Blowing the seeds of innovation

How scaling unfolds in innovation processes towards food security and sustainable agriculture

WAGENINGEN UR
For quality of life

Ministry of Economic Affairs

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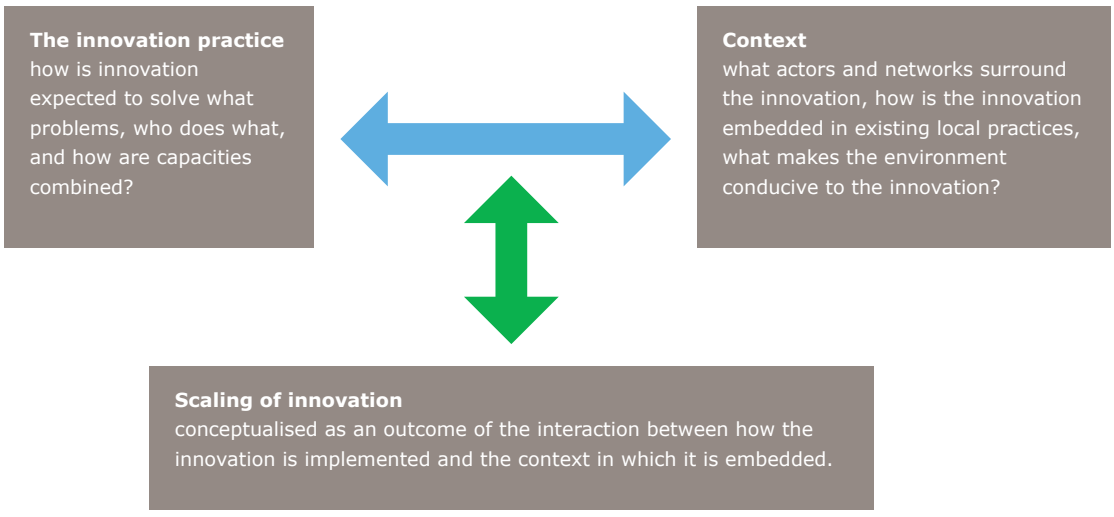
Broadening the perspective on scaling

Policymakers and practitioners involved in research and development often think about innovation related to sustainable agriculture and food security as the natural outcome of best practices. However, when looking more closely at scaling of innovations it tends to be an unpredictable, complex process, depending on the interaction between the 'DNA' of the innovation and the context within which it is taking place. This policy brief presents a summary of the results of a two year strategic research project 'Innovation systems and scaling in practice' which was executed by Wageningen UR.

Innovation is the process of making changes to something established by introducing something new[1]. A new 'thing' is generally defined as an invention or novelty. Innovation differs from an invention in that innovation refers to the use of a novel idea or method, whereas invention refers more directly to the creation of the idea or method itself, irrespective of whether it is being used and with what effect. In working on innovations, practitioners thus face the challenge of bringing new practices and techniques to scale. Looking at scaling processes in practice we find many dimensions, questions and implications that often seem to be left unaddressed.

This research builds on the observation that whether an innovation is adopted on a wide scale is the outcome of complicated interactions between the nature of the innovation itself and the context wherein it lands (figure 1). This implies that scaling of an innovation can take place in one context and not in the other. A 'one size fits all' approach to steering processes of scaling is often insufficient. It is necessary to assess when, where and why some innovations lapse into inactivity while others go to scale and even indicate system change. This policy brief aims to broaden the perspective on innovation by zooming in on how novel practices spread or multiply: how do innovations scale? The core of this booklet consists of three case studies from different countries. The case studies document how specific innovations were able to include larger numbers of people, to spread over larger areas or to multiply in different circumstances. In Benin long term interventions to promote integrated soil fertility management were studied to see whether and how scaling occurred. In Kenya the substantial spreading of dairy business hubs (DBHs) was examined to learn what are success factors for scaling this innovation. The case in Denmark looked in detail at how a co-innovation process contributes in unexpected ways to the scaling of integrated pest management. The combination of cases broadens the scope on the role and shapes of scaling processes in innovation towards sustainable agriculture and food security and sustainable agriculture.



The scalability of new practices, rules and interaction patterns does not solely depend on the design of an intervention or a facilitated transition process *per se*. Whether such an intervention or transition process is able to include large numbers of people, to cover an extensive area, or to accomodate growing transaction volumes is an outcome of the interaction with the context wherein it touches down. The figure above makes scalability dependent on the nature of this interaction: is the fit between intervention and context conductive to scaling?

Figure 1. Scalability as an outcome of an interplay between innovation and context.

[1] Oxford Dictionaries, 1988. New Oxford Dictionary of English, p.p. 942. Oxford University Press.

New value chain interactions trigger scaling

Scaling integrated soil fertility management in Benin

Loss of soil fertility is a major problem for small-holder African farmers and is an obstacle to sustainable agricultural development and food security. Integrated soil fertility management in combination with the development of high added value in agricultural value chains is a socio-technical innovation to simultaneously increase productivity, reduce poverty and maintain soil fertility. A comparative study in two areas in South Benin was designed to get an understanding of this innovation process and the conditions that affect scalability.

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The scaling issue

Integrated soil fertility management (ISFM) has been implemented in Benin and in other African countries for more than 20 years. Researchers, policymakers and businesses have tried to steer scaling of ISFM according to various theories of change [see box]. This case study focuses on the districts of Ifangni in South East Benin and Klouékanmè in the south west. Both areas are densely populated and subject to pressure on and fragmentation of agricultural land.

ISFM consists of existing local practices such as crop rotation, intercropping and the use of household organic waste, coupled with new techniques such as combining mineral fertilizers with local organic matter, composting, cover crops and planted Acacia fallow.

Vicious circle

The farmers in both districts are aware that soil fertility has been decreasing over decades and are willing to invest knowledge, money and labor in new soil fertility techniques, especially mineral inputs and seeds. However, several contextual factors of the agro-ecological system make it difficult for most of them to invest in ISFM. With an average farm size is about 0.5 ha, farmers are caught in a vicious circle: they have low monetary income and thus less possibility to invest in organic and mineral fertilizers. They are also unable to put parts of the fields under planted fallow in order to increase the fertility of the soil.Only better-off farmers can forego parts of their harvest for a seasonal fallow and the expectation of higher yields during the next growing season. Decreasing fertility leads to diminishing land returns, which makes investment in soil management even more difficult. The situation is most critical in Klouékanmè because land fragmentation and differentiation in land ownership are further advanced there than in Ifangni.

Woman in niébé beanfield.

Furthermore, many farmers have to rent land through short term and insecure contracts. They cannot be sure to harvest the returns on their investment in ISFM. The few who do own their own land, often do not dare to take out bank loans because of the risk of a harvest failure. Also organic material is scarce. In Ifangni, only the small group of farmers with larger farms has access to enough organic material, either from natural bush fallows or from oil palm and their byproducts after processing. Farmers in Klouékanmè depend entirely on crop residues and household organic waste to make compost. The compost that is available is primarily used for the commercial crop and not for the home food supply.

Ifangni farmers have more opportunity to invest in land fertility because they are better organized and thus more resilient to supply and price fluctuations in fertilizers. Farmers collectively order fertilizers in bulk from agro-dealers through their organizations. However, a recent subsidy programme for mineral fertilizers seem to constraint this initiative.

Improving value chains

The study showed that farmers who are able to buy organic and mineral fertilizers are farmers producing crops with a relatively high market value. In order to improve the possibilities for investment in ISFM, there has been a shift in interventions towards organizing agricultural value chains for new high producing crops as well as simultaneously improving the market position of smallholder farmers and their access to mineral fertilizers, organic material, quality seed and financial services.

Yellow maize was introduced to Ifangni as a high value crop targeting emerging feed markets with the support of the International Fertilizer Development Centre. A Farmer Field School (FFS) learning group was organised for the collective marketing of yellow maize. To increase demand for maize, assistance was provided to develop local small-scale chicken farms and contracts were signed with animal feed agro-dealers.

In Klouekanmè, farmers on very small farms have specialized in cowpea and tomato as cash crops and those on larger farms in orange trees. The production and marketing of tomato and oranges is quit a complex matter, but farmers have successfully organized these activities. In both tomato and orange fields, farmers have adopted recycling of organic matter and transfers of waste from neighboring market towns.

New and increased levels of transaction

The study in Benin showed that improving the value chain was an important precondition for scaling ISFM. The combination of technical and organizational changes encouraged the spread of ISFM. The level of cooperation between farmers in Ifangni in growing yellow maize and animal feed producers in need of stable supply on one hand, and regional chicken farmers who buy it for feed on the other hand, is a good example of this. The growing interdependencies between buyers and sellers and their contractual arrangements induced a flow of changes in the pre-financing of the production and the ordering of external inputs that had become more profitable when used on higher value crops. This triggered an evolving process of selection, improvisation and technical change altering soil management in a larger area, which in turn sustained the development of markets fed by the new or improved value chains.

Integrated soil management in Benin: the transition from a push to a pull model

In the 1980s, research institutions in Benin focused on the use of mineral fertilizers and the development of soil fertility techniques which were then promoted among smallholders by agricultural extension agents. This top-down approach was in the 1990's replaced by more participatory approach, such as Participatory Technology Development (PTD) and Farmer Field Schools (FFS) focused on the knowledge, capability, problems and perspectives of farmers themselves.

Integrated soil management came back on the agenda with the recent attention given to fighting poverty and food insecurity by promoting sustainable value chains. New projects focus on developing markets for products with a relatively high market value and strengthening the value chain organizations for these products. It is expected that these initiatives will make investment in soil fertility more economically viable. The history of integrated soil management shows a change in thinking about innovation processes: from a push model where obstacles are seen to be the driving force behind innovations towards a pull model where innovations are seen to be caused by and promoted as a response to new opportunities[1].

[1] Floquet, A., S.D. Vodouhè, J. van den Berg, C.R. Tossou, B. Triomphe en R. Mongbo, 2013. *Models in innovation studies: a critical reflection out of the cross-comparison of 4 innovation processes in Benin*. Paper accepted for publication in the proceedings of the international workshop on Agricultural Innovation Systems in Africa (AISA), 29–31 May, 2013, Nairobi, Kenya.

Improving dairy business activity in Kenya

Research into up-scaling and the potential for spreading the concept into neighbouring countries

Business hubs in the dairy sector in Kenya have been set up so that small scale dairy farmers can deliver more and better quality dairy products to urban consumers by means of a strong link to both input and output markets. The progress made in up-scaling this socio-technological innovation has been the subject of research in this case study.

Jan van der Lee and *Alberto Giani* – Centre for Development Innovation, Wageningen UR.

The issue of up-scaling

The analysis of the Kenyan experience with dairy business hubs has been based on interviews with key informants and literature research. The objective was to distil lessons for further up-scaling in Kenya and for implementation of the concept in neighbouring countries with a different (socio-political) context. The researchers looked at how the socio-technological innovation within a hub has been up-scaled and what factors have resulted in growth in the number of hubs.

The innovative feature of the dairy business hubs is the clever coupling between collection and refrigerated storage of milk to process and market it collectively for large numbers of small dairy farms on the one hand, and the use of the farmers' collective clout to buy in production aids and services at a better price. Private investments and social capital are activated in this way in order to promote the development of small dairy farms[1].

The collection and refrigeration facilities ensure a stable outlet for small dairy farmers. The potentially higher income from the milk and the lower cost price for production aids due to the increased scale are attractive. The farmers get better access to the (growing) market by collaborating and milk processors have in turn a better delivery guarantee and more milk of a higher quality. This offers opportunities to meet the growing urban demand. A savings and credit society operating in the dairy business hub, allows farmers to finance investment in production aids and services which cost more than current earnings from milk can pay for. This attracts suppliers of services that the collection business itself does not offer.

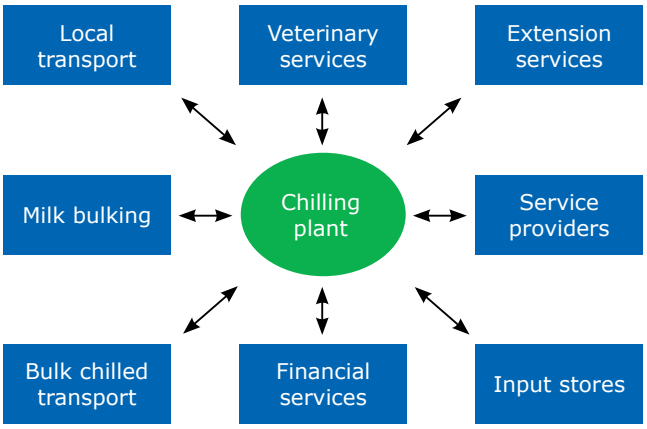

Figure 2. Dairy business hub associated services.

Beneficial and disadvantageous elements for up-scaling

The scalability of business hubs is determined among other things by the number of services offered (see figure 2). Bigger and larger numbers of dairy business hubs stimulate suppliers and processors to invest in growth and expansion of the number of hubs. Because this demand is coupled to the social capital found in farmer organisations, a business hub set-up develops that matches the local context and easily leads to the involvement of small dairy farms and farming organisations. In addition, the collaboration between all the important stakeholders in the chain has the effect of reducing chain fragmentation and this brings more stability and vitality to the sector.

Of all the factors that obstruct scalability, the considerable investment needed to set up a dairy business hub is the most significant. Development organisations play an important role as investor and business practice advisor. There is just one proviso, and that is if there is no simultaneous investment in the capabilities of individual stakeholders in the chain, then the durability of the growth is endangered.

Another obstacle is the "leaps" that need to be taken to expand volume. Gradual growth in volume results in a situation whereby a refrigerated silo is either 'too big for today's needs' or 'too small for tomorrow's'. Farmers have to find the large sums needed to finance future growth in the earnings from their current production – which grows only gradually. Buying important services which do not directly lead to increased production cannot be financed without some risk.

[1] Kruse, G., 2012. The Chilling hub Model and Social Capital in Dairy Value Chain Development. Heifer International, Kenya.

Context related characteristics
Dairy business hubs are generally active in areas conducive to dairy farming, with adequate infrastructure; with a large number of small but capable farmers who can be "clustered" around collection points; and where there is a significant demand for production aids and services but the supply is under-developed.

When considering up-scaling dairy business hubs, a number of context-related criteria can be identified[2]. There is still a widespread practice of direct selling by farmers and collection businesses to consumers, shops, the hospitality industry, schools, etc. (the informal market) and this shows that even in Kenya, the demand from the formal dairy chain is not self-evident. However, because of increasing urbanization and the emergence of a middle class with greater purchasing power, the (formal) demand for dairy produce is growing strongly there.

A favourable climate for entrepreneurs is a contributing factor to the hub's success. The Kenyan government stimulates private investment and development of farming organisations and takes account of the vested interests of parties in the chain and their suppliers. Private investors are inclined to see potential for investing in the growing dairy sector.

The scarcity of suitable land and water supplies has lead to intensification of agrarian systems and limits dairy sector growth. The challenge is to produce enough animal feed without compromising human food production, sustainable land management and still keeping production costs competitive in a world market.

Interaction between mechanisms and context
Thirty-five of the 225 dairy cooperatives in Kenya now have dairy business hubs that service a quarter of all dairy farms and process one fifth of the total milk production. These hubs are concentrated in the highlands of the North Rift and Central regions.

Their development into fully-fledged dairy business hubs followed a number of scaling dimensions: growth in membership of the farmers organisations and cooperatives; larger scale and better quality services; involvement of more suppliers and processors; and increase in milk volumes by increasing production and being relatively more proactive in marketing.

Contribution of results to decision-making about scaling
The most important criteria for applying the dairy business hub concept in other countries are: i) a robust demand by urban consumers, ii) milk production potential, iii) presence of capable farmers, processors and suppliers, and iv) a good climate for entrepreneurs. Even if all these criteria are fulfilled, up-scaling is not simply a question of 'plug and play'. The evolution of services has to pace itself to market demand.

Dairy business hubs themselves can also influence the transition process from an informal to a more formalized marketing. Milk supply through formal channels in Kenya has increased markedly since the EADD project and other development organisations such as SNV have been investing in the hubs and farmers organisations.

A driving force from within the local sector is essential for successful up-scaling of dairy business hubs. Developing the capabilities of farming and small business organisations is, therefore, very important in both the area of technical know-how and management skills.

Milk reception at the Metkei business hub (*Photo Henric Verjans*).


Selling feed Ndumberi business hub (*Photo Jan van der Lee*).

[2] Poulton, C., A. Dorward and J. Kydd, 2010. The future of small farms: new directives for services , Institutions and Intermediation. World Development 38: 1413-1428.

It is never too soon to think about scaling

Scaling integrated Pest Management in Denmark

Innovation projects often concentrate on developing an innovation for a certain situation and then only think about the possibility of applying it on a bigger scale at the end. In this article we argue that it is better to turn things around, using experience gained in a Danish pilot in applying integrated crop protection measures in grain cultivation. The question is not so much how you should scale an innovation, but more what scaling processes are needed to achieve the desired future scenario.

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PURE – IPM in a nutshell

PURE stands for Pesticide Use-and-risk Reduction in European farming systems with Integrated Pest Management (IPM). PURE is a research project financed by the EU with the objective of developing practical IPM solutions to reduce the dependence on pesticides in the most important cropping systems. In this way, PURE is designed to contribute to the reduction in pesticide risks to health and the environment without compromising food production and food quality levels.
Website www.PURE-IPM.eu

The up-scaling issue

The Danish pilot in cultivating grain is part of the EU-project PURE (see box). For the main part, PURE uses a traditional research cycle of testing, validating, demonstrating and communicating Integrated Pest Management (IPM) solutions based on scientific insights. Four co-innovation pilots, each in a different European country, form an exception. In these cases, context-specific IPM solutions are the subject of experiments in the field. The main question was: how can you ensure that the successful IPM solutions will be applied on a bigger scale in the agrarian sector?

Preparing for the future

The participating Danish farmers, all members of the IPM network, are role models for the agrarian sector. Together with advisors, they made an inventory of the problems encountered in Denmark's crop cultivation sector taking into account the strong community lobby against the use of chemical pesticides. They then used this as a basis for selecting possible solutions. The farmers in this network wanted to prepare for a future scenario where chemical crop protection is outlawed. The challenge was to achieve this without compromising economic viability. They experimented with a combination of mechanical weed control and a variety seed mixture to lower the risk of disease. The combination of early non-chemical intervention for weeds and prevention of fungal infections fits into the PURE objective of reducing pesticide use and matches the central principles of integrated crop protection. The farmers' research question was: under what circumstances and for what price can chemical crop protection be replaced by mechanical weeding and hybrid seed mixes?

The experiment from different perspectives

The farmers began with enthusiasm, but at the end of the year the results were disappointing. There was little difference between the variety mixtures and the monocultures in terms of fungal infections, even though the yield was more or less comparable. Extremely wet conditions made mechanical weeding ineffective, with the result that the farmers applied chemical herbicides instead. In terms of the objective of up-scaling IPM solutions, this experiment seemed to offer little result.

Taking a broader view on up-scaling than just focusing on these specific IPM solutions, then the Danish pilot offers some interesting perspectives. Up-scaling becomes a means of achieving a certain impact instead of being the goal.

For *farmers* it is clear that chemical pesticides are cheap and effective in comparison with non-chemical methods. However, during this process they have become convinced that they need to take into account a possible future without chemicals. For that reason, they are prepared to examine the practical and economic implications. They are also willing to enter into discussion with other farmers, so that they, too, broaden their view of the future. Finally, the pioneering farmers want to give a signal to the community in general that they are taking measures to achieve the desired pesticide-free agriculture, but society also needs to be aware of the costs involved.

The story is somewhat different for the *advisors*: farm advisors were quite sceptical about the pilot. They are used to offering cut and dried solutions for their clients' current problems. They do not recognise the relevance

ofthe tested IPM solutions for other clients. In the pilot the PURE team faces the challenge of focusing on the future instead of on current problems and solutions. They act as sparring partners for farmers. In this way the farm advisors could gradually gain experience in this role under supervision of the PURE staff.

Danish social and political policy is to work towards reduction of the dependence on chemical crop protection. For some time now, there has been growing social and political pressure to replace chemical methods with non-chemical ones. In 2012 it became illegal to use chemical pesticides and herbicides on any government land. Note that this political ambition has been formulated by the participants in the pilot as their own future scenario.

Up-scaling forces

Working from the point of view of the new up-scaling issue, three up-scaling forces have been identified that could contribute to the intended result. Firstly, the pilot has broadened the time perspective and the possible solutions for the Danish agricultural sector. This broader time perspective is an important condition for the implementation of IPM and pesticide reduction. When farmers are more focused on the future and become more proactive in their business practices, they have taken the first step in charting alternatives for pesticide use.

In order to apply IPM as a management strategy a farmer must be able to make a problem analysis, to think up solutions for his own business and test them and evaluate the results. These skills contribute to an expansion of his innovation capability; the second up-scaling force. During the pilot, the farmers discovered not only that mechanical weeding demands considerable investment and special skills, but it was important to have chemical herbicides as a fall-back position because in wet years it is difficult to achieve good results. These are important insights that they can use in their business practice as well as their lobby for a pragmatic policy on crop protection methods.

In the third place, the pilot has challenged business advisors to become sparring partners for the farmers.

The supervisory team noticed a significant resistance from the advisors who also displayed a defensive attitude towards the anti-chemical trends in the community. Farmers rely on the short term solutions offered by the advisors and in normal circumstances do not develop an IPM strategy. During the pilot, the advisors and farmers did follow an IPM strategy.

If the three up-scaling forces described above are facilitated and utilized to the full, then this could have a greater impact on the reduction of pesticide risks than the development and promotion of specific IPM solutions. This insight offers a basis for a strategy that harnesses and amplifies these forces so that they can be used optimally to realise the intended impact. By raising the question what up-scaling processes are needed to achieve the desired impact at the beginning of a project, the strategy for up-scaling becomes an integral part of an innovation project.

Innovations unfold in unexpected ways

This policy brief aimed to broaden the perspective on innovation by zooming in on specific cases to study how novel practices spread or multiply: how innovations scale? Each case had their own contribution to the thinking about scaling. The Benin case showed how during the innovation process new and increased levels of transaction came about and that the accompanying feedback mechanisms triggered interactions between different innovations at the local level. The emerging combination of technical and organizational changes, as well as the growing involvement of different players in the selection of options, encouraged the spread of an integrated approach to managing soil fertility. The Kenya case on the scaling of dairy business hub's (DBH) revealed the contextual factors which are key to the success of scaling the concept. These factors could be used as criteria for selecting appropriate context for introducing dairy business hubs in other countries. Furthermore the case illustrates the value of studying the scaling processes in one country in order learn how scaling could work in another country. The Danish IPM case distinguishes three scaling forces which broaden the perspective on scaling. Furthermore the case suggests to reverse the thinking about scaling. Instead of asking how a certain novelty can be scaled, it is recommended to start from the intended impact, and then define which scaling processes are needed to achieve the desired outcome.

The cases firstly display how useful the framework has been in understanding innovation processes. Most importantly the framework inspires to carefully examine the context in which the innovation is taking place.

Further, the cases show how innovation is a continually evolving bundle of technological, organisational and institutional processes, involving networks of multiple actors whose ideas and knowledge lead to adjustments and improvements to innovations along the way. There is also the suggestion that scaling can be engineered if the innovation already has clear boundaries and a strong functionality for managing supply of inputs and outputs. The three country cases indicate that scaling seems to be less easy to steer in settings where the innovation is more open, where different actors seek to combine or select bundles of technical and organisational options. Technologies are often seen as central to innovation, transferable from one context to another, but in practice, technologies are shaped by people using them within their social, economic and institutional context. Social and institutional changes are always needed so that new technologies can be fully integrated into local practice. Scaling then becomes more dependent on a selection of "recipes" and on how induced interventions find a fit with established processes of problem-solving and handling risks. Hence, whether a technical or organisational innovation achieves scale is hard to predict or plan. Some of the cases also showed that innovations are more likely to scale if rigid pre-planned prescriptions about what to do are avoided and if these innovation processes are supported over a long time in a flexible way adapted to the specific context and the evolving opportunities. The scaling of innovation therefore centres on building the capacity of institutions to interact closely on the ground with diverse stakeholders and to acquire the skills to support making the fit between intervention and context conducive to scaling.