1 On Regimes, Novelties, Niches and Co-Production

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At specific conjunctures in time, the need arises to introduce new key-terms to single out and highlight phenomena that – until then – have lain hidden in the obviousness of everyday life. Novelty production is, we believe, such a key-term. Derived from the rich tradition of technology studies, it is a new and probably somewhat unfamiliar concept in agriculture, in the world of farmers, fields and agricultural engineers. Its use may even cause some unease, since it refers to longstanding practices that hardly seem to need any further discussion, let alone any new terms. However, we believe novelty production to be a concept that, together with the associated notions of socio-technical regimes and strategic niches, might help find new ways out of the many-facetted crises that agriculture is currently facing.

Novelties and novelty production

What then is a *novelty*? A novelty is a modification of, and sometimes a break with, existing routines. It is, in a way, a deviation. A novelty might emerge and function as a new insight into an existing practice or might consist of a new practice. Mostly a novelty is a new way of doing and thinking – a new mode that carries the potential to do better, to be superior to existing routines. Novelties can be seen then as *seeds of transition*. At the same time, though, we should stress that a novelty is often perceived as something different, as a potential critique of current performances. When novelties emerge, especially in the beginning, they are sometimes seen as 'monstrosities'.

The metaphor of seeds of transition is a useful one, since it helps to clarify, right from the beginning, three essential elements. First, novelties need *time* – just as seeds require cultivation and nourishment to germinate, grow, flower and set fruit. They follow a specific unfolding through time before the final outcome (their 'usefulness') can be assessed. Equally novelties require time to show whether or not the entailed (or assumed) promises really do materialise. Secondly, seeds require a particular ordering of space, or more generally: a particular organisation of *context*. Sowing seeds on rock bed or in a desert is useless. One needs a well-

prepared seed-bed, a well organised distribution of water, proper crop protection, and so on. Translated to the level of novelties, this implies that one change in existing routines often implies a second one and then a third and fourth, etc. The first improvement spurs the second one, because it both requires and informs it. That is, a novelty seldom remains isolated; a novelty will result in a wider *programme* of interrelated, and mutually reinforcing novelties. Thirdly, the inherent *insecurity* needs to be stressed. Just as harvests may fail, novelties might turn out to be failures as well. Novelties are related to *expectations*. It is, however, far from evident whether the eventual outcomes will match the initial expectations. Thus a novelty is, to echo Rip and Kemp (1998), 'a new configuration that *promises* to work'.

Continuing the same analogy, we could equate the notion of novelty to a mutation through which a single new variety of seed arises, through mutation in just one seed. That single seed falls on the ground, germinates, the plant grows, flowers, sets seed and shows characteristics that other non-mutated seeds do not have. That is a first, one-off, different outcome. If this first outcome is 'recognised' by the environment as being advantageous, more seed with this new characteristic might be produced. This would then be a second-level or 'general acceptance level' outcome: a general recognition in the context that this represents a beneficial change. Conversely, the 'first' outcome might go unnoticed (which is the most common scenario). Then the novelty remains a 'hidden one' – it might even be nipped in the bud.

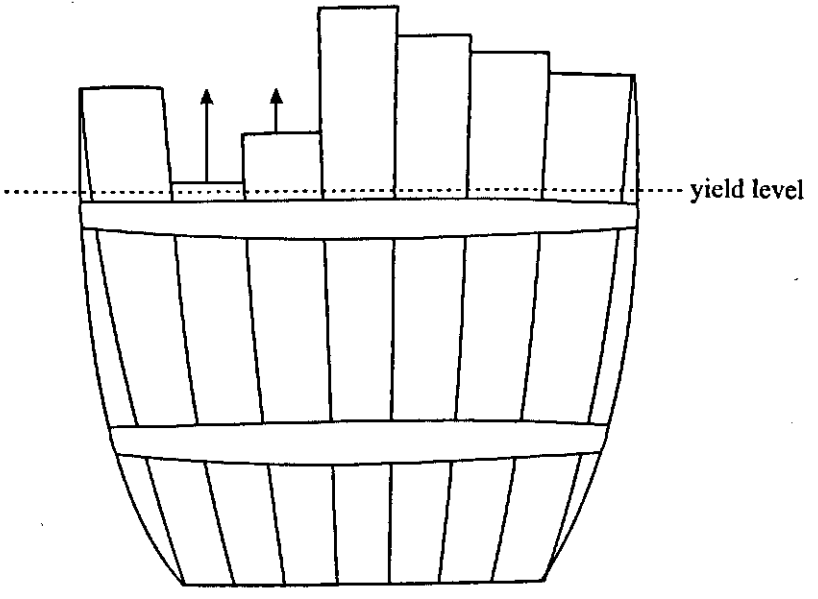
The history of agriculture is a history of novelty production. Over the centuries farmers have introduced, on purpose or unintentionally, small changes in the process of production, resulting in a steady but ongoing increase in yields. This process has been amply documented by, amongst others, Slicher van Bath 1960; Boserup 1965; de Wit and van Heemst 1976; de Wit 1983; Richards 1985; Bieleman 1987; and Osti 1991.

Analytically speaking it might be argued that novelty production is intrinsic to agriculture as co-production, i.e. to agriculture as the ongoing encounter, interaction and mutual transformation of the social and the natural (Toledo 1992; Rip and Kemp 1998; Roep 2000; van der Ploeg 2003). Agricultural production involves the co-ordination and fine tuning of an extensive range of growth factors, including the amount and composition of nutrients in the soil, the transportability of these nutrients, the root capacity to absorb them, the availability of water and its distribution over time and so forth. Even the relatively simple cultivation of wheat involves more than two hundred such growth factors and more emerge with the growth of knowledge.

What is important is that these growth factors are not constant through time, they are not fixed since 'Genesis'. They are constantly changing

because they are regulated, modified and co-ordinated through the labour process in agriculture. For example, the amount and composition of nutrients in the soil are modified through the work of farmers (see Hofstee 1985 for an impressive discussion of farmers' management of soil fertility before chemical fertilisers were available). 'Transportability and distribution of nutrients' depend on ploughing, and the availability of water is regulated through irrigation and drainage. In the end, yields depend on the most limiting growth factor, as illustrated in Figure 1 in which the growth factors are represented as the staves of a barrel. The water level, i.e. the yield, depends on the shortest stave.

Figure 1 Growth factors composing the agricultural process of production (von Liebig 1855, see also de Wit 1992a and b)



The combination of these two points leads to a third one. That is that within their *praxis* farmers are continuously looking for the 'shortest stave', that is for the limiting factor[1]. Through complex cycles of careful observation, interpretation, re-organisation (often taking initially the form of experiments) and evaluation, novelties are found and/or created. That is, existing routines are changed. This is an ongoing process: once the original limiting factor has been corrected, another will emerge as the newly limiting one.

Novelty production is, in agriculture, a highly *localised* process: time and again it is dependent on local eco-systems and on local cultural repertoires in which the organisation of the labour process is embedded.

This implies that what emerges in one place (and at a particular time) as an interesting novelty, will probably not pop up in another place or if it does it might have adverse effects or hold little or no promise.
Novelty production is very much interwoven with, i.e. emerging from and resulting in a specific type of knowledge, that is *local knowledge* or, as Mendras (1970) phrased it *l'art de la localité*. This is artisanal knowledge (*'savoir faire paysan'*, according to Lacroix 1984); knowledge about fine-tuning and mutual adjustment of growth factors through the co-ordination of tasks and subtasks. Such knowledge results in, and in turn enriches novelty production.

Socio-technical regimes

According to Rip and Kemp (1998), a socio-technical regime is the 'grammar or rule set comprised in the coherent complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artefacts and persons, ways of defining problems – all of them embedded in institutions and infrastructures'. A regime, then, specifies the way in which the societal segment dedicated to produce new technologies, new rules, new modes of doing, is working. In this way it also puts its own specific mark on its products[2].
Current socio-technical regimes in Western agriculture impose, in the first place, a set of supranational, national and, sometimes also, regional regulations. These specify targets (e.g. quality standards for milk; maximum ceiling for nitrogen losses per hectare; maximum level of nitrate in groundwater; required reduction of ammonia-emissions), techniques and practices assumed to be necessary to realise these targets (e.g. legally required injection of manure into the subsoil; coverage of slurry silos), timetables, control systems and sanctions. The regimes also, directly or indirectly, prescribe farming practices. These prescriptions may cover such aspects as cattle density per hectare, the architecture of farm buildings and the level of investments and variable costs associated with environmental measures and regulations. They strongly influence the material nature of fields, cows, fodder and manure (see Sonneveld *et al.* in this volume). That is, a socio-technical regime does not order only the 'social', it also orders the 'material'.
Thirdly, a socio-technical regime implies a specific trajectory for ongoing research and development. Innovations that are considered to make the emerging or established regime more coherent, more adequate and/or more efficient, will be constructed and implemented, whilst others that are considered less relevant (or not relevant at all) will remain 'underdeveloped'. More generally speaking, a regime implies also a specific distribution of knowledge and ignorance (Hobart 1993). It produces insights, databases and common rules for identifying and

proscribing what will be produced within the 'privileged way forward'. Other possible trajectories will necessarily remain in the 'shade'[3].
Fourthly, a socio-technical regime links different places. It links operations at farm level with decision-making centres at national and supra-national level. It links R&D practices and the associated flow of innovations with farms and also with the involved state apparatuses, by showing what is possible and what will become feasible in the short and medium term. It also links to the public at large which, through the operation of the regime, is informed about 'progress' in agriculture. In short: a socio-technical regime links different levels, different actors and different dimensions (including the social, the technical and the material). The more coherent these interlinkages are, the more efficient the regime will be.

Regimes evolve over time. The specificity of *current* socio-technical regimes in agriculture resides in a number of elements. The regimes tend to be generic and regulations are applied regardless of specific circumstances. They are legitimised through claims on scientific grounding and aim for clear, uni-linear and unambiguous prescription and controllability as an explicit design principle. This in turn creates a preference for prescribing specific means and creates a subsequent confusion between goals and means. Moreover, the socio-technical regimes build on the previous regimes. The ones in existence today stem from the great modernisation project that reshaped Europe's agricultural systems in the second half of the 20th century. Many of the features of these regimes have directly contributed to the many-sided problems of sustainability that we face today. These features were (and remain) scale-increases at farm enterprise level, industrialisation of production and processing and the increased interwovenness with, and dependency on, markets and market-agencies. These same characteristics might also be characterised as leading to a range of disconnections. As agricultural enterprises became increasingly integrated into new socio-technical regimes, they became progressively disconnected from the parameters that had previously defined their development trajectories. These parameters included local eco-systems, local knowledge, local skills and craftsmanship, local specialities, local social relations and cultural repertoires, regional town-countryside relations and the economic relations embedded in them. The local 'grammar of farming' (or farming style as Hofstee 1948 and 1985, would have put it) became increasingly replaced by a new 'grammar', now orientated towards modernisation. At the same time it was strongly intertwined with a range of institutions, state-apparatuses, regulations, new technologies, new patterns for the social and spatial division of labour, new professional identities and new ways of problem-definition and problem-solving.

During the modernisation trajectory the driving forces of agricultural growth changed in a radical and far reaching way. Whilst for centuries it was farmers[4] who sought for and then corrected the limiting growth factors (the 'short staves' of Figure 1), in the era of modernisation the agrarian sciences took over this role of upgrading of specific growth factors (and subsequently adjusting others). In consequence a new division of labour emerged: farming became increasingly embedded in, and dependent on, the socio-technical regimes and the process of upgrading was considerably accelerated.

In this context, the process of intensification[5] changed drastically. Before the 1950s it was largely dependent upon the quantity and quality of farm labour[6]. Now intensification has become basically a function of applied technologies, the associated inputs and the corresponding rules and procedures. In the present socio-technical regime ongoing upgrading represents an institutionalised trajectory, but one whose path could have been different if the regime were different. In other words it has created a path dependency (North 1990; Knorr-Cetina 1996), which is produced through a range of rules, laws, organised bodies of knowledge, procedures and increasingly by available artefacts, the size and lay-out of fields, and institutionalised mechanisms for selection and reproduction of plants and animals (Wiskerke 1997; Groen *et al.* 1993; Jongerden and Ruivenkamp 1996; Bouma *et al.* 1993).

The accelerated upgrading of growth factors, and the associated intensification, specialisation, spatial concentration and scale enlargement, runs increasingly counter to a range of social and ecological limits and reactions. The more so since natural growth factors entailed in the local eco-systems are being replaced by artificial growth factors: the 'art of farming' has become increasingly disconnected from locally available resources and the eco-system, and from local socio-economic patterns and relations (Altieri 1990; van der Ploeg 1992). As a result novelty production by farmers (but not only farmers) is increasingly blocked since the production of progress is now largely taken over by those institutions that form part and parcel of the reigning socio-technical regimes.

The sustainability issue

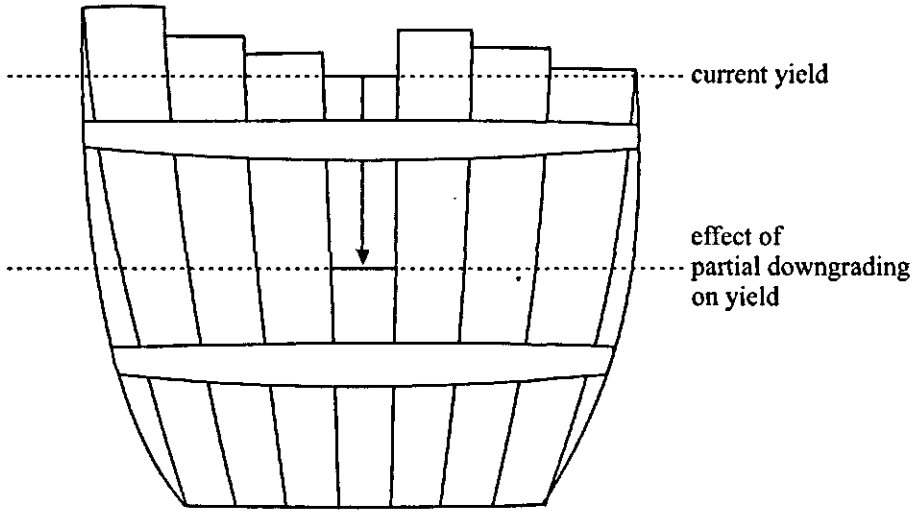
Sustainability is, for many reasons, a key issue in world agriculture as illustrated in many declarations and commentaries (Delors 1994; Van Aartsen 1995; Fischler 1996; Cork Declaration 1996; Iacoponi 1996; RLG 1997; South Africa's Rural Development Frame Work 1997)[7]. Agriculture's achievements in the twentieth century should not be underestimated. Food production has increased dramatically as a result of technological

breakthroughs in plant breeding, fertilisation and biocides. World cereal yields were doubled in just forty years, an astonishingly short period relative to the thousand years it took for English wheat yields to quadruple (from 0.5 tons to 2.0 tons per hectare). But this progress has come at a price. Agriculture now contributes significantly to the general environmental crisis the world is facing. Emissions of a range of pesticides and nutrients to soil, water and air are having severe consequences in the short, but especially, the long term. Secondly, agriculture both causes, and suffers from resource depletion. Fertile top soils are washed away, destroyed and/or salinated; aquifers containing the irreplaceable stocks of sweet and clean water are dried up or severely contaminated. Highly valuable genetic diversity (plant and animal) is eroded and once gone is lost forever. The energy use of many agricultural systems increasingly contributes to the menace of global warming. Finally food quality and safety are increasingly threatened, as shown by an ever-continuing series of food scandals all over the world.

The issue of sustainability is intrinsically interwoven with socio-cultural and politico-economic dimensions and problems. Whatever processes occur, be they growth, development, stagnation, or specialisation, they all have implications for the widening and deepening problems of sustainability. Examples from this volume alone include: overgrazing, soil degradation and the associated unemployment and poverty in parts of South Africa (Adey *et al.*), the sharp reduction of biodiversity in maize production in Kenya (Hebinck and Mongo), and the massive accumulation of nutrients in parts of Europe (Reijs *et al.*). These (and many other) expressions of unsustainability are *institutionalised* They are firmly rooted in the institutional patterns as well as in the 'hardware' (technologies, infrastructure, trading patterns, etc.) that shaped and governed developments to date (Marsden 2003). In other words: many, if not most environmental problems are the outcome of socio-technical regimes. They cannot be considered as simple deviations or errors, which can easily be addressed and resolved. On the contrary, tackling these problems implies considerable and often far-reaching adaptations if not entire shifts in the regimes that have given rise to them.
In Europe, the reigning socio-technical regimes are increasingly having to adapt their programmes in order to address the issue of sustainability. All across the EU specific regimes have been implemented that are orientated towards reducing the environmental pressure caused by agriculture. These regimes are co-ordinated at the level of the EU: which sets global targets, although the means for achieving these vary slightly between countries and sometimes regions.

One of the common features of these regimes is that they frequently aim to meet sustainability criteria through introducing additional regulations that aim to down-grade a few, specified growth factors (see Figure 2).

Figure 2 Partial down-grading (or the way current regimes try to impose sustainability in agriculture)



New societal objectives such as e.g. more bird life in meadows, cleaner ground water, fewer additives in food, or lower ammonia emissions, are translated into a reduction of specific growth factors and specified in terms of the associated tasks. Hence, mowing should be delayed, fertilisation should be reduced, manure should be applied through injection into the soil, etc. However, through such partial down-grading the carefully constructed co-ordination of the whole is disrupted and a range of discongruencies will emerge. Costs will rise and yields will drop. The dominant technological regime deals with this by financially compensating for the associated drops in productivity and/or increased costs. Schemes for landscape and nature conservation are clear expressions of this approach. While often successful in the short term the dilemma that they give rise to is becoming very clear. The more agriculture uses this approach to move towards sustainability, the higher the associated financial burden will be (ADAS 1996; Slangen 1994).

We cannot know beforehand whether or not a socio-technical regime has the capacity to resolve the problems of sustainability and to reach its professed (though sometimes conflicting) goals. This will depend on many factors, a few of which we refer to below:

- The degree to which agriculture has been effectively aligned and standardised. If a considerable degree of heterogeneity exists (due to, among other things, 'promising pockets' of not yet disconnected and/or re-connected agricultural systems, ref. Adey *et al.* in this volume), a generic environmental policy and, consequently, a coherent socio-technical regime is likely to run counter to the variety of real life situations. This is more likely if the development trajectory is highly institutionalised and, therefore, inflexible.
- The degree to which the proposed solutions and innovations are in line with the interests and rationale of the involved actors.
- The degree to which the preferred trajectory is rooted in a comprehensive understanding of the complexities of farming and its interactions with living nature. The less this is the case the greater the chance that unexpected and unintended consequences will emerge and hamper, or even undermine, the proposed trajectory[8].

Alternative roads towards sustainability

There might be other roads to sustainability. Many of these are emerging from current forms of novelty production. In the current context (of harnessing regimes) novelty production involves an ongoing search, through practice, for adequate ways to handle environmental problems (including the problems introduced by the rules, procedures and artefacts stemming from the socio-technical regime). Frequently there is a clear distinction between what we term 'novelties', which result from that search, and the innovations and prescriptions introduced by the reigning regime. These novelties emerge directly from farm labour processes and the associated local knowledge. That is, they are highly adapted to local particularities[9]. Novelties also pop up as organisational and/or technical devices that a) fit into the existing processes of production (albeit transforming them) and b) render considerable gains not only in terms of sustainability but also in economic, institutional and social terms. In short: innovations and novelties have different 'life-histories' and are, therefore, quite often different in substantive terms as well.

A brief example (that will be further discussed in chapters 7 to 9 of this book) will help illustrate this point. It is derived from dairy farming in the Northern Frisan Woodlands (in the Netherlands). Farmers here operate in a small-scale landscape, characterised by hedgerows and a micro-relief that is associated with relatively wet and dry soils existing close to each other. The style of farming economically (that is, opting for a low use of external inputs) is very typical for the area (van der Ploeg 2000). A straight forward application of the rules and procedures imposed by the socio-technical regime would cause considerable problems here, or

possibly even produce a series of highly counterproductive effects. Convinced of the case for, and inevitability of, more sustainable approaches farmers (after an initial period together with involved scientists and politicians) here developed a range of new approaches. Building upon local experiences they proposed the production of 'better manure', to be realised with adapted feeding techniques, additives and different grassland management strategies[10]. The production of 'better manure' was understood, presented and eventually realised as a promising alternative to the 'end-of-pipe' technologies proposed by the reigning regime. Thus, producing better manure became a road towards sustainability that differed remarkably from the prescribed method of injecting manure into the subsoil. Other novelties accompanied this: a new machine for spreading manure was developed, tested and in the end widely used and region-specific programmes for conserving natural and landscape values were designed and implemented[11].

Through all these novelties the farmers were able to meet the generic environmental goals more quickly, and in a far more convincing way, than many other areas of the Netherlands. Probably even more important, they succeeded in combining these 'environmental gains' with considerable social, economic and institutional gains. Central to all this was the opportunity that the concerned farmers could develop their own local ways of reaching the general environmental goals (see below). This required considerable flexibility, creativity and innovativeness on the part of the farmers because the environmental goals were generic in character and largely imposed by EU headquarters in Brussels. The farmers could easily have opted to criticise the environmental threshold values for nitrate in groundwater and the associated application rates of organic manure as being too severe and harmful to the economic feasibility of farming operations. The same can be said about the prescribed reduction of ammonia evaporation from manure. Rather than challenge these thresholds in court, as has been done elsewhere (resulting in futile battles with bureaucrats) the farmers made a great leap forward by taking these thresholds for granted and by developing – through a range of interconnected novelties – new management practices that would meet these thresholds. As it turns out, economic farming is possible under such conditions. In fact, management is improved and results in more sustainable production systems.

Niches and strategic niche management

The practices discussed above, the associated learning processes and the ongoing production of other, sometimes promising novelties, were only made possible by the gradual but persistent creation of a niche. A niche is *a protected space in which novelties can mature* (Kemp, Schot and Hoogma

1998). The particular niche developed in the Northern Frisan Woodlands was an environmental co-operative (see Stuiver and Wiskerke in this volume and also Renting and van der Ploeg 2001)[12]. These co-operatives emerged from lengthy negotiations between farmers and authorities, resulting in a contract between the Minister of Agriculture and local farmers. The Minister granted farmers the necessary space for manoeuvre, to develop and mature their own means or novelties on the understanding that the farmers would meet, if not exceed, the general environmental aims more quickly and more efficiently than elsewhere. The thus established protected space (or niche) made it possible to check whether the previously hidden novelties had the potential to become new constellations that not only showed promise, but demonstrated their operational effectiveness.

The niche developed further and consolidated itself through the construction and institutionalisation of a range of new social relations, networks, the development of new (local) knowledge, the capacity to 'deliver', etc. The creation of a governing board for the co-operative opened opportunities for creative and active farmers, which had a major effect on the activities of everyone. Progressive farmers led and inspired the others. In the absence of such a co-operative, peer pressure between the many farmers in the area might have stifled novelty production, as farmers watch each other closely and those that are wary of change can easily be the most vocal and appear as the voice of wisdom thereby inhibiting change. Under such conditions the tone is set, not by innovative farmers, but by the most conservative ones, who can easily sway local opinion. It is important to stress that without the niche provided by the environmental co-operative the development of novelties would have been impossible. Making better manure and improving soil biology (through, amongst other things, on-surface application) would simply not have been options if manure injection became obligatory. The same goes for many of the other novelties.

This book will also discuss several other niches. Some of these have been created deliberately, as is the case with the *Zeeuwse Vlegel* group (Wiskerke and Oerlemans, this volume) and the 'wine routes' in Tuscany (Brunori *et al.* this volume). Other niches are, as it were, the unintended outcome of specific regimes, as is the case in Luo Land in West Kenya (Mango and Hebinck, this volume). The 'promising pockets' in South Africa, described by Adey, Kotze and Rijkenberg are another example.

Novelties as radical innovations

From the argument developed so far two opposing positions emerge: the socio-technical regime vs. the niche. In a way this contrast comes down to another one: innovations vs. novelties. Here the notion of innovation

strongly links with regime as innovations fit into the prevailing regime, and are often, although not exclusively, produced by the institutions forming part of the regime and neatly follow its 'grammar'. Innovations are incremental. They build upon the state-of-affairs, the logic and the grammar. They are also incremental in so far as they represent the next small step forward along predefined lines. Novelties on the other hand are, as it were, radical innovations. They entail (at least potentially) the possibility of a regime-shift. Novelties are, in one or more ways, 'at odds' with the reigning regime. They are not easily integrated and emerge, more often than not, from the 'periphery' of the prevailing regimes.

Although in general terms there are differences between novelties and innovations (these concern amongst other things their different genesis[13], grammars[14] and horizons of relevance[15]) the contrasts that we have drawn between them are not necessarily that clear cut. Throughout agricultural history emerging novelties have been explored by extension services, individual scientists and/or state services. They have nurtured these novelties, unpacking them from the particularities of time and space, testing them and, where possible, improving them so as to make further dissemination possible[16]. Furthermore, many of the institutions within the current regimes also are involved in novelty-production.

That is, regardless of the differences between novelties and innovations, the two might intertwine and complement each other very well. The current problem, though, is that the two are increasingly separated, if not diametrically opposed to each other in terms of validity, scientific grounding, effectiveness and competitiveness. Some promising changes in agronomic research do incorporate novelties as part of a process of prototyping farming systems. These studies first pay attention to local expertise, which is then followed by expert input on those areas that need further clarification. In other words, research of the classical type is intended only to fill in the remaining gaps (Bouma 2001a and b). This is in contrast to the major thrust in academic agronomic research, in which detailed research is often the starting point, that is used to generate series of coefficients that characterise various hypothetical farming systems that appear, on paper, to fulfil criteria for sustainability. With no relation to real-world systems and with little opportunity for farmers to participate in their development, systems generated in this way are bound to die in abstract beauty.

The troublesome relations between regimes and niches compose a key theme of this book. We believe that these troubled relations (which will be amply documented throughout this book) represent a major problem. Firstly, because a considerable amount of innovativeness (and corre-

spondingly: a range of potential solutions) is lost in this way. Secondly because regimes will lose their legitimacy: the trust required for their smooth functioning will be eroded. Thirdly, the transaction costs associated with the functioning of agriculture and food production will rise to levels that are in the end (if not already) far too high.

We also believe that, through strategic niche management, better ways might be developed to handle the current contradictions and tensions. In the final chapter of this book we will systematically address this theme, through revisiting and re-analysing the empirical case studies that centre on the 'difficult marriage' of regimes and niches.

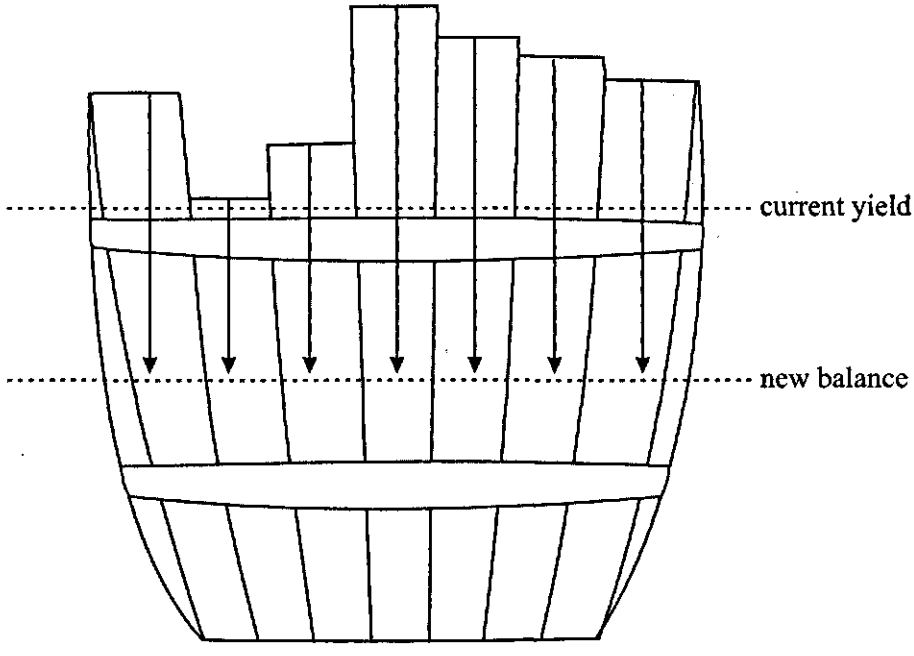
Strategic niche management has implications that extend way beyond agriculture. The role of science in post-modern society is changing. Rather than providing answers to questions that have been phrased by scientists themselves, scientists – in order to survive – now have to take part in interactive processes with a wide variety of stakeholders engaged in creating joint learning opportunities. Scientists have to do more in future than solve self-defined problems. They also have to explain, to negotiate, to clarify and to build on the novelties they observe and/or fashion.

Re-balancing co-production

There is, we believe, an important theoretical background to be discerned within the current processes and forms of novelty production. Several of the empirical expressions of novelty production discussed in this book entail adopting a radically different perspective. In contrast to the current approach, which focuses on *partial* downgrading, whilst continuing to upgrade other growth factors, the case studies entailed in this volume explore the possibility of an overall, well co-ordinated and congruent *re-balancing* of all relevant growth factors. This is achieved by a systematic and integral reorganisation of the labour and production process, that aims to create a new balance that allows for farming to become both ecologically and economically sustainable. Instead of one growth factor, the whole range of relevant growth-factors is 'shortened', re-structured and brought back in line (see Figure 3)[17]

A brief illustration might help to clarify this notion. In many places grassland management is adapted, for instance, to allow for the development and maintenance of natural values (flora, birds, animals) or the conservation of water in the subsoils or to keep marginal lands under cultivation in order to prevent ecological destruction. Consequently, fodder produced in these grasslands will have a lower energy value compared to fodder produced under 'optimal' conditions. However, if the animals have been bred to be dependent on high energy fodder this creates a discongruency. This can be resolved in two ways.

Figure 3 Rebalancing as radical alternative



In the current approach the farmer is compensated financially so that he or she can buy the required 'energy' elsewhere. The alternative would be to select (that is to create or 'build') a new breed whose nutritional demands correspond more closely with the changed grassland production. Evidently such an adaptation will require a range of further changes within the farm, as well as in the interrelations between the farm and the economic and institutional environment in which it operates. All the relevant subsystems and interrelations have to be reorganised so as to create a new equilibrium (van Bruchem 1998).

There is some evidence, partly theoretical, partly empirical, that such new equilibria do not necessarily imply an overall reduction in income levels (see e.g. van der Ploeg 1994a and 1994b; van der Ploeg *et al* .1997; and ILEIA studies reported from the Third World: Reijntjes *et al.* 1992; Haverkort *et al.* 1991; Compas 1998). A well integrated overall process of re-balancing might imply substantial cost-reductions and may generate new income-opportunities (Broekhuizen *et al* .1994 and 1997). However, the insights into and experiences with such an overall re-balancing remain very scattered in the literature. Equally no well-articulated theoretical representation of this perspective has yet been developed. This is a reflection of the dominance of the prevailing technological regime (see for a general discussion North 1990 and Hobart 1993).

Hypothetically, an overall re-balancing (as illustrated in Figure 3) might result in income improvement. Apart from immediate savings (less fertiliser, less concentrates), a range of indirect effects may emerge. The 'lowering' of a range of growth factors might considerably reduce the total stress in the productive system, which might translate into a reduction of diseases (both in plants and animals). In turn this may reflect in lower expenditure for veterinarian assistance and intervention and in prolonged longevity, which in its turn might help to reduce the costs of breeding heifers to replace cows, etc. When the 'lowering' of a range of (artificial) growth factors goes together with the re-introduction of nature, these effects might be even stronger (soil biology and the associated autonomous nitrogen delivery capacity of the subsoil play an important role in this respect; see Verhoeven *et al.* 1998). The extent to which these effects will emerge depends on the 'art' of re-balancing and the skills of those involved.

The methodological starting point of the case studies entailed in this volume is, in itself, simple but powerful. It is related to the fact that *in practice* many farmers realise forms of re-balancing, in order to adapt their particular farm enterprises to the particular ecological and/or economic situation in which they operate[18]. Re-balancing can also occur as a result of farmers trying to adapt their business better to the peculiarities of the products they produce (Ventura and van der Meulen 1994; Roep 2000), or adopting new strategies[19] *In situ* experimentation and local knowledge play a crucial role here (Box 1990; Stuiver and Wiskerke in this volume). An impressive range of sometimes astonishing novelties[20] is the outcome of this innovativeness of farmers. However, these mostly remain as 'hidden novelties' because the prevailing scientific regime does not yet recognise that such novelties are the key to effective innovations rather than a nuisance that distracts from the grand-designs that have been constructed scientifically, following the established regimes.

This book therefore addresses a number of interrelated themes. First of these is studying the relationship between novelty production and rebalancing. A second is exploring the rigidity and flexibility of relations within the dominant agricultural regimes in the Netherlands, South Africa and Italy. Special attention will be given to the question of why and how so many novelties remain 'hidden' or, *vice versa*, under which conditions some novelties are absorbed, transformed and generalised through the reigning socio-technical regimes. The role of science will receive particular attention. Thirdly attention is focused on some 'strategic niches' in which favourable conditions exist that make it possible to go beyond the impasse that exists between the production of novelties, on the one hand, and the technological regime on the other.

This leads to a discussion of the implications of 'strategic niche management' (Kemp, Rip and Schot 1997) on the ways in which agricultural research is currently organised.

The AGRINOVIM programme

This book stems from a five year, international research programme funded by the Dutch NWO, in which the Universities of Perugia (Italy), Natal (South Africa) and Wageningen and Twente (both in the Netherlands) are participating. AGRINOVIM focuses on three areas of study each containing, in one way or another, a particular niche within which novelty production is taking place. These are the 'promising pockets' in South Africa, the Apennine mountains in Abruzzo, Italy and the Northern Frisian Woodlands, where the already introduced environmental co-operatives are located. In each of these three areas the research centres on processes of novelty production, on the complex interrelations between niche and regime and on forms of strategic niche management.

In each of these niches sustainability emerges as a specific problem. In the Abruzze, for instance, the ongoing decline of dairy farming and animal breeding from the mountain zones is seen as a priority problem requiring specific interventions and new institutional relations. Without farming (and especially grazing) it is impossible to maintain the rich but fragile eco-systems (Biondi 1996; Meeus *et al.* 1988). There is a clear need to design farming systems that fit the particular ecological conditions, yet also need to be capable of existing within the increasingly globalised market conditions (Ventura 2001 and more generally Long 1985 and 1996).

Given the support of the *regions*, the interest of the involved farmers and the availability of the extensive experimental facilities of the University of Perugia, the prospects of developing new and proper techno-institutional designs (that regard both the further maturing of novelties and the strategic management of niches) are relatively encouraging.

The same applies to South Africa. Here, there is a considerable need to develop new farming systems that include indigenous flora and fauna (many species are to be considered 'novelties') and which can also offer new employment and income facilities to resource-poor farmers (Lipton *et al.* 1996). At the same time the land reform framework and the experience and the experimental facilities of the University of Natal in Pietermaritzburg provide a positive institutional setting for the design of farming systems based on integral re-balancing.

The third niche is located in the Frisan Woodlands, an area in the North of the Netherlands where farmers have created the 'environmental co-operatives' discussed earlier.

On a theoretical level the AGRINOVIM programme aims to integrate previously largely disconnected disciplines and bodies of literature. These are neo-institutional economics[21], rural sociology[22], social constructivism (or actor network theory) [23] and classical agronomy[24]. Multi-level analysis is central to this process, and is used to simultaneously address (1) 'material realities' (at the micro-level) such as fields, animals, grassland production and manure, (2) social realities such as the evolution and differentiation of farming styles (at the meso-level), (3) macro-level patterns of interaction, such as the interrelations between farms, markets and institutions and between 'novelty production' and technological regimes and (4) the impact of collective actions that aim to secure a definitive shift in techno-institutional designs towards new forms of agricultural development. In (4) the complex interactions between micro, meso and macrolevel play a central role (Knorr-Cetina 1981).

We acknowledge that the proposed integration of these disciplines into one multi-disciplinary approach is an ambitious one. Still, a serious effort of this nature is long overdue and should no longer be postponed. Many papers and governmental bulletins mention the importance of multi-disciplinarity without exploring the practicalities of this approach. In this respect Bouma (1999, 2001a, 2001b) emphasises the need for each discipline to define its expertise (in different degrees of detail) in order to clarify its potential role within the disciplinary toolkit. This approach can avoid the problem of different disciplines attempting to communicate on totally different wavelengths. Bouma also advocates use of research chains which start with user expertise and expert knowledge at different spatial levels and then draw on detailed research to fill in the gaps. This is in stark contrast to much current research, which starts from a detailed, but uncontextualised, approach (which is a tested means of securing publication in single disciplinary scientific journals) but which does not necessarily connect with the real world and the novelties emerging from it.

The contents of this volume

This book is divided into three sections. The first sets out some of the major theoretical lines needed for a proper understanding of novelty production and niche management. Moors, Rip and Wiskerke summarise the international literature on the dynamics of innovation and systematically introduce the central concepts of regime, niche and novelty. Ventura and Milone broaden the theoretical discussion from a neo-institutional perspective. They argue that time and again novelties entail and imply *boundary shifts:* in which the boundaries between the farm enterprise, on the one hand, and markets and market agencies, on the other, are redefined and reorganised. Sometimes these shifts are small

ones, sometimes more fundamental. Boundary shifts can sometimes make a considerable positive contribution to the incomes realised from the re-balancing that occurs as a result of novelty production. The last chapter of this section (by Stuiver, Leeuwis and van der Ploeg), focuses attention on local knowledge and its development as crucial pre-conditions for much novelty production

The second section concentrates on novelty production in Dutch dairy farming, focusing on the VEL and VANLA co-operatives in the Northern Frisian Woodlands. First Stuiver and Wiskerke synthesise the ongoing but often fragile process of novelty production, stressing that novelty production results in an expanding *programme of change* – a programme that is one of the fruits of the initial *seeds of transition.* Then Reijs, van Bruchem, Lantinga and Verhoeven explore the technicalities of new pathways towards sustainability, focusing on the reduction of N surpluses. Their discussion is followed by a new theoretical perspective on 'the role of land in agriculture' (by Sonneveld, Veldkamp and Bouma). Through the introduction of the concept of *phenoforms* they build, on the practical progress realised in the VEL and VANLA area, whilst also offering a new conceptual 'bridge' to link theory and practice.

The third section presents a range of contrasting experiences from different parts of the world. First Adey, Kotze and Rijkenberg discuss the radical transition in agricultural research, extension and policy in post-apartheid KwaZulu Natal. In this rapidly and radically changing context of agricultural production they describe and analyse the emergence and development of *promising pockets* (i.e. niches) for sustainable agricultural and rural development. This is followed by a Dutch example (*Zeeuwse Vlegel*) on the construction of an alternative short food supply chain (wheat and bread). In this Wiskerke and Oerlemans analyse the dynamics of building a niche for sustainable baking wheat cultivation *vis-à-vis* the prevailing regime of wheat breeding, production and processing. Next the story moves to Spain. Remmers gives a detailed case description of the development and marketing of new cheeses in a mountainous rural area of Southern Spain (Alpujarra). This illustrates the crusade that rural innovators must embark on in order to succeed, and the qualities they must possess to do so. Central to Remmers' argument is the concept of serendipity, i.e. the process of unexpected transformation from something marginal into something valuable. In his contribution Remmers develops the concept in terms of an actor's capacity to perceive, at the appropriate moment, what is valuable for the success of a rural enterprise and argues that this is a crucial capacity in processes of alignment. The Spanish case is followed by an example from Kenya, in which Mango and Hebinck explore the relationship between culture, markets, technology and

agriculture. They demonstrate the interfaces between the cultural repertoires of local people and the scientific repertoires of research institutions. In their contribution, Mango and Hebinck seek to explain how local culture 'reads' local as well as scientific knowledge and new technologies (in this case the hybrid maize varieties and accompanying packages). They also explain how local culture forms part of a 'defence line' against the practices that are introduced and favoured by scientific knowledge. In the last chapter of this section Brunori, Galli and Rossi, use the example of wine routes in Tuscany, to explore *collective action* at the local level. They identify that the capacity to create alliances with the outside world is one of the key elements for success in novel rural development practices. Collective action enables small entrepreneurs to mobilise social relations, to improve their economic performance and create new opportunities for growth. This is, according to the authors, due to the fact that collective action in a wine route results in *coherence* and *synergy*.

This volume concludes with an epilogue in which Roep and Wiskerke propose a more pro-active framework for studying and managing the co-evolution of technical and institutional change. This framework, which is an attempt to integrate the different theoretical lines discussed in the first section, can be used both as an analytical tool and a reflexive management tool. The epilogue summarises the strategic lessons learned from the empirical examples for novelty creation and niche management in agriculture.

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Notes

1 Of course this depends on historical conditions and, more specifically, on the social relations of, and in, production (Hayami and Ruttan 1985)

2 Scientific institutions and 'expert systems' are important cornerstones of today's regimes (Giddens 1990; van der Ploeg 2003). Hence, it is not only the socio-technical regime that affects the type of innovations being realised, but also the regimes of science itself. Despite claims of academic freedom, most scientific disciplines have clear sets of written and unwritten rules and different 'schools of thought' that strongly define the type of scientific activity that will be rewarded by the system. Many academic journals are still disciplinary in character and thrive on ever more detailed investigations that have, at best, only remote relevance to real world processes.

Thus a technology is composed of a semi-coherent complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, and institutions and infrastructures (Rip and Kemp 1998; Kemp *et al.* 1994 and 1997; Dosi *et al.* 1988 and 1993; van Bentum 1995; Buttel and Goodman 1989; van der Ploeg 1987; Rambaud 1983). Technological regimes have been characterised in agrarian sciences as TATE, or Technological Administrative Task Environments (see Benvenuti 1982, 1989 and 1990), producing an ongoing flow of techno-institutional designs which 'co-order' both the material and the social world (see Bijker and Law 1992; Lente 1994; van der Ploeg 1993; Vacca 1989; Bouma 1993).

3 That is, a regime defines to a considerable degree the agendas for scientific and applied research. In that sense a regime also links the present with the future and the future with the present (see van der Ploeg 2003).

4 Every now and then assisted by the representatives of classical agronomy as, e.g., Zacaria Iahia 1802; Barigazzi 1772; Cuppari 1969 and Marenghi 1923.

5 Intensification refers to the dominant type of agricultural development, that is to produce more output per object of labour; that is per unit of land, per animal, per vineyard, etc. Upgrading of growth factors is evidently essential to intensification.

6 This implies that also the specific patterns of communication, the interests, prospects and values of those involved, etc., play an important role. See for a further discussion Beaudeau 1994; Engel 1997 and Leeuwis 1993.

7 The international development of precision agriculture provides an intriguing footnote to the above discussion. Clearly, precision agriculture is part of the dominant technological regime. However, by using information technology and global positioning systems, management can be varied in space within a field focussing on local demands of crop which, as any farmer knows, vary considerably within a field. By fine-tuning management practices within a field to the varying needs of the plant, which can also follow guidelines of organic agriculture if so desired, resource use and negative environmental side effects to soil and groundwater are minimised (Bouma *et al.* 1999).

8 New regulations that oblige farmers in the Netherlands to inject manure into the subsoil provide an example of this. Such an operation, which is a typical example of the logic of the current regime in Dutch agriculture, are intended to reduce ammonia emissions to permitted levels. However, some experts claim that a considerable part of the injected ammonia later evaporates through the stomata of the grass-leaves (Erisman 2000). Injection might have destructive effects on soil biology (thereby reducing the autonomous nitrogen delivery capacity of the subsoil, so that far more fertilizer and/or concentrates are needed). These two factors may undermine the rationality of injection and erode the legitimacy of the institutions prescribing it. The underlying problem here is that environmental policies were constructed with insufficient insights into the practices of farming. What was most noticeably missing was insight into promising deviations.

9 And not, as is the case in the institutionalised production of innovations, more or less disconnected from local particularities.

10 Eshuis *et al.* 2001; VEL/VANLA *et al.* 1997 and more generally van Bruchem 1997 and van Bruchem *et al.* 1998.

11 This is a relevant detail especially since the straight forward application of official environmental legislation is, in several situations, at odds with nature conservation objectives (especially bird life) as well as with landscape preservation.

12 More detailed reading, especially on the crucial 'take off' stage of the first co-operatives can be found in de Bruin 1997; de Bruin *et al.* 1994; Hees, Renting and de Rooij 1994; VEL/VANLA *et al.* 1997; Verhoeven *et al.* 1998; Renting and van der Ploeg 2001 and van der Ploeg, Frouws and Renting 2002. An international comparison, that also considers these co-operatives, is outlined in OECD 1996.

13 See Wiskerke (1997) for the case of wheat varieties and van der Ploeg (1993) for the case of potato-breeding in the Andes.

14 A beautiful analysis is contained in van Kessel (1990). See also Darré (1985) and Dupré (1991).

15 Conklin (1957).

16 Engel (1997), who made an extensive study of extension practices in the Netherlands estimates that, of the total 'supply' of innovations offered by the extension services between 1960 and 1980, some 40 per cent were directly derived from the insights that extensionists obtained from experimenting and/or pioneering farmers. A further 40 per cent was obtained from other extensionists who in turn had got a considerable degree of their ideas directly from other farmers. Only some 20 per cent of the new ideas followed the cannonical line that goes from basic research, via applied research to extensionists. As far as applied research is concerned van der Zaag, once the leading expert in potato breeding and cultivation, estimated that some 80 per cent of all major changes in Dutch potato industry after WW II, initially emerged as farmers' bred novelties. These novelties then became, as it were, 'absorbed', 'unpacked' and 'reformulated' by the research institutes (see van der Ploeg 1987). Vijverberg (1996) in his turn, reconstructed the 'life-histories' of some of the main innovations in the Dutch horticultural sector. He showed that only when there was a strong interaction between farmers and researchers, did the resulting innovations prove to be successful. Nonetheless, the dominant (intellectual) model that represents the flows of communications, the interaction of blocks of knowledge, etc., and which strongly informs agricultural policy in this respect, remains at odds with this empirical situation.

17 From a theoretical and methodological point of view, the graphical representation contained in Figure 3, entails at least two major problems. The first is that many farms cannot be conceptualised as just one 'barrel' – they are, instead, a series of connected and communicating barrels. Reference to a farm familiar to the authors, the Ivy Farm in South Africa, might illustrate this. The Ivys had carefully controlled grazing camps for their Bonsmara beef breed. These beef animals were slaughtered and sold in their own butchery. In addition they had a fattening beef feedlot which also contributed to their butchery. The Ivys therefore had a 'barrel' for the grassland, another for the Bonsmara beef feedlot and yet another for the butchery. These different 'barrels' had to be co-ordinated in a precise way. At the same time the interrelations might change. Recently, the Ivys have sold their Bonsmara herd, reduced the size of the feedlot and introduced game hunting onto the farm. Their butchery now handles game and trophies. Fenced off grazing camps have disappeared. Overall, family income has increased through these changes, whilst farming is now more sustainable and natural resources are used more intensively and more efficiently.

The relevance of this illustration relates to the second point. That is that the 'staves' of the barrels cannot be seen (as is the case in the classical Von Liebig model) as independent from each other. Reducing one or some 'staves' (or growth factors) in one particular 'barrel', might well lead to the increase of other 'staves' in other parts of the farm (other 'barrels').

Doing away with the fences, for instance, created considerable opportunities for game farming. This can also apply to single 'barrels': decreasing one stave may well increase (or decrease) another dependent one. In novelty production we are frequently confronted with such sets of dependent variables. This means that the lowest stave does not determine yield or income; lowering it may in fact push up yields or income. For the sake of simplicity, though, we stick to Liebig's method of representation. However, when discussing and illustrating the 'lowering of a range of growth factors' (further on in this text), these two points underlie our arguments.

18 These adaptations to different specificities are reflected in the impressive heterogeneity of agriculture; see in this respect Almekinders, Fresco and Struik 1995; Beaudeau 1994; Bouma 1994 and 1997; Bowler *et al.* 1995; Hebinck 1990; Jollivet 1988; Kerkhove 1994; Leeuwis 1989; Manolesco 1987; Roep *et al.* 1991, Steenhuisen de Piters 1995; Wiskerke 1997; Remmers 1998. In this respect it is telling that several of these studies refer to particular 'novelties'.

19 Broekhuizen *et al.* 1994 and 1997; Marsden *et al.* 1992; Drooger, Fermont and Bouma 1996; Droogers and Bouma 1996.

20 Box 1990; Dupre 1991; Leeuwis 1993; Isart and Llerena 1997; Compas 1998; van der Ploeg and Long 1994; van der Ploeg and van Dijk 1995; Alders *et al.* 1993; Haverkort *et al.* 1991; Osti 1991 and Swagemakers 2002.

21 Especially as far as this refers to the structure and dynamics of agricultural enterprises and the relations in which they are embedded (Saccomandi 1991 and 1998; Pennacchi *et al.* 1996; Bagnasco 1988). In this context special attention needs to be paid to issues of value adding (Ventura and van der Meulen 1994; Ventura 2001) and the analysis of 'funds and flows' (Georgescu-Roegen 1972; Romagnoli 1994). Equally important is the analysis of innovative processes generally and novelty production especially in terms of transaction costs. See Ventura and Milone in this volume.

22 Especially those parts that regard the dynamics, heterogeneity and malleability of the processes of production and labour (van der Ploeg 1990; Long 1985; Toledo 1992), the grammar, dynamics and reach of local knowledge (Conklin 1957; Darre 1985; Leeuwis 1993; van Kessel 1990; van der Ploeg 1987) and the creation of novelties (Remmers 1998; Roep 2000; Osti 1991; Swagemakers 2002).

23 Especially those parts that concern co-production and co-evolution (Rip 1995; Rip, Misa and Schot 1995; Knorr-Cetina 1996; Latour 1991 and 1994; Callon 1986; Law 1994) and technological regimes and path-dependencies (Rip and Kemp 1998; North 1990).

24 Especially as far as it implicitly focuses on key issues of co-production as the interactions between agriculture, soil and ecology (Bouma 1994; Droogers and Bouma 1997), the socially constructed interactions between soil biology, grassland production, cattle selection, cattle feeding and manure production (van Bruchem *et al.* 1997b; Penacchi *et al.* 1996) and the inclusion of indigenous flora and fauna into different farming systems (Biondi 1996; Conklin 1957).