Upscaling grassroots innovation for sustainable agriculture: experiences from the Dutch dairy sector

Frans Hermans[1], Dirk Roep[2] and Laurens Klerkx[1]

[1] *Knowledge, Technology and Innovation Group, Wageningen University, The Netherlands*

[2] *Rural Sociology Group, Wageningen University, The Netherlands*

Abstract: It is an open question how grass root innovations can have a wider impact beyond the people directly involved in their initial development. Processes of replication, scaling-up, but also translation and institutional entrepreneurship are likely to play different, but important roles in the institutionalisation of new innovations. However these processes, and the different actors involved in them (farmers, scientists and innovation brokers) so far have remained underappreciated in the literature. Our contribution to the workshop therefore has the aim to further explore these processes in which a local innovation becomes institutionalised on higher system levels. We will do this by presenting our study of the development and spread of the "kringlooplandbouw" (low external input farming) in the Dutch dairy farming sector. The concept of low external input farming got its start in the environmental cooperatives of the Northern Frisian Woodlands in the early 1990s and it a good example of grassroots innovation in which local farmers, together with scientists, civil servants, NGOs and farmer unions worked on the reduction of environmental loads and the improvement of the local landscape at the same time. Since that time, the concept of low external input farming has spread over the Netherlands and it has become somewhat of a catchphrase that has attracted the interest of farmers, researchers, consultants and politicians. As a result different networks in different regions have sprung up over the years that are trying different forms of low external input farming, sometimes even practices that contradicting and conflicting approaches. We will analyse the different actor coalitions that make up the different regional networks, alongside their different practices of low-external input. We will analyse these so-called "unfolding webs" (Van der Ploeg et al., 2008) and the overlap and contradiction between the various approaches and their typical sustainability discourses that accompany them. An important conclusion of our contribution is therefore that the model of adoption and diffusion is not an adequate model that is applicable on the spread of agricultural grassroots innovations. Instead, the political dimension of innovation networks and the negotiation processes between different groups of actors deserves more attention.

Keywords: grassroots innovation, upscaling, participation, low external input farming, dairy sector

Introduction

In this paper we will address the question of the successful diffusion of grassroots innovations for sustainable agriculture. Although grassroots innovation is desirable because of its inclusion of many types of local stakeholders in the innovation process, its practical implementation is often fraught with difficulties. One of the main problems it that grassroots innovations, through the involvement of stakeholders, quickly lead to a 'unique' solution that is difficult to scale up or apply in other contexts (Van de Kerkhof & Wieczorek, 2005). It is an open question how such grass root innovations can have a wider impact beyond the people directly involved in their initial development. Processes of replication, scaling-up, but also translation and institutional entrepre-

neurship all play different, but important roles in the institutionalisation of new innovations. However these processes, and the various actors involved in them (farmers, scientists and innovation brokers) have remained underappreciated in the literature (Smith & Seyfang, 2013).

In this paper we will present an historical study of the development and spread of the practice of "kringlooplandbouw" in the Dutch dairy farming sector. The development of kringlooplandbouw is a good example of a grassroots innovation in which local farmers, together with scientists, civil servants, NGOs and farmer unions have worked on the reduction of environmental loads and the improvement of the local landscape at the same time (Wiskerke & Van Der Ploeg, 2004 ; Hermans et al., 2013). Since the approach got its start in the 1990s it has spread across all parts of the Netherlands and it has been even tried out at the European level. As such this case provides a good case to illustrate the different mechanisms that have contributed to the spread of the approach.

The paper starts with a short overview of different theories that have been used to study the spread of an innovation from the initial pioneers to a broader population. Subsequently we will introduce our case and describe the history of kringlooplandbouw in the Netherlands, based on a number of important projects where the approach has been tested and improved. We will identify three different innovation coalitions that each have promoted a different form of low external input farming and see how these forms have taken root in different communities and how these coalitions have worked to promote their specific practice of kringlooplandbouw and the meaning of the word "kringlooplandbouw" has changed over time.

From novelty to innovation through diffusion, translation and institutional entrepreneurship

Historically the adoption and diffusion model has dominated the thinking about the spread of innovations. However, over the years, the view of what an innovation constitutes has broadened and nowadays innovations are defined as successful combinations of 'hardware', 'software' and 'orgware' (Smits & Kuhlmann, 2004). Innovations not only require new knowledge and modes of thinking but also a reordering of institutions and new forms of organisation. A successful innovation therefore is not only about the adoption or rejection of an individual technology, but it is also about changing 'the rules of the game', effectively reforming institutions that define the existing practices (Roep et al., 2003 ; Lounsbury & Crumley, 2007). Innovation processes therefore necessarily involve a wide variety of actors. The relationships between farmers, consultants, policy makers, supplier and processing industries, retail outlets, customers, NGOs and financial service providers form a complex network where a single actor is unable to advance an innovation alone (Hall & Clark, 2009 ; Knickel et al., 2009). Cooperation between different actors in a so-called technical niche is important to develop and promote an innovation (Schot & Geels, 2007). Actors in these niches are involved in a struggle to influence or redesign established rules and frameworks in their favour and eventually replace the existing 'socio-technical regime' (Geels, 2002 ; Geels & Schot, 2007).

However, as Smith has argued: practices from the niche level are almost never simply adopted in a socio-technical regime but most of the time some form of translation takes place (Smith, 2007). In the process of up-scaling and innovation, the original idea is reworked, expanded and improved upon by an ever changing coalition of new partners. The goal of this paper to follow over time how the idea of nutrient management on dairy farms has developed and spread over the Netherlands and how this has changed the original core idea.

Methodology

Data gathering involved a mix of participatory observation, document analysis and in-depth interviews with some of the people involved in the low external input farming practice all over the Netherlands. The history of the VEL and Vanla cooperatives and the pioneering work that was done between 1992 and 2008 were done mainly on document analysis. The developments in the rest of the Netherlands were investigated using interviews with key informants: 5 scientists from various discplines (plant science, animal science soil geography) two of them leaders of research programmes. One civil servant responsbile for the project management in the province of Drenthe and four (commercial) consultants involved in organising and facilitating farmer study clubs on the topic of kringlooplandbouw (researchers, consultants, civil servants and farmers). In addition, participatory observations were used of these of study clubs but also of seminars and other activities organised by different organisations connected to the kringlooplandbouw network.

An open interviewing format was used for the interviews. A brief introduction of their personal involvement on the topic of kringlooplandbouw and how they viewed its development was included in all the interviews.

Based on these data we constructed an innovation history of the nutrient management approach and how it developed over time. Using the idea of 'unfolding webs' (Van der Ploeg et al., 2008) we have followed how different project have followed on each other and how different groups of people have pursued their own form of nutrient management with in their own innovation coalition.

Results

We have identified three pathways through which 'kringlooplandbouw' has developed within the Netherlands: the alternative track, the provincial track and the national track. Figure 1 gives an overview of the different projects and programmes that have contributed to different forms of nutrient management. We will shortly discuss these different programmes and how they are linked together. Subsequently we will discuss how the narratives and coalitions have changed over time.

The VEL/Vanla cooperatives

The concept low external input farming got its start in the environmental cooperatives of the Northern Frisian Woodlands in the early 1990s. This group of farmers introduced the environmental cooperative as a new form of farmer organisation, the experimented with landscape maintenance and management in order to generate new forms of income and finally they experimented with nutrient management as a new approaches to dairy farming (Renting & Van Der Ploeg, 2001 ; Roep et al., 2003 ; Eshuis, 2006). The environmental cooperatives as an organisational form and the landscape management became quickly institutionalised (within 10 years). The nutrient management approach however, took far longer.

The nutrient management idea developed in the VEL/Vanla cooperatives is a form of low external input farming and is rooted in a holistic systems perspective at the farm level. The nutrient flows from grass to cows to manure to soil to grasslands is followed and managed. An important part of this nutrient management approach, and according to some actors even the most important part of it, is the treatment and application of cow manure on the grasslands using surface broadcasting of the manure. This application method for spreading manure has been prohibited by law in 1990 in order to reduce ammonia emissions and farmers are only allowed to use manure injectors.

The manure injectors at the time were very heavy machines and they were unsuitable for the small scale plots of the local farmers. As a result. Farmers felt the threat to have to cut down the hedges surrounding their lands and which gave the area a unique landscape. The VEL/Vanla farmers therefore lobbied the national government and in 1996 the Minister created experimentation room for this group of farmers to try and develop other means to combat ammonia emissions. They obtained an exemption for the broadcast spreading of manure provided they would reduce their emissions more quickly than they would have to do in other regions. As a prerequisite the Minister ordered the involvement of a number of scientists to properly monitor en evaluate the effectiveness of their experiments.

The nutrient management projects of the Northern Frisian Woodlands

In 1998 a new phase of the development of the environmental cooperatives commenced. The original two local cooperatives merged together with three new cooperatives to form the cooperative of the Northern Frisian Woodlands. Additional research funds were obtained from NWO (Netherlands Organisation for Science) and the grassland experiments for which the farmers got their exemption also commenced at the same time, creating a great influx of researchers within the local network.

In 2001, the group of involved scientists split internally over the interpretation of the manure application experiments. The spark that ignited this controversy was the publication of the book 'Good manure does not smell' (Eshuis et al., 2001) by a group of scientists affiliated mainly with the rural sociology department of Wageningen University claiming the success of the grassland experiments. The second group of scientists, mainly affiliated with the animal sciences department of the same university, contested the claims that were made on statistical grounds. See Van der Ploeg et al (Van der Ploeg et al., 2006 ; Van Der Ploeg et al., 2007) for the technical details of the experiments and their possible interpretation.

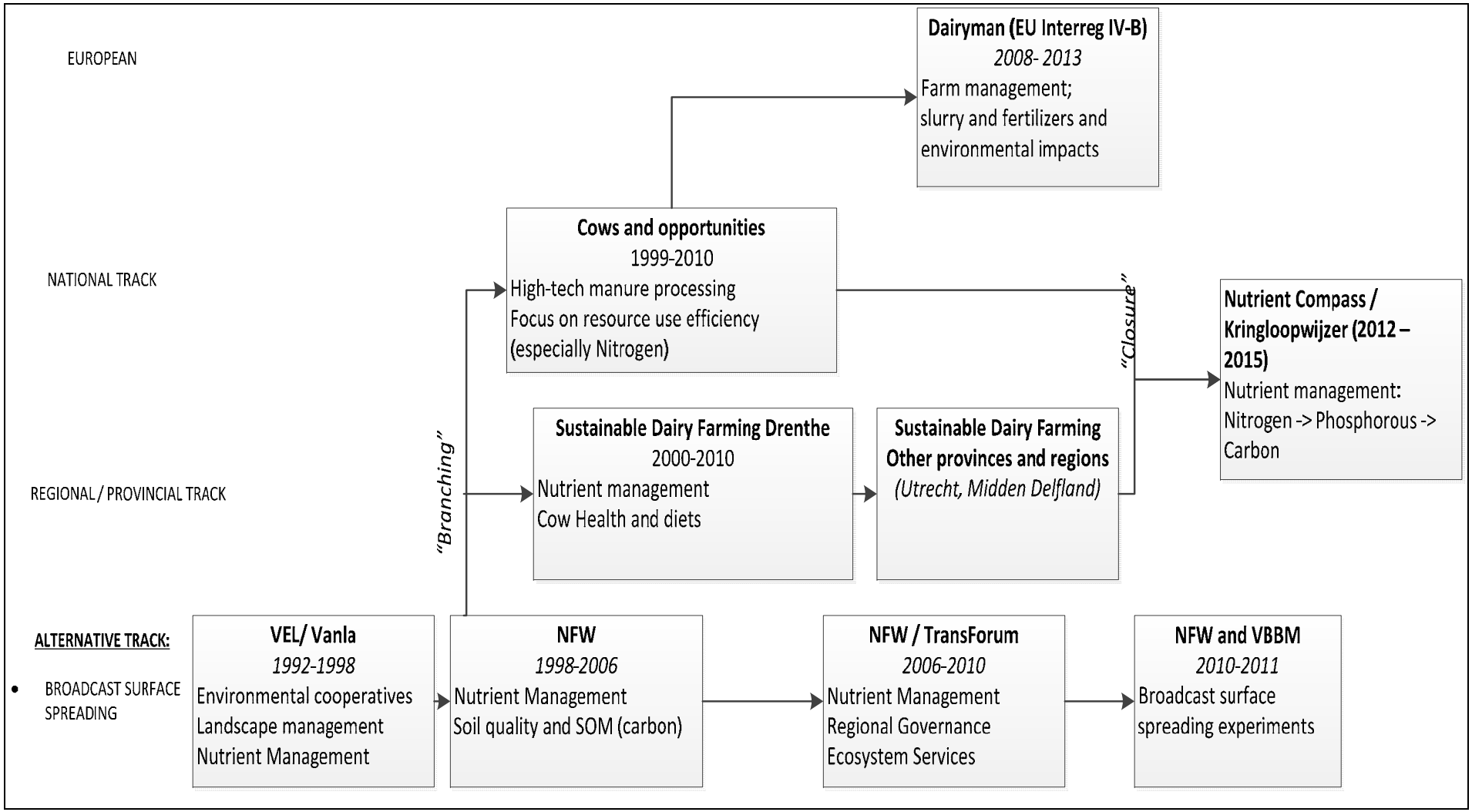
This scientific controversy marked an important point in the development of the nutrient management approach. Since that time, not one single, but three competing visions of nutrient management can be identified. Each of these innovation coalitions has developed its own vision on kringlooplandbouw.

Regional governance programme of NFW and TransForum

The controversy about the effectiveness of the grassland experiments was never fully resolved within the nutrient management research programme. In the end a compromise was reached to do more research into the link between grassland quality, manure application and soil quality. New research funds were obtained from a new Dutch innovation programme called TransForum. TransForum required in exchange for its financial support that the local network was broadened to include more attention for possibilities for regional governance and ecosystem services (Stuiver & Verhoeven, 2010 ; Gerritsen et al., 2011 ; De Boer et al., 2012).

The study on the effectiveness of surface broadcast spreading within the TransForum project was only partially successful. Although the results indicated that surface broadcast spreading might result in more ammonia reduction than previously thought, at the same time it was recognised that this result depended very much on weather conditions and the motivation of individual farmers to work on the reduction of the emissions (Sonneveld et al., 2009). For the expert board of national government tasked with supporting the manure law (Commissie Deskundigen Meststoffenwet) the results were not good enough to officialy start allowing the broadcasting manure. They concluded that there remains a substantial gap in emissions from surface broadcasting of manure compared to conventional methods for manure injection (CDM, (2011).

Figure 1: Three different development pathways of nutrient management



Collaboration between NFW, VBBM and NVLV

Broadcast surface spreading is not limited to the area of the Northern Frisian Woodlands but is also practised in other parts of the Netherlands. The VBBM: Vereniging tot Behoud van Boer en Milieu (association for the conservation of farmers and the environment) has been important in the promotion of the practice in other parts of the country. Together with the NFW they have successfully lobbied for the extension of the exemption for broadcasting manure over the years.

The latest addition to the debate on surface spreading of manure has been an investigation of the effectiveness of other ways to do manure surface spreading using a duo-tank filled with water. This way of applying the manure provides the wet conditions of rainfall and dissolves some of the ammonia (Nienhuis, 2012), this work also criticised the measuring techniques of ammonia emissions of the conventional manure injectors. An international commission of ammonia emission experts subsequently made a review of different measuring techniques and concluded that the conventional method to measure ammonia emissions from manure was still the best but that the Netherlands has lost its edge in the scientific field and more research was necessary (Erismann et al., 2012 ; Sutton, 2013). A small sub-network of this group is actively working on new novelties and has gone on to research other controversial topics under the name of 'quantum agriculture' that qualify as pseudo-science and 'fringe physics': re-vitalising water, neutralising negative electromagnetic radiation from the earth and sending out specific frequencies in stables to combat animal diseases. This small sub-network has organised itself in the Netwerk Vitale Landbouw and Voeding and 'Quadrupool Academy'.

The regional / provincial track Sustainable Dairy Farming Drenthe

The second pathway in which nutrient management on dairy farms was developed and spread over the Netherlands was via a number of commercial consultants. These consultants often had experience in the projects and study clubs of the Northern Frisian Woodlands and were influenced by the holistic perspective of the thinking about nutrient flows and extensification of dairy production. An important role in the development of this approach was played by the Duurzaam Boer Blijven Drenthe programme in the province Drenthe. The Duurzaam Boer Blijven programme (Sustainable Dairy Farming) was first known under the name of 'Bedreven Bedrijven Drenthe'. In a later stage the name was changed in order to stress its links with similar programmes in other provinces that were running under the name Duurzaam Boer Blijven. Over a period of 10 years different projects were organised that applied the concept of low external input farming using farmer study clubs.

The motivation of the provincial authorities to start with low external input farming has been to gain the trust of the farmer's organisation within their geographical borders. The provincial authorities were committed to work with the method since the farmers were enthusiastic about it. However, the most controversial element of the approach (surface spreading) was not included in the study clubs that were set-up within the projects.

Over the years the practices within the study clubs have broadened. The first years, nutrient management has been the focus of attention. No university scientists have been involved in the network and most monitoring has been done by the province itself, or by commercial advisory companies. Based on their own measurements of ground water and surface water quality, the province became convinced that the participating farms were in fact reducing their environmental loads significantly. In later years, new actors (veterinarians and the feeding industry) have entered the collaboration and have started their own projects within the financial room provided by the provincial government.

The perspective on low external input farming changed as well. The measurements done at the individual farmers pointed out that the approach was most successful on intensive farms in terms of reducing environmental loads. In the last phase of the project an annual 'Most Sustainable

Dairy Farmer of Drenthe' award ceremony was organised and the winner each year has been one of the intensive farmers that participated in the project.

With some of the early results of the Drenthe programme the consultants were also able to interest other actors: provincial government but also a milk factory (CONO) in other parts of the Netherlands. Similar programmes have been set-up as the programme in Drenthe. With this expansion other topics were gained also in importance, such as issues of processing and certification issues to ensure the quality of the working method of the farmers.

The national and international track: cows and opportunities / Dairymen

The third group of actors working on nutrient management are the decedents of the animal scientist that were originally involved in the VEL/ Vanla grassland experiments. They have focussed on the nitrogen cycle and phosphate cycle since these two nutrients are the most important from the perspective of existing European environmental legislation (the European nitrate directive). This group had a research programme in place called Koeien en Kansen: Cows and Opportunities (Aarts, 2000). Goal was to increase resource use efficiency using methods developed at De Marke and testing these on commercial farms. In the project, 17 farmers were selected from all over the Netherlands, but with a special attention for farmers with good communicative skills and a high prestige with other farmers. Knowledge transfer in this case was done with intensive coaching of the participating farmers by scientists involved in the cows and opportunities programme (Oenema, 2013).

Their approach of nutrient management sets itself apart from the other two approaches by its focus on technology (relying on manure separators, manure fermentation and high-tech stable concepts), precision feeding and fertilization and its focus on nitrogen and phosphorous instead of (organic) carbon in the soil.

The Dairyman project was an international version of the Cows and Opportunities project funded under the EU Interreg IVB for a couple of North Western European countries, including Ireland, England, France, Belgium and Luxembourg. Again the idea was to work on innovations at farm level and exchanging knowledge between farmers from different countries and work on creating a network of pioneer farms and knowledge exchange centres.

Convergence of two tracks in the Kringloopwijzer/ Nutrient Compass

Some of the consultants working within various provincial projects and the scientists working on the national track have started to collaborate in a new project focussing on further specifying exact calculation rules for the various nutrient flows: the nutrient compass. The calculating method has its roots in the practice that focusses more on the nitrogen and phosphorous management of the Cows and Opportunities project, but the idea is to incorporate the carbon flows in a future version of the method.

For the consultants this is a good way to prove the scientific robustness of their working method, while for the scientist this is an interesting way to disseminate their work to a broader audience. The unified goal of this working group is to get (scientific) agreement on many of the nutrient flows of a farm. By bringing all these pollutants in a single calculation method, the promise is that it will become possible to calculate the environmental pressure per farm and thus also rewarding or punishing individual farmers giving them a greater incentive to bring down their environmental loads.

The dairy sector would like to move away from the 'instrumental laws' that (for instance) prescribe the injection of manure, and go to this type of personalised schemes at the farm level. The idea is that the government only sets the overall aims and the farmer can decide where to focus on: Ammonia, Methane or Phosphate and the ways method with which they want to in realise these objectives.

At the moment the different regional networks all have different certificates that focus in different indicators. None of these certificates has yet a formal status, but if all actors agree on this calculating method, it could form the basis of a national certification scheme approved by the government. Lobbying is done in Brussels to convince the EU as well that such an approach could be beneficial and that it should be allowed under the Nitrogen Directive.

Discussion and conclusions

The analysis shows that the practice of nutrient management after its initial origin in the VEL/Vanla cooperatives, has spread all over the Netherlands, following three different paths, each involving a specific coalition of actors, practices and discourses.

Some of the pioneers in the original niche have remained faithful of their alternative track. Their successful lobby and networking at the political level has resulted in a continued exemption of national environmental legislation between the years 1996 and 2013. However, the practice of broadcast surface spreading of manure has remained as a small niche practice and has never made it into the mainstream. The involvement of scientists in the niche has been limited to their participation in a scientific debate on the effectiveness of surface broadcasting of manure. This is a highly technical subject and the two sides in this debate each frame the problem differently: the experts from the Commissie Deskundige Meststoffenwet argue from the perspective of ammonia emissions alone, while the other side argues that other factors (soil life, methane emissions and fuels/ gas consumption of the manure injectors) should be included in the evaluation as well. Frustrated with this scientific debate some actors in the niche have become more radical over the years in their rejection of 'conventional and reductionist scientific methods' and have started to experiment with pseudo-scientific methods as revitalised water and 'earth rays'.

The second pathway has been the most successful in its reach of dairy farmers all over the Netherlands. The key to their success has been their decision to focus on low external input farming without the controversial broadcasting of manure. By adapting the method developed in the NFW, they were able to form a coalition of regional farmer unions, provincial government and environmental organisations that supported the implementation of the approach. This approach has become well established in different parts of the Netherlands. The actors driving this pathway, first beyond the geographical border of the NFW and later beyond the borders of the province of Drenthe, consisted of a small number of commercial consultants that have specialised in 'kringlooplandbouw'. Scientists did not have any formal position within this network and did not play a significant role. This coalition also has made the largest development in the narratives of kringlooplandbouw they use. The start of the project was characterised by a focus on extensification of dairy production, but based on empirical results, intensive dairy farmers became more central in in the approach and the approach is propagated as giving different farmers different options that will fit their own farming style.

The national research projects of the cows and opportunities project did not involve a lot of farmers directly (only 17) however their impact has been far greater than that. Their conceptualisation of nutrient management on a dairy farm had a different starting point. This coalition was supported by scientists and some of the larger regime actors on the Dutch dairy market.

The regional and the national track have in recent years grown more together. Experience and knowledge with nutrient management on dairy farms has built over a number of research projects but also in different regions and in different constellations of actor groups. In the Nutrient Compass project, this knowledge has become formalised in specific rules for calculating excretion norms. There is a certain irony in the history of nutrient management in the Netherlands. What started as an approach to work on extensification of dairy production is currently being hailed as a promising method to work on 'sustainable intensification': when farmers reduce the environ-

mental load per cow, they can have more cows and thereby increase their production. The case shows that in the up scaling of an innovation, its meaning can thus radically change its meaning and it can ultimately even turn into its opposite.

References

Aarts, H. F. M. (2000). Resource management in a 'De Marke' dairy farming system. Wageningen, Wageningen University,

CDM - Commissie Deskundige Meststoffenwet, Werkgroep 'Ammoniakemissie bij bovengrondse aanwending dunne mest' (2011). Review Ammoniakemissie in de praktijkproef "bovengrondse aanwending van drijfmest".

De Boer, H. C., Dolman, M. A., Gerritsen, A. L., Kros, J., Sonneveld, M. P. W., Stuiver, M., Termeer, C. J. A. M., Vellinga, T. V., De Vries, W. & Bouma, J. (2012). Effecten van kringlooplandbouw op ecosysteemdiensten en milieukwaliteit : een integrale analyse van People, Planet & Profit, effecten op gebiedsniveau, en de potentie voor zelfsturing, met de Noardlike Fryske Wâlden als inspirerend voorbeeld. Wageningen, Wageningen UR.

Erismann, J. W., Hensen, A., Duyzer, J. & Lantinga, E. (2012). Review of ammonia emission and deposition research and state of knowledge in relation to the models and factors used in policies Driebergen,

Eshuis, J. (2006). Kostbaar vertrouwen : een studie naar proceskosten en procesvertrouwen in beleid voor agrarisch natuurbeheer Delft, Eburon, Wageningen University and Research Centre, Mansholt Graduate School of Social Sciences

Eshuis, J., Stuiver, M., Verhoeven, F. P. M. & Van der Ploeg, J. D. (2001). Goede mest stinkt niet; een studie over drijfmest, ervaringskennis en het terugdringen van mineralenverliezen in de melkveehouderij/ Good manure does not smell; a study on slurry, experiential knowledge and the reduction of nutrient losses in dairy farming. Wageningen, Rurale sociologie, Wageningen universiteit.

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy 31(8/9): 1257-1274.

Geels, F. W. & Schot, J. (2007). Typology of sociotechnical transition pathways. Research Policy 36: 399-417.

Gerritsen, A. L., De Vries, W., J., K., Stuiver, M., Vellinga, T. V., Sonneveld, M. P. W., Dolman, M. A. & Bouma, J. (2011). Inhoudelijke voortgangsrapportage project: "evaluatie van effecten en toepassingsmogelijkheden van kringlooplandbouw door zelfsturing". Wageningen, WUR, LEI, Alterra, LAD, Livestock Research.

Hall, A. & Clark, N. (2009). What do complex adaptive systems look like and what are the implications for innovation theory. Maastricht, UNU-MERIT.

Hermans, F., Stuiver, M., Beers, P. J. & Kok, K. (2013). The distribution of roles and functions for upscaling and outscaling innovations in agricultural innovation systems. Agricultural Systems 115: 117-128.

Knickel, K., Brunori, G., Rand, S. & Proost, J. (2009). Towards a better conceptual framework for innovation proceses in agricultural and rural development: from linear models to systemic approaches. Journal of Agricultural Education and Extension 15(2): 131-146.

Lounsbury, M. & Crumley, E. T. (2007). New Practice Creation: An Institutional Perspective on Innovation. Organization Studies 28(7): 993-1012.

Nienhuis, C. (2012). Reduction of ammonia emission through the combined application of liquid manure and water with The Green Duo. Wageningen, Wagneningen University,

Oenema, J. (2013). Transitions in nutrient management on commercial pilot farms in The Netherlands. Wageningen, Wageningen University, Plant Production Systems

Renting, H. & Van Der Ploeg, J. D. (2001). Reconnecting nature, farming and society: Environmental cooperatives in the Netherlands as institutional arrangements for creating coherence. Journal of Environmental Policy and Planning 3(2): 85-101.

Roep, D., Ploeg, J. D. v. d. & Wiskerke, J. S. C. (2003). Managing technical-institutional design processes: some strategic lessons from environmental co-operatives in the Netherlands. Netherlands Journal of Agricultural Science 51(1-2): 195-217.

Schot, J. & Geels, F. W. (2007). Niches in evolutionary theories of technical change. Journal of Evolutionary Economics 17: 605-622.

Smith, A. (2007). Translating Sustainabilities between Green Niches and Socio-Technical Regimes. Technology Analysis & Strategic Management 19(4): 427 - 450.

Smith, A. & Seyfang, G. (2013). Constructing grassroots innovations for sustainability. Global Environmental Change 23(5): 827-829.

Smits, R. E. H. M. & Kuhlmann, S. (2004). The rise of systemic instruments in innovation policy. International Journal of Foresight and Innovation Policy 1(1/2): 4-32.

Sonneveld, M. P. W., Bos, J. F. F. P., Schröder, J. J., Bleeker, A., Hensen, A., Frumeau, A., Roelsma, J., Brus, D. J., Schouten, A. J., Bloem, J., De Goede, R. & Bouma, J. (2009). Effectiviteit van het Alternative Spoor in de Noordelijke Friese Wouden. Wageningen, Wageningen UR.

Stuiver, M. & Verhoeven, F. (2010). Kringlooplandbouw: Op weg naar geborgde bedrijfsspecifieke milieuresultaten. Wageningen, Alterra, Wageningen UR.

Sutton, M. (2013). Summary Report of the "Review on scientific underpinning of ammonia emissions factors and ammonia deposition models". Edinburgh, Centre for Ecology and Hydrology.

Van de Kerkhof, M. & Wieczorek, A. (2005). Learning and stakeholder participation in transition processes towards sustainability: Methodological considerations. Technological Forecasting & Social Change 72: 733-747.

Van Der Ploeg, J. D., Groot, J. C. J., Verhoeven, F. P. M. & Lantinga, E. A. (2007). Interpretation of results from on-farm experiments: manure-nitrogen recovery on grassland as affected by amnure quality and application technique. 2. A sociological analysis. NJAS - Wageningen Journal of Life Sciences 53(3): 255-268.

Van der Ploeg, J. D., Van Broekshuizen, R., Sonnino, G. B. R., Knickel, K., Tisenkopfs, T. & Oostindie, H. (2008). Towards a framework for understanding regional, rural development. In

Unfolding webs; the dynamics of regional rural development. J. D. Van der Ploeg and T. Marsden. Assen, Van Gorcum.

Van der Ploeg, J. D., Verschuren, P., Verhoeven, F. & Pepels, J. (2006). Dealing with novelties: a grassland experiment reconsidered. Journal of Environmental Policy and Planning 8(3): 1999-218.

Wiskerke, J. S. C. & Van Der Ploeg, J. D. (2004). Seeds of Transition; essays on novelty production, niches and regimes in agriculture. Assen, Royal Van Gorcum.