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Diverging and Converging Pathways

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Workshop 2.5: Beyond participatory methods-approaches for facilitating transformation of agriculture and agri-food systems

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Rarely in the history of agricultural research and practice has a concept spread as quickly as participatory methods. In less than 30 years, they have changed the rhetoric of research organisations, extension service providers and aid agencies. They have aided research in communicating more effectively with farmers, agricultural input suppliers, traders, consumer groups and policymakers. They have made research more democratic, responsive and effective. Today most actors underline the utility of participatory methods in their daily work. Participatory methods have transformed our understanding of agricultural research and development – eventually, they have transformed farming systems. In the course of their application, however, participatory methods have been transformed too. Few researchers pay attention to the silent erosion of values and quality standards participatory methods once implied. They rarely realise or articulate that participatory methods meant more than active involvement of people in agricultural projects and programmes that affect them. Few remember that participatory methods initially aimed at reallocating power to marginalised members of society. Today, we often ignore that standard use (or misuse) of participatory methods in research and development programmes has silenced poor people, leaving social relations and political exclusion unaddressed. The starting point for this workshop was the disparity between the original ideas that drove participatory methods and the practices of today. Much of this disparity does not originate from stakeholders, such as farmers, or the participatory methods themselves. The problems are caused by the way researchers and agricultural development experts apply the methods. Therefore, this workshop addressed the patterns driving what we call 'conventionalisation' of participatory methods. If we understand how and why this conventionalisation occurs, we will be in a better position to steer the re-transformation of participatory methods, and eventually regain some of their original strengths. Any research or organisation engaging in transformative action, remains ineffective if it does not address application challenges of participatory methods.

As convenors of this workshop, we believed that regaining what has been lost is a valid justification for discussing conceptual, empirical and experiential ideas around the topic. We also proposed that existing participatory methods will not be sufficient for solving current sustainability challenges and wicked problems. We feel that to promote change, facilitation methods have to enable deep, radical transformations of agri-food systems. We see a need for fresh ideas on how to facilitate the transformation of values, beliefs and self-perceptions of people engaging in multi-actor processes, as well as structures and operational procedures without prescribing outcomes. This workshop, therefore, explored methods in support of individuals and groups who pursue such transformation. From participants, we sought methodological propositions for what IFSA 2016 called enabling *'purposeful social and technological transformation of farming systems in different parts of the world'*. The possible entry points for the discussion included theories and concepts around resilience, adaptive governance, and translational leadership. Propositions needed to be applicable to action research, work for change agents and coaches, as well as community leaders. Although they are relevant all around the world, we focused on societies experiencing precarious livelihoods, socio-ecological fragility, and power asymmetries.

Experiences for advancing participatory methods exist in established fields outside agriculture, including management studies, organisational development, group dynamics and counselling. At the same time, we wanted to learn from emerging civic movements that confront unsustainable production, trading, consumption and disposing patterns. Therefore, contributions were invited from various backgrounds, with special emphasis on game-changing transitions towards sustainable agriculture. We were particularly interested in contributions establishing links to socio-technological transitions, transition management, strategic niche management, radical innovation, multi-level perspectives and other aspects of emerging middle-range theories.

Participatory design of agroecological farming systems' needs to match the collective goal of transformation with farmers' professional projects

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Abstract: Transforming agricultural systems toward more sustainable production pathways is a current societal demand. Researchers are invited to take part in and to account for this transformation. Consequently, some of them use participatory approaches to re-design farming systems, embedding farmers in the process in order to increase the success of effective transformations. However, the inclusion of the farmers does not always ensure that real transformations will occur. This uncertainty stems from the possible gap between the individual projects of farmers and the collective project that set the transformation goals. We believe that filling this gap requires taking account of and understanding the farmer's situation: the one on which he can actually act. To explore these tensions between the individual and the collective sides, we analysed a participatory project led by five farmers among a group of 100 dairy sheep farmers located in the south of France. The objective of these five leading farmers was to design a method to trigger the agroecological transformation of farming systems by showing the other farmers that it is possible to improve at the same time their income, their autonomy and to protect the environment. Our analysis of the first steps of this project suggests that taking farmers' professional projects into account when willing to facilitate the transformation of farming systems allows them to effectively consider possible changes in their system. As such, transforming agricultural systems calls for participatory approaches that take farmers' individual projects into account and help them to define their specific situation, identifying the levers that they can actually activate to change it.

Keywords: Agroecology, action research, co-design, professional project, dairy sheep farmers, Roquefort AOC region.

Introduction

Transformation of agricultural systems towards more sustainable ones is a current issue that has to be considered at different levels. From an individual perspective, it calls for a transformation of farming activities (Béguin & Pueyo, 2011; Coquil et al., 2012) so that farmers and agronomists learn to work more with nature instead of against it (Mayen, 2014). At the same time, the design of sustainable food systems requires the integration of farmers' knowledge and their participation in the design process, which calls for more participative, local and collective innovation processes (Altieri & Nicholls, 2008; Guzmán et al., 2013; Warner, 2008).

To deal with this issue, agronomists involve themselves in participatory approaches in order to design more sustainable agricultural systems (Bos et al., 2009; Meynard et al., 2012; Lefèvre et al., 2014; Moraine, 2015). One of the current problems is that implicating agricultural stakeholders in the design process does not guarantee that transformation will actually occur in the real world (Sanders et al., 2007).

Other researchers study the ongoing transformation process on farms and territories where stakeholders are involved in sustainable transformation pathways (Chantre, 2013; Coquil et al., 2012; Gowing & Palmer, 2008; Lamine et al., 2009). At the farm level, the transformations that will take place are far more complicated than simple changes in techniques and practices. For farmers, it calls for a redesign of their activity more than of their technical systems (Coquil, 2014). This process takes time and must be achieved “step by step” (Coquil et al., 2011). It corresponds to an evolution of practices, norms and values (Coquil, 2014), and is linked to the evolution of the internal situation on the farm, as well as to the way that the farmer’s environment and networks develop (Magne & Cerf, 2008).

We think that there is a gap between objectives that are collectively designed in a participatory project that aims at promoting the agroecological transformation of farming systems, and what farmers are willing and able to do on their farms, linked with the evolution of their individual situation and project.

To address that gap, we propose to analyse a participatory project led by five farmers among a group of 100 dairy sheep farmers located in the south of France. The aim of this project is to trigger the agroecological transformation of farming systems by showing the other farmers that it is possible to improve at the same time their income, their autonomy and to protect the environment. We were involved with the leading group in that project within a participatory action-research perspective. During a co-design process, we built two agroecological diagnostic tools for the local dairy sheep farming systems and defined the desirable state to be achieved in order to improve them. We analysed what happened when the five leading farmers presented the project and the first results to the other farmers in the association. We discovered that it is necessary to take account of and to understand farmers’ individual projects when willing to co-design the transformation of their farming systems.

Materials and methods

Case study: the SALSA project

The SALSA project is a project established and led by the AVEM Association (Millavois Association of Veterinarians and Farmers). AVEM is an association where veterinarians are employed by members to provide classical veterinary services as well as to visit the farm two or three times per year at critical moments of herd management. The association has developed a health methodology based on ecopathology using a preventive approach, working with farmers on herd management. The association is also a training and learning group that organises training workshops, promotes the exchange of knowledge between veterinarians and farmers, and carries out development projects. The association includes 160 farms today, mostly dairy sheep farms, three veterinarians and one agronomist who is in charge of coordinating different development projects. The SALSA project is one of them and has been set up by a group of five leading farmers.

The aim of the SALSA project is to trigger the agroecological transformation of farming systems by showing the other farmers in the association that it is possible to improve at the same time their income, their autonomy and to protect the environment. The first task of the project was to build agroecological diagnostic tools for dairy sheep farms and to implement them on all the farms to highlight good practices and levers to be used to develop a sound agroecology. In the second part of the project, they asked INRA to propose a methodology to accompany the system redesign. The working committee of the project includes the five leading farmers, one of the veterinarians and the association's agronomist (who is in charge of running the project), a local farmers' organisation that provides technical and economic advice for farms (the CETA organisation, "de l'herbe au lait"), the Grandes Causses Regional Park (south of France, Roquefort AOC area), INRA of Toulouse (the three authors) and a local agricultural high school.

During the first year, the working committee met together seven times to build the diagnostic tools. Farmers chose to adapt two existing tools that they had already used in the past for other projects. The working committee designed two different tools: a multi-criteria assessment tool of the impact of the farm on the environment and natural resources, and a technical-economic calculation tool to evaluate the milk produced autonomously on the farms (without feed or chemical inputs). During the first phase of the work, the leading farmers were very involved in the tool design. The choice of indicators to be included in the environmental assessment of farms and how to weight them for aggregation were subject to strong debates. But more than that, they were an illustration of different visions of the desired agricultural model. These debates between farmers more or less stopped the day we obtained the first diagnostic results that we were able to synthesize on one graph, where the x-axis represents the global grade the farm received with the environmental assessment, and the y-axis the rate of milk produced autonomously on the farm. This representation of the results established a sort of consensus about the objectives of the project: to increase the level of autonomy that prevents the farm from being too dependent on external resources, while reducing its impact on the environment. The general idea behind this is to improve the efficiency of farms by more effectively managing the link between herd size and the agronomic potential of the farm.

After one and a half years of work, the global diagnostic had been implemented on 15 farms, including those of the five leading farmers. The survey was conducted by the AVEM agronomist for the environmental assessment and by the CETA technician for the rate of milk produced autonomously on the farm. At that point, the working committee decided that it was important to start communicating about the project in order to find out who was interested and who would be ready to participate in the next steps to promote changes on their farms. At that point, we decided to organise presentation workshops to present the project and the first results obtained with the agroecological diagnostic to the other members of the association. To encourage participation, we decided to organise four local workshops in the four historical areas of AVEM. In each one, one of the five leading farmers presented the project and the results of the diagnostic for his case. That communication is based on the results of our observation of the first year and a half of that project and, more specifically, on what happened in these workshops.

Methods

A participatory action-research approach with an accompanying perspective

The researchers participated in the project from the very beginning of the process since they helped the farmer's association to draw up the project. In this project, they were members of the working committee and responsible for coordinating the last task: building a method to accompany the re-design of the farming system.

The three researchers developed a participatory action-research methodology. Participatory action-research is a research approach where the aim of research is not only to understand a given problem but also to provoke changes through action. Researchers immerse themselves in the context of the subjects they study, with the objective of encouraging them to become co-investigators of the research (Foth & Axup, 2006). As a matter of fact, the researchers wanted to investigate the design methodologies and concepts in a context of farming system transformation in order to explore their interest in and relevance to the agroecological transformation of farming systems.

In the first part of the project, they were active observers (Soulé, 2007). The objective in that first stage was to understand the situation they were involved in and to understand the farmers' needs and motivations to be involved in that project. To do so, they participated in all of the working committee meetings and led a series of 20 comprehensive interviews with members of the AVEM Association to better understand the diversity of farming systems and practices in the association and to form a better idea of farmers' needs and projects beyond the leading group.

Our analysis of these interviews has been a basis for discussing the advancement of the project. In fact, we showed the diversity of farmers' concerns and projects, raising the question of how to involve this diversity of farmers in the next step of the project. This led to the organisation of the workshops where we proposed to organise a participative activity to collect participants' opinions about the project and to explore their willingness to participate in the next stages of that project.

Methods for collecting material and analysis

Together with the working committee, we organised the workshops in two parts. The agronomist, the CETA technician and the representative farmer of the leading group were in charge of coordinating the first one. The objective was to present the project and its objectives, the diagnostic tools that had been designed and the diagnostic results for the case of the leading farmer, in comparison to the 15 other diagnostics done, which where anonymous. We were in charge of coordinating the second part in order to collect the participants' opinions about the project and to start discussing their will to be involved in it in the future. To do so, we used a metaplan methodology to provide all of the participants with the opportunity to express their opinions about two questions: (1) are you interested in the SALSA project? (explain why); (2) what would you like to do in the next steps of the project? The workshops lasted between two and three hours.

Table 1. The four different workshops we participated in

Workshop	Region	Date	Number of participants	Case presented
1	Ma Region	27/11/2015	13 (10 organic farmers + 3 conventional)	Farmer 1
2	Mi Region	30/11/2015	3 (2 organic farmers + 1 conventional)	Farmer 4
3	L Region	30/11/2015	8 (6 organic farmers + 2 conventional)	Farmer 2 (farmer 3 present but not presenting his case)
4	V Region	08/12/2015	6 (6 organic farmers)	Farmer 5

We participated fully in the four workshops and recorded them. We only transcribed the exchanges with and between participants and the leading farmers' interventions. We then analysed the transcript using a content analysis methodology to identify and compare participants' reactions for each workshop (Berg & Lune, 2012). Next, we analysed that reaction regarding the context of each workshop and the way the project had been presented, and the leading farmers presented their results and their specific case to the others.

On the basis of the analysis, we observed that one of the workshops was different compared to the three others, both in terms of the presentation of the case and in terms of the participants' reactions. We decided to illustrate our results by comparing two workshops (workshop 1 and workshop 3), which were the most representative of these two different reactions. To compare the two workshops, we built a table of comparison with the following elements: (1) the diagnostic results for the farmers presenting their case; (2) the way leading farmers reacted to the presentation of their case; (3) the way leading farmers talked about the SALSA project regarding their personal project; and (4) the way participants reacted during the project presentation and first results.

Results

We summarised the proceeding of workshops 1 and 3 on a table that compared: (1) the diagnostic results for the farmers presenting their case; (2) the way leading farmers reacted to the presentation of their case; (3) the way leading farmers talked about the SALSA project regarding their personal project; and (4) the way participants reacted during the project presentation and the initial results.

We chose to present these two workshops because they were representative of the different reactions we observed in the four workshops (See Table 2). In fact, in workshops 1, 2 and 4, participating farmers were quite interested in the project, and the leading farmers presenting their case expressed their will to continue with the project, starting to imagine some changes they could implement on their own farms. On the contrary, in workshop 3, both participants and the farmer from the leading group were less receptive to the project and formulated more criticisms and hesitations about the future of the collective project.

Analysing those two workshops we observe three main results: (1) when presenting their diagnostic to the others, farmers do not enter into the detail of their practices, but they explain their past and present choices and their personal project; (2) workshops do not go the same way depending on whether the farmer's personal project corresponds to the goals of the SALSA project; and (3) the groups with which we conducted the workshops seem to influence participant reaction.

If we compare the proceedings of workshops 1 and 3, we observe that the two farmers who presented their diagnostic to the others did not react the same way. In the first workshop, farmer 1 tried to explain the cause of his results to the others. Doing so, more than describing his practices, he explained the past choices he made, which led him to his situation today. His project today is to find a way to reduce work and find an organisation where he would be less constrained by herd care. He expressed his interest several times in the project helping him to think about what he could do better now. In the third workshop the farmer, who was also participating in the project from the beginning, appeared to be more skeptical about his results and the project philosophy. He criticised the criteria chosen and the calculations made in the diagnostic several times. At one point, he even expressed his disagreement with some general objectives of the project. His project is to produce cheese on the farm using rangeland pasture. Buying dry alfalfa is a way to secure his production. He is not looking for more efficiency in his practices and does not want to improve his productivity. When explaining the cause of his diagnostic results to the others, he seemed to be quite satisfied with the way he manages his farm now and does not express the desire to change anything, at least not in the perspectives proposed by the project.

Moreover, we observe a different reaction of participants in these two workshops as well. In workshop 1, participants were less critical about the project and the diagnostic tools. They were also more constructive about understanding the situation of farmer 1, with some of them trying to help him to think about what he could do to progress. In workshop 3, on the contrary, they criticised the tools and the project, and some of them clearly disagreed with the project philosophy. Farmers from the Ma region that came to workshop 1 were almost all from the same dairy as farmer 1, which means they have the same rules for milk production (few limitations in terms of volume, incentives to produce as much as possible outside the natural milk production period of ewes, etc.). We think that this could be an explanation of their more positive reaction to the project. Moreover, they proposed to continue the work collectively with the dairy. Farmers that participated in workshop 3 had more heterogeneous sales' channels and seemed to believe that they have very different soil conditions within the L region, which made the comparison and collective work less relevant from their point of view.

	Diagnostic result	Farmer's reaction to the presentation of his case.	Match between individual and collective project	Participant reactions
Workshop 1: Farmer 1 (Region Ma)	Farmer 1 has an organic farm of 150 ha and breeds 630 ewes for a milk production of 2200 hL of milk per year, which he delivers entirely to the T dairy. His farm is positioned on the upper mean of the group for environmental evaluation for the 2013 season. However, in the same period, he obtained a negative rate of autonomy for his milk production.	When the facilitator presented the diagnostic results, farmer 1 explained that when he converted to organic farming, he started with the T dairy, which did not limit him on the amount of milk he could produce, at a fairly good price. He said that at that time he had a big loan to reimburse, so he thought that “for that price it’s worth it to buy feed inputs and produce more”. He added, “We want a good regularity in the production, we aim more or less at 300 L/ewe, so it’s not easy to know if you should reduce the herd a little or not […]. It’s more comfortable to buy, and it’s one of the difficulties we face on our type of farm”. Later in the meeting, one of the participants asked him to explain what he wishes to do and change now that he knows the results of the diagnostic. He answered, insisting again on the fact that now he still has pressure from the bank to reimburse his loan, but he will soon be under less pressure. He added: "It’s true that now I am starting to get older I am wondering if I shouldn’t think differently, like “my farm size is such and such, I have one particular soil, what can I do with it?” I’d like to find a way to maybe work a little less, and I'd rather see the social aspects. I now have one worker, maybe we could see if we could be	The farmer explained that he thinks the project philosophy is to help farmers (including himself) to think about what they could improve in their system to reduce incoherencies between farm size and herd size. The farmer explained that he is asking himself if he could reduce the number of ewes and the quantity of milk produced on his farm in order to make the size of the herd correspond better to the size of the land. The farmer said that he wishes to improve his welfare at work and he is wondering what he could do to do so.	They expressed their interest in the diagnostic and the project and, more specifically, they were interested in the possibility of evaluating their environmental impact. Proposition to improve the diagnostic tools by adding social criteria. Proposition to continue the project with the dairy to communicate about good practices and see if milk contracts could be better matched to the size and potentialities of farms.

Workshop 3: Farmer 3 (Region L)

	associates tomorrow, or maybe have two workers… etc. Is my farm easy to transmit? " Then he said he did not know if three people working on the farm would be possible without having more ewes, which was not his idea because he thought it would have an even greater environmental impact since it would mean buying more inputs. The facilitator answered that maybe it would be more coherent to try to see what could be done with fewer ewes and less inputs. He agreed on that.		
Farmer 2 has an organic farm of 270 ha where he breeds 320 ewes, for a milk production of 650 hL. He transforms 1/3 of this amount on the farm to sell cheese at the farm and on local markets. The other part of the milk is sold to the Roquefort industry. His farm is well positioned for the environmental evaluation for the 2013 season (among the best).	When the facilitator showed the diagnostic of farmer 2 on the graph, farmer 2 asked what the result of autonomy meant: "so does it mean that I am like 60% soilless?" After explaining that this result meant that he was ensuring all the maintenance, plus 40% of the farm production with internal resources, the facilitator pointed out that the result was also due to the type of feed inputs he bought (dried alfalfa). Farmer 2 answered that for him, the environmental impact of dried alfalfa was over-estimated from his point of view compared to the cost of other products like soy meal. Then he explained: "I am not looking for my ewes to produce too much. I think that if it was more than 150 L, I would have to feed them a lot to maintain their condition. And using the rangeland is an assumed decision on our farm […] Then, about	Farmer 2 let farmer 3 present the project. Farmer 3 explained that from his point of view, the core objective of the project is to question the link between the soil and herd and to work on the efficiency of the practices to improve the autonomy and environmental impacts. He then insisted on the importance of being able to compare farms to be able to see what the others do differently and think about changes to be made.	Some participants think it is complicated to compare farms because of the diversity of soil conditions. Participants were critical about the philosophy of the project. "I don't really agree, because I have always been skeptical about the quest for more autonomy. It depends on where you are. It depends on whether you transform or you sell your milk and how much you sell it for. Because, when you see our type of soil, if you sell your milk well, between what you buy and what you sell, it can be good for the farm". Others thought the idea

Workshop 3: Farmer 3 (Region L)	He obtains a rate of milk produced in autonomy on the farm that corresponds to the mean of the group.	the choice of dried alfalfa, it's for the ration equilibrium. Before, I was buying soy meal. And it's the cheese production that made us change, for the equilibrium of the ration, it's easier to use […] Besides, we don't have much cereal. And this year, I used the dried alfalfa and I find them in better condition. Feeding them cereals bothers me because I have the impression they don't digest it well. I see the seeds in the dung when I lead them on the road… and Olivier [the vet] told me to try the dried alfalfa and I recognised that… But I don't want to defend it. But… it's a choice. "	Farmer 2 said several times that the tool could be improved and that he is not absolutely convinced by the calculations made. "I agree with Mathieu, we lack economic criteria". "I understand the criticism. It's true that I am not always looking for more efficiency" Farmer 2 did not express the desire to make changes on his farm now.	was good because some of the dairies would soon have to impose a maximum level of inputs to comply with new requirement specifications. Proposition to improve the diagnostic tools by adding social and economic criteria. Most of the farmers said they were interested in implementing the diagnostic on their farm.

Table 2. Table describing the proceedings of workshops 1 (Ma Region), and workshop 3 (L Region) regarding the way the leading farmer and participants reacted to the presentation of the project and the results of the diagnostic for leading farmers

Discussion

The description of these two workshops showed the importance of taking individual farmers' projects into account when they were willing to co-design the transformation of their farming systems: (1) to ensure that the collective project matches the project of the farmers by offering them the role of co-designers; and (2) to give them the opportunity to express their individual project and to put them in the position of thinking about which changes could be made on their farm. In fact, in the first part of the SALSA project, when the diagnostic tools were co-designed with the farmers, debates between the leading farmers about what should be evaluated and what weight should be given to each indicator were very rich. They disagreed on what should be considered as the ideal situation to aim for: for example, “Is it an end in itself to achieve organic farming?” or “Is it better for the environment to buy dry alfalfa that comes from Spain and conduct your herd extensively on rangeland, or to intensify pasture and forage production to be more autonomous?”. Even when we reached a form of consensus on co-designing tools, some disagreements still existed. Comparing the reactions of farmers 1 and 3 in the two workshops confirms this. We think this first observation calls for a feedback on the methodology we used to design the diagnostic tools. In fact, the tools we built with farmers are very normative and carry strong assumptions of what is the desired state to aim at. This type of tool looks to start individual reflection and, if they are built locally, they can help in comparing farms, but they carry several limitations to the transformational process of farming systems: they promote a standardised vision of what should be the ideal situation to aim for and they do not allow for consideration of the territorial dimensions which it is necessary to take into account to deal with systemic changes (Barbier & Lopez-ridaura, 2010). This observation questions the value of the collective consensus obtained: does it have a generic value because it has been defined locally, during a process led by a group of farmers themselves? Some authors think that searching for collective consensus is a way to involve people in collective action (Russell & Ison, 2000). We suggest exploring methods that favour the expression of controversal issues. They would give a better opportunity for people to think about what compromises they are ready to make regarding their specific situation.

The diagnostic tools and the overall project philosophy should have led participants to talk about technical issues and farm practices. However, when farmers presented their results in the two workshops, they talked also about their past and present choices unveiling their own norms and values. This result outlines the importance of considering the transformation that is to take place from the point of view of the farmer who is going to implement it. This echoes the work done by Coquil et al. (Coquil et al., 2011) when exploring the transition to autonomous dairy systems from the farmer's perspective. These authors proposed seeing this transition as a transformation of the farmer's professional world as a whole and not only of his technical system. Farmers are re-designing their professional activity “step by step”, trying to solve incoherencies they meet in their activity. For that reason, a farmer's personal situation and their professional project should be taken into account when designing changes to take place in the long run. Consequently, farmers should be given an opportunity to explain them in the collective process.

To conclude we think it would be relevant to put the transformation of farmers' activities at the core of the transformation process of farming systems. In a context where agroecological transition is to be defined locally and partly collectively (Duru et al,, 2014; Guzmán et al., 2013), the challenge is to coordinate the design of a collective project setting goals and means to change, with the re-design of farmers' activities at an individual level. This stems from the development of participatory methodologies that places professional development at the heart of the co-design process (Béguin & Pueyo, 2011; Gorli et al., 2015; Vänninen et al., 2015). This type of intervention calls for a facilitating researcher, whose role is more to help the development of the resources needed by farmers to transform their activity (Beauvais & Haudiquet, 2012). Lastly, a challenge for further research is to adapt or develop reflexive methods and settings that will help farmers to record and discuss the consequences of their choices. Together with co-design methods it will create a set that will reinforce farmers' authorship in the redesign of their own farming system.

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The potential and limitations of mobile-learning and other services in the agriculture sector of Kenya using phone applications

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Abstract: Low productivity, income and food security in Kenya are often due to the low level of adoption of modern agricultural technologies. Smallholder farmers, who produce the majority of agricultural products, face various challenges, including access to adequate information, services and key value chains. Effective dissemination and adaptation of generated knowledge, practices and technologies to diversify production and foster resilience to recover from shocks and stresses amongst farmers are lacking. Regular extension services have failed to achieve the transformation from subsistence-oriented production to productive (semi-) intensive farming practices encompassing modern agricultural technologies. Information and Communication Technology in Africa is developing fast and the use of mobile phones has progressively moved beyond mere communications. Technology start-ups are taking advantage of the conducive environment in Kenya and building mobile applications that offer health, banking and, increasingly, agricultural services. Agriculture applications can provide farmers with an array of services from production systems management to climate information and market access. Yet while many of these applications have real potential to further social and technological transformation, particularly by engaging the youth and providing data to the government, they struggle with distribution and the set-up of sustainable business models.

Keywords: Africa, mobile training, information dissemination, resilience

Introduction

Similar to many other African countries, the agriculture sector in Kenya is regarded as one of the main drivers of the country's economic growth. It employs about 70 per cent of the population, both directly and indirectly, and contributes about 25 per cent to the Kenyan Gross Domestic Product (KNBS, 2014). The sector is composed of mostly rural smallholder farmers that practice rain-fed agriculture on less than 3 ha of land, which produces about three-quarters of the country's agricultural output (GoK, 2010).

On-farm productivity however remains low, trapping farmers, who have very few alternative sources of employment and income, in a poverty cycle. Low agricultural productivity is often linked to low adoption of improved agricultural technologies, including better cultivars, fertilisers, pesticides, and practices (Aker, 2010). A mix of several factors prevents the adoption of new agricultural technology and innovation by farmers and involves the level of education, individual risk preferences, capital and perception, as well as inputs such as land, labour and credit, as well as access to information (Aker, 2010). Relevant and suitable information on best practices, new technologies, post-harvest handling and value-addition are key in order to boost productivity (Munyua et al., 2009). Other factors include complex structural challenges, such as access to quality inputs, markets, technology and loans (Salami et al., 2010). Unable to diversify or adopt better technologies and practices leaves small holders vulnerable to the impacts of natural hazards, such as extreme weather events or pest and disease outbreaks. Hence, when disasters cause crop, livestock and income losses, poorer farmers are the least able to recover, further aggravating food-insecurity and poverty.

New mobile phone-based agriculture services are increasingly offering solutions to address challenges as traditional extension services are struggling to fill the knowledge gap and drive structural change. This paper provides an outline of which mobile agricultural applications exist in Kenya, how they developed and what impacts Information and Communication Technologies (ICTs) could have on agricultural training and service provision. It will further examine how their various features can increase the adoption of agricultural technologies, access to key services and integration into profitable value chains, and as a consequence enhance resilience and foster social and technological transformation of farming systems. The research for this work involved a desktop review of secondary sources of information as well as interviews with the key app provider in Kenya.

Resilience and promotion of sustainable farming systems

Over the last decade, resilience has become a key concept in international development. The concept also underpins the newly adopted Sustainable Development Goals, which build the basis for a new development agenda (UNISDR, 2015). While precise definitions vary between organisations, the United Nations' Food and Agriculture Organisation (FAO) defines resilience as: *"the ability to prevent disasters and crises as well as to anticipate, absorb, accommodate or recover from them in a timely, efficient and sustainable manner. This includes protecting, restoring and improving livelihoods systems in the face of threats that impact agriculture, nutrition, food security and food safety."*

Advances in building resilience into agriculture are largely clustered around the following four key components: soil fertility; water-availability; diversification; and a strong local community (Thompson et al., 2015). Considerable research and development has been conducted to intensify crop and livestock production, improve agricultural technologies and develop resilient food production systems (Juma et al., 2013). Such practical farming systems include conservation agriculture (CA), agro-ecological farming and climate smart agriculture (CSA), amongst others. They share various common principles and practices such as integrated pest management, crop rotation and sustainable water management practices such as rainwater harvesting or irrigation efficiency.

One of the main challenges to achieving high productivity and resilience is the effective dissemination and adaptation of the knowledge, practices and technologies. Farmers need to be able to access this knowledge and these practices to profit from these advances and to be accurately trained to foster their long-term adoption. Various public-sector programmes and international development agencies' initiatives focus on distributing new practices to often remotely located farmers. However, reaching smallholder farmers, particularly in remote regions, is time-consuming, expensive and has shown limited results in terms of adoption of improved agricultural technologies.

Traditional extension services, such as the trainings and visits (T&V) system, extensively promoted by the World Bank during the 1970s, do provide a high rate of return on investments

(Birkhaeuser et al., 1991). Good extension services require adequate and well-trained extension staff and continued funding for training and follow-up visits (Birkhaeuser et al., 1991; World Bank, 2005). Verification of their impact on adoption of agricultural technologies and productivity remains limited despite decades of investment in and experience with a variety of public extension programmes. Their limited geographic scale and poor sustainability, as well as low motivation and accountability of the field staff reduce the effects of extension services (Anderson & Feder, 2007). The quality of the Kenyan extension service varied strongly during the different political eras and between the geographic regions. The current political devolution process, which was initiated in 2013 and involves the transfer of health, education, transport and agriculture services to the 47 counties, has led to very mixed extension provision between the newly formed counties.

Other extension channels for agriculture information are TV, radio, print media and manuals, that might create initial interest in new systems with farmers, but are static tools and do not allow questions, clarification or in-depth training. These tools and extension services primarily address the information gap, yet do little to address the structural challenges farmers face and hence lack the transformative power required.

The latest information and training tool, which many famers already carry in their pockets, is the mobile phone. In theory, once set up with the relevant applications, both smart and none-smart phones have the potential to inform, train and monitor farmers, as well as change operational processes when established as open platforms that include input supplier and markets.

Mobile subscription and use

Following global trends, mobile phone ownership and sim-card subscription are continuously growing in Africa. Sub-Saharan Africa (SSA) recorded 389 million unique subscribers in 2015 representing a penetration rate of 41% as reported by GSMA (2015), the representing body for all mobile operators globally. Yet mobile phone subscriptions vary greatly between countries, with a mobile penetration in Kenya of over 80% but only 34% in neighbouring Ethiopia. One factor why the number of mobile phones is are still trailing behind the rest of the world is affordability. With 43% of Africans still living on less than $1.90 a day (33% in Kenya), many cannot afford the cost of a handset or regular phone credit (Beegle et al., 2016). Many people do however have access to a mobile phone through ‘device sharing’ between family or community members without owning a phone themselves. Illiteracy and digital illiteracy are additional barriers that limit the use of mobile phones or their functions.

An inconsistent and slow network is the key technical barrier in many regions in SSA. However, GSMA (2015) projects that by 2020 a more extensive network coverage will be available, offering high-speed mobile broadband connections i.e. 3G and 4G technologies. Based on this the developing world will experience an increase from currently less than one-third to nearly two-thirds of all connections running on mobile broadband networks in 2020 (GSMA, 2015).

ICTs, in particular mobile phones, are not only used to communicate, but also to access information and a growing range of new applications and services. In Kenya these increasingly include to make or receive payments, access political news or look or apply for jobs (PEW, 2015). Mobile phone applications (“apps”) are software applications designed to run on mobile devices. They are having an increased impact in terms of making crucial information available in the fields of health (mHealth) or services, such as banking (mobile money), where mobile phones have transformed consumers' banking behaviours and promoted financial inclusion in the region (GSMA, 2013). Paving the way in Kenya was the mobile banking application M-Pesa, which was launched by the mobile phone provider Safaricom in 2007. Currently used by over 15 million Kenyans, M-Pesa allows users to send and receive money, pay bills, save, or use cashless payment services. High mobile phone ownership, together with M-Pesa's prominence and the resulting cultural transformation, have shaped a new realm with technological innovations continuously expanding the list of new services and applications.

Information and communication technology for agriculture

While the mobile app landscape in SSA is still dominated by health and finance services, agricultural support solutions (often referred to as mAgr or m-agriculture) have entered the field. A wide range of applications provides information and services via voice, short message service (SMS), USSD (Unstructured Supplementary Service Data – a message service allowing access to data through a menu structure) and the Internet (Aker, 2010). ICT's main function and core value is the ability to collect, process, exchange and distribute information (Brugger, 2011). Agriculture apps can roughly be categorised into the following four themes: 1) ICT for production systems management; 2) ICT for market access services; 3) ICT support services, including financial inclusion; and 4) data collection (Brugger, 2011; FAO, 2013). Many apps providers frequently bundle some of these functions, aiming to offer one-stop shop solutions for their customers.

Various agriculture-based mobile phone apps that target underserved small-scale farmers such as iCow, mFarm, Esoko, M-Shamba, FarmDrive, Plantwise, Haller Farm app, M-Samaki and WeFarm, have been launched in Kenya. It is mainly young developers living in Nairobi that have initiated many of these start-ups. They see the opportunity to tackle challenges that their families and friends face in their rural homes.

Several advantages make mobile applications a great addition to traditional extension tools. In contrast to an extension service network, mobile phone apps are instant, interactive, far-reaching and relatively low-cost, with a range of benefits and expandable features. Agricultural apps can offer a suitable solution to help farmers to adopt modern and sustainable farming practices and build clusters, and offer vital links to input provider and local markets in poor and remote areas where farmer are unable to access the Internet or have no or little support through extension services.

Apps' potential to increase resilience

At the sector-level, it is clear that in order to holistically strengthen resilience on national, community and the individual level complex governance and policy reforms are required. Factors that drive resilience such as improved infrastructure, research and coordination must be integrated into public investment policies and planning.

More pertinent to measuring apps' capacity to promote resilience is to examine their impact on the farmer level. One methodology often used to illustrate how resilience can be achieved at the farmer level is the 'sustainable livelihoods approach', adopted by Oxfam Great Britain in the early 1990s. Market-oriented and diverse livelihood strategies are thereby believed to lead to progressive livelihood outcomes, such as less vulnerability and improved income and food security. Following this market-based approach to improve rural livelihoods, agricultural apps have the potential to offer better access to a) information, b) extension services, c) links to markets and d) finance in Kenya. As illustrated in Figure 1, existing agricultural applications promote productivity and performance of individual farmers, as well as whole agricultural value chains and include supporting services and connected sectors. To give a specific example: a farmer can be made aware about the benefits of a technical advance such as a greenhouse, get access to credit to afford this new technology, and receive training on how to best use it, order inputs and find a market to sell the products grown in the greenhouse. Easing those traditional bottlenecks empowers farmers to have the opportunity to make informed choices, access technical and financial services and participate in lucrative value chains.

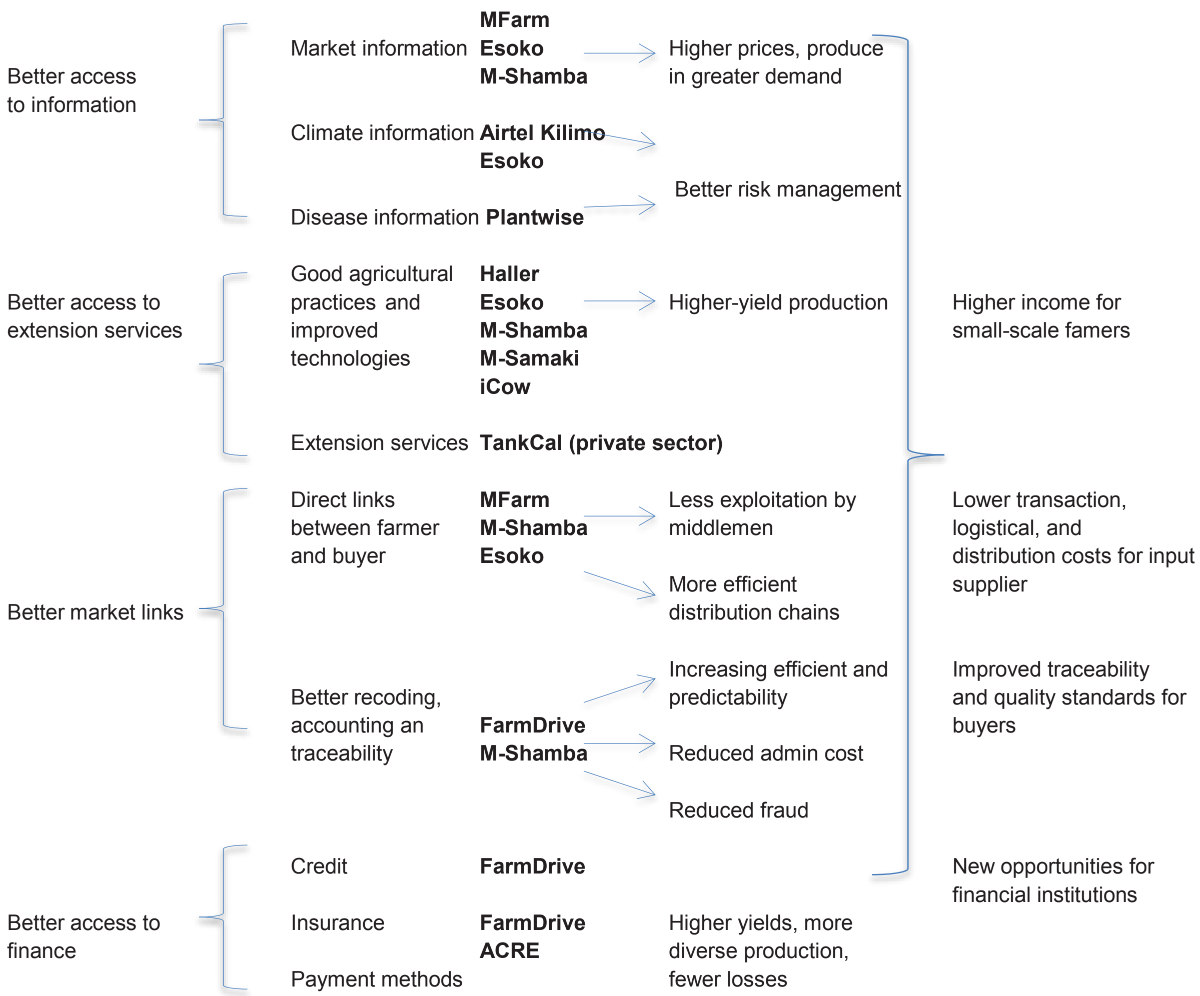

Figure 1. Potential results generated by mobile applications for agricultural and rural development in Kenya (*Source: modified after Qiang et al. (2011))*

How these app services foster resilience becomes apparent when breaking down the above cited definition of “resilience” and matching it with services that agricultural apps can offer:

"*resilience is the ability to - **prevent** disasters and crises* > good agricultural practices & improved technologies

*as well as to the ability to - **anticipate*** > climate & disease information

*- **absorb*** > crop & livestock insurance

*- **accommodate*** > good agricultural practices & improved technologies

*- **recover*** > access to credit

…from them in a timely, efficient and sustainable manner."

Information and training

Agricultural apps can provide relevant and up-to date information on best practices, crops and new tools. In practical terms: for farmers to know what soil conditions, climatic and water requirements new varieties of crops have before planting, allows for information-based decision-making.

Several apps go further than just providing information. They teach new skills or farming practices, through regular SMS- or voice-based tutorials. Training farmers 'on the job' and on their farms, follows a 'learning-by-doing' approach, increasing the likelihood that they will eventually 'own' and adopt those improved practices. The crucial advantage of such apps is that they allow the user to inquire, learn and train at a time and place of their convenience. Also, information and services can, if the network permits, be accessed promptly and when specific information is needed. Additionally, research in mobile learning has shown that through regular contact, participants remained more committed and showed significantly better results (Ayoma & Oboko, 2013).

Examples of this type of app available in Kenya include: **Haller app,** which provides detailed farming instructions to smallholders, varying from how to increase soil fertility to how to maintain a beehive; **M-Shamba** which targets small-scale crop and poultry producers and teaches best practices; **M-Samaki** which guides fish farmers through a complete fish production cycle, giving advice on topics ranging from feeds and pond health to marketing and harvest; **iCow** which tracks the life cycle of cows and retains all relevant information specific to each cow; and **WeFarm** which provides free peer-to-peer SMS-based advice (launched in 2011 it currently has 43,000 users in Kenya, Peru and Uganda that ask and answer questions, about topics such as livestock and crop diseases and new farming). Providing a much more comprehensive management solution is ***M-Shamba's Farm System*** function that allows farmers to track farm activities including revenue and expenses. This addresses a large practical challenge for farmers and a key component of provability, which is record keeping.

Various companies also started using apps to inform and teach customers about their products. Syngenta's **TankCalc** aids farmers in calculating the right measures for their plant protecting products.

Climate information

In a country where agriculture is over 90 per cent rain-fed, receiving climate and weather data helps Kenyan farmers to plan farming activities and to decide when to plant their crops. Good climate advice can proactively prepare smallholder farmers to become more climate-resilient, in particular when linking forecasts directly to explicit agronomic advice on how to respond to specific weather conditions. The GSMA even goes as far as recommending *“donors to put weather forecasting and monitoring at the core of climate adaptation funds, and to focus on mobile-centred projects in order to increase the opportunity to scale services and generate socioeconomic impact“* (GSMA, 2016, p. 4).

Yet in order to be relevant climate data and advice needs to be site-specific, which currently is often not the case. There are two main reasons why this is needed: (i) unless farmers have a smart-phone with GPS functions, it is difficult to determine their exact location due to the lack of a formal street address system; and (ii) Kenya’s many localised micro-climates make exact forecasts particularly difficult.

‘Climate apps’ available in Kenya include: **Airtel Kilimo**, which provides forecasts for the coming week, based on data provided by the Kenyan Meteorological Department; and **Agro-Weather Tool**, funded by the World Bank, which aims to increase the adaptive capacity of farming communities in Kenya and Ethiopia through improved access to information on weather and climate patterns. In addition, one of **ESOKO**’s many services includes sending SMS messages with weather and agronomic tips.

Access to credit

Many banks and financial institutions have traditionally shunned agriculture loans, as lending to smallholder farmers is perceived as high cost, high risk and with low returns. However, tackling the unmet demand for credit by farmers also helps foster resilience, as access to financial services is crucial for smallholders to make long-term investments to enhance productivity, quality and diversity. Affordable, collateral-free credit allows farmers to, depending on their respective priorities, invest in: a) sustainable climate-smart technology, such as drip irrigation systems; b) a means to increase productivity, by for example diversifying their crop or livestock profile; c) improved post-harvest practices, such as building better storage facilities; or d) value addition methods like building a smokehouse for smoking fish. Moreover, access to loans grant farmers the opportunity to commence or expand into different non-farming activities.

Microcredit schemes have a positive impact on farm productivity and generally a good repayment rate (Okon et al., 2012; Girabi & Mwakaje, 2013). Although, as Adams and Bartholomew (2010) point out, microcredits are often not effective if farmers lack business skills and access to markets for their products.

The Kenyan app **FarmDrive** addresses the high-risk challenge by generating individual credit profiles, based on farm information and expenditure and profit history. They currently offer two types of loans, an input financing loan and a diversification loan for larger investments such as irrigation systems. Farmers borrow on average around 15,000 - 20,000 KES (150-200 US dollars).

Price information and market access

One of the most common ICT interventions, aiming to provide more financial transparency in the agricultural value chain, are pricing services. Farmers receive prices for a range of commodities either on demand or pushed at pre-set intervals. A second type of service allows farmers to use their mobile phones to trade and market their produce, via trading platforms that match producers with buyers. These services provide farmers with better market intelligence, first in the crop selection at the production stage and later, by providing better bargaining power during the selling process. As trading platforms can link remote farmers to regional markets, they support the emergence of a more diverse rural economy (McNamara, 2009). Improving market-access for smallholders advances their resilience by enabling poor farmers to participate in higher-value agriculture chains, which in turn improves their income (McNamara, 2009). Trading platforms also eliminate the middleman, thereby driving structural changes in the value and supply chain and increasing profits for farmers.

The Kenyan ‘pricing app’ **M-Shamba** offers a marketplace function that has been designed to promote the trade of agricultural commodities while using basic mobile phones. Farmers can post their products using SMS, an android app or via the internet. **MFarm** offers a ‘Daily Prices’ update with price information on 42 crops in five urban markets, as well as a marketplace service***.*** **Esoko** not only links buyers and sellers, but also creates SMS alerts on prices and buyers for selected crops. **ConviFarm/Kilimo Rahisi** app combines various services and connects rural farmers with information and services offered by agricultural related companies based near the user. This simplifies farmers’ access to inputs and increases the customer base of agro-based companies. Sectors covered include beekeeping, organic farming, irrigation services, rabbit rearing, hydroponics and livestock feed.

Insurance

Insurance is another financial innovation that can build resilience for farmers. Originating in the United States of America to help agricultural producers recover from the effects of the Great Depression and the Dust Bowl, farmers can insure against losses that are unavoidable and beyond their control. In the African context, insurance can save poor farmers from the complete loss of their livelihood after a disaster and help to restore their farming systems for production in the next seasons.

The Kenyan app **ACRE** (formerly known as Kilimo Salama which in Swahili means “Safe Agriculture”), is a micro-insurance programme designed for Kenyan farmers, built through the collaboration of Syngenta Foundation for Sustainable Agriculture, UAP Insurance and Safaricom. **FarmDrive** is in the process of incorporating crop insurance, so that the farmers who take out loans will be able to bundle these with crop insurance.

Apps and social and technological transformation

Returning to the ‘sustainable livelihoods approach’ framework helps to establish how the numerous services and functions which agriculture apps provide might assist with transforming related processes and structures and fostering some of the social and technological transformation required.

That agriculture apps have the potential to instigate social transformation becomes apparent when considering their great ability to reach and engage the youth in Kenya. Defined as the population between 18-35 years of age, the youth represent 37% of the population, but constitute more than 70% of the unemployed (IEA, 2016). Yet at the same time, young people increasingly abandon agriculture as a source of employment and migrate to the cities to look for alternative opportunities. The average age of farmers in Kenya today is 60 years (UNDP, not dated.). Re-engaging the youth through the means of agricultural apps could therefore help tackle youth unemployment and an ageing-farmer population. A key advantage is that by providing relevant advice and proficient services, apps can change young people's attitudes towards agriculture, by encouraging them to approach farming as a profitable business. A report by the IICD found that agriculture apps take advantage of the "*youth's affinity for using ICTs, their capacity to innovate and their propensity for taking higher entrepreneurial risks*" (IICD, 2013, p. 4). Ninety percent of the 24-38 year old farmers in Western Kenya that were researched use ICT on their farm, which further confirms this hypothesis. The report also stressed that more young people had shown an interest in investing in farming lately, which the farmer representatives that had observed this trend linked to the various ICT applications that had recently been introduced.

A process that takes place, often by default or as a side-process, is that agriculture apps collect a large amount of information on their users, commodity prices and climate records, which in total is referred to as "big data". Using and analysing this data could help governments to better monitor, analyse and react to developments in the field. This independently-gathered data could be harnessed and provide evidence-based policy making, more targeted extension service provision and more effective resource allocation. This potential has been recognised by the application providers themselves. **MFarm** has specialised in selling their data to companies, NGOs and government bodies, offering various licences to access their database. **Esoko** offers agricultural data collection using their trained field researcher team.

Another opportuity for governments to use mobile applications in agriculture would be through a specifically designed app to monitor, support and verify the work of their extension officers, or even outsource some parts of the extension services (following the example of a project in Uganda). There, the Grameen Foundation recruited and trained rural community members to act as trusted agents in their communities and to use simple Java-enabled mobile phones to provide information services to farmers, including farming practices, market conditions, pest and disease control and weather forecasts, and to collect data from villages (Brugger, 2011).

As mentioned before, agri apps can foster the technological transformation by supporting the uptake of new improvements in technology. While it might seem obvious, the first step for improved agricultural technologies to be taken up is for farmers to have heard about them. According to Rogers (2003), forerunner of the diffusion of innovation theory, the first stage in the innovation adoption process is "knowledge", followed by "persuasion", "decision", "implementation" and "confirmation". While a mix of factors subsequently influences the actual rate of adoption of a new innovation, awareness is a fundamental prerequisite. Those agricultural apps with training functions can furthermore promote the "implementation" of agricultural innovations.

The technological transformation potential of apps increases further when combined with sensor technology. Various types of sensors that monitor temperature, soil fertility and water quality facilitate more precision in farming. How this kind of technology can be applied has been demonstrated by **M-Poultry** in Uganda. Farmers monitor the temperature sensors in chicken-brooders and food and water availability via a sound sensor through their phone.

Challenges

While agricultural apps do offer a lot in theory there are however considerable challenges in the field.

Paradoxically, most apps struggle with one of the key problems that they are attempting to solve: distribution. Apps often perform poorly when it comes to their own marketing and distribution, which incorporates the interlinked components of dissemination, comprehension and long-term uptake or adaption. While initially only a small user-group might be required during the trial and test phase, a significant scale-up is often essential to guarantee the financial sustainability of the start-up business in the long-term. A group of USAID researchers (Burns & Dolan, 2014) discovered that **iCow**, a widely acclaimed Kenyan app which has been running for over five years, is unknown to dairy cooperatives within a four hour radius of the company's base in Nairobi. M-Farm, they found, has fewer than 20,000 users. This relatively low adoption of applications and services is mainly due to low awareness of their existence. Burns and Dolan conclude that in order to spread distribution, apps services need to expand their marketing and outreach.

Tightly linked to the adoption is the actual understanding of the new service and its functions. While some apps, such as weather and pricing services, are straightforward, some more complex solutions like **FarmDrive**, that combine services, still need a formal introduction and training. One solution is to introduce the application in capacity building workshops. However, awareness campaigns and training for user acquisition often become a major cost-factor for tech start-up apps, which are generally short on funding.

Related to distribution is the challenge of ensuring the actual long-term adoption of apps' solutions. Much depends on the users seeing the added value in the service provided and if they are willing to pay for the service. To ensure the applicability and usefulness of these applications requires a thorough user research and design process; generally the first step in the development process (Burns & Dolan, 2014). Key to the further uptake and understanding of the content communicated is to offer services in well-timed portions, in a language that is understood, both linguistically and comprehensibly (i.e. using farmer language) and distributed in a suitable format. This would, for example, mean choosing a short voice-message service in a region with high illiteracy, in the locally spoken language, using simple and widely-used terms. Additionally, it is wise to monitor the users' experience and test if content and features are understood, relevant and can, if possible, be further fine-tuned.

Many agricultural apps give farmers the opportunity to ask questions or to give feedback, unlike other agricultural information channels such as newspapers or radio. The use of these apps can advance a participatory process, allowing farmers to provide input on the pertinence of the services and advice shared and vital insights into realities on the ground. Perhaps most importantly for agriculture app providers is to design their product in ways that include such crucial feedback loops and promote user-involvement on content and functions, so allowing their services and information to be interactive, suitable and relevant.

Another challenge, shared with other tech start-ups is financial sustainability. Currently, the majority of agriculture apps are partially or completely funded through donors, charities or incubator programmes. To achieve commercial sustainability and to turn a SMS-based information service into a business without donor funding is still very difficult (Southwood, 2013). Most common funding models rely on charging the user a small fee for each SMS sent, which is split between the network operator and the application developer. Yet so far only very few agricultural apps have managed to generate the user-volume required to finance their business and recoup the cost of operating the service in this way.

The final challenge is the limited interaction and functions of basic phones i.e. non-smart phones, which the majority of mobile phone users own. Mobile phone applications real potential is best-realised through smart-phone driven applications, such as instant messaging and video streaming. As most people are visual learners, new information and training have a higher impact when supported by short videos and pictures. Influenced by the technical capabilities, many of the agriculture app services in Kenya start with an Android version for smart-phones, but later shift to basic phone versions after realising that their user-base still own basic phones. Currently smart-phone ownership is too low in rural Kenya to make Android apps viable. More affordable smart-phones, together with an improved broadband network will be likely to lead to a rise in the adoption of smart-phones (Ericsson, 2014).

Conclusion

In this paper it has become apparent that agriculture apps offer a range of services and functions that can, if adopted, allow farmers to be better informed, take up improved technologies and integrate into value chains, thus improving their productivity and resilience. The use of mobile applications could also help to re-engage the youth with farming and improve and speed up extension services. They can furthermore assist in advancing some of the social or technological transformation needed, though since these are multi-faceted, gradual processes, they will require time and sustenance through other initiatives.

Agriculture apps however are not the 'silver bullet' that will be able to solve all challenges for smallholders; they are an additional tool in the toolbox. Still essential for them to work is to strengthen the agricultural sector as a whole through agricultural research, supportive policies and programmes, to improve market access, rural infrastructure and better collaboration between stakeholders (local and national institutions, the private sector and NGOs). Apps can only deliver information that is tested and verified; they can only provide good climate data if it has been recorded and made available, and only build linkages along value chains if those already exist and to markets that are accessible.

It is currently too early to judge what impact ICT-based agricultural services can really have, since their diffusion and long-term sustainability are still big obstacles. So far, very little research has been conducted on the actual impacts of applications as empirical trials are complicated due to a range of threads including serial correlation and spill over effects, as highlighted by Aker (2010). Future research should focus on how mobile phone apps can be made more accessible and their uptake increased, as well as on how participatory processes can be further improved in terms of feedback and uprating on content and services vital to farmers.

The potential of the ICT sector is of great interest to the development sector. USAID runs various ICT programmes, the FAO has developed the SAFA Smallholder App for soil analysis and GIZ recently launched the ICT4Ag Coordination Unit, looking to accelerate the adoption of tech solutions for their numerous projects and within agriculture value chains.

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Participatory research: a comprehensive process for a new generation of researchers

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Abstract: Participatory research approaches are regularly included in agricultural research projects for development. Participatory research is a real comprehensive process. This article shows through two study cases the importance of understanding the diversity and the complexity of a problematic and to take this into account before acting. In the African Great Lakes region, maintaining soil fertility is a continuous challenge; its degradation is highlighted in the majority of the latest scientific publications. Meanwhile, farmers' ingenious practices to overcome this problem haven't attracted much attention. The first case study is about a systemic analysis of soil fertility management in banana-based smallholder farming in Burundi. Exploring the complexity of the rural realities, the method highlighted diversity in the practices as well as the multiplicity of farmers' problem-solving skills. The second case study gives an example of this second step of the process: acting in a research-action project in South Kivu. Banana crops in the region have been attacked by a bacterial wilt for which there are no technical solutions. In this case, our method allowed co-constructing the reflex of prevention by training based on the local reality of farmers. By working via interactions with stakeholders, we made partnerships with actors at different levels. This methodological process redefines the role of researcher as an integrator between the micro level of farmers and the macro level composed of the actors of the innovation network. This new kind of researcher needs to acquire some skills to carry out this new job for facilitating the transformation of agriculture.

Keywords: Comprehensive, diversity, complexity, action-research, integrator-researcher

Paradigm shift in agricultural research: new needs and approaches

The paradigm of agricultural modernisation and its productivity growth hypothesis are currently being challenged.

Starting in the sixties with the Green Revolution, agricultural modernisation sustains an increase in the crop yield through the use of inputs and technologies. This allowed a significant increase in production in the regions suited to its establishment. Nevertheless, 850 million people still suffer from hunger and half of them are small farmers or farm workers living in rural areas (FAO, 2012). The problem of hunger seems more ascribable to access and distribution than it is to production (Mathijs, 2011). Moreover, the modern agricultural paradigm seems not to correspond to the environment of the majority of small family farms, which represent 85% of world agriculture (Von Braun et al., 1991). In these regions, these agro-technical approaches resulted in many failings, due to unfavourable institutional environments, but also to technical solutions unsuitable to farmers' real needs, lacking consideration for their logic and their intrinsic capacities (Lavigne-Delville et al., 2004). In addition, most of those who are not in a situation of food insecurity are facing erosion of their income and their autonomy (FAO, 2011). This socio-economic crisis related to an "ill-development" is accompanied by an environmental crisis (Stassart et al., 2012). The global agri-food system is a major source of degradation of natural resources and its negative externalities are widely criticised.

Alongside this double crisis an agro-environmental transition of agrarian systems is getting under way. Agro-ecology puts into perspective the vision of agriculture and of innovation. From its point of view, external technologies are no longer at the centre of the systems, but rather the agro-systems' peculiar functions e.g. the optimisation of the hydrologic cycle (Altieri, 1989). The combination of ecological and agronomic knowledge, together with farmers' scientific know-how, is therefore considered of primary importance (Stassart et al., 2012).

This transition requires change in the classical research paradigm (Collinson, 2000); that calls for new approaches based on system perspectives and a comprehensive framework. In Agricultural Research for the Development (ARD), farming systems' research approaches promote an interdisciplinary holistic framework, rather than a narrow technology or crop focus, with identified farmers' problems and constraints as the basis for planning research and extension activities. That changes the model of technology development from a linear transfer of technology model to an iterative approach based on learning and adaptation. Adaptive methods and tools are therefore necessary. Among them, participatory research can draw on both indigenous and scientific knowledge systems (Adrienne & Sherington, 1996). In interaction both with farmer and scientific and government institutions, the role of researcher also changes. Integrating farmers' arguments, he/she can better approach the complexity of rural realities and farming systems. Besides, its outsider perspective on available technologies, new market opportunities, processing possibilities and policy influence draws on resources not normally available to local farmers or communities (Collison, 2000).

In this article we illustrate this systemic and participative approach as a whole process in action-research through two case studies focused on the banana-based cropping system in the Great Lakes region. More specifically, we show the researcher's approach at two distinct stages: the MSc student and the PhD student. In the first case study, the student achieves the first step of the process: understanding the diversity as well as the multiplicity of farmers' problem-solving skills. The second case study demonstrates how the PhD student takes this into account to propose a solution adapted to local rural realities.

Context of the case study: the Great Lakes region and the importance of the banana crop

Burundi and South-Kivu are located in the Great Lakes region, characterised by a particularly diversified environment and uneven reliefs. Its climate is tropical, tempered by altitude. Small farms, with an average size of less than one hectare (Karamura et al., 1998) are located on the hills on up to 20% of slope (Rishirumuhirwa, 1993).

The current farms' organisation is divided up into five different soils. The two main production systems consist of dense banana plantations encircling the house or "rugo", associated with shade plants (1) and food crops associated with scattered banana trees (2). The cultivation of cassava or sweet potato, demanding very little contribution from fertilisers, is generally carried out in single-crop farming on plots, at times far from the habitation (3). Some afforestation or residual pastureland occasionally covers the top of hills or slopes which are unsuitable for cultivation (4). In the “swamps”, referring to the small wetlands that separate the hills and the big marshland in the valleys, we find different farming systems: beans crop rotation + corn or potato with rice, fodder weed, vegetables, etc. (5).

In this country, with a predominantly rural population, the cultivation of banana has an important place at the food, social and economic level.

Since the last century, following the cultivation of pastureland and epizootic diseases, banana has replaced livestock as the new source of green manuring (Cochet, 2001). Contributing more than 50%, it represents the main element producing biomass (Rishirumuhirwa & Roose 1998).

Banana plantation means a lot to the farmers. First of all, it is the source of food: as juice, beer, starch and fruit banana can be consumed in many forms throughout the year. The production method provides its perennial nature and ensures food security during times of hunger. Banana represents also the main and at times the only source of income for the rural population, through the selling of bunches, juice or beer in local markets or to middlemen (Picq et al., 1998).

The multiplicity of banana's functions for the population in the Great Lakes region, illustrates the complexity of the farming systems based on banana cropping and the need to adopt approaches that are capable of taking it into account.

Case study on soil fertility in Burundi: MSc student’s approach to conduct a comprehensive assessment to understand the diversity

This first case study illustrates the approach adopted by the second author as an MSc student in agronomy, to conduct a systemic assessment of soil fertility management in banana-based smallholder farming in Burundi.

Genesis

In Burundi, soil fertility is a permanent challenge for farmers. Temperatures that are propitious to chemical alteration and the humidity conditions, together contribute to diminish intrinsic soil fertility. Besides, higher pressure on arable land leads to cultivation of marginal soil and to the fragmentation of plots.

Scientific researches in this domain generally adopt a quantitative approach based on scientific expertise. These may, for instance, assess the amount of nutrients and underlying agriculture practice.

In Burundi, international development programmes are promoting Integrated Soil Fertility Management (ISFM). ISFM is defined as an organised set of practices for soil fertility management, which implies the use of chemical fertilisers in association with organic fertilisers and the use of improved seeds (Vanlauwe et al., 2010).

Fertility degradation marks the consensus among the vast majority of scientific papers and development programmes. Meanwhile, farmers' ingenious practices to overcome this problem have not attracted much attention: they develop specific strategies to overcome constraints and these strategies are suited to the local specific conditions. Capitalising on the diversity of these practices and understanding their foundations, is an essential scientific exercise.

This first case study analyses soil fertility management practices in smallholder farming through a systemic and comprehensive approach based on farmers' discourse.

Methods

We have conducted semi-structured interviews in three provinces in Burundi (Gitega, Cibitoke, Ngozi), characterised by different agroclimatic conditions. The in-depth interview process was guided by an outline of open-ended topics that cover a broad range of themes linked to soils' fertility management. For this last topic and using snowball sampling (Pires, 2007), the names of other interesting actors were collected. The sample therefore constituted during data collection with the aim of maximising the diversity of structures and practices. The final sample was constituted of 23 farms. Through these interviews we aimed to:

1. Identify the distribution of the biomass between different plots in a given farm, and to try to understand the "how" and the "why" of such actions;

2. Identify the factors contributing indirectly to soil management: i.e., to understand farmers' drivers and expectations.

The totality of the interviews was transcribed. To analyse it we coded the transcriptions with keywords using qualitative data analysis software (R software's RQDA package).

The data resulting from the coding of the interviews was cross-referenced with those resulting from direct observation of plots. Hence, we have listed the fertility flows within an m x n matrix. Through a clustering by fuzzy logic method, a typology was created from the matrix, leading to identification of four groups of farmers/farming practices. Building upon these results we developed a resource management model, enriched by farmers' justifications.

Results

Despite a relatively small sample, we observe diversity in fertilisation techniques (1) and in motives expressed by farmers to justify the latter (2). Resource management models illustrate this diversity (Figure 1).

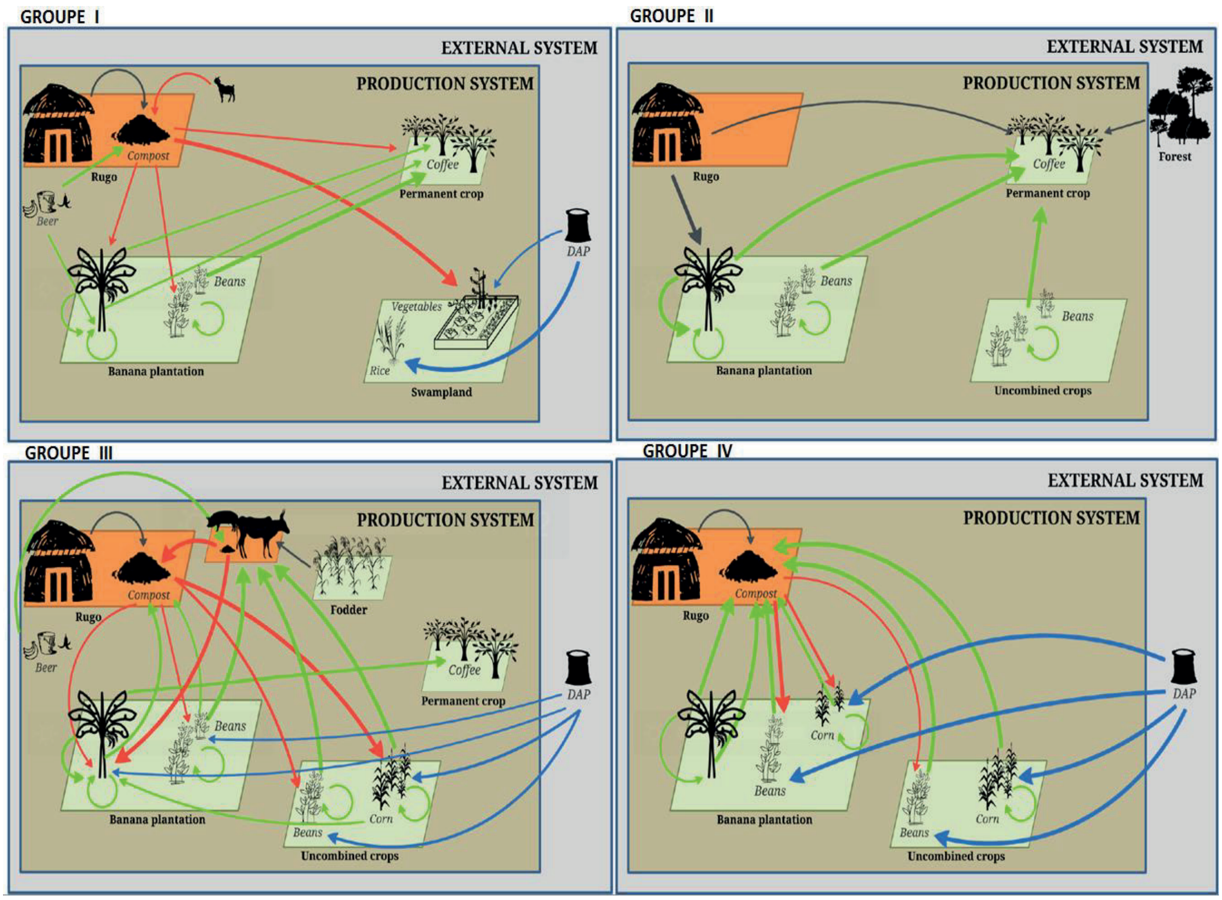
The groups differ notably in the nature and origin of the utilised biomass. Farmers from groups I and III possess livestock and can thus benefit from animals' manuring; whereas farmers from groups II and IV receive only plant biomass.

By letting small cattle graze outside the farm's limits and by importing leaves from surrounding forests, groups I and II mobilise external biomass. On the contrary, by conveying crops' residues to the livestock or to the compost, groups III and IV exploit only farm's internal biomass.

Discourse analysis reveals that farmers' scope for intervention is narrow and directly determined by the limitation of three fundamental resources: natural environment, work force and liquidity. According to the farm's priorities, these three resources are allotted preferentially to certain activities.

The example of group IV illustrates this decision logic. The five farms have a surface area of less than 0.5 hectare and are located in Gitega, one of the least fertile zones of Burundi. In addition, farmers are compelled to work externally to meet their family's needs. In the face of these constraints, farmers from this group implement fertilisation techniques based on the primary role of banana plantation and the transfer of plant residues to the compost.

> "*You need resources to buy livestock. I cannot afford it. So, what I do, I prefer to gather all the weed in the compost, I accumulate all the weed and once decomposed, I use them as fertiliser. That's all that we use here, at my place*" [4114].



Legend: Green, red and blue arrows illustrate respectively cultures' residues, manure and chemical flux. The thickness of the arrows depicts the importance of flux if resources are subject to different uses.

Figure 1. Resources management models[1]

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[1] *Icons used in the graphs created by Anand Prahlad, Francisca Muñoz Colina, Joel McKinney, Michael Zick Doherty, Adam Zubin, Lance Hancock, Liliane Lass Erbe, Ana Maria Lora Macias, Rhys de Dezsery, Agne Alesiute, Shawn Erderly, Ben Didier, James Fenton, Philip Glenn, Nastja Vivod, Francesco Cesqo Stefanini, Lucas fhñe, Luca Santomauro, Jose Morbàn, from Noun Project.*

Moreover, farmers compost faeces and associated crops in order to make the most of the organic matter.

> *"I use toilets' manure. We have to identify other means to ameliorate the fertility of our soils… If I use compost, I can harvest a few pans; but if I've used toilets' manure, I may harvest more than seven pans of beans. It's not the same thing"* [4121].

> *"In fact, if I fertilise beans and corn, the banana tree can take advantage of it, and with its roots it draws up the elements that I have used for those two crops"* [4114].

Facing a shortage of manure and limitation of financial resources and work force, farmers of this group resort sometimes to practices like chemical fertilisers and stubble burning; otherwise they would have themselves considered these practices as harmful to the conservation of soil fertility.

> *"Last season I didn't have organic manure. I have put some chemical fertiliser to maximise yield; but considering the long-term effect, it's negative…. It's harmful for the fertility of soils"* [4119].

> *"I prefer not using burning (he refers to the burning of weed). However, when I get some work, I'm not here (he refers to his farm) to check what my spouse and children do. Them, they do burning even though it's not a recommended method"* [4119].

Farmers of group III differ from the other groups in terms of the means of production used. They all possess big cattle (cows or pigs), bred in permanent stabling. Besides, they draw substantially on chemical fertilisers, applied -in combination with organic fertilisers- to all crops except coffee. On the other hand, with the animals being kept indoors, farmers must dedicate more work and effort in order to harvest fodder, compost faeces and to spread the decomposed manure. Thus, they use more inputs and fixed capital per hectare and can be labelled as capital-intensive and labour-intensive. Group III seems to be the most in tune with the agricultural modernisation paradigm, according to which intensification is defined as yield per surface unit through growth in work and soil productivity (Bonny, 2011).

Lessons

In this case study, we adopted a systemic and comprehensive approach to mobilising social skills. As an MSc student in agronomic sciences it was possible to break away from the technical logics to take into account the farmers' knowledge. This approach allowed us to demonstrate the diversity and the judicious nature of farmers' fertilisation techniques. In this way, far from ignoring the soil fertility dynamic and the capital importance of its retention, farmers implement their practices depending on constraints and circumstances.

Diversity of practice nevertheless faces the homogeneity of expectations expressed by the farmers. A stronger integration of cattle, single-crop farming and the utilisation of chemical fertilisers (in combination with organic soil-enriching agents) are the three wishes that appear almost systematically in farmers' discourse. These practices correspond to the technologies of the Integrated Management of Soil Fertility (IMSF, GIFS in French), currently proposed by development programmes. These tools are aimed mainly at intensifying agriculture and increasing its productivity. However, discourse analysis shows that the farmers' case is not limited to increasing production. They include other elements as well, like practical issues and notably the organisation of the work (distance, weight, etc.). The diversity of practices in a small farming system constitutes a real wealth for Burundi. It contributes to the overall resilience of production systems. However, the homogeneity of farmers' expectations questions the durability of traditional farming methods: farmers have always been innovating but with the new actors of development they learn to adapt their expectations to the supply of these actors.

Case study on banana plant disease in Idjwi: PhD approach taking into account the complexity and the diversity

This second case study illustrates the approach adopted by the first author as a PhD student in agronomy to implement actions for a lasting management of the banana disease by the farmers. This research-action started during PhD thesis work on the systemic analysis of innovation process in the banana-based cropping systems of the Great Lakes region.

Genesis

The Idjwi Island is located in the Kivu Lake between Rwanda and the Democratic Republic of the Congo in Congolese territory. It is a large island of 310 square kilometers with a high density of population: 160,000 inhabitants distributed in the North and the South of the island separated by a nature reserve (Figure 2a). The population is primarily rural and there is no motor-road on the island (Figure 2b). The island has been preserved from the regional conflicts taking place on the surrounding land of Kivu. The favourable tropical climate tempered by the altitude affords great food production, particularly in fruits such as bananas and pineapples. Idjwi is considered to be the granary of Bukavu and Goma, the capital cities of South and North Kivu, respectively.

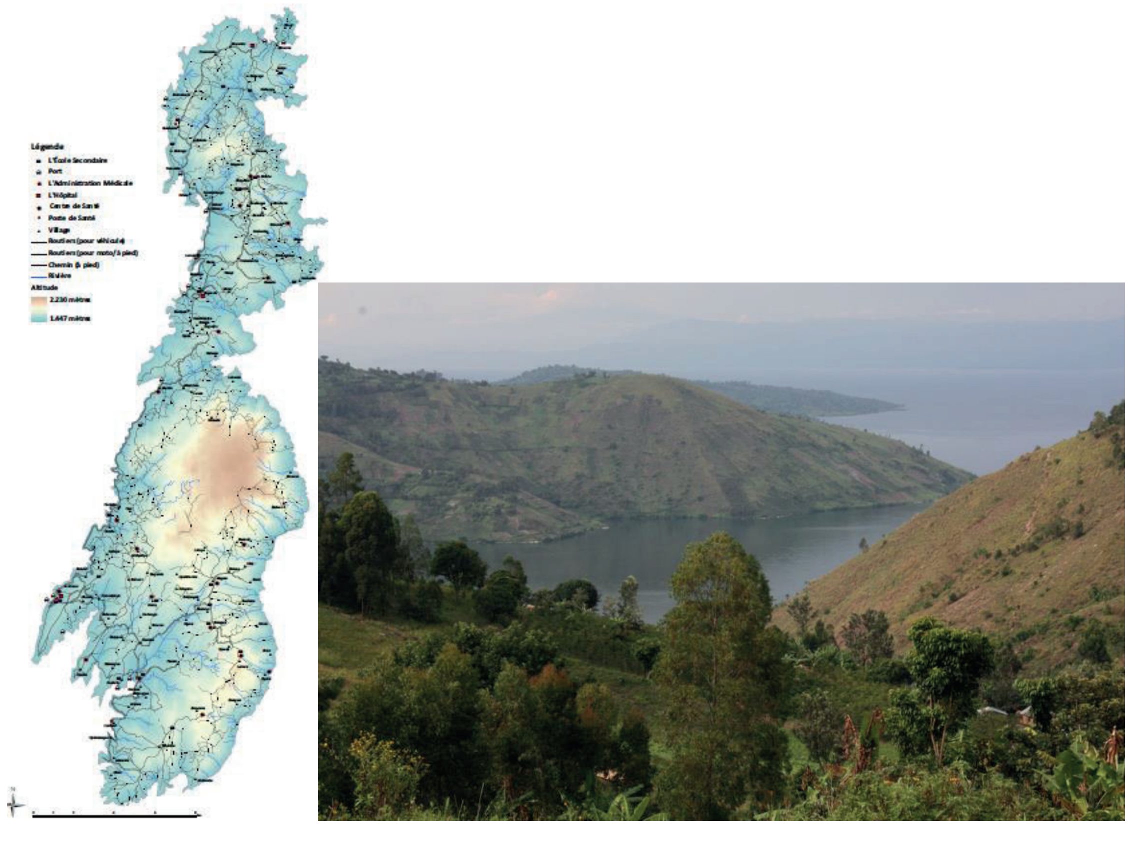

Figure 2. (a) Map of Idjwi territory; (b) View of the rural landscape of the island

Since the beginning of the 2000s, the banana plantations of a part of the Great Lakes region of Africa – including Idjwi Island since 2004 – have been attacked by a destructive bacterial disease: the Banana *Xanthomonas* Wilt (BXW). The bacterium causes the loss of banana production by withering of leaves, early ripening of fruit and production of bacterial exudate. A technical solution for this disease (e.g. resistant banana plant varieties) doesn't exist. The only precaution (measure of action) is the prevention of the disease in the banana plantation.

The disease, and in turn the reduced production, has a dramatic impact for the farmers and islanders on food and nutrition, rural economy, household insurance, social exchange, ceremonies and agronomic aspects. We observed these damages during our first visit to Idjwi in February 2012. It was the last field trip to the Great Lakes before starting the redaction of the PhD thesis (Idjwi was not in the study sites). The disease seemed epidemic since 2010 in the North and the South of the island. The farmers were bereft, without information about the disease or the way of management. Only the local centre for the rural promotion had some idea of the preventive practices to undertake.

Back in Bukavu[2], we had planned, independently of the observation in Idjwi, a meeting with the research-action partners who had collaborated with us during the thesis process, for defining the possible further actions in link with the banana. During the meeting, one of the partners highlighted the BXW as the priority issue. The next day, we invited the other stakeholders around the table and we created the Cell of Coordination of the Actors in South Kivu for the management and the battle against BXW (C-aSK of BXW). The cell was divided into two working groups: the first was a kind of legal group with the objective of getting a by-law for the declaration of the disease as an epidemic; the second group was technical and developed a framework of actions in three axes: (1) sensitisation, training and organisation; (2) transition; and (3) replantation and reconversion.

Back in Belgium, we saw the experts in plant disease and asked the mandated authorities (the Belgian Head office of the Overseas Development) about the actions in progress for this problematic. We discovered that some "survival funding" had been granted by Belgium and that the FAO[3] was in charge of the operational working in the Great Lakes region. Idjwi was not in the action-sites for the first round of financing but could be included in the second, nine months later. Nine months was too long for us. We decided to initiate a diagnostic and exploratory survey in the Idjwi Island to complete the action framework and formulate the recommendations for actions.

Three months later (time to identify some funding), we were in Idjwi with a team of six people and during a ten day period covered the entire island with our data collection.

Methods and results

The data collection on Idjwi was organised around three methods according to the six objectives of the diagnostic and exploratory survey (Figure 3):

- 136 **GPS localisation points and determination of the category of infection** in each farm interviewed and with a systematic method for covering all the Administration Divisions (AD) of the island;

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2 *The nearest town close to Idjwi in the Southern Kivu part of the continent.*

3 *The Food and Agriculture Organisation of the United Nations*

- Six **focus groups** in each AD with one representative of each village and the head of the AD (12 to 18 people per group);
- 36 **individual interviews** in each AD with 1 or 2 farmers in each category of infection (healthy, early epidemic, epidemic, post-epidemic).

In 10 days, with six people and using these three methods, almost 20 types of outputs were produced for analysing the BXW situation and the consequences in Idjwi covering the three axis defined by the C-aSK of BXW in February 2012.

The first assessment from the data about epidemiology proves the severe epidemiology status for the Idjwi territory: the vast majority of the island is at an epidemic level with 64 villages out of 66 visited where the disease is present. The importance of damage due to the disease is proportional to the multiplicity of banana functions in the everyday life of the population.

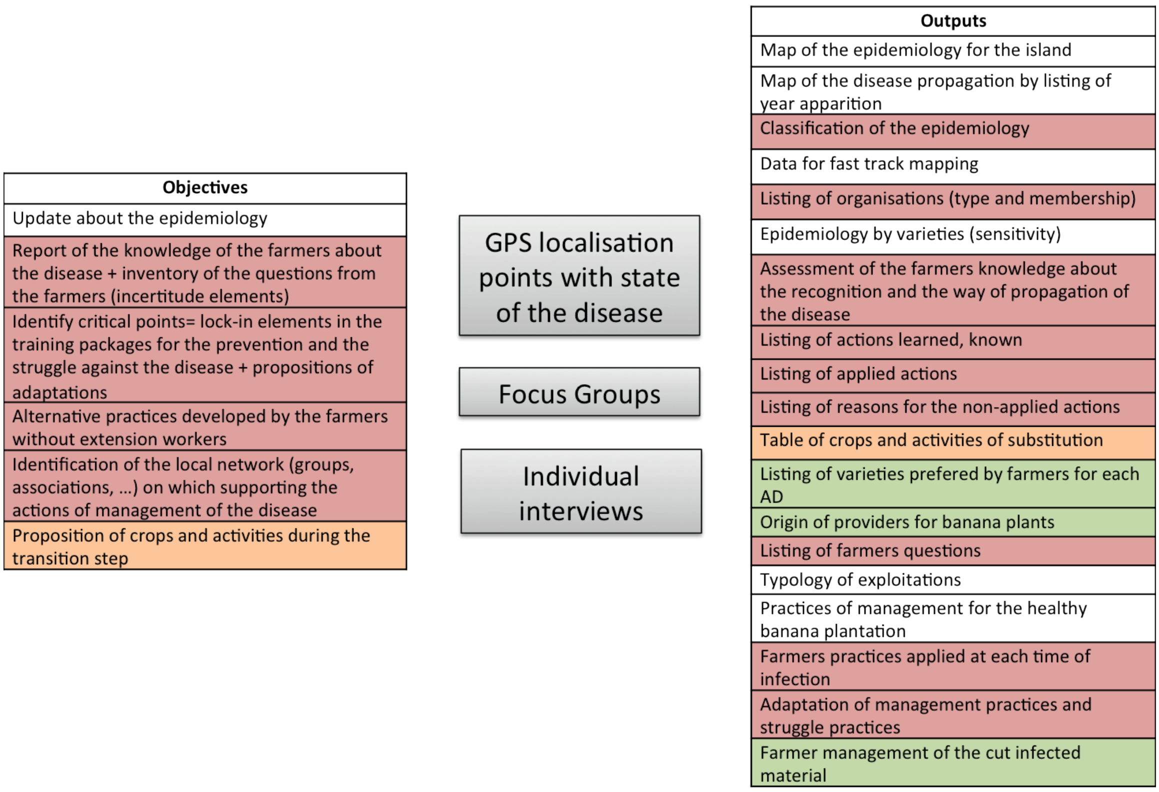

Figure 3. The three methods used to address the six objectives of the diagnostic and exploratory survey and the 19 types of outputs generated. The objectives and outputs are distinguished between the three axes of the actions framework defined by the C-aSK of BXW. (*Legend: white - information for diagnosis axis; red - information for sensitisation, training and organisation axis; orange - information for transition axis; green - information for replantation and reconversion axis)***.**

The main assessments after the survey in May 2012 were that (1) the farmers do not have the relevant information available and misunderstandings about the origins of the disease impair a good integration and implementation of the prevention and control measures. Reactions to the proposed practices are heterogeneous: some farmers display high motivation considering the massive impact of the disease, while others are daunted by the size of the challenge. In some cases, the measures taken are inefficient when not fully and carefully implemented and as a consequence, farmers are reluctant to pursue the struggle. The different levels of reaction are also proportional to the state of the epidemics. The prevention and control measures generate an increase in the workload in systems that already are very labour intensive. All farmers are not equal in front of this workload increase. (2) For all actors, banana is a non-substitutable crop in the system. A transition phase (quarantine) or a strategy of substitution implies a full appraisal of all the functions of banana in the agricultural, social and economic system. (3) Most of the farmers are the members of an association but these have no or very few activities in relation to banana cropping.

We present here only general assessments but full and precise results (e.g sorting of banana varieties by use; description of symptoms by part of the banana plant by the farmers; listing of conditions for the replantation, etc.) will be available following this study[4].

This analysis entailed recommendations along the three axis of C-aSK of BXW having to take into account the adaption of measures according to the epidemiology level: (1) Appropriation of advice by the farmers is better when the conversation starts from their own conceptions and practices. Use the "extension in resonance" for initiating a reflex in the mind and the practices of the population; (2) Transition: Cassava, sweet potato and bean (grown by women) can be substitution options for the staple food role. Maize and legumes are possible to a lesser extent. Pineapple could be used for juice, beer and social aspects particularly in the South. Small businesses and husbandry are potential options for the economic dimension. Main requirements are a good provision of seeds and a real autonomy of farmers in their decision processes; and (3) Replantation of banana has to be thought through in close connection with farmers. Sanitary status of the new planting material and relevant varieties are the key issues. Local networks have to be built around the banana issue[5].

Actions

The diagnostic and exploratory survey entails impacts at different levels of actions with various actors from the micro up to the macro level (see Figure 4 in last part of this article):

- Signature of the by-law by the provincial government of DRC for the declaration of the disease as an epidemic;
- Inclusion of our university (UCL) by the Belgian Head office of Overseas Development as an actor in the Special Fund (« survival funding ») and spreading of the FAO activities in Southern Kivu including Idjwi;
- Set-up of production of healthy plant material by the collaboration of the Provincial Inspection of Agriculture and a Belgian NGO (Louvain Coopération);
- Mobilisation of the Centre for the Rural Promotion in Idjwi: demonstration plot and broadcast on the local radio for the diffusion of information about the disease and the prevention practices;

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[4] See annex 1 of the report "Food security risks in the Great Lakes region – Rapid response to the threat of banana diseases". Baret, P., Van Damme, J. and Colin, J. Earth and Life Institute – Université catholique de Louvain.

[5] The recommendations are also multiple. See report "Phase-pilote de contribution à la lute et à la gestion du flétrissement bactérien du bananier (BXW) au Sud Kivu". Van Damme, J. Earth and Life Institute – Université catholique de Louvain

- Collaboration with Kidogos[6] and a local organisation for the multiplication of healthy banana plants.

The implication of UCL into the FAO funding enabled us to continue actions on the axis of training for the population of the Idjwi Island with the application of the principle of “extension in resonance”. On the basis of the results of the diagnostic and exploratory survey of 2012, its updating in 2014 (outputs about report of farmers’ knowledge and questions) and the expertise of a phytopathologist, training for two groups (one in the North and one in the South of the island) of around thirty people of three types: “pilot farmers”, extension officer, and local leaders/authorities are organised (training of potential future trainers). The training consisted of a classroom part (with support for the trainer structured according to the main topics to be addressed for understanding and struggling with the disease; each topic including the questions and elements applied by farmers collected during the surveys) and a part in the fields. Four copies of this support guide have been left for the handover to potential trainers. A second fundamental part was provided in the fields for the observation and the demonstration of the information taught during the classroom part. A final part was provided for the agronomists: a diagnostic methodology for the disease with the use of detection kits.

After this essential process of training, a collaboration with a local dynamic supported by a small Belgian association has been coordinated for an action in the last axis of the CaSK-BXW framework: the replantation. As a first step, the trained people in the North and the South each teach more or less three others farmers who have taken part in the survey of 2012 and 2014 as a priority. In a second step, in the South, a technique of rapid multiplication of healthy banana plants was experimented with using local materials. In 2015, 132 farmers have benefited from healthy banana plants coming from this scrupulous process including trained farmers and farmers having participated in exploratory and diagnostic surveys.

Lessons

Giving a sufficient overview of the genesis and the process of actions was important to understand the importance of working in a comprehensive way and thus increasing the likelihood of success and the sustainability for projects in ARD. In comparison, in another country also infected by the disease, a recurrent annual funding allows the massive distribution of banana plants. The varieties distributed are imported from research centres and considered as improved but they are not adapted to the practices of the farmers. Only two or three different varieties are provided while more than ten have multiplied in Idjwi with the consultation of local farmers and taking into account the local preferences. No information or training, either about the techniques for growing these imported plants or about the prevention practices against the disease, is provided with the distribution. In consequence, each year more than one million euros are spent on the distribution of new banana plants that even the farmers start to weary of as they do not give anything over the years.

The case of the management of BXW in Idjwi Island has taken around 3.5 years since the observation of the first symptoms and the replantation of healthy banana plants. It will also take more than one year before consumption of bananas from this process by the households. In total a process of five years, yet accelerated by four key elements of success: (1) the knowledge gained of the banana-based cropping system by the timing at the end of the phase

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[6] Non-profit-making organisation

of data collection for the thesis about this; (2) the systemic (comprehensive) approach and the methodology used (co-construction of innovation) developed during the PhD process and proven by accident in Idjwi; (3) the network of efficient partners who met as the result of others research-action experiences during the PhD ; (4) the background of the phytopathologist. The process involved a succession of three essential steps: the rigorous technical diagnosis and the exploratory survey conducted in a comprehensive way; the training in resonance with actors; and only after that, the replantation in consultation with farmers and local infrastructures.

A new role for researchers in ARD: the integrator researcher at the interface between the actors and the disciplines

We tried to illustrate the importance of taking into account the diversity of practices and the complexity of the realities with the interactions between the elements of a system including the actors. The first case showed the diversity of soil management strategies implemented by farmers depending on constraints and circumstances. This diversity faces however the technological packages spread by the development programmes. The second case took place in a context where there weren't technical solutions to diffuse like a resistant variety. The classical actors of research then were deprived of their usual tools (diffusion of a technical solution) and our comprehensive approach made it possible to get results.

In these two study cases, the researchers have distinct positions (respectively MSc student and PhD). Nevertheless, they both adopted an approach allowing the systemic and participatory approach required for successful research-action.

In this last section, we propose to gather the key-elements of the approach in a new role for the researcher in ARD: the integrator researcher.

The interface of actors

In ARD, the actors of the network of innovation are organised around three levels of decisions and actions: (I) the macro level with the national and international institutions of ARD - the governments and overseas development, the research centres and universities with the specialised scientists, the funding organisations, federations, associations and NGOs; (II) the micro level composed of the farmers and their representatives; and (III) the meso level, between the macro and micro levels, gathering all the actors whose mission is to diffuse from the macro to the micro level the technical and organisational propositions (innovations). This level includes decentralised authorities and agencies, local associations, NGOs, federations and cooperatives.

In this model, the diffusion of innovation is top-down from the macro level to the micro level with a rapid diagnosis of the problems and a conception of the solution at the macro level with a large effort deployed by the actors of the meso level for the adoption of this solution. In our case studies, however, we devoted time to the observation and fine comprehension of the systems thanks to an original combination of tools resulting from agronomy and social sciences. During this stage, the issues and the capacities of the micro level are also identified and objectified by the researcher (at the meso level). Unlike a rapid diagnosis, this kind of rigorous analysis is able to facilitate the emergence and design of relevant innovation (technical, social, institutional, etc.).

On the basis of the exploration - in a transverse way through the levels of actors and through a geographical way with actors on the same level - the integrator researcher can compose (with the knowledge and the practices of the farmers identified at the micro level and with the technical and organisational proposals of the other actors of the network) innovations according to the needs and realities identified at the micro level.

The interface of disciplines

The actor at the meso level in ARD generally has the background required to challenge and consult the other actors of the network of innovations (at macro level). However, apprehending the micro level implies a set of methodological principles (from social tools) to define the problems, the propositions of solutions and the framework to evaluate its relevance (Cornwall et al., 2002). Among those, the most important is undoubtedly the capacity to enter into dialogue with the farmer and to help him to express the reasoned choices that it poses according to the constraints that he/she faces. These choices reflect indeed the strategies, more or less conscious and explicit, of adaptation of the farmers to the agro-ecological, socio-economical and institutional conditions in the continuation of their objectives (Yung & Bosc, 1999).

In the case of Idjwi, we chose working with "technicians of rural development (TRD)" rather than the agronomist. Indeed, it is easier for TRD to learn the principles of plant pathology than for the agronomist to learn the comprehensive attitude for exchange of knowledge with the farmers. The education of the agronomists in developing countries of the Great Lakes region involves a very top-down approach. The acquisition of social skills as described above implies a re-education more complicated than a technical training for the TRD with a social background.

Becoming an integrator

To summarise (Figure 4), the actor-integrator takes on several functions. He/she is first an actor integrated into the system that he/she is analysing, and in which he/she also delivers inputs during all the process of knowledge construction. He/she is also a rapporteur (arrow 1) and translator (arrow 2) of the needs and challenges at the micro level towards the macro level to ensure these are fully taken into consideration. As an integrator, after the identification of the issue at the micro-level, the researcher can combine on the one hand the knowledge and the practices of farmers acquired (arrow 1) and on the other hand, the capacities and the technologies developed by the researchers (arrow 3). In reverse, he/she is also a rapporteur-interpreter of the innovations (in the sense of technical, organisational, etc. propositions) from the whole of actors of the network of innovation (including farmers from other contexts) towards the actors of the micro level. So that the farmers can adapt and integrate those that are most appropriate to them (arrow 4).

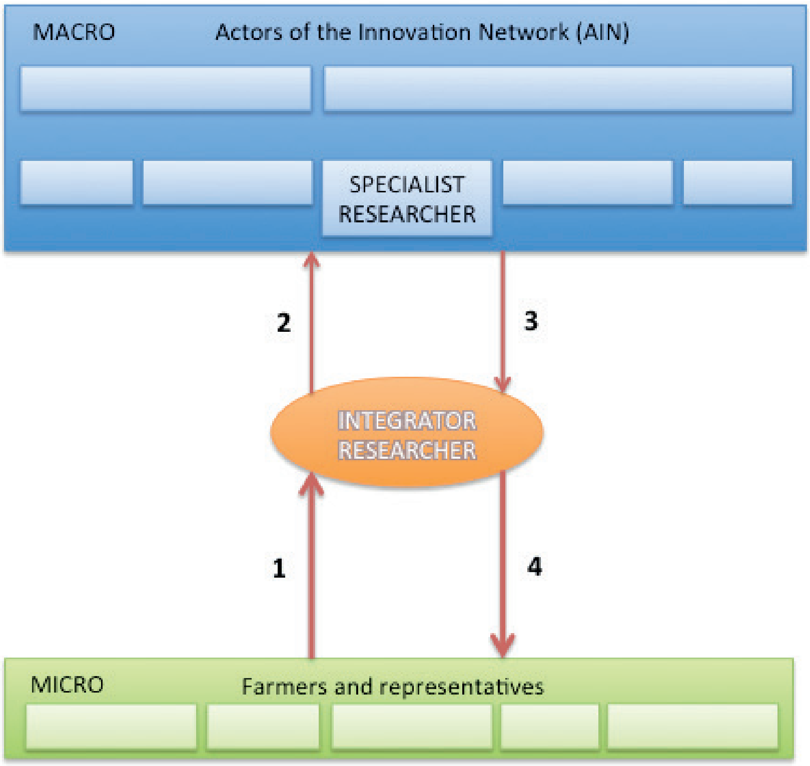

Figure 4. Scheme of the integrator researcher and its functions at the interface between the actors of micro and macro levels

This new type of researcher at the interface of actors and discipline requires the acquisition of new skills notably from social sciences and a comprehensive approach (Ruault, 1996). Without advocating that all the researchers must become integrators, these new competences and approaches should be included in the course for students in agronomy in order to give them the possibility of choosing their way without leaving gaps to be filled after their studies.

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Theory-based innovation platform management. A contribution of sociology to agriculture research and development.

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Abstract: Farmers and peasants in the Global South are among the most vulnerable people and constitute the largest segment of their societies' food insecurity. Farmers in the Global North are either costing a large amount of taxpayers' money and or causing serious environmental threats. But is it fruitful to pinpoint the farm as the relevant system? Could it be a false problem? If so, which system should be at the centre of attention of science and practice in order to transform farms and livelihoods towards sustainability and resilience? In order to answer this question, we have to agree that farms are human fabrics, which have evolved in time and space within specific socio-ecological conditions. They are embedded within people's communities and nations, and globally connected through markets. Human societies have become large and complex, but all of them depend on food in order to sustain their members. No state can afford hunger riots without being destabilised, neither can a state ignore threats caused by unhealthy food and ongoing environmental deterioration. If this thinking is correct, then we have to deduct that societal parameters, combined with economic, agronomic and ecologic ones have to be considered in every design intending to transform such systems. This requires interdisciplinary teamwork and involvement of practitioners covering local to at least sub-national levels. But more importantly, a new understanding of the evolutionary nature of socio-ecological forms is required, which breaks with the artificial boundaries between nature and culture and considers concepts and ideas like "life", "conscious", "memory", "right", "person" and "freedom" as truly scientific ones which can and shall be applied scientifically when dealing with food and agriculture. We propose therefore as a first prerequisite of implementing successful design methods a broader scientific concept of our object, which enlarges the scope for social and human sciences within the sector. Secondly, as the phenomena studied and treated are forms of life and unique creations in time and space, only locally knowledgeable stakeholders as part of the local society can solve the concrete problems with the eventual support of science and research. Beforehand, the stakeholders need to properly identify the real problems; a process which is often done too hastily and superficially. Innovation platforms are proposed as an innovative institution capable of managing these processes. The performance conditions of such platforms are discussed as being equally important as their structure. We should finally give up the hope to find easy top-down solutions and rather realise the value of the concerned people and institutions on each scale, but particularly at local society level.

Keywords: Innovation platform, farming system, socio-ecology, systems theory, sociology, local society, district level agrifood systems, local actors, transformation

Introduction

Social and technological transformations of farming systems happen on a continuous basis, as they are embedded as processes within larger societal contexts. Our understanding of these processes thus depends on our theoretical or practical perceptions of history, society and economy. This narrative is proposing a theory based on sociology but crossing its borders in order to highlight the function and role of innovation platforms (IP) as a means to practically transform and adapt farming systems at sub-national level. We built the arguments on realities from Southern countries with a colonial history. Farming systems of this context are the first to experience the effect of globalisation.

Food and agriculture are contentious issues in modern times. Globalisation and world markets are reshaping communities, nations, trade regimes, production technologies and human destinies all over the planet. Rural poverty, weak states, hunger, deteriorating landscapes, depleted soils, diminished water tables, declining biodiversity and climate change pose grim pictures after over 60 years of development work at international level (IAASTD, 2009; Luhmann, 2004; Ziegler, 2011). Farmers and land labourers working on shrinking land resources have become the people most vulnerable to food insecurity in African societies. Their voices are politically marginalised and rarely heard by the state, thus farmers do not participate in technology development policy discussions. Agricultural technologies are dominated by multinational agro-industries that often control global market channels. Agricultural economics was dealing as a specialised discipline with the market and policy dimensions, mainly within national boundaries or covering specific value chains. Rural sociology, strongly developed in the USA and later in Europe, has covered mainly the societal conditions of farmers and rural populations since the early 20th century. Since about the 1980s, environmental, social, political and cultural dimensions have multiplied the research complexity. Interdisciplinary and transdisciplinary research has grown rapidly since, but with unsatisfactory results (Alrøe & Noe, 2014) . The body of science itself has been divided since the 17th century into natural and moral or cultural sciences. Natural sciences produced a huge body of knowledge, which was instrumental in shaping modern technology. It shaped modern civilization and was instrumental in a tremendous growth of material wealth. Moral, cultural, social and historical sciences dealing with food and agriculture lacked the prestige and where never able to provide an effective body of scientific knowledge.

Nowadays it is a less contested fact that both agriculture, food systems and rural development as well as science are co-produced by humans and their societies (Nicolay, 2016). Our agricultural and food systems are shaped by scientific and technological development of the last 200 to 500 years. Commodity chains (like cotton, cacao, palm oil, tea, meat), established for the global market, have formed rural areas by technology innovation in plantations and worker migration attracted by fabrics and urbanism. The wealth created with industrialisation has contributed to an explosion of scientific workers, disciplines and journals. For some years the majority of people have lived in urban settings, in both industrialised and so-called developing countries. Farming systems research, trying to cope with this new dynamic, grew up in the 1970's, partly as a response to the failure of conventional positivist and reductionist research to address the agricultural problems and livelihood strategies of small farmers, mainly in the least developed countries. Hunger in the global society appeared as a scandal and required answers and responses from the agriculturalists. The farming system was trying to deal with complexity, sustainability and at the same time integrating natural and social sciences (Giller et al., 2011). However, the systems theory applied was limited to the farm level. “Society at large”, including economy, politics and innumerable social systems and organisations, remains mainly ignored. Based on Luhmann (1995), we propose a theory of sociology adapted to the food and agriculture sector in order to fill the gap in our understanding and handling of the societal “factors and processes that shape and constrain farming systems” (Nicolay, 2016). The Luhmannian system provides two advantages: it captures global society (national societies become sub-systems) and allows the systematic observation with its related environment at local level. Compared with socio-ecological based methods (Kok et al., 2015), it provides factors from social systems within (global) society in order to explain farming transformation. By proposing a method including the full range of factors, from natural environment across farming system, technology and economics to society (including the human factor), we hope to provide a tool for researchers in the agriculture and food sector which is robust enough to strengthen the position of science in order to inform polices (Rasmussen et al., 2015).

Demystification of innovation platforms

Farmers are under social influence not only from actors of the agriculture sector, but also others outside it; therefore these key actors should be included by extension approaches, particularly local governments and rural dwellers (Wauters & Mathijs, 2013). Ideally, all “key actors” influencing both adopters and non-adopters of a given area should constitute a platform in the form of an organisation in order to identify factors impeding and promoting an adoption or innovation. We then call this platform an IP or Innovation Platform. IPs are functional organisations with the potential to deal with factors going beyond the narrow boundaries of the agriculture sector and farming systems’ approach but reducing complexity and opening up new potential for creative solutions for the agriculture actors. The challenge from a practical point is to identify the “key actors”. The assumption is that an IP with the complete set of key actors (as individuals) has a high probability of addressing the relevant “enabling environment” and reducing the risks that participatory technology development between farmers and researchers will fail after a certain period (Bennett & Cattle, 2013; Sterk et al., 2013). Here we believe that sociology can contribute by predicting the key actors in a given context within a country. This requires however sociological competency, which is rarely available within food and agriculture projects and programmes. Without a proper sociological understanding, i.e. conceptualising society and social systems as communication, the risk is high that the key factors will not emerge in the discussions and solutions developed. Sociological bottlenecks will persist and solutions elaborated hardly become effective.

Why is it so hard to understand complex issues within society? Luhmann was of the opinion that a theory of society and therefore of global issues, including agriculture, economy, politics, ecological deterioration, climate change and social discrepancies, was blocked within the discipline of sociology through the distinctions made on national, cultural, regional and political notions (Luhmann, 1998)[1]. These distinctions can be seen as internal societal differences. He then proposed to conceive society as the enclosing social system with the capacity to observe. Through observation, the internal sub-systems are reproducing communication with communication, and operating as autopoietic systems. Society today has reached such a

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[1] Luhmann’s last publication is used here for most explanations on his theory of society. It summarises a large body of publications over a span of 30 years. For a shorter overview of the Luhmannian system see also Luhmann (1997).

complexity that it can produce many self-descriptions of sub-systems, like food and agriculture, and observe observers of such sub-systems. If we accept this idea, then we have to renounce on only true descriptions (i.e. propositions that are objectively true independent of the perception of the observer) of our sector, food and agriculture, and discuss about the meaning of scientific propositions in given time and space bound contexts. We then have, instead of the objective truth, which can be recognised and authoritatively proclaimed, only temporal sequences of communications and evolutionary selections of convincing propositions within specific (social) boundaries. If the target of science is to find regularities in order to understand patterns and make predications, we have to identify and focus on systems rather than elements constituting these systems. This can lead to meaningful scientific knowledge helping to reduce complexity.

Farming systems and agricultural operations as communication happen within society. The same can be said for communication related with food processing, retailing and consumption. Structures constituting the food and agriculture sector, like soil fertility management, farming households, sustainable livelihood systems, markets, value chains, transnational corporations, food policies, farmer movements, innovation platforms, agricultural colleges, food security conferences, yam systems or organic cotton systems, R4D[2] programmes and even complex production systems like organic agriculture, can then be observed as differences of social systems. Unfortunately, the concept used for "system" is still the classical one, understanding it as an object rather than a relation of system/environment. Luhmann believes that this fact is due to the European bias in putting people at the centre of the worldview, assuming that only people can observe and think (Luhmann, 1998). Value chain systems are understood as objects and they are approached as entities with related elements, treated as social variables. The environment is only seen as context and narratives are describing its function or non-function[3]. The best we can expect from this object-based method is an infinite accumulation of empirical facts, but hardly any explanatory power. We can assume that this can be prevented, if sociology of agriculture does not perceive its "object" - the food and agriculture sector with its many elements - as an object, but rather as a system/environment difference, in which systems are autopoietic sets of communication.

It was clear already from the beginning of the young science of sociology of agriculture, that "*agriculture depends on the social, economic and political factors shaping it*" (Buttel, 1990). A relatively simple way to visualise society or aspects of it are social network analyses (Brunori et al., 2013; Thuo et al., 2013). However, they cover only one dimension and might be too simplistic for our purposes. Innovation platforms (IP) have become a fashionable concept within agriculture for development, particularly in Africa (Sanyan et al., 2016; van Rooyen, 2009). In most cases, the members and topics of discussion within them are not guided by social theory but rather by the interests of the initiators of the IP, which reduces their lifespan and effectiveness. We have worked for years with the concept of learning circles including farmers, researchers and extensionists (Nicolay et al., 2014). We consider them as equivalent to the concept of IP. Another concept used is Rural Resource Centre or RRC, understood as community-based centres used as venues for training and demonstration of new practices which function as a hub for stakeholders interactions (Bertin et al.,2014). This concept comes close to the Farmer Field School (FFS) promoted and used for a long time by FAO (EA, 2010). In contexts where adoption is at the centre rather than innovation, management areas or

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[2] *Research for Development*
[3] *See for example (Carolan, 2012)*

bodies are used as a concept (Eakin et al., 2015). In both cases, institutional context, social capital and individual capacities are key variables. All these forms are in principle equivalents of IPs.

We consider that innovation platforms constitute a special form of social systems, i.e. organisations. Innovation platforms (IP) are networks or simple social systems with the purpose of solving their members' problems through concrete and systematic communication (and nothing else than communication) in order to produce or construct desired innovation. The platform adopts innovation as a systemic and dynamic institutional or social learning process and recognises that innovation can emerge from many sources (science, practice, indigenous knowledge or elsewhere), complex interactions and knowledge flows. It comprises the information and understanding of stakeholders and collaborators of diverse societal (economic, media, social, politics etc.) actors as members, and the organisations that govern their behaviour, all working towards a common objective and a transparent interest. IPs have become a common tool and concept in development in order to facilitate the innovation process (Adekunle & Fatunbi, 2012; Mapfumo et al., 2014; Misiko, 2014; WB, 2012). Experiences with IPs are both positive (Dror et al., 2015; Nicolay, 2014; Posthumus, 2014) and critical (Dabire, 2014). Conceived with the proposed sociological method, IPs provide a logical advancement of the farming system perspective and have the promise to support sustainability transitions in food and agriculture.

Embedding the IP simultaneously in the function systems of global society and its "local society"

We propose to read the "object" social system or society including its natural environment as a text, which has been constructed by many actors and actor-networks, and narrated by them to different audiences in various social systems and contexts and social fields. Only in a specific local space and time can it be realistic to understand and "predict" meaningful phenomena and possible changes with more probabilistic accuracy (Lamine, 2015; Nicolay, 2016). We might call this a territorial agrifood systems' perspective. It is obvious that apart from institutional factors, cultural aspects[4] are included in such analyses (Kolawole, 2013) as well as multi-level perspectives, including the niche-innovation and the indigenous regime, as well as the exogenous context of the socio-technical landscape (Geels, 2011). The theoretical base is deducted through a "triangulation" of four theories and concepts (Nicolay, 2013): Luhmann's social system theory (Luhmann, 1998), Bourdieu's (1994) concept of the capitals, Latour's concept of actor-networks (Latour, 2005) and Wittgenstein's language game concept (Wittgenstein, 2010 (1953)). The complexity of today's food and agriculture systems require adequate tools in order to observe and understand them meaningfully. We use here the term "local societies" in a pragmatic way, going beyond the sociological meaning of social system (just communication), but including relevant "elements" for our purpose like infrastructure, people and land[5]. Our world and society is highly segmented, differentiated and globalised. However, people live locally, act mainly locally and perform their lives in social patterns, which can be unveiled by local people, journalists, artists, politicians, entrepreneurs and scientists just to name some prominent actors in our context. The same is true for our "object" of interest,

[4] In the logic of systems theory: this means memory
[5] To note that the differentiation process of society –particularly in the Global South- is less advanced at local level, leading to divergent paths of development. Our method is therefore limiting the Luhmannian system only at national to global level. But the global level impacts every local level on earth. This is reflected in Table 1.

society/social system within the context of food and agriculture. We hypothesise that every "local society" can be characterised in a meaningful and holistic way by a set of 14 parameters and 82 variables as listed in Table 1. Seven function systems are proposed as highly relevant for the food and agriculture sector: Economy, Politics, Law, Civil Society, Culture, Mass media and Science.

Table 1. List of parameters and variables characterising a "local society" at sub-national level

Parameter	**Variable**						
Demography	Pop'n density	Structure					
Infrastructure	Health	Roads	Schools	Water	Electricity	Credit	Processing
Human capital	Age	Health	Knowledge	Dignity	Food Security	Family	Migration
Economic capital	Legal Property	Ag. Markets	Investments	Farm Type	Tech. Devel'ment	Poverty	
Financial capital	% HH with cred. Access	Incomes (HH, other)					
Social capital	Customs	Trust	Education Status	Networks	Cities	Clans	Organisa-tions
Cultural capital	Languages	Values	Norms	Innovations	Myths	Ritual	Collect. Memory
Symbolic capital	Influence	Rights	Territoriality	Governance			
Economy[f]	Ag Sector	Industry	Services	Land Market	Production	Consump-tion	Land
Politics[f]	Coherent ag. policy	Coh'nt. rural dev. policy	Security	Leadership			
Law[f]	Property Rights	Land Laws	Human Rights	Labour Rights	Customary Law		
Civil Society[f]	Local Communities	Tribes	Age Groups	CBO	NGO	Move-ments	Gender
Culture[f]	Languages	Custom and Habits	Education	Art	Collective Stories	Religion	
Mass media[f]	Radio Access	TV Access	Mobile Phones Acc	Internet/ Soc.Media	Press Access	Word-Of-Mouth	
Research/ Science[f]	Ag. and Social Sciences	Ag. Research	Innovations	Higher Education	Farmer Research		

f stands for function system (see Luhmann 1995). The highlighted fields are considered key variables in the case of the Machanga society survey (Kenya, December 2015)

We complement these function systems with the concept and six different forms of capital (human, economic, financial, social, cultural and symbolic) and with the main forms of infrastructure. Each of the 14 parameters is defined by a set of variables, whereby the majority are latent (hence they are further defined by indicators). Now each IP is situated within such "local societies", which are not concepts or models but real[6]. The main task is to identify the critical variables with respect to the adoption process, respecting the interests of the IP members. Only by addressing them, can sustainable solutions be found and transformation

[6] *For more details see Nicolay (2015) on ResearchGate*

succeed. The seven function systems[7] are by "nature" global, but in most cases with outreach up to local level. Empirically, in each concrete local society we will find a unique constellation of these phenomena, depending on how we make the distinctions (Spencer-Brown, 1972). More decisive is the choice of these seven function systems, particularly the contested ones: laws, politics, culture and science. We can hypothesise their existence and even their influence on the food and agriculture sector. It is Important to be aware that they are always influenced by a global dimension.

The six forms of capital are less abstract and can be treated as local or national. They are somehow complementary to the globalised function system and include the human factor[8]. Let's take for example the variable "custom". In the social capital form, we can focus our observation on the most striking forms of custom, which we hypothesise affect the sector. Here we base our assessment on qualitative and quantitative surveys. The results will provide probabilistic propositions on the specific influence of each identified custom. On the other side, looking at "customs" from the function system perspective, we always need to reflect the global aspect of it; respectively we need to observe customs which may have their origin outside the locality. Another example are the variables "influence" and "rights" from the symbolic capital parameter. They differ mainly from the "property rights" (Law) and "leadership" (Politics) variables through the nature of the perspective, whereby the capitals include the human factor.

The "local society profiling", defined as capturing its main features, is best done by a team of trained sociologists or social scientists; conducting a sort of peer assessment. A team can do the profiling in 2-3 days, if available literature and statistical data is collected beforehand. This team will highlight only the critical variables and parameters and explain them in a report written for non-sociologists. This pragmatic method seems more convenient than conducting a costly (in time and finances) survey of over 300 households in order to get a representative picture of previously elaborated assumptions. The outcome, a report on the societal factors impeding a given adoption by households or farming systems, will then be discussed within expert groups and the IP. The method of using the pre-defined matrix of parameters/variables reduces the subjective differences amongst the experts or peers and facilitates the dialogue and the mutual understanding. Our proposed focus on "local society" might be a neglected sphere of research, as it shows co-effects of the complexity of a globalised world society (Luhmann, 1998), but at the same time the specificities of its own territoriality, farming systems, culture and history. Considering that the large majority of people live and work at this scale, including and particularly farmers, land labourers, peasants and consumers, we should better understand this reality and social dynamic, but always in relation to the interest of our research. If not, the overwhelming complexity would make any trial of understanding futile. We have proposed a scientific method based on the concept of "local society" as an element of the global society in order to improve the performance of the IPs. However, understanding the context of the IP is just one of the requirements of a successful transformation. The other part is even more complex and beyond research: it is the management or performance of the IP process.

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[7] *Each function system has to fulfill a specific function in society. More in Luhmann 1998 and 1995.*
[8] *To recall that humans constitute one form of the environment of society in the Luhmannian system. The other main form is ecology.*

IP management and performance

The purpose of the IP is to induce change, to install a new technology or innovation or to transform parts of the economy and society in order to solve specific problems or to achieve a targeted aim. It is not about producing knowledge, but it has to take a decisive step: to perform a narrative, to act at a collective level in order to assure a socio-ecological transformation. The IP then is like a collective actor reaching out with its performance to a given audience (Alexander et al., 2006). This function of the IP is decisive and needs major attention once the IP is installed. The consciousness of its members and the clarity of the social boundaries (decide on tribe, clans, administrative unit etc.), internal rules (of the IP) and identities (symbols) become key factors of success. Moreover, here we leave the safe ground of science and are fully on the stage of development and (performing) action. It goes beyond management as the audience is always in the majority representing public interests[9] and various organisations; food issues are in most cases public issues. It is therefore important to have at least one member and leader within the IP who is strong in performing, culturally competent and authentic within the audience. As our audience is in most cases within the range of a "local society" with eventually 10- to 100,000 people, the competency to reach out is key for the success of the IP. What counts at the end is the communication and performance of the needed transformation by the actors; it is not limited to the technical solutions proposed and its knowledge and information.

The most important skill of an "IP facilitator" is to imagine the "local society" which embeds or "hosts" the IP and in which the adoption and transformation process is supposed to happen. This sociological imagination would be an asset in order to steer the process of the IP. Most important is to capture the various dimensions and function systems, which are important in the given process. It can be the visioning of shifting priorities, like economy>politics or then culture>mass media. The time dimension and the dynamics of the group discussions as well as of the surrounding "local societies[10]" need to be taken into account. If the empirical part, the previous observation of the local society has been done properly, the issues of the debates will in principle be easier to deal with. This requires both agricultural and sociological understanding of the "context" and skills by the facilitator and high social competency. This performing act is always related to intuition and is thus closer to art than to science. But as long as the foundation is based in scientific reflection and theory, the following discourses should allow transparent and fruitful dialogues. Fruitful because the situational and subjective dimension will break the artificial boundaries of scientific disciplines or practical routine. Sterile monologues and silo thinking can be minimised and the living phenomena, as they are at stake during the debates, discussions and performances, should be at the centre. Mega-topics like SDGs (sustainable development goals), gender and climate change thus have a better chance of being addressed as important cross-cutting issues. The IP facilitator needs support from various organisations with a solid status and influence in the "local society"; ideally universities and the Ministry of Agriculture are some of them. One element of the support is a shared vision on the current dynamics of both the sector and larger socio-economic development by the involved organisations and involved leaders. More universities should become active in developing joint curricula and research projects between agriculture and social science departments. In Kenya, the Kenyatta University (KU) has embarked on such a

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[9] Like food security, justice, peace, sustainable development, fairness, soil and biodiversity preservation etc.
[10] To note that we have to deal with many "local societies" within a nation, over 100,000 worldwide (according on how we draw the line or boundary), but only one (1) Global Society.

programme but will need more support in order to train MSc and other students in better integrating agronomics, economics, sociology and rural development.

IP success requires therefore theory and practice, research and development, hard and soft, written and oral skills. This may become a challenge if the moderation of the IP is under the responsibility of an organisation which is not encouraging managerial and action-performance but rather academic production. In order to induce (societal) change, science and research based knowledge needs translation and discussions within social groups and amongst real people in real settings. Books and manuals alone are just not enough.

Conclusion and Outlook

We propose as a first prerequisite of implementing successful design methods a broad and systemic scientific concept of society as our object, which enlarges the scope for social and human sciences within the sector. Secondly, as the phenomena studied and treated are forms of life and unique creations in time and space, only locally knowledgeable stakeholders can solve the concrete problems with the eventual support of science and research. Beforehand, the stakeholders need to properly identify the real problems; a process which is often done too hastily and superficially. Innovation platforms are proposed as an innovative institution capable of managing these processes. We recognise that the performance of the IP is as important as the internal processes in identifying solutions. This performance is more than communicating; it is changing the behaviour of the audience. We should finally give up the hope of finding easy top-down solutions and rather realise the value of the concerned people and institutions at each scale, but particularly at village to district level. A new understanding of the evolutionary nature of socio-ecological forms of agriculture and food systems is required, which breaks with the artificial boundaries between nature, humans and society and considers concepts and ideas like “thought”, “life”, “consciousness”, “memory[11]”, “right”, “person” and “freedom” as truly researchable ones, which can and should be applied scientifically. We propose with this method a list of parameters and variables to get as close as possible to capture these concepts, knowing that there will remain a difference between the method, its application and “reality”. However, we can make a significant improvement in capturing “reality” and facilitating transformation of agriculture and agrifood systems, if we succeed in integrating in our narratives and reports variables like dignity, trust, value, collective memory, human rights, art and religion. They all relate to food and agriculture in our time.

We agree with Campbell (2015), that rather than being divided by theoretical differences, we have to agree on the political intent in order to achieve: greater food security; food justice; democratic control of supply, demand and resources; and sustainability and resilience. This proposed approach in promoting IPs in a sociological intention might be close to the views of New Institutional Economics (Ménard, 2011), but it goes beyond the core issues of economics. At the end, the participants will realise that issues of food and agriculture are in fact issues of life, in which humans and society are included and interwoven with biological and psychological phenomena, always moving and never static (Bergson, 1911). The participatory nature of IPs embedded in a set of participating institutions like universities, state offices (like Ministry of Agriculture), farmer organisations, private sector actors and industry, and NGO/CBO can catalyse transformative processes in a systemic and sustainable way, at least

[11] *Often called culture*

at local level. The current state of Modernity requires major changes in order to face the manifold challenges (Alexander, 2013). Agriculture is at a cross-roads (IAASTD, 2009); the future of sustainable farming, of our agricultural land, of the living conditions in rural and urban areas including the natural climate, of dignity and justice, of peace and civilization is open. The performance of agriculture, food systems and rural development will play an important role at both local/national and regional/global level. A more unified and coherent science, based on collective meaning and faith in the power of truth, is indispensable for mastering this cross-roads. We can collectively repair some of the damage done during the five centuries of Western imperialism. Sociology can provide explanations of the main strains of concern, but it can only become effective if integrated into the existing knowledge pool of agricultural scientists and practitioners. More research on the complex socio-ecological realities at local level and their relations with the function systems at global society level is required.

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