Towards Sustainable Livestock production in the Netherlands

Outline of a Learning and Experimentation Strategy (LES)

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Introduction

During the second half of the 20th century, livestock production in the Netherlands evolved in a close national alignment between politics, policy and sector representatives. 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 malodors from livestock units and mineral surpluses. Later, emphasis shifted to impaired animal welfare, and to 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 at solving or mitigating the problems by stimulating research, subsidy programs and regulatory actions. In most cases, these measures led to reducing the specific problem and simultaneously to additional technical measures 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 used similar approaches to finetune 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 systems innovation that had been developed in other domains. As a further step, in 2008 the Dutch government set 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 (sector innovation agenda's), demand for projects with a focus on system innovation (SI) 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, notably top down and bottom up. Top down approaches are characterized by 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 in which farmers 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 process 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. Therefore, a major challenge is to make a fruitful combination between the top down and bottom up approaches. It is this challenge that we will address in this paper. To this end we will present a tentative framework to assess bottom up approaches on their potential to contribute to system innovation and subsequently make them part of a broad learning and experimentation strategy in which the lessons from top down and bottom up are combined. We are currently (mid 2009) engaged in a project to test this framework and on the basis of this modify and elaborate it for wider applicability.

The dynamic of system innovation

The central issue in this paper is how learning and experimenting in projects may contribute to system innovation. The traditional model sees innovation as a diffusion proces: 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). Although extensive later work has show that these diffusion models are over-simplistic they are still widely held valid in policy arenas and also in scientific circles. (e.g. Gielen en Zaalmink, 2003) Policy makers, after a succesful project, immediately tend to pose the question: "And now, how do we scale up".[1] The attractions of these models for policy makers and researchers is one of the realities we have to face when seeking to contribute to system innovations.

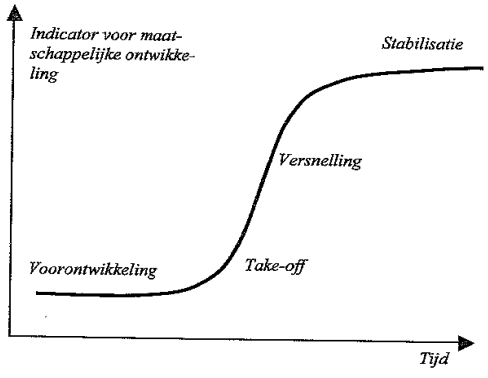

Figure 1. Phases in a transition (Rotmans, 2003)

The so-called multi-level perspective (MLP) 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).

[1] This is our own experience in a variety of projects.

Socio-technical systems are located at the meso-level and are characterised as regimes to indicate a set of shared rules that guide and constrain the work of actors within a production and consumption system and the way technological systems are embedded in society. Engineering heuristics are aligned with rules of the selection environment (Rip et al, 2001: 272).

According to this school of thought, 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 further development. The niche is formed against the background of the existing regime and landscape. 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 sociotechnical landscape (macro-level). Supported by actors willing to invest in the new concept (industries, R&D organisations, government) and protected from competition at the market place, 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 fulfill.

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 the 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. In a later stage, the new regime may even trigger changes at the landscape level (e.g. the computer regime leading to applications such as the internet with its pervasive impact on society).

This perspective allows for a much more dynamic view on innovation processes as its application to a variety of historical cases has shown. These studies, however, still tend to focus on the vicissitudes of a specific alternative technology to an existing system (although that 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).

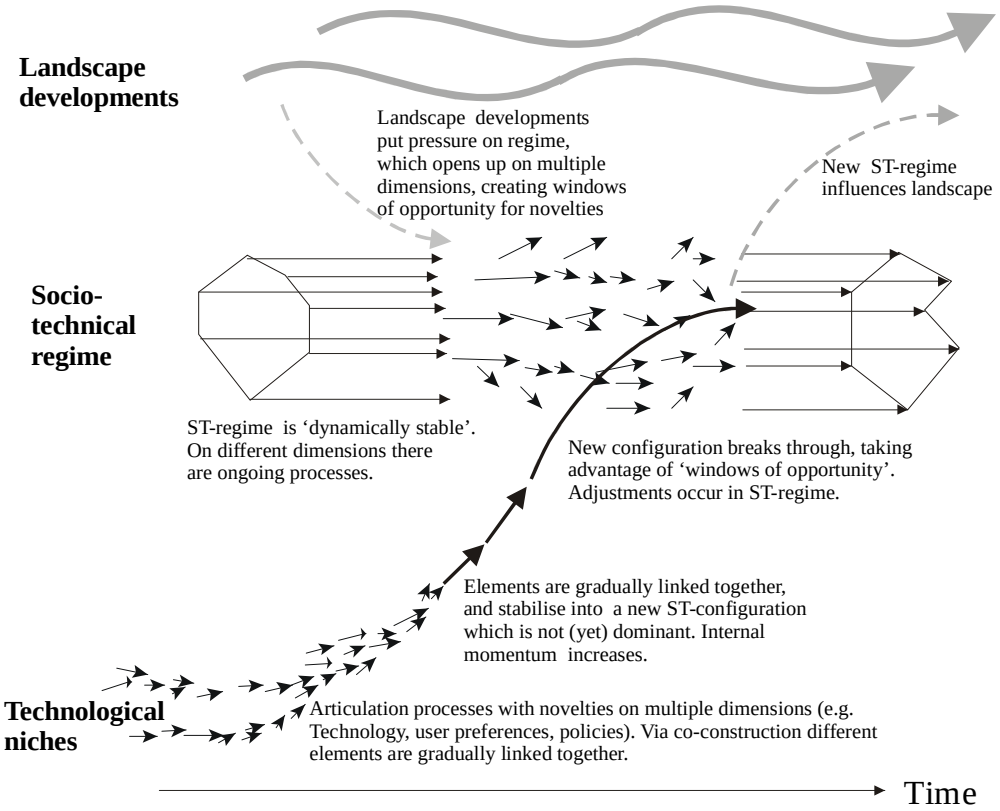

Figure 2: A dynamic multi-level perspective on system innovation (Geels, 2005)

Portfolio of promises

The historical cases show us that system innovation are not the result of the 'massive diffusion' of a new technology but a lengthy process of combining and re-combining 'partial innovations'. These partial innovations may be anything but partial to the people working on them but to add up to a system innovation they have to be linked to other partial innovations that initially are developed elsewhere.

This implies that, to induce or stimulate system innovations, attention should not go to a single novelty but to range of novelties that we call the 'portefolio of promises'. It is called a promise because each of these has attractive sides from a certain sustainability perspective (e.g. lower CO_2 emissions) but it has also problematic sides (e.g. more expensive, missing infrastructure, etc.) or unknown sides (e.g. it may turn out to perform badly on overlooked sustainability dimension).

In a project seeking to develop a new 'integrally sustainable' husbandry systems for dairy cows ("Kracht van Koeien" (Competence of Cows); 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.

In terms of the MLP, the portfolio of promises would not just constitute a niche but consist of a variety of niches that, initially, are largely worked on in separate networks. Some of the examples of promises above can hardly be called a niche since, at present, they are rather local activities carried by small networks although they may later develop into a more global niche. Because we also want to include these promises in the 'pre-niche' phase we prefer the general term *promise* to the more specific term *niche*.

For each of these promises a process of learning and experimentation (contributing to niche formation) is needed to find out in practice how the problematic sides may be solved and to check whether new sustainability problems might be created. For the individual promise, 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. To make a more encompassing contribution to system innovation, a learning and experimentation strategy should work at two levels, the level of each individual promise and the level of the portfolio.

- The promise level: because we are not only looking at technical innovations but also at new practices, new meanings, etc., it is improtant to make various stakholders, to whom the experiment may be relevant, part of the network exploring it (the 'promise network'; e.g. the 'roofed shelter network' in the Competence of Cows 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 SI tends to be a lengthy process).
- The portfolio level: because system innovation will result from a proces 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 current 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. Based on this integration, experiences may be exchanged between projects. 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 a form of SNM at the level of individual promises along with an integral analysis at the portfolio level. In the next section we will show, however, 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 LES approaches: top-down and bottom-up

Top-down

Generally, top down approaches 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, scenario's, dynamic modeling, elaborating visions and actions of co-design. 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 onceiving of socio-technical functions and for the means of providing for them.
- A heuristic: Visions act as problem-defining tools by pointing to the 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 (including and excluding),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, 2000) has gained considerable attention. It starts by constructing visions of a desirable future and then uses a method called backcasting to define short term actions. The backcasting is carried out in interaction with stakeholders (Quist et al., 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 experiments in the near term.

In our view, these approaches are too 'neat' and take too much of a planning approach towards developping the future. Innovation in practice is a very messy process in which a wide variety of stakholders 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 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 the sector in question along with concrete suggestions for various 'sub-systems' (the 'promises'). Via various communication outlets we try to make these images widely known in the sector and invite concrete farmers to try and inplement various aspects of it on their own farm. For laying hens[2] this has resulted in a new system by the name of Roundell that is currently experimented with by concrete farmers. For dairy cows, visions of four sustainable new systems have been launched early 2009 (See Bos, 2009) and since we have been frequently approached by farmers who want to try out aspects of it. A project on new husbandry systems for fattening pigs is currently (mid 2009) ongoing.

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 is *not* (or hardly) influenced by such global visions. Since these 'bottom up' initiatives outweigh the top down initiatives by far this begs the question whether and, if so, how the bottom up inititaives 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 agricultural 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 approach).

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 such a view, local innovative initiatives are hardly relevant. They may lead to nice niche products but 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

[2] See Groot Koerkamp and Bos (2008) for the envisioning and designing approach.

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 en 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.

Not all initiatives, however, will necessarily conctribute to sustainable development. This begs the question how to assess which intiatives might make such a contribution. We can approach this issue in various ways. Firstly, we may ask the question "Which initiatives **are** sustaible?". This may sound like an over-simplistic question but it is one that the current political situation in the Netherlands 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) This asks for criteria that would allow counting to assess whether the target has been met.

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 (initially there may be financial protection), etc. Such criteria are much more qualitative in nature and 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?" Such initiatives are then seen as learning experiments to contribute to the knowledge base about barriers and chances for sustainable development. Thus, they are made part of the 'portfolio of promises' within LES. This requires a process of continuous monitoring of what goes on at the bottom level in terms of innovation and assess the relevance of the locally learned lessons within the broader portfolio.

We are currently (mid 2009) engaged in developing methods for doing this in practice for one specific promise, notably new floors and soils for cow-sheds (our "LES-pilot"). This should provide the basis for a more general methodology to 'follow' a much wider set of promises. Since the number of local initiatives is enourmous we need a selection device that helps us identify the 'most promising' initiatives. Tentatively, we are now using the framework below in our LES-pilot.

Sustainability dimensions	Promise a	…	Promise n
Animal welfare			
Environment			
Farmer relevant issues (Working conditions, profitability, etc.)			
Public issues			
Potential to contribute to integral vision a			

…			
Potential to contribute to integral vision n			
Potential contribution to design example a			
…			
Potential contribution to design example n			
Contribution to institutional change			
Linking potential to other promises in the portfolio			
Network characteristics (e.g. single farmer vs. variety of stakeholders)			
Anchorage (Linking to niche and or regime; cf. Elzen et al. forthcoming)			
Contribution to sectoral innovation agendas			

Table 1: Evaluation framwork for bottom-up initiatives

Conclusion

To develop a sustainable animal production system (as well as a variety of other systems) will require a wide range of changes, a true system innovation indeed. Currently, there two approaches to tackle this challenge, called a top down and bottom up approach in this paper. Each of these has its strong and its weak sides:

- 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 its constituting parts (the promises) do not fit in well with the existing system. This makes it difficult to 'anchor' 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 would require enourmous (public) resources.
- 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 botom 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 strategie thus attempts to combine (1) top down and bottom up approaches and (2) the individual promise (in some cases 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 livesstock production sector.

Acknowledgement

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