studies. The second step was to introduce participants to transversal lessons learnt from the 3 SAS-STRAT case studies. At the end of these two sessions, first exchange between the participants enabled progressing in formulating a common expertise on how to understand strategies for integrated management

of soil quality. This transversal analysis was developed acording to three structuring themes (chosen by the SAS-STRAT research team):
    - Sustainable soil quality management , a problem of transition in sociotechnical systems, with self-locking effects on current practices
    - Addressing complexity of soil quality
    - Contribution of scientific and technical tools to soil quality management
- Session 3 : Strategic diagnosis of the stakes and challenges for integrated soil quality management in Europe. The principle of this session was to encourage the emergence of shared expertise on integrated management of soil quality in the territories but also at European level. In order to enable this, Mutadis has developed this strategic diagnosis using the method of “patrimonial audit” (used for the French case study) with a panel of 13 actors (see annex 12) including members of the SAS-STRAT research team, European officials (European commission DG Research, DG Environment and Joint Research Centre) and stakeholders from France and Switzerland. The presentation of this strategic diagnosis was followed by a discussion with the participants of the worshop.
- Session 4 : Recommendations - how to create conditions for actors' practices to take into account integrated soil quality. At the end of the seminar, once the different levels of information and lessons presented and discussed, participants' expertise was mobilized in the form of parallel working group sessions in order to formulate recommendations that are shared by the group for developing integrated soil quality management. Four major issues have been proposed to guide the discussion:
    - What instruments to put into debate soil quality ? What instruments of qualification to support deliberation? How to build indicators to evaluate progress with the concerned actors in a project approach ?
    - How to develop situated collective learning processes? How to go from individual advice to joint construction of soil qualification? What role of research & expertise?
    - What integration forums between global stakes, sectoral priorities and the logic of territory? How to put collectively into debate this articulation?
    - How can regulatory frameworks facilitate the construction of a living organisation of soil quality management? What contribution of each level and what type of subsidiarity? How to facilitate the engagement and capacity of innovation (technical, political and social) of the various actors?

8.2 Sustainable soil quality management, a problem of transition in socio-technical systems: trouble within the regime and self-locking effects on current practice

In this section we propose to look at what we learn from the Belgian, Dutch, and French case studies about the conditions favouring the emergence and reinforcement of dynamics of change in farmers' practices. We shall first review briefly the general framework of transition theory, *i.e.,* the multi-level perspective that we have developed in the Belgian case study. Then we shall see how change entails a phase of destabilising the regime and how this can lead to two types of change: 'fit and conform' versus 'stretch and transform'.

8.2.1 The general framework

Amongst the various schools of thought that have come out of Sustainability Transition Studies, we position our analysis within the multi-level perspective set out by Geels (2002) and Geels and Schot (2007). Here, transitional processes are interpreted as being the dynamics of interaction amongst the three analytical levels defined by Geels and Schot (2007) as follows:

1) *Niches of innovation*: spaces where radical new approaches emerge then to mature and progress whilst remaining more or less protected from the pressure of selection exerted by the *regime*.
2) *Socio-technical regimes*: sets of norms, standards, beliefs, regulations, and cognitive routines that direct the trajectories of practices within a given sphere. The stability of a *regime* is founded on the strong interdependence of these various components. This engenders a degree of irreversibility that makes the *regime* more or less resistant to change.
3) *Socio-technical landscape*: the environment considered to be exogenous to the *regime.* It encompasses macro-economies, large-scale models of cultural representations, and macro-political trends and developments.

8.2.2 Factors that destabilise non-sustainable soil management practices?

While the European Commission, through its official European report *"Towards a thematic strategy for soil protection (COM 206/238 final)"* acknowledged in 2008 'that soil is a vital and largely non-renewable resource increasingly under pressure and that among the threats to soil are erosion, a decline in organic matter, local and diffuse contamination, sealing, compaction, a decline in biodiversity and salinization', Member States need to raise public awareness of the importance of good soil quality and the opportunities for society's sustainable development that good soil practices provide. Recent publications about changes in soil quality management underline in the same way that whilst it is necessary to make the science/politics interface more effective, the matter of awareness is a major factor for making such changes possible (Otte, Maring et al. 2012). As these authors point out, the invisible nature of the wealth that soils contain – and yet, the soil is the number one source of biodiversity when it comes to species – and the slowness of the processes in which soils participate make this a particularly non-interactive subject. The problem of soil quality is not a public problem today. What can be done to make this problem 'exist'?

Smith, Stirling and Berckhout (2005) understand regime change to be a function of two processes: (1) shifting selection pressures on the regime and (2) the coordination of resources available inside and outside the regime to adapt to these pressures. Selection pressures consist of socio-ecological pressures coming from broad political, social, and economic 'landscape' developments. They argue that 'without at least some form of internal or external pressure that brings trouble in the regime it is unlikely that substantive change to the developmental trajectory of the regime will result'. We explore the shift in selection pressure and the creation of resources available to be sensitive to this shifting pressure and look after the trouble that will let windows of opportunity for change emerge.

8.2.2.1 Shift in selection pressure from the landscape

The French case study shows very well how agricultural and climatic changes in the Normandy Seine watershed will increase significantly the pressure that is exerted on soil quality in the region, where the soil's limestone fraction makes it highly vulnerable to such changes. The increase in the frequency

and intensity of precipitation coupled with the replacement of meadows by root crops and/or spring crops, such as potatoes and maize, along with galloping urbanisation, led to a significant increase in the frequency of floods in the Normandy Seine watershed between 1960 and 2000, with damage that would increase to include human fatalities.

The connections that were established (expertise) and incorporation of these events (linked to both climate change and changes in agricultural practices) in people's memories (media, etc.) have exerted pressure that is pushing for switching to alternatives to the sectoral soil management and town planning approaches, in which agriculture and prevention are disconnected, that prevail today.

One such change that is currently taking shape is the emergence of a new 'living soil' paradigm to replace the classic concept of soil as a substrate or 'means of support'.

8.2.2.2 Resources that create public disruption – trouble – within the techno-soil regime

Let us point out, before delving into the issue, that it is indeed the liveliness, with its openness and interactiveness, unpredictability and changeability, sensitivity and emotional dimension, that has brought our society, in the name of animal welfare, to challenge radically the artificial and mechanical nature of landless livestock farming operations. This reminder of animals' status as 'living beings' is a source of disruption within livestock farming schemes. It weakens a series of certainties and beliefs about the role that animal products must play on our plates and makes other ways of envisioning breeding and production possible.

Destabilising the sectoral soil management regime, in which soil is reduced to a mechanical and physical chemical medium, is thus a must. Such upset in the sectoral soil regime has indeed arisen amongst farmer's profession. It takes the shape of the movement of soil conservation agriculture, which pleads for a return to 'living soil agriculture' (Vankeerberghen, Stassart *et al*. 2014 (to be published)). Moreover, some of the movement's spokespeople have no qualms about developing this living soil concept in opposition to that of the dead soil that has been produced by our agro-industrial model and his techno-regime blind to the living dimension of soil.

However, this development is currently confined to profession. The unease is sectoral and not widespread in the population. It will be possible to destabilise the current regime only if the public is able to gauge the importance of having living soils. Various instruments are available to enable politicians to include living soils in politics and to upset the regime in place. We shall mention two such types of tool: awareness-raising and media publicity tools and participatory tools. On the one hand, certain investigative documentaries have definitely played a major role in catalysing and relaying the concerns that certain practitioners, NGOs, and scientists have shared, albeit in confined circles, for a number of years. Just consider Al Gore's 'An Inconvenient Truth', which put climate change issues on the agenda, or, more recently, Marie Dominique Robin's 'Moissons du Futur'

(http://www.arte.tv/fr/les-moissons-du-futur/6815836.html) regarding agroecology. On a more modest scale, the English campaign around the OPAL – Open Air Laboratory – programme on soil and earthworm surveys (http://www.youtube.com/watch?v=HHh7TW2Ude0) and the 'memory house' of AVISA – Austreberthe Valley Flood Victims' Association – are also resources that open laypeople's eyes to the slow and mostly unseen issues of soil life.

To bridge the gap between information and training, and even learning, our Dutch partners' proposed adaptation of the FAO's Visual Soil Assessment (VSA) (Shepherd 2010) is an 'upsetting' practice to recommend, especially when it comes to its civic version, the aim of which is to turn the problem into a public issue. VSA is good tool for interdisciplinary interaction and is easily understandable by everyone.

A multi-scale approach – a succession of the three steps of establishing a national soil map, setting a typical profile of the area/landscape on paper, and doing VSAs – should be developed. This makes it possible to keep an eye on the whole picture and on the particular points of connection amongst the various management scales. It gives a nice feeling of integration and of a 'situated' exercise. The sensory dimension of the activity, *i.e.*, touching, seeing, tasting, and smelling, is a real advantage. That is why the Belgian team recommended repeating the VSA exercise in France and Belgium with some adjustments.[7] The VSA exercise should help people to hear more about farmers' historical

[7] Adaptation to the soil function/issue, balance between participation of famers and experts, landowners and users, civil society actors

knowledge. Farmers often gain historical knowledge of their plots of land's potential from the regular observation of their practices' results. They may not need the VSA, but the VSA might give outsiders access to such knowledge.

The existing regime is destabilised or upset by the combined actions of these pressure shifts and coordination with internal resources that will make these pressures noticeable and meaningful to the players themselves.

8.2.3 'Fit and Conform' versus 'Stretch and Transform' change

If we take the regime's destabilisation as a given, we can consider the Belgian, French, and Dutch cases to be examples of the socio-technical dynamics of change based on three different types of public policy instrument, to wit:

- **the market** in the Dutch case: The CONO cooperative has founded a quality commodity chain that includes the criterion of sustainable soil management in the differentiated quality of its products;
- **the territorial approach** in the French case: The SMBVAS can be seen as an inter-municipal group that is trying to get integrated, multipartite management to emerge from the trickling down of agricultural practices and urbanisation on the scale of the catchment area;
- **the profession** in the Belgian case: Greenotec ASBL is a new producers' trade association that is trying to transform farming conventions regarding the management of living soil.

We shall explain these empirical dynamics briefly using the analytic points of view that Smith and Raven (2012) have developed. These authors effectively make a distinction between two approaches, which they call 'fit and conform' and 'stretch and transform'.

8.2.3.1 'Fit and conform' approach – the case of CONO cooperative

As innovations become competitive under conventional, regime terms, the 'soil quality innovation' is 'empowered' in the sense that its developing competitiveness leads to its increasingly widespread dissemination. The implication is that this niche innovation is developed in such a way that it fits into and conforms to a relatively unchanged selection environment, namely, the milk market.

The cooperative CONO has to be understood in the overall transformation of the global dairy market. The liberalisation of European milk production will lead to the end of milk quotas and the probability of price decrease. Therefore, CONO must be and continue to be competitive with much bigger dairy companies. This means constantly innovating. Its brand, Beemster, uses the reputation of the Beemster world heritage as an opportunity to give some added reputation to the handcraft quality.

The integration of soil quality as one criterion of CONO's total quality is possible because as a farmers' cooperative, CONO has developed a double function: on the one hand, it is trying to make progress in the qualification of its cheese products and on the other hand, it tries to re-distribute the added value of this specific qualification along the food chain (4000 euros/dairy farmer). That is why soil quality can emerge on the market as a factor of price differentiation. Currently CONO gives a price premium of 0.0025 euro per kg milk to the dairy farmers who participate in the soil programme.

Smith et al. label this 'fit and conform' empowerment and define it as processes that make niche innovations competitive within unchanged selection (market) environments. The building of such market mechanisms linked to soil qualification relies on the know-how of 'innovation brokers' (Klerkx 2012) such as our Dutch partner Boerenverstand.

8.2.3.2 'Stretch and transform' approach – an attempt from water managers to influence framers' practices

'On the other hand, the institutionalization of some socio-technical innovation practices within a reformed regime is also advocated in the transition literature. This suggests that some features of the niche space are institutionalized as new norms and routines in a transformed regime. Here, the niche is empowered by enabling it to change its selection environment, rather than be subordinated by it. We label this as "stretch and transform" empowerment and define it as processes that re-structure mainstream selection environments in ways favourable to the niche'. (Smith and Raven 2012)

The SMBVAS - Syndicat Intercommunal des Rivières de l'Austreberthe et du Saffimbec/Intermunicipal union to manage the rivers Austreberthe and Saffimbec – that was created in 2000 can be considered an attempted territorial construction of the problem that linked runoff, erosion, and flooding to agricultural practices through their impacts on soil quality. For this reason, a land area rather than a sector is taken into account, with all of its dimensions of interdependence: hydraulic infrastructure, urbanisation, agricultural practices, and soil quality. The actions taken by the SMBVAS mainly concern the construction of hydraulic and retaining structures, its advisory role on local urban development, and also its incentive actions regarding agricultural practices.

SMBVAS has gained a fair degree of recognition on the national level (the watershed is recognised as a 'high risk territory' within the meaning of the Flood Directive due to its action.) However, this attempt to change things from a territorial perspective faltered because of SMBVAS's lack of political strength. Its impact on the major agricultural commodities – grain and potatoes – thus remained limited to extension work with the individual farmers. Although the pressure of the socio-technical landscape is increasing on the European level (Communication on EU soil – 2002, Proposal for a Directive on the monitoring of soil quality as widely as possible – 2003-2005, and Thematic Strategy for Soil Protection, which includes the draft Directive – 2006) the overall action of the SMBVAS is evaluated as 'fitting and conforming' to the sector, treating the symptom rather than the cause of problems '*What is happening is good for the short term, but what about the long term?'.*

The problem of SMBVAS capacity is the building of a legitimised link between the soil and water runoff: The former requires long-term, systematic management whilst the latter is managed in the short term using a sectoral approach. Indeed the territorial approach lacks political legitimacy: Mudslides and flooding are a big concern in Pays de Caux but they are not linked to farmers' practices in the views of all actors. Material investments such as river engineering works have an unexpected negative consequence: they erase the visible marks of runoff/flooding problems (mudslides) and therefore reduce social pressure on the problems (which are not solved). Resistance is coming from the irreversibility of farming practices that are locked by logics of soil exploitation and cereal production (with the harbour of Rouen) and potato production, which prevents the issue of soil destruction being raised.

Consequently, the stakeholders identified a deficiency: '*...there is no comprehensive and concerted approach to soil quality'*. They noted, amongst others, the lack of consistency between the territorial consistency plan,[8] Local Urban Land Use Plans, [9]and Water Development and Management Plan;[10] as well as the inconsistencies between individual and collective actions. '*The decisions are taken sector by sector. Everyone makes decisions, but perhaps not with a concern for the consistency of the whole'.*

8.2.3.3 'Stretch and transform' approach within the farming sphere: the case of Greenotec in Belgium

Where the territorial actors seems to have failed to transform the technical soil management regime in the French case, the Belgian case of Greenotec showed, on the contrary, that an initiative confined to the profession, one that persuaded farmers to get involved in soil conservation agriculture, by taking a practical approach to the problem (problems of the soil, organisation of work, etc.) and collective learning dynamics was able to overcome the irreversibility of the idea of the soil as a simple substrate that is linked to tilling practices. This transformation was described in the Belgian case study through the concept of innovation by removal. The normative and cognitive break made in the way of thinking of soil management definitely belongs to the 'stretch and transform' type of change: The soil conservation farming movement is spreading across Europe, in all its various forms, after winning over North and South America the (Vankeerberghen et al. *forthcoming*). It is turning the humus regeneration model based on the traditional complementarity of livestock and crops into a new virtuous triangle of no ploughing, plant cover, and crop rotation in which the earthworm is both the plough and the livestock that fertilises the earth.

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[8] SCOT (*schéma de cohérence territoriale*): multi-municipality town planning document to ensure area-wide consistency

[9] PLU (*plan local d'urbanisme)*: town-planning on the municipal level

[10] SAGE (*schéma d'aménagement et de gestion des eaux*): water management and engineering plan encompassing the river's entire catchment area

8.2.4 Conclusions

When does transition occur? When the pressure coming from the landscape level and or the pressure from the micro/niche level destabilises or upsets the regime in such way that momentum or windows of opportunities are created that allow convergence between the dynamics of change on the niche, regime, and landscape level. However, change meets with very great resistance from the regimens in place. This is linked in particular to the commodity chains' lock-in effects, as we have seen in the French case of Pays de Caux.

We then tackled two issues, namely, the destabilisation of the regime in place (VSA and climate crisis) and the possible sources of impetus to overcome the blockages and irreversibilities that are linked to the sectoral management of soil quality, *e.g.,* territorial schemes (Pays de Caux) and collective learning (Greenotec)

Our conclusions thus take the shape of two hypotheses. On the one hand, we think that the matter of soils is not sufficiently recognised as an issue. If unease has developed in the regime, this upset is not public. It remains limited to the sector, which avoids fundamental challenges being made. On the other hand, when such fundamental challenges are issued, they can lead to adaptive or transformative strategies, depending on the model of collective action, its legitimacy, and its reflexivity.

8.3 Taking complexity into account in soil quality management

This section focuses on the lessons learnt from the French, Dutch and Belgian case studies as regards management of the complexity of soil quality issues. We shall first summarise the conceptual framework of the "patrimonial approaches" used in SAS-STRAT for this analysis, then we will analyse the notion of integrate soil quality and how complexity is into play in this notion, how the actors concerned by soil quality access this complexity and how integrated soil quality management strategies are dealing with this complexity. Finally, we will identify some characteristics of governance frameworks favouring the development of integrated soil quality management.

8.3.1 Conceptual framework for addressing complexity

The conceptual framework on which is based the analysis of complexity grounds on the "patrimonial approaches" developed by Henry Ollagnon (Ollagnon, 1989 and Ollagnon, 1998) for the evaluation and adaptation of public policies of the French Ministry of Agriculture. This approach focuses on solving "complex and multi-stakeholders" problems, and more specifically – and this from its beginning – problems related to the management of "living realities" of nature (e.g. biodiversity or particular species, natural resources like waters), by a "patrimonial" management of qualities of these living realities (i.e. management of these qualities as a common good by a network of actors).

In this approach, complexity is defined as follows: "complexity (cum: with, plexus: what makes connections, what makes connections together, to form a whole – [is] both what makes a whole (an entity) and what interacts (the relationships))" (Ollagnon 1998). This complexity is threefold. It characterizes every living being. "Every living being exists as a complex living whose identity remains singular, who grows and reproduces, with a certain degree of autonomy and adaptive variation, in interaction with his species and his environment" (Ollagnon 1998). Complexity also characterizes the environment (also living) in which maintains and develops all living beings. But it also characterizes the ongoing interactions between living beings (including humans of course) and their environment. "Between a complex and evolving living being and a complex and evolving environment exists a complex and evolving relationship."

Human beings are at the heart of the management processes of nature as a living reality. In fact, "humanity increasingly has to "manage" the state of nature, the state of living reality ("manage" is "gérer" in French, coming from "gerere": to hold, make, manage, conduct for his own account and / or for others account)" (Ollagnon 1998). Voluntarily or involuntarily, directly or indirectly, human beings increasingly influence the state of nature through their daily actions (be the consequences of these actions on natural realities intended or unintended). The result of all these daily acts is called "effective management".

One of the fundamental concepts of the patrimonial approach is the concept of management of "total quality" of living realities. "This is a complex notion, at the systemic sense of the term, because the quality is both "elements", "relationship" and "whole" (Ollagnon 1989). The total quality is at the same time the consequence of the effective management and the element that reveals it. It is defined as the union of:

- the current quality (which can be observed today), and the potential quality (as it is managed nowadays for tomorrow) of the considered living reality (e.g. agricultural soils);
- the quality as a whole and also multiple in space and time;
- the natural and artificial intrinsic quality, and the human and relational quality defined as "the quality of the relationships between each stakeholder and the intrinsic quality", and "the quality of the relationships between the different stakeholders, in relation to the intrinsic quality"

Such a living "total quality" is at the same time the consequence of the effective management and the element that reveals it. Quality "is considered, on the one hand, as a physical object (scientific and technological point of view,) and, on the other hand, as the result of the involvement (positive or negative) of a set of stakeholders operating within an ecological and human unit (socio-political and relational point of view) (Ollagnon 1987).

Finally, living realities also have a "trans-appropriative" character: a single stakeholder, with a single economic, ecological or technical-institutional approach, cannot manage the living quality, because it takes place "into, through and beyond each public and private appropriation" (Ollagnon 1998).

Degradation of the living “total quality” can then be explained by the difficulties and even disabilities the stakeholders face, influenced by only pragmatic or universalist approaches, to manage these “trans-appropriative” living qualities. Thus, the living qualities might not be deteriorated by an “over-exploitation” (without denying this reality), but because these trans-appropriative realities are not invested and not managed, in a mode of knowledge and action based on public and private “appropriation”.

The patrimonial approach focuses on the modes of management of the qualities that are problematic. Instead of ignoring these qualities or simply reducing degradation pressure, the patrimonial approach addresses processes of “patrimonialisation”, that is, a process in which the various actors concerned by the quality at stake appropriate this quality like an “heritage” of which the actors is a “holder”. From a systemic and strategic point of view, the concept of heritage can be defined as "all tangible and intangible elements centred on a holder which helps him maintaining and developing his identity autonomy by adaptation over time and space in an evolving universe” (Ollagnon, 1979). Heritage does not exist in itself; in order for this heritage to exist, there must be "elements", "patrimonial relations" and "heritage holders."

8.3.2 What is complexity in integrated soil quality?

Soil quality refers to a wide variety of intrinsic qualities: physical structure, chemical properties, content of organics matter, soils as a medium for life (micro-organisms, earthworms…), soil capacity to filtrate and retain water… However, agricultural soils are also an environment that is both natural and human: qualities of agricultural soils also include elements that relate to the relationships between soils and people: soils as a support for landscape and human life, soils as an heritage transmitted by previous generations and passed to future generations… It is difficult to separate fully the qualities of each other - like a growing number of objects that are situated between humanity and nature (Latour, 2006). Soils are therefore a complex object insofar as they integrate physical, chemical and biological qualities, and social and human qualities.

A soil cannot be considered as “good” or “bad” as such; assessing the qualities of a soil always refer to a specific use (or set of uses) that is considered: a soil is more or less adapted to given uses. Different users can therefore have a different understanding of the quality of a same soil. In the case of agricultural soils, the understanding of soil quality incorporates the capacity of the soils to be a sustainable support for food production. However, the understanding of the qualities of agricultural soils is not limited to its functions for farming. In effect, another element of complexity in soil quality is the multiplicity of uses (by various actors) for a given soil. These uses include active and explicit uses (e.g. food production for the farmer that cultivates a soil) but also more indirect or passive uses (e.g. populations downstream a given soil can be considered as “users” of the capacity of the soil to filtrate and retain water).

The 3 case studies considered in SAS-STRAT show 3 different illustrations of complexity of soils through different types of interrelation between different qualities, different uses (and corresponding understanding of soil quality) and actors:

- In the French case study, we can observe an attempt to reconcile two different understanding of soil quality on the territory of a watershed: on the one hand, the understanding of farmers, who produce in a great majority using conventional practices, under market constraints which leads them to adopt intensive ploughing practices and, on the other hand, water management organisations and local communities that manage the consequences of agricultural practices on water flows (strong erosion, floods, mudslides) and wish to develop a preventive approach.
- In the Dutch case study, a dairy cooperative (CONO) tries to reduce the environmental impact of dairy farming practices in order to answer Dutch consumers’ demand for responsible food production. In doing so, the cooperative has developed an integrated tool for assessing, monitoring, promoting and rewarding farming practices taking into consideration a wide range of physical, chemical and biological qualities and the impacts of farming. In this case, the considered process tries to bridge the understanding of soil quality of the cooperative, the farmers and the consumers.
- The Belgian case study considers the farmers’ organization Greenotec, which gathers farmers in the whole region of Wallonia, and supports the efforts of farmers in moving towards conservation agriculture and use of simplified cultivation techniques or non-ploughing techniques. In this process of transition, the farmers progressively modify their understanding of soil quality and integrate new qualities (structure, biological life of soils…) in order to

respond to various issues (that are farmer-dependent). These issues include technical difficulties (difficulties to plough, reduction of productivity…), economic issues and concerns regarding the impacts of farming on the environment.

A specificity of the soil quality issue is that the farmer is the main manager of soil quality through his farming practices. However, a wide range of actors is influencing directly or indirectly these practices

- Upstream in the production process: farming advice services, providers of seeds and plant protection products, providers of machines…
- Downstream the production process: buyers of food products defining specifications for the products, global market trends…
- In the territory: local communities, other farmers, farmers' families, local authorities, local market
- At the regional, national and European level: public actors that set the legal, institutional and regulatory framework for farming and land and water management

Another characteristic of soil quality complexity observed in the case studies is the multiplicity of scales and spaces where soil quality is at stake. In effect, many different territorial levels are at play, the agricultural plot, the farm, the local community, intermediate geographical entities (e.g. watersheds), the regional level, the state level, the European level and the global level (e.g. through global food markets). In addition to this multiplicity of relevant geographical scales and spaces, agricultural sectors (e.g. dairy production, potatoes production, wheat production…) are also relevant spaces and governance frameworks that influence soil quality.

8.3.3 How do concerned actors access the complexity of soil quality issues?

The case studies reveal that soil quality is related to various diversified, discrete realities that are included in specific and appropriate spaces (including the space of private land property). It also rests on moving entities that can be part of the land (water, materials, biodiversity, pesticide, fertilizer…).

The management of these realities takes place within a particular economical and socio-political context and a particular network of stakeholders. In three different contexts, the SAS-STRAT case studies show three different types of strategies and types of access points in dealing with complexity of soil issues:

- In the French case study, complexity of soil quality issues is addressed from a territorial perspective. Initiators of strategies aiming to deal with complexity of soil quality are actors of an intermediate territorial level (between the local community and the region). The entry point for addressing complexity of soil quality issues is the soil-water system in the watershed of Austreberthe and Saffimbec.
- In the Dutch case study, soil quality is addressed from the perspective of an economic sector (dairy farming). Initiators of strategies of improvement of soil quality management in the CONO cooperative, which establishes a link between the requirements of the markets and dairy farmers (members of CONO) through a policy of construction, assessment, valorisation and marketing of a conception of quality of dairy farming that notably incorporates soil quality management.
- In the Belgian case study, soil quality is primarily addressed from the point of view of the farmer confronted to a particular issue in its production process. Greenotec is then a tool for helping farmers to progress in the understanding of their issues and use the tools of conservation agriculture to solve their problem and go through a transition dynamics that modifies both their practices and their understanding of soil quality.

An important point to be noted is that in each of the 3 case studies, the process of development of a new understanding of complexity of soil quality issues and of management of this complexity does not start from soil quality concerns but from issues that encompass or relate to soil quality issues (water management in the French case, answering market demand for sustainability in the Dutch case, and a variety of issues met by individual farmers in the Belgian case).

8.3.4 Integrated soil quality management: strategic approaches to cope with complexity in a multi dimensional and multi-stakeholder approach

The three case studies considered in SAS-START show different approaches of integrated soil quality management. However, they show that integrated soil quality management refers to a management of soil quality that is integrated in a double way:

- It refers to practices of soil quality management that take into account a wide range of soil qualities rather than a reduced set of qualities (e.g. the content in nitrogen, potassium and phosphates)
- It also refers to a type of management of soils that takes into account multiple actors and multiple uses of soils that are relevant to these actors

Integrated soil quality management can therefore be considered as strategies for managing the *total quality* of soils, by addressing altogether soil quality, the relationship of the different stakeholders to soil quality and the relationship between the different actors in relation of soil quality management. However, the case studies have shown that the process of gathering a variety of stakeholders around soil quality issues in a sustainable way requires that integrated soil quality management be encompassed in the management of the total quality of a broader object that is relevant and topical for all stakeholders.

As highlighted in the previous section (cf. section 6.7.2.2.1), the development of integrated soil quality management strategies is rather a *transition process* involving a variety of actors individually and in common over certain duration rather than the implementation of a defined framework or method. This process. This process is typically of several years duration (transition processes of farmers considered in the Belgian case study could last up to 15 years).

As regards complexity management, integrated soil quality management can be understood as a process of collective definition of commonly relevant framework of understanding and management of soil quality. This process involves a double definition or redefinition:

- *Redefinition of soil quality itself*: in the Dutch and Belgian case studies, the understanding of soil quality evolves towards an understanding of soils as a living entity that encompasses a wide range of qualities of agricultural soils. In the French case, this transformation of the understanding of soil quality is not achieved for the farmers, but the very process of the case study (developed through participatory approaches) is a first step in a strategy of water management organisations to share a common understanding of soil quality issues with all concerned actors.
- *Definition/redefinition of a broader strategic object that encompasses soil quality issues:* a key condition for a network of heterogeneous actors to develop a common strategy for soil quality management is the definition of a *common good*[11] recognised by all. This common good is a common strategic object that enables a variety of stakeholders to meet, build a common understanding of this strategic object and manage its quality together (thus managing its total quality). In order to enable cooperation of variety of actors, this common strategic object can be broader than the sole issue of soil quality (though encompassing this issue). This is the case in the Dutch and French cases, where integrated soil quality management strategies are considered within the framework of a broader strategic object (sustainability of dairy production in the Dutch case, quality of the water-soil complex in the French case), which is (Dutch case) or potentially is (French case) a common good for the various concerned actors. The Belgian case shows a different situation in which soil quality management is focused on the famer and its relationship to its soil – as there is only one category of actors involved (farmers) in the transition process, it has not been necessary to resort to a broader strategic object.

[11] The notion of common good is different from the notion of general interest: the general interest is identified by a collective actor that has mandate for acting in the name of all (e.g. the State or a public authority) and is usually opposed to individual interests: the role of the collective actor is then to ensure that the general interest prevails over individual interest. The common good is related to a group of actors (that can include both public and private actors), it is freely identified by each of these actors (through a cooperation process or spontaneously) as beneficiary for all, in synergy with each actor's individual interests.

The system of actors that is at stake in this definition/redefinition process is not fixed: there is a process of *co-evolution* between the understanding of soil quality (and of broader strategic objects encompassing it) and of the system of actors that manages it. As complexity unfolds (by the consideration of new issues, dimensions, spaces and scales…), the associated system of actors enriches with new actors. Any entry point in soil quality management can therefore lead to a process of identification, sharing and management of complexity insofar as the actors have the capacity to reframe soil quality issues and connect to other actors.

We can observe in the 3 case studies considered in SAS-STRAT that the strategies for addressing complexity are *situated*: there is no standard strategy for developing integrated soil quality management, but rather specific processes that depend on the particular conditions defined by

- The regulatory framework: different regulations (e.g. the regulations deriving rom the nitrate European directive, regulations deriving from water management directives, as well as notional or regional regulations) are putting constraints on the practices of farmers (e.g. as concerns cover crops)
- The market constraints: in the French case study, the price structure is pushing the farmers to use deep ploughing techniques (e.g. potatoes are sold at a better price when they have no concavities, pushing farmers to intensely plough so the soil offer minimum resistance to the development of the tubercle); conversely, in the Dutch case study, the market demand for sustainable farming is an incentive and a resource for CONO to develop incentives, technical support and facilitation to help farmers improving their practices, in particular as regards soil quality management.
- The specificities of the territory: in the French and the Dutch case, specific characteristics of the territory influence the network of actors and the soil quality management practices. In the Dutch case study, the Beemster polder is both a particular environment for farming (connecting soil and water issues) and a resource for marketing of CONO Beemster cheese (as a UNESCO World Heritage site). In France, the watershed of Austreberthe and Saffimbec is connecting soil and water management through important erosion issues.

One particular difficulty in addressing complexity in integrated soil quality management observed in the case studies is notably the need to act

- Taking into account the different relevant geographical scales and governance levels (from the agricultural plot and the farm to the global scale)
- At the crossroads of perspectives between the territory and the agricultural sectors.

8.3.5 What governance framework to deal with complexity?

The governance framework for addressing soil quality is key for addressing complexity of soil quality issues. Appropriate governance frameworks should aim at:

- Promoting an ecological, technical, economical and political organization, for the management of soil quality, in appropriate entities,
- Facilitating the engagement of public and private actors in the organization and support of the management of soil quality, at the level of each plot,
- Favouring territorial dynamics that
    - reinforce the capacity of the actors to identify the soil qualities they want to support
    - reinforce the capacity of action of these actors, notably by enabling them to invest into facilitation & change catalysis
- Enabling constructive interaction between national & European dynamics on soil quality and territorial dynamics

As integrated soil quality management strategies are developed through a progressive process in which stakeholders get empowered and address complexity, this governance framework need be flexible enough to enable a co-evolution of the framing of soil quality issues, of the system of actors engaged in the management of soil quality and of the governance framework. Moreover, the evolution of soil quality itself can be considered as a part of this co-evolution process.

Finally the case studies also show the key importance of actors playing a role of technical and strategic *facilitation*. These facilitators support the individual efforts of actors to adapt their strategies and practices but also facilitate the development of a common understanding of soil quality issues

(and of broader strategic issues encompassing soil quality) and of a common strategy of all concerned stakeholders. They finally facilitate voluntary inclusion of the common strategy in each actor's actions. In the Dutch cases study, this role is played by Boerenverstand. In the Belgian case study, it is played by Greenotec (there the facilitation tool has been built by the farmers themselves) and in the French case study this role is played by the AREAS and by the staff of the SMBVAS.

8.3.6 Conclusions

Integrated soil quality management is a strategic process that relies on the engagement of heterogeneous actors at different governance levels (rom the farm level to the European level). It relies on the voluntary engagement of these actors managing soil quality in common as a common good. This engagement cannot be achieved solely by classical public action tools like standards, regulations and financial incentives In this perspective, public policies (at the regional, national and European level) should notably be "enabling policies" providing a framework for the common engagement of a variety of actors (farmers, local communities, water management agencies, market actors, civil society…) and facilitating this common engagement.

From the point of view of the patrimonial approach, designing soil quality policies (in particular European soil quality policies) requires to deepen several questions:

- The identification of the modalities of effective management of soil quality in a sufficient variety of national situations, notably the relationship that links users in charge of the utilitarian characteristics of soils and the stakeholders concerned by sustainability of soils (type of stakeholder, type of patrimonial relation to soil quality, relation of property or usage to soils…)
- The identification of conditions and means for a better management of soil quality, taking into account the specific economic, social, political… context of each country and its influence on the relations of the various stakeholders to soils
- The identification of the fields of application of the subsidiarity principle in the framework of a European policy

Finally, the design of soil quality policies should also start from volunteer territories and actors, and take stock of effective situations of integrated soil quality management.

8.4 Contributions of scientific and technical tools to soil quality management

In the three case studies considered in SAS-STRAT, we can observe the presence and important role of scientific and technical tools:

- In the French case study, scientific and technical tools are used or monitoring the watershed of Austreberthe and Saffimbec, the flooding and the water quality.
- In the Belgium case study, Greenotec NGO supports the farmers by bringing technical advice to facilitate transition towards simplified cultivation techniques. They mobilise tools like soil profiles to help farmers understanding the different qualities of their soils.
- In the Dutch case study, a specific soil quality assessment tool has been developed: the Visual Soil assessment (VSA) tool.

In the case studies and in the two previous sections of their transversal analysis, we have established that integrated agricultural soil quality management can be defined as

- A transition processes in which the farmers progressively transform both their understanding of soil quality and their practices of soil quality management by incorporating new dimensions and qualities in their understanding of soil quality issues.
- Is a strategic process in which a heterogeneous network of actors (farmers, authorities at different territorial levels, water managers, technical advisers, local communities, buyers of agricultural products…) try to improve soil quality itself, the relationship of each actor to soil quality and the relationships between the different actors as concerns soil quality. A condition for these heterogeneous actors to develop a common strategy of soil quality management is the identification of a common good shared by the different actors.

Therefore, integrated soil quality management supposes an evolution of the understanding of soil quality by the various concerned actors at two different levels: the understanding of soil quality of each individual actor on the one hand, and an emerging common understanding. Scientific and technical tools play a role in both these aspects.

At first, we will introduce the key characteristics of the VSA tool introduced in the framework of the Dutch case study. Then, we will consider two key aspects: the role of a particular type of scientific and technical tools: *intermediary objects*, which facilitate cooperation within a heterogeneous network of actors. We will then consider the new types of roles of scientific and technical actors that appear trough the case studies. Finally, we will summarise the key lessons learnt from this analysis.

8.4.1 A specific tool developed in the framework of the Dutch case study: the Visual Soil Assessment (VSA) method

In the framework of the Dutch case study, the "visual soil assessment" (VSA) was introduced as a tool for mutual understanding of soil quality. This tool is developed by the FAO and focuses on the visual aspects of soil quality. This method assesses and scores several properties for soil quality (e.g. presence of earthworms, soil structure and root pattern). It allows the user to easily identify soil properties that need to be improved, in order to increase sustainable management (e.g. zero-tillage, permanent grassland, low amount of fertilizer application). This method clearly helps the farmer to make decisions in management. Sustainable soil management is closely related to the provision of ecosystem services, such as soil fertility (by carbon storage and decreased nutrient leaching), decreased greenhouse gas emissions, decreased erosion rates, water retention and water quality. Use of the VSA creates new insight for the debate about the integrated management of the soil amongst different stakeholders. The VSA-method has been reworked to make it applicable for Dutch conditions[12]. The accuracy of this tool was tested in 2012 by comparing visual observations with laboratory measurements (Sonneveld et al., 2013)

During the Dutch case study in the Beemster area, we showed that CONO cheese factory and Ben&Jerry's are leading the sustainability debate in the Netherlands and in the Beemster region. They

[12] The Dutch version of the VSA was launched in September 2013, and is now accessible at http://mijnbodemconditie.nl

took steps, tried to be ahead and invest money and time in monitoring, evaluating, scoring and improving the sustainability measures of their members, the factory, the area and the other actors within the chain. Instruments developed by CONO (like the COW Compass) have been taken over as good practice by other dairy factories all over the Netherlands. For soil, they were actively looking for a better and more farmer-friendly score, so they adopted the Dutch version of the VSA.

Considering the different levels of government (EU, Nation, Province, Water board, Farm, parcel) it seems that the farmer himself is making the big difference between good or bad soil management, although he can be highly influenced by decisions of overarching collaborations (such as CONO over the dairy farms in the Beemster). The starting point of sustainable management occurs at the smallest level, which is farm and plot level. This is where the VSA comes in and is a powerful method for creating insight and optimizing soil management. The CONO cheese factory wants to stimulate good management practices and tries to reward farmers by doing so.

The VSA score was not only a decision support tool for farmers; it also supported the development of a mutual understanding of soil quality. Focusing on the visual aspects of soil quality, the VSA tool created a new impulse for the debate about the integrated management of the soil among the different stakeholders. A debate was started between the owners of the land (the farmers), the (local and national) governments, the water board, but also NGO's and consumers (the buyers of the dairy products) that are concerned about depleting the soil and too much nutrient losses to the environment. In our cases we learned that there could be different facilitators of this debate. In The Netherlands it is a dairy co-operative because they where very much focused on a concrete outcome of the sustainable soil discussion: a new and more inclusive instrument that is useful for farmers and can underline their sustainability program. This part also succeeded in the SAS-STRAT project and resulted in a new (widely supported) integrated tool for assessing soil quality in The Netherlands: www.mijnbodemconditie.nl

But we also learnt that the link between "land management" and "soil quality management" was not obvious. Those managements don't imply the same actors and do not always address compatible issues. A possible new scale is the water board (a water body/area). Water and soil are interrelated by the question of nutrient infiltration. Scientist can make tools and models more "water body specific", governments can make rules and regulations that fits better to the regional soil specific situations and farmers can learn from best practices and develop (together with their co-operatives) more region specific guides for soil management.

8.4.2 A specific role of “intermediary objects” for facilitating cooperation within a heterogeneous network of actors

In the Dutch and Belgian cases studies, the VSA tool or soil profiles have a specific role insofar as they are tools

- with a sound scientific and technical basis
- that are easily interpreted in the conceptual, cultural and practical framework of different types of actors (e.g. scientists, farmers, market actors…)
- for knowledge and for action
- of technical ad social nature, insofar as they are both technically sound and enable actors of different nature, backgrounds, knowledge types… to gather and discuss soil quality issues

In order to understand the specificity of these tools in soil quality management, a useful framework is given by the notion of “intermediary objects” proposed by Jeantet and Vinck (1995) in order to explain the role of technical objects (physical objects that are support for interactions like sketches, prototypes, experimental constructions…) that are support of social interactions in design processes. These intermediary objects are not only pure support for information but also constitute means of mediation as they enable negotiations and compromises.

Another useful notion is the notion of “hybrid object” developed by Bruno Latour (1991) in order to give account of objects that are both in the sphere of nature and society (e.g. HIV, the ozone layer, the climate) and cannot be fully understood through the sole tools of the sciences of nature or the sole tools of sociology. Agricultural soils are typically such a hybrid object. Dealing with this kind of hybrid objects requires resorting to both science and social interactions (including interactions between scientists or experts and non-scientific actors). In this perspective, we can understand the role of tools like VSA or soil profiles as intermediary objects (in the sense of Jeantet and Vinck) that help

structuring and developing interactions between actors of different nature in order to understand and manage agricultural soils as a hybrid object.

The intermediation function played by these tools in fulfilled simultaneously in at least two ways:

- these tools constitutes an intermediary between the soils and an heterogeneous system of actors that is concerned by soil quality;
- they constitute an intermediary between these actors of different nature, insofar as they can be easily understood and interpreted in each actor's own framework of understanding and action, they facilitate the evolution of each actor's understanding of soil quality issues (e.g. transition towards a conception of soil as a living entity) and they are a support for building a common understanding between the different actors in the system;

If we understand integrated soil quality management as a process of co-evolution between soil quality and the system of actors that manages it, these intermediary objects can be considered as support for this co-evolution. They are therefore linked to a particular moment of the co-evolution process. In a further stage of the co-evolution process, new or adapted intermediary objects can be needed, thus translating a new state of the needs and of the comprehension framework of the different actors in the system of action.

8.4.3 A renewed role of scientific and technical actors: technical mediation

The case studies considered in SAS-STRAT also show a specific role of scientific or expert actors playing a role of translation and mediation by facilitating the access of non-expert actors to scientific knowledge and technical capacities. In the Dutch case study, this role is played by Boerenverstand with the support of Wageningen University and in the Belgian cases study, this role is played by Greenotec association. They perform a key function of technical mediation or innovation brokers acting as a catalyst for change (ex: Greenotec, Boerenverstand). They contribute to the transformation of soil quality management by:

- Raising awareness of soil quality issues at individual level,
- Supporting collective learning process by facilitating access to scientific results and technical tools,
- Facilitating multi-stakeholder discussion around a shared reality,
- Facilitating cultural change (e.g. move from a view of soil as support to a view of living soils),
- Providing technical tools (VSA an soil profiles) that play a role of intermediary objects that can facilitate a recomposition of the understanding of soil issues and enable an integrated assessment of many dimensions of soil quality

This role of technical mediation is both of a technical and of a social nature and therefore requires a double competence of these mediators: a technical competence on the one hand, and social skills of facilitation on the other hand.

8.4.4 Key lessons learnt from the case studies

A specificity of the VSA and soil profiles analysis methods lies in the fact that they are both scientifically sound and able to be reached directly (through the human senses) by the farmers, without any technical intermediary (e.g. a measurement device). In addition, they are supported by a concrete medium, the soil itself, and therefore fits in a direct relation between the farmer and his soil and the results are more easily appropriated and interpreted by the farmers (who can establish a direct link between the observation and their farming practices). This visual/concrete aspect seems to be a key factor in the success of these technical tools as intermediary objects.

The scientific robustness of the tool is also very important for trustworthiness and for the capacity of the technical tool to fit in the universalist framework of interpretation and thinking of actors like scientists and experts, public authorities and companies (e.g. CONO). However, the objective of these tools is not to objectify universally valid facts but to facilitate learning processes and change dynamics.

Both intermediary objects and technical mediators help the various concerned actors to create together a common language and common representations (e.g. through discussions around the "soil pits" in order to discuss the interpretation of soil profiles or VSA results). Hence, they are not only supporting tools not only or the famers, but are also actually or potentially a useful tool for a wide range of actors (e.g. companies like CONO engaged in processes of soil quality assessment and

promotion, scientists and experts engaged in interactions with farmers, public actors developing soil quality policies…).

9 Recommendations

Grounding on the results of the case studies and on their transversal analysis, the SAS-STRAT team proposes the following recommendations. These recommendations also integrate the outcomes of the last session of the Integration workshop (Paris, 17th-18th June 2013) that were developed together with the workshop participants.

9.1 Fostering multi-stakeholder and multi-level processes

The case studies and their analysis have shown that developing integrated soil quality management requires developing a multi-stakeholder process (including public authorities, farmers, farming advisers, market actors, local communities, associations…) that will gradually modify the understanding and actions of the various actors and favour the emergence of a common strategy. In particular, public policies (including incentives) for soil quality should be designed through dialogue with all actors.

As shown through the case studies and their analysis, soil quality management is a multilevel issue that engages a variety of governance levels: the local and regional level (territorial level), the national level and the European (and international) level.

Conditions for developing such multi-stakeholder and multi-level processes include:

- The creation of exchange forums at the territorial, national and European level. These exchange forums should notably gather stakeholders from different governance levels. In particular, exchange forums developed at the national level should also include territorial actors from territories in which territorial exchange forums are organised.
- Multi-stakeholder processes should associate a wide variety of actors beyond farmers (consumers, market actors, local communities, farming advisers, landowners…). All stakeholders should be included (or at least proposed to be included) from the beginning, in particular the farmers, so that no one is facing fait accompli. Including the whole variety of actors is also a condition for developing mutual understanding between these actors.
- Begin with the adaptive action to go towards transformative action: the starting point of the process is the current state of the governance framework and system of action and the building of a common understanding of soil quality issues and of a common strategy within a heterogeneous system of actors is a process that takes time to develop. First actions taken through these multi-stakeholder processes should therefore aim to improve soil quality management within the current framework of action then, during the course of the process, the development of a common understanding and strategy and the evolution of the relationship between the different stakeholders may lead to evolutions in the governance framework and the system of action.
- These multi-stakeholder processes are also collective learning processes. They should favour mutual learning by acknowledging this collective learning dimension (everyone has something to learn in the process), welcoming all types of inputs and types of knowledge (scientific knowledge as well as knowledge based on experience and practice).
- Finally, at the territorial level, multi-stakeholder processes should include a practical dimension through e.g. farm visits or on-field discussion on the basis of soil profiles or Visual Soil Assessment results.

At a European or transnational level, collective learning processes based on the presentation and common analysis of cases (including territorialised cases), such as the SAS-STRAT Integration workshop can be a useful tool to

- Identify concrete processes of integrated soil quality management, their innovativeness, their limits and the obstacle they still have to lift
- Identify elements of public policies for supporting these processes and favour cooperation between multiple types of stakeholders
- Progress towards a common understanding of integrated soil quality and the means to develop within a pluralistic group of actors (farmers and their professional organisations, policy makers at the regional, national and European level, soil scientist and experts, market actors, extension services, local communities, civil society organisations…)

9.2 How to design public policies for soil quality?

Most often, the mere existence of a public policy on a particular issue is a condition (or a strong facilitating factor) for public actors to address this issue, as they need a legal basis to do so. The case studies and their analysis (carried out together with stakeholders) enabled to sketch out some characteristics of suitable public policies in the field of soil quality. These characteristics are developed hereafter.

A key factor in soil quality management is the transformation of the understanding of soils by farmers to include the notion of living soil (acting as a partner for agricultural production rather than a passive medium). Public policies should include the promotion of this understanding of soils as a goal.

Soils are managed by the farmers in the framework of private property of soils. However, soil quality has an influence on a wide range of actors. It should therefore be managed as a common good (or common heritage) through voluntary project entities gathering the different concerned stakeholders and with the support of appropriate facilitation tools.

Soil quality management takes place in concrete territories that integrate all type of issues (water quality issues including the issue of nitrates, soil quality issues, biodiversity issues, economic issues…). A usual mode of action in public action is to address issues in silo through sectoral policies, which influence farming practices (and sometimes impose strong constraints on them). As these general and sectoral policies multiply, integration between these policies at the territorial level becomes more and more difficult. Rather than taking the form of an additional sectoral policy focused on the management of soils a resource, soil quality policies can alternately favour the development of territorial policies that take into account a resource. Transversality is needed in public policies so that possible contradictions could be identified and overcome. Such transversality could only be developed at the territory level.

A national or European public policy on soil quality issues should also introduce levels of subsidiarity. In effect, the case studies have shown that integrated soil quality management can develop in an indirect way, i.e. through the management of other issues relevant for all actors at a territorial level, and which include soil quality issues (e.g. quality of the soil-water complex or quality of dairy farming). These broader issues are case-dependent and vary from one territory to another. In the perspective of subsidiarity, public policy should conciliate the use of standards (if needed) and the tool of contract with territorial and sectoral actors, which gives room for flexibility and adaptation to specific territorial and sectoral contexts.

The case studies and their analysis have shown that integrated soil quality management supposes a process of progressive transformation of farming practices. A public policy on soil quality should therefore take into account this dynamic dimension by taking into account the notion of path of changes in agriculture and adopting a dynamic vision of soil quality. Moreover, these public policies should also take into account the different time scales (time scales of field actors, of research, of administration) in the perspective of a living process of change. In particular, transition processes are long processes for farmers that can last more than a decade.

In this dynamic perspective, soil quality policies should notably help identifying handicaps or obstacles in transition processes and support their overcoming. In particular, the benefits of investing in soil quality can take several years to appear fully, while the costs of quitting some conventional farming practices are often instantaneous. The issue of financial support of this transition phase should also be taken into account in public policies at a national and/or territorial level.

Agricultural soils are entities that are both natural and human-shaped. Integrated soil quality management requires both scientific and technical tools and socio-political processes. Soil quality

policies should therefore integrate social and economic dimensions in addition to the physical, chemical and biological dimensions of soils.

Promoting sustainable soil quality management requires developing project dynamics at the territorial or sectoral level. In order to favour the positive engagement of the different types of actors, these project should enable the development of win-win situations in which the common good identified by the different engaged actors is in synergy with each actor's interest.

Moreover, as different initiatives exist for development of sustainable soil quality management, identifying these initiatives, favouring exchanges of experience (at the national and European level) and analysing the return of experience of the existing initiatives can be a starting point for the design of soil quality management policies.

9.3 Organisation of farmers – encouraging a collective learning process among farmers

The case studies have shown that collective learning processes among farmers are powerful tools to support transition in farming practices. These processes gather voluntary farmers who find support for solving their own issues and/or who are motivated by incentives (e.g. price premiums from buyers of food products in the case of CONO, public subsidies for funding the transition phase in the soil quality policy of the Swiss canton of Bern). In particular, exchanges between farmers in small groups, to share experience, in a friendly atmosphere favours empowerment and trust building and create a feeling of a common process.

These collective learning processes require several conditions:

- The voluntary character of the engagement of farmers
- Facilitators who support dialogue and exchanges between farmers and with other actors (role played by Greenotec and Boerenverstand)
- Access to technical and scientific resources (technical advice, farming equipment, support from soil scientists…) to be experienced by farmers.
- Actors playing a role of technical mediation and facilitate the translation between the scientific sphere and the sphere of farmers' practices. Some actors can cumulate this function with the facilitation function.

Such collective learning processes should be encouraged, though without reducing the autonomy of farmers in these processes. This could be done by different means, notably

- Supporting existing organisations (like Greenotec in Belgium) which facilitate collective learning processes and support transition of farmers towards more sustainable soil management
- Favouring the gathering of farmers in local & regional groups
- Favouring contractual and voluntary mechanisms between farmers and other actors who can constitute resources (notably technical resources) in the collective learning process.

9.4 How to address soil quality in education?

The evolution of the cognitive framework (of farmers and other stakeholders) for understanding soils is a central element in the development of integrated soil quality management strategies. In effect, integrated soil quality management requires a holistic understanding of soils as a living entity rather than soil as a substrate.

Changing this cognitive framework is not only a matter of developing collective learning process among farmers, it is also a matter of education and professional training as this is a key element in the formation of the cognitive framework of the different actors (in particular farmers and other professional actors in the food sector like market actors, farming advisors… but also consumers, public authorities…).

The promotion of quality of "living soils" can be carried out at all levels and with all types of publics (including children), and soil quality can be integrated into education programmes. Showing concretely soil quality (showing soil profiles, earthworms…) is in particular a good way for raising interest of non-

professional actors (in particular pupils).

Evolutions in the education and professional training as regards soil quality management can be facilitated by dialogue and collective learning processes involving farmers, other professional actors, consumers, public authorities and civil society actors.

9.5 Developing the contribution of research, expertise and extension services

As showed in the transversal analysis of the case studies (cf. section 6.7.2.2.3), technical and scientific actors play a key role in the development of integrated soil quality management strategies. Their contribution in these strategies is to propose tools supporting multi-stakeholder processes ad collective learning processes rather than proposing prescriptive tools.

Soil scientists as well as actors in a position of technical and scientific mediation (who can be scientists or other types of actors) are should therefore be integrated in the development of integrated soil quality management strategies from the beginning of the process and cooperation between scientists, farmers and technical mediators should be favoured.

Extension services can play a role of facilitation of change (by giving advice and technical resources supporting evolution towards integrated soil quality management) or conversely be a factor of reinforcement of socio-technical locks (by orienting farmers towards mainstream practices). In this perspective, public policies addressing soil quality management should play a particular attention to this type of actor. In national contexts where extension services is mainly provided by public organisations, they can be used in public policy as strong drivers for change (see e.g. the role of public extension services in the Danish policy for pesticide reduction). In contexts where extension services are mainly provided by private actors, the voluntary engagement of these actors should be sought both at the national and territorial level.

9.6 Other recommendations

The recommendations produced with stakeholders during the SAS-STRAT Integration workshop also include a few recommendations that do not fit in the previous subsections and do not give matter for a specific subsection. These recommendations are given hereunder:

- Creating public awareness and favouring public debate on soil quality issues by showing the advantages of sustainable soils for all actors (not only for farmers)
- Rebuilding a relationship between urban people and soils
- Favouring connections between the territorial level and the global level and interacting with international bodies (FAO, United Nations, Secretariat of the international Convention on biological diversity…)
- Connecting to markets by including soil quality in official property acts and working with buying centres and market intermediaries
- Mobilising various funding schemes and ne methods of fundraising (e.g. protection fund fuelled by public and/or private funds)
- Adapt the tax schemes for agricultural machines in order to favour equipment less damaging for soils.

10 Anticipated use and application of results

There is much to do about 'ecosystem services'. Farmers manage a large part of our soils and they try to minimize inputs and maintain or improve (quality and quantity) outputs. The better they do, the better it is for them (for their income) and for society. Improving soil quality gives long-term efforts and is not always in line with short-term profits. The quality of the soil is a theme that needs to be addressed continuously. The "visual soil assessment" can play an important role in the promotion of (more holistic) soil quality. Beside the overwhelming amount of chemical indicators it can add an extra score that helps to (again) make the farmer actually look at his soil and gives direct feedback how to further improve.

The most important first step is to make the score. So institutes (like the water board or the local governments) can promote, encourage the scoring. A relatively new actor is the milk company that needs to sell the milk on a marked that demands more sustainability. Also there the first steps are to promote and encourage the farmers to score. Because of the practical, more holistic way of approaching soil quality, the scoring was at the end of 2013 taken over by other dairy companies like FrieslandCampina (which is among the 5 larges dairy companies in the world). Also schools started to train agricultural students and the VSA score is a subject of many study groups now.

Of course this is only a beginning. There is more time needed to develop the scores for other types of soils. Also the exact meaning of a higher score in relation to ecosystem services need to be further clarified. Probable a combination of N, P and C nutrient cycle calculations, chemical soil samples together with visual indicators can score the farm (or better the farmer) as a whole.

In the upcoming years a PhD student (Maricke van Leeuwen) will further work on the visual soil assessment. One of the goals is to find more scientifically proof of the relation between visual indicators and chemical indicators. Also to make a step toward that can finally lead to rewarding better soil quality/soil management (eco system services).

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12 List of abbreviations used in the project

AREAS Association Régionale pour l'Étude et l'Amélioration des Sols de Haute-Normandie (Regional Association for Soils Study and Improvement in Haute-Normandie)

ASBL	Association sans but lucratif (non-for-profit association)
CA	Conservation agriculture
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GESSOL	Programme de recherche Fonctions environnementales et GEStion du patrimoine SOL (Research programme Environmental functions and management of soil heritage)
INRA	Institut National de Recherche Agronomique (National Institute of Agronomical Research)
IUSS	International Union of Soil Sciences
LTO	Land en Tuinbouw Organisatie (Dutch Federation of Agriculture and Horticulture)
OM	Organic Matter
SAS-STRAT	Sustainable Agriculture and Soil: comparative study of strategies for managing the integrated quality of agricultural soils in different regions of Europe / Belgium, France, Netherlands
SIRAS	Syndicat Intercommunal des Rivières d'Austreberthe et de Saffimbec (inter-municipality organisation of the rivers of Austreberthe and Saffimbec)
SMBVAS	Syndicat Mixte de Bassin Versant de l'Austreberthe et du Saffimbec (Mixed syndicate of the watershed of Austreberthe and Saffimbec)
SOC	Soil Organic Carbon
ULg	University of Liège (Belgium)
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VSA	Visual Soil Assessment
WWF	World Wildlife Fund

13 Annexes

13.1 Annex 1 – Common grid of analysis

The three approaches are based on a literature review and the expertise gathering and analysis of stakeholders (scientists, experts, elected people, but also farmers, inhabitants of the territories…). Through exchanges and meetings of all partners of the SAS-STRAT project, a common grid of analysis was built, which will be used in each case study, for the literature review and the questioning of the actors.

Questions to be answered through review of literature (books and articles), policy documents, Internet sites, reports on meetings, reports of projects in the area

- What are the characteristics and unique qualities of this specific soil?
- What is the history of this soil? (Use of soils, activities, geology…)
- What is the historical trajectory on soil management: what were the past practices, what are the current practices?
- What are the devises/objects that steer the management of the farm/farmer: soil profile, (chemical) analysis, observation of flooding and drought, earthworms, etc.?
- Which kind of knowledge is necessary? Farmer practical knowledge, observations, technical agency, research centre, etc.?
- How can this be an example of integrated sustainable management of soil quality?
- How came the question of quality (sustainability) of soil management issue at the agenda?
- Who did what? What are the consequences of these actions? What consequences can be drawn out?

Strategic grid for the micro-macro/systems analysis

The three research-intervention teams will use the same definition of the strategic issue at stake (formulated in terms of quality management) like “Conditions and means of a better management of soil total quality in the considered territory?”

The first phase of literature review will be followed in the three countries by a “procedural phase” in which each research-intervention team will meet strategic representatives of macro actors (actors who have global expertise) and micro actors (actors who have local expertise). Each actor will develop a “micro macro expertise” about the strategic issue at stake with the help of the facilitator. The three research-intervention teams will use the following common grid of analysis.

Practical note:

In this document, the following elements are pointed out:

- in black: the questions of the standard IDPA grid (coming from the patrimonial approach) and the questions of the questionnaire established for the Dutch and Belgium case that are identical but not formulated in the same terms
- in blue: the questions added to the IDPA grid due to the confrontation of the IDPA grid with the questionnaire established for the Dutch and Belgium case
- in green: added questions that will be asked at the end of the interviews (questions taken from the questionnaire for the Dutch and Belgium case)

The common grid of analysis:

I) IDENTIFICATION OF THE SITUATION, THE CONCERNED STAKEHOLDERS AND THE PROBLEMS

I1) What are the main emergent qualities / characteristics at stake? (formulated in terms of total quality)

- What are the different understandings of "soil" and "soil quality"?

I2) What are the quality-systems? (natural, artificial and human entities – Multi- Stakeholders-Complex)

I3) Who are the main concerned stakeholders? What are their contributions and demands of quality, co-contributions and co-demands of quality, quality agreements?

- Description of the co-evolution of the relationships that occur between these actors and this soil: how actors influence the quality of the soil and how quality of the soil influences the actors? This includes the following elements:
    - Ownership (direct: farmers and indirect: nature organisations)
    - Soil managers
    - Policy influence and policy development (e.g. CAP policies, regional policies)
    - Current rules, standards and regulations that are related to soil on different levels (e.g. non tillage rules, etc.)
    - Societal debate
    - Experimenting and developing innovations with soil
- What are the questions and problems of quality identified by the interviewee regarding integrated management of soil quality?

I4) What is the key problem? (the strategic core of the issue at stake)

D) DIAGNOSIS OF THE UNDERTAKEN ACTIONS

D1) Active stakeholders and their actions

- Who are the active/committed stakeholders?
- What are the actions undertaken by the active stakeholders?
- Which is the assessment of these actions by the interviewee?
- What is the evolving social network related to this soil?
- What categories of actors, through their representatives, are involved in the management and preservation or development of this specific soil?

A. Elected and administrative representatives of the considered territory

B. Soil scientists (among them members of the SNOWMAN network in the concerned country)

C. Soil-Land owners (e.g. farmers, nature conservation organisations…)

D. Farmer organisations

E. Actively involved regional citizens

D2) System of active stakeholders

- What are the organisation and the ways of operation of the System of Active Stakeholders (SAS)?
- What assessment of the actions undertaken by the SAS can you make?

D3) Effective management resulting from the system of active stakeholders

- Which assessment of the effective management of the MSC quality through the undertaken actions of the SAS can you make?
- How are these actions relevant in the perspective of the identified problems? (Regularity, efficiency, effectiveness, relevance towards the key problem)
- What is your diagnosis of current actions for this specific soil, particularly individual actions, collective actions (regulations) and the collective method of action?

P) PROSPECTIVE

Evolution of the situation, the problems and the responses (= What is your anticipation of evolutions and problems that are facing the quality of the soil? (e.g. climate change))

P1) Time and space horizons

- Time horizons: what are the time scales at stake?
- Spatial horizons: what are the spatial scales at stake?

P2) Scenarios

- What is the most probable scenario of evolution?
- What would be a negative scenario of evolution?
- What would be a positive scenario of evolution?

P3) Stakes, threats and assets

- Which stakes can you identify in relation to these scenarios?
- Which threats can you identify in relation to these scenarios?
- Which assets can you identify in relation to these scenarios?

A) PROPOSITIONS OF ACTIONS - STRATEGIES

A1) Quality requirements and objectives

- Which quality requirements should guide future actions?
- What are the quality objectives (criteria for realisation and means) according to you?
- What are in your view the conditions and means of a better-integrated sustainable management of soil quality?

A2) which mode of quality management should be established?

- What alternative ways to govern the soil do you propose?
- Who is, in your opinion, responsible for the governance of sustainable soil management?
- What are your views on the different responsibilities in soil governance within the network of actors? (e.g. views on the different roles of CONO, regional government, farmers)

A3) Proposed actions

- What are the ranges of actions to take?
- What are your proposed solutions to overcome the identified challenges?
- What are your proposals for actions?
- In particular, which actions do the project initiator has to led?

A4) What is the relevant framework/process for change management?

A5) Which assessment processes should be established? (success criteria according to the interviewee)

ADDITIONAL QUESTIONS (at the end of the co-expertise process):

- Narratives on the soil by different categories of actors: what are the metaphors, the pictures, the stories (successes, failures…) that circulate in the network?
- What are the different stories about the identification of the qualities at stake and the problems met with this specific soil?

13.2 Annex 2 – Bibliography for the French case study

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13.3 Annex 3 – Patrimonial audit contract for the French case study

UFR Gestion du vivant et stratégies patrimoniales

ADEPRINA

Contrat d'audit patrimonial

« Conditions et moyens de l'amélioration de la gestion de la qualité des sols sur le territoire du bassin versant de l'Austreberthe et du Saffimbec ».

entre

Le Syndicat Mixte du Bassin Versant de l'Austreberthe et du Saffimbec (SMBVAS)

Représenté par Monsieur Michel CORTINOVIS

En sa qualité de Président

ci-après dénommé "le commanditaire"

et

L'Association Régionale pour l'Étude et l'Amélioration des Sols (AREAS)

Représentée par Monsieur Jean-François OUVRY

En sa qualité de Directeur

ci-après dénommé "le commanditaire"

et

Monsieur Didier CHRISTIN, ingénieur agronome, auditeur patrimonial senior et responsable scientifique du projet SAS-STRAT, Sol et Civilisation

Mademoiselle Elise LEVINSON, ingénieur agronome, auditrice patrimoniale junior et doctorante AgroParisTech / Adeprina

ci-après dénommé "l'auditeur patrimonial"

et

Monsieur Henry OLLAGNON, professeur, concepteur-superviseur de l'audit patrimonial,

Monsieur Ambroise de MONTBEL, ingénieur de recherche, coordinateur opérationnel de l'audit patrimonial

Les susmentionnés signataires du **présent contrat** s'accordent sur les points suivants :

Article I : Contexte et la finalité de l'intervention

La réalisation de cet audit patrimonial entre dans le cadre du programme de recherche européen SNOWMAN (« Connaissances pour des sols durables »), dont l'un des objectifs est de fournir des informations et des données pour la possible mise en place d'une directive européenne « sols ». Y travaillant de façon conjointe avec des équipes hollandaise et belge, dans un projet nommé « SAS-STRAT » (Sustainable Agriculture and Soil : comparative study of strategies for managing the integrated quality of agricultural soils in different regions of Europe), l'un des objectifs de l'équipe française (partenariat Sol et Civilisation, Mutadis, AgroParisTech / Adeprina) est de montrer que des actions sont actuellement menées dans les territoires pour prendre en charge la qualité des sols, et que si une directive européenne « sols » était rédigée, elle devrait tenir compte de cette « gestion effective ».

Le Syndicat Mixte du Bassin Versant de l'Austreberthe et du Saffimbec (SMBVAS), situé au cœur du Pays de Caux, a été créé le 13 juillet 2000, suite aux inondations à répétition de la décennie 90. Il a pour objet « l'étude, l'aménagement et l'entretien du bassin versant de l'Austreberthe et du Saffimbec sur le territoire des collectivités adhérentes », et travaille avec les autres Syndicats de bassin versant de Seine-Maritime à des études, des actions de gestion, et des actions d'animation, de communication et de sensibilisation auprès des acteurs concernés par la problématique des ruissellements, afin de les faire travailler sur ces questions.

L'Association Régionale pour l'Etude et l'Amélioration des Sols (AREAS) est un acteur essentiel du travail mené en Haute-Normandie sur la problématique des ruissellements et de l'érosion. Ses missions sont de trois types : apporter un appui technique à des maîtres d'ouvrages, transmettre la connaissance, et produire de la connaissance par des expérimentations. Elle développe, pour ce dernier point, une activité de type « recherche appliquée » afin de construire des données locales pour mieux comprendre les phénomènes en cours, les données nationales ne correspondant pas souvent au contexte régional.

Les réalités transverses que sont les ruissellements érosifs dans le Pays de Caux entraînent des dégradations. Des actions curatives (à partir d'ouvrages de régulation dynamiques) et préventives (à travers un volet agricole et un volet urbain, qui prennent en charge l'évolution du territoire) ont été menées à l'initiative des Syndicats de bassins versants. Même si ces actions sont menées en accord avec les propriétaires privés, il reste à générer un « comportement quotidien de gestion de la qualité des sols » dans les bassins versants, dans des situations qui ont la caractéristique d'être complexes et de mettre en jeu de multiples acteurs publics et privés, parfois situés dans des endroits géographiquement distincts (amont / aval). Ce comportement partagé permettrait de renforcer les actions préventives, en particulier avec les grands propriétaires fonciers que sont les agriculteurs.

Ainsi, les trois partenaires que sont le Syndicat Mixte du Bassin Versant de l'Austreberthe et du Saffimbec, l'Association Régionale pour l'Etude et l'Amélioration des Sols, et l'équipe française du projet SAS-STRAT, se rejoignent sur l'intérêt de mener à bien un audit patrimonial d'exploration stratégique, dont l'objectif est de rechercher les ***« Conditions et moyens de l'amélioration de la gestion de la qualité des sols sur le territoire du bassin versant de l'Austreberthe »*** en sollicitant les principaux acteurs, pour définir avec eux la stratégie à suivre pour élaborer cette coaction complexe.

Article II : Présentation de l'audit patrimonial

L'*audit patrimonial* est une *procédure d'exploration et de mobilisation stratégiques* en vue de concevoir et de mettre en œuvre une action intrinsèquement complexe et multi-acteurs, exprimée en termes de gestion de la qualité. Il est mis en œuvre par des auditeurs patrimoniaux, qui agissent en tant que « tiers faciliteur », recueillant toutes les formes de connaissance et notamment l'expertise des multiples acteurs qu'ils sollicitent « en tant qu'experts ». Il vise à déterminer les conditions et les moyens par lesquels cette action sera prise en charge par l'ensemble des acteurs qui constituent le « complexe multi-acteurs » concerné par celle-ci.

La procédure d'audit patrimonial vise ainsi à :

- faire se rencontrer les différentes formes d'expertise et donc d'intelligence (universalistes, expertise spécialisée, expertise des acteurs en tant qu'expert),

- rechercher des situations positives pour tous les acteurs (jeu à somme positive « gagnant/gagnant », au sein du complexe multi-acteur concerné),

- mettre en lumière les chemins de changement par lesquels les acteurs pourront effectivement construire ensemble cette situation de façon acceptable pour tous.

Article III : Déroulement de l'audit patrimonial

La liste des 30 personnes à auditer sera établie en commun par le commanditaire et l'équipe formée par Sol et Civilisation et AgroParisTech / Adeprina (auditeurs, superviseur et coordinateur).

A l'issue de ces 30 auditions, une réunion de restitution des résultats du travail pourra être organisée avec le commanditaire, si celui-ci le souhaite. Elle conviera l'ensemble des personnes auditées, et visera à valider avec elles les résultats présentés.

Article IV : La grille d'entretien

L'écoute active de chacune des personnes auditionnées se fera selon la même grille stratégique, dite grille I.D.P.A., qui sera aussi la grille d'intégration utilisée dans le rapport de synthèse :

- **Identification** de la situation et des problèmes : Quelles qualités en jeu ? Dans quelles entités ? Quels acteurs concernés ? Quelles offres et demandes de qualité ? Quel est le cœur stratégique du problème ?
- **Diagnostic** de l'action engagée : Quels sont les acteurs actifs ? Quelles actions ont-ils engagé ? Comment évaluer ces actions ? Quelle organisation et quel fonctionnement du système d'action ? Quelle évaluation de la réponse apportée au problème ?
- **Prospective** : évolution des problèmes et des réponses, échelle spatio-temporelle, établissement de trois scénarios (tendanciel, négatif, positif), enjeux, menaces, atouts.
- **Action** : Quelles exigences-qualité ? Quels objectifs-qualité se fixe-t-on ? Quelle est la gamme des actions à mettre en œuvre (techniques, économiques, relationnelles...) ? Quel mode d'action des acteurs ensemble à construire ? Quel est le chemin de changement envisageable ? Quels critères personnels d'évaluation de la réussite ?

Remarque : du fait du partenariat, au sein du projet SAS-STRAT, avec une équipe belge et une équipe hollandaise ayant des méthodologies de travail différentes, et dans une optique de travail de recherche, la grille d'entretien I.D.P.A sera enrichie si nécessaire, après l'audition principale, et de façon clairement séparée, des questions suivantes :

- Quelle est l'histoire de ce sol ? (utilisation, activités, géologie…) Quelles sont les métaphores, les images, les histoires que vous connaissez au sujet de ce sol ?

- En particulier, quelles sont les histoires liées aux qualités en jeu et aux problèmes que vous associez à ce sol ?

- Quels sont les concepts et objets qui entrent dans les choix de gestion des agriculteurs (profils de sols, analyses chimiques, observation des périodes d'inondations et de sécheresses, présence dans le sol de vers de terre, etc. ?)

Article V : La déontologie de l'audit patrimonial

L'audit patrimonial est une procédure sécurisée qui s'appuie sur le respect de cinq règles :

- avant chaque entretien, strictement personnel, libre et volontaire, l'auditeur informe la personne auditée du nom du commanditaire de l'audit patrimonial, et de son libellé ;
- l'auditeur patrimonial garantit explicitement et personnellement à chaque personne auditée la stricte confidentialité de ses propos, et celle-ci accepte de porter à la connaissance commune ce qui est partagé par tous, dans une formulation qui ne doit nuire à personne ;
- l'expertise recueillie n'engage ni le commanditaire, ni l'auditeur, ni la personne auditée dans une obligation d'agir ;
- les audits donnent lieu à un rapport de synthèse qui engage la responsabilité personnelle de l'auditeur patrimonial ;
- le rapport de synthèse et le support de présentation de la restitution sont gérés sur le plan de la confidentialité et de la diffusion par le seul commanditaire de l'audit patrimonial.

Article VI : Résultats attendus

Les résultats attendus par la réalisation de cette convention sont :

- l'audition et la mobilisation de 30 personnes,

- l'organisation d'une réunion de restitution (après validation avec le commanditaire).

Article VII : Délai de réalisation :

Une réunion de pré-restitution sera organisée au cours du séminaire français du projet SAS-STRAT, prévu les 24, 25 et 26 octobre 2012. La restitution devant les personnes auditées aura lieu d'ici la fin du mois de novembre 2012. Le rapport de synthèse de l'audit patrimonial sera rendu au commanditaire dans les 2 mois suivant cette restitution.

Article VIII : Responsabilité et confidentialité

Les documents produits à l'issue de l'intervention sont la propriété du commanditaire, qui donnera son accord pour l'exploitation dans le cadre du projet de recherche. Les matériels et supports d'enquêtes intermédiaires restent sous la responsabilité des auditeurs. La confidentialité des entretiens individuels est assurée par les auditeurs, sous leur seule responsabilité.

Article IX : Clause de publicité

Les communications publiques réalisées, le cas échéant, à l'attention des médias, devront mentionner l'identité des auditeurs patrimoniaux et la participation de Sol et Civilisation et d'AgroParisTech / Adeprina. Les communications réalisées dans le cadre du projet SAS-STRAT citeront le Syndicat Mixte du Bassin Versant de l'Austreberthe et du Saffimbec (SMBVAS) et l'Association Régionale pour l'Étude et l'Amélioration des Sols (AREAS).

Fait en 3 exemplaires, à Limésy, le 18 septembre 2012,

Les commanditaires

Les auditeurs patrimoniaux

Le superviseur

Le coordinateur opérationnel

13.4 Annex 4 – List of interviewees in the French case study

NOM	STRUCTURE
Acteurs macro et "experts"	
Jean-François OUVRY	Directeur de l'AREAS
Michel CORTINOVIS	Président du SMBVAS
Yves LE BISSONNAIS	INRA. Spécialiste français de l'érosion
Philippe MARTIN ou Céline RONFORT	AgroParisTech / INRA
François FIHUE ou Valérie GENOUVILLE	Président de la Chambre d'agriculture de Seine-Maritime Chef du Pôle Territoires de la Chambre d'agriculture de Seine-Maritime
Pascal MAGOAROU	DDTM et MISE (Mission Inter Services de l'Eau)
Mr. Valéry MORARD	Ministère de l'Ecologie - Commissariat Général au Développement Durable / Service de l'Observation et des Statistiques (SOeS)
Stéphanie BIDAULT ou Nicolas BAUDUCEAU	CEPRI (Centre Européen de Prévention du Risque d'Inondation) : Déléguée Générale et Directeur Scientifique et Technique
Pierre STENGEL	Directeur scientifique "Environnement, écosystèmes cultivés et naturels" à l'INRA, GIS Sol (INRA / Ministère de l'Agriculture)
Antonio BISPO	GIS SOL ADEME, Département Gestion Biologique et Sols (DGBS), Direction Déchets et Sols (DDS)
Jérôme BOURLET DE LA VALLÉE	Elu vert au Conseil Régional de Haute-Normandie. Aussi à la COMITER (Commission Territoriale Seine-aval de l'AESN).
Caroline LABOUCARIÉ ou Hervé PLUSQUELLEC (aménagement foncier A150) et Aurélie WOUDSTRA (ouvrages hydraulique douce)	Directrice de l'Environnement au Conseil Général de Seine-Maritime
Dominique CHACHUAT	Chef du Service Agriculture et Pêche au Conseil Général de Seine-Maritime
Rémy FILALI ou Vincent MARTIN	Directeur de la Direction Territoriale et Maritime Seine-Aval de l'Agence de l'Eau Seine-Normandie Chargé de projets Milieux aquatiques et Agriculture à la Direction Territoriale et Maritime Seine-Aval de l'Agence de l'Eau Seine-Normandie

David ROLLAND	Chargé de mission à la Fédération des chasseurs 76 ; Programme AGRIFAUNE
Jean-Paul LAROCHE	Président de la Fédération Départementale de pêche de l'Eure
Cyril QUEFFEULOU	EPFN (Etablissement Public Foncier de Normandie
Acteurs micro	
Dominique GRANDSIRE	Agriculteur polyculture élevage
Mathieu SOUDEY	Agriculteur polyculture élevage
Paul LESELLIER	Agriculteur polyculture élevage
Mya BOUZID	Coordinatrice du SMBVAS
Laurent DELAPORTE	Agriculteur
Didier LUCAS	Agriculteur
Reynald TOCQUEVILLE	Agriculteur
Julien BERTHEUIL	Maire d'Auzouville l'Esneval
Michel BENTOT	Maire de Barentin
Etienne ROUSSELET	Maire de Croix-Mare
Hubert HONDIER	Maire d'Emanville
André LEFRANCOIS	Maire de Fresquiennes
Daniel GRESSENT	Maire de Sainte Austreberthe
Jean-Christophe EMO	Maire de Villers Ecalles
Daniel BOULENGER	Président de l'ASIVA (Association des sinistrés de l'Austreberthe)
Gérard CAPRON	Président de l'Association Duclair environnement
Jean-Phille DOUILLET	Jeune agriculteur
M. BARBULEE	Jeune agriculteur

13.5 Annex 5 – Belgian case study - bibliography

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13.6 Annex 6 – Collaboration convention with Greenotec

Présentation à Greenotec du projet SAS-STRAT en Région Wallonne

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+32 473 41 56 45

Le projet de recherche SAS-STRAT s'inscrit dans le cadre général de l'amélioration de la gestion des sols agricoles, et notamment de l'augmentation de l'efficacité des politiques et des réglementations sur la protection des sols agricoles. Il a pour objectif général d'identifier, décrire et analyser les conditions et les moyens nécessaires pour une gestion durable des sols agricoles, en prenant compte de la variété actuelle et/ou potentielle de la qualité des sols, y compris au-delà des aspects de production agricole. A cette fin, une analyse comparative entre trois études de cas au Pays Bas, Belgique et France est réalisée. Le cas belge considéré est celui du développement de l'agriculture de conservation des sols et plus particulièrement de la conception et diffusion de ce modèle à travers l'association GREENOTEC. Cette analyse devrait permettre d'identifier les conditions qui permettent de prendre en compte de nouveaux problèmes liés au sol agricole et de redéfinir ce qui constitue la qualité du sol. Les résultats de cette recherche seront discutés avec les parties prenantes impliquées dans ces questions à un niveau national et européen, l'objectif global du projet étant de fournir aux législateurs, administrations et praticiens des lignes directrices sur la façon d'améliorer la gestion des sols agricoles en intégrant les enjeux liés à la qualité des sols, de l'échelle locale à l'échelle européenne en passant par les niveaux intermédiaires (régionaux et nationaux).

Le projet SAS-STRAT prend place au sein du réseau européen de recherche SNOWMAN (*Sustainable management of soil and groundwater under the pressure of soil pollution and soil contamination*) et rassemble des équipes de chercheurs provenant de France, des Pays-Bas et de Wallonie. Le consortium se compose d'un groupe de scientifiques expérimentés couvrant le domaine de la sociologie, des sciences politiques, de l'agronomie, et de la gestion des ressources naturelles. En Wallonie, le projet s'étend de mars 2012 à septembre 2013. Il est financé par la DGARNE et est réalisé par Pierre Stassart et Audrey Vankeerberghen[*], sociologues spécialisés dans l'étude de la transition des modèles agricoles.

Cadre méthodologique de la recherche

Le cadre d'analyse choisi pour cette étude est la Théorie de la Transition (Geels 2007). Selon cette théorie, tout profond changement de pratiques résulte de l'interaction entre trois niveaux : la "niche" (expérimentation/innovation), le "régime" (organisation sectorielle) et le "paysage" (organisation institutionnelle). Suivant ce cadre d'analyse, nous souhaitons mener nos observations de terrain à trois niveaux :

[*] Attachés au campus d'Arlon de l'ULg, dans l'unité SEED, (Socio-Economique Environnement et Développement), une équipe pluridisciplinaire ancrée dans la sociologie développant des recherches dans le domaine de l'environnement et du développement durable (http://www.dsge-arlon.ulg.ac.be/SEED/).

1. chez les agriculteurs afin de comprendre comment s'effectue la transition à un niveau individuel,
2. à travers la communication de Greenotec aux agriculteurs (journées d'étude, formations, newsletter, etc.) afin d'aborder la question de l'apprentissage des agriculteurs et de comprendre l'articulation des transitions individuelles avec un modèle collectif de transition,
3. au sein des organes de réflexions internes à Greenotec afin d'étudier la construction collective d'un modèle de transition.

Calendrier provisoire des enquêtes de terrain

De mai 2012 à mars 2013 (toute la durée de la phase d'enquêtes de terrain) :

- participation à des journées d'étude, formations, séminaires
- participation en tant qu'observateur extérieur aux organes de réflexion au sein de Greenotec et comité technique avec la RW

De mai à août 2012 :

- entretiens exploratoires avec des fondateurs et le coordinateur de l'asbl
    - objectifs : comprendre la genèse et l'évolution de Greenotec, cerner sa situation actuelle, le profil de ses membres (état des lieux permettant de définir une méthodologie d'enquêtes de terrain)
- documentation sur les TCS, non-labour, etc.

De septembre à décembre 2012 :

- entretiens/observations chez les agriculteurs

De janvier à avril 2013 :

- rédaction du rapport sur l'agriculture de conservation en RW

Fin mars 2013 :

- soumission à Greenotec du rapport final de l'étude

Convention de collaboration entre l'ULg et Greenotec

Note liminaire

Dans le cadre de ce projet, nous souhaitons construire avec Greenotec une collaboration qui soit bénéfique à la fois pour nous et pour les membres de l'asbl. À cette fin, nous suggérons cette convention de collaboration permettant de clarifier les attentes de chaque partie et d'objectiver la procédure de recherche. Nous tenons à préciser que cette convention n'a aucune valeur contraignante: elle constitue plutôt une charte éthique d'entente. Elle reste, par ailleurs, ouverte à toute possibilité de modification durant la recherche.

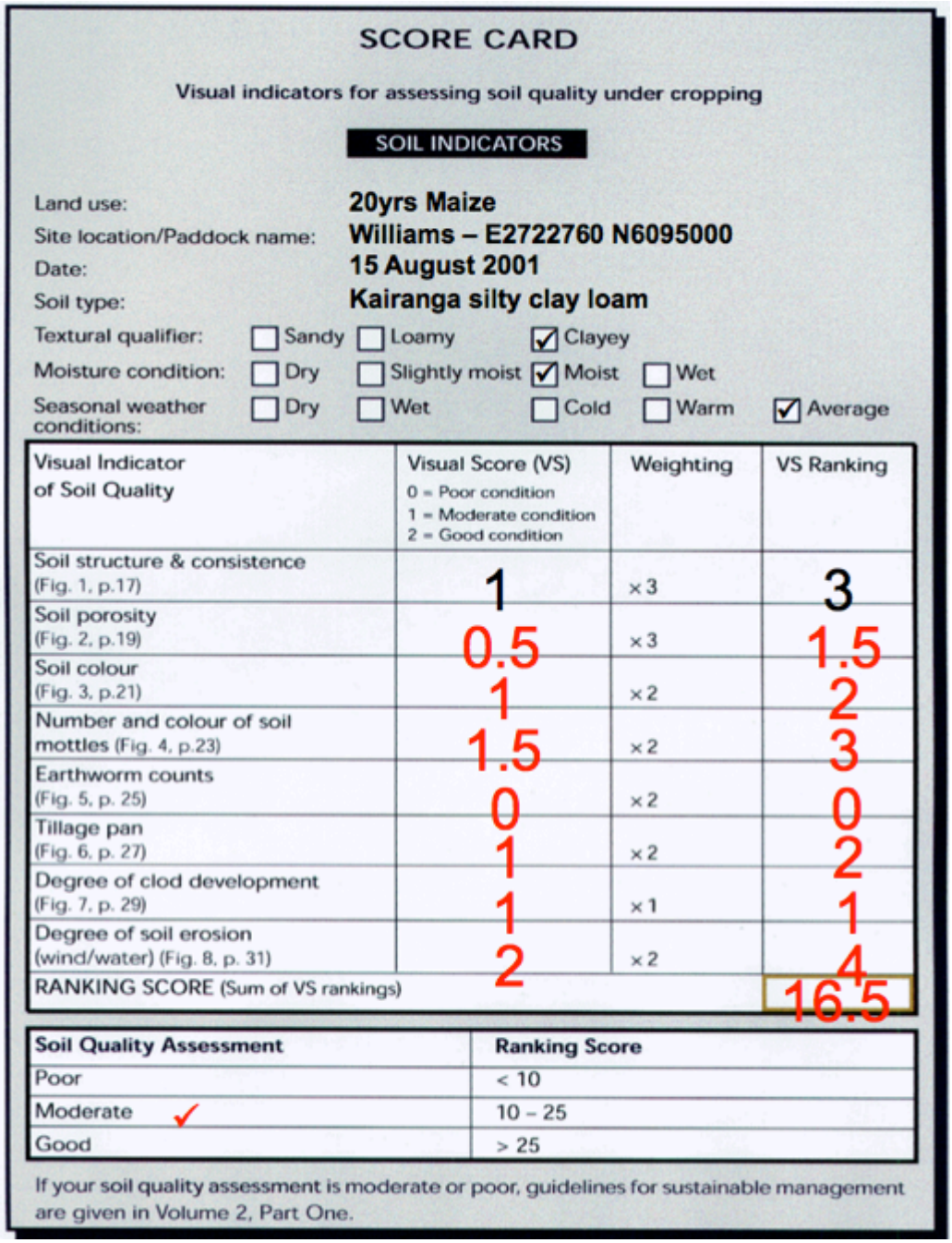
L'ULg s'engage à :

- Offrir la possibilité pour le coordinateur de Greenotec, s'il le souhaite, de participer aux journées de terrain organisées lors des rencontres entre les différentes équipes de recherche aux Pays-Bas (5 et 6 juin 2013), en France (24 et 25 octobre 2013) et en Belgique (13 et 14 mars 2013).
- Offrir la possibilité à Greenotec de participer aux comités techniques du projet avec la RW.
- Inviter Greenotec au séminaire de clôture présentant les résultats de l'étude SAS-STRAT (septembre 2013).
- Respecter l'anonymat des personnes interviewées et la confidentialité des informations lorsque celle-ci est demandée.
- Soumettre la première version du rapport final à Greenotec pour commentaires

Greenotec s'engage à :

- Donner la possibilité à Audrey Vankeerberghen d'accéder à la documentation que Greenotec possède sur l'agriculture de conservation, les TCS, etc.
- Donner la possibilité à Audrey Vankeerberghen de participer aux journées de formation, journées d'étude et séminaires organisés par Greenotec.
- Permettre à Audrey Vankeerberghen de participer en tant qu'observatrice extérieure aux organes de réflexion au sein de Greenotec ainsi qu'au comité technique avec la RW.

13.7 Annex 7 – Visual Soil Assessment scorecard



SCORE CARD

Visual indicators for assessing soil quality under cropping

SOIL INDICATORS

Land use: **20yrs Maize**
Site location/Paddock name: **Williams – E2722760 N6095000**
Date: **15 August 2001**
Soil type: **Kairanga silty clay loam**
Textural qualifier: ☐ Sandy ☐ Loamy ☑ Clayey
Moisture condition: ☐ Dry ☐ Slightly moist ☑ Moist ☐ Wet
Seasonal weather conditions: ☐ Dry ☐ Wet ☐ Cold ☐ Warm ☑ Average

Visual Indicator of Soil Quality	Visual Score (VS) 0 = Poor condition 1 = Moderate condition 2 = Good condition	Weighting	VS Ranking
Soil structure & consistence (Fig. 1, p.17)	1	×3	3
Soil porosity (Fig. 2, p.19)	0.5	×3	1.5
Soil colour (Fig. 3, p.21)	1	×2	2
Number and colour of soil mottles (Fig. 4, p.23)	1.5	×2	3
Earthworm counts (Fig. 5, p. 25)	0	×2	0
Tillage pan (Fig. 6, p. 27)	1	×2	2
Degree of clod development (Fig. 7, p. 29)	1	×1	1
Degree of soil erosion (wind/water) (Fig. 8, p. 31)	2	×2	4
RANKING SCORE (Sum of VS rankings)			16.5

Soil Quality Assessment	Ranking Score
Poor	< 10
Moderate ✓	10 – 25
Good	> 25

If your soil quality assessment is moderate or poor, guidelines for sustainable management are given in Volume 2, Part One.

13.8 Annex 8 – List of participants of SAS-STRAT Integration workshop (Paris, 17th-18th June 2013)

Alexandre Abiven	Expert in the Inter-community union for the management of the rivers Austreberthe and Saffimbec (Syndicat Intercommunal des Rivières de l'Austreberthe et du Saffimbec – SMBVAS), France
Stéphane Baudé	Mutadis (France)
Mia Bouzid	Director of the SMBVAS (France)
Didier Christin	Sol et Civilisation (France)
Hélène Cordonnier	Public Service of Wallonia (Service public Wallonie), Belgium
Michel Cortinovis	President of SMBVAS (France)
Esther Goidts	Public Service of Wallonia (Service public Wallonie), Belgium
Dorieke Goodijk	Sustainability manager at CONO cooperative (the Netherlands)
Gilles Hériard Dubreuil	Director of Mutadis (France)
Elise Levinson	AgroParisTech (France)
Ambroise de Montbel	AgroParisTech (France)
Vincent Martin	Water Management Agency of Seine-Normandie (Agence de l'eau Seine-Normandie), France
Henry Ollagnon	Professor at AgroParisTech (France)
Jean-François Ouvry	Director of he Regional Association for Soils Study and Improvement in Haute-Normandie (Association Régionale pour l'Étude et l'Amélioration des Sols de Haute-Normandie – AREAS), France
Gérard Rass	Secretary General of the Association pour une agriculture durable (APAD – Association for Sustainable Agricultrure), France
Joost Salomeez	Environment, Nature and Energy Department of the Flemish government (Department Leefmilieu, Natuur en Energie - LNE), Belgium
Jurgis Sapijanskas	Ministry of Ecology, Sustainable Development and Energy (France)
Pierre Stassart	Researcher-teacher at the University of Liège (Université de Liège, ULg), Belgium
Wolfgang Sturny	Chief of the Unit of Soil protection of the Office for Nature and Agriculture of the Berne canton (Switzerland)
Raynald Tocqueville	farmer (France)
Audrey Vankeenberghen	University of Liège (Université de Liège, ULg), Belgium

13.9 Annex 9 – Programme of the Integration workshop (Paris, 17th-18th June 2013)

SNOWMAN NETWORK

Knowledge for sustainable soils

Sustainable Agriculture and Soil: comparative study of strategies for managing the integrated quality of agricultural soils in different regions of Europe / Belgium, France, Netherlands

Integration workshop

Paris, 17th-18th June 2013

Working languages: French, Dutch

First announcement

Version of 11th June 2013

Context

There is a wider and growing awareness of soil as a natural element as important as water and air. Its importance is related to the fact that soil is a support to many activities essential to human life (for a long time, it was even considered only from a food perspective), but also it is a system in itself, on which topical questions today (biodiversity, climate change...) are dependent.

In the policy field, the European Commission has adopted in 2006 a Soil Thematic and a proposal for a Soil Framework Directive (this directive is still under discussion) with the objective of "establishing a common strategy for the protection and sustainable use of soil based on the principles of integration of soil concerns into other policies, preservation of soil functions within the context of sustainable use, prevention of threats to soil and mitigation of their effects, as well as restoration of degraded soils to a level of functionality consistent at least with the current and approved future use."[13]

Karlen et al. (1997) define soil quality as 'the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation'[14]. This definition and its discussion have underpinned the research developments in the first decade of the 21st century. It reflects the acknowledgment of the research and policy community that soil quality management is a multi-faceted question.

Indeed, soil is a complex element: it has intrinsic qualities (physical, chemical, biological), but also constitutes an environment that is both natural (support to fauna and flora) and human (with social, cultural and economical dimensions and values). Although the multi-dimensionality of soil is now widely recognized, soil research has been mainly focussing on physics and biology. The research from humanities is still limited. This may be explained by the fact that soil is seldom an issue in itself for social and political sciences, but is most often considered as an object related to other issues (urbanisation, agriculture, protection of the environment). Soil complexity resides not only in its multi-dimensional character, but also in the difficulty to separate fully the various qualities of soils one from another - like a growing number of intermediary objects situated between humanity and nature. Soil tightly integrates physical, chemical and biological qualities together with social and human qualities. Like for any other complex issue, the complexity of soils can not be reduced by a clinical examination that would enable separate the different qualities and soil functions one from another and would not take into account their interdependence and interactions deep.

Soil complexity is particularly obvious as regards agricultural soil. This type of soil currently faces a number of challenges related to complexity and lack of integration. When looking at productive agriculture soils we see that farmers can develop or damage soil quality by their management. Acknowledging this, various initiatives and farmer innovations throughout Europe have developed to address and improve integral sustainable soil management. Among new developments impacting agricultural soil in Europe, conservation agriculture that has provided new approaches, e.g. simplified cultivation techniques, non-ploughing, which, by producing change, reveal the complexity of soil management. These approaches build on the quality of the soil and on the different functions of cover plants (soil protection, improvement of biodiversity, and soil structure, carbon storage...). They improve the biological quality of soil, can prevent from erosion while they often need to increase the use of pesticides. They also provoke changes in the relations among farmers, as well as in the relations between farmers and other stakeholders (local and central authorities, experts, industry...). The impacts of these changes for soil quality only begin to be assessed, often from a single perspective, while there is a clear interaction between soil quality, agronomic technology, food industry, pesticides industry, regulation, etc.

But what do the various concerned actors understand as the quality of agricultural soil? How to maintain, and improve this quality? How to address the complexity of soil quality by developing strategies which take into account the variety of uses and values of soil and their interactions? What

[13] Proposal for a Directive of the European Parliament and of the Council establishing a framework for the protection of soil and amending Directive 2004/35/EC

[14] Schuman. 1997. Soil quality: A concept, definition, and framework for evaluation. Soil Sci. Soc. Amer. J. 61:4-10

can be the complementary contribution of EU and national policy and of regional and local practices? How to support actual transition towards sustainable management of soils and the associated innovations pathways? These are the questions within the SAS-STRAT project and on which this integration workshop aims to shed light.

The SAS-STRAT European research project

This integration workshop is organised in the framework of the SAS-STRAT[15] European research project, which is developed within the SNOWMAN[16] European research network. This project aims at identifying, describing and analysing conditions and means for a sustainable management of cultivated soils in Europe, that takes into account a variety of current or potential qualities of these soils, including and beside agricultural production. It relies on the comparative analysis of 3 case studies in France, Belgium and the Netherlands related to integrated management of soil quality.

This research is developed with a participatory methodology and case-study approach, in strong cooperation with stakeholders, who contribute with their own expertise on integrated soil quality.

SAS-STRAT is developed by an interdisciplinary and pluralistic research team composed of academics, research centres, consultants and association. The team notably includes actors engaged on the field with farmers, thus playing a role of facilitators of change in soil management practices.

The case studies mobilise different theoretical backgrounds to analyse soil quality management and mingles the analytical tools of

- The theory of transition[17], that is inspired by evolutionary economist and innovation sociology and has been set-up firstly in Netherland as a framework of cooperation between scientist, managers and administrations to understand the dynamics of changes towards sustainable development[18]. In this theoretical framework, deep innovations and transformations result from the interactions between "niches" (innovative modes of management), the "regime" (the mainstream mode of management) and the "landscape" (the broader social, institutional and economical context, beyond the considered activity). In the Belgian case study, Conservation Agriculture (CA) is considered as a "niche" that emerged from the conventional agricultural "regime" (the ploughing regime) by the removal of the ploughing[19] (Goulet & Vinck 2011).

- The patrimonial approach developed by Henry Ollagnon[20], which is meant to address complex issues of management of natural resources. This approach is both *systemic* and *strategic*. This approach is systemic as it focuses on actual systems of natural resources management as crossroads of interactions between human and natural systems. As a systemic approach, it addresses complexity of this system by taking into account the various interactions between actors, qualities and dimensions at stake for a given issue. The patrimonial approach notably relies on the work of Bernard Motulsky for whom "The systemic approach says both that there is no system in itself in reality (i.e. without an observer), but it is nevertheless possible to speak of

[15] The full title of the project is: "Sustainable Agriculture and Soil: comparative study of strategies for managing the integrated quality of agricultural soils in different regions of Europe / Belgium, France, Netherlands"

[16] http://www.snowmannetwork.com

[17] see Geels, F.W. et Schot, J., Typology of sociotechnical transition pathways, Research Policy, 36, 2007

[18] see Grin, J., Rotmans, J., Schot, J., Geels, F.W., Loorbach, D., 2010. Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change. London:Routledge

[19] see Goulet, F. et Vinck, D., L'innovation par retrait. Contribution à une sociologie du détachement, Revue française de sociologie, 532, 2012.

[20] See Ollagnon, H. (1987). "Une nécessaire rencontre des approches théoriques et pragmatiques de la gestion de la nature: l'audit patrimonial de type système-acteurs." Cahier du GERMES(12): 15. and Ollagnon, H. (1998). Une approche patrimoniale de la gestion de la qualité. Une application à la nature et au vivant. Pour une écologie de l'action. UER Analyse économique. Paris, Université paris I "Panthéon Sorbonne": 622.

this reality in terms of system."[21] Motulsky's works are a fundamental contribution to the improvement of the living management. It leads directly to a *systemic and strategic epistemology*, i.e. an epistemology focused on the identification and the resolution of problems, basis of the strategic approaches stakeholders need to manage living quality and, more broadly, to act in an inherently complex and multi-stakeholders universe.

The project develops in 3 phases:

- Development of a common methodological framework ensuring inter-comparability between the 3 case studies included in the project;
- Development of the 3 case studies (see annex for a short description of the case studies);
- Integration of the lessons learnt from the 3 case studies and formulation of guidance and recommendations.

The results of this project will give elements on how to positively take into account the different qualities of soils into an integrative and multiple stakeholders soil management strategy. Doing so, it will

- Outline ways of integrating soil ecosystem services into decision making and governance;
- Analyse and provide recommendations on methodologies and strategies to build a multiple stakeholder and multiple quality decision making;
- Outline solutions for a more sustainable agriculture and agricultural management.

Objectives of the integration workshop

The Integration workshop organised in Paris on 17th and 18th June 2013 is directed towards the different actors concerned by soil quality management: farmers and their organisations, policy makers and public authorities at the local, regional, national and European level, civil society organisations, soil science research community, …

This workshop aims to

- share and discuss the outcomes of the 3 case studies
- draw lessons from these results in terms of approaches, tools and governance frameworks to address and deal with the complexity of soil quality management and support innovation and transition pathways towards more sustainable soil quality management
- elaborate recommendations directed towards policy makers and soil science community which will be integrated into the guidance which will be produced by SAS-STRAT at the end of the project.

The workshop will be interactive and will cross presentation of results by the SAS-STRAT team and discussions in working groups with the participating stakeholders. In this perspective, the targeted audience for this seminar is of about 40 participants.

[21] see Motulsky, B. (1980). Du système au problème. Essai sur les implications épistémologiques de la systémique. Philosophie, Université Laval: 153

Agenda

Monday, 17th June 2013

12:00 Welcoming of the participants and lunch buffet

13:00 Introduction

13:20 Session 1: Presentation of case studies

Cases studied in the framework of the SAS-STRAT project

- French case study: Conditions and means of the improvement of the management of soils quality on the territory of the catchment basin of Austreberthe and Saffimbec (Didier Christin, Sol & Civilisation and a stakeholder engaged in the case)
- Belgian case study: Transition trajectories towards conservation agriculture – the experience of Greenotec association (Pierre Stassart, ULg and a member of Greenotech)
- Dutch case study: market incentives and visual soil assessment tools as drivers for change towards sustainable soil management practices for dairy farming in the Beemster polder (Frank Verhoeven, Boerenverstand, and a stakeholder engaged in the case)

Return of experience from other cases

- Public policies for facilitating transition towards sustainable soil management in the Swiss canton of Bern (Wolfgang Sturny, Head of the Service of Soil Protection of the Office for Agriculture and Nature of the canton of Bern)
- Supporting farmers' transition towards conservation agriculture: the experience of the French association APAD (Gérard Rass, Secretary General of the APAD)

Each presentation will be followed by a discussion with the participants

16:40 Session 2: Lessons learnt from SAS-STRAT case studies

16:40 Discussion in parallel working groups: lessons learnt from the 3 cases studies and from the return of experience presented during

18:00 Presentation of lessons learnt from the 3 case studies of the project by the SAS-STRAT team

Theme 1: sustainable soil quality management, a problem of transition in socio-technical systems, with self-locking effects on current practices

Theme 2: addressing complexity of soil quality

Theme 3: contribution of scientific and technical tools to soil quality management

18:45 End of 1st day

19 :00 Guest dinner

Tuesday, 18th June 2013

9:00 Session 2 (continued): report from the working groups

9:45 Session 3: Strategic diagnosis of the stakes and challenges for integrated soil quality management in Europe

Presentation from SAS-STRAT research team followed by discussion with the participants. This diagnosis is based on a transversal and multi-level strategic analysis taking into account the complex and multilevel character of soil quality management.

10:45 Session 4: Recommendations: how to create conditions for actors' practices to take into account integrated soil quality

Participants will split in parallel working groups (with interpretation) and work on possible recommendations on the basis of a grid of questions proposed by the organisers

13:00 Lunch break – buffet in the premises of the workshop

14:30 Session 4 (continued): Report from the working groups and discussion

15:30 Conclusion

Roundtable with representatives of farmers' organisation engaged in the development of conservation agriculture, representative of national governments of France, Belgium and the Netherlands and representatives of local governments.

16:30 End of the workshop

13.10 Annex 10 – Presentation of the APAD during the SAS-STRAT Integration workshop (Paris, 17th-18th June 2013)

L'Agriculture de Conservation
Un potentiel démontré et réaliste
Comment le faire progresser ?

Un sol fertile est le fondement indispensable de toute agriculture et de toute civilisation

- Un sol fertile produit SIMULTANEMENT :
  - productivité ET profitabilité ET environnement,
  - 4 services :
    - » production,
    - » biodiversité, eau, air (C/énergie/climat).
- Beaucoup de civilisations se sont effondrées parce qu'elles ont trop tiré sur leurs sols, faute de pratiques de conservation.
- Causes de dégradation des sols : dégradation de la vie biologique, donc de la matière organique.
- Causes de dégradation des fonctions biologiques et de la MO : perturbation du sol, sol non couvert, insuffisance de restitution de biomasse.

Références

- **Soil Thematic Strategy (2007)**
- **SoCo Commission Européenne 2007 à 2009 :**
  - http://eusoils.jrc.ec.europa.eu/projects/SOCO/factsheets.html
- **Rapport parlementaire EU Agriculture et changement climatique – S.Le Foll - 2009**
- **FAO : Produire plus avec moins - Guide à l'intention des décideurs sur l'intensification durable de l'agriculture paysanne :**
  - http://www.fao.org/ag/save-and-grow/fr/index.html
  - http://www.earthprint.com/productfocus.php?id=FAO111278

La situation des sols en Europe (Soil Thematic Strategy – 2007, SoCo 2009)

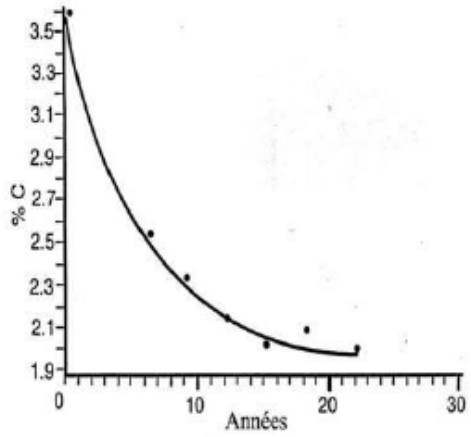
- Menaces sur les sols européens identifiées par Soil Thematic Strategy :
  - Erosion, Compaction, Perte de matière organique, Perte de vie biologique, Pollution, Bétonnage…
- Solutions suggérées par le projet SoCoi: les méthodes de l'Agriculture de Conservation (supprimer la perturbation mécanique et couvrir les sols).
- 99 % des sols européens sont travaillés mécaniquement :
  - France : 1/3 labourés systématiquement,
    2/3 en travail plus ou moins réduit,
    » Seuls 1 % sont en semis direct permanent.
- Promotion politique du travail mécanique en solution de désherbage

Base scientifique de la conservation des sols
(FAO, Amir Kassam & al) :
la perturbation du sol DEGRADE la VIE BIOLOGIQUE et l'HUMUS

HUMUS = C + N

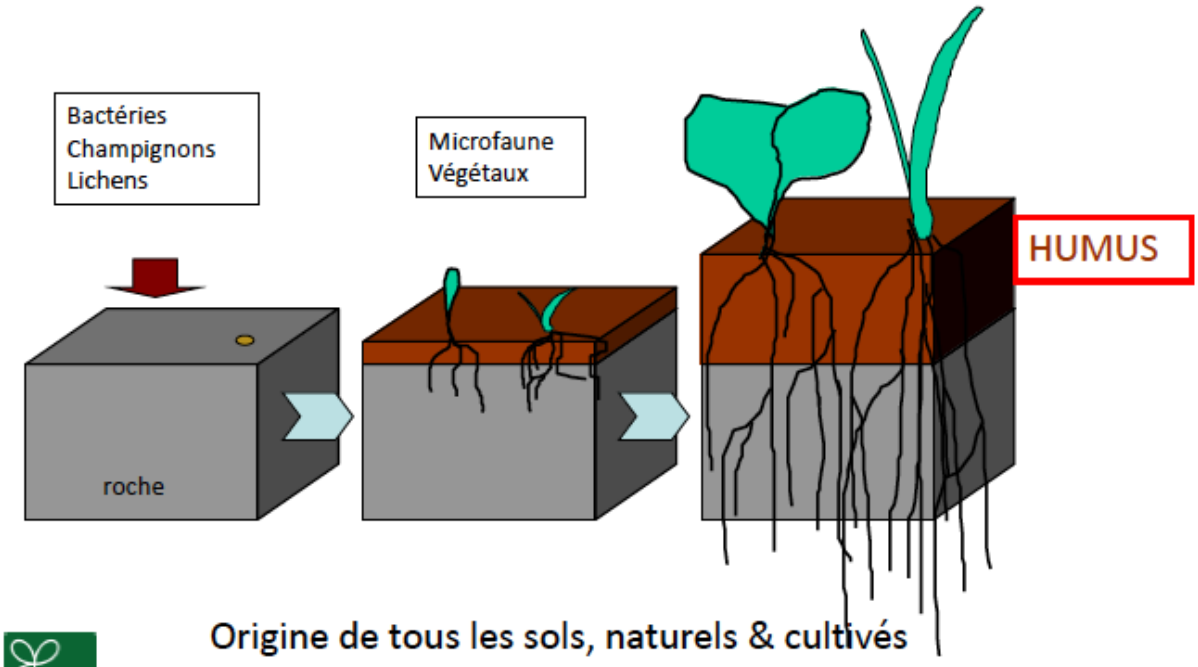
HUMUS + O2 => CO2 + NO3-

effet de serre + nitrates
+ perte d'humus



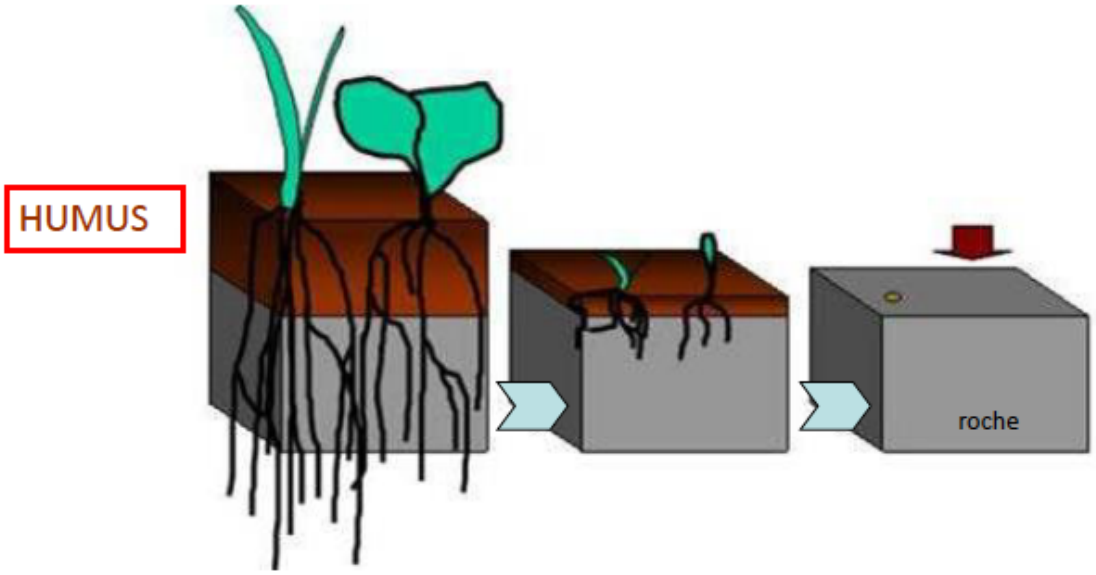
Evaluation des pertes en carbone
après conversion des prairies
en terres cultivées (Johnson 1973)

Formation d'un sol



Origine de tous les sols, naturels & cultivés

Dégradation d'un sol



Perturbation maximale du sol
et destruction des organismes vivants

Le sol est exposé au soleil et à la pluie

On commence par labourer

On fait des mottes

Des mottes bien compactes

Plus on affine plus l'érosion s'intensifie

L'érosion continue tout l'hiver et le printemps

Terre stérile sans matière organique ni vie biologique : compaction, battance… : perte de production, pollutions..

En toute saison, printemps comme hiver, le sol continue de se dégrader

La charrue
« refait la structure »
et enfouit
la végétation

La herse rotative
émiette les mottes
et affine le lit de
semences

Le résultat final est toujours le même

Effets de la dégradation des sols sur l'environnement

- Erosion, MES, pesticides, nitrates, phosphore…
- Perte de biodiversité

Comment on gère en Europe les effets collatéraux de la politique de production

- Nitrates dans l'eau
  => directive Nitrates
- Pesticides dans l'eau, risque…
  => Directive utilisation durable des pesticides
- Qualité écologique des milieux aquatiques
  => Directive cadre sur la qualité de l'eau
- Biodiversité :
  => Directive habitats, verdissement de la PAC (zones de compensation)
- Sol : pas de directive, le dernier souci

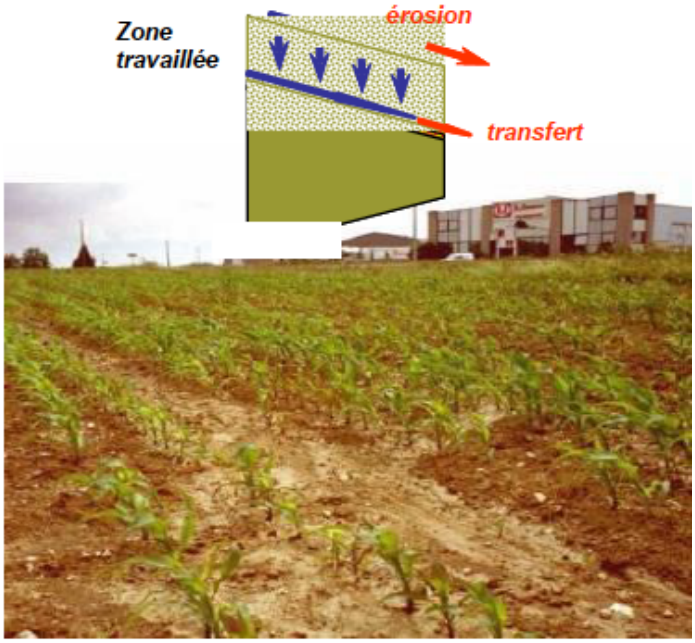
21

Nitrates : impact d'une expertise et d'une réglementation monofactorielle

- Nitrates dans l'eau =>
- Mettre des CIPAN pour capter les nitrates +
- Ne pas employer d'herbicides sur les couverts =>
- Intensifier le travail du sol sur les zones sensibles

- Augmente minéralisation et pertes de nitrates
- Augmente instabilité structurale, érosion, ruissellements P et phytos….

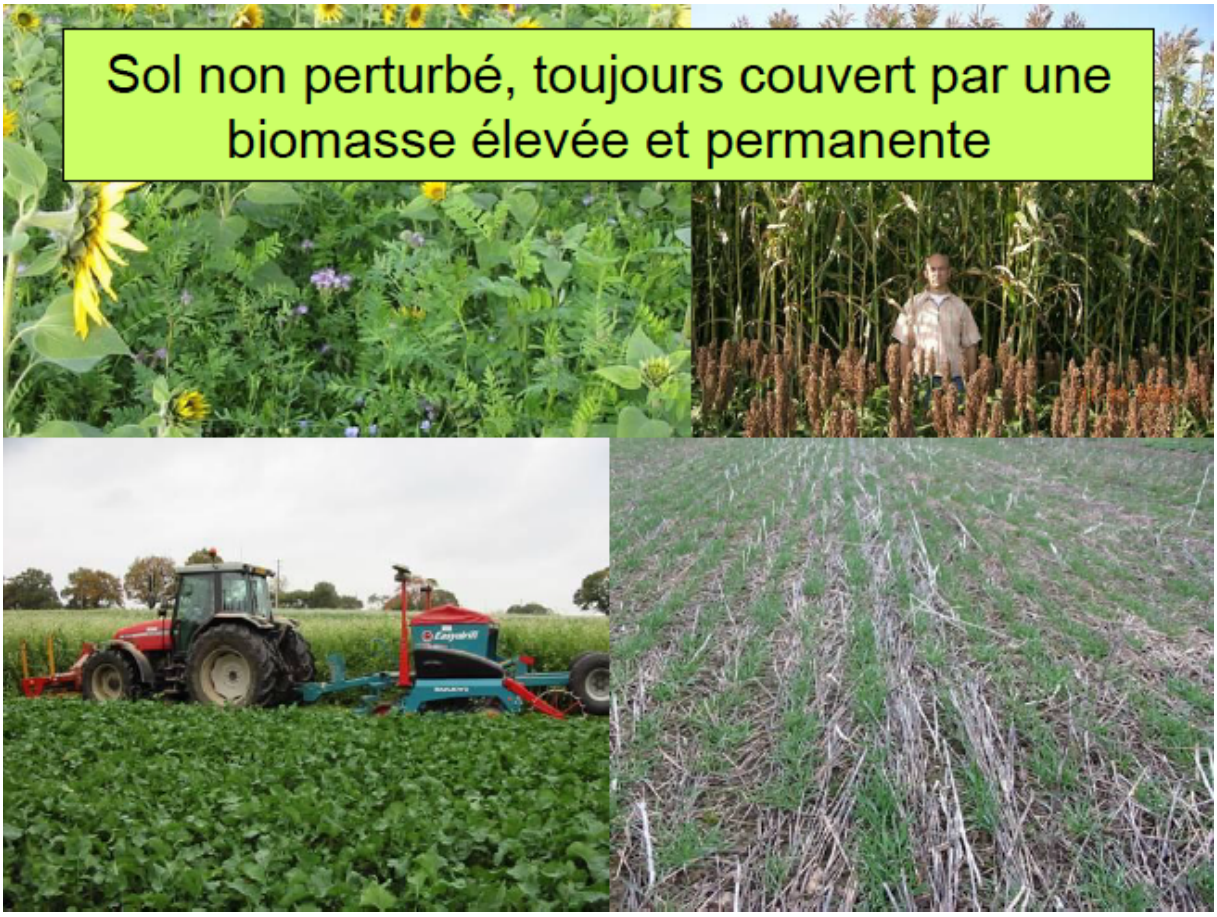
Itinéraire « officiel » CIPAN + mécanique



LABOUR > érosion + nitrates + ruissellements pesticides

L'Agriculture de Conservation (AC)
référence FAO + PNUED + AFD

- **FAO :**
  - **Couverture végétale permanente**
  - **Pas de travail du sol**
  - **Rotations diversifiées**
- **CIRAD : SCV = semis direct sous couverture végétale**
- **NB : Zero-Tillage = No-Till = = Semis Direct**
- **Non pas : « Sans-Labour », TCS = Techniques Culturales Simplifiées**



Mélange de couverts pour faire de la biomasse et protéger la surface contre la pluie et le soleil.

Avec une couverture comme celle-ci, il est impossible d'avoir une érosion du sol ou du ruissellement.

Semis Direct du blé
dans les repousses de colza et de graminées

Semis Direct dans la Phacelie

L'outil qui ne demande pas de fuel pour structurer le sol

Les Vers de terre créent une porosité dans le sol et recyclent la matière organique… **gratuitement !**

Maïs semé en Direct après l'ensilage du seigle

La biodiversité du sol crée une architecture favorable à la bonne gestion de l'eau

Gestion durable de l'eau

- Quantitative :
  - meilleure rétention et restitution (moins de pertes par ruissellement, pas de blocage de la capillarité) :
    - Diminution des inondations
    - Plus de résistance à la sécheresse

- Qualitative :
  - Pas de minéralisation excessive de la MO en NO3-
  - Pas de ruissellement, meilleure rétention dans le sol (MO)
  - Epuration par dégradation biologique des molécules dans le sol

APAD

Effet sur gaz à effet de serre (GES)

- Arrêt du déstockage du C de la MO en CO2
- Stockage de C dans le sol par augmentation de la MO des sols agricoles : puits de carbone
- Augmentation de la biomasse produite et recyclée dans le sol sous forme de MO

- Division par 3 de la quantité de gazole utilisée

- Division de moitié de l'azote minéral (gaz fossile)

APAD

Déstockage de C de la MOS en CO2 atmosphérique

Référence Don Reicosky, Univ Minesota, USDA ~200 g CO_2 m^{-2} en 24 heures

Perte de CO_2 = 419 tonnes = 114 tonnes C en 24 h. !!!

Un passage d'outil = 500 kg de C/ha perdu
= 50 kg de N/ha

Oxyder la matière organique pour perdre la fertilité !

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La biodiversité de l'ensemble de l'écosystème

Les 4 services de l'agriculture

- La production de grain (ou de fibre, ou d'aliment)
- L'eau, qualité + gestion quantitative
- Une biodiversité dans les écosystèmes anthropiques
- Gestion du Carbone, impact climatique et énergies renouvelables

Les 4 s'améliorent EN MEME TEMPS, par les mêmes méthodes de gestion durable des sols

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Quelques résultats chiffrés

- Les scientifiques du Centre de Recherche Conjoint de la Commission Européenne (Joint Research Center) ont étudié l'Agriculture de Conservation entre 2007 et 2009, sur demande de la Commission Agricole du Parlement Européen.
- Les résultats corroborent ceux de l'APAD et de l'ECAF :
  - Environnement : sol, eau, biodiversité, effet de serre,
  - Profitabilité et production.
  - http://eusoils.jrc.ec.europa.eu/projects/SOCO/factsheets.html

Les résultats des agriculteurs qui ont persévéré et réussi au fil des ans
(SoCo + APAD France – Maure de Bretagne (35))

- Rendements maintenus ou améliorés
- Sol et écosystème améliorés :
  - Matière Organique : **+ 1 % en 10 ans**
  - Biodiversité : **Vers de terre X 5**
  - Réduction des pollutions : **NO3 /2**
  - Séquestration C : **1 à 4 tonnes/ha/an**
- Compétitivité augmentée
- Réduction des intrants :
  - Fuel, énergie : **/ 3**
  - Fertilisants : **- 30 %**
  - Chimie : **/ 2**
  - Temps : **/ 2**
  - Argent : **300 €**

Produire Plus

Produire Mieux

En étant plus compétitif

Avec moins

APAD

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Potentiel de production supplémentaire pour l'Union Européenne

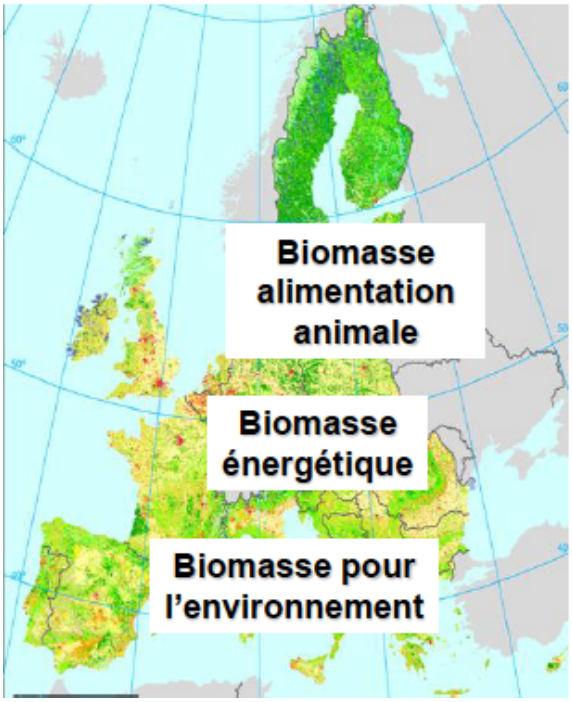
97 millions ha de terres arables Europe (25)
(Source : Agreste. Agriculture)

⇩

Agriculture de Conservation Intensive

sur 50 % surface = 50 millions ha

⇩



Productions Additionnelles :

60 millions tonnes de grains
= 20 millions tonnes de biocarburants de 1ère génération
= 40 millions tonnes de tourteaux, et...

100 millions tonnes de biomasse
= 19 000 mWh de biogaz
Crédits Carbone
= 110 millions tonnes C / an

Valeur : + 80 milliards € /an

Les freins pour les agriculteurs

- Les agriculteurs :
  - Connaissance du sujet
  - Confiance
  - Pressions psychologiques
  - Pas d'intrants appropriés : engrais spécifiques, semences…
  - Pas de soutien pour références ou expérimentations.
  - Réglementations taillées pour le conventionnel
- Les groupes d'intérêts et de pression :
  - Des médias en faveur de l'agriculture biologique
  - ONG, groupes politiques et administration suivent
  - Puis les chercheurs, syndicats, agrofournisseurs et industriels…
- La recherche scientifique :
  - Grande influence envers les politiques
  - Méconnaissance de l'AC, du fonctionnement des sols et des écosystèmes, et du fonctionnement des fermes

Situation et besoins en France

- Double performance ECONOMIQUE ET ENVIRONNEMENTALE
- Protection des SOLS : étude SoCo.., Directive Européenne.., FAO…
- Engouement TCS, SCV, Couverts…., vie biologique des sols…
- L'Agriculture de Conservation se développe ailleurs : 130 M ha…
- En France : 99 % des sols arables temporairement nus et travaillés.
- Politiques publiques et organisations sont équipées pour le conventionnel. Manque de références, prise de risque difficile.
- Besoins : mutualiser les savoirs, créer les références…
- Créer le pont entre les pionniers expérimentés et les agronomes
- Une organisation dédiée à créer ces ponts : l'APAD

Une nouvelle Association pour la Promotion d'une Agriculture Durable

- APAD historique : promotion des TCS, création et appui sur une antenne terrain. Travail en direct avec des agriculteurs motivés.
- Focus sur politiques publiques européennes (LIFE, thématique stratégique sol, SoCo,, rapport parlementaire Le Foll sur changement climatique).
- **Redéploiement depuis 2 ans :**
  - **Agriculture de Conservation (FAO) : SCV, 0 perturbation.**
  - **Politiques publiques européennes : ECAF.**
  - **Politiques publiques françaises : LAA.**
  - **Soutien de la communauté internationale de l'AC (FAO).**
  - **Implantations régionales.**
  - **Partenariats avec l'amont et l'aval : cluster WEST,**

    l'IAD rassemble agriculteurs, fournisseurs, coopératives…

APAD

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Spécificités de l'APAD

- Rassemble les agriculteurs en AC (SCV), et les représente :
  - Fait le lien entre le terrain et le meilleur de l'expérience internationale.
  - Fait le lien avec les opérateurs économiques .
- Développe un savoir-faire spécifique :
  - technique : la mise en œuvre pratique des SCV,
  - opérationnel : mise en place de groupes, diagnostics des situations, agronomique et institutionnelle, analyse des freins, identification et activation des priorités…
- Promeut, en partenariat avec chaque opérateur territorial .

APAD

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Animation technique

- Echange technique en réseau : journée technique Chambres Février 2012, organismes économiques Juin 2013.

- Structuration de l'approche technique pour le compte des groupes (Mission JR Lucas) :
  - Identifier pb techniques, hiérarchiser, proposer réponses adaptées : préconisation, formation, validation / démo, expérimentation / recherche.
  - Etablissement de partenariats avec des fournisseurs de solutions : ceux de l'IAD, les autres…

- Elaboration de protocoles d'étude et de diffusion avec les groupes locaux, les opérateurs et les partenaires techniques.
- Participation à des projets d'études Européens, Casdar, ANR…

APAD

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Formations

- Répondre de manière organisée et cohérente aux besoins de formation :
  - Groupe et réseaux de développement.
  - Partenaires privés, organismes économiques (dont IAD..).
  - Acteurs de l'eau.
  - Ecoles : formation élèves et formations continues.

- Identifier besoins, identifier formateurs, partager supports et contenus pour un tronc commun identifié. Formaliser et contractualiser de façon professionnelle.

- Equipe de formateurs rassemblant les meilleurs metteurs en œuvre pratiques des SCV, mais aussi théoriciens et pédagogues du sol et de l'écosystème, et de l'agriculture durable.

APAD

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Organisation opérationnelle de terrain

- Besoin : se rapprocher des leaders locaux qui veulent participer à l'action nationale et / ou nous demandent de les aider à animer leurs régions. Se rapprocher des acteurs locaux : organismes économiques, organismes publics.
- Deux antennes régionales constituées en 2012 en Associations selon la loi de 1901 :
  - APAD Centre Atlantique
  - APAD Centre Est
- Demandes de groupes locaux d'en créer d'autres. A terme une fédération couvrant le territoire.
- *Partenariat avec tous les acteurs des territoires : besoin d'intermédiation / de spécialistes du dialogue des parties prenantes.*

APAD

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La clé : dialogue sociétal : définir en commun les objectifs de l'Agriculture Durable, et les évaluer ensemble

- Des indicateurs comme outils d'évaluation de la durabilité, et des démarches de progrès à entreprendre,
  - pour soi comme agriculteur,
  - pour dialoguer avec la société.
- Une plateforme de création commune de la Durabilité dans le système de production : agriculteurs, amont, aval

APAD

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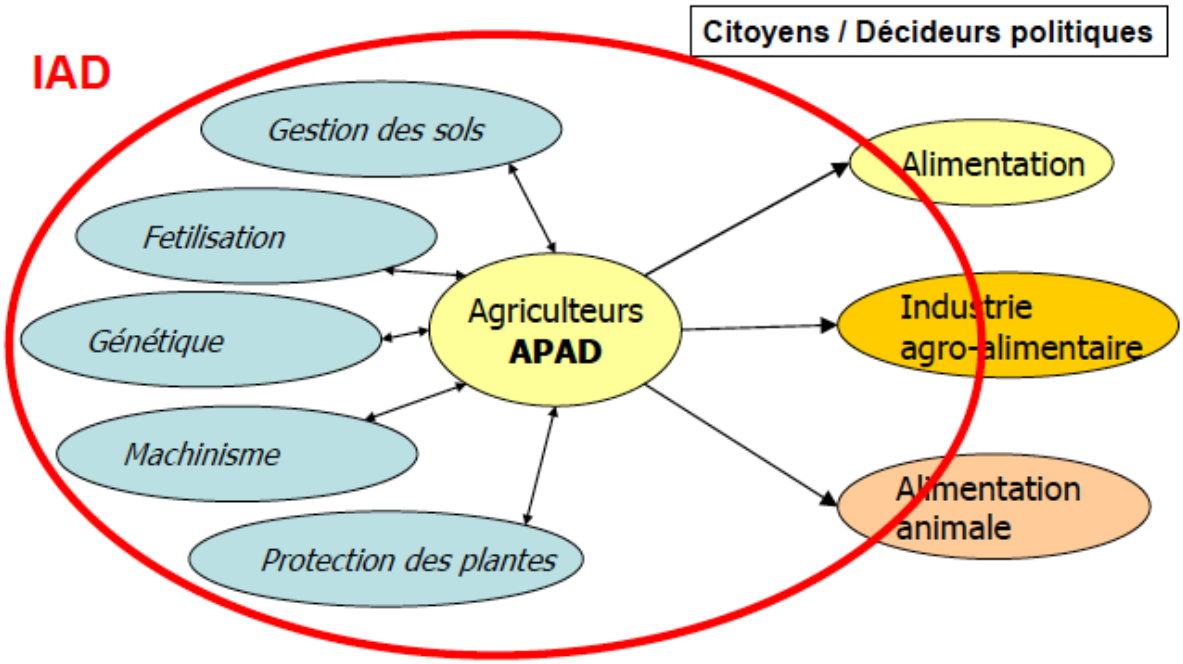
IAD = une initiative collégiale pour développer et faire connaître cette Agriculture Durable

IAD = Institut de l'Agriculture Durable

- 100 % privé, 80 agriculteurs, associations, entreprises, coopératives

- Des Indicateurs d'Agriculture Durable validés par 160 agriculteurs, en cours de déploiement sur plateforme internet IndicIADes
- Un rapport « l'Agriculture de 2050 commence maintenant »
- Des Rencontres Internationales de l'Agriculture Durable
  - Janvier à Paris : FAO, experts internationaux, thématique : Paiement des Services Ecosystémiques : eau, biodiversité, climat…

Toutes les parties prenantes sont concernées par l'Agriculture Durable



Institut de l'Agriculture Durable

INSTITUT DE L'AGRICULTURE DURABLE

APAD

NEW HOLLAND AGRICULTURE

groupe nouricia

SEMEATO

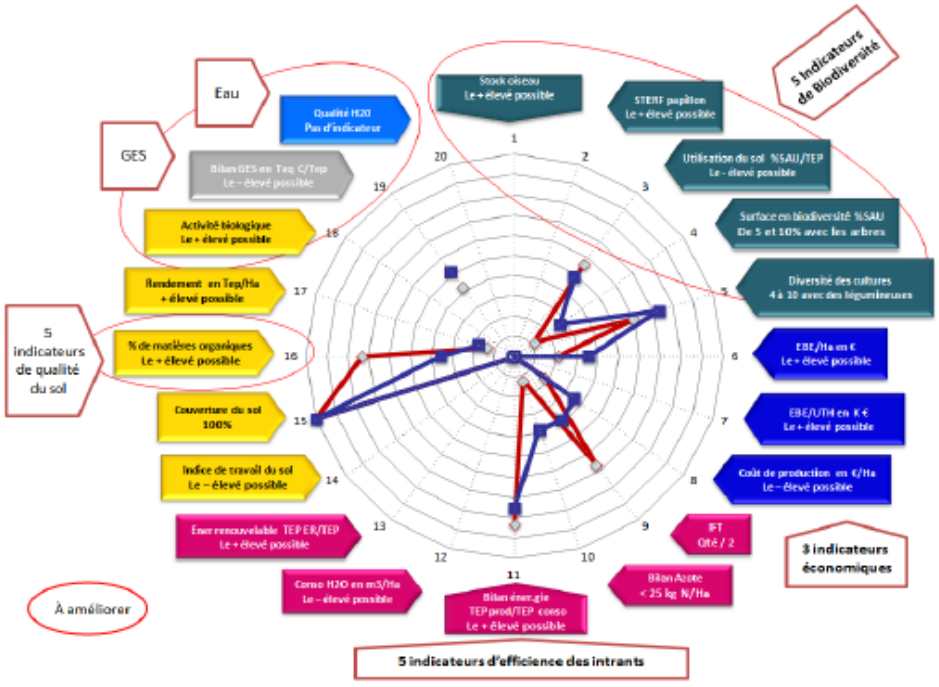
syngenta

PRP TECHNOLOGIES

BERTINI

MONSANTO imagine

Les indicateurs de l'Agriculture Durable servent à fixer sur les fermes les objectifs de progrès communs, et à les mesurer



APAD

Spécificité des indicateurs de l'IAD

- Issus d'un benchmark international, basé sur l'occurrence / pertinence pour les agriculteurs acteurs.
- Ont été co-construits entre les agriculteurs et les meilleurs experts et scientifiques internationaux.
- Utilisables sur leurs fermes par les agriculteurs eux-mêmes, en auto gestion.
- Evaluent surtout des résultats, et non seulement les moyens mis en œuvre selon des normes).
- Sont mesurables et ont du sens à l'échelle de la ferme.
- Directement liés aux pratiques, dans une approche système.
- S'emploient simultanément, de façon systémique, pour un résultat global du système.
- Permettent de mesurer ses propres progrès par rapport à ses objectifs, mais aussi de dialoguer avec citoyens et représentants.

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Références

- **IAD : rapport « L'Agriculture de 2050 commence maintenant »:**
  - http://www.institut-agriculture-durable.fr/images/fichier/79_L-agriculture-de-2050-commence-maintenant-FRANCAIS.pdf
- **World Congress of Conservation Agriculture, Brisbane 2011 : public policies for sustainable agriculture - FAO**

Merci de votre attention

www.apad.asso.fr

Gérard Rass gerard.rass@apad.asso.fr

06 07 40 42 59

13.11 Annex 11 - Public policies for facilitating transition towards sustainable soil management in the Swiss canton of Berne

Public policies for facilitating transition towards sustainable soil management in the Swiss canton of Berne

SNOWMAN NETWORK – Integration workshop in Paris, 17 June 2013

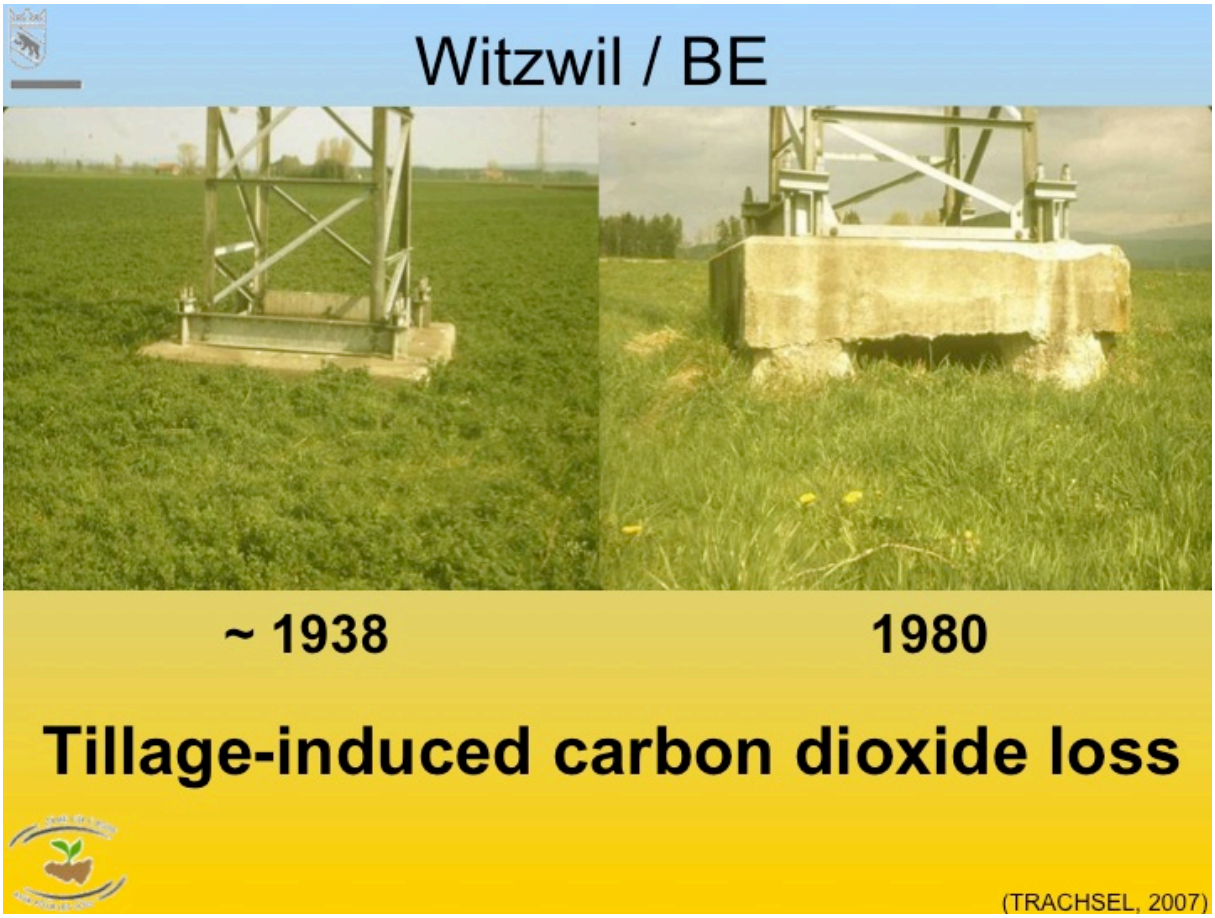
Wolfgang G. STURNY

Bernese Office of Agriculture and Nature, Soil Conservation Service, Zollikofen

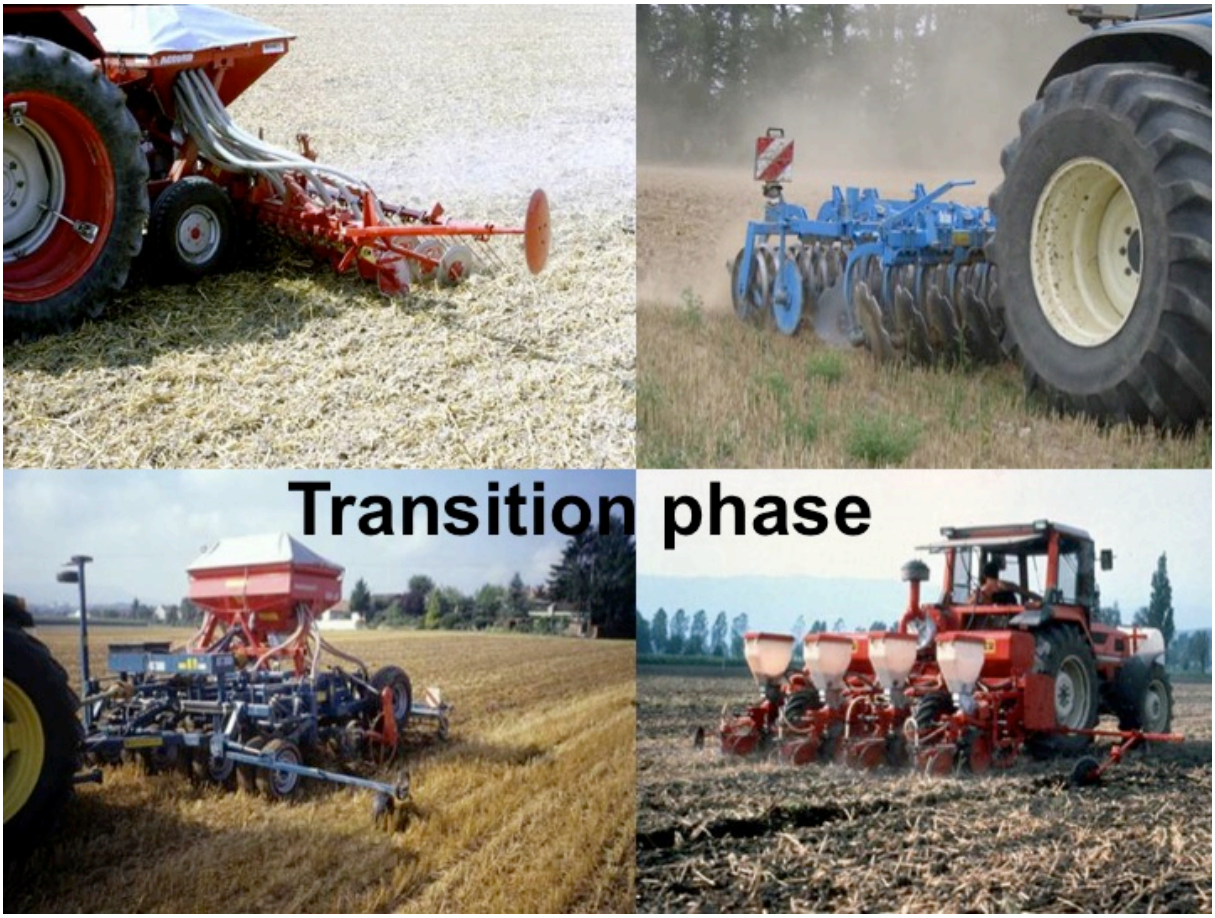
Contents

- Agricultural mechanization – problems and crucial experiences
- „Oberacker“: a long term demonstration field experiment (*no-tillage vs. plough*)
- Promotion of soil conservation tillage systems – including farmer to farmer‘s incentive program
- Conclusions & outlook

Agricultural mechanization – problems and crucial experiences


Witzwil / BE
~ 1938
1980
Tillage-induced carbon dioxide loss
(TRACHSEL, 2007)


High tillage intensity causes soil erosion: CH = 840‘000 t / year
(PRASUHN, 2009)

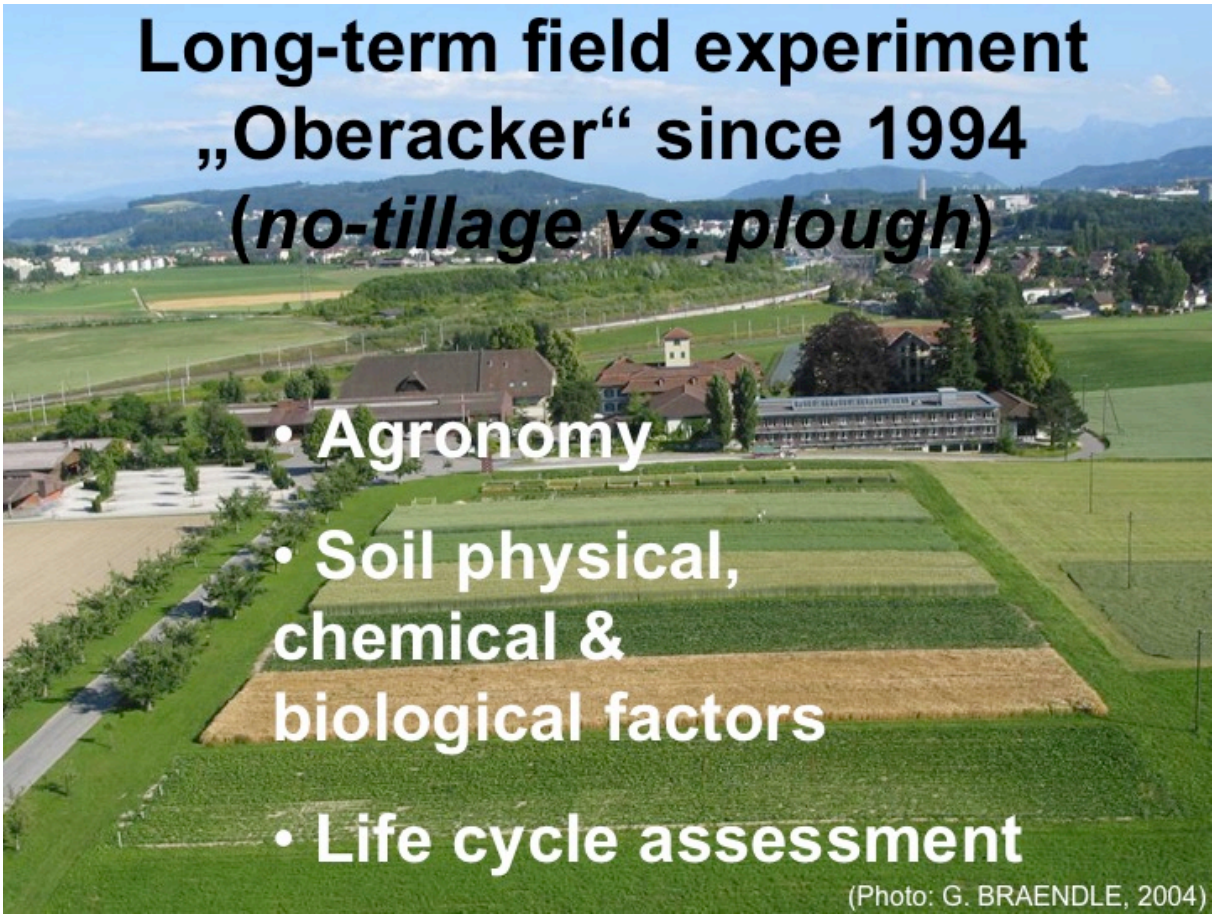

Transition phase


ALTHAUS
Maize strip tillage

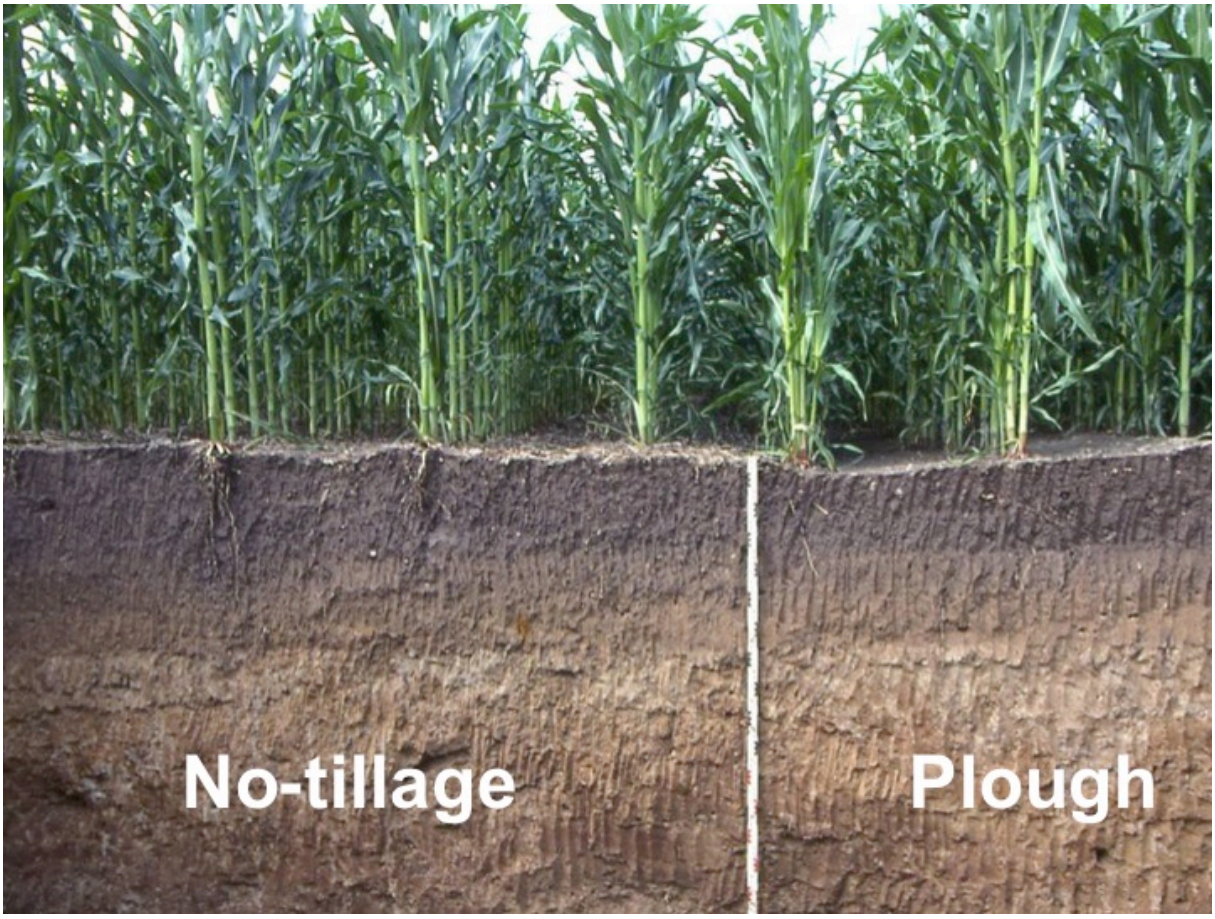
Definition of a no-tillage system

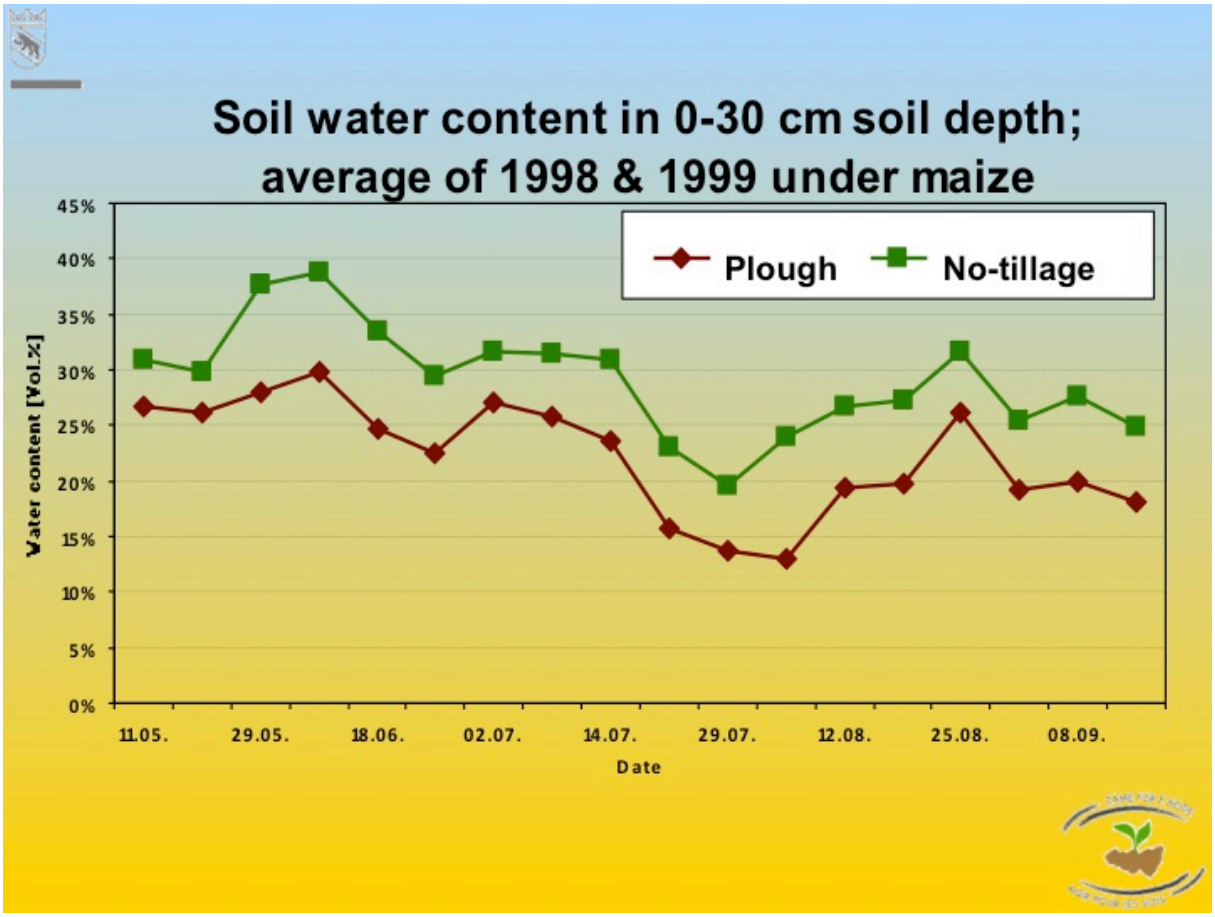
NO-TILLAGE is a cropping system, in which seed is placed directly into an untilled soil covered by plants or plant residues – without any previous soil cultivation.

By means of special openers such as a disc, hoe or cross slot just a slot is opened in the soil and closed instantaneously after seed placement. No more than 50% of the soil surface is being disturbed during the direct seeding operation. Fertilizer can be placed in the soil at the same time.

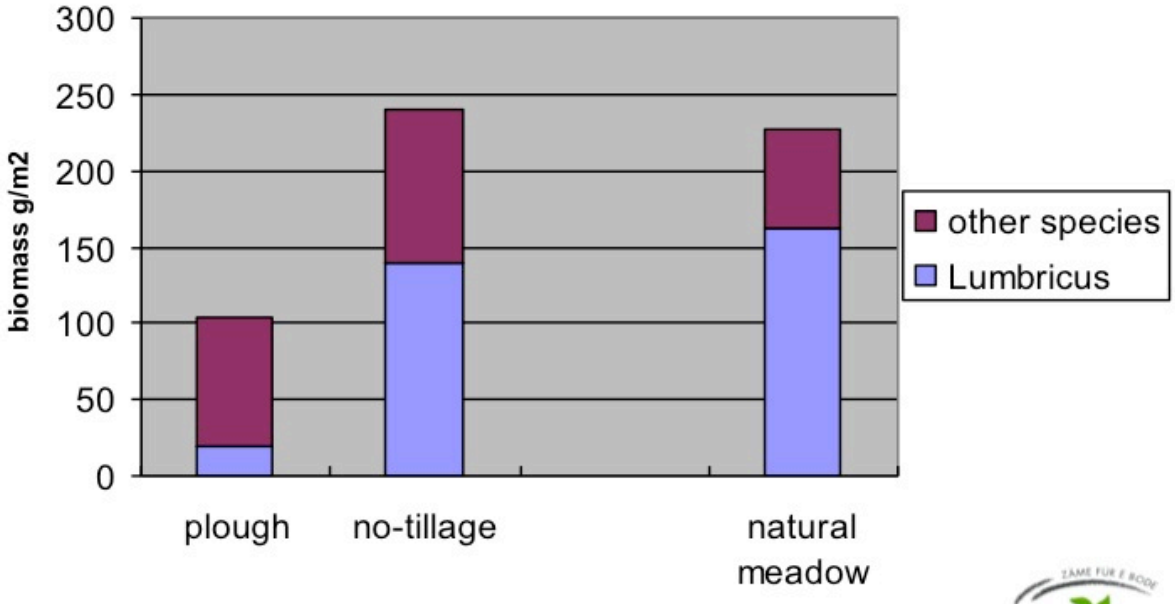

Long-term field experiment
„Oberacker“ since 1994
(*no-tillage vs. plough*)
• Agronomy
• Soil physical, chemical & biological factors
• Life cycle assessment
(Photo: G. BRAENDLE, 2004)


Zollikofen


No-tillage
Plough

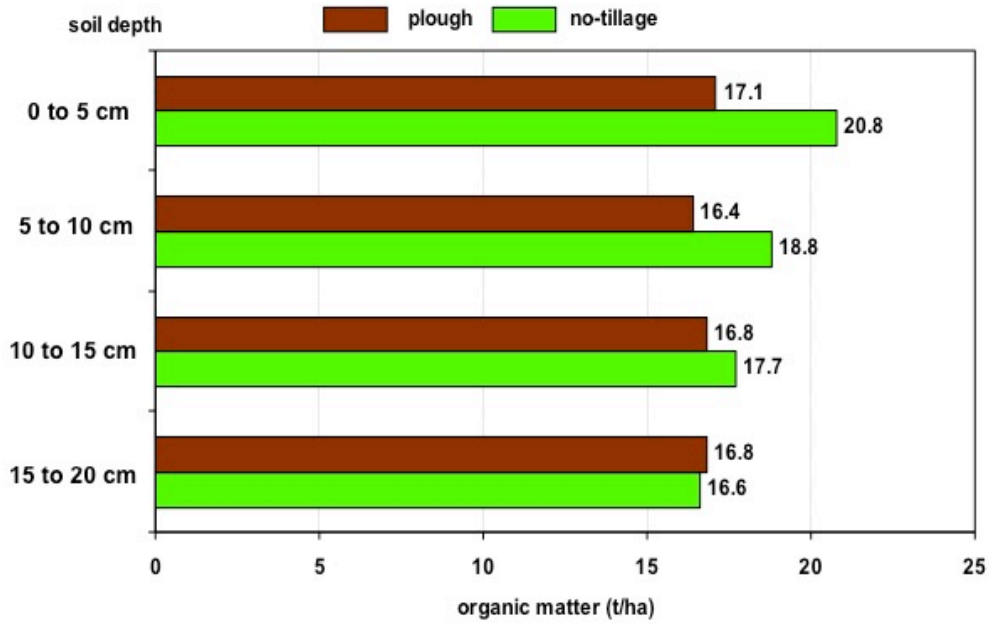

Soil water content in 0-30 cm soil depth;
average of 1998 & 1999 under maize
Plough
No-tillage
Water content [Vol.%]
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
11.05.
29.05.
18.06.
02.07.
14.07.
29.07.
12.08.
25.08.
08.09.
Date

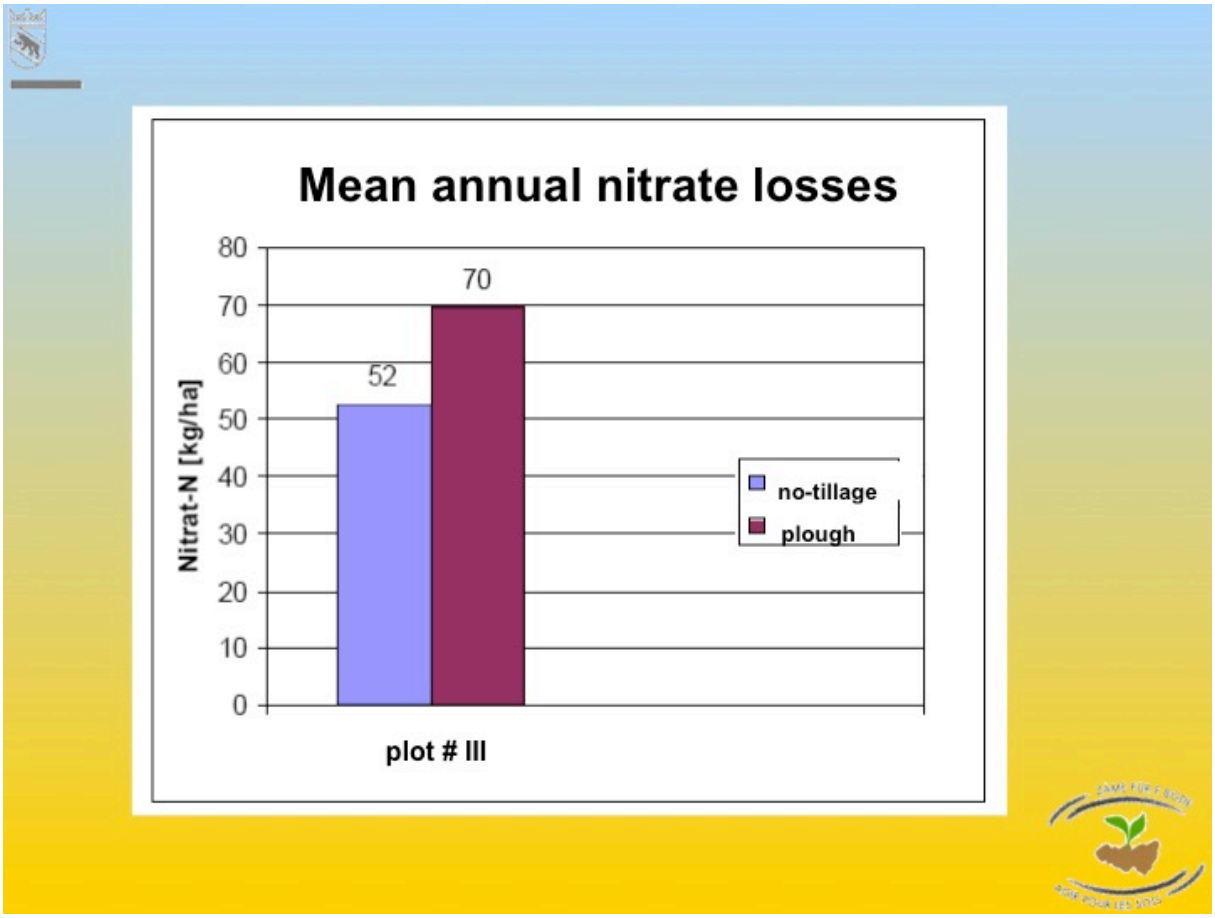
Earthworm population

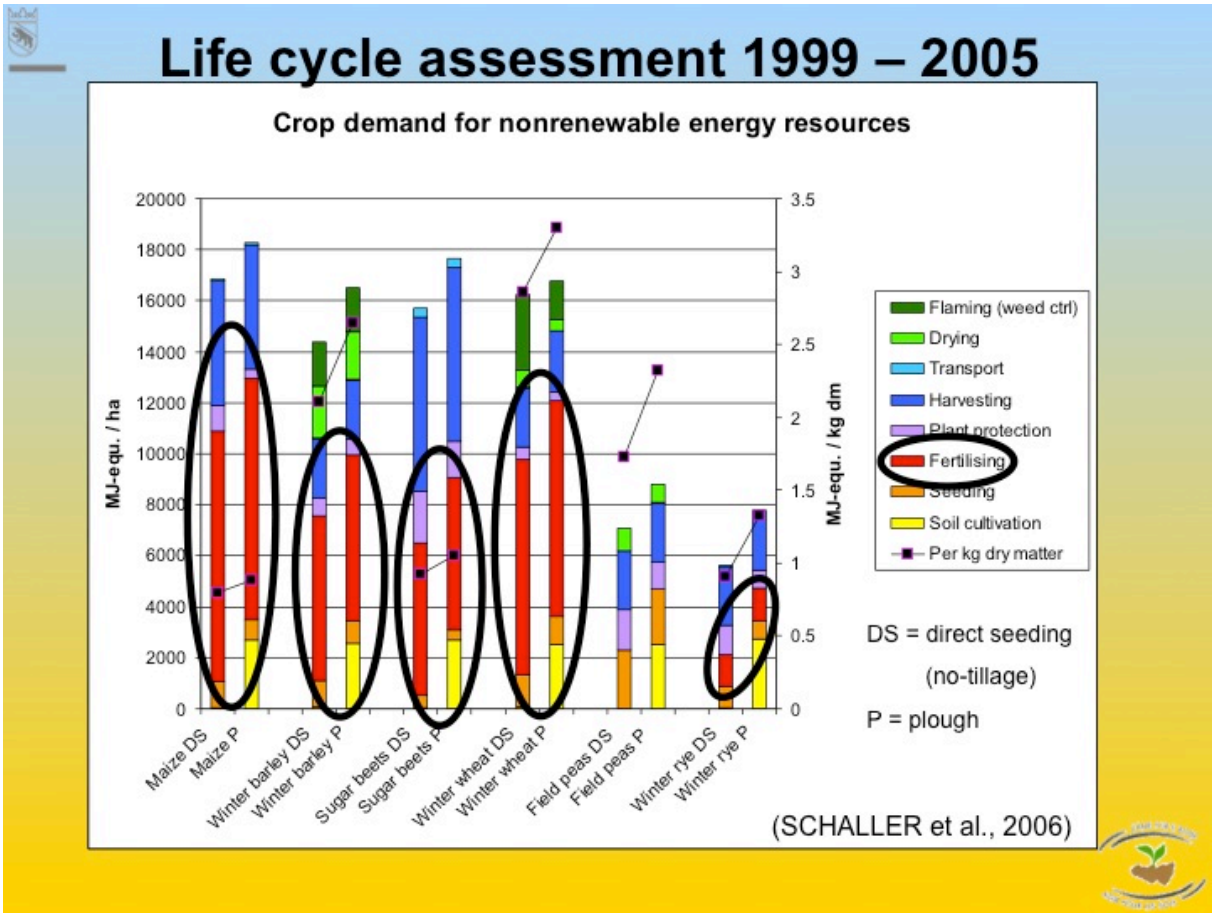


Organic matter content

(after 5 years)




Mean annual nitrate losses
Nitrat-N [kg/ha]
80
70
60
50
40
30
20
10
0
70
52
no-tillage
plough
plot # III


Life cycle assessment 1999 – 2005
Crop demand for nonrenewable energy resources
MJ-equ. / ha
MJ-equ. / kg dm
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
3.5
3
2.5
2
1.5
1
0.5
0
Flaming (weed ctrl)
Drying
Transport
Harvesting
Plant protection
Fertilising
Seeding
Soil cultivation
Per kg dry matter
Maize DS
Maize P
Winter barley DS
Winter barley P
Sugar beets DS
Sugar beets P
Winter wheat DS
Winter wheat P
Field peas DS
Field peas P
Winter rye DS
Winter rye P
DS = direct seeding
(no-tillage)
P = plough
(SCHALLER et al., 2006)

Promotion of soil conservation tillage systems

SWISS NO-TILL

Swiss soil conservation association

= platform for knowledge exchange

Schweizerische Gesellschaft für bodenschonende Landwirtschaft
Association suisse pour une agriculture respectueuse du sol
Associazione svizzera per un' agricultura rispettosa del suolo
Swiss soil conservation association

General Situation: *Members*

- 340 members
  (mainly farmers and contractors, but also extension people, research workers, and teachers)
- 7 members of the executive committee
  (trimonthly meetings)
- 18 members of a steering committee
  (1 annual meeting)
- Office:
  Regula Schwarz, Oberdorf 7, CH-2514 Ligerz
- http://www.no-till.ch

Activities: *Events*

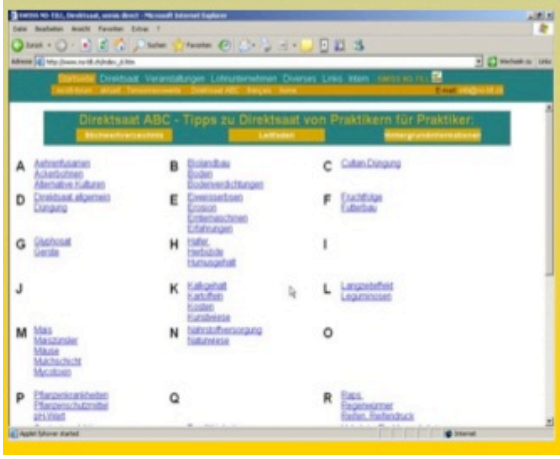
- General assembly
- Annual Meeting (~150 attendees)

Main Speakers: 1996 Friedrich Tebrügge, Germany
2003 Frédéric Thomas, France
2005 Guy Lafond, Canada
2006 Christian Linke, John Deere
2007 Rolf Derpsch, Paraguay
2009 Alfred Gässler, Semeato
2010 Dietmar Näser, Germany
2011 Dirceu Gassen, Brazil
2012 Frédéric Thomas, France
2013 Jana Epperlein, Germany

- 2 official field days in June
  (in German and in French)
- A few more field days in September,
  organized by members of SNT

Activities:
Dissemination of a no-till ABC

- Collection of farmer‘s no-till experience
- 19 interviews with members of SWISS NO-TILL
- Published on internet
  (http://www.no-till.ch/direktsaat/ABCStichwortverzeichnis.htm)
- Partner project with the Bernese Soil Conservation Service; Agroscope ART; ITADA



Activities: *Research projects*
Comparison of 5 corn planters for no-till (3-year program)

Name: Cross-Slot (Prototyp)
Säschar: Cross-Slot - Schar
Düngung: Unterfussdüngung im Cross-Slot - Schar integriert
Vereinzelung: John Deere
Besitzer: Wyss & Lauper AG
3266 Wiler

Name: FAL/mNT - Amazone (Prototyp)
Säschar: Zinkenschar mit Oeffnungsscheibe
Düngung: Zinkenschar
Vereinzelung: Amazone
Besitzer: Agroscope FAL Reckenholz
8046 Zürich

Name: Alphatec/Kinze (Prototyp)
Säschar: Doppelscheiben-Säschar (Kinze)
Düngung: Ausbringung über Wellenscheiben
Vereinzelung: Kinze
Besitzer: Peter Wyss
3063 Ittigen

Name: John Deere MaxEmerge (Serienmaschine)
Säschar: Doppelscheiben-Säschar (John Deere)
Düngung: Unterfussdüngung mit Einscheiben-Schar
Vereinzelung: John Deere
Besitzer: Wyss & Lauper AG
3266 Wiler

Name: Semeato (Prototyp)
Säschar: Doppelscheiben-Säschar (Semeato)
Düngung: Unterfussdüngung mit Einscheiben-Schar (Guillotine, Semeato)
Vereinzelung: Nodet
Besitzer: Migamo, Stephan Minder
4938 Rohrbach

Knowledge transfer (field days, consulting)

Contributions for conservation tillage in Swiss cantons

Canton	Project	Measures	Contribution
Aargovie	Decree for the support of no-tillage in nitrate-susceptible regions	• **Contributions for no-tillage of grassland, maize, winter cereals, and maize strip tillage** • **Maximum 10 ha/farm** • **Contributions according to crop and soil tillage treatment** • **Contract period: 1 year**	**135-400 €*ha^{-1}y^{-1}**
Berne	Decree for the retention of life basics and cultural landscape	• **Promotion of minimum and no-tillage in nitrate-, erosion- and compaction-susceptible regions** • **Contract period: 5 years, minimum 2 years of no-tillage** • **Contributions according to crop and soil tillage treatment**	**135-335 €*ha^{-1}y^{-1}**
Lucerne	Decree for the support of strip and no-tillage to reduce erosion and phosphorus run-off into waters	• **Promotion of no-tillage for all crops and maize strip tillage** • **Contract period: 1 year or 3 years (higher contributions)**	**135-335 €*ha^{-1}y^{-1}**

1 910.112

5 novembre 1997

Ordonnance sur la préservation des bases naturelles de la vie et des paysages (OPBNP)

Le Conseil-exécutif du canton de Berne,

vu les articles 41, 44 et 51 de la loi cantonale du 16 juin 1997 sur l'agriculture (LCAB),

sur proposition de la Direction de l'économie publique,

arrête:

1. Objet

Article premier La présente ordonnance contient les dispositions d'exécution de la loi cantonale sur l'agriculture (LCAB) dans le domaine de la préservation des bases naturelles de la vie et des paysages.

2. Protection du sol dans l'agriculture

Art. 2 [1]Le Service de la protection des sols peut en allouant des aides financières encourager la conversion des exploitations aux méthodes du semis direct, du semis en bande fraisée ou du semis direct sous litière.

[2] Il peut s'engager par voie contractuelle à verser aux exploitants et exploitantes des subventions à la conversion pendant cinq ans et des indemnités pour les frais qu'ils encourent pour faire effectuer par des tiers les contrôles d'érosion et de teneur en nitrates.

[3] Les subventions à la conversion s'élèvent à 600 francs au plus par hectare et par an; elles sont modulées en fonction du type et des méthodes de culture.

[4] Les contrats par lesquels le Service de la protection des sols s'engage à verser des subventions à la conversion sont conclus selon un ordre des priorités qu'il détermine, étant prises en compte en premier lieu les exploitations situées dans une région comportant des risques particuliers en raison de la teneur particulièrement élevée du sol en nitrates, du danger de compactage ou d'érosion, ou dans le bassin d'une zone de protection des eaux souterraines ou d'eaux de surface polluées.

[5] Après la phase de conversion de cinq ans, le Service de la protection des sols peut verser d'autres subventions dans le cadre d'un contrat de relais de cinq ans afin d'assurer la permanence des fonctions du sol dans les régions mentionnées au 4e alinéa et de garantir la qualité de l'eau selon les critères établis. Ces subventions se montent à 500 francs au maximum par hectare et par an.

Annexe 3 au contrat de conversion

Indemnités pour la phase de conversion

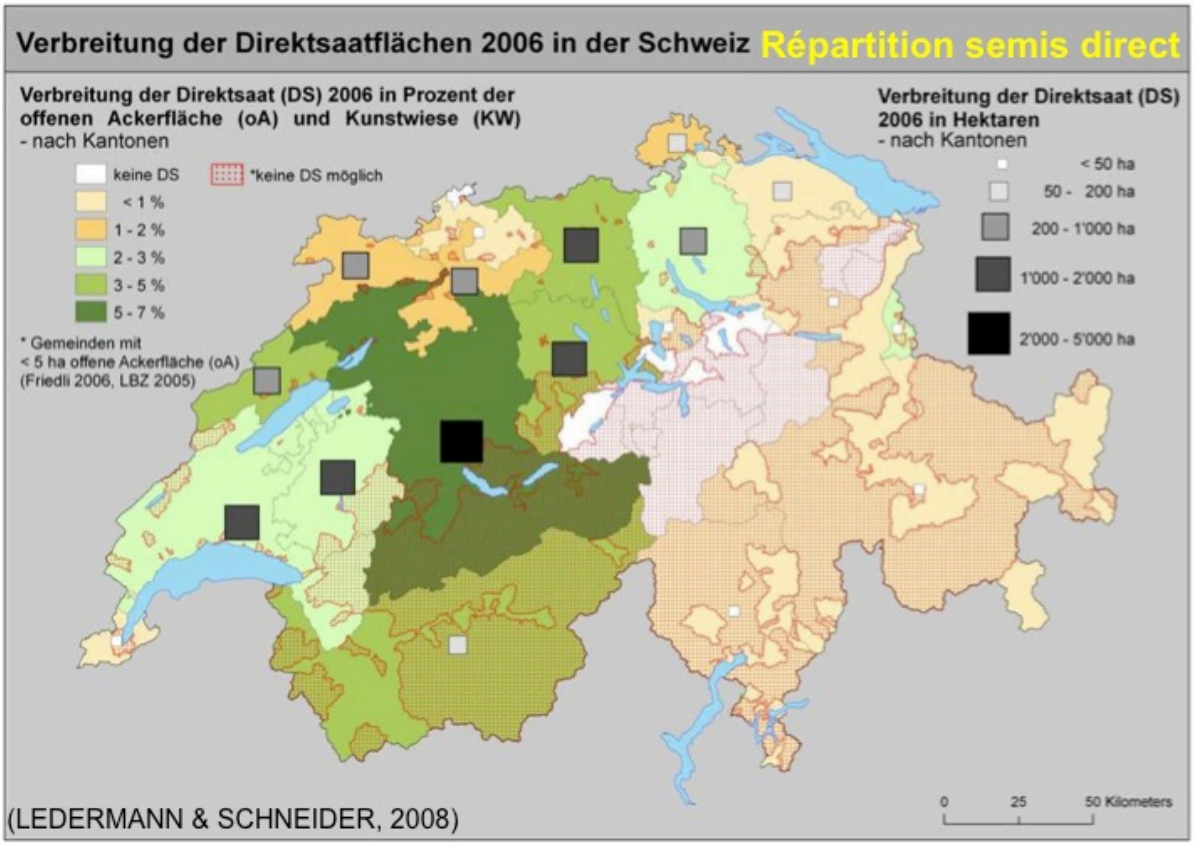
Exigences : - aucun labour
- 2 semis direct en 5 ans
- < 50% de sol „remué“

Cultures	Variante de transition semis sous litière	Variante-cible semis direct
	Frs par ha & année	Frs par ha & année
1 Céréales d'automne	150	300
2 Céréales de printemps	150	300
3 Colza d'hiver/de printemps	300	500
4 Maïs semé en bande fraisée	450	
5 Maïs d'ensilage/maïs-grain	300	500
6 Pommes de terre	500	600
7 Betteraves sucrières/betteraves fourragères	350	550
8 Pois protéagineux, soja, féverole	250	400
9 Prairie artificielle, jachère verte	0	200
10 Tournesols	300	500
11 Autres cultures après accord écrit spécial avec le Service environnement et agriculture		

OPBNP – semis sous litière et semis direct : état à fin 2009

année	nombre d'exploitations sous contrat (n)	superficie sous contrat (ha)	dont cultures principales semées sous litière (ha)	dont cultures principales en semis direct (ha)	paiements (CHF)
1996	91	339	126	39	127'927.00
1997	147	712	280	273	265'938.00
1998	191	877	329	494	276'526.00
1999	263	1'258	362	804	321'393.00
2000	360	1'709	439	1'067	412'263.50
2001	445	2'269	463	1'436	550'325.20
2002)*	445	2'437	477	1'563	602'853.05
2003)*	458	2'485	472	1'436	602'124.75
2004)*	437	2'513	455	1'471	607'564.95
2005)*	420	2'535	372	1'588	624'557.95
2006)*	420	2'519	426	1'593	635'998.35
2007)*	415	2'426	455	1'568	621'263.65
2008)*	443	2'628	481	1'526	659'707.00
2009)*	425	2'601	564	1'436	609'342.65
Total					6'919'471.15

**) Plafond de CHF 600'000.- bloqué à partir de 2002 (listes d'attente)*





Programme de promotion des sols du canton de Berne

2009 – 2015

http://vol.be.ch : «Agriculture & Nature (OAN)»
➔ «Agriculture»
➔ «Protection des sols»
➔ «Programme de promotion des sols»

Loi fédérale du 29 avril 1998 sur l'agriculture

Programme Ressources (dès 2008)

Art. 77a et 77b

•Contributions à des projets régionaux et à des projets spécifiques à une branche qui sont destinés à rendre l'utilisation de ressources naturelles plus durable

•L'OFAG (Office fédéral de l'agriculture) participe aux dépenses imputables à raison de 80% au maximum

•Le soutien de l'OFAG à titre d'aide initiale est limité à 6 ans

•Le programme est volontaire

Coûts totaux CHF 60 Mio. : participation Confédération = $^3/_4$; canton = ¼

Principe des 3 piliers

Formation et vulgarisation	Catalogue de mesures	Monitoring & contrôle
Visites de cultures Cours de perfectionnement Projet «De paysans à paysans» (principe de base)	Buts environnementaux Mise en œuvre volontaire Possibilités de choix Contributions incitatives	Monitoring sur des exploitations pilotes: - Protection du sol - Protection des plantes - Pureté de l'air (régional) Contrôle de l'application des mesures
Buts: Transmettre les nouvelles connaissances Echanger les expériences	**Buts:** Collecter les expériences acquises Adapter la production	**Buts:** Mettre les effets en évidence Garantir la transparence

3 domaines de mesures

Travail de conservation du sol	Entretien du sol et mesures culturales	Epandages réduisant les pertes d'ammoniac
		
1) Semis sous litière 2) Semis en bandes fraisées ou semis direct 3) Labour hors raie (peu profond)	4) Rotation des cultures 5) Enherbement hivernal 6) Sous-semis 7) Renoncer aux herbicides 8) Compostage du fumier	9) Rampe à pendillards 10) Train de roulement ménageant le sol

Mesures de protection du sol et de valorisation de l'azote

	N°	Mesure		Attestation de qualité pour les contributions incitatives		Indemnité en CHF/an	
		**Systèmes de culture ménageant le sol** (Domaine de mesures I)		**Contributions seulement si toute la surface cultivable (y compris prairies artificielles) de l'exploitation est sous contrat**	Annexe I	Exploitation PER	Exploitation BIO
	1	Semis sous litière	*Renoncer au labour pendant toute la durée du contrat (exception n° 3)*	• Selon définition semis sous litière • «Test de la pièce de 5 francs» après semis ou plantation		150.-/ha	225.-/ha
	2	Semis sur bandes fraisées ou semis direct		• Selon définition semis sur bandes fraisées ou semis direct		300.-/ha	450.-/ha
	3	Charrue hors raie		• Profondeur maximale 15 cm • «Test de la pièce de 5 francs» après semis ou plantation (illustration en annexe)		150.- seult combiné au n° 7	150.-/ha
		**Régénération du sol et mesures relatives à la culture** (Domaine de mesures II)		**Contributions par ha ou t**	Annexe II		
	4	Rotation		• Au moins 6 cultures principales • Seules les prairies artificielles d'au moins 2 ans et/ou légumineuses donnent droit à une contribution		200.-/ha PA et/ou légumineuses	200.-/ha PA et/ou légumineuses
	5	Couverture hivernale du sol		• Mesure subséquente au plus tôt 21 jours avant la culture de printemps • Couverture d'au moins 30% du sol avant mesure subséquente (illustration en annexe)		200.-/ha	200.-/ha
	6	Sous-semis		• Au moment de la récolte de la culture principale, le sous-semis doit être visible sur toute la surface (illustration en annexe)		200.-/ha	200.-/ha
	7	Renoncer aux herbicides		• Durant l'année de récolte, c'est-à-dire depuis la récolte de la culture précédente jusqu'après la récolte de la culture principale		300.-/ha	--
	8	Compostage du fumier		• Selon directives de l'annexe II • Le fumier frais effectivement composté donne droit à une contribution, à raison de 20 t par ha et par an au maximum		20.-/t ou 10.-/m³	20.-/t ou 10.-/m³
		**Systèmes d'épandage réduisant les pertes d'ammoniac** (Domaine de mesures III)		**Contributions au maximum pour 4 apports par ha et par année**	Annexe III		
	9	Purinage par tuyaux	*Rampe à pendillards, distributeur à tuyaux semi-rigides avec socs ou enfouissement du lisier*	• Purinage par tuyaux depuis la fosse à lisier ou le bord du champ		80.-/ha et apport	80.-/ha et apport
	10	Véhicules et machines ménageant le sol		• Circulation sur le sol avec citerne à pression dans le champ • Attestation de qualité dès 5 t de charge maximale par essieu		60.-/ha et apport	60.-/ha et apport

http:// www.vol.be.ch

Test de la pièce de 5 francs

Déployer un double mètre sur le sol de façon à ce qu'il forme un rectangle de 40 x 60 cm. Placer une pièce de 5 francs à l'intérieur.

Combien y a-t-il de mottes plus grosses que la pièce de 5 francs ?

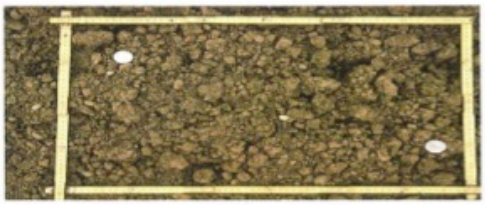
Observation
Plus de 20 mottes d'une taille supérieure à la pièce de 5 francs. Plusieurs mottes plus grosses que le poing.

Appréciation
Lit de semence très grossier. On peut tolérer un tel lit de semence pour :
- les céréales d'automne,
- le maïs (en conditions humides).

Conseil
En conditions sèches, rouler avant le passage du semoir.

Observation
Environ 20 mottes d'une taille supérieure à la pièce de 5 francs. Quelques mottes dépassent la grandeur du poing.

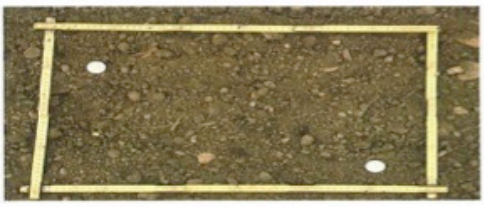
EXIGENCE



Appréciation
Lit de semence idéal. La terre fine assure une bonne levée et les mottes protègent la surface du sol contre l'érosion. Conditions optimales pour toutes les cultures à mettre en place.

Exigence

Observation
Pratiquement aucune motte plus grosse que la pièce.



Appréciation
Lit de semence trop fin. Un tel lit de semence favorise la battance, le croûtage et l'érosion. Ce sol est menacé.

(Source : Service romand de vulgarisation agricole, janvier 2001)

Manuel de contrôle Programme de promotion du sol Canton de Berne

Version avril 2013

Internet:
www.ipringe.ch
www.be.ch/Bodenschutz

Version avril 2013

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Conclusions & outlook

To plough or to no-till?

(John Deere Agri Services, 2006)

Farmer to farmer incentive program

« De paysan – à paysan »

Wissensmanagement Umwelt

Patricia Fry

Projet de recherche et de diffusion d'expériences paysannes favorables à une exploitation durable du sol

Bénéficier des acquis d'autres agriculteurs

- Les agriculteurs qui mettent en application une protection mécanique du sol dans leur exploitation possèdent un savoir-faire spécifique.
- Le savoir transmis par des agriculteurs sera plus facilement reçu par les autres agriculteurs (cf. Davenport & Prusak 1998).

Une nouvelle approche «de paysan – à paysan» favorise la protection mécanique du sol dans l'agriculture

- Recherche du savoir acquis par les paysans en matière de protection du sol
- Diffusion du savoir par le biais du cinéma et des réseaux paysans

Extraits du film pilote «De paysan – à paysan»

Langue et ...
«Le sol ressemblait à du Nidelkäse qu'on aurait jeté au sol.»
Minder, Rohrbach

... métaphore
«Ce sol est comme de la cendre.»
Minder, Rohrbach

Processus d'apprentissage
«Quand j'ai semé directement la première fois, j'étais méfiant. Nous avons commencé par du blé d'automne. Au début, je pensais que la semence mourrait. Et j'ai été surpris de voir que ça poussait. Le blé est aussi beau que ce colza.»

Arguments
«Avec le semis direct, on a un système qui permet d'abord de produire meilleur marché et ensuite de ménager le sol. Je suis convaincu à 100% que le semis direct est une bonne chose.»

Expériences positives
Les réseaux comme les inspections de champs, les associations locales et les Communautés de machines agricoles se prêtent parfaitement à la diffusion

Farmer to farmer approach to bridge the gap between agricultural & environmental institutions:

- accompanying group with all actors
- short films in collaboration with actor groups
- triggering discussions within farmer networks & policy makers: farmers can take up arguments much more easily from successful colleagues
  - => same profession
  - => same culture
  - => same language

Conclusion (1)

- Effective knowledge and technology transfer using the scientific and practical expertise from the whole range of agro-climatic regions across Europe: this is where ECAF excels with their National Associations
- Extend existing incentive programs for Conservation Agriculture (CA) with already existing agro-environmental measures
- Establish a network of CA demonstration farms with special focus on crop rotation and cover crops – where possible

Conclusion (2)

- Field days/visits including practical hand-on farmer demonstrations (e.g. yearly national festival for non-inversion and no-tillage in France)
- Develop and introduce adequate tillage equipments and drills to handle non-inversion and no-tillage field conditions, respectively
- Research projects (scientific; on-farm)

Conclusion (3)

- Extension service with specialized CA consultants and tools (e.g. innovative farmer to farmer approach for knowledge transfer in CA; film), making use of the snowball/multiplier effect
- Include not only administrative authorities, but also politics, farmer organizations, industry (food; agricultural engineering), consumer organizations
- Establish a market for emissions credit trading for soil carbon sequestration

Farmer to farmer

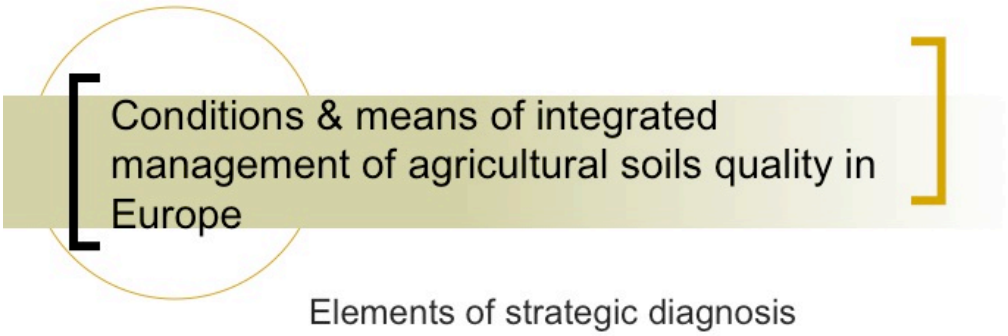
Success stories for sustainable land use

Project leader: Patricia Fry


„CHANGE IS FIRST DENIED,
THEN VEHEMENTLY OPPOSED,
FINALLY ACCEPTED AS BEING SELF-EVIDENT."
Bill Crabtree (13.03.1997)
„Le changement est d'abord nié,
ensuite on s'y oppose farouchement,
finalement il est accepté et devient même évident."

13.12 Annex 12 - Conditions and means of integrated management of agricultural soils quality in Europe – Elements of diagnosis

Presentation made during SAS-STRAT Integration workshop – Paris, 17th-18th June 2013



Elements of strategic diagnosis

Stéphane Baudé, Mutadis

SAS-STRAT Integration workshop
Paris, 18th June 2013

1

Objectives and method

- Objective: bring elements of strategic diagnosis at a European level as a complement to the case studies
- Interviews with 13 people including
  - Members of the SAS-STRAT research team
  - Public actors concerned with the issue of soil quality management
  - Actors engaged in initiatives promoting integrated soil quality management
- Interviews carried out according to 4 strategic items (IDPA grid) :
  - Identification of the situation, stakeholders and problems
  - Diagnosis of current actions
  - Prospect
  - Action proposals
- This presentation summarises key elements of strategic diagnosis stemming from the interviews.
  - It is however not a patrimonial audit (which requires more interviews)

2

List of interviewees

- Massimo Buroni (European Commission, DG Research)
- Gilles Hériard Dubreuil (Mutadis, France), member of the SAS-STRAT team
- Luca Marmo (European Commission, DG Environment)
- Murièle Millot (Ministry of Ecology, France)
- Simon Molenaar (SKB, Netherlands)
- Luca Montanarella (Joint Research Centre, Europe)
- Henry Ollagnon (AgroParisTech, France), member of the SAS-STRAT team
- Gérard Rass (Association for Sustainable Agriculture – APAD, France)
- Jurgis Sapijanskas (Ministry of Ecology, France)
- Pierre Stassart (University of Liège, Belgium), member of the SAS-STRAT team
- Wolgang Sturny (Office for Agriculture & Nature of the Canton of Bern, Switzerland)
- Elisabeth Vérame, (French Observatory of Living Soils)
- Frank Verhoeven (Boerenverstand, Netherlands), member of the SAS-STRAT team

3

Identification of the situation, stakeholders and problems

4

Soils bear multiple qualities that are interdependent and vulnerable

- According to the interviewees, soils, as water, is a key resource for humanity in general and for agriculture in particular. Soil and water are interdependent systems.
- In Europe, 40% of soils are agricultural soils. Unlike air or water, soil is a private property in Europe → a soil parcel is managed by a single actor (owner or tenant)
- For interviewees, soils deliver a variety of functions (food & biomass production, support for buildings, milieu for biodiversity, recycling of organic matter, CO_2 catchment & storage, regulation & filtering of water fluxes, pollutant degradation, archaeological memory)
  - Soil functions are linked to a variety of physical, chemical and biological dimensions as well as to the relationships between men and soils
  - Soil functions link soils with various societal challenges (answer to food demand, energy, climate change, biodiversity conservation, …)
  - Integrated soil quality can be seen as the capacity of soils to deliver multiple services
- For interviewees, quality of soils (notably agricultural soils) has an inter-generation dimension

5

Soil quality management is strongly linked to the vision of soils and to the management performed by soil managers

- Interviewees notice that soil quality management includes social, political and economic dimensions (spatial planning, society's relationship to soils…)
- According to the interviewees, 2 main visions of agricultural soils compete: soils as substrate (essentially focused on N,P,K concentrations) vs. living soils (taking into account a wide variety of aspects: organic matter, structure, underground biodiversity, oligo-elements…)
  - Various interviewed actors insisted on the importance of soils life for different soil functions (transformation & transportation of nutrients, water filtration, support for biodiversity…)
- Interviewees also consider agricultural soils as a long-term integrator of the effective management of agriculture and land planning on a territory
- According to interviewees, agricultural soils are private property but their quality appears as a common good for all stakeholders

6

A wide range of concerned stakeholders, at all jurisdiction levels

- All interviewees stress that society is the final user of soil functions and beneficiary of soil qualities → we are all concerned with soil quality
- They also stressed that farmers, as direct managers of agricultural soils, are key players for maintaining or not soils in good condition
  - Their management is strongly guided by the sakes of their own activity (productivity, benefits, but also their vision of the quality of their practices)
- Extension services are also key concerned actors for interviewees
- Different interviewees stressed that food industry and buyers of agricultural goods can help to integrate (or not) soil quality concerns into the market structure
- Movements initiated by farmers and scientists (e.g. conservation agriculture) are also frequently mentioned

7

A wide range of concerned stakeholders, at all jurisdiction levels (2)

- European, national, regional and local policy makers are considered as important concerned actors
- Interviewees most often considered researchers and research prescribers as important stakeholders
- The world of education and professional training is considered as important stakeholders by various interviewees.
- Water managers were frequently mentioned among concerned stakeholders
- Some interviewees also mentioned NGOs (notably environmental NGOs) and other civil society organisations
- The interviewees also frequently mentioned concerned stakeholders at a supra-national level, notably the FAO and its Global Soil Partnership

8

Soil quality is at stake at all levels from very local to global

- For the interviewees, the agricultural parcel & the farm are the place where effective soil management is performed and where the different influences exerted over the farmer are integrated
- According to the interviewees, between these 2 scales, there is a variety of relevant scales and entities:
  - Local communities (as spatial planners and responsible for managing the consequences of soil degradation e.g. erosion)
  - Intermediary entities between local and regional level (watershed, polder, …) notably linked to the soil-water complex
  - Regions (or federated entities)
  - The national (or federal) level
- For interviewees, soil quality is also at stake at a global level in particular through the global character of food markets

9

Issues identified by interviewees

- Soils are vulnerable to degradations (pollution, erosion, loss of organic matter, compaction…) that can be irreversible. Threats to soil are not uniformly distributed
- Continuous loss of agricultural soils in Europe due to urbanisation & artificialisation(about the surface of Cyprus every 10 years)
- For the interviewees, soil managers do not always take into account the impact of their activities on soils
  - Soil qualities & associated functions deteriorate in various areas of Europe
  - Available agricultural surfaces in Europe decrease
- Agricultural soil quality is often invisible, its degradation is perceptible only through weak signals. It is occasionally visible through
  - Severe events (e.g. floods, mudflows…) visible by society
  - Soil quality visualisation tools (e.g. visual soil assessment)
- For different interviewees, climate change, in the current state of agricultural practices, reinforces threats on agricultural soils

10

Issues identified by interviewees (2)

- For a majority of interviewees, farmers are dependent on their socio-technico-economic context.
  - Strong interdependencies in the food system creates systemic locks that can hamper the evolution of farming practices
  - For most interviewees, maintaining income is a key issue for farmers
    → Economic sustainability is an important criterion for transition.
- For interviewees, agricultural soil quality is difficult to define in a way that is shared by all actors and translated in concrete practices
- Some interviewees stress that European societies have progressively disconnected from agricultural soils
  - They relate this to an utilitarian & technical vision of agricultural soils that does not favour the development of a patrimonial relationship to soils
- Interviewees stressed that agricultural soils are subject to different sectored policies, but there is generally no global soil policies
- For different interviewees, tools for managing soil quality are designed without putting soil managers in a central & active position, as key actors of transition

11

The core strategic issue for the interviewees

- For interviewees, soil degradation is “low noise issue”, e.g. a phenomenon that is not seen as a problem by all stakeholders. How do we build the conditions of awareness on soil issues?
- For interviewees, improvement of soil quality and of its management is de facto a strategic issue for all actors
  - What is the relationship between our societies and soils? What vision of soils do we develop together? How do we build a patrimonial relationship between men and their soils in Europe? How do we make trade-offs?
- How to build a governance system for agricultural soils that
  - puts together the various levels of understanding and action?
  - enable positive mobilisation of all actors without degrading the freedom of action of agricultural soil managers?
- How to facilitate mobilisation of all types of actors, development of innovation and emergence of concrete solutions?

12

Diagnosis of current actions

13

The current system of actors

- For all interviewees, farmers are in first line in agricultural soil management
  - Some of them strongly engage in a collective way with a vision of soils as living soils
- Most interviewees identify a wide range of actors influencing more or less strongly farmers' practices
  - Economic actors upstream (seed companies, input and material firms) and downstream (buyers of food products, including cooperatives)
  - Extension services (often linked to upstream and downstream actors)
  - Other farmers can influence what a farmer sees as good practices
  - Public authorities at the regional, national and European level establish public policies in various domains that are translated into incentives or constraints for the farmer
  - The CAP orients production modes, size of farms…
- Land planning policies influence artificialisation & erosion

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The current system of actors (2)

- Interviewees stressed that national and European research has mobilised quite recently (end of 90's) on soil quality issues and produces research that
  - was initially oriented towards risk identification and mitigation,
  - more recently (since 5 years) addressed positive stakes of improvement of soil quality
- The European Commission proposed in 2006 a soil thematic strategy with 4 pillars: legislation (framework directive), integration of soil issues into other policies, research and awareness rising
  - However, the directive is still blocked by the opposition of 5 countries
- NGOs are perceived by interviewees as weakly mobilised on soils issues, that do not appear to them as a priority (compared to other environmental issues). However, interviewees note a rising of NGOs' awareness of soil issues

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The current system of actors (3)

- Interviewees note that some actors at a territory level (local authorities, water management organisations, farmers…) mobilise on soil quality but hardly provoke a global mobilisation (in particular of farmers) on their territory
- Different interviewees noted that public policies influencing soil management are decided in a sector-wise way and are sometimes contradictory
  - The European soil strategy (integration pillar), pushes for integration of soil issues into other public policies, but integration is sometimes difficult
- Interviewees stress that for soil quality issues, there is insufficient linkages between the key categories of actors: soil managers (in particular farmers), policy makers, research, firms and the world of education and professional training
- Various interviewees see farmers in a reactive rather than proactive position, except a minority of farmers strongly mobilised in niches like conservation agriculture

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Outcomes of the actions

- For interviewees, awareness on soil issues has developed at all levels but is still not enough developed and does not provoke global mobilisation
- Interviewees identify innovation niches that succeed in facilitating transition for their members but
  - They are still niches rather than mainstream
  - They can be hampered by some public policies (e.g. limitations of cover crops in nitrate regulations)
  - They often have low visibility for public authorities and are often not considered as a leverage to improve soil quality globally
  - The relevance, quality of efficiency of their practices is put into doubt by some actors (arguments of insufficient scientific proof of their benefits, glyphosate issue…)

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Outcomes of the actions (2)

- Interviewees stress that research has developed knowledge on soils, the risks and threats they are subjected to and possible remediation as well as on farming techniques. But little knowledge has been developed on social, political and economic conditions for change
  - Moreover, some interviewees pointed out that soil research is fragmented between European (FP7, SNOWMAN, Horizon 2020) and national research programmes and synergies and complementarities between research projects could be improved
- Innovation niches have developed understanding of conditions for change at farmer level. However, at a global level, there is no shared vision of systemic conditions for change
  - For some interviewees, systemic change is to be triggered by the European level through a future soils framework directive

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Outcomes of the actions (3)

- For interviewees, policy makers are becoming aware of the necessity to develop transversal approaches to soil quality
- According to interviewees however, despite raising awareness on soil issues, soil quality management still is a “niche” issue which is not the object of strong enough political mobilisation
  - Project and initiatives develop at the territory level. But at higher jurisdiction levels, existing reflections and discussions hardly entail effective action
  - Some interviewees stress that there are various concerned players taking action at their level of action but there is a difficulty to achieve coordinated or integrated action
- As a consequence, the tendency of degradation of soil quality and reduction of agricultural surfaces in Europe goes on.

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Prospect

20

Time scales: a long-term issues that takes place now

- A great majority of interviewees stress that soil degradation is often a quick phenomenon, sometimes irreversible. Conversely, soil regeneration is often a slow process. Soil quality management is an intergenerational issue but calls for rapid mobilisation.
  - One interviewee however pointed out that soil regeneration may be relatively quick in certain conditions.
- Some interviewees stressed that, on the short term, soil management is strongly influenced by other crises or issues (energy, pesticides, economic crisis, food crisis)
- At an individual level, transition trajectories deploy on a typical time span of 5 to 15 years
- Research is a quite slow process (10 years for research results to produce concrete impacts according to some interviewees)
- Some interviewees point out that food markets will take at least 5 to 10 years to integrate soil quality issues.

21

Space scales: a multi-scale issue involving all levels from the parcel to the planet

- Fro interviewees, soil quality management is taking place at first on the agricultural parcel and at the farm level but also involves all higher decision and action levels:
  - The farm is the place where change of practices take place
  - Local community is an important scale for spatial planning
  - Intermediary territorial levels are typical scales for management of soil & water systems (watersheds, polders, …)
  - The regional & national levels for public policies & regulations
  - The European level is seen as very important by various interviewees in terms of leverage on the national & regional level
  - The global level is relevant for the structure of food markets. It was also mentioned as a place for global initiatives for soil quality

22

Baseline scenario: localised or limited progress but degradation trends go on

- Interviewees often underlined the difficulty to elaborate a baseline scenario due to the sensitivity of soil management evolutions to versatile short-term factors (food prices, evolutions of the food & energy markets, economic crisis, …)
- In the baseline scenario soil quality continues to be dealt with in a fragmented way. Limited or localised progress is achieved but no significant progress at a global scale.
- Technical tools (mapping, GIS, decision-support tools) develop but leave little room to farmers' creativity & innovation
- Soil quality issues are managed through regulations & standards rather than by economic, technical & social dynamics
- Insufficient political mobilisation leaves the problem stagnant including in the case the soil framework directive is adopted
- Outcome: the current degradation trend does not invert

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Negative scenario: a worsening of the baseline scenario which would jeopardise the current modes of farming

- For some interviewees, the baseline scenario is already the negative scenario
- Interviewees figured out negative scenarios as a worsening of the baseline scenario due to
  - Economic/ecological crises that would put soil quality issues in the shade, orient actors towards short-term and make means scarce
  - Or a too strong regulation of farming practices that would impede the development of innovation dynamics and of new practices by farmers
- Conjunction of strong economic pressure and quick of soil degradation make impossible to act quick enough
- Artificialisation and fertility loss go on and worsen, making European agriculture rely essentially on inputs rather than soils and reinforcing the dependency of farmers on upstream and downstream actors

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Positive scenario: taking in charge living soils in all their dimensions

- In this scenario, soil life is considered by all actors as an asset and soil quality becomes a positive stake for all actors, including farmers (in terms of energy & input savings, fertility, …)
- Society progressively rebuilds a relationship to soils, with some proximity & respect of soils
- Intensification of exchanges between scientists, policy makers, farmers, firms and the world of education and professional training allows to produce a European strategy that is supported by all
- Soil quality actually improves and brings a net contribution to sustainable development of territories
- A governance framework is built, which
  - Enables the various actors to build common "contracts" for soil quality
  - Gives room to emergent dynamics of transition and reinforces them
  - Uses technical tools as resources for an evolution of practices rather than automatisms or control systems
- Europe succeeds to maintain its agricultural productivity while reducing environmental impacts of agriculture

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Stakes, threats and assets for the future according to the interviewees

Stakes

- For farmers: sustainability of farming (incl. revenue)
- Developing awareness
- Rebuilding a patrimonial relationship to soils
- Continuing the efforts to put soils on the agenda
- Facilitating exchanges
- Accommodating top-down & bottom-up approaches with levels of subsidiarity that favour innovation
- Maintaining soil fertility and agricultural surfaces in Europe

Threats

- Climate change
- Competing uses of soils
- Low visibility of soil issues
- Tensions on global food production
- Economic crisis in Europe
- Land status, that may condition the solutions to soil quality issues

Assets

- Soils are a limited and hardly renewable resource. Soil issues are too important not to show interest in them
- Research
- Farming movements (peri-urban farming, conservation agriculture) tending to change the relationship to soils
- Integration of ecosystemic functions in the reflections about farming

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Action proposals

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Requirements for action according to the interviewees

- Changing: going on the current tracks is not an option
- All actors must be aware of the importance of soil quality issues
- Reinforcing relationships & exchanges between farmers, policy makers, firms and the world of education & professional training, in an open state of mind
- Moving from a static vision to a dynamic and patrimonial vision of soil quality centred on relations between people and soils
- Facilitating and supporting emergent innovation dynamics in which farmers are actively engaged
- Addressing soil quality issues at the both from an agronomic & technical point of view and from the point of view of governance & social dynamics
- Building innovative cooperation modes and governance patterns that are neither bottom-up nor top-down but enables circularity between innovation and public policies
- Not focusing on short-term horizons

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Key objectives for action and modes of common action of the various actors

Objectives

- Position soils strategically in European & national political agendas
- Develop new relationships & collective learning between scientists, policy makers & field actors
- Inventory existing innovative approaches
- Find conditions for step-by-step evolutions
- Give value to all that contributes to soil reconstruction
- Build new relationships
- Recreate independent extension services linking research, public policies & farmers

Modes of common action

- Build transversal actions
- Build shared management tools & indicators supporting transition dynamics
- Public actors have a role to play in facilitating cooperation between the different concerned actors
- Establish a clear & common strategy of soil preservation at the regional, national & European levels
- Articulate European strategy and emerging dynamics on-field
- Address soil quality issues with firms

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Actions identified by the interviewees

Interviewees have identified few concrete actions :

- Inform citizens and all actors of the importance of soil quality issues (through all available media) and develop societal debate
- Targeted events for specific publics (policy makers, farmers, scientists)
- Take into account soil quality issues in spatial planning decisions
- Coordinate research at the national and European level (e.g. through Joint Programming Initiatives – JPI)
- Build an observatory of socio-technical innovation dynamics
- Support civil society and professional initiatives that my reinforce citizens' interest in living soils
- Facilitate firms taking into account soil quality issues
- Developing the European soil partnership
- Issue a soil framework directive

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Success criteria for interviewees

- Development of societal awareness of soil quality issues
- Development of an understanding of soils as a living entity
- Number & vitality of innovation dynamics
- Capacity of the various actors to effectively address the complexity of soil quality issues
- Capacity of actors to trigger systemic changes
- Showing that integrated soil quality management is possible through concrete initiatives
- For some interviewees, the issuing of a European soil framework directive is by itself a success criterion
- For some interviewees, effective constitution of the European soil partnership is by itself a success criterion

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Conclusion

- Soil quality degradation is an urgent issue which concerns everybody but is a “low noise” issue
- Farmers are in a central position for evolution of practices but it is difficult for them to change alone
- Little improvement is foreseen for the future
- There is an evolution of the vision of soil quality issue from a vision centred on risk management toward a vision centred on positive stakes
- All actors are aware that they will need to act together, but they do not know how to do this

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