

13 Reflecting on Novelty Production and Niche Management in Agriculture

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Introduction

Since the early 1990s, we have witnessed a comprehensive and far reaching transformation of agriculture throughout Europe. It has gained its momentum as a counter-force to the sometimes disastrous side effects of an over-modernised agriculture and over-industrialised food supply chain. This is not only happening in marginalised areas, unsuitable for modern industrialised agriculture, but also, if not more so, in the most successful growth poles of modernisation, such as the Netherlands. This drive for a radical turn can be understood as a quest to once again rebalance agriculture with societal needs. Although the need for a radical turn has become more or less commonly accepted, the route to follow is still subject to dispute. There are many different interests at stake and many threats to vested positions. So we find ourselves in a difficult transition from a specific way of ordering, with its evolving socio-material order, to another; in other words, from the socio-technical regime (see Moors *et al.* in this volume) connected with modernisation, that has been dominant for several decades, to an alternative regime. This alternative mode of ordering (Law 1994) has to be built up from scratch by experimenting with promising ideas that will bring forth all kinds of working bits and pieces (novelties). In turn these have to be welded together into a properly *working whole* (Roep 2000). The new regime is shaped when moving along the track. This is a recursive process, with feed backs, feed forwards, set backs and inevitable detours. Success and failure go hand in hand, depending on ones perspective and may change over the course of time.

Radical innovation, in contrast to incremental innovation, implies a rupture with the widely shared and self-evident ideas and routines and with the vested ways of thinking and doing. When the logic of the vested order is challenged and turned upside down, the process of innovation creates instability and disorder. This then requires a common and convincing *guiding principle* that can show the promise inherent within

this dramatic process and provide sufficient *room for innovation* within the vested order.

During recent years several models or guiding principles have been proposed to address the unsustainable character of modern agriculture. According to Marsden (2003) three different models can be distinguished, which are currently competing in shaping agriculture and rural space:

- 1 The *agro-industrial model*: an accelerated modernisation, industrialisation and globalisation of standardised food production characterised by high levels of production, long food supply chains, decreasing value of primary production and economies of scale.
- 2 The *post-productivist model*: the countryside as a consumption space characterised by the marginalisation of agriculture (due to its low share in Gross National Production), the provision of private and public rural services and the protection of rural nature and landscape as a consumption good to be exploited by the urban population.
- 3 The *sustainable rural development model*: the integration of agriculture, nature, landscape, tourism and private and public rural services, characterised by re-embedded short food supply chains, multifunctional agriculture, rural livelihoods, new institutional arrangements and economies of scope.

The theoretical and empirical essays in this volume are based on the premises of the rural development model. Their central point of departure is that the problems created by modernisation, i.e. through disconnection, have to be countered by a *(re)particularisation of agriculture* (Roep 2000), i.e. reconnecting it again to its social and (agro-) ecological environment. This has also been conceptualised as the principle of downgrading (see van der Ploeg *et al.* in this volume).

The second and third parts of this volume (chapters 5 to 12) demonstrate that innovative farmers and farmers' collectives (in collaboration with other stakeholders) have produced an impressive range of promising novelties. However, many of these novelties remain hidden or are at least not generally acknowledged (by the vested order) as relevant building blocks for a transition towards sustainability.

This raises two questions. First, why do these novelties remain hidden? And second, how to uncover these promising, but still hidden, novelties and enhance their diffusion in order to facilitate a transition towards sustainable rural development? Before addressing these questions we will briefly reflect on the process of agricultural modernisation. Second, we will discuss the specificities of agriculture in relation to novelty creation and strategic niche management. Next we will briefly outline some of the lessons learned for novelty creation and strategic niche management in agriculture. We conclude this epilogue by discussing a pro-active framework for studying and managing radical innovation processes in agriculture.

On institutionalised capacity and incapacity: an institutionalisation perspective on agricultural modernisation

Producing and marketing food products of basic quality at competing consumer prices (i.e. bulk production) has been the main ordering principle guiding agricultural and rural development in all EU member states (and also in many other countries) for several decades. In primary agriculture this was translated into increasing the production per animal, per hectare and per labour unit. This drive towards maximisation of productivity has been realised through specialisation, intensification and scale enlargement.

The construction and reproduction of this track was, to a large extent, realised and facilitated through government policies. By adjusting the working of the market on the one hand and directing the supply of new production-techniques on the other a specific distribution of opportunities and restrictions was arranged, thereby creating a selective space for manoeuvre for farming, in which only modernised farms were expected to survive (van der Ploeg 1987; Roep 2000; Wiskerke 1997).

Through alignment and co-ordination the modernisation project gradually got more momentum¹ and the capacity to have the complex whole work effectively, from the cell of a plant to the European Community, grew. This capacity is very specific and became solidified through a nearly endless, varied and heterogeneous series of socio-material phenomena: specific policy instruments, specific knowledge and skills brought forth by specific research programmes, specific animal and plant breeds obtained through improvement, specific farm machinery, specific buildings, a specific production environment created through large scale reconstruction of the countryside, an extension service equipped to spread a specific message, the promotion of specific interests by co-evolved interest groups, a specific organisation for processing and selling of a range of specific products, a specific report between the family and farm business and between the family farm and environment, etcetera. This *institutionalised capacity* (Roep 2000) in turn works as a pre-ordered reality for the actions of engaged persons, providing a limited institutionalised space of action of opportunities and restrictions, or a selective institutional environment. Modernising thus became taken for granted, an institutionalised practice based on a widely shared and objectified range of ideas on how to think, feel and do. It came to define how things should be done and became seen as inevitable. That is why the translation of *the* working of the market and *the* progress made in (production) technology into *the* optimal order was called rationalisation.

Primary agriculture became embedded in an *organisational-institutional environment* with the characteristics of a quasi-organisation, where people were committed to their destined role and tasks: the co-realisation of a

modern way of producing and marketing on rational grounds. Benvenuti (1982) has incisively interpreted this orderly whole as a Technological-Administrative Task Environment (TATE) because of its strong prescriptive impact on the style of farming (see also Ventura and Milone in this volume). The working of the market as well as progression in technology were considered as autonomous and linear processes and therefore acquired a strong notion of inevitability. The unavoidable future was then predicted through the extrapolation of these autonomous and linear processes. This was often done with great eagerness and firmness. From the projected junction of both processes a picture of optimal farming in the future could be derived. This was in turn translated into what was perceived as an optimal complementary socio-material environment. Practice was then measured according to this virtual optimal farm in a virtual environment (van der Ploeg 2003). This implied an agenda (van Lente 1993): what had to be done to realise this. This rang the bell for the next round in the reordering of agriculture and the countryside. Farmers and farms were classified in terms of modern versus traditional, vanguards versus laggards, farms with and farms without future perspectives (van der Ploeg 1987). This distinction further legitimated the selective use of resources in policy. Through a specific (re)distribution of restraints and opportunities the limited space for action was even further restricted (see e.g. de Bruin 1997). Future explorations of promising technological progress were converted into a demand for that technology, resulting in a promise-requirement cycle (van Lente and Rip 1998). The obvious and inevitable was thus realised, like a *self-fulfilling-prophecy* (van der Ploeg 1995). This process repeated and re-enforced itself and propelling a seemingly autonomous process whose expression lay in the gradual outbuilding of capacity along a *narrowly demarcated technological trajectory* (Roep 2000; see also Moors *et al.* and Ventura and Milone in this volume). The capacity that was built was impressive, but the dynamics of this trajectory also had the features of a treadmill, of machinery out of control and almost impossible to step off of.

To unravel the working of this whole in all its parts is an enormous job. Here we restrict ourselves to one specific angle: the essence and impact of the *institutionalised capacity*. As we argue, the essence of modernisation was the generalisation of a specific way of farming intended to maximise productivity. All kinds of local socio-material characteristics, e.g. different agro-ecosystems such as peat land areas or hedge rows, were seen as obstacles to be overcome or to be eliminated. Particular agro-ecosystems had to be reconstructed materially as well socially to meet generalised optimal standards: creating optimal production conditions for optimal farm management. This *disconnection* of farming from the historical

particular socio-material environment is inherent to the modernisation project (van der Ploeg 2003; Roep 2000)

The modernisation project did not come out of the blue, nor was it implemented in a socio-material vacuum. It originated from a pluriform society², from a mosaic of interacting differential modes of ordering or styles. The intention was to re-model this according to modern standards and to rationalise it. This was always a matter of interaction, exchange and mutual influencing; of interlocking innumerable projects (Long and van der Ploeg 1994). Retrospectively one can conclude that the modernisation project gathered sufficient momentum to enforce a radical re-ordering of the existing socio-material whole. In other words, the agricultural modernisation project – in particular the keyword ‘structural development’ – became, in the course of time, institutionalised. Institutionalisation is, according to Zijdeveld (2000: 31-32),

‘the historical process in which initially individual and subjective behaviour (the unity of acting, thinking and feeling) is imitated, and then repeated in time to such an extent that it develops into a collective and objective pattern of behaviour, which in its turn exerts a stimulating and controlling influence on subsequent individual and subjective actions, thoughts and feelings. This creates taken-for-granted routines that may clear the way for the design of new actions, thoughts and feelings, if, that is, these routines do not fossilise into stifling expressions of traditionalism’.

Institutionalisation is thus a historical process in which individual and subjectively experienced behaviour is objectified into behaviour patterns, which are, as it were, detached from the individual concerned. What began as a choice to achieve policy goals (i.e. safeguarding domestic food supply, contribution of agriculture to the growth of domestic prosperity and a good living for those working in agriculture) became a self-evident development trajectory. Modernisation was transformed from a choice for a specific development route into a development route that was no longer questioned and subsequently one that went without saying (i.e. an objectified fact). Once institutionalised, the modernisation project legitimised the structural development measures designed to achieve the goals that it had defined. Legitimation, according to Berger and Luckmann (1967: 111),

‘justifies the institutional order by giving a normative dignity to its practical imperatives’.

The inevitable modernisation of agriculture also de-legitimised alternative options, routes and policy objectives: alternatives were classified as unacceptable because they were at odds with the self-evident.

But, as remarked before, the success story of agricultural modernisation also had a downside. Not everything went that smoothly and according to expectations. The radical reordering of agriculture and countryside ran

up against resistance from nature as well society. This expressed itself in all kinds of unforeseen social and material side effects that were under-appreciated or not appreciated at all. For example: a decline in natural values and a deterioration of valuable (cultural) landscapes, structural surplus production and rising public costs of market interventions, increasing environmental pollution connected to the intensification of land use, lagging family farm incomes, marginalisation of disadvantaged regions, emerging problems with animal welfare related to the maximisation of productivity. The impact of these undesirable side effects grew alongside the capacity built along the, once promising, modernisation trajectory. This triggered a counter-offensive, i.e. a process of subjectification as a reaction to a preceding objectification, as part of a cyclical, repeating fundamental anthropological process (Zijderveld 1974).

For various reasons societal opposition to the negative side effects of modernisation increased and ultimately the legitimacy of the modernisation project was seriously questioned. Not that the modernisation project had never been controversial, on the contrary. It has always been criticised from different angles and, at times, has been the subject of violent opposition by farmers. But the more effective that modernisation became, the more tangible the side effects became and the more criticism rose. The taken-for-granted nature of the project, and the notions of autonomy and inevitability that went along with it, were fundamentally questioned. A swelling counter-movement slowly but surely undermined the legitimacy of the project. At the same time a gradually growing number of farmers were looking for a way out to avoid what was supposed to be inevitable: i.e. either to continue along the track of increasing productivity, specialisation and scale-enlargement or to quit farming. This contained the seeds for change: ideas that look for a transformation of the vested order. But this couldn't occur without a struggle. The counter-offensive needed more momentum and, for that reason, more allies. In order to germinate and reach maturity potentially innovative ideas need fertile soil. They need to be nursed and protected against the vested order. This pioneering requires the institutionalisation of a tailored, selective and, protected space; an *institutionalised innovative space* where the necessary knowledge and skills can be built up. Studies of farming styles (see e.g. van der Ploeg & Long 1994) revealed that farmers were exploring new ways and that they were supported by new allies. In words and actions these farmers opposed prolonged modernisation. Studies of farming studies and follow up research on innovative farmers' collectives (see e.g. van der Ploeg and van Dijk 1995) show how these pioneers turned away from the vested order and managed to create some innovative space on their farms in order to counter modernisation. In doing so they tried to extend this capability, creating more institutional

space for a different way of farming and extending it through new arrangements with the support of new allies. But these challenging and promising initiatives still lacked the maturity and momentum to become a real alternative to modernisation. They were still too fragmented, too isolated, too fragile and vulnerable within the current institutional settings. To grow into mature, self-evident, institutionalised ways of farming the modernisation project itself had to be stopped and dismantled to give way to a radical institutional innovation.

With this emerging new trajectory came the notion of *institutionalised incapacity* as the reverse side of the institutionalised capacity built up during modernisation: the astonishing incapacity of the vested order to let things work out differently, which went far beyond unwillingness or obstruction. Where problems due to over-modernisation asked for new answers, the techno-institutional environment of agriculture followed the same old pattern. This incapacity was very evident when innovative groups of farmers in several regions addressed specific questions on how to re-particularise farming (see e.g. Roep 2000; Wiskerke 1997; Wiskerke *et al.* 2003): i.e. how to readjust farming again to specific agro-ecosystems, or how to commercialise the particular natural and cultural values by means of regional typical products. This move to a *(re)particularisation of farming*, countering the impact of modernisation, demonstrated the almost total absence of specific knowledge and skills, and the unwillingness of the vested order to countenance a radical change (van der Ploeg 2003).

This brings us to a more general remark: building the capacity to have a whole work specifically also implies a (latent) incapacity to have the whole work differently. The narrower the chosen trajectory, the more effective but also more one-sided the institutionalised capacity will be and the more evident the level of institutionalised incapacity will become. In the nineties this clearly was the case for many EU member states regarding agriculture and the countryside. The modernisation project was able to have such an impact because it was so very selective, one sided and rather simplistic in its goals. Surrounded by notions of obviousness, autonomy and inevitability the modernisation trajectory was pursued more or less blindly. Every deviation from this straight forward course would, according to vested opinions, only lead to detours and a loss of scarce time and resources. Of course, all kind of obstacles would appear, but the general belief was that they could be overcome through technological means.

Even when the call for a different way of producing and marketing food attracted more response from society, modernisation continued to be carried and propelled by the vested order. The gap between productivist agriculture and societal needs widened. The need for radical change was

first acknowledged by major parts of the vested order in the course of the nineties, after a succession of food and animal disease scandals had severely undermined consumers' trust and important markets collapsed: societal needs had to be met, consumers' trust and legitimacy restored.

Novelty creation, SNM and the locus and focus of farming

To enhance the development and diffusion of promising novelties Moors *et al.* (this volume) propose the construction of desirable transition paths through the strategic management of niches. Strategic Niche Management (SNM) is proposed as a tool for simultaneously managing both technical and institutional change and smoothing the diffusion process of promising novelties. The knowledge and expertise of users and other actors, such as policy-makers, researchers or representatives of public interests, are brought into the technology development process, in a process conceptualised as *smart experimentation*.

SNM was initially developed by the 'Twente school' in science, technology and society (STS) studies (Hoogma 2000; Hoogma *et al.* 2002; Kemp *et al.* 1998, 2001; Rip & Kemp, 1998). Initially it was a tool for nurturing promising technologies in transport to enhance the rate of application by making them more robust and by building a complementary institutional setting in which they can function properly. Later, it became part of a broader framework: the construction of new technological regimes and the possibility of intentionally working towards desired regime change. In this volume the focus is on agriculture and rural development which, in our view, differs substantially from domains such as transport or energy. Differences in the nature of farming imply both empirical and theoretical differences with respect to novelty creation and SNM.

The first difference regards the specificity of the *locus* and *focus* of farming. Agriculture can be seen as a specific form of co-production, as the result of all kinds of interacting ordering processes with different socio-material effects in time and space (Roep 2000). One specific feature of farming is that it involves the transformation of dead and, more specifically, of living matter. Additionally, because farming is located in an agro-ecological environment, it is an open system, so is subject to all kind of uncontrolled processes, which make it rather unpredictable. Although agro-technological development has attempted to minimise these characteristics, farming still depends, albeit to different degrees, on the working of uncontrolled 'natural' processes and therefore on farmers' knowledge of how things work locally (Stuiver *et al.* this volume). If one adds to this the different cultural and politico-economical circumstances farming is subjected to, and the relative small-scale (mostly family) business structure, one can understand the striking diversity in farming. Evidently, this has implications for knowledge development and

innovation, which should be based on diversity rather than seeking to overcome and destroy it.

A second, related difference regards the *locus* and nature of novelty creation. In (hi-tech) industrial sectors novelty creation is located mainly within specialised, capital intensive and isolated research and development (R&D) centres. The R&D scene is dominated by a few industrial conglomerates. Agriculture, however, consists of a multitude of relatively small-scale (mostly family) enterprises. There have always been innovative, leading farmers but, in general, a lack of resources and co-ordination has hampered innovation and diffusion. From the early 19th century onwards a publicly funded system for applied research, education and extension was developed to enhance the application of novel, more productive, farming practices. Until World War II this R&D body interacted strongly with innovative farmers. Innovation in agriculture was mainly founded on novelties created and/or tested by farmers. R&D was rooted in and sustained diversity. This changed fundamentally in the post war era when a mono-functional, productivist perspective on agriculture became institutionalised. For this regime diversity in farming and local specificity became obstacles to overcome. The expanding R&D infrastructure became the *locus* of novelty creation and innovation. Novelties created by farmers became irrelevant and subsequently were unnoticed. Nowadays, with modern agriculture in crisis, a re-particularisation of farming and subsequently a re-grounding of innovation in diversity and novelty creation by farmers could prove to be a promising solution for sustainable agricultural development. However, this promise implies debates, controversies, conflicts and even struggles with the vested institutional order. This explains why creating and maintaining room for novelty creation and smart experimentation by farmers is such an important element in the strategic management of promising niches.

Lessons learned for SNM in agriculture

In the second chapter of this volume Moors *et al.*, following Hoogma (2000), state that the success of early niche development depends on the quality of learning and the quality of institutional embedding. Geels & Kemp (2000) argue along similar lines that successful niche development and management depend on the quality of the processes that shape niche development:

- 1 The development and alignment of strategies and expectations;
- 2 Learning processes;
- 3 The creation and stabilisation of a social network.

Looking at the different cases discussed in this volume, i.e. different examples of agricultural niches, we can conclude that learning and institutional embedding (or more specifically alignment of expectations

and the creation of a social network) are indeed key factors to understand the (relative) success and failure of radical innovations. However, the different cases discussed also point to some specific lessons that are important for successful niche development and management in agriculture. We will briefly outline these lessons.

1 Create and maintain a learning environment

The different cases discussed in this volume show that learning is a multi-dimensional process. First of all it requires learning about the effectiveness, or performance, of a novelty for achieving a specific goal. Second, a learning environment should facilitate double-loop learning processes (Hoogma 2000): i.e., learning about the assumptions, meanings and preferences that relevant actors have (and develop) during the process of novelty creation. Third, it is important to learn about organisation, network building (i.e., the enrolment of others) and niche management as well as about the complex interaction between the technical and institutional aspects of novelty creation.

2 Explore and understand diversity

It is of crucial importance to explore and attempt to understand the relevant diversity. This is a critical success factor, especially in the initial stages. Reference to previously hidden novelties ('deviations from the routine'), shows that these are real phenomena that are being discussed, as opposed to mere plans or intentions. Of course, the capacity to present these initial deviations (or hidden novelties) as solid and as promising becomes, in this respect, decisive just as, further on in the process of SNM, the capacity to further unfold these novelties into a convincing and well-functioning programme is a central requirement. This is clearly illustrated by the case of the VEL and VANLA environmental co-operatives (see Stuiver and Wiskerke, Reijs *et al.* and Sonneveld *et al.* in this volume). The further unfolding of novelties implies a process of (re-)design affecting both the technical and the institutional aspects. Levels of performance are improved and objectified (made visible and scientifically founded), both to the farmers involved and to the outside world.

3 Make new and effective connections

At the heart of this process of (re-)design there is a simple but powerful 'triangle' of farmers, surrounding actors (other rural entrepreneurs, researchers, extensionists, farmers' unions, etc.) and the endogenous development potential required in the local constellation (the promises resulting from the local 'deviations from the routines'). In the end (re-)design is about making new and effective connections (see Mango and Hebinck in this volume) and creating coherence and synergy (see Brunori *et al.* in this volume). These examples show the importance of the basic

'triangle', which places local practices and resources as a starting point for further processes of unfolding.

4 Creating alignment is a continuous process

The alignment of strategies and expectations is not a finite, linear converging process. Full alignment will probably never occur, and if so, only temporarily. Continuous re-alignment at later stages is thus as important as alignment during the initial phase. As with actors' expectations and strategies, the stability of a niche is, or can be, of a temporary nature (see e.g. Wiskerke and Oerlemans in this volume). Continuous management and evaluation of the niche and its surrounding network, aimed at maintaining individual responsibility for, and commitment to, the collective goals, approach and products, remains an important activity. It is therefore important to stay in control and avoid a kind of expropriation of the (re-)design process.

5 Improve ones own situation and prospects

A fifth and perhaps self-evident lesson is that the actors are involved because of the prospect of improving their own situation and prospects. If there is no progress or reciprocity (at the level of either the material and the moral economy) then every attempt at successful niche management will fail. This evidently applies to all parties involved.

6 Change agents are crucial to set a process in motion

Visionaries are needed to make the connection between societal developments at the broad landscape-level (see Figure 1), putting pressure on the dominant regime, and creating room for manoeuvre at the local-level. Their role is to envision windows of opportunity, express expectations and enrol alliances. The cases discussed in this volume have taught us that in agriculture local leaders (not necessarily farmers) can play an important role as visionaries or change agents.

7 Assess the value of the unexpected

The case of the *Quesería Morisca* (Remmers in this volume) demonstrates that the success of a novel socio-technical configuration may depend on the capacity of the people involved to transform the unexpected or unintended into something useful or valuable. This implies that results of experiments should be assessed only according to initial expectations and promises. Evidently this also has implications for the organisation of learning processes, i.e. the quality of learning processes also depends on the capacity to make use of, and build innovations upon, unexpected outcomes.

A revised framework for studying and managing technical-institutional change

Based on the contributions to this volume we have developed a more proactive framework for studying and managing the co-evolution of technical and institutional change (Figure 1). It is an elaboration of the work on technical change and transitions carried out by Kemp *et al.* (2001; see also Figure 1 in Moors *et al.* in this volume) and Geels (2002). The institutionalisation perspective (i.e., the routinisation and socio-material sedimentation of practices) and the interaction between the material, technical and social components of technical-institutional change is made more explicit in the vertical dimension. This dimension is to be understood in terms of expanding socio-material spaces; going from local practices (where the actors are) to the wider world. The dynamics along this spatial dimension can be studied in terms of actor-worlds.

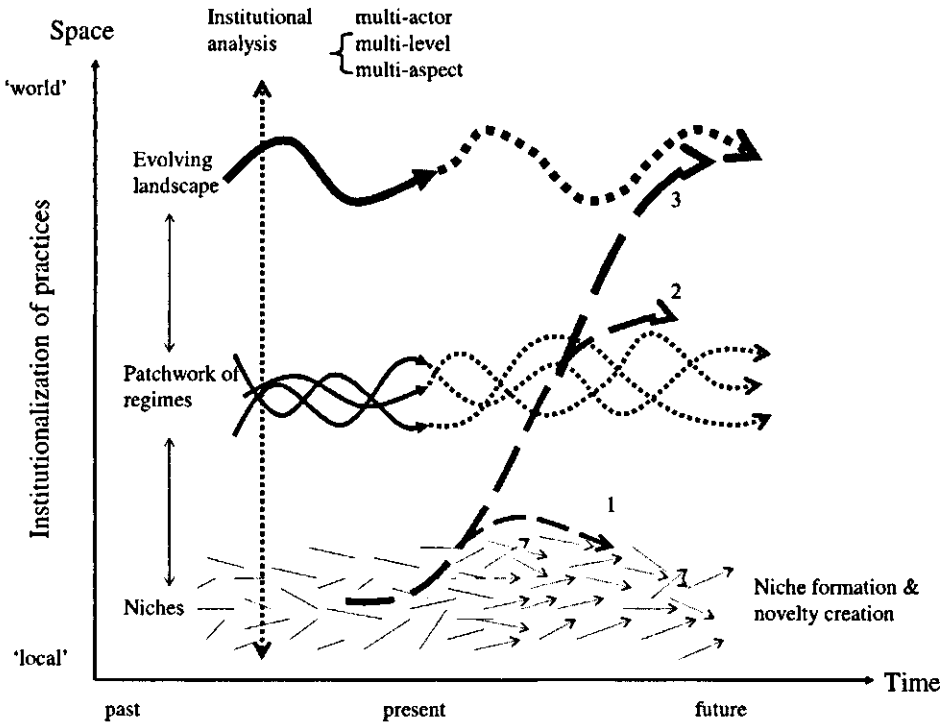


Figure 1. An overall framework for studying and managing technical-institutional design (1 = No breakthrough of novelties; 2 = System innovation and regime shift; 3 = Transition). After Roep (2002).

The framework can be used as an analytical tool to study and comprehend the complexity (multi-actor, multi-level, multi-aspect) of technical-institutional change. However, it can also be used as a reflexive

tool in order to question oneself: how far has a transition in agriculture come and what can we do about it? By way of conclusion we will do the latter and will make some remarks on how to relate novelty creation, (system) innovation and transition as inputs for a pro-active management of technical-institutional design processes:

- 1 The transition in agriculture is still in the early phase of development and, although we can see the emergence of a new regime and the contours of a system innovation in the different niches described in this volume, a reversal of regimes is still a long way off. As the modernisation regime has been a strongly dominant force for some decades, innovation and transition in agriculture are seriously hampered by the institutionalised incapacity to do things differently (Roep 2000). This (consciously or not) obstructs novelty creation and consequently system innovation and, in the long run, a transition towards the sustainable development of agriculture and the countryside. Institutional innovation (as part of a reversal of regimes), exploring new ways of doing and new ways of formal organisation, is crucial for the transition in agriculture to take off.
- 2 No matter how much we talk or write about it, (system) innovation and transition are started by piecemeal changes that are locally produced, by novelties created by innovative actors which need to be nurtured in niches to develop their potentialities. In pro-active terms this means that innovation and transition are inevitably rooted in promising, innovative practices. This implies that we need to stimulate novelty creation, niche building, smart experimentation and the creation of communities of practice (building social capital) in order to explore and evaluate the potential of (a connected range of) novelties. Such potential needs to be evaluated at different levels, e.g. at the level of the farm, sector, region and society at large, as considerations of sustainability will differ between these levels, and this will influence design criteria. Taking into account the specificity of agriculture it is important to base system innovation and transition upon the innovative work of farmers.
- 3 Innovation or transition policy is more effective at the start or take-off of a transition, when things are still fluid and relatively open, than in the later stages of transition (Rotmans *et al.* 2000). Policy needs to stimulate and facilitate novelty creation and smart experimentation, in order to learn from, and further develop, their potentialities in respect to system innovation and transition.
- 4 Innovations and transitions have to be connected to ongoing dynamics and be rooted in innovative practices. Innovations and transitions are not neutral processes: there is a lot at stake. One can explore different, competing transition paths that lead to different outcomes. The prospective outcomes, as well as the prospective transition paths

leading to these outcomes, will be subject of debate. One management or design tool, which is often used, is that of projecting different (visionary) desirable future images and then projecting possible transition paths back from this point to the present situation, identifying the obstacles to overcome and what is needed along the way (backcasting). One must however keep in mind that creating these future images and possible transition paths is merely an instrument and not a goal in itself. One cannot disregard current dynamics and enforce these, even though some force is sometimes needed to effectuate change. Top-down management of innovation and transition, focused on a single goal is not appropriate in a pluriform society, as we have learnt from the several decade long process of modernisation.

- 5 Finally we want to reiterate the importance of simultaneous design of the technical (artefacts, machines and systems) and institutional functionalities (rules, roles and procedures) of novel configurations in order to create a more properly working whole. Even if they are not aware of it, institutional and technical engineering are not entirely heterogeneous activities (Law 1994). Technical engineers presuppose or, often implicitly, design a complementary institutional setting, and institutional engineers often do the same in reverse. This emphasises the need for inter- or even trans-disciplinarity as a sound foundation for intentional technical-institutional design.

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Notes

1 'Technological systems, even after prolonged growth and consolidation, do not become autonomous: they acquire momentum. They have a mass of technical and organisational components; they possess direction, or goals; and they display a rate of growth suggesting velocity. A high level of momentum often causes observers to assume that a technological system has become autonomous... The large mass of a technological system arises especially from the organisations and people committed by various interests to the system. ...The durability of artefacts and of knowledge in a system suggests the notion of trajectory, a physical metaphor similar to momentum.' Hughes (1987: 76). 'Momentum, however, remains a more useful concept than autonomy. Momentum does not contradict the doctrine of social construction of technology, and it does not support the erroneous belief in technological determinism. The metaphor encompasses both structural factors and contingent events.' (*ibid.*: 80).

2 The more far reaching society becomes, the more pluriform it will be (Berger and Luckman 1966; Zijderveld 1974). Several modes of ordering will co-exist, as distinguishable styles with differential socio-material effects. The interplay of these different modes of ordering actually shape society. If a society is stretching out in time and space, where most members have no direct interpersonal contacts, a common styling in the way certain things have to be done becomes crucial for effective co-ordination and social cohesion. Mapping the differences and similarities, the interplay, the construction and destruction of a vested order: all this belongs within the classic repertoire of empirical sociological research.