Towards sustainable livestock production systems – Outline of a Learning and Experimentation Strategy (LES)

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Abstract: *Over the past decade, the Dutch Government has increasingly emphasised the need for integral solutions for sustainability problems in the livestock production sector. This led to the adoption of research approaches in line with transition management and system innovation that had been developed in other domains. In 2008, the government set further policy targets of 5% and 100% sustainable livestock production at the farm level for 2011 and 2023 respectively. Policy measures included stimulation of sector initiatives for sustainable agriculture (sectoral innovation agendas) and demand for projects with a focus on system innovation. Two broad approaches may contribute to the realization of these targets, notably top down and bottom up. Top down approaches are usually research-led and characterized by the formulation of visions of future livestock production systems. At the same time a broad variety of bottom up initiatives is taken by farmers who develop and try out new approaches to meet the challenges as they see them. Currently, the links between the bottom up and the top down processes are relatively weak. As both may contribute to a system innovation, a major challenge is to make a fruitful combination between the two approaches. To this end we have developed what we call a "Learning and Experimentation Strategy" (LES) that we will elaborate in the paper.*

Keywords: *system innovation, sustainable livestock systems, governance of innovation, strategic niche management, project management, programme management.*

Introduction

During the second half of the 20th century, livestock production in the Netherlands evolved in a close alignment between politics, policy and sector representatives. The main focus was on increasing production efficiency with a strong orientation towards export. Gradually, this modernization process became criticized for its negative side effects. Early criticism emphasized the dangers of chemical pest and weed control, emission of malodours from livestock units and mineral surpluses. Later, emphasis shifted to impaired animal welfare, and contagious and zoonotic animal diseases, especially after outbreaks of a variety of epidemic animal diseases in the past decade, including classical swine fever, foot and mouth disease, avian influenza and BSE. Recently, criticism centered on contribution of livestock production to climate change and to excessive claims on natural resources of food production.

Governmental policies aimed to solve or mitigate the problems by stimulating research, subsidy programs and regulatory actions. In most cases, these measures led to reducing the specific problem by technical means and regulations for the livestock production system. Thus the agricultural system that had emerged during the first modernization (Beck, 1992) met the first attempts of reflexive modernization. The latter, however, used various thoughts and approaches (hard and soft institutions) rooted in modernity. Thus, the actors involved on the one hand continued to increase production efficiency and on the other tried to fine-tune inputs (of nutrients, agrochemicals, manure, etc) to needs in general.

Since the mid 1990s, the search for integral solutions gradually received attention, which led to governmental policy partially adopting research approaches in line with transition management and system innovation that had been developed in other domains. In 2008, the Dutch government set specific policy targets of 5% and 100% sustainable livestock production at the farm level for 2011 and 2023, respectively (LNV, 2008). Policy measures included stimulation of sector initiatives for sustainable agriculture (sectoral innovation agendas), demand for projects with a focus on system

innovation and societal design and subsidy instruments for agricultural entrepreneurs and integral research.

To meet the challenges in the livestock production sector two broad approaches evolved: top down and bottom up. Top down approaches are typically research-led and often start with the formulation of visions of future livestock production systems. These included redesign of primary production (Bos and Grin, 2008), inclusion of new functions in primary production, vertical integration in the supply chain and combining functions of different agricultural activities in agro-production parks (Grin and Van Staveren, 2007). The underpinning of the sustainability claim of such visions varied from expert analysis only, results of extensive stakeholder consultation to deliberate co-design by scientific experts and stakeholders.

At the same time, a broad variety of bottom up initiatives is taken by farmers who develop and try out new approaches to meet the challenges as they see them. Most of these initiatives are not guided by broad future visions and focus on specific aspects.

Currently, the links between the bottom up and the top down processes are relatively weak. From the top down perspective, the bottom up initiatives are even considered risky since they typically address a relatively small problem within the current system and might solidify the system rather than opening it up whereas the top down approaches explicitly seek to change the system at large.

However, a system innovation can never be 'organized from above'. It needs to make use of the 'innovative energies' within the existing livestock production sector, i.e. lessons learned in the bottom-up process. A major challenge is to make a fruitful combination between the top down and bottom up processes. It is this challenge that we will address in this paper.

Much research has been done on top-down approaches like Strategic Niche Management (Hoogma et al., 2002; Schot and Geels, 2008) and Transition Management (Rotmans, 2003; Loorbach, 2007). For this reason we will focus on the bottom-up processes in this paper but within the overall ambition of combining this perspective with top-down approaches. We will present a tentative framework to assess bottom up initiatives as well as top down projects on their potential to contribute to system innovation. This framework serves as a tool in a broad learning and experimentation strategy in which the lessons from top down and bottom up are combined. We are currently (early 2010) testing this framework in various sectors and on the basis of this we will modify and elaborate it for wider applicability.

The dynamic of system innovation

The central issue in this paper is how learning and experimentation in projects may contribute to system innovation. The traditional model sees innovation as a diffusion process: via innovators, early adopters, early majority, late majority and eventually laggards (Rogers, 1962). Also system innovations have been portrayed as a sort of diffusion process, distinguishing the following phases: pre-development, take-off, acceleration and stabilisation (figure 1; Rotmans, 2003).

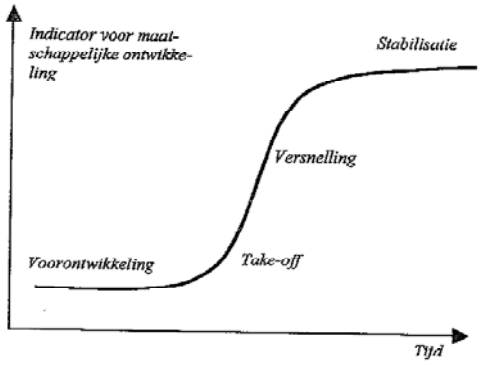

Figure 1. Phases in a transition (Rotmans, 2003)

Although extensive later work has shown that these diffusion models are over-simplistic they are still widely held valid in policy arenas and also in scientific circles (e.g. Gielen and Zaalmink, 2003). Policy makers, after a successful project, immediately tend to pose the question: "And now, how do we scale up". The so-called multi-level perspective (MLP; Rip and Kemp, 1998; Geels, 2002) provides a more dynamic view on innovation. The core of the MLP is that system innovations are shaped by interaction between three levels: the socio-technical landscape, the socio-technical regimes and niches (figure 2). Socio-technical systems are located at the meso-level of *socio-technical* regimes. These regimes indicate a set of shared rules that guide and constrain the actors within a production and consumption system in how they try to tackle various challenges they encounter. This typically leads to evolutionary patterns of innovation. The *socio technical landscape* is an exogenous environment of factors with a broader societal relevance like the need to reduce CO_2 emissions. *Technological niches* are the breeding ground for radical innovations that initially poorly fit the regime.

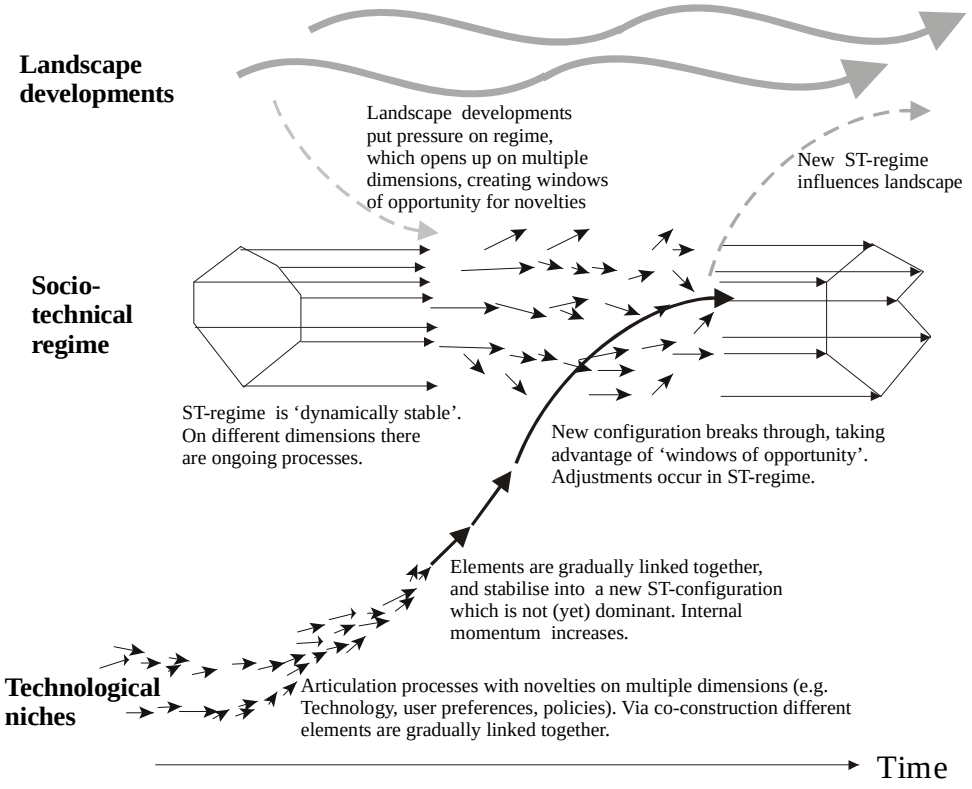

Figure 2. A dynamic multi-level perspective on system innovation (Geels, 2005).

In the MLP dynamic, system innovations develop as follows. A novelty emerges in a local practice and becomes part of a niche when a network of actors is formed that share certain expectations about the future success of the novelty, and are willing to fund and work on further development. Niches may emerge and develop partly in response to pressure and serious problems in an existing regime which can be either internal to the regime itself (such as animal welfare in industrial animal production) or come from the socio-technical landscape (e.g. the current pressure to curb CO_2 emissions which affects more than just the animal production sector). The further success of niche formation is on the one hand linked to processes within the niche (micro-level) and on the other hand to developments at the level of the existing regime (meso-level) and the socio-technical landscape (macro-level). Supported by actors willing to invest in the new concept (industries, R&D organisations, government) and initially protected from competition at the market place (e.g. through subsidies), the technology is improved within the niche, broader networks are formed around it, and more is learned about technical directions for improvement and functions it may fulfil.

After some level of improvement of the technology, and after learning more about its potential, it may find its way in specific market applications, often typical segments that exploit new functional characteristics of the technology and focus less on cost structures (e.g. organic food). Through further improvement, increasing reliability, and cumulated experiences and learning about functionalities and potential applications the technology can spread to other market niches and/or trigger expansion of market niches. Processes of rule formation also play an important role, such as the development of standards and regulations for the technology, and processes to reduce the mismatch of the emerging technology with the rules of the dominant regime. As it starts to compete on or with main markets, the novelty may transform or substitute the existing regime and thus trigger a system innovation process.

This perspective allows for a very dynamic view on innovation processes as its application to a variety of historical cases has shown. These studies, however, tend to focus on the vicissitudes of a specific alternative technology to an existing system (e.g. sailing ships replacing steamships; Geels, 2002) although the new technology does not simply diffuse but changes in the process. This works fine for retrospective studies but it is problematic to use as a heuristic in a 'learning and experimentation strategy' seeking to contribute to system innovation. We do not know which alternative development will play a key role in the development towards a sustainable livestock sector. We need to acknowledge that 'innovation in action' is much messier than retrospective historical studies portray it. (See e.g. Elzen et al.; forthcoming).

Portfolio of promises

In the MLP, niches are the locus to learn about and further develop novelties. A niche consist of a variety of projects that share a technical nucleus, e.g. electric propulsion for cars (Hoogma et al., 2002). Using the niche concept in a sector like animal production, however, is problematic because innovative projects and practice initiatives are very diverse. For instance, they may relate to new types of animal food, new manure collection technologies, new husbandry systems, etc. Learning between these initiatives is often minimal and, therefore, they do not fit the definition of a niche in MLP.

To address such innovations we will use the term 'promise'. The term promise expresses that each of these novelties has attractive sides from a certain sustainability perspective (e.g. lower CO2 emissions) but it has also problematic (e.g. more expensive) or unknown sides. Initially, a promise may just be an idea or a concept, explored in a single project. After a certain period of time more projects may be started in connection with the novelty. When these projects start exchanging information the promise may thus develop into a niche.

Historical cases show that system innovations are not the result of the 'massive diffusion' of a new technology but a lengthy process of combining and re-combining 'partial innovations'. This implies that, to induce or stimulate system innovations, attention should not go to a single novelty (or promise) but to range of novelties that we call the 'portfolio of promises'. In a project seeking to

develop a new 'integrally sustainable' husbandry systems for dairy cows ("Kracht van Koeien" (Cow Power); cf. Bos, 2009) we distinguish about a dozen such promises, including separate collection and processing of manure and urine, minimum space of 360 m^2 per cow throughout the year, cheap but sustainable roofed shelters (rather than a closed barn), etc.

For each of these promises a process of learning and experimentation is needed to find out in practice how the problematic sides may be solved and to explore whether new sustainability problems are created. For an individual promise, even if it does not (yet) constitute a niche, the approach of Strategic Niche Management (SNM) provides valuable suggestions on how to do this (Hoogma et al., 2002; Schot and Geels, 2008). But SNM looks at the level of a single novelty and not at the portfolio level, i.e. across a variety of niches in MLP terms. To make a more encompassing contribution to system innovation, we need a learning and experimentation strategy that works at two levels, at the level of individual promises and at the level of the portfolio of promises.

- The **individual promise level**: because we are not only looking at technical innovations but also at new practices, new meanings, etc., it is important to make various stakeholders, to whom the experiment may be relevant, part of the network exploring it (e.g. the 'roofed shelter network' in the Cow Power project mentioned above). Because a wide variety of 'partial innovations' will be required for a system innovation a large number of such networks will be required for a long period (as system innovation tends to be a lengthy process).
- The **portfolio level**: because a system innovation will result from a process of combining and recombining partial innovations it is important to analyse how various promises might be linked to create a full system that is more sustainable than the existing one. Such an analysis at the portfolio level (the 'portfolio integration') may result in starting new experiments with linked promises (thus creating a new, more encompassing promise) or in giving feedback to ongoing experiments to include certain aspects based on the portfolio integration. Because a variety of promise networks need to be running for a longer period this portfolio integration should be a more or less continuous activity.

This combination of learning and experimentation at two levels we call the "Learning and Experimentation Strategy" (LES). It can be seen as an extension of SNM in two directions: (1) it addresses promises before they constitute a niche and (2) it looks across a range a promises (or multiple niches in SNM terms). In the next section we will show that LES has a further extension compared to SNM (as well as to Transition Management) by incorporating 'top down' as well as 'bottom up' initiatives.

Two complementary LES approaches: top-down and bottom-up

Historical system innovations have rarely been planned and they usually developed solely out of bottom up processes. The idea to deliberately evoke system innovations for societal goals (like sustainable animal production) is relatively new. In top down approaches like SNM and Transition Management (TMgt), organised projects are crucial in achieving this. Organising projects, however, does not imply that the bottom up dynamic has been halted but this is ignored in SNM and TMgt. A 'complete' approach to evoke system innovations should combine the top down and the bottom up processes. We will discuss each of these below.

Top down

Generally, top down approaches are research-led and start with the exploration of possible sustainable futures (Hirsch Hadorn et al., 2008). The nature of such explorations varies widely and could be based on extrapolation of trends, scenarios, dynamic modelling, elaborating visions and actions of co-design or *ad hoc* methods to define a future system without the problems of the existing one. Future explorations serve functions like giving directions to short term actions, a certain loosening up from today's preoccupations and achieving opening up and congruency among stakeholders about a future orientation. Smith et al. (2005) distinguish the following functions of a future exploration or vision building exercise:

- Mapping a 'possibility space': Visions identify a realm of plausible alternatives for conceiving of socio-technical functions and for the means of providing for them.
- A heuristic: Visions act as problem-defining tools by pointing to technical, institutional and behavioural problems that need to be resolved.
- A stable frame for target-setting and monitoring progress: Visions stabilise technical and other innovative activity by serving as a common reference point for actors collaborating on its realisation.
- A metaphor for building actor-networks: Visions specify relevant actors (by inclusion and exclusion), acting as symbols that bind together communities of interest and of practice.
- A narrative for focusing capital and other resources: Visions become an emblem that is employed in the marshalling of resources from outside an incipient regime's core membership. (see also Rotmans, 2003; Loorbach, 2007; Berkhout et al., 2004; Brown et al., 2000).

In the Netherlands, the approach of Sustainable Technological Development (STD; Weaver et al., 2000) has gained considerable attention. It starts by constructing visions of a desirable future and then uses a method called back casting to define short term actions. The back casting is carried out in interaction with stakeholders (Quist, 2007). The approach of Transition Management follows a comparable methodology (Rotmans, 2003). Here a 'basket of visions' is developed with a variety of stakeholders which are also 'translated back' into concrete projects in the near term.

In our view, these top down approaches take too much of a planning approach towards developing the future. Innovation in practice is a very messy process in which a wide variety of stakeholders are active and one of the challenges is to use the 'innovative energy' that is already there. To achieve this, we have been involved in vision building exercises with sectoral stakeholders for various livestock sectors, including laying hens, pigs and dairy cows. Most often the visions take the form of a report or brochure giving general 'contours' of more sustainable husbandry systems for a sector along with concrete suggestions for various 'sub-systems' (the 'promises'). Via various communication outlets we make these images widely known in the sector and invite concrete farmers to try and implement various aspects of it on their own farm. For laying hens, this resulted in a new system by the name of Roundel that is currently experimented with by concrete farmers (Groot Koerkamp and Bos, 2008; Klerkx et al., 2009). For dairy cows, visions of four sustainable new systems have been launched early 2009 (Bos, 2009) and since we have been frequently approached by farmers who want to try out aspects of it. One of the promises now tried out in various farmers are new floors for cow houses. New floors could make contributions to sustainability aspects including animal welfare and reduction of emissions (esp. ammonia by early separation of manure and urine). A project on new husbandry systems for fattening pigs has been concluded in early 2010 (http://www.duurzameveehouderij.wur.nl/UK/projects/).

Bottom-up

The initiatives that are inspired by these visions can be seen as part of a 'top down' dynamic which is fed by the explicit goal to develop 'integrally sustainable' husbandry systems. But we have to be modest because most of the innovative activity in a sector develops bottom up and much of this is *not* (or hardly) influenced by global sustainability visions. Since these 'bottom up' initiatives outweigh the top down initiatives by far in numbers this begs the question whether and, if so, how the bottom up initiatives could also be incorporated in a learning and experimentation strategy.

Let us take a closer look at this bottom up process, i.e. the ongoing process of innovation in the animal production sector that takes place for a variety of reasons. This does not mean that such actions are not guided by visions. They usually are but these visions tend to be of a more local nature or address a specific dimension of sustainability (rather than the 'integrally sustainable' visions in the top down approaches).

We can take two different views at the agricultural (including animal production) sector. In the first, agriculture basically refers to the primary production at the farm with the goal of producing all sorts of food products (called 'conventional agriculture'). By far the largest volume of agricultural products

is produced in a rather uniform fashion. Important characteristics of this system are cost price competitiveness and production for international food corporations. (cf. Van der Ploeg, 2008) Innovation focuses on this competitiveness. Other directions for innovation are neglected and the embedding of agriculture in the existing system is considered self-evident. Visions of change are confined to the farm level or the desire that the food processing industry take the lead (cf. the Innovation Agenda for the pig husbandry sector in the Netherlands). In such a view, local innovative initiatives are hardly relevant. They may lead to nice niche products but they will hardly contribute to sustainable development.

In the second view, by contrast, the multitude of local initiatives is seen as a source of potential change and inspiration. These initiatives are not only seen as an effort to innovate at the farm level but they are inseparable from their institutional embedding. Roep et al. (2003) refer to this process in the agricultural sector as 'technological-institutional' design which is connected to what they call effective reformism. Their basic idea is that especially in the agricultural sector the initiatives from farmers typically aim at simultaneously realising technical change as well as creating a new institutional environment (new routines and links with various stakeholders, including advisors, supplier and processing corporations, public authorities, the general public, etc.). In this process, the expectations of farmers as well as the other stakeholders change. Thus, such initiatives may form the 'seeds of transition' (Wiskerke and Van der Ploeg, 2004; see also Roep and Wiskerke, 2006) although they are not guided by 'integral sustainability' visions.

This means that such bottom up initiatives are certainly relevant for a learning and experimentation strategy for sustainability. LES should analyse the contributions of such bottom up initiatives as well as top down organised projects concerning the contribution they make or can make to the development of individual promises as well as the whole portfolio.

This is captured in Figure 3 which gives a representation of the multi-level dynamic, focusing on the relationships between projects, practice initiatives, promises and the regime.

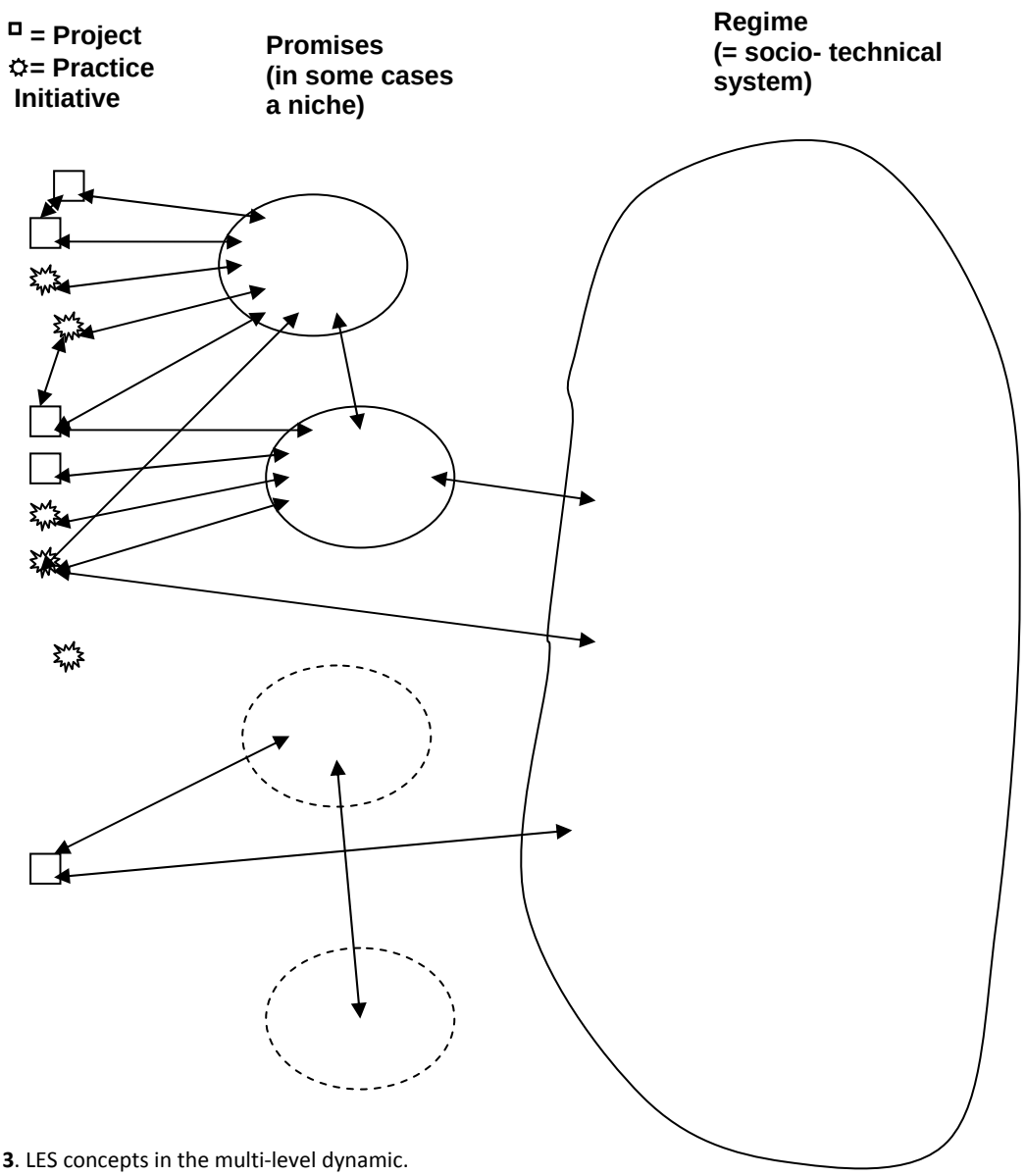

Figure 3. LES concepts in the multi-level dynamic.

Some explanatory remarks concerning the figure:

- Two-way arrows are used to indicate that influences may go both ways.
- Projects and initiatives may contribute to more than one promise.
- Some of the promises have been dashed, indicating they are (still) conceptual ideas that are not or hardly supported by a network. One of these is not supported by any project or initiative, indicating it is still just a conceptual idea.
- Projects and practice initiatives may influence each other directly.
- Projects and practice initiatives may also have an influence on the regime directly.
- Promises may also influence the regime.
- Promises may influence one another.
- One isolated initiative is not connected to any promise as an example of many such initiatives that do not fit the portfolio of promises.

Assessing Promises

Farmers apply innovations for a variety of reasons. There may be thousands of such initiatives, some of which may be inspired for sustainability reasons while many others are motivated otherwise. This begs the question how to assess which initiatives might make a contribution to sustainable development. This is not simply a matter of listening to the farmers' motivations as historical studies show that later developments may go in directions very different from what the initiators intended or aspired to.

We can approach this issue in various ways. Firstly, we may ask the question "Which initiatives are sustainable?". This may sound like an over-simplistic question but it is one that the current political situation in the Netherlands (as well as in many other countries) confronts us with. A 2008 white paper from the minister of Agriculture states that by 2011 5% of the Dutch husbandry systems should be sustainable (LNV, 2008). Therefore, the ministry needs criteria that allow counting whether the target has been met. In the Netherlands such criteria have been and are being developed in the form of sustainability indexes for various agricultural subsectors. These indexes provide criteria that are assessed in a quality assurance scheme (cf. www.smk.nl).

The second approach in assessing bottom up initiatives is to see them as part as an ongoing process. The question then becomes: "Which initiatives have a potential to contribute to sustainable animal production?". This requires a broader set of assessment criteria such as the presence of a broader vision on sustainability, institutional embedding and change, risk insurance for individual farmers, room to learn and experiment, a potential to apply the innovation in a commercial setting eventually (e.g. via initial financial support), etc. Such criteria are more qualitative than under the first approach and more open for debate.

As a third approach, the question may be reversed. "How can we use these initiatives to learn about possibilities for sustainable animal production?" The initiatives are then seen as learning experiments to render knowledge on barriers and chances for sustainable development. Thus, they can be made part of the 'portfolio of promises' within LES. This requires a process of continuous monitoring of which innovations are explored in the animal production practice and assess the relevance of the locally learned lessons within the broader portfolio.

An important aspect of this third approach is that bottom up initiatives (esp. when analysed in combination with top down projects) can be used to learn about uncertainties. Some of the main uncertainties are (1) whether the envisaged innovation compares favourably to existing practices (2) whether the innovation produces new unforeseen risks when applied during a longer period and on a larger scale and (3) how the innovation potentially compares with other competing solutions. Furthermore in connection with the overall goal of system innovation a major uncertainty is whether the combination of top down and bottom up learning and experimentation might eventually lead to weakening of the existing regime and to a shift towards another socio-technical system.

In LES, we follow a combination of the second and third approach. The points raised above imply that we need a tool to assess the various promises on their potential contribution to sustainable animal production. Tentatively, we are now using an evaluation framework in which we assess each initiative on the following dimensions:

- Sustainability gains/losses: an assessment of whether the novelty might improve sustainability on various sub dimensions as PPP and animal welfare;
- System renewing potential: an assessment of whether the promise might help break the lock-in in the existing system;
- Risk of strengthening lock-in: the reverse of the previous point: is there a risk that the innovation might consolidate the existing system and block further renewal for a long time ahead (e.g. because of huge investments made);
- Give momentum to change processes: does the novelty set things in motion that can be expected to continue for a considerable time.

For each of these main dimensions we distinguish various sub-dimensions. We are currently (early 2010) testing this framework by applying it to the dairy-cow and pig sectors. We are exploring whether this leads to a meaningful comparison of various promises (top down projects as well as bottom up initiatives) and whether this serves as a good starting point for an analysis at the portfolio level. This empirical testing is likely to lead to some changes in the methodology and thus helps us to refine the Learning and Experimentation Strategy that we seek to develop.

Challenges for further LES development

We are developing LES as a strategy to contribute to system innovation via a combination of learning from projects and learning from practice initiatives. To realise this ambition poses a number of challenges and raises a number of questions. Below, we list a number of aspects that need further elaboration:

- **Promises monitor.** Various system innovation projects in the Netherlands are being monitored to optimise learning, but it is necessary to extend this to monitoring of practice initiatives. This raises various new questions, e.g. which of the numerous initiatives to actually follow? The evaluation framework in the previous section can be used to help make such decisions.
- **Promises analysis and evaluation**. The results of a variety of projects and bottom up initiatives need to be evaluated in relation to each other. But how to do this and translate this into topics for further exploration (e.g. via new projects) still needs to be developed. The evaluation framework above provides a first stepping stone for this.
- **Portfolio analysis and evaluation**. The next step is to move beyond the promises level and analyse the data collected at the portfolio level. We still need to develop methods for relating data on various promises. One starting point may be to evaluate the data against the background of various visions of a sustainable new system (e.g. as developed in the Cow Power project) but this would still require new evaluation methods.
- **Portfolio management**. In the present situation, management takes place at the level of projects and, to a lesser extent, at the level of programmes. A Learning an Experimentation Strategy, however, would also require forms of management at the portfolio level which are currently non-existent.
- **Stakeholder management**. A system innovation will require contributions from a variety of stakeholders which can only be realised by involving them in various activities in LES. But it is still an open question who to involve in which of the tasks above.

Conclusion

The societal and political pressure to develop more sustainable animal production systems (as well as other agricultural systems) has grown over the past decade and is not likely to go away. This will require system innovations in various sectors (such as animal production) and sub-sectors (e.g. dairy cows, pigs, etc.). Approaches like SNM and TMgt have rendered a variety of suggestions on how to use learning in series of projects to contribute to sustainable development.

These approaches, however, ignore that in the ongoing dynamic in these sectors a large number of stakeholders is tinkering with a variety of innovations trying to solve a range problems as they experience them. In historical system innovations such bottom up processes were the dominant drivers for transitions. Current attempts that seek to evoke system innovations towards sustainability therefore cannot ignore this bottom up dynamic and should make it part of their strategies.

The LES approach that we propose here does acknowledge this bottom up dynamic. It attempts to combine the learning that takes place in bottom up practice initiatives (often farmer-led) with the more deliberate attempts at learning in planned projects that are often research led. This combination does more justice to the innovation dynamic that is actually taking place than the more narrow focus on projects by approaches like SNM and TMgt.

Combining top down and bottom up in LES also allows combining the strong and weak sides of each of these approaches, notably:

- Top down approaches are driven by the development of a vision (or set of visions) of an integrally sustainable new system. Thus, sustainability goals are baked into the process. The weak point is that these new visions and their constituting parts (the promises) do not fit in well with the existing system. This makes it difficult to 'anchor' (cf. Elzen et al., forthcoming) these novelties within the current system and gain practical experience. Such an anchoring, however, is required to get a transformation process going. Starting this process 'from the outside' is difficult and may trigger a lot of resistance.
- In bottom up initiatives such anchoring is guaranteed since the initiatives come from within the existing system. But because of this anchoring it is difficult to take along broader sustainability issues which would require more radical steps.

In current practice (also in transition initiatives in other sectors), top down (i.e. driven by integral sustainability visions) and bottom up constitute separate approaches. Certain parties may be working on one approach who are hardly in touch with parties working on the other approach. Both, however, will contribute to the system innovations that are in the making. Furthermore, because each of these has its weak and its strong sides it is important to link them in a learning and experimentation strategy, LES.

Current policies often make a distinction between improving sustainability in the short term by adapting existing systems and working on integral sustainability in the long term through system innovation. Bottom up initiatives are primarily seen as contributing to the former which, however, constitutes a limited view. Judging such initiatives on direct sustainability criteria may indeed provide information on their potential to make short term contributions. However, also incorporating other criteria (cf. the evaluation framework above) may reveal their potential to contribute to more integral sustainability in the long term as well. This also provides the opportunity to link learning from bottom up initiatives to learning in various top down inspired projects. Subsequently, by 'zooming out' to the portfolio level, an integral analysis may generate new ideas on how linking between various promises (irrespective of whether they come from top down or bottom up learning) could result in identifying a 'higher level' promise as a contribution to a system innovation. Such a broader learning and experimentation strategy thus attempts to combine (1) top down and bottom up approaches and (2) the individual promise (which in some cases may be a niche) and the portfolio levels. Thus it seeks to make a much more effective use of existing innovative potential in the sector than other approaches and is it likely to make a larger contribution towards developing a sustainable livestock production sector.

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