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par

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Designing intervention to support endogenous agricultural innovation process in the South: identifying conditions for its effectiveness. The case of an irrigated scheme in Tunisia.

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« l'emancipation, c'est l'affirmation, pour soi-même et pour le reste de la société, du pouvoir de penser, d'inventer et de décider ce qu'on a à faire »

Jean-Pierre Darré,
Le pouvoir d'initiative et d'invention.
Nouvel enjeu des luttes sociales.

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Abstract

African farmers are under pressure to innovate. In the field of agricultural innovation studies, the growing dissatisfaction with the linear model of innovation transfer in which the innovation is conceived by researchers, transferred by extension agents and then adopted by farmers, pushed the researchers to look for alternatives. The recognition of actors not belonging to the scientific world as sources of innovation, the growing focus on the role of farmers and their knowledge in the innovation process and the recognition of different dimensions of innovation (beyond just new technology) influenced the way in which the academics now study innovation. In the innovation systems approach, innovation defined as a social or economical activity useful for the agricultural development, emerges in a complex system of heterogeneous actors as a result of the social learning that takes place during their interactions. This change of approach entails change in the position of farmers who are now, equally to other actors, recognized as sources of innovation. But what is really the position of farmers in the most common operationalization of the AIS approach, innovation platforms? We are focusing our interest on farmers for two reasons: they are recognized as key actors for food security and they are the ultimate users of agricultural innovation, those who put it in practice. Thus the analysis of the effects of different types of interactions, learning processes and power relations on the position of farmers in the innovation process is central for this thesis.

On the basis of the analysis that we conducted in the study area – the irrigation scheme El Brahmi in North West Tunisia – we designed a tool to mobilize the innovation capacity of local farmers. The proposed methodology includes elements of companion modeling, and is based on the "self-design" principle. We developed a simulation game that is co-constructed by players – dairy farmers – while they play. They develop, discuss, negotiate and test innovative solutions to reach objectives that they themselves define. While doing it, they mobilize local knowledge and become co-authors of their own learning and of the method to support their innovation process.

Key words: innovation systems, endogenous innovation, participatory methods, knowledge co-construction, companion modeling, community of practice

L’accompagnement des processus d’innovation agricole endogène au Sud : Quelles conditions pour son effectivité et efficacité ?

Le cas d’un périmètre irrigué en Tunisie.

Résumé

En 2008 les auteurs du rapport IAASTD (*Evaluation internationale des sciences et technologies agricoles pour le développement*) ont constaté le besoin de placer l'agriculture dans un large contexte social, économique et écologique en suggérant une approche systémique, holistique et interdisciplinaire à la production et partage des connaissances. Durant les années suivantes les scientifiques, notamment dans le domaine de l'agroécologie, ont reconnu que la plupart de défis autours de la production alimentaire durable pourraient être traités par l'innovation dans des systèmes alimentaires locaux et la petite agriculture. Cependant cette reconnaissance du rôle des petits agriculteurs n'implique pas automatiquement leur participation active dans les processus d'innovation dans le cadre des projets de recherche pour le développement ni dans la définition de ces projets. La question-clé à laquelle il faut alors répondre est comment s'assurer que la liberté de choix des petits agriculteurs soit vraiment respectée.

Dans cette thèse nous interrogeons l'approche de systèmes d'innovation dans laquelle l'innovation émerge dans un système complexe d'acteurs hétérogènes comme étant le résultat de l'apprentissage social qui a lieu pendant leurs interactions. Cette approche diffère quant au rôle des agriculteurs par rapport au modèle linéaire d'innovation où il consiste seulement à adopter les technologies produites par la recherche. Ici, l'importance des interactions entre les agriculteurs et les autres acteurs du système est mise en avant et les agriculteurs sont désormais reconnus comme une source d'innovation au même titre que les autres acteurs. Mais dans l'opérationnalisation de l'approche, les plateformes d'innovation, est-ce vraiment le cas ? De nombreuses études montrent que les paysans sont souvent amenés à suivre les modalités proposées par d'autres acteurs et leur influence sur le processus d'innovation et sur l'agenda des plateformes reste limitée.

Nous nous intéressons aux agriculteurs, d'une part comme acteurs clé pour la sécurité alimentaire et d'autre part comme les usagers finaux de l'innovation agricole, ceux qui la mettent en pratique. Nous faisons l'hypothèse que les interactions entre les agriculteurs sont aussi importantes pour leur rôle dans le processus d'innovation que leurs interactions avec d'autres acteurs du système. Nous mobilisons les concepts de communauté de pratique et de groupe professionnel local pour analyser les processus qui se produisent entre les agriculteurs, notamment la construction et la reconstruction des discours et la construction des normes et des « façons de faire » qui règlent les pratiques locales.

L'approche des systèmes d'innovation introduit aussi un nouveau type d'acteur intermédiaire, spécialisé dans la facilitation du processus d'innovation : *le broker d'innovation*. En partant du constat que ce type de facilitation ne prend pas assez en compte les asymétries de pouvoir, nous proposons l'*accompagnement* comme mode d'intervention plus pertinent pour appuyer les agriculteurs dans le processus d'innovation. Ce concept, développé par des sciences de l'éducation, est utilisé par l'approche de modélisation d'accompagnement à laquelle nous adhérons.

Nous nous posons la question sur la possibilité et les modalités de conception et d'application d'une méthode d'intervention de type accompagnement qui permettrait d'appuyer les agriculteurs locaux dans le processus d'innovation dans le contexte d'une plateforme d'innovation, en renforçant leur capacité d'agir sur le processus.

Basé sur l'analyse de la zone d'étude – le périmètre irrigué El Brahmi au Nord-Ouest de la Tunisie - nous avons construit un outil visant à mobiliser la capacité d'innovation des agriculteurs locaux. La méthodologie proposée contient des éléments de modélisation d'accompagnement, et notamment s'appuie sur le principe de « self-design ». Nous avons proposé un jeu de rôles que les joueurs co-construisent en jouant. Ils développent, discutent, négocient et testent des solutions innovantes pour atteindre les objectifs qu'ils définissent eux-mêmes. Ainsi ils mobilisent leurs connaissances et deviennent co-auteurs de leur propre apprentissage et de la méthode d'appui à leur processus d'innovation. La démarche laisse une grande autonomie aux joueurs pour dévélopper des solutions qui ont donc un sens pour eux. Dans notre cas cela a incité quelques participants à introduire les changements dans leurs pratiques.

List of tables and figures

Abreviations

AIS	Agricultural Innovation Systems
CIFRE	*Conventions Industrielles de Formation par la Recherche*
ComMod	Companion Modelling
CoP	Community of Practice
CRDA	*Commissariat Régional au Développement Agricole*
CTV	*Cellule Territoriale de Vulgarisation*
DSS	Decision Support Systems
EAU4Food	European Union and African Union cooperative research to increase Food production in irrigated farming systems in Africa
FFS	Farmer Field Schools
HLPE	High Level Panel of Experts
IAASTD	International Assessment of Agricultural Science and Technology for Development
INGC	*Institut National de Grandes Cultures*
IP	Innovation platform
LPG	Localized Professional Group
OEP	*Office d'Elevage et Paturage*
PCoP	Project Community of Practice
PID	Participatory Innovation Development
PRA	Participatory Rural Appraisal
PTD	Participatory Technology Development
WUA	Water Users Association

Chapter 1. General introduction

1. Farmers and agricultural innovation

In 2008 the authors of the International Assessment of Agricultural Science and Technology for Development (IAASTD) recognized the need to place agriculture in a wider social, economic and ecological context, and suggested "an interdisciplinary, holistic and systems based approach to knowledge production and sharing" (McIntyre et al. 2009). During the following years, scientists, especially in the field of agroecology, became increasingly aware that most of the challenges surrounding sustainable agricultural productivity can be addressed through localized food systems and small-scale agriculture (de Schutter 2014). Smallholder farmers were brought into the spotlight as potentially being the key to world food security (HLPE 2013). However, while the focus on small-scale farming may seem to be good news for those who see peasants as central in ongoing struggles for food sustainability (see van der Ploeg 2008), and who advocate active participation of farmers in agricultural research and innovation development (Hagmann et al 1996, Reijntjes and Waters-Bayer 2001), this is not necessary the case: innovation in smallholder farming does not automatically equal innovation *by* smallholder farmers. According to de Schutter (2014), the key question is how to ensure that the freedom of choice of small-scale food producers is truly respected. Even in settings that are explicitly designed to give farmers equal position in knowledge production and sharing, farmers are often expected to work along the lines that somebody else has drawn.

According to Waters-Bayer and Rölling (2014) there is a growing scientific consensus: it is by strengthening agricultural innovation systems – the linkages and interactions among diverse stakeholders – that the capacity of small-scale farmers to face the multiple social, economic, ecological and political challenges will increase. The Agricultural Innovation Systems (AIS) framework, a now very popular approach, theoretically gives equal weighting to farmers as sources of innovation (Hall 2007). Without doubt, this is an important change comparing to the top-down nature of the technology transfer model (Kline and Rosenberg 1986, Rip 1995), which ignored the fact that farmers, placed at the receiving end of the linear process, produce knowledge, innovate and have their own interests (Chambers et al. 1989). At the same time, it has to be recognized that among the diverse actors who together with farmers form innovation systems, there are many whose interests and objectives may not be in line with those of farmers and who are at the same time more powerful.

Despite over three decades of increasing popularity of participatory approaches, there is still room for improvement regarding the position of farmers in research or development projects. While farmers' ability to provide valuable data is surely recognized, the same doesn't always apply to their ability to

analyze. We speak of farmers' learning much more often than of farmers as knowledge producers. Farmers may be expected to be experts on "local", but are rarely inquired for their systemic view on farming.

In this thesis, we investigate the ways of supporting farmers in becoming more equal participants in the innovation process in the context of a research project.

2. Towards a systemic view on agriculture

Researchers started to look at agriculture in a systemic way long before the publication of the IAASTD report that we quoted. In France, the first conceptual bases of agrarian systems theory (*systèmes agraires*) (Deffontaines and Osty 1977, Mazoyer 1987, Mazoyer and Roudart 1997), which was at its peak in the 1980s, date back as far as 1946. It aims at analyzing the transformations of farming techniques along the interconnected change in social interactions, not only at local, but also at national or even global level. An agrarian system is defined as ''a way of exploiting an agro-ecosystem that is historically defined and sustainable, adapted to the bioclimatic conditions of a given area, and responding to the social needs and conditions of the moment'' (Mazoyer 1987). The main methodological postulate is to conduct historical analysis of changes in farming systems on a given territory, to grasp its inherent dynamics in order to propose an intervention that would fit into it. It offers the possibility of a dynamic analysis of the process of transformation in a local agricultural system in its wider context.

Another interesting example comes from Australia, where in 1980s at Hawkesbury College Richard Bawden was postulating a change in paradigm that would allow to embrace the complexity and dynamics of agriculture and its relationships with the environment (biophysical and socio-economic) in which it is conducted (Bawden 1995). This approach was called *systemic agriculture* and based on systemic (and participatory) inquiry. Building on Checkland's soft systems concept (1988), Bawden argued that the systemicity should be transferred from the world to the way of investigating the world. For the agricultural science it meant that "all the issues connected to farming were studied as if they were interrelated" (Bawden 1995).

3. Towards a systemic view on innovation

Looking at agriculture as part of a bigger picture affected the way of thinking about agricultural innovation. Systemic approach to innovation was - a much needed (Kline and Rosenberg, 1986; Röling, 1988) - alternative to the classical linear model of technology transfer (Jarrett 1985), in which innovation (understood as "new technology") was conceived by researchers, transferred through extension and then

adopted (or often not adopted) by farmers. The foundation of so called Green Revolution, while successful in some parts of the world, largely failed when applied to smallholding farming, especially in Africa (Richards 1985), resulting in search for other models. Views on both process and nature of innovation evolved. Innovation became considered a co-evolutionary process, requiring not only technical but also combined social, economic and institutional change (Klerkx et al 2012) and thus being more than just a new technology. Thinking of innovation's success in terms of diffusion of technology (Rogers 2004) was replaced by focusing on the diffusion of the process of innovation; and what used to be regarded as conditions for its adoption – new social and organizational arrangements – was now understood as integral components of innovation (Leeuwis and Aarts 2011).

Systemic approach to innovation had different faces: actor-network theory (Callon 1986), agricultural knowledge and information systems (Rölling 1990), or strategic niche management (Geels 2002). But it is Agricultural Innovation Systems approach (AIS) (Hall et al. 2002, 2004, Clark 2002, Sumberg 2005, World Bank 2006, Sanginga et al 2009, Spielman et al 2010, Adekunle et al 2012, Touzard et al 2014), that some authors see as a culmination of systemic thinking about innovation (Klerx et al 2012). Initially developed outside of the agricultural studies as Innovation Systems (IS), the framework was later adapted and used to study agricultural innovation, mostly in developing countries. This approach, increasingly popular in the research-for-development projects, recognizes that innovation emerges in a complex system of agents who all produce, exchange and use knowledge.

4. Farmers in AIS framework and intervention

In this thesis, we look at the AIS framework though the presumed shift in power relations that the approach entails and its effect on the situation of farmers. In the AIS framework science abdicates from its powerful position of the sole source of innovation. Theoretically, different AIS actors participate in the innovation process on equal terms, so the AIS framework gives equal weighting to farmers as sources of innovation (Hall 2007). However, the AIS framework is by no means farmer-centered or farmer-first, but it rather postulates directing attention away from the farm and the farmer (Scoones et al. 2009) as the focus is on the innovation process occurring in the space of interaction between different actors.

In a typical AIS intervention, farmers along other actors participate in innovation platforms (IPs). IPs are multi-stakeholder set-ups orchestrated to generate innovation. Interaction between different actors is organized around knowledge production, sharing and use. The way innovation platforms are implemented, made some researchers voice concerns over farmers' participation, as it seems that position assigned to farmers in many platforms bares similarities to their position in the technology transfer model – implementers, but not designers of innovation, with little influence on innovation process and little recognition of their knowledge (Kabambe et al 2012, Swaans et al. 2014, Cullen et al.

2014). Hence the postulate, voiced by some authors, to review farmers' participation and to directly address power relations in innovation platforms (Cullen et al. 2014).

5. Empowerment through participation

In this thesis, we use Foucault's understanding of power, seeing power not as a commodity to be held, but as something decentered and dispersed, omnipresent in the complex networks of discourse, practice and relationships (Foucault 1997/1975), governing "by telling people what they must be, by enabling and conditioning the possibilities for their action, and by constituting regimes of truth by which they may understand and live their lives" (Kesby 2005: 2040). This has consequences on thinking about empowerment – not as something that can be given or taken, passed from one person to another, but as something produced by discourses and practices (Clegg 1989). Within this view on power and empowerment, participation can be seen as such a powerful discourse and practice. While the claim that participatory approaches can serve to empower participants has been questioned by some (Long and van der Ploeg 1989, Long and Villarreal 1989, Mohan and Stokke 2000, Henkel and Stirrat 2001), we share the view that a participatory process can contribute to constitution of an empowered agency, i.e. an agency capable of overcoming dominant frameworks (Kesby 2005).

Agency is defined by Giddens (1984) as the ability of an actor to act to change the course of events. It appears as juxtaposed with the concept of structure in the longstanding sociological debate on the primacy of one over the other in shaping human actions, that can be retraced to the works of such classical authors as Simmel (1903/1995) or Elias (1939/1999) and that can be found, among the others, in the works of Berger and Luckmann on social construction of reality (1966), Bourdieu on *habitus* (1972) and finally in the structuration theory of Giddens (1984). The concept of agency got under the radar of innovation scholars. When the structural elements started to be perceived as components of innovation, questions arose about the role of individual agency in the innovation process (Klerkx et al. 2012). Some authors started to use the concept of innovation agency (Klerkx et al 2010) as something determined by the resources and competences that the actors have at their disposal, emphasizing the importance of one's ability to enroll others in one's innovation projects (Engel 1995, Ekboir 2003, Aarts et al 2007). For the purpose of this thesis we understand agency as conscious (actors are strategizing) and reflexive, but constituted and achieved through available discursive and practical means (Kesby 2005), with participatory approaches aiming at providing participants with the means to constitute an empowered agency.

6. Facilitating innovation process

Several authors present facilitation as a way to improve performance of AIS (World Bank 2006,

Oreszczyn et al. 2010). The approach to facilitation best described in AIS literature is innovation **brokerage** (Klerkx and Leeuwis 2009a; Klerkx and Leeuwis 2009b). Innovation brokers are dedicated systemic intermediaries (Van Lente *et al.* 2003), whose functions are described as follows:

- Demand articulation (through problem diagnosis and foresight exercises)
- Network composition (making sure that linkages exist between relevant actors)
- Innovation process management (comprising such elements as for example facilitating the alignment in the heterogeneous networks constituted by actors from different backgrounds and reference frames, dealing with conflicts or establishing working procedures).

The role of innovation brokers can be fulfilled by organizations or individuals; Klerkx et al. (2012) suggest also that it could be intentionally undertaken by researchers dedicated to action research. To our understanding, innovation brokers act upon the object of innovation process (problem diagnosis, responding to question *what?*), the actors of innovation process (network composition, responding to question *who?*), and to a certain extent upon the process itself (responding to question *how?*), however the main focus is on improving communication between the network actors, which is only one dimension of innovation process. Also, while the differences of reference frames between actors and the possibility of conflicting interests are recognized and acted upon, an innovation broker does not deal with power asymmetries between stakeholders. This understanding of brokerage places it close to the domain of network management.

Koutsouris (2014) presents brokerage slightly differently, as a form of knowledge management (Roth 2003, Dobbins et al 2009, Kitson 2009). The role of *knowledge broker* is to facilitate knowledge spread or knowledge sharing, in and between groups, to facilitate experiential learning and to deal with contextual factors in order to manage new knowledge and support innovation.

The same author makes a distinction between brokerage and **facilitation** as different forms of intermediation. Reviewing literature on facilitation, he describes it as assisting, individuals or groups, in the process of moving towards change, while affecting both internal (direct and indirect) and external (inward and outward) group processes. It is pointed out, that according to many theorists, the role of facilitator is to create an ideal speech situation in terms of Habermas (1984), where all participants have the same position in discussion. That entails that acting upon power asymmetries among participants is a methodological necessity (Ulrich 2003, Barnaud 2008).

Accompagnement can be seen as another form of intermediation. The concept comes from education studies (L'Hostie and Boucher 2004; Lafortune and Deaudelin 2001; Pelletier 2004; Paul 2004) where some of the authors present it as a new paradigm (Ardoino 2012, Boutinet 2002). The term is sometimes translated into English as *coaching*, however this translation obscures its meaning and seems

inappropriate for the context in which we use it in this thesis. While some authors describe *accompagnement* as a relation with an individual (Paul 2004), for others it is possible to accompany groups (Lafortune and Deaudelin 2001, Dionne 2004, Charlier et al. 2004, Savoie-Zajc 2004). In such case, *accompagnement* is seen as a process of knowledge construction in interaction and capacity building through collective reflection with peers (Lafortune 2006). Paul (2009) calls it "collaborative self-education", where the person who is accompanied is author of their own transformation, deconstructs and reconstructs their own knowledge through multiple mediations. However, it is not a maieutic process - *accompaniment* does not consist of simply delivering something that is already there, and it cannot be boiled down to introspection (Paul 2009). The process can be best described as co-construction, where both sides, participants and a facilitator, dispose of resources. *Accompagnement* bears similarities with facilitation as it concerns assisting individuals and groups towards change, but what is characteristic here, is that the goal of this process is not pre-defined and participants do not need to know what they want at the start of the process (Boutinet 2002). Another characteristic is the emphasis put on the context. All *accompagnement* has to be thought of and acted with regard to the context proper to those who we "accompany", and this context has to be permanently brought to light (Liiceanu 1994). At the same time, the context is not regarded as a factor determining the process of change - the concept of individual agency is brought forward.

	facilitation	**brokerage**	***accompagnement***
Who is "facilitated"?	groups or teams (Hilton 2001, Auvine 2002); groups and individuals (Thompson *et al*. 2006)	networks	individuals (Paul); groups of individuals (Dionne 2004, Lafortune et Deaudelin 2001, Boucher et Jenkins 2004, Lafortune et Martin 2004, Charlier et al. 2004, Savoie-Zajc 2004)
Type of intervention	change management	network management/ knowledge management	change management
Context is important	yes	yes	yes
Objectives	clear	clear	can be uncertain or unknown
Overall aim	to reach the objectives	to improve communication in innovation network	empowerment
Deals with power asymmetries	yes	no	yes

Table 1-1. Different types of facilitation of the process of change

Both institutional partners of this thesis (Lisode and Green) use the French term "accompagnement" to describe their interventions (as in *modelisation d'accompagnement*). In the ComMod charter (ComMod 2004) it is described as "to help stakeholders govern a situation along a continuous and gradually enriched itinerary, instead of proposing ready-made expert solutions". In the context of innovation, the "accompagnement-based" intervention means one in which researchers do not propose an innovation, but support an innovation process already in place. In that sense, it is in opposition to technology transfer. The work conducted for this thesis was underpinned by a reflection on the concept of

accompagnement, its relation to the question of empowerment and on how to make it operational in the work with farmers on innovation.

7. Research objective and questions

The central question of this thesis was formulated as:

To what extent and under what conditions a participatory intervention can support the local innovation process in the context of an innovation platform for irrigated agriculture in the South?

We developed the study around the following sub-questions:

- What social processes (knowledge exchange, interaction, learning) shape the innovation system in the study area?
- What is the position and role of the farmers in this system, and whether and how it could be strengthened?
- What is the current knowledge and practice of farmers concerning the area in which they look for innovative solutions? What are their sources of knowledge and standards of practice?
- In experimental terms, how could we use the knowledge of the above to design a support tool that could have an effect on certain aspects of the local innovation system (individual and collective learning, collective dynamics, power relations, dominating discourse and practices), and what could the effect be?

The research questions are treated in three articles that form the core of this thesis.

1. Farmers as agents in innovation systems. Empowering farmers for innovation through communities of practice[1]

In the first article of this thesis we point out that the systemic frameworks dealing with innovation focus on the interactions that farmers have with other actors, while not sufficiently exploring the processes that occur in interactions inside farmers' peer groups. We investigate the role of communities of practice of farmers in the innovation process. Building on works of Wenger (1998) and Darré (1991), we look at communities of practice as spaces of not only learning, but of production and reproduction of discourse and construction of norms that constitute a framework for farmers' agency. We study how knowledge is produced, exchanged and used in our research area in Tunisia through focusing on interactions between actors (farmers and farmers; farmers and other actors), their sources of knowledge and discourses they

[1] Dolinska, Aleksandra and Patrick d'Aquino. Paper published in *Agricultural* Systems 142 (2016) pp. *122-130*

reproduce in relation to their actions. We study the role of communities of practice in the innovation process on concrete examples of on-going innovation projects that we identified in the research area. We pose the question whether the concept of community of practice could be used as a tool in the intervention in innovation systems.

The article contains analysis of the context in which El Brahmi farmers make their decisions about changes in their practices. We put together different elements to draw an image of declining extension services, farmers working in relative isolation with very little technical support, getting more and more dependent on the private sector and getting used to play by its rules. Most farmers have trouble breaking out of the individualistic discourse to try collective action, and they are reluctant to discuss and develop new ideas together and even more reluctant to try the ideas out. In this landscape we find and investigate islands of successfully introduced locally developed innovations. We conclude that the intervention should aim at changing the rules of interaction. Within groups of farmers towards discussing practice and sharing ideas, and towards collective action; between farmers and extension services towards better demand articulation and knowledge co-production; between farmers and private sector actors towards more independence.

2. Bringing farmers into the game. Strengthening farmers' role in the innovation process through a simulation game, a case from Tunisia[2].

In the second article, we look at the AIS through its claim about giving equal weighing to all actors, and thus to farmers, as sources of knowledge. We discuss the position of farmers in innovation platforms – the most common operationalisation of AIS framework. As some authors identify the need to directly address power relations in innovation platforms, we propose a method to support farmers' participation in knowledge production, sharing and use in a platform-based research project in Tunisia. We describe the approach we took to identify, together with local dairy farmers, their innovation needs and how we designed a tool that would make it possible for them to explore, discuss and simulate their own solutions for improving their farming activities, while changing the rules of their interaction with each other and with others. We present the simulation game LAITCONOMIE and the results of its implementation in our research area. We discuss the potential of participatory tools to empower farmers for innovation.

The fact that we used the *self-design* principle (d'Aquino et al. 2002) to design our game tool, made it possible to mobilize principally farmers' knowledge in the intervention and to make farmers authors of their own learning. They proposed and developed improvements to their practices going towards the direction of their own choosing. In the game, farmers gained more independence from other actors in

[2] Dolinska, Aleksandra. Paper under review in *Agricultural Systems*

the value chain and their interaction with extension services became more equal; they also undertook collective action. Some of them used the game as a rehearsal for reality and later tried out some of the developed ideas on their farms. We concluded that this kind of simulation is a way of leaving big part of the decision making concerning the intervention to farmers, allowing them to develop resources that may have an empowering effect.

3. Creating favourable conditions for farmers' active engagement in a research project. Lessons learned from implementing the Community of Practice concept in innovation platforms in Tunisia, Mozambique and Ethiopia. [3]

The third article analyzes implementations of participatory methodology in three different research areas within the same research project: in Tunisia, Ethiopia and Mozambique. The paper further explores the concept of community of practice (CoP) on which the methodology is based, and its relevance for the AIS framework. The paper is co-authored by researchers working in the three areas. We propose a framework to compare different strategies to organise farmers' participation in the knowledge production in the project, based on the three core processes in a CoP: mutual engagement, negotiating a joint enterprise, and building a shared repertoire of common resources. In an ex-post analysis, we follow the evolution of the method on three sites, looking at the elements of the context that influenced research strategies and investigating the role that farmers were given at each stage of the process when it comes to knowledge production, sharing and use. We explore whether it is possible to create conditions for a community of practice to emerge in a research project.

With this article we "zoom-out", placing the thesis' work in the context of a larger research intervention and its dynamics, and comparing the approach that we took and the tool that we designed with other methods: on-farm experiment and collective experimentation.

[3] Dolinska et al. Paper accepted for publication in a special issue of *Irrigation and Drainage.* While this paper has many authors, it was initiated and written by me. I am also the author of data collection framework and the analytical framework. I conducted the work in Tunisia that is described in the paper, as well as the evaluation of the participatory aspects of the work conducted in Mozambique, where I went in June 2015 to interview farmers.

8. Institutional context of this thesis

8.1 CIFRE fellowship at Lisode

The work presented in this thesis was conducted in the context of a CIFRE fellowship, which means that it was hosted by a private company and had to respond to its demand. The company in question is **Lisode**, a cooperative consultancy based in Montpellier specialized in designing and implementing participatory approaches in research and development projects, in both the North and the South, and in various contexts ranging from natural resources management, through urban planning, to agricultural innovation.

From its beginnings Lisode develops its own participatory tools and methods, including serious games, and has large expertise in facilitation. However, its main expertise and real focus is on designing participatory process. While members of Lisode act mainly as consultants, they are involved in research on participation and regularly publish on the topic (Imache et al. 2009, von Korff et al. 2012, Dionnet et al 2013). Lisode doesn't offer technical expertise related to farming, but their activities are not limited to simple facilitation between the experts and local stakeholders. The objective is to create conditions to collectively analyze local needs and to mobilize local expertise towards commonly defined goal. This often means acting on local power relations towards bigger engagement of stakeholders in a decision-making process.

In 2011 Lisode became a partner in a European research project on innovation to improve food production in irrigated schemes in five African countries. They co-developed the project's general methodology (Froebrich et al, in preparation) combining learning alliances and communities of practice. The idea was not so much to engineer communities of practice of farmers, but to test whether or not (and how) it is possible in a research project to create conditions for communities of practice to emerge. One of the French-speaking countries involved in the project, Mali, was chosen as a PhD project destination. When the 2012 outbreak of violence in Mali made the fieldwork there impossible, the PhD project was transferred to post-revolutionary Tunisia.

The expectation towards the PhD findings was that they are operational. What's more, there was a need to develop a process of intervention that would be effective not only in the environment of a research projects (with its relatively long duration), but also in consultancy work, and tools that could provide added value for Lisode's clients working on developing innovations.

8.2 Being GREEN

The academic partner of this CIFRE fellowship was GREEN, a research unit of CIRAD (French Agricultural Research Centre for International Development). GREEN stands for *gestion des ressources renouvelables et environnement*, i.e. management of natural ressources and environment. Founded in 1993 by Jacques Weber, this multidisciplinary research unit developed their specific approach to deal with decision-making in socio ecological systems, focusing on complex interactions between actors characterized by different points of view, interests, frameworks and acting from different positions of power (Weber 1995). GREEN's signature trait is companion modeling or ComMod (Bousquet et al. 1996, Barreteau 1998, d'Aquino et al. 2003, Antona et al. 2005, Etienne et al. 2010) at the same time methodology, approach and research posture to which GREEN researchers largely contributed and which they still use and develop further. Companion modeling, based on participatory multi-agent modeling and using short-lived simulation tools (games and computer models), demands from researchers to take a stand on their position towards power relations in a given research area and is open to the idea of acting upon them through empowering chosen actors (typically the least powerful). Even though the thesis work does not directly concern natural resources management, the approach, the tools and the posture are directly inspired by the expertise of GREEN.

9. Challenges of the fieldwork

9.1 Minimizing the translation bias

From the beginning, I was aware of a possible bias in my research related to the fact that my knowledge of the locally spoken language – Tunisian Arabic - was very limited. I made a serious attempt to learn it (I took classes in France and tried to practice as much as I could in Tunisia), and at the end I could have simple conversations with farmers about crops and some of the basic issues that they were dealing with. Nevertheless, I recognize that the language issue had some consequences for my research. First, I could only find close collaborators among farmers who could speak French, which excluded those farmers who could not. My interactions with this group of farmers were limited to formal interviews, with a translator. Second, I relied on translators for the big part of my interviews. To minimize the potential negative impact of this situation I spent a considerable amount of time explaining to both translators who worked with me my objectives and needs and my attitude towards farmers. I worked with translators who knew the research area, had an understanding of agriculture (and later of dairy farming), but were not farmers themselves and did not belong to local farmers' networks, to minimize bias. And third, I had to rely on a local facilitator and a translator for my workshop. The facilitator was

carefully chosen and well prepared. Before going to the field, he first animated a test game session with researchers in Tunis, in French, so that I could make sure that we are on the same page when it comes to the game animation.

9.2 Assuring participation

In research on participatory methods, fieldwork is essential. While it is not very common to describe difficulties of fieldwork in scientific papers (and thus no accounts are found in the papers presented in this thesis), it does play an important role in the way that research is conducted. Simple logistics may put a lot of bias on the research intervention and, consequently, significantly influence the results (Chambers 2014). In my case, the main challenge came from the fact that the context of my research made it difficult to establish informal relations with the people in the research area. The quality of interaction is important - participatory research is not possible without participants. Being a female researcher in a conservative area of a Muslim country, working in a predominantly masculine environment, was problematic – I had to go extra lengths to establish informal relations with local actors and to access some of the spaces where they were meeting. Even more challenging were interactions directly related to research activities, as I had to deal with the negative image of a researcher that local farmers have. To give them justice, this image was not entirely undeserved. I witnessed a local researcher interviewing farmers through a car window, without leaving his car seat, and I was surprised by how much I myself surprised farmers when I showed up in rubber boots ready to learn about how they farm, an image they have rarely (or, according to some of them, never) seen before. But my extended presence in the field, my flexibility towards farmers and my genuine interest and appreciation for what they had to offer resulted in establishing a relation of trust and their willingness to help me with my research.

There are no clear rules on how long it takes to prepare a participatory intervention and no framework that would make it possible to asses if the environment is ripe. Using tools such as games demands more good will, trust and commitment of participants than more traditional methods (such as interviews) do. I tried to identify my own locally meaningful indicators that local actors are ready to make such a commitment. The most important ones concerned situations in which farmers made me a participant of their activities: they invited me to participate in their meetings to observe, or they organized at their own initiative my participation in their meeting with regional authorities.

Coming from an environment (Lisode and GREEN) where the work with participatory approaches is strongly value-driven, it was essential for me that participants in my research find their own interest in participating. It seems that this objective was met and the process is described in the following chapters.

Chapter 2. Farmers as agents in innovation systems. Empowering farmers for innovation through communities of practice.

Abstract

This paper examines the role that communities of practice (CoPs) of farmers play in the innovation process. The Agricultural Innovation Systems approach focuses mainly on interactions and learning between farmers and other actors but less on collective processes occurring between farmers. In CoPs farmers not only collectively construct knowledge, but also produce and reproduce discourses and norms providing framework for individual actions, that both can hamper or support innovation. We combined different qualitative methods to explore the role of CoPs of dairy farmers in three on-going innovation projects in an irrigated perimeter in North-West Tunisia. We found farmers belonging to CoPs more empowered for innovation that those working individually with expert support. However, this was only true in the CoPs where access to external sources of knowledge was assured. Addressing farmers as collectively constructing knowledge and opening space for negotiation of meanings were conditions determining the success of one of the innovation projects. CoP's ability to collectively produce discourse should be used and farmers should be supported in developing innovation narratives. This implies sharing power with farmers over the innovation process.

Keywords: agricultural innovation systems, innovation process, community of practice, farmers' agency, discursive space

1. Introduction

Assuring world food security in a sustainable way is a challenge that cannot be met without increasing productivity and sustainability of smallholding farms in developing countries (McIntyre et al. 2009, Hounkonou et al. 2012). After the linear model of technology transfer proved ineffective in meeting this challenge, it is now recognized that an interdisciplinary, holistic and systems-based approach to innovation is needed (McIntyre et al. 2009). Such is the now widely adopted Agricultural Innovation Systems (AIS) approach, that sees innovation as emerging from interaction between a set of agents who contribute to the production, exchange and utilization of knowledge (Hall et al. 2003, 2004, Clark 2002, Sumberg 2005, World Bank 2006, Sanginga et al.2009, Spielman et al.2010, Adekunle et

al.2012, Klerkx et al.2013). In the systemic approach new actors are incorporated in the picture, such as NGOs (Farrington and Bebbington 1994) and private sector (Hall et al 2002), new roles are theorized, such as innovation brokers (Klerkx et Leeuwis 2009a) and traditional roles are being redefined, such as those of researcher (Leeuwis and Aarts 2011), extension services (Faure et al 2011) or government (Lundval 1992). When it comes to farmers, they are no longer described in terms of their relation to technology (as technology adopters), but rather through their interactions with other actors of the innovation system (Poncet et al. 2010).

Within the AIS framework, the focus is, unsurprisingly, on interaction and social learning between diverse actors, thus *between farmers and other actors*. This is reflected in the AIS interventions based on creating innovation platforms (Ergano et al. 2010, Perez Perdomo et al. 2010, Ngwenya and Hagmann 2011, Adenkunle and Fatumbi 2012, Hounkonnou et al. 2012, Kabambe et al. 2012, Kilelu et al. 2013) or learning alliances (Mvumi et al. 2009, Oladele and Wakatsuki 2011, Ashley et al. 2012). Such experimental set-ups are always multi-stakeholder, typically including farmers' representatives, other actors along the value chain, researchers, relevant state administration actors, as well as civil society actors (NGOs). A number of works confirms that farmers obtain knowledge through their participation in heterogeneous networks (Klerkx and Proctor 2013). The fact that farmers do not have enough interaction with other actors is presented as an element hampering innovation, which is said to fail because farmers are either separated from the sources of creativity and appropriate knowledge (Hall and Clark 2009), or disconnected from networks offering access to innovation and resources (Spielman et al. 2009), or else because farmers alone do not have enough power to initiate the institutional changes necessary for an innovation to spread (Hounkonnou et al. 2012).

At the same time, as Klerx and Leeuwis (2009) point out, focusing on farmers' connection with different sources of knowledge may lead to undervalue the importance of peer networks. The importance of learning and interaction *between farmers* was emphasized in the numerous works which present peers as the source of knowledge the most used by farmers (Solano et al. 2003, Klerkx and Leeuwis 2009b). Farmers' capacity to produce knowledge on their own (Chambers et al. 1989) and to innovate (Richards 1985) has been recognized since the 1980s, and a large body of work demonstrates that this is knowledge in its own right, distinct from that of agronomists and extension workers (Goulet 2013). Confronting their peers and sharing their experiences is said to be crucial especially for farmers engaging in innovative activities alternative to the intensive agriculture model (Ingram 2010, Curry et al. 2012, Goulet 2013).

Learning in peer groups was conceptualized by Lave and Wenger (1991) and then further by Wenger in his work on *Communities of Practice (CoP)* (1998, 2000). A CoP is an informal learning community characterized by a shared practice of its members, their voluntary engagement and a shared repertoire of communal resources (routines, norms, artifacts, vocabulary, styles, etc.) that members have developed

over time (Wenger 1998). According to Wenger, communities of practice are essential for social learning systems, as they are "social containers of competences" (2000: 229). While CoPs were examined in organizations and demonstrated as beneficial to organizational development, their role in the agricultural innovation remains generally under-researched, with few exceptions (Oreszczyn et al. 2010, Morgan 2011, Madsen and Noe 2012).

The question we therefore address in this paper is: what is the role of farmers' communities of practice in innovation process? Instead of focusing mainly on learning in the CoPs, about which much has been already said, this paper examines CoPs as spaces of production and reproduction of discourse and construction of norms that constitute a framework for farmers' agency. By analyzing interactions, inside and outside of communities of practice, through which these processes occur, we hope to contribute to the discussion about how to empower farmers to innovate in the innovation systems. The paper continues by drawing a conceptual framework of learning, discursive space and agency in communities of practice (Section 2). In section 3 we present our study site in North-West Tunisia together with our research methods, followed (Section 4) by our findings from two stages of the study – the first part focusing on interactions inside and outside of CoPs and the second one dealing with the role of CoPs in three local innovation projects. We analyze and discuss these findings in section 5 and conclude in section 6 with some suggestions for intervention in innovation projects.

2. Communities of practice and their relation to innovation

2.1 Different concepts of communities of practice in the context of farming

CoPs are associated with the type of learning process that can be described as social construction and knowledge sharing, rather than knowledge transfer (Morgan 2011). In a CoP, knowledge is an emergent property of social interaction and not a commodity (Ison et al. 2014). It is practice that creates circumstances for knowledge creation, which makes it possible to mobilize tacit knowledge (Duguid 2008). This is important in the context of farming - a lot of farmers' knowledge has a tacit character that cannot be captured in discussion (Barnaud, 2008).

There are conceptual differences between how different authors approach communities of practice of farmers. Oreszczyn et al (2010), concluding from their own research on introducing GM crops in the UK, see farmers as a distributed CoP (in terms of Wenger, a CoP that is not characterized by geographical proximity and direct interaction) and further propose new concepts as more adapted to the context of farmers' learning and innovation - *network of practice* (similar to community of practice but with weaker ties; can be composed of several communities of practice and involves non-farmers; see

also Eastwood et al 2012) and *web of influencer*s (an even broader network of agents who influence farmers thinking and practice).

In the French speaking literature (Darré 1985, 1987, 1991) we find a very well developed concept of *Localized Professional Group* (LPG). LPG is a type of community of practice specific to farmers who work on the same territory, in similar conditions and who stay in regular and direct interaction (Darré 1987). According to Darré, what all farmers do, can be conceptualized as two parallel strains of activity. Next to what is commonly understood as farming activities, performed according to local standards, farmers are involved in constantly redefining the rules which determine why farming is done rather one way than another. This, according to Darré, is a collective process that happens in dialogue between peers. Goulet (2013), recognizes the contribution of Darré, but chooses the concept of Wenger, as he finds Darré's condition of geographical proximity too constraining to talk about learning communities of farmers who are bond rather by a common type of practice (for example organic farming) than a common territory. Most differences between these concepts (questions of geographical proximity or direct interaction as determining CoPs), are contextual, but there is one important conceptual difference – the question of boundaries of a CoP. Some authors point out the risk of insufficient openness of CoPs to new knowledge and practice which can limit their ability to generate innovation (Brown and Duguid 2000, Swan et al. 2002). For Oreszczyn et al (2010) and Eastwood et al (2012) CoPs have to be seen as embedded in wider networks from which new knowledge can flow, and members of which can act upon CoPs as boundary spanners. Darré (1987) offers another angle to look at the problem of boundaries, emphasizing the fact that individual farmers belong in parallel to networks of dialogue other that their LPG, where they have access to other sources of knowledge, other representations of reality and other discourses. This "multi-membership", as Darré calls it, is the source of novelties. In this sense, all farmers are potentially boundary spanners – agents who can pass knowledge between the community and the outside world (compare Oreszczyn 2010 et al and Kelrkx et al 2010).

2.2 Communities of practice and discursive space

Leeuwis and Aarts (2011) describe discursive space as linking the space of thinking with the space of doing, a space where actors negotiate the construction of their world through competing storylines. A number of works deals with the role of discursive space in technological change (Pesh 2015), in innovation journeys (Lovell 2008) or in shaping an innovation (Klerkx et al 2010). Here again, we find a concern related to boundaries - it is suggested that discursive fixation inside organizations (or learning communities) can be too strong, up to preventing discursive fields from changing (Pesh 2015). For Darré (1987), alternative storylines find their way into CoPs through membership of farmers in other dialogue groups; they can be mobilized in the on-going debates and negotiated with other members. Individual actors deal with different sets of meanings and it is the mismatch between them that opens up their

discursive space (Pesh 2015). The continuous debates in farmers' groups, in which farmers negotiate which options are accepted as locally possible, justify their choices and construct arguments, are Darré's main interest. In the Wenger's CoP theory, even though not much emphasis is put on dialogue, negotiating meaning is one of the fundamental processes in communities of practice (Wenger 2000) and discourse is an important part of a shared repertoire of a CoP. In the study of innovation process, to which "telling a good story" is essential (Klerkx et al 2010), learning communities should be taken into account as spaces of discourse production.

2.3 CoP – Agency – Innovation relation

Dealing with complex relations in the innovation systems requires an understanding of how both collective and individual capabilities are strengthened (Spielman et al. 2009), which means that we have to look also at what is happening at the level of an individual (Hekkert et al. 2007), at the agency of innovators in their socio-institutional and technological environment (Klerkx et al 2013). Giddens (1984) defines agency as capability of an individual to "make a difference" to a pre-existing state of affairs or course of events, thus we should talk about agency when we talk about innovation. First thing that conceptually connects CoPs, agency and innovation is practice. Innovation can only become real in its practical application and the notion of 'practice' refers to reproduction of activities by individual agents (Pesh 2015). The second element is the question of social norms, collectively constructed in farmers' communities, which constitute a framework for individual decisions (Darré 1985) and are features of innovation agency (Klerkx et al 2010). When Darré criticizes linear development model for ignoring collective processes of construction of rules by farmers, he sees it as taking away innovation agency from farmers, since in linear model how to farm is decided by research and development professionals (Darré 1985:13). Farmers as technology practitioners are regarded as outsiders, those who, according to Van De Poel's definition (2000), are not involved in the design of, and decision-making about a technology, even if their contribution to change is undisputed. Thus focusing more on communities of practice in innovation systems could contribute to recognizing farmers' agency in innovation process.

2.4 A framework for analyzing innovation projects

Darré (1991) described LPGs according to criteria concerning: sources of innovation (unique/diverse, internal/external), interaction (the capacity to exchange with the other groups of actors outside of an LPG), and dialogue (the way the choices are justified; the type and the quality of argumentation). Drawing on this work, we propose a framework to identify and analyze communities of practice in the environment of innovation projects and their role in the innovation process. We add special focus on

discursive space as determining the success of innovation (Figure 2-1). In the following section we present how we applied our framework in Tunisia.

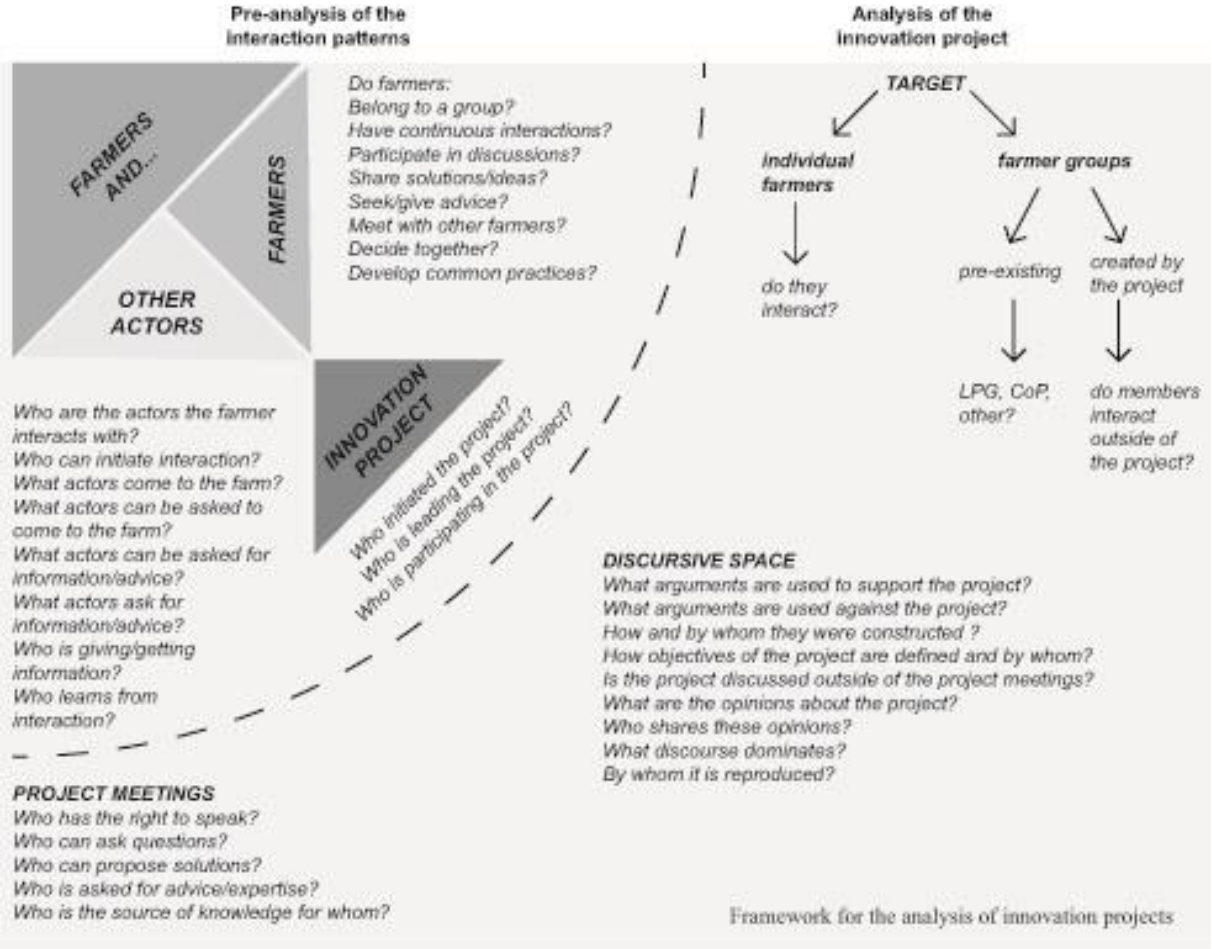

Figure 2-1. Framework for analyzing innovation projects

3. Materials and methods

3.1 Study area

Our research was conducted in the irrigated perimeter El Brahmi in the region of Jendouba in the North-West of Tunisia. The perimeter, covering around 5000 hectares, was planned and built in 1978. As most large-scale irrigation schemes worldwide it was based on a state-managed planned innovation process and 'diffusionist' extension services (Poncet et al 2010). Originally, the perimeter was designed for a quadrennial rotation of cereals, sugar beet, forage crops and market gardening with integrated dairy cattle breeding. This design was backed up by the state-owned industry – two milk factories and a sugar factory – that were securing demand for milk and sugar beet. Tunisian policies of decentralization and privatization, the recent Tunisian revolution of 2011, but also changes in the landscape of the local

economy (closing down of the sugar factory and one of the milk factories), resulted in the collapse of the initial system. Dairy farming decreased significantly, and quadrennial rotations were replaced by biannual (cereals-gardening or cereals-forage) or by monoculture (cereals). The management of the perimeter was decentralized. The state extension services are today almost non-existing; only two agents are left in the Local Extension Office (CTV) with minimal budget and no means of transport, which makes their work in the field practically impossible. Post-revolution instructions to avoid public gatherings and group activities for security reasons, further limited extension work. The Office of Livestock and Pasture (OEP) has a single extension agent operating in the perimeter, following the work of a small number of individual dairy farmers. Some extension activities are also undertaken by the National Institute of Field Crops (INGC), an applied research institute located 10 kilometers from the perimeter. The state extension activities have been replaced by advisory services offered by private actors – engineers working for private companies involved in contract farming (industrial tomato and, more recently, cereals) or in the sale of pesticides who favor work with individual farmers.

The collapse of the original system affected dairy farmers gravely. Many of them were using a sub-product of sugar beet as an easily accessible, inexpensive ingredient of their cows' diet and have lost access to it since the quadrennial rotation was abandoned. Dairy farming in El Brahmi is now highly dependent on the industrially produced concentrate feed. Its high price reflects the world market prices of its two key components - soya and corn. Its production and sale is operated by private companies with no control from the state, and farmers regularly report problems with the quality and/or price of the product. This, in combination with the uncertainty concerning the commercialization of milk, forced a number of farmers to sell their cows. Milk collection and transformation is now in private hands, while the price of milk is still fixed by the state. Over the years, dairy farming became a hardly profitable activity and farmers are in search for solutions to improve their economic situation.

3.2 Study method

Building on Darré's criteria (1991), we developed our study around the following elements: interactions between actors (farmers and farmers; farmers and other actors), their sources of knowledge and discourses they reproduce in relation to their actions. Our unit of study was the irrigation perimeter and our focus was on dairy farming. We combined various qualitative methods in our study. We conducted individual semi-structured interviews and focus group interviews with various system agents (sixty three interviews in total, two thirds of which with farmers), we used informal conversations, participatory observation and document study. In choosing our informants we followed the "snowball method": while answering our questions about their sources of knowledge and interaction patterns, our informants mapped for us a constellation of people to interview, places to visit and events to observe. The first set

of interviews was conducted between September and October 2012, the second between March and June 2013. A final, shorter field visit took place in September 2013.

In the first stage of our study, we analyzed interaction and knowledge exchange patterns and identified related communities of practice. Based on the interviews, we identified three local innovation projects (on-going) for further analysis in the second stage. By "innovation projects" we refer to projects of change in agricultural practice that aim to improve dairy farmers' situation. The innovation projects we identified were: (1) introducing no-till farming (initiated and implemented by the INGC), (2) on-farm concentrate feed production (undertaken independently on three farms; two individual and one corporate) and (3) creating a dairy farmers' cooperative (initiated by three farmers and supported by the state administration). We applied our analytical framework to analyze and compare the dynamics of the three innovation projects focusing on the role of communities of practice.

4. Findings

We first describe interactions that we discovered among dairy farmers in El Brahmi and the communities of practice that we identified, followed by our analysis of three on-going local innovation projects, focusing on the role of CoPs that were involved or emerged around them.

4.1 Interaction, dialogue and sources of knowledge of El Brahmi dairy farmers.

4.1.1 Disconnected farmers

The majority of the farmers in El Brahmi emphasized the isolated and individualistic character of their activities: "everyone works alone", "everyone has their own ideas", "we do not share", "we do not discuss". This discourse reflected a standard of practice; farmers typically did not share with fellow farmers what they had learned on their farms. Even though some of them conducted experiments with results that could interest others, or found solutions to problems that concerned all farmers, they would keep these findings for themselves. In some cases, similarly to what was suggested by Chiffoleau (2005) and Klerkx et al (2010), this could be attributed to the competition between farmers (if, for example, an innovative solution made it possible to harvest earlier and be among the first on the market), but such cases were rare. The interviews with individual farmers revealed their sense of disconnection from other actors, confirming similar observations by Spielman et al (2009). "No one is coming to see us", "No one invites us anywhere", "No one gives us information" – small farmers described themselves as isolated, abandoned by state extension services and neglected by research and development projects. Some of them were not aware of the existence of private advisory services in the perimeter, many considered it inaccessible.

4.1.2 A disconnected CoP

One of the CoPs that we identified in El Brahm (CoP1) fell under the description of Darré's LPG. These farmers, situated in close proximity, highlighted the similarity of their working conditions, and mentioned holding continuous discussions about how to farm best, which has resulted in a set of similar farming practices that the group developed over the years. Some of the CoP1 members are regularly visited by an OEP agent, but according to their account, they do not learn anything new from these interactions. The farmers pointed out the disconnection of their group from other networks. They recalled "better times" when their community was in regular contact with Austrian engineers from a commercial farm near-by, who were their important source of knowledge, innovation and advice and with whom they could discuss new ideas. Since the Austrians left, they could only discuss about farming within their group, but as they told us: "after all this time we have nothing new to add to the discussion, now we can only talk about politics and football".

4.1.3 Connected CoPs

The other two CoPs were distributed communities of practice. The first one (CoP2), described by one of its members as "a circle of fellow farmers", was a small group of well-educated dairy farmers connected by personal ties; the second one (CoP3) was formed by former state-employed agricultural technicians, who installed themselves in the perimeter under a scheme of long-term state lease of farms of 10 hectares (10 farms in total); most of them extended their farms by renting additional surface. Both groups were reported to hold regular meetings to discuss the challenges connected to farming, share new ideas and to seek solutions together. Farmers perceived their membership in these groups as beneficial for their farms' performance.

Some members of CoP2 and CoP3 had a dense network of connections beyond their CoPs. The beneficiaries of the state-lease farms belonged to the local network of the National Institute of Field Crops (INGC). Being part of this network assures invitations to certain events, such as information days or product presentations, as well as participation in research projects (project teams who want to work in the area usually pass through the INGC). Some of these "well connected" farmers were members of a new farmers' union (Synagri); many were in regular contact with the regional administration. Those who were not former state technicians, gained useful knowledge while exercising other professions (a former worker of the agrochemical warehouse, a teacher in agricultural high school). Many of the farmers from both groups had an opportunity to observe farming practices in other regions or countries during their travels, some regularly participated in events organized at the regional or national level (training sessions, lectures).

While the "disconnected" farmers were concerned about the lack of access to knowledge and information due to their lack of interaction with other actors, for the "well connected" farmers the concern was different. They underlined the fact that those actors who plan research, build curricula for farming education, train agricultural engineers and design agricultural policy, do not ask farmers to share their experiences and, hence, they are not aware of the real problems of Tunisian agriculture. Another problem they identified was a lack of experience of many of the extension agents, agricultural engineers and researchers. The interviews revealed that for farmers, "experience" represents tacit, context-specific, localized knowledge, and could be gained principally through practicing agriculture. Interestingly, several of the interviewed farmers expressed the view that the role of researchers should be to transfer experience-based ideas of farmers to the higher levels of authority where they could be implemented.

4.1.4 An absent CoP

Some individual farmers had interactions with private extension agents (agricultural engineers or technicians working for private companies operating in the perimeter and offering paid advice to farmers). Farmers who knew about the possibility of such services and who could afford it, would turn to an advisor for punctual technical advice, especially concerning the choice of product to use in a particular situation (pest control or fertilization). Some farmers in El Brahmi were found to be very dependent on such advice and would address their technician any time they encountered something unusual, identically to what was described by Darré (1985). One farmer told us a story how he was travelling to the town with a potato in his pocket looking for an "expert" who could confirm a (quite common) potato disease.

We observed a different model of interaction in the case of one private engineer. Adel, an advisor working for a company representing the biggest international pesticides producers, was pointed by many farmers as their main, most valuable and, sometimes, sole source of knowledge. Adel stood out in the eyes of farmers for his experience, the quality of his advice, his availability, his willingness to work even with small farmers, and for the fact that his advice was free of charge (even if his main goal was commercial, his advice was not always conditioned by purchase of his company's products). While Adel was the only source of knowledge for some of his clients, his own sources of knowledge were very diverse – scientific publications, trainings provided by his company, visits abroad, and internet. He also admitted getting constant inspiration from farmers' questions and the problems they approached him with. As Adel worked with farmers individually, and he did not cover a specific area, farmers that he worked with did not interact with each other and there was no direct exchange of experiences and learning between them – they did not form a community of practice and Adel did not encourage one, even though he was well aware of possible advantages. He himself belonged to a community of practice,

a space of regular exchange for colleagues working in different areas of the country, where they could discuss the progress and the problems of "their" farmers and share tips and advice.

4.2 Role of communities of practice in on-going innovation projects in El Brahmi

4.2.1 No-till farming

Tunisia is experimenting with conservation agriculture since 1999 when a no-till program started under the lead of the INGC (at this time under a different name), targeting cereal production in different climatic zones of the country. Today, in El Brahmi, the program is focused on forage crops. The program works by choosing certain farmer "leaders" (dairy farmers) who are expected to disseminate the technique among a number of farmers working at their proximity, called "satellites" (five per leader). The innovation dissemination strategy for this project is based on existing interactions between farmers – the leaders were chosen among the former state technicians (a CoP) - farmers who had their networks and who were known to INGC as respected (and followed) by their peers. The results are consistently good (higher yields with lower costs). The main factor hampering wider adoption of the technique is the difficulty to access the specialized no-till seeder. The INGC owns such a seeder, but its availability is limited; only the farmers directly involved in the program (leaders and satellites) can use it. The market price of the seeder places it out of reach for most of other individual farmers.

Even though the project is of technology transfer type, the program coordinator at the INGC is open for discussion and farmers' suggestions, recognizing their knowledge and taking into account their ideas. The participants proposed to test the no-till technique on new crops, initially not planned in the program, and their suggestions were accepted. The coordinator considers following farmers' ideas as a learning opportunity for himself and his institution.

The participants developed their own arguments supporting the choice of no-till technique: firstly, that it makes it possible to harvest, and therefore to feed cows, regardless of the weather conditions (the compacted soil makes the field accessible even after a heavy rain when normally labored parcels become inaccessible) and secondly, that no-till farming is a good adaptation to the problem of the scarcity of workforce in the perimeter. This argumentation, different from the argumentation of the Tunisian conservation agriculture program, was welcomed by the program coordinator, who presented it to us as "farmers' reasons" and who included them into the official project narrative.

As program leaders belonged to several networks, the technique spread further. We discovered that a small number of farmers not participating in the program but having friendly relation with one of the program leaders adapted the technique outside of the involvement and control of the INGC. These dairy farmers (initially two families), found out about farmers' experiments around the no-till technique

through informal conversations with the farmer leader and decided to give it a try. As he presented it as something “in the making”, as an “experiment”, they did not feel constrained by the strict standards of use of the technique. They knew they could not afford a machine, so they skipped mechanical seeding and collectively, with the support from the farmer leader who shared his experiences from the project, constructed a new standard for practice with manual seeding that fit their specific conditions. They successfully introduced no-till on a highly appreciated legume-grass mixture of ray-grass and alfalfa. A temporary community of practice formed around this technique, even though, normally they did not have a habit of regularly exchanging their farming experiences or seeking each other’s advice.

This experience stands against a popular narrative in El Brahmi that states that “no-till technique is good only for big farmers”. The argument is that the necessity to use the expensive seeding machine puts the technique out of reach of smallholder farmers. The narrative of the machine is repeated by several actors (see Table 2-1). Farmers who reproduce this discourse are not aware that there are farmers in the perimeter who use the technique successfully without the machine. Farmers who seed manually, talk about the importance of irrigation and the appropriate level of seeding as necessary conditions for success. As there is little opportunity for dialogue between different groups of farmers, these different discourses don’t have a chance to be negotiated.

Actors	**Discourse**	**Related actions**
Small farmers outside the program leaders network	Machine is necessary - No-till technique is for the big farmers only (who can afford the machine)	Ignoring the technique
Small farmers inside the program leaders network	Machine is not necessary	Adaptation of the technique to the manual seeding
Big farmers (farmer leaders and their acquaintances)	Machine is not a must but it is necessary on a big surface	Putting the purchase of the machine in the program of the cooperative project
INGC (National Institute of Field Crops)	Machine is necessary	Starting a project of constructing an affordable machine from local materials
CTV (Local Extension Office)	Machine is necessary	Do not talk about the technique with smallholder farmers
OEP (Regional Office of Livestock and Pasture)	Machine is necessary	Do not talk about the technique with smallholder farmers Supporting a cooperative project of farmers to collectively purchase the machine

Table 2-1. Narratives about no-till technique

4.2.2 On-farm concentrate feed production

The high price and unreliable quality of the industrial concentrate feed was identified as one of the major problems of dairy farmers. We found three farms in El Brahmi who tried to overcome it by producing their own concentrate on-farm. The first one is a corporate farm of 500 ha. The farm's engineers, using their own knowledge, prepared a formula, that they further tested and improved. Using their connections within the dairy industry, they purchased a second-hand mixing machine (from a factory that was closing down) and started production of a high-quality, lower-cost concentrate (20% cheaper than the industrial one) that successfully continues. None of the individual farmers that we interviewed, were aware of the on-farm concentrate production on the corporate farm as there are no regular interactions between them and the farm's engineers or workers. The members of the CoP3 did know about it, through a family connection of one of them to the corporate farm's main engineer. They did not repeat the experience on their own farms, as feeding systems they use do not rely so much on the concentrate - they work towards independence from industrial feed through forage autonomy.

One member of CoP1 (who differed from the others because of the bigger size of his farm and his better financial situation) also introduced on-farm concentrate production. Despite investing in an expensive machine, that he believed necessary, he stopped his production when the only enterprise in the region providing an easy access to all concentrate ingredients closed down. He claims that purchasing ingredients individually on the market is impossible. His experience was known to other members of the CoP and the group adopted his narrative. They all individually told us all that (1) a machine is needed to mix the concentrate and (2) the ingredients are not available (*see Table 2-2*). This discourse was further supported by the OEP agent who regularly visits some of the CoP members. He dismissed the idea of mixing the concentrate manually (and was not aware that it was being successfully done by one farmer in the perimeter). His argument is that manual mixing cannot assure equal distribution of vitamin component in the concentrate which would necessarily result in a decrease in milk production.

The third example comes from a farmer from CoP2, who manually mixes his own concentrate from ingredients that he buys from several sources. Being a dairy farming technician, he knows the formula to compose the concentrate. The cost of concentrate that he produces is 30% lower than the price of the industrial one, and he reports no change in milk productivity due to manual mixing. The feeding system that he uses is not heavily based on concentrate. In his CoP other members got interested in the opportunity of producing their own concentrate and asked him to purchase ingredients also for them. Also one of the innovator's neighbors told us he was considering starting his own production in the near future, based on the same formula (that the innovator shared with him).

Actor	Discourse	Source	Related action
Individual farmers 1	Not aware of such a possibility	none	-
Individual farmer 2	It is possible to individually buy ingredients and mix concentrate on farm. Manually mixed concentrate is of good quality.	Innovator 3 (neighbor)	Intention to try/First step (getting a formula)
Community of practice (CoP)3	Machine is necessary to mix the concentrate of good quality.	Corporate farm (Innovator 1)	None Alternative discourse (forage autonomy)
CoP2	It is possible to mix concentrate manually It is possible to purchase ingredients It is possible for an individual farmer	Innovator 3	Intention to try/First steps (getting a formula, ordering ingredients)
CoP1	It is not possible to mix the concentrate manually It is not possible to purchase ingredients It is not possible for individual farmer	Innovator 2 OEP (Regional Office of Livestock and Pasture) agent	No intention to try

Table 2-2. Narratives about mixing concentrate feed on-farm

4.2.3 Dairy farmers' cooperative

The initiative for creating a dairy farmers' cooperative in El Brahmi is generally attributed to three farmers. Two of them are close friends and former state technicians (CoP3), while the third one belongs to CoP2. They all have wide networks of contacts through participating in activities organized for dairy farmers on national level. Having seen well-ran cooperatives during their travels abroad, they became advocates of farmers' cooperation.

There are several other actors who got involved in the project when the initiators were looking for support. The Regional Commissary for Agricultural Development office (CRDA) has a special two-person division dealing with the question of farmers' organization. Promoting farmers' cooperatives is a policy of the state. One of the CRDA agents drafted a business plan for the future El Brahmi cooperative, based on very rough cost estimates. The CRDA also offered to give the cooperative an old hangar in El Brahmi to be used as a cooperative's warehouse. In addition, the OEP and INGC are also in favor of the project, seeing it as an opportunity to reach larger number of farmers with their extension activities. Another actor on board is the Tunisian Agricultural Bank; a special account for the future cooperative is already open; preferential credits are available for cooperatives.

As the project was on-going, during our presence in the field, we had an opportunity to directly observe its different events. We participated in a meeting of the leaders of cooperative projects from different areas, held in the CRDA regional office in Jendouba, where also an OEP representative was present. The observation revealed problems concerning the standards of interaction between different actors. While CRDA declared full support to the farmers' ideas, it tried to impose its own vision of the project without letting farmers express their ideas and concerns. The meeting was dominated by the speech of the CRDA representatives and the OEP representative, while the farmers were allowed to speak almost only to report the factual information concerning the progress of their local projects (how many members a given cooperative has acquired, how much money was collected). The El Brahmi project leader (from CoP3) was disappointed by the administration's attitude and expressed his preference for "making it on our own". For him the cooperative was supposed to be a project "by farmers, for farmers".

Another event we witnessed, was an "information meeting" organized for farmers by the same farmer and with the participation of one more project leader (from CoP2). We observed similar standards of interaction as those from the multi-stakeholder meeting. The participating farmers were not given space to voice their doubts, questions or ideas. The organizer gave a speech about the cooperative. When the farmers started to discuss together what advantages the future cooperative could represent for them, they were quickly interrupted by the other project leader who announced that "they" had already passed the stage of discussion and would not "waste time" for it anymore; a concrete action plan had to be drawn instead. When we talked to the participating farmers few days after this meeting, we found them discouraged and convinced that the project served only the interests of big farmers.

Informal and mostly spontaneous "information meetings" about the advantages of the cooperative project have been held in the local cafés and on the local Thursday market punctually over the period of approximately two years. As the public of these meetings changed each time, more new farmers were getting interested by the idea of creating a cooperative, while those who participated in the first meetings have already abandoned the idea of the project.

While the overall attitude towards the idea was largely positive, a number of smallholder farmers expressed the view that the cooperative is meant for the big farmers only, contrary to the intention of the most active of the project initiators. This reflected a lack of common, consistent strategy that also became apparent in the interviews; there was no shared vision of the activities of the future cooperative, of its development strategy and more broadly, of its principle objectives, even among the three project initiators (*see Table 2-3*).

Main objective of the cooperative	• Facilitate access to agricultural inputs and machines; • Operate a cooperative milk collection center; • Produce concentrate feed; • Provide access to training and innovation.
Starting strategy	• Start from one single activity; • Initiate several activities in parallel; • Start with a restraint group of farmers in similar situation and with similar interests, who know and trust each other; • Gather the biggest possible number of farmers to increase the starting capital that needs to be high.
Target group	• Cooperative will serve interests of big farmers; • Cooperative will serve the interests of smallholder farmers.
Attitude towards cooperation	• People in El Brahmi know that cooperation is the necessary solution, we have to organize; • People in El Brahmi do not want to collaborate; this is against their mentality due to the bad memory of collectivism.

Table 2-3. Inconsistent narratives about vision and strategy for future cooperative

Different visions of the future cooperative and of preferable strategy have never been confronted. They have never been collectively discussed and negotiated – farmer meetings did not provide space to do it, neither did multi-stakeholder meetings. We also discovered that the business plan prepared by the CRDA (not based on the analysis of the context, as admitted by its author) became a source of major misinformation; many farmers were convinced that the (very high) amount proposed as a starting capital in this document, was the amount necessary to legally start a cooperative according to the Tunisian law. A possible explanation is that the document, since it was produced by state administration, was interpreted as a legal framework. This misunderstanding, reproduced by many farmers, has acted as a major discouragement.

When asked why in their opinion the cooperative has still not been created despite the long efforts, everyone explained it in terms of "mentality problem" of local farmers. This anti-cooperative mentality was connected to the "bad memory of collectivism" that farmers kept after the failure of the state-imposed cooperatives installed in Tunisia under the presidency of Habib Bourguiba in the 1960s. While most of the farmers talked about this anti-cooperative mentality as omnipresent in the perimeter, they did not exhibit it themselves. On the contrary, they often expressed the view (both individually and when in a group facing other actors) that organized cooperation between farmers was the only option and the key to solve many of the problems in El Brahmi, or even presented it as a cross-cutting issue that should

be given priority before any other, more technical issues are tackled. Many of them individually formulated consisted arguments to support the cooperative project. Still, all the actors involved in the project repeated the "anti-cooperative mentality" narrative.

5. Discussion

5.1 The empowering effect of CoPs

While farmers who worked individually, felt limited in their access to new knowledge and the members of CoP1 admitted that their discussions became sterile after they lost their external sources of knowledge, farmers who belonged to the CoPs and in parallel had access to diverse sources of knowledge, valued their participation in the CoPs highly. For them they constituted spaces where new ideas could be exchanged, discussed and developed. This stands in opposition with the results of Oreszczyn and colleagues (2010) who found that farmers did not feel that they learned directly from their interactions with each other and did not consider any farmers' groups they belonged to as influential. While literature provides many examples demonstrating that either heterogeneous (Solano et al. 2003; Klerkx and Proctor 2013) or peer networks (Ingram 2010; Curry et al 2012; Goulet 2013) are essential for farmers' learning and innovation, our results suggest that innovation is stimulated the most at the intersection of horizontal interaction inside farmers' CoPs and external interactions of its members with other actors. Thus, when initiating innovation project, involving existing learning communities is a promising strategy, as demonstrated by the example of no-till program. This presumes openness for the type of learning associated with a CoP, and for recognizing farmers as agents of the process, as it was the case of the INGC agent piloting the no-till program. Addressing individual farmers, as in cooperative project, seems much less effective. When no space was provided for farmers to negotiate meanings around the cooperative project, the project failed despite the heterogeneous network created around it and institutional conditions being favorable (legal framework, state policy and financing possibilities). Leuuwis (2000) reminds us, and the example of Adel confirms, that working with individual actors can be also a strategic choice, in particular in the private extension services where such a strategy is more profitable. Klerkx and Leeuwis (2009b) refer to Rivera's argument that individual demand driven extension (as in the case of Adel) locks farmers in a commercial orientation preventing their empowerment as a group around their specific interests. This gives a hint about the empowering effect of communities of practice, which was earlier suggested by Darré (1985). The cooperative project is a good example to support this line of thinking – without being able to react to the proposed organizational innovation as a group, farmers did not manage to start the project that would potentially strengthen their position and lower some of the pressures coming from the privatization of dairy farming and from its powerful actors (milk collectors, concentrate producers, private input providers etc).

On the positive side, the empowerment of participants of the well functioning CoP2 and CoP3 was manifested for example through their lower dependence on industrial concentrate feed and readiness of some of the members to undertake innovative projects, but also in opinions that they voiced: that the fact that farmers do not participate in planning agricultural research, education, training and policy negatively affects the quality of all the above. While the AIS literature considers disconnection of farmers from wider networks as problematic mainly for farmers, these farmers saw it more as the problem of the other side. The recognition of farmers' knowledge and innovation capacity (Chambers 1989, Richards 1985, Waters-Bayer 2009) concerns almost exclusively the knowledge and innovation related to agricultural practice. The turn towards the wider, more complex, systemic approach to agriculture did not result in taking farmers into account as holders of knowledge related to the issues going further than narrowly understood farming. The farmers' suggestion that taking their advice into account would be beneficial for the innovation systems could be explored by the designers of interventions such as innovation platforms, concerned with agriculture in a large, systemic sense. So far, as Hounkonnou et al (2012) demonstrate in their work from West Africa, smallholder farmers' agency usually does not go beyond farm level.

5.2 The standards of interaction affect innovation process

Our comparison of innovation projects clearly demonstrated the importance of the standards of interaction and dialogue in the CoPs for innovation process. The fact that a heterogeneous group of actors is engaged in an innovation project does not yet determine its success. We can look at the multi-stakeholder meeting of the cooperative project as an innovation platform. Farmers (leaders of the cooperative projects from different areas) were participating in the meetings of the multi-stakeholder group at the regional level, but they were not participating in them on equal terms. They were not given time to speak nor the opportunity to influence the design of the project that they were expected to execute. In El Brahmi, the leaders' initial enthusiasm of gaining support of all the different (and powerful) actors, soon transformed into frustration, as it became apparent that the usual power relations are in place, in which the role of farmers is limited. This not stop them however from reproducing the same interaction pattern during the horizontal interactions with other farmers. At the same time, the no-till farming project, which started as a technology transfer exercise, evolved into an interactive innovation process, around which emerged a community of practice (another one that the one designed by the project initiators). Ison et al (2014) while doubtful about the possibility of engineering CoPs, believed that it is possible to create conditions for a CoP to emerge. In the light of our findings, we can say that quality of interaction is such a condition. In the example of no-till project, the leading INGC agent was showing a genuine interest in farmers' input, he recognized that learning was mutual, was open for farmers' suggestions and these suggestions were actually taken into account, shifting the project

towards co-construction rather than transfer (compare with Sewell et al 2014 on sharing power between farmers and research team).

5.3 Importance of constructing narratives in communities of practice

The cooperative project was hampered by the dominating discourse of non-cooperation and the narrative of the bad memory of collectivism. This confirms earlier statements by Leeuwis and Aarts (2011) that storylines have direct effect on innovation process in the sense that they shape the space for change. That the narratives determine the realm of possible is demonstrated also by other "impossibility narratives" from our cases. "No-till farming is good only for big farmers" and "Producing own concentrate is not possible" may be in the opposition to the actual experiences of some farmers in the perimeter, but the strong presence of these storylines in the discursive space still stops other farmers from considering these activities as realistic options.

Even though actors involved in the cooperative project disposed of many diverse and often contradicting, but individually coherent arguments for farmers' cooperation, they did not give themselves time and space to negotiate a common narrative (or narratives) that could not only unite different actors involved in the project, but also compete with the dominating discourse (see also Lovell 2008, Hajer 1995). The farmers in El Brahmi stayed passive towards dominating 'uncooperative mentality' discourse and neither the institutional leaders of regional project nor the local farmer leaders decided to directly address this blocking factor by formulating a new "cooperative mentality" narrative. This is in line with the work of Klerkx et al (2010) who demonstrate that shaping an innovation involves 'selling a good story' ref),. Based on our findings, we could add that shaping an innovation should involve *co-constructing* a good story. In the no-till case, the INGC agent opened his institution's story for negotiation with participating farmers, who added their own arguments. As the story was passed further by a farmer leader as an open narrative, it could be further transformed by an emerging community of practice of farmers outside of the project, resulting in generating a local innovation.

6. Conclusions

Informal and spontaneous character of communities of practice makes it difficult to both work with existing CoPs (Layadi et al 2011) and create new ones as part of a project (Ison 2014). Nevertheless, the potential to mobilize CoPs as tools in intervention is generally recognized. While several authors explore how extension could form new peer networks (Klerkx and Leeuwis 2009b) or strengthen existing ones (Hamunen et al 2014), others go even further, evaluating networks as policy instruments (Beers and Geerling-Eiff 2013). Creating conditions for farmers CoPs to emerge seems like a good strategy. This means offering to farmers the possibility to negotiate meanings, or as Sewell et al (2014)

put it “sharing power with farmers”. This is good news, as it makes it a decision of those who intervene (researchers, extension professionals, development consultants).

This could mean arriving with a narrative that is open for change - not with a “good story” to sell (Klerkx et al 2010) but rather with an “open story” for farmers to negotiate, develop or re-write. Our research demonstrated that farmers’ agency starts with the capacity of changing discourse. Exploring their discursive space makes it possible to identify storylines that may stop farmers from innovating. Then the effort should be focused on supporting farmers in developing new competing narratives and arguments to defend them.

Interventions based on multi-agent settings, such as innovation platforms, should make space for farmers to collectively construct their participation in the platform’s activities. Connecting platforms with local communities of practice seems to be a good way to create environment conductive to knowledge co-construction. Turning towards learning communities of farmers as spaces where norms shaping individual behavior are collectively constructed and new narratives can be produced, empowers participating farmers as agents of change in agricultural practice.

Chapter 3. Bringing farmers into the game. Strengthening farmers' role in the innovation process through a simulation game, a case from Tunisia.

Abstract

While farmers are recognized as equally weighing sources of innovation in the AIS framework, their participation in knowledge co-production within multi-stakeholder settings such as innovation platforms is still often limited. Farmers participate more in implementing than in designing innovations or in shaping innovation process. Drawing on the Companion Modelling approach and critical companion posture, we designed a simulation game based method that we tested with dairy farmers in the irrigated scheme in the North West Tunisia with the objective to engage farmers in a research project as equal knowledge producers, support the process of collective construction of improved farm strategies and create conditions for farmers to get empowered to pursue their innovation ambitions. The LAITCONOMIE game, based on the self-design principle, creates conditions for farmers to mobilize their knowledge and knowledge of others to respond to their local innovation needs and to imagine their own innovation system. Despite a modest scale, the game experiment brought results in terms of knowledge co-production and of change in farming practice of the participants.

Keywords: innovation; knowledge co-construction; participation; simulation game; companion modelling; innovation platforms

1. Introduction

The shift from the linear technology transfer model towards systemic approaches to innovation such as now widely used Agricultural Innovation Systems approach (AIS) (Hall 2007, Spielman et al. 2009, Adekunle et al. 2012) theoretically changed the position of farmers in the innovation process – from passive recipients of science-produced technologies to an equally weighting source of knowledge among diverse interacting actors of innovation systems (Hall 2007). How does it look in practice? The most common operationalization of AIS approach are innovation platforms (IPs) (Adekunle and Fatunbi 2012, Ngwenya and Hagmann 2011, Ergano et al. 2010), multi-stakeholder settings orchestrated to generate innovation. Platforms bring together different key actors, related to a particular innovation

process and organize their interaction aimed at production, exchange and use of knowledge. Farmers are typically among these actors. However, despite a new theoretical positioning of farmers in the innovation process and a large body of participatory methods to draw from, it seems that innovation platforms still do not always do well when it comes to integrating farmers as equal participants in knowledge production. Platforms are sometimes misunderstood as dissemination tools (Kabambe et al. 2012; Cullen et al. 2014) while farmers are considered consumers and not producers of knowledge and technologies (Mugittu and Jube 2011). An overview of various case studies (Nederlof et al 2011, Cullen et al 2014) shows that more often than not, farmers are assigned a role to implement, but not to design innovation, and their participation in establishing the platform's agenda is weaker compared to other actors. As in the example coming from Oladele and Wakatsuki (2011) they may participate as testers of innovations, while platform's success is being measured by the number of farmers willing to provide their plots for experiments. Analyses (Dangbegnon et al. 2011) typically emphasize what farmers learned through their participation in platforms and not what platforms learned through farmers' participation. Furthermore, their knowledge and experience may be openly judged by other IP members as less adequate than their own (Cullen et al. 2014). As the actual position of farmers in knowledge production and dissemination (Fløysand and Jakobsen 2011) and in shaping innovation practices and processes (Friederichsen et al. 2013) is object of concern, some authors call to explicitly address power issues in IPs (Swaans et al. 2014, Cullen et al. 2014).

It is clear that platforms may suffer from some of the limitations of participatory approaches. These include using participation to serve external agendas, when it is mechanically incorporated into top-down approaches (Cornwall et al 1994); formatting local knowledge instead of truly taking it into account in the projects, when expert-designed methods determine what can be known and how it can be known (Mohan 2001, Hailey 2001) and disempowering instead of empowering local communities, when they are involved in problem diagnosis but not in constructing solutions (compare Nelson and Wright 1995.). At the same time innovation platforms seem to avoid some of the possible traps of participatory approaches, such as overemphasizing insider/outsider divide, romanticizing local knowledge, underplaying the contribution of external actors or neglecting links to wider processes and institutions (Kesby 2009).

Criticism over how participation is implemented in practice has been voiced since the concept became widely used (Cooke and Kothari 2001), also by its proponents (Guit and Shah 1998). At the core of the criticism are very often questions of power and empowerment, with some authors questioning the very possibility of empowerment through participation arguing that participation itself is a form of power (Cooke and Kothari 2001, Hickey and Mohan 2005). At the same time Kesby (2007) while recognizing participation as a form of power, sees the potential of participatory methods to empower participants by providing them with resources enabling them to make a change in their lives (Kesby 2007). From this

perspective, the objective of participation goes further than to structure group process so that non-experts can actively articulate their knowledge, values and preferences (van Asselt and Rijkens-Klomp 2002). Modification in the distribution of power becomes one of the main objectives of participatory approaches (d'Aquino 2007), with some researchers choose to address the question of power directly in the design of participatory methods (d'Aquino et al 2002a, Barnaud et al 2010). Such approach is used in the type of participatory modeling known as Companion Modeling or ComMod (Antona et al. 2005, Etienne 2011). This perspective on participation, deriving from critical systems theories (Ulrich 1995) sees dialogue and communication as insufficient in multi-stakeholder environments characterized by power asymmetries, as it is the case of innovation platforms, and advocates strategic intervention on the side of less powerful, a posture that Barnaud and van Passen (2013) named *critical companion*.

Within this perspective, we have experimented with the integration of the framework, posture and some methods of Companion Modeling in the activities of an innovation platform at a local level. Through this experiment we investigated the possibility of engaging farmers in a research project as equal knowledge producers. We describe our experience of designing and implementing a tool to mobilize and valorize farmers' knowledge in the context of a research project in an irrigated scheme in Tunisia - a simulation game-based method focused on facilitating a process of collective construction of improved farm strategies. Despite its modest scale, the method brought results not only in terms of learning but also of change in attitude and in farming practice of the participants.

2. Co-constructing knowledge with farmers

Production, exchange and use of knowledge are central to innovation. A lot of research has been done on how farmers learn. Many authors point out the group dimension of farmers' learning, be it inside farmer groups (Darré et al 1989, Darré 1991, Goulet 2013) or in networks composed of farmers and other stakeholders (Chiffoleau 2005, Oreszczyn 2010). It is recognized, that learning through shared experience is particularly effective (Cristóvão et al. 2009) and that learning in a group improves analytical skills (Schad et al. 2011). The idea that farmers learn in groups has been used in set-ups such as farmer field schools (Davis et al 2012, Friis-Hansen and Duveskog 2012) or in the attempts to engineer farmers' communities of practice (Ison et al 2014, Dolinska and d'Aquino 2016). In a typical platform set up, the representatives of farmer groups are often invited to participate, but not groups of farmers.

Other works emphasize the role of dialogue in farmer innovation (Chantre 2011) which is consistent with the idea that informal communication plays an important role in innovation process (Sligo and Massey 2007, Leeuwis and Aarts 2011). Darré (1991) describes how farmers develop and adopt new ways of practicing agriculture through dialogue inside what he calls localized professional groups. It is

inside these groups that arguments to support an idea for change need to be found and defended before any change is implemented.

Experimentation is another dimension of farmers learning (Hocdé and Triomphe 2006, Darnhofer et al 2010) and has been used as part of on-farm research and farmer field schools' activities (Coudel 2009).

Within the perspective of IPs, experimenting doesn't necessary mean learning by doing – it can be replaced with learning by simulating, which according to some authors has advantages over actual practice (Senge 1990, Isaacs and Senge 1992, McCown et al. 2009). Linking theories of experiential learning, simulation and gaming, Ulrich (1997) lists the characteristics of simulation that make it potentially more conductive for innovation development than other methods: an immediate feedback, a possibility to experiment without negative consequences and a learning situation that is abstracted and simplified. He points out that simulation creates an environment in which established perceptions can be challenged easier than in real life (Ulrich 1997). Simulation allows self-reflection and questioning of one's own practice (Martin 2014), exploration of new perspectives (Conjard 2003) and discovery (Axelrod 2003).

Simulation has been used in relation to farming in the field of Decision Support Systems or DSS (Nguyen et al 2007, Matthews et al 2008). In typical DSS scientists build precise hard models to indicate to farmers the best strategies to manage their farms, which is obviously prescriptive and not participatory. DSS has never become widely used by farming advisers (Farrié et al 2014), and has been criticized for not addressing farmers' specific concerns and excluding experiential knowledge (Derner et al. 2012), among other things. A critical self-reflection in the DSS field led some researchers to shift towards using simulators not to design the best practice for farmers but to enable farmer discovery learning (McCown et al 2009), to enhance learning of both farmers and advisers (Duru et al 2012), to make farmers reflect on their strategies while exploring and simulating innovations to their farming systems (Le Gal et al 2013). The group and dialogical dimensions were incorporated and researchers started to use simulation models interactively in a discussion with farmers (Carbery et al. 2002) and in group workshops rather than individually, sometimes in a form of games (Martin 2015, Farrié et al 2014). This allowed some integration of farmers' knowledge into the process, for example to parametrize a game or to fill-in the gaps in the game design by adding new elements (Martin 2015).

These developments can be seen as a step towards modeling with stakeholders (Lynam et al. 2007, Daniell 2008, Renger et al. 2008, Voinov and Bousquet 2010), where one of the main objective and challenges is to incorporate plurality of values, epistemologies and knowledge (Ravera et al 2011). Participatory modeling, next to promoting creativity and innovation, allows integration of analysis and deliberation, makes it possible to explicate tacit knowledge and to investigate both individual behaviors and collective dynamics (Squires and Renn 2011).

Among different types of participatory modeling (Antunes et al. 2006, Voinov and Gaddis 2008, Sandker et al. 2010), Companion Modeling or ComMod (Antona et al. 2005, Etienne 2011) is the one that applies in practice critical companion posture. ComMod is a participatory approach developed in 1990s, used principally in natural resources management. It applies short lived simulation tools (agent based models and role playing games) to deal with interactions among actors and between actors and their environment in complex systems. As it can be used both as method to explore with stakeholders the functioning of their socio-ecological systems and as a decision support tool (Barreteau et al. 2003), its expected outcomes are social learning and/or technological/organizational innovation (Voinov and Bousquet 2010), while the level of participation can go from interactive participation, where participants share diagnostic tools and results to self-organization where participants transform lessons from participatory process into decisions, according to the scale by Pretty (1995).

Among many documented ComMod cases, there are some that apply the self-design modelling principle (d'Aquino et al. 2002a, d'Aquino and Bah 2013), pushing the participation of local stakeholders in the modelling process even further. The self-design principle, that was first used in 1998 in Senegal (d'Aquino and Bah 2013), allows actors to autonomously construct models of their reality (games, computer-based models, geographical information systems) and to propose their own management solutions. Researchers do not build a model incorporating local knowledge, but leave autonomy in constructing the model (in the form of a game) to players who play themselves. As explained by d'Aquino et al (2002b) the rationale behind it is to explore the 'implicit' parts of their reality, and to mobilize their knowledge, with the assumption that they know more about their system than researchers do. It is a bottom-up approach in a sense that first local actors build their own conceptual framework (model) and identify knowledge they find useful, and only then other actors are invited into discussion.

Berthet et al. (2016) in their comparison of participatory methodologies to support situated innovation (including companion modeling) make an interesting parallel between exploitative versus exploratory innovation (the former using existing knowledge to achieve clearly identified objectives for improvement, and the later acting without pre-defining objectives, performance criteria nor required knowledge) and rule-based versus innovative design process (the former with design objectives defined a priori and requiring already available skills and the later in which design objectives and essential knowledge and skills are poorly defined). This suggests that explorative innovation should be supported with tools of which design is not definite. Tools based on self-design principle are a good example – the method is being constructed in the process by the participants. This makes them potentially useful for supporting an innovation process.

We used these insights to design a method to mobilize farmers' knowledge and empower farmers to engage in the innovation process. We were looking for a method that would recreate conditions for farmers' knowledge production, exchange and use: that would have a *group* dimension, a *dialogical*

dimension and *learning by simulating* dimension, and that would be based on a *self-design principle*. In subsequent section we present the method, together with the context and results of its implementation.

3. Materials and methods

Our research was part of a larger project, European and African Union for Food (EAU4Food), which aimed at co-developing and testing with local farmers improved farming practices in irrigated schemes in different parts of Africa. The EAU4Food methodology consisted of organizing at each project site an innovation platform operating at two levels: regional and local. At the local level, where we intervened, the approach was inspired by the concept of Community of Practice (Lave and Wenger 1991). The ambition was to build with farmers and other relevant actors (e.g. extension agents, value chain actors), learning communities around specific locally identified innovation needs. Our objective was support co-creation of one such a learning community with the farmers in irrigated perimeter El Brahmi in the North West Tunisia.

3.1 Project site

The El Brahmi scheme, constructed in 1978, covers 5000 ha, most of which are cultivated by around 500 individual farmers. Main crops are cereals, in rotation with horticultural crops and in part with forage crops or, rarely but increasingly, in monoculture. The original design of the El Brahmi scheme was based on a quadrennial rotation with cereals, forage crops, horticultural crops and sugar beet. It included two milk factories and one sugar plant. Over the years, while Tunisia was undergoing political and economical changes, this system collapsed. The sugar plant and one of the milk factories were closed; the remaining milk factory was privatized. New private actors arrived in the scheme, offering contract farming (mostly tomatoes) and private technical advisors replaced disappearing state extension services. These transformations put farmers in a difficult position between state intervention (fixed price of milk, subsidy for irrigation of forage crops) and uncontrolled private market (milk collection centres offering industrial concentrate feed on credit, contracts on tomato production, marketing of pesticides). Many farmers abandoned or limited dairy farming, the others turned to feeding system heavily relying on industrial feed with consequences on rotations - forage crops less frequently cultivated.

3.2 Our approach – from identification of the topic to game design and testing

Our approach was to first build an understanding of the innovation dynamics in the research area and to identify an innovation need that would be engaging enough for farmers to generate group dynamics. This was firstly done through the general EAU4Food activities (a series of participatory diagnosis

workshops), and then completed by a series of thirty in-depth semi-structured interviews with farmers, representatives of milk, cereal and tomato value chains, state extension agents, private technical advisors, administration and representatives of a local applied agricultural research institute (Dolinska and d'Aquino 2016).

On this basis we chose dairy farming as the topic of our intervention. Additional context information was derived via another thirty in-depth interviews, and via participatory observation. We asked farmers, other actors of milk value chain, extension agents and researchers to share with us their representations of dairy farming main dynamics, their analysis of its problems and their ideas for solutions (for results see Table 3-1 in the Results section). We collected examples of locally introduced innovations. We used this information to design a simulation game LAITCONOMIE with the objective to mobilize farmers' knowledge and innovation capacities and create space where they could formulate their innovation objectives and strategies. The elements that we wanted to include in the design were: group dimension, dialogue and collective argument building between farmers, experimenting solutions through simulation. We decided to use the self-design principle to design our tool to enhance farmer participation in knowledge production, sharing and use.

The first idea for the game and then the prototype were presented and discussed during two sessions of the Simulation Community of Practice (Dionnet et al 2013) in Montpellier and Tunis. Some of the ideas were consulted and validated with a small group of local farmers supportive to our research plan. A Tunisian facilitator was trained to facilitate the game session and an extension agent from the regional Livestock and Pasture Office was invited to participate in the game session as an expert. From the interviews we knew that both parties (farmers and the extension agent who was the main link between them and the extension office) had misconceptions about each other's knowledge, needs and objectives. We wanted to work with farmers who interact outside of the project in order to create an opportunity for the participants to talk about the game after the session. As no formal farmer organization existed in the scheme, we identified informal dialogue groups that had some characteristics of communities of practice. We invited farmers belonging to two such groups from different areas in the scheme to participate in the game workshop.

4. Results

4.1 Phase 1: From problem identification to game design

4.1.1 Focus on dairy farming

Dairy farming was a concern of an array of actors besides dairy farmers themselves (Table 3-1). It was seen as interconnected with other agricultural issues. On the scale of the irrigation scheme, the strategies

of dairy farmers were said to affect on long term soil fertility and as consequence, the production of cereals. For dairy farmers it was a matter of economical survival – they struggled to make their activity profitable. Dairy farming emerged as an area where a lot of local dynamics were concentrated and one where the need for innovation was directly expressed and already acted upon – some innovations in the area of forage crops and their storage, farming techniques, cow feeding and farmers' organization were considered or already tested by local farmers. These few experiences were mostly individual and isolated. Two exceptions were a no-tillage program led by a local applied research institute and a project of creating a dairy farmers' cooperative, led by three farmers with an institutional support at the regional level (Dolinska and d'Aquino 2016).

Diagnosis of dairy farming problems by local actors	
Issue as formulated by local actors	**Actors who formulated the issue**
Suboptimal milk production due to the lack of technical knowledge of farmers	Farmers, extension agents, researchers, milk collectors, a OEP agent
Dependence on the industrial concentrate feed, moving away from forage crops	Some of the farmers, a OEP agent
Insufficient forage surface per cow ratio	A researcher
Lack of farmers' organization resulting in the weak position of farmers in the milk value chain	Farmers, regional administration representatives, OEP agents, a milk collector
Low quality of industrial concentrate feed, produced in the private sector with no quality control over the ingredients	Farmers
Lack of innovation capacity of farmers	Extension agents, researchers
Lack of strategy of farmers, lack of planning	A researcher, a OEP agent

Table 3-1.Problem identification by local actors

4.1.2 "Laitconomie" simulation game

The LAITCONOMIE simulation game revolves around dairy farming. The game includes two of the issues local dairy farmers are currently challenged with, namely:

- Low revenue from dairy farming represented by a monthly invoice from the milk collection centre where the price of concentrate feed is subtracted from the revenue from milk.

- Uncertainty towards the quality (uncontrolled) and the price (depending on the fluctuations of global soya and corn prices) of industrial concentrate feed on which farmers in the scheme depend heavily

The players enact dairy farmers. A milk collection centre is represented by a simple computer program operated by a game facilitator. A dairy farming expert is present to provide specific knowledge if needed. Each player sits at a separate table representing an individual farm and is given a set of cards. There are five categories of cards: land, cows, crops, types of cow feed (including concentrate feed in kilograms) and milk production (in litres).

The objective of the game is described as to farm in the best possible way. At the start of the game the players are assigned a number of cows and a number of 1 ha plots to cultivate. Each round starts with farmers taking decisions about their land use (crops they want to grow on each plot) and the feeding system they want to implement (what do they give to their cows, coming from their farm or purchased outside). They display the cards in front of them accordingly.

When everyone has decided, each player explains his strategy and estimates the volume of milk (per cow) that he could produce. This data is introduced into the computer program. There is no expert model, no relation between feeding system and milk production is provided – farmers base their estimations on their own knowledge and experience. As these estimations are collectively evaluated, farmers need to construct arguments to support them. This is where the expert may intervene to provide his expertise, if farmers invite him to the discussion.

As a next step, players 'sell' their milk to the milk collection centre. The program calculates an amount on the monthly invoice for each player - the cost of purchased concentrate is subtracted from the revenue from milk production. The players are given three additional pieces of information: how big a part of their revenue was spent on the concentrate feed (in percent), what is the surface cultivated with forage crops per cow on their farm and what is their revenue per cow. The price of milk remains fixed and the price of concentrate increases whenever the game facilitator decides. Other costs are deliberately not included to simplify the game. We assumed farmers knew local prices and would take decisions accordingly, or they would be corrected by other players. At the end of each round the results are displayed on a large board, so that players can compare them with those of others and follow everyone's evolution.

After a few rounds, an additional option is introduced: on-farm concentrate feed production (one of the local innovations we identified). The price of self-produced feed is lower comparing to industrial feed. However, to be able to purchase ingredients (that can only be purchased wholesale), one needs a number of cows bigger than that of an individual player. In this way, a farmer who wants to opt for this solution

needs to seek the collaboration of others. In addition, players may opt to purchase an expensive mixing machine (instead of mixing manually) that allows for production of better quality feed.

No instructions are given to farmers about their interactions, or their interactions with the expert. The expert is instructed to intervene only at farmers' request. The game stops when the facilitator decides. A feedback session is organized at the end. Throughout the game session, a translator is present to translate farmers' argumentation and discussions as well as the content of the feedback session.

4.2 Phase 2. The game session

4.2.1 Introducing change

Farmers started by reproducing their current farm strategies and introduced changes throughout the game. First choosing new forage crops, crop associations and crop storage techniques (e.g. corn for silage, alfalfa, ryegrass and *berseem* clover association), then improving technical itinerary and diversifying cow nutrition. They all improved their milk production and reduced costs, mostly due to a turn towards on-farm production of the concentrate feed. Until this option was introduced, the industrial concentrate feed consumption had not significantly lowered. The surface of forage per cow first increased in all farms but then lowered as many farmers opted to expand their herds. The arguments that farmers were giving when justifying their production estimations were becoming more and more detailed and more technical with each round.

Participants introduced new elements to the game: races of cows and quality of industrial feed, both with the consequences on milk production, and soil characteristics with consequences on yields. New rules were introduced by players: purchasing and selling cows and renting land. All players except one created a cooperative and re-arranged the game space by joining their tables together. They started to collectively plan their next steps, introducing discussion time before decisions about strategies were made. One player introduced a whole new activity – meat farming. When it comes to the game's objective, for most players it was to increase the herd, even if it meant lower milk production or lower financial results.

4.2.2 Difficult transition towards new rules of interaction

We had to intervene in the way the expert was constructing his role. At first, he did not follow our instructions, but would spontaneously go in front of the group and start lecturing about technical aspects of dairy farming. After we reminded him that he can provide expertise only when asked by other players, he started to respond only to farmers' open questions or to individual requests, providing information that was needed to develop or defend a farmer's idea. Often armed with pen and paper, a farmer and the

expert were making detailed calculations concerning yields and the impact of nutrition on milk production.

4.2.3 Expanding the boundaries of the game

While farmers explained their strategies, they often used arguments that went further than the scope of the game. For example, they would evoke improved soil fertility as leading to higher income from cereal production, which would in turn secure financing for expanding the herd, or they would speak of increased quantity of manure that would make them save money on fertilizers to be allocated elsewhere. They also explained their preference for buying more animals as a need to secure future educative needs of their children or cover extra costs related to life events such as a wedding.

4.2.4 Feedback session: Players' perception of the game

All participants evaluated the game as easy to play, understandable and representing well their reality and mentioned learning as the main result of the game. The expert saw it as an innovative extension tool, but also as a way to explore the state of farmers' knowledge. He learned what farmers already knew and which information needed to be complemented or provided all together, as well as which extension messages failed. One farmer remarked that the game created an opportunity for researchers to learn what farmers knew about their environment. According to farmers, playing the game improved their understanding of their own situation. But they also saw its potential to improve the understanding of other actors of the value chain. Although the players knew that the game was used for research purposes, they saw it as a tool that they could use themselves. Even if farmers mostly played individually (until they formed a cooperative), they appreciated the opportunity to share their ideas with other farmers and pointed out a collective character of what they constructed in the game. Farmers concluded from the game that collective action is needed to improve their situation.

Farmers' perception of the game	Farmers' quotes
Diagnosis	*When we play the game, we are like a doctor who makes a diagnosis. We understand what our problems really are.*
Boundary object to communicate with other actors	*We could interest the milk collection centres with our problems if we made them play the game.*
Decision support	*You gave us a new tool that we can use to make our farming better*
Enabling collective decision	*Discussing with others always brings new ideas. When we discuss together, we create our own collective rules, our sharia.*
Introspection	*The game extracts what is deep in the farmer.* *When you play, you look [at farming] through the eyes of someone who has all the possibilities, this allows you to understand, to discover, what is really important for you.* *[When you play] you use your imagination, but this imagination comes from the core of what it is to be a farmer.*

Table 3-2. Farmers' perception of the game according to feedback session results and evaluation interviews.

4.3 Phase 3: Back to real life

All the players admitted speaking about the game and its results after the session (inside their dialogue group and with family members). Some of them were willing to discuss again with the participants they first met during the game. Those who had not been in contact with the extension agent before the game, said they could now call him for information or would be informed by him about the activities organized by his institution.

4.3.1 Introducing change

Some of the players admitted to changing their real practice after the game session. One farmer (who during the game turned to meat farming) designed a new system for his farm. He spoke of a change that playing the game provoked in him, making him understand what kind of farmer he wanted to be. After the game, he formulated his 'dream project' that he described to us in detail. He also showed us what steps he has already taken to implement it – rearrangement of the stables and purchase of new cows. He also joined the leaders of the local cooperative project (together with another game player) and spoke of his dedication to the project.

Another farmer (who prior to the game session was described to us as 'underperforming' by his milk collector and by the extension agent), changed his rotation system, introducing more forage and corn for silage, and abandoning contract tomato. He also diminished the quantity of the concentrate feed and planned for purchasing new cows. This was the exact strategy he tested during the game. Before taking

his decision, he consulted the expert who played the game, but also verified his choices with other sources. He claimed that it was the game that convinced him, as he saw that this strategy was working for him. He advised his brother to introduce similar changes. He supported his choice with arguments, referring to soil fertility and cow nutrition rules. He also evoked regaining control over his own farming after abandoning contract tomato.

Another participant decided to re-introduce alfalfa in his rotation (that he rejected before as occupying a plot for too long), referring to the long-term strategy, using soil fertility and impact on milk production arguments and listing advantages in comparison with previously cultivated crops. One player started using an adapted version of the table which the players were requested to fill in during the game, for follow up and planning on his farm. Two of the players explored further the question of on-farm feed production – they looked for information about the price of the mixing machine and for people who tried this solution. They did not take the decision to try it, explaining that they would prefer to do it while in a collective rather than individually.

4.3.2 Participants' suggestions for game improvement

Three months after the game session, players proposed further developments - introduction of new players (a veterinary, an inseminator, a bank), new elements (machines) and new game scenarios (use of antibiotics and control of milk quality). The extension agent proposed to accompany game session with field visits to see some of the solutions tested in the game implemented in real life.

5. Discussion

5.1 Knowledge co-construction and innovation

One of the main goals of our intervention was to create conditions in which farmers would get involved in the innovation process. As our results show, this goal was achieved, both in a virtual environment and in real life. This supports the idea that simulation creates a situation where established perceptions are challenged and learning occurs (Senge 1990; Ulrich 1997; McCown 2002). Judging by all the participants' comments during the debriefing session and individual interviews, LAITCONOMIE acted as an effective learning environment. We could observe clear advantages of learning through shared experience (Cristóvão et al. 2009) and putting in use analytical skills while in a group (Schad et al. 2011). Even though in our case, practice was only simulated, we may argue that the game session allowed for a temporary community of practice to be created (Dolinska et al, forthcoming).

While farmers' learning is a commonly quoted outcome of innovation platforms (or other interventions), what is characteristic for our case is that the participants were authors of their own learning; they

deconstructed and reconstructed their own knowledge (see Paul 2009 on accompaniment),. They were also the ones to evaluate their knowledge and the effects of its use. There was no transfer of expert knowledge inside the game, but knowledge co-construction by farmers and an expert. This changed typical power relations. As for our intervention, we cannot speak of innovation transfer, as we did not transfer any solutions through the game, but we can describe the game workshop in terms of *innovation process transfer* (Le Bellec et al 2012).

The process of knowledge exchange and co-construction was mediated by the game that acted as boundary object (compare Klerkx et al. 2012), with its shared vocabulary represented by cards and computer program (Farrié et al 2015).

The use of simulation game had also an effect of discovery, as previously described by Axelrod (2003) and Barreteau et al (2003). The players of LAITCONOMIE reconstructed and explored their system, and both farmers and expert used the game as a diagnostic tool, identifying individual and collective knowledge gaps, which according to Berthet and colleagues (2016) is an important factor driving innovation. Farmers contributed also to defining the innovation system, by proposing additional actors to be incorporated in the game, and hence potentially in the platform (veterinary, inseminator, bank) or pointing at the need to explore additional scenarios (quality control).

The knowledge produced during the experiment was exactly the knowledge suited for the specific local conditions and for participants to achieve their goals. As Dung (2008) observed in his own research, during a game a 'smart' player may make use of the game to gather knowledge from other players or researchers to support his hypotheses in technology development. The kind of knowledge produced through simulating in interaction with others was described by McCown et al. (2009: 1020) as personal knowledge of a participant that was meaningful to his/her future practice while at the same time shared and 'negotiated' through discussion. The spatial proximity of the participants and the situated character of the process, make it possible to integrate tacit knowledge (Healy and Morgan 2012) and to develop solutions that can be integrated in the local system and provide value, a condition for a finished innovation (Leeuwis and Van den Ban 2004, Aguilar-Gammegos et al 2015).

5.2 Empowerment

In LAITCONOMIE we tried to recreate the collective process of knowledge construction by farmers, by introducing collective evaluation of farmers' estimations of the effects of their strategies on milk production. This encouraged farmers to negotiate how to better do things but also to build their own arguments for why to do them. This can be seen as contributing to regaining agency. According to authors such as Darré (1985) and van der Ploeg (2008) farmers' agency is negatively affected by the

dominant trends in agricultural development - transformations of food systems that have occurred as a result of privatization and globalization that limit the control of farmers over how they farm, leaving them a very narrow margin of initiative, while keeping them dependent on a technical control from a distance, on being told 'what to do'. Part of our results is in line with these observations. Lifting limitations to farmers' agency in the game acted as an incentive for farmers to implement changes, not only to innovate, but to innovate in the direction that made sense for them. Even if we introduced solutions that made sense for us by adding options to the game, it was up to the farmers whether to test them or not when constructing their own projects.

Our objective during the intervention was to leave as much space as possible to farmers. The basic elements of any game: the rules, the objective, the construction of roles (see Dionnet et al 2008) in LAITCONOMIE were constructed by players during the game, which we believe to have an empowering effect. The game objective – to farm better – was open for farmers' interpretation. The activities in which the participants engaged while playing – constructing, analyzing, negotiating and collectively evaluating and validating strategies to achieve their goals – provided them with resources on which to draw in order to transform their farming practice (compare Kesby 2007). Participatory intervention can create space where participants can rehearse for reality and when empowered practice is 'reperformed' beyond the arena of intervention, we can talk of empowerment (Kesby 2007). We can tell that some of the LAITCONOMIE players, used the game as an opportunity to reherse steps to be taken beyond the game session. In transforming lessons from the participatory intervention into decisions, they transformed the process from interactive participation into self-organization (Voinov and Bousquet 2010). Mwaseba et al (2015) make a distinction between instrumentalist and transformative perspective on empowerment. The former focuses on the process and in general is translated into capacity building, while the latter is focused on outcome of empowerment. In that sense, a simulation game acting as a real decision support tool may be an appropriate method if we take a transformative perspective on empowerment.

6. Concluding remarks

Joining the debate about the potential of empowerment through participation (Cooke and Kothari 2001, Kesby 2005, Hickey and Mohan 2005) seems to be particularly interesting in the context of the need to improve farmers' position in innovation platforms. By leaving as many elements open as possible, we create space for participants to decide their own development priorities and, to a certain extent, to imagine their own innovation system (compare Scoones et al. 2008).

The fact that it's the local farmers' knowledge that is principally mobilized by this method makes it particularly interesting in projects that have an ambition to co-construct solutions with local actors. As

there was no need to mobilize technical expertise to design our simulation game, we were free to follow the participants and their choice of the topic, even though there was no dairy farming expert in our team. There was no constraint of having to compromise between our interests and expertise and those of farmers.

The game itself is very simple and requires minimal technical input as well as minimal human, technological and financial resources to be deployed, other than a skillful and open minded facilitator. However, the basic elements around which the game is constructed have to be chosen carefully and with a good understanding of how local actors perceive their system and its dynamics, therefore a preliminary analysis is needed. It is possible to envision including other platform actors in the game.

While we realize that our experiment was very modest in scope and scale, its results suggest that there is a real interest in further exploring the potential of self-design simulation tools in participatory projects in the area of agricultural innovation.

Chapter 4. Engaging farmers in a research project. Lessons learned from implementing the Community of Practice concept in innovation platforms in irrigated schemes in Tunisia, Mozambique and Ethiopia.

Abstract

The role of smallholder farmers in multi-stakeholder innovation platforms and thus in the innovation process that these platforms facilitate remains often limited. The EAU4Food project, aiming at increasing food production in irrigation schemes in Africa through improved farming strategies, used a local level platform design inspired by the community of practice (CoP) concept, which opened space for farmers' interactive learning and enabled their active participation in the innovation process. In this article we present examples of how this approach has been implemented in Ethiopia, Mozambique and Tunisia. We analyze the level of farmers' participation that was achieved at different stages of implementation, namely: deciding how to set up the CoP, identifying innovation needs and conducting and assessing the experiment. Among different strategies deployed by EAU4Food researchers, working with dialogue groups, engaging farmers in data analysis and passing the responsibility for elements of the research process to farmers, proved to be the most effective in strengthening farmers' involvement and sense of ownership. The use of a simulation game to test innovations also showed promising results and should be explored further. The attitude of researchers proved to be an important factor in achieving high level of farmers' engagement in the project.

Keywords: community of practice, innovation platforms, farmers' participation, participatory methods, simulation game

1. Introduction

Over 25 years have passed since Robert Chambers and colleagues published their seminal book "Farmer First: Farmer Innovation and Agricultural Research" (Chambers et al., 1989) which contributed greatly to the recognition of the capacity of farmers to develop their own innovative farming solutions, paving the way for wider participation of farmers in agricultural research. Since then many participatory methods have been developed to actively involve farmers in research and development activities, such as Participatory Rural Appraisal (PRA), which incorporates the knowledge of rural stakeholders into the

process of planning development interventions; Participatory Technology Development (PTD) in which scientists and farmers jointly carry out experimentation to develop technologies appropriate to local conditions and which evolved into Participatory Innovation Development (PID), to include broader understanding of innovation, beyond just technology. Co-production of knowledge with farmers was promoted through group learning set-ups such as Farmer Field Schools (FFS), through different types of farmers' experimentation (Hocdé and Triomphe, 2006) or through a more participatory use of simulation-based Decision Support Systems (DSS) to enhance mutual learning between farmers and researchers (McCown et al., 2009). However, despite the merits of these new approaches, there is still considerable room for improvement when it comes to meaningful farmers' participation in agricultural research.

In innovation studies, farmers are recognized as actors who produce, exchange and use knowledge. Agricultural Innovation Systems (AIS), an increasingly popular framework dealing with agricultural innovation, theoretically gives farmers weight equal to other actors in the innovation process. Still, several authors emphasise farmer's weak position in innovation systems (Ngwenya and Hagman,2011), their lack of control over knowledge production and dissemination (Fløysand and Jakobsen, 2011) and their weak position relative to external actors in shaping innovation practices and processes (Friederichsen et al., 2013). These issues are very relevant to innovation platforms (IPs), multi-stakeholder set-ups which are orchestrated to catalyze innovation (Ergano et al., 2010; Adenkule and Fatunbi, 2012). For example, platforms can be misinterpreted as dissemination tools, with farmers expected to participate in implementing but not designing innovation and playing no part in establishing the platform's agenda, while their knowledge may be regarded as less legitimate then other actors' knowledge (Cullen et al., 2014). Ensuring effective participation of smallholder farmers in IPs, to mobilize their individual and collective capacities and knowledge for innovation, remains a challenge (Spielman et al., 2009).

Mindful of the potential pitfalls of IPs and drawing on previous experiences, concerted efforts to include farmers in initiating innovation processes were made in a trans-disciplinary research project called *European Union and African Union cooperative research to increase Food production in irrigated farming systems in Africa* (EAU4Food), in which the authors of this article participated. EAU4Food was initiated in 2011 to tackle the challenge of food security in five countries of Africa: Tunisia, Ethiopia, South Africa, Mozambique and Mali. The objective of the project was to co-develop, test and implement together with local actors improved farming strategies, to increase food production in irrigated schemes *(*Froebrich et al., *xxx*), which are typically recognized as arenas of important innovation dynamics (Jamin et al., 2011). In each participating country the project established innovation platforms including local research partners, farmers and other key stakeholders. Partly overlapping, these platforms operated at two levels: district (or similar) and local (Froebrich et al, xxx). The platforms at the local level were

named by the project team “Communities of Practice” (CoP), after the concept of Wenger (1999). For the purpose of this paper we will call them Project CoPs (PCoPs). They were thought of as spaces where project researchers, farmers and other local-level actors (for example extension agents, value chain actors) could build a common understanding of problems, and then, drawing on local knowledge and innovations, together propose and test innovative solutions. Ideally, they would act as real communities of practice, generating a pool of knowledge and a set of practices that could be mobilized by local actors in the future.

The concept of community of practice, first used by Lave and Wenger (1991) and then developed by Wenger (1999), describes how people engaged in a similar activity effectively learn through shared practice. CoPs are defined by three criteria: mutual engagement, joint enterprise and shared repertoire of common resources, such as experiences, stories, tools, and ways of addressing recurring problems.

The theoretical underpinnings of the CoP concept are compatible with the AIS approach. First, the positioning of the CoP concept within the learning theory is similar to the positioning of the AIS approach within innovation theory – as opposed to a linear model of transfer. In a CoP, knowledge is an emergent property of social interaction and not a commodity that can be “transferred” (Ison et al., 2014). Learning through a CoP is seen as a process of social construction of knowledge (Morgan, 2011). Second, the relation between knowledge and practice in a CoP makes it possible to mobilize tacit knowledge (Duguid, 2005). This is important in the context of farming, as a lot of local farmers’ knowledge has a tacit character that cannot be captured in discussion (Barnaud, 2008).

Although the majority of CoPs evolve spontaneously, Wenger (1999) does not exclude situations when CoP is created in a response to an outside mandate, providing that the practice is always shaped as a response of the participants to their own conditions and in their own context. There is no condition of minimum duration of interaction for a group to become a CoP – according to Wenger, a community needs to last “long enough for significant learning to take place” (Wenger 1999).

CoPs are promoted as effective tools to support learning in organizations, and while their use in agricultural context is not widespread, their potential to be mobilized as tools in intervention is generally recognized. At the same time, Ison and colleagues (2014) remain sceptical about the possibility to design or engineer CoPs, but they stay open for the possibility of creating conditions for CoPs to emerge.

In this study we analyze how the EAU4Food participatory methodology comprising the CoP concept was implemented in three different study areas: Ethiopia, Mozambique and Tunisia. We compare different strategies used for engaging farmers in knowledge co-production in the innovation platforms of the EAU4Food project. Our purpose is to gain an understanding of if and how, in the context of a research project, we can create conditions for a group of farmers to become a learning community engaged in innovation processes and in this way to increase chances for the project to have lasting

impact. Our study is focused on the process and not on the outcomes and thus may include projects that were not completed in the moment of writing this article.

2. Materials and Methods

We conducted a study of how the project methodology was implemented in Ethiopia, Mozambique and Tunisia. The authors of the article were directly involved in the design of the methodology and/or in its implementation on one of the sites. Our study covers the period from the moment in which farmers entered the process until the experiment phase (that was still on-going in Mozambique when the article was written), and in Ethiopia and Tunisia it includs as well elements of an ex-post evaluation. The entry point was common for each site: the first project workshops. The objective of these workshops was to identify, with farmers, the constraints to agricultural production in their irrigation schemes and to jointly establish a research agenda that would address these constraints, drawing on local knowledge and practices. Innovative solutions were to be subsequently identified, co-designed and tested with farmers. The study follows the evolution of farmers' participation in the project over the period of three years, which had different modalities and followed a different calendar depending on a site.

2.1 Study sites

In Ethiopia, the project was implemented in Gumsalasa irrigation scheme in Tigray region, located in the North of the country. The construction of the irrigation scheme was completed in 1995 and irrigation started in the area for the first time in 1997. The scheme, located in a drought-affected region, depends on flood water collected during the rainy season in an earthen micro dam. The command area, fluctuating year to year, usually covers around a half of 110 ha that are equipped. About 368 smallholder farmers are engaged with irrigation in the scheme. Crops commonly grown in the irrigation season include maize, wheat, barley and vegetables such as onion and tomatoes.

In Mozambique, the project was implemented in the Chókwè irrigation scheme, located in the Mozambican part of Limpopo River Basin, in the Gaza Province. It is irrigated with the water from the Limpopo River. The scheme, built in the 1950s (with extension in 1979), formally comprises a total area of 35,000 ha. Only 28,600 ha are actually equipped and only 10,000 ha are presently being cultivated with rice, maize and horticultural crops. Farmers (12,000), who occupy land in the scheme, are mostly smallholders.

In Tunisia, the project was implemented in El-Brahmi irrigation scheme in the north-west of the country in the Jendouba region. The scheme, constructed in 1978, covers 5000 ha, cultivated by around 500

farmers as well as two private companies, who jointly occupy 600 ha. The scheme is irrigated with the water from the Medjerda River and from a mountain reservoir. Main crops are cereals, horticultural crops and forage crops, and dairy farming is an important activity in the scheme.

2.2 Data collection and analytical framework

In each location we followed the evolution of the project CoP methodology around one type of innovation with one group of farmers (there were several innovations tested in each site): irrigation scheduling in Ethiopia, composting in Mozambique and a virtual test of farmers' innovations in dairy farming in Tunisia (i.e. simulation game). We chose to focus on three processes in the implementation of the methodology that we coupled with three processes defining a CoP in the sense of Wenger (1999) in a following manner:

- setting up PCoPs - mutual engagement
- identifying innovations to work on - negotiating a joint enterprise
- learning through innovation testing - building a shared repertoire of common resources

We completed the framework for each location using qualitative data concerning different stages of the evolution of the PCoP process (Table 4-1). Given our objectives, the data collected was focused on farmers: their participation and role at every stage of the process. We relied on secondary data from project reports, back to office reports, and minutes of meetings from the three locations. This information was complemented with our own participatory observations from different sites, as well as with information that we gathered through interviews with farmers at different stages of the process, depending on location.

SETTING UP A COMMUNITY OF PRACTICE			
	First CoP meeting (describe)	Next CoP meeting (describe)	Next CoP meeting (describe)
What kind of farmers participated?			
How were they selected (selection criteria)?			
How were they invited? (Invitation/open access/…)			
Did the participants know each-other prior to the PCoPs?			
Did the participants have a chance to interact outside of the project?			
Did the participants have a history of collective action?			
Did they have a common discourse on topics discussed in PCoPs?			
IDENTIFYING INNOVATION NEED			
	First stage (describe)	Next stage (describe)	Next stage (describe)
Chosen theme			
Farmers' participation in this choice			
Elements of negotiation between farmers and research team			
Space for discussion between farmers			
Farmers' knowledge mobilized in the process			
LEARNING THROUGH TESTING INNOVATIONS			
	First stage (describe)	Next stage (describe)	Next stage (describe)
Modality			
Farmers' participation			
Farmers input			
Elements of negotiation between farmers and research team			
Space for discussion between farmers			
Tacit knowledge mobilized in practice			

Table 4-1. Data collection framework

We examined the data for cross-case patterns (Yin, 2013). For every stage in three processes, farmers' participation was evaluated using a tool adapted from the work of Pretty (1995) on different types of participation (Table 4-2). There are other tools to describe/assess the level of stakeholders' participation (Arnstein, 1969; Lynam et al, 2007), but we think that the one we chose best describes the articulation between the objective of researchers and type of participation, and makes it possible to clearly describe the role of farmers in the process.

Level of participation	Farmers' role
Self-organization	The lessons from the participatory process are transformed into decisions by farmers themselves
Interactive participation	Farmers participate in joint analysis – new groups may be formed that participate in local decision-making process
Functional participation	Farmers participate by forming groups to meet predetermined objectives related to the project. Such groups are initiated and facilitated by researchers but may become independent over time.
Participation by giving opinions	Researchers listen to farmers' views that may or may not be taken into account in decision-making
Participation by giving information	Farmers provide information to be analysed by researchers
Passive participation	Farmers receive information

Table 4-2. Typology of farmers' participation (adapted from Pretty 1995). The colour code from red to green represents the level of participation from the lowest to the highest.

3. Findings

3.1 Stage 1 – setting up Project CoPs

In our three cases, differences in implementation of the PCoP methodology occurred from the initial stage of the process – inviting farmers to the first project meetings (summarized in Table 4-3). In Ethiopia, the participants of the first PCoP were chosen by the elected committee of the Water Users Association (WUA) among farmers actively participating in water management, to represent different locations of the scheme – upper, middle and lower, left and right banks, as well as different wealth groups, as per the consensus reached between the WUA leaders and the research team. In Mozambique the research team adopted another strategy – three farmers' associations were selected (among many existing in the scheme), representing farmers of different socio-economical and geographical situations. Participation in the meetings (separate for each association) was left open to all the members. On Tunisian site, local WUAs are contested by most of the farmers who do not recognize appointed staff as legitimate and are dissatisfied with their services. Except for the dysfunctional WUAs there are no other farmer associations. The research team partly relied on a local agricultural research institute network to invite individual farmers and partly invited farmers met through a preliminary series of interviews. This resulted in a rather random group of individual farmers, with underrepresentation of smallholders.

The methodology used in all three locations at this stage combined interactive workshops and field visits. The farmers identified and prioritized the main constraints to agricultural production in their schemes. This diagnosis was completed by capturing problems in photographs taken by farmers directly in the field which were then displayed and collectively discussed. The participants "prioritized" problems voting for the most important for them (Tunisia) or most critical for irrigated agriculture

(Mozambique). In Ethiopia the problems were ranked according to the scale of impact that addressing them could have on local population ("how many people would be positively affected by solving a given problem") and evaluated in terms of the possibility of addressing them through research. In Ethiopia and Mozambique farmers were engaged in problem analysis, using a method known as "problem tree" to identify causes and consequences of the main problems. In Tunisia, some elements of analysis were conducted at a later stage, albeit less systematically, during the multi-stakeholder platform meeting when diverse stakeholders worked in thematic groups.

		Ethiopia	**Mozambique**	**Tunisia**
		Irrigation scheduling	**Composting**	**Dairy farming**
1. Setting up a PCoP	Entry point (farmers invited)	Individual farmers for the first rounds, community of neighbours for the innovation test	Farmers associations throughout the process	Individual farmers for the first round and informal dialogue groups of farmers for the innovation test
	Participation in meetings	Individual selection by a third party - selected by members of the WUA committee using criteria agreed with researchers	Self-selection (inside a selected group)	Individual selection by a third party - personal invitation by a researcher/spontaneous invitation by a peer
2. Identifying innovations to work on	Source of tested innovation	Research team, in response to priority issues identified by farmers	Research team, in response to priority issues identified by farmers and after negotiation with farmers	Each farmer individually/research team after a series of interviews
3. Innovation testing	Planning the test	Researchers, with input from farmers and other stakeholders	Researchers/farmers	Each farmer individually
	Elements of negotiations (farmers-researchers)	On whose plot the test will be conducted	Tested innovation, schedule, responsibilities, crops to apply the compost on	None. Farmers were free to introduce any changes.
	Responsibility for conducting the test	Researchers and farmers	Farmers, with support from researchers	Farmers
	Test type	Test on individual plot	Test on a common plot	Virtual test individual/common
	Space for informal dialogue around the test	Neighbourhood of test plot	Association/common plot	Contacts within dialogue group

Table 4-3. Main differences in the implementation of the project methodology in the 3 cases

An attempt was made to identify local innovations in all locations, however in Tunisia, the discussed solutions were mainly theoretical, while in Ethiopia, the focus was on existing practices which would

benefit from, or could be complemented by, the research. After completing the problem analysis with farmers, research teams elaborated research proposals for innovation testing (Ethiopia) and concept notes for future innovation development (Mozambique). In Tunisia, only general themes for research were identified with farmers, but no research proposals were made at this stage.

3.2 Stage 2 – Identifying an innovation to work on

The process of engaging farmers around a joint enterprise was organized differently in the three locations. One of the problems identified by Ethiopian farmers - poor water management at plot level (which farmers related to other priority problems, such as salinity and water logging) – was addressed through a research proposal "Comparative assessment of conventional and simplified practical approaches to irrigation scheduling". The proposal, developed by researchers, was presented to farmers (and other stakeholders) in the second round of meetings, where it was enriched following their comments. Individual farmers who were willing to participate, and whose plots fulfilled the criteria for the test, were recruited. Their role was to provide plots for the experiment and to actively participate in the set-up and follow-up of the experiments, sample and data collection and interpretation of results.

In the case of Mozambique, the final choice of innovation to be tested was made during a participatory workshop organized specially for this purpose. The problem of high production costs prioritized by farmers was tackled in a concept note proposing to work on "decreasing fertilization costs through alternative soil fertility conservation practices". The research team interviewed farmers from three associations (ten per association) about their agrarian practices, perception of fertility and knowledge about soil fertility management and then used the synthesis of these interviews to trigger discussion. One workshop per association was organized on the topic of farmers' perception and practice of seven soil fertility conservation techniques: legume inter-cropping, manure, compost, crop residues, rotations, fallows and use of mineral (inorganic) fertilizers. Farmers were asked to analyze advantages and disadvantages of each practice and the constraints for their adoption, and to express their preference for a practice to be tested. Farmers from one of the associations showed their interest in testing the manure application, while recognizing the difficulty to access the necessary quantity of manure in the irrigation scheme, where animals are not allowed. In response, the research team proposed to instead experiment with compost, combining less quantity of manure with locally available rice residues, which would valorise local organic material and decrease fertilization costs. The proposition was accepted by the president of the association, who led other farmers to participate. Subsequent interviews with project participants revealed that this was the usual mode of functioning inside the association, where the president was a central and powerful figure.

In Tunisia, another attempt to establish a research agenda was made during the second round of project meetings. A thematic meeting on one of the problematic areas proposed and prioritized by farmers - dairy farming (alongside two other meetings on other identified themes) was called. Local research team did not want to make it open to the wider public, instead the researchers, in consultation with local extension agents, invited individual farmers that they considered potentially interested. Participation was very low and most participants were new to the project (i.e. they had not been present in the previous round). The participants suggested two general topics for research – how to increase milk production and how to better plan cow nutrition, but again no specific innovative practice to be tested was proposed, as there were no experts on these topics in the research team.

3.3 Stage 3 – Learning through innovation testing

The process of planning, organizing and conducting innovation tests also had a different course in all three cases. In Ethiopia, farmers and researchers agreed to jointly perform the test activities according to the research plan – farmers participated in taking measurements of the amount of water applied during each irrigation application, in collecting soil samples to measure soil salinity and in taking measurements of the biomass and grain yield at the harvest stage that would be used for measuring Crop Water Productivity at the end of the season. Two irrigation scheduling methods were tested against farmers' own usual practices. At this stage an experiment-specific project CoP was created. On each test plot, the research team organized additional meetings for neighbouring farmers, at the vegetative and at the harvest stage of the test. Farmers observed and commented on the results, exchanging ideas with other farmers, researchers and local extension staff, and giving their own interpretations. The results of the test (along with results of other similarly organized project experiments) were presented during another series of meetings bringing together different experiment-specific PCoPs.

In Mozambique, the test was planned on the common plot of the association. All the elements – the land made available for the test, the scheduling of the test, the crop on which the compost would be applied, the farmers responsible for each test activity – were negotiated between farmers and researchers during a participatory planning workshop. Farmers took full responsibility for regularly turning the compost, measuring its temperature and humidity and reporting the results to the research team. They received necessary training. It was decided that farmers would actively participate in the establishment of the field trial (when compost is applied), in its monitoring and evaluation, and that participatory workshops would be organized with farmers after the completion of each stage of the experiment, until the final participatory evaluation.

In Tunisia, a PhD researcher who was studying the scheme (the first author), and was aware of dairy farmers' interest in finding innovative practices to improve their cow feeding practices and milk

production without increasing the costs, proposed to prepare a virtual test of farmers' ideas in the form of a game. A role playing game called LAITCONOMIE was designed around topics previously chosen by farmers (milk production and cow nutrition) in which participants, playing dairy farmers, aimed to improve milk production whilst simultaneously finding alternatives to the use of an expensive industrial concentrate in their feeding system. The game, designed according to the "self design" principle (d'Aquino et al. 2002, d'Aquino and Bah 2013), evolved around interactions between farmers about their individual practices and the impact of these practices on their milk production. The invited players came from two different informal dialogue groups (understood as a group of farmers who know each-other, work in similar conditions, regularly interact and discuss their practice) that the PhD researcher identified through interviews. An extension agent from the regional office was serving as an expert, providing technical advice when requested by farmers. The farmers were free to introduce their own rules and propose any improvements to their practice they wanted – new crops, new agricultural techniques, changes in the feeding system, new organization of work. They were themselves evaluating and explaining the impact of each new practice on milk production, but these evaluations had to be validated by the group (the other farmers and the local expert, but not the researcher). A simple computer-based tool was calculating farmers' income from the milk collection centre. The ideas developed and virtually tested by farmers included introducing new crops such as alfalfa, introducing a ryegrass and berseem clover association, introducing silage techniques, combining milk and meet farming and forming a cooperative to produce their own concentrate feed, along with many small technical improvements in growing forage crops discussed in details with the peers and the expert.

Different ways in which the participants were involved in practical action are characterised in Table 4-4.

	Experiment with farmers (Ethiopia)	Collective experimentation (Mozambique)	Simulation (Tunisia)
Innovation tested	Two irrigation methods	One composting technique	Different techniques and forms of organization - virtually
Relation farmer/researcher	Alongside researchers	Independently after being trained by researchers	Independently, but process (the game) facilitated by a researcher
Relation farmer/farmer	Individual experiment but observed by other farmers	Collective experiment (task division)	Individual experiments, but discussed with other farmers. One collective experiment(decided by farmers).
Relation to practice	Hands-on and observation	Hands-on and observation	Verbal explanation of techniques and their effects.
Feedback on results	Comparison of effects of experimented practices and usual practice – control group	Results delayed in time. Observation of effects of self-initiated experiment (different crop – faster results)	Immediate – simulation
Responsibility for results	Researchers	Farmers	Farmers (but no real consequences)

Table 4-4. Different characteristics of learning through practice in different strategies

When it comes to building a common repertoire, in Ethiopia, farmers and other local stakeholders participating in tests, proposed that the researchers should produce a "best practices" guide, gathering experiences from different experiments that could become a common reference in the scheme. Farmers interviewed after the irrigation scheduling experiment reported applying measurement techniques that they learned through the process and sharing results with neigbors as well as adapting their irrigation technique in regard to the newly acquired knowledge on the relation between flooding practices and waterlogging, salinity problems and plant stunting. Before, during the experiment phase, participating farmers were explaining research to others. In Mozambique, farmers interviewed at the stage of compost application, were all confident in their capacity to produce compost without external guidance. They also reported that they taught the technique to others, both inside and outside the association, and emphasised that the project built a competent human resource that would be now available to guide compost preparation for the association in the future. There are signs that the group took ownership of the process – farmers contacted the research team before the rainy season, with the suggestions on how to protect the compost heap from the coming rain and before the planned field trial, they conducted a spontaneous experiment applying compost on a garden crop (zucchini). In Tunisia, although the simulation experiment lasted only half a day, in the evaluation interviews all participants reported

learning. Three months after the workshop half of the participants introduced solutions tested during the simulation game on their farms (new crops and crop associations, changes in the cow feeding system in the summer) and one designed and implemented a new production system, combining some of the ideas developed in the game with his own ideas, claiming that participating in the game inspired him to develop and follow his vision.

In all three locations, the participants of the test groups had an opportunity to communicate on daily basis. In all locations, participants admitted in the interviews that they spoke about the project experiences with other participants, but also with other people, for example: family members in Tunisia, people at church or market in Ethiopia, members of other associations in Mozambique.

Table 4-5 present different types of participation that farmers experienced at different stages of the process in the three cases.

	Ethiopia	**Mozambique**	**Tunisia**
First round of meetings – the diagnosis	Interactive participation	Giving opinions	Giving opinions
Definition of research agenda	Giving opinions	Giving opinion	Giving opinion
Identifying innovation to be tested	Interactive participation	Interactive participation	Giving opinion (decision about the game) Self-organization (decisions in the game)
Planning innovation test	Giving opinions	Interactive participation	Self-organization (in the game that was designed by a researcher)
Conducting innovation test	Interactive participation	Interactive participation/ Self-organization	Self-organization (in the game)
Sharing and Interpreting results	Interactive participation	Self-organization (self-initiated test)	Self-organization (in the game)

Table 4-5. Different types of participation at different stages of the process in the 3 locations. The colour code used is the same as in table 4-2 (page 70) and represents the level of participation, with dark green corresponding to the highest level

4. Discussion

4.1 Importance of the context

In the cases that we have presented different elements of the context provide a canvas for building locally adapted strategies to implement project methodology. Whilst the details vary, three common factors can

be identified: local institutional landscape, composition of the research team, and working culture (Table 4-6). While analyzing the local institutional landscape was an important component of the EAU4Food project, more explicit linkages between the results of this analysis (the situation in place) and the participatory research strategy, including design of PCoPs, could have been made. For example, the effort to identify informal dialogue groups in Tunisia could have been made at the initial stages of the project. Moreover, identifying elements belonging to the other two categories – composition of the research team and working culture context - could usefully inform the participatory process if made explicit at an early stage of the project, helping to pinpoint elements that could potentially enable or hamper implementation of participatory methods. Participatory approaches incite as much enthusiasm as scepticism, and some researchers may always feel more conviced by and comfortable with conventional, formal research under controlled conditions (Neef and Neubert 2010). It could be recommended to share from the start and with all the members of the research team expectations and reservations towards participatory research process and to take them into account when adapting research strategy.

Contextual factors	**Elements identified from the case studies**
Local Institutional landscape	actual role of water users associations in research area and their perception by farmers existence of farmers' organizations local networks existence of informal dialogue groups
Composition of the research team	local research team members' preferences regarding work with farmers preferences of workshop facilitators regarding facilitation tools prior knowledge of the research area by the research team access that researchers have to local networks type of expertise available in the research team
Culture and working culture	cultural expectations regarding interactions between farmers and researchers mutual perceptions of farmers and researchers the ideas, experiences and attitudes of external researchers (partners of the project, PhD researchers, interns, etc.)

Table 4-6. Context areas and elements

4.2 Working with existing dialogue groups

Creating a learning community around a jointly negotiated topic is, as Ison and colleagues (2014) suggested, difficult to engineer. Ideally, both should emerge together. In real life, a project team needs to start somewhere. As our results show, starting with identifying a group that already exists and has a

history of dialogue is more promising than trying to engage random individuals around a topic. It is easier when there are formal groups in place that can be assumed to be dialogue groups (as in Mozambique, see Sanchez-Reparaz et al, xxx); otherwise an effort needs to be made to identify informal dialogue groups. Targeting neighbouring farmers is a strategy that may pay off – the farmers work in the proximity of each-other, in similar conditions, facing similar problems. When the spatial organization of the research area makes it difficult, further efforts may be needed to identify dialogue groups. In Tunisia, a number of interviews had to be conducted to identify informal dialogue groups of dairy farmers in the irrigation scheme after working with a random group of individual farmers failed to bring expected results. The strategy to work with existing dialogue groups, rather than with random groups of farmers, is backed up in the literature on learning and innovation among farmers. Darré (Darré et al., 1989; Darré, 1991, 1993) in his extensive body of work emphasized the central role of dialogue in informal localized groups of farmers in shaping and changing their farming practice. Morgan (2011) in his study of farmers converting to organic farming concluded that regular contact in dialogue groups is crucial to engaging in learning communities. Goulet (2013) pointed out that learning in dialogue groups is of key importance especially for farmers practicing new or alternative farming methods. Choosing to work with groups of farmers who have opportunity to communicate outside of the project has the advantage of making use of existing dialogue spaces, where project activities can become a topic of everyday informal conversations, recognized as crucial for innovation (Leeuwis and Aarts 2011).

At the same time, as pointed out by Layadi et al. (2011), it is not easy to take dialogue groups into account in a project, due to their informality. Another possible drawback is that engaging with an existing group means dealing with existing power relations and with the existing group decision-making patterns. These elements can be exploited for the benefit of the project, as it was in Mozambique, but wrong understanding of existing patterns could as well easily hamper the project's success.

4.3 Learning by doing or by simulating

The importance of learning through shared practice is emphasized in many studies (Schad et al., 2011; Cristóvão et al., 2009). In all presented cases, the strategies to create conditions for experiential learning (Kolb, 1984) were different: farmer experiment in Ethiopia, collective experiment in Mozambique and simulation in Tunisia.

Experimentation strategies in both Ethiopia and Mozambique proved to be successful in terms of experiential learning – farmers gained new skills during the project. However, involving farmers in agricultural experiments may also have some disadvantages. First, farmers take a risk engaging their time and resources in experimentation that may not bring expected results (i.e. increased yield). Second, there are time constraints related to the agricultural calendar or irrigation calendar – the timing is not

always compatible with the timing of a participatory process. In Mozambique, the moment when the group agreed to engage in the compost experimentation, was not in line with the farming calendar and the whole process had to be delayed. Both these constraints can be avoided through the use of simulation. As Isaacs and Senge (1992) put it, simulation creates learning environment where time can be slowed down or sped up and the risks of experimentation eliminated. It can also engage farmers' tacit knowledge in similar ways that practice does. The experience from Tunisia shows that simulation can be considered a useful tool in some cases. Here, it allowed participants to identify, share and test their own ideas for innovative practices in a risk-free setting, and to test many different practices in a short time (during one game session), simulating a condensed PCoP.

4.4 Passing the baton to farmers

In the light of our findings, sharing responsibility for the results with farmers is important at different stages of the process. Involving farmers in analysing and not only producing data, seems to be a good strategy for identifying a possible joint enterprise. In Tunisia, where participatory analysis was not conducted, identified topics were perhaps too general to provoke farmers' engagement.

When farmers not only provide but also analyze information, the activity traditionally reserved for researchers, it brings both parties closer to "co-construction" of knowledge and allows to go past the logic of "transfer" (Barnaud, 2008), increasing farmers' ownership of the process. This was evident in the Ethiopia case, where farmers became comfortable enough with the research to explain it to other actors (Ludi and Oates 2015).

Another strategy was to make farmers responsible for the experiment phase. The Mozambican and Tunisian examples show that this strategy can produce a sense of competence and encourage farmers to lead their own experiments outside of the intervention.

While most of the project in all locations was based on interactive participation, the level of participation was generally lower in the phase of establishing research agenda or sometimes planning innovation test. This is in line with previous findings (Nederlof et al 2011, Cullen et al 2014). Through the lenses of CoP theory, this stage is key – it is around common objectives decided at this stage that the learning community is formed – they become the joint enterprise, what brings the community of practice together. It may be more strategic to push farmers' participation at this stage even more.

As for the experiment stage, it was the withdrawal of the researchers that assured further going participation in Mozambique and Tunisia. In Mozambique they were simply absent from the field after ceding the conduct of the experimentation on the farmers, while in Tunisia, the self-design principle used to design a game assumes the leading role of the participants in proposing and testing solutions.

5. Concluding remarks

Although we speak of farmers' participation, it is the readiness of researchers to work in a participatory manner that is crucial to the success of any participatory approach. While the position of a researcher in a linear model of technology transfer is comfortable and familiar, sharing power over the research process with farmers is not. In our project, the local researchers who had little former experience in working in participatory ways had to rethink, at least for the project duration, their role in the innovation process. As our experience suggests, for a research project that has participatory ambitions, the choice of consortium partners, and further, the individuals who will actually implement the project in the field, is key. Individuals' attitudes towards their own role in the research process should be discussed in advance; commitment to participatory principles is vital. This should also be reflected in the way that project's impact is evaluated, as limiting evaluation to measurable scientific output (number of papers, h-index, etc.) does not encourage investment in participatory work.

Another lesson learnt is to take advantage of those elements of the context that can facilitate participatory process implementation, for example, to use existing group dynamics (formal or informal), as this is a factor that can enhance the presence of the project between and beyond the moments of direct intervention, creating more space for learning and engagement of the participants.

Increasing ownership of the project by local actors by involving them early and as much as possible in the process (for example in establishing a joint research agenda) can be suggested as a way to increase chances for a better integration of research results, as they could be considered a commonly developed resource. This can be further strengthened, for example by giving the participants a role not only in generating data, but also in their analysis and interpretation, or by giving them full responsibility for some parts of the experimentation process. It is essential to try to involve farmers as central change agents, driving the process (Froebrich et al, in preparation).

Simulation and gaming can be recommended as one of the participatory research strategies when dealing with innovation. It creates a space to explore and test different solutions that is safe both for the participants and for the researchers.

Chapter 5. General discussion and conclusions

The objective of this thesis was to fuel the discussion on how to better include the points of view of farmers in supporting endogenous innovation processes and to provide rationale and direction for future interventions.

1. Overview of the research process and findings

Our main objective was to identify ways to facilitate endogenous innovation processes, thus it would only be natural to draw from what is already relatively well described in the AIS literature concerning facilitation of innovation – the concept of innovation brokerage (Klerkx and Leeuwis 2009a, 2009b). This concept is built on a set of ideas (reflected in the functions of innovation brokers) about what processes need to be strengthened to facilitate innovation, namely:

- Demand articulation (achieved through problem diagnosis and foresight exercises)
- Network composition (assuring linkages between relevant actors)
- Innovation process management (comprising such elements as for example facilitating alignment between actors from different backgrounds and with differing reference frames, dealing with conflicts or establishing working procedures).

All three elements focus on interaction between all various actors of an innovation system. Through the analysis of local innovation dynamics in our study area we identified additional elements to explore: the importance of peer groups, the question of farmers' agency and the question of power asymmetries among actors. Our focus was set on one group of actors – the farmers.

The focus on farmers, their interaction with their peers, and their situation of power comparing to other actors, may seem not to fit a framework which purposefully moves beyond the farm and the farmer (Scoones et al 2009) and emphasizes the importance of interaction between diverse stakeholders for innovation process (Hall et al. 2004, Spielman et al. 2010). However, besides being dictated by the analysis of the situation in our study area, our focus on farmers has another two dimensions. Firstly, it is a pragmatic choice. Family farming lays at the intersection of issues related to farming (social, economic, environmental and political), and smallholder farmers are recognized as very important actors for food security (de Schutter 2014). What's more, innovation, as defined within the AIS framework (Hall et al. 2004), is something that is in use, and in the domain of farming, farmers remain the ultimate users of innovation. Second dimension is connected to our posture: from a critical systems perspective (Ulrich 2003, Barnaud 2008) and according to the critical companion posture (Barnaud and van Passen

2013), strengthening the position of less powerful stakeholders is a methodological necessity and smallholder farmers are identified as the weakest link in innovation systems (Ngwenya and Hagmann 2011).

To analyze how farmers produce, exchange and use knowledge with their peers, we turned to the works of Darré on localized professional groups of farmers (LPG) (Darré 1985, 1987, 1991) and we explored how a more general concept of communities of practice (CoP) (Lave and Wenger 1991, Wenger 1999) can be used in the context of agriculture. Both concepts are similar in the sense that they describe groups of people who share a concern for something they do. The group members engage in the collective processes of defining the way that their shared activity is practiced, and of learning how to practice it better (innovate). Practice and dialogue about practice are at the center of the process. Through practice and dialogue the members construct what Wenger (1999) calls a shared repertoire of resources, and what Darré (1987, 1991) describes as norms (or standards) of action.

In our study area, the irrigated scheme El Brahmi in North-West Tunisia, the character of interaction between farmers and their peers was an important factor in the success of different innovation projects that we identified (described in Chapter 2). Farmers who belonged to dialogue groups were more empowered to make change in their farming practice, and less susceptible to be blocked by dominating discourses. This made us look at farmers' dialogue groups as spaces where farmers not only learn together, but also collectively (re)construct institutions (understood as rules giving shape to their actions) and discourses (storylines), and where they constitute agency. All three elements are recognized as playing a significant role in innovation process (see for example van Mierlo et al. 2010, and Hounkonnou et al. 2012 for the role of soft institutions; Leeuwis and Aarts 2011, and Pesh 2015 for the role of discourses and storylines; Courvisanos 2007, Klerkx et al 2010, and Vanninen et al. 2015 for the importance of agency). While El Brahmi farmers learned and found sources of innovation in networks composed of diverse actors, it was the processes occurring inside peer groups that were central to increasing their active participation in innovation process. Even if next to individual farmers, a group of diverse and powerful actors was united around an innovation project, the lack of discursive space that farmers could share and use with their peers hampered the innovation process.

Our findings were in line with what Darré (1985) described in connection to LPGs. Darré focuses on the power relation between farmers and other actors when taking decisions about the shape and direction of their activity (farming). He points out that if no space is accorded to dialogue between farmers in the rural development activities on a given territory, farmers tend to lose their agency (their ability to decide a course of change) and become increasingly dependent on technical advice of external actors, a trend observed as well by van der Ploeg (2008). In other words, a way for farmers to actively participate in the innovation process is through negotiating in their local peer groups the shape that their farming would take.

Following this line of thinking we proposed to design a tool to support farmers' innovation process that would aim at increasing farmers' agency, understood as the ability to take intentional action and make a difference over a course of events (Giddens 1984). We opted for a participatory simulation game, that we called LAITCONOMIE. Simulation is recognized to create a good learning environment (Senge 1990, Lynam et al. 2002) where established perceptions can be challenged (Ulrich 1997). Role playing games (simulations with human agents) are known to be very effective in stimulating exchanges among participants and collective construction of solutions (Barreteau et al. 2003, Dumrongrojwatthana 2010). They allow players to gather knowledge of other players to support their hypothesis in technology development (Dung 2008). They can also act as boundary objects, that is entities, more or less tangible, both material and processual, that are shared, but used and interpreted differently by multiple actors. Boundary objects stimulate interaction between actors and help them making connections across boundaries, discovering new meanings, and understanding how introducing new ideas can affect current practices (Madsen and Noe 2012, Klerkx et al 2012). To preserve its transformative learning potential, a boundary object should not create consensus (Madsen and Noe 2012) – negotiation of meaning around a boundary object is central for generating change (Star 2010). Many game experiments set the frame of the game on the basis of a previously designed computerized simulation model (Barreteau and Bousquet 2001). However, to enhance the negotiation of meaning around a boundary object, we decided not to use an expert model as a basis for the game but to invite farmers to shape their own individual models attempting to represent the relation between cow feeding system and milk production in their dairy farming. Through our game, they are led to "unpack" these 'self'-models and to confront and negotiate them with their peers, and with a local expert. Through this collective learning process, the individual models evolve into a shared model, which is strategically used by farmers to achieve the objectives that they themselves defined during the game. As we set the objective of the game as "to farm better", each player needs to decide what it means for him: to earn more money, to produce more milk, to expand herd, to decrease uncertainty, etc. The objectives are reflected in the decisions that players take during the game, as they have to think of strategies that would lead them where they want to go. The decision to start from farmers' models instead of an expert model had another advantage: it made it possible to mobilize farmers' own knowledge (including tacit knowledge) in the learning process and in designing innovative solutions, but without isolating it from people's practice (as it was intuitively mobilized in the game simulating their everyday activity) and without attempting to transfer it. This is important as the so called "local" knowledge gains its vitality from being deeply implicated in people's lives (Agrawal 1995).

To stimulate the process of construction of rules by farmers, we opted for a game in which, all the constitutive elements of the game – roles, rules and objective – are left open and are co-constructed by farmers while they play. This approach is directly inspired by the self-design modeling process (d'Aquino et al. 2002, d'Aquino and Bah 2013), which privileges autonomous design of decision-

support tools (in our case, the game) and of management solutions by local stakeholders. Following the self-design principle the game should be developed according to local people's perspective, with expert advice at their disposal and under their direct control (d'Aquino 2007).

The simulation brought into play, and thus helped to identify, the processes important to stimulate innovation in our research area: sharing knowledge between farmers, changing rules of interaction between farmers and state extension service towards more partnership, changing interaction between farmers towards collective action, changing the relation of farmers to private sector towards more independence. The game session brought results in terms of learning (as it was designed as a learning process): while constructing, verbalizing, and negotiating their strategies, farmers refined their ideas and learned new things about cow feeding, forage crops (growing and storage techniques) and farm management. It also brought results in terms of changing farming practices of some of the players: after we left the study area, some of the farmers followed up with developing new strategies and applying them on their farms. While we are careful about these results, being aware of a small scale of our experiment, we can see that our methodological choices contributed to tangible results.

2. Research intervention as "accompagnement"

The review of our research process shows it is consistent with the concept of *accompagnement* (fr.), as described in Chapter 1 (Antona et al 2005). In the context of innovation, adopting the rules of *accompagnement* means that we do not transfer innovation, but support the emergence of the innovation process in place. Both the objective of the process and the way to reach that objective were co-defined over the course of action with the farmers. We began our research journey with identifying the thematic areas where local farmers were seeking to innovate, and, through the self-design game, we made them construct their own innovation strategies without bringing in external technical expertise.

By using this concept to design our intervention, we followed a long tradition in the participatory development studies to reach back to education theories. Suffice it to mention the works of Paulo Freire (1970), which stay an important reference for many authors working on action research, participation and empowerment (Chambers 1994, Neef and Neubert 2011, Faure et al. 2014).

We compared our research approach with more standard methods of working with farmers on innovation, such as farmers' experiments (both individual and collective) used in the same research project in other study sites (Chapter 4). The strategy to support endogenous innovation process rather than proposing technical solutions was no less effective in terms of stimulating learning and generating improved farming practices of the participants. Next to that, it had the advantage of creating space for farmers to collectively build their own strategies instead of taking ownership of expert strategies, as it

was the case on the other study sites. Using the self-design principle to design methods to empower participants seems promising.

3. Theoretical contribution: final thoughts on farmers' position in AIS framework

3.1 Farmers as agents in innovation systems

We see a certain paradox in the position of farmers within the AIS framework. On the one hand, theoretically farmers are recognized as a source of innovation at the same level as other actors of innovation systems (Hall 2007). This improves farmers' position comparing to technology transfer model (Leeuwis and Aarts 2011). On the other hand, AIS framework introduces new actors, such as private sector actors, typically more powerful than farmers and with potentially conflicting interests. As the AIS framework is by no means "farmer first", the question how to strengthen the position of farmers through intervention is not much explored in the AIS literature, except for some suggestions to facilitate collective action as means of empowering farmers in the innovation systems (Hellin 2012) or as means of triggering change in interactions between different actors of the system towards improving the farmers' position (Ngwenya and Hagman 2012). The idea that we would like to submit for discussion is that the support for farmers in innovation processes must go through improving their agency – their participation in deciding how things are done and what direction farming should take. This is why we draw from the not so recent works of Darré (1985, 1987) and revisit his idea to focus on the collective process of negotiating local ways of farming. By doing this, we do hope to have added to the existing pool of reflection on improving the position of farmers within innovation systems.

3.2 Going with farmers beyond the farm level

The rationale behind the AIS framework, behind moving "beyond the farm and the farmer" and involving other actors, representing interrelated issues – economical, environmental, social – is to approach agriculture in a systemic way; to tackle its complex problems by bringing in other types of knowledge and broadening the view. In practice, as Hounkonnou et al (2012) put it, in multi-level innovation platforms the work with smallholders and other local actors ensures that the work at the higher levels focuses on and is informed by data on smallholder issues. Thus, what farmers are expected to contribute is still no more than the knowledge of the farm. Their influence on the platforms' agenda is weak (Cullen et al. 2014). Such a situation is not new for the participation scholars. A parallel can be made between the position of farmers in IPs and what Berger (2014) observed about the position of inhabitants in participatory urban development projects. He points out that lay citizens are often

perceived as incapable of formulating general reflection, going beyond the problems of their street and considered not legitimate to hold the kind of discourse that is reserved for experts. For example, the opening discourse that sets direction for the participatory process, defines the objectives and frames future actions is never delivered by participants. Citizens are invited to participate in discussions, but the topic, the objectives and the rules of discussion are set by the participation experts. We hope to contribute to the systemic reflection on agricultural innovation with the idea that applying the principles of *accompagnement* and self-design to the research process makes it possible to go beyond the farm *with farmers*, allowing them to collectively and autonomously sketch the innovation systems that make sense to them and to frame the innovation process through formulating objectives and ways of proceeding.

4. Methodological contribution: participatory methods towards empowerment for innovation

Our work in Tunisia had two dimensions – analysis and participatory intervention. Our analysis was focused on processes inside local systems of knowledge production, exchange and use. Innovation systems are often analyzed and described from a structural (static) point of view, while process view (dynamic) is less represented in the literature and the question of individual agency less explored (Klerkx et al. 2012). We made farmers central to our analysis. We put forward the question of quality of their interactions with peers and other actors of the system, their participation in production of discourses and their agency. The results fueled the design of our participatory intervention tool.

When choosing a participatory simulation game, our objective was not only to simulate farming practices – many simulators of this kind exist and are used as DSS tools (McCown et al 2009, Le Gal et al. 2013). We designed a tool that would encourage farmers to simulate processes similar to those occurring in communities of practice (Lave and Wenger 1991): engaging around a shared practice, defining a joint enterprise and most of all, to build a shared repertoire of common resources, such as experiences, tools, and ways of addressing problems (Wenger 1999). In order to play our game, farmers had to make (or to collectively learn to make) strategic choices – some authors define empowerment as just that: a process through which people gain ability to make strategic (as opposed to everyday) choices (Kabeer 1999, Kesby 2005). In the game players have agency that makes it possible for them to make change in the way they practice their profession. It can be said that LAITCONOMIE provides space to rehearse empowerment (compare Kesby 2005).

A self-design game also provides space for farmers to go beyond the farm level. At the first glance it may seem that a game where players play themselves (d'Aquino et al. 2002, 2003), limits their input on general issues and does not allow to go beyond particular individual situations. It is, however, not the

case. What a self-design game brings into light, are the rules behind the players' actions, and the meanings that the players attribute to their activity. What it mobilizes is local knowledge, including tacit knowledge. In our case, through adding elements to the game and suggesting improvements in the debriefing (new players, new objects, new rules, new scenarios), farmers expanded the universe of the game (starting from the level of their own farms), (re)constructing an innovation system that made sense for them.

A very important characteristic of the tool that we developed is the special role given to verbalization. Although the game has visual supports (cards, table with results), talking to other players is more important than manipulating supports (which happens mainly at the stage of individual decision-making). Unlike in typical games, there is no common game board representing a common territory. The space that players share is discursive space. This makes sense for innovation development – discursive space is where the sphere of thinking meets the sphere of doing. As Leeuwis and Aarts (2011) put it, it is the altering of discursive space that provokes the emergence of meaningful innovation. In our game, individual strategies and their results have to be verbalized, to be shared. Players (co)produce and negotiate discourses and storylines. In her work on *accompagnement*, Paul (2009) talks about the importance of embedding the process of explaining, verbalizing and formalizing knowledge (including tacit knowledge) in a collective process. Lafortune (2006) explains that verbalization means sharing with others the description and analysis of one's practice and of one's reflection process. Through listening to others and sharing experiences and observation, participants position themselves and develop a critical view towards their own actions. Astier (2004) argues that verbalization makes it possible to re-mobilize, in future practice, tacit knowledge that has been mobilized in past actions. This is the process that we attempted to reconstruct between the rounds of LAITCONOMIE. The focus on speech goes against an increasingly strong trend in participatory methods to privilege other forms of participants' expression, that include role playing games, among other methods (Bonnacorsi and Nonjon 2012). However, while through inviting various forms of expression the field of participation gets expanded, Berger points out that replacing deliberation by other tools bears a risk of silencing the participants' arguments (Berger 2014). In LAITCONOMIE, we combine two approaches to participatory methods – we give deliberation a privileged role inside a simulation game.

This said, the main methodological contribution is not to increase the participation of farmers' points of view in the process of innovation development, but to invite farmers' points of view into the process of *supporting* innovation development, where farmers become authors of their own learning, co-constructing the framework, and the environment in which this learning can take place.

5. Practical application of results

As this thesis work was part of a larger intervention in an innovation platform-based project, the initial idea was to inscribe the approach into a multi-level approach. However, the project in Tunisia encountered constraints that very much limited the platform's activities, which made the realization of this research plan impossible. Our final strategy was to involve a representative of regional animal farming extension office in the local level activity (in the game session) and to create conditions for knowledge co-construction between the two levels.

Nevertheless, the experience that we had with LAITCONOMIE, allows us to make suggestions for further application of the method. Ideally, in the context of an innovation platform, a self-design game could act as a powerful tool to increase farmers' participation in an innovation platform (and thus in an innovation process), if used at the initial phase of the project. It would assure substantial contribution of farmers in establishing the platform's agenda as well as in setting its limits. Two processes occurring during the game could inform the composition of the platform: adding new actors to the game, whom farmers judge necessary to develop their innovation ideas, and identifying knowledge gaps and needs for external expertise. How players define the objective of the game, a process similar to defining joint enterprise in a community of practice, could be taken into account in defining the platform agenda. Instead of having individual farmers (or farmer representatives) providing input for other actors to make an analysis of local needs, we would get a position (or positions) constructed and formulated by farmers themselves through a collective, deliberative and informed process. The phase of debriefing after the game could fuel additional elements in terms of potential blockages or further demand articulation.

The idea that different types of knowledge (or different combinations of knowledge) create different innovation systems, with different values, directions and politics, is not yet well explored, but nevertheless present in the academic reflection on innovation (Scoones et al 2009). Prasad (2007) provides an example of how different sources (science and civil society, in the case that he describes) generate different innovation systems around rice production. Recognizing this idea provides an alternative for trying to incorporate diverse types of knowledge into an innovation system. In our case, an innovation platform and agenda based on the game session results would have been different than the innovation platform and agenda defined by the research project of which our activities were a part. The interest for the method that we propose comes from the fact that when playing the game, farmers model an innovation system that makes the most sense to them, and thus an innovation system that could potentially successfully generate innovative farming practices.

6. Directions for further research

What would be interesting to explore further is to what extent the type of intervention that we propose could affect power relations surrounding the construction of innovation platforms or other multi-stakeholder settings orchestrated to produce innovation. An innovation platform, just as any other space of participation, is never neutral, but constructed as a means of control (Lefebvre 1991/1974) and shaped by power relations (Cornwall 2002). What would be, if any, the consequences of increasing farmers' active participation in shaping these spaces for their agency in the long term and for their further interactions with other involved actors? What mechanisms would have to be set in motion for the simulated communities of practice to evolve into more sustained structures, or for farmers to follow up with collective action? Are some contexts more conductive for this type of intervention than others? Is this approach suitable for any type of innovation? Addressing these questions would entail further experiments in various contexts and involving various types of innovation.

6.1 Further potential contributions from other disciplines

To increase understanding of what precisely is happening inside a game when farmers are developing and testing solutions, theoretical input from design science could be suggested. The process of developing new solutions can be conceptualized as a design process, with the participants as innovation designers. And, thus, design literature could provide insights concerning different dimensions of the game. Works on the role of self-reflection in design (Cross 2007) to look at each player's trajectory, works on sketching (Do and Gross 1996) to investigate the process of testing and improving solutions between the rounds of the game, works on community of practice surrounding the designer (Cennamo et al 2010) to tackle the collective aspect of the game, works on verbalization of design process and narrative approach (Logan 2008, Morton and O'Brien 2006) to further research the role of verbalization in the game , and the works on peer critique (Gray 2013) to investigate the role of negotiation and validation process at the end of every round. Design science has already been successfully used in the context of agricultural innovation by Berthet et al. (2016), who propose a reflexive framework to analyze participatory design methods for agroecological innovation and apply the framework to compare three methods used with agricultural systems stakeholders.

7. Final remarks

Despite their well known and well described shortcomings, participatory approaches still have a potential of becoming a resource that the participants could use to introduce real change in their practice. In this thesis we investigated ways to proceed in order to create conditions in which the participants

could and would use this resource. For us, it meant to make the participants co-define the participatory tool itself as well as its purpose. All the elements and options that we did provide in the game were locally developed, and the expertise that we put at the disposal of farmers during the game was locally available. Following the concept of *accompagnement*, we assisted farmers in constructing their objectives and the ways to reach them. We were happy to observe that some of them decided to implement actions that they co-constructed and simulated during the game, on their actual farms. Did we teach them anything? No. We created a space in which they could find their own ideas, verbalize them, construct arguments to support them, confront and negotiate them with their peers, develop them further using new (locally available) knowledge and perform actions of their own, choosing in the safe environment of simulation. Farmers could also reflect on which other actors they would need in order to put some of these ideas into practice, imagining their own innovation system. This way of facilitating innovation process, we believe, is drawing upon the empowering potential of participatory approaches.

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Annexes

Annex 1. EAU4Food project report: Preliminary findings and ideas for the WP3 in Tunisia

El Brahmi irrigartion scheme

Characteristics of local innovation system: knowledge exchange, learning and collective action

Vertical knowledge exchange

The state extension services have very limited resources and their presence in the field and their recognition among local farmers is minimal.

The private sector is actively present (companies selling pesticides and fertilizers, tomato industry, re-emerging sugar beet industry) providing extension services. The engineers and technicians working for these companies are often the main (if not the only) source of information and innovation for the local farmers. Some of these engineers earned the big trust and respect of the local farmers. They themselves

admit getting inspiration and learning from the exchanges with farmers. The private companies are also a potentially reach source of data for the research.

The INGC is very active in the area, providing an important source of information and innovation. It also has intermediary function between private sector and farmers (they organize presentations of new products or distribute invitations to the presentations of new equipment). However, it is reaching only a limited circle of bigger and better educated farmers. Small farmers are not connected to this network.

Some of the farmers admit to use information of their farm workers whose experience and expertise they highly value. These are the farmers that can be generally characterized as innovative.

Many farmers express doubts about the vertical exchange channels, describing researchers and engineers as "office researchers" and their knowledge as "theoretical" and of little practical use. They claim that farmers often know more than engineers and value rather the practical experience than theoretical knowledge.

Horizontal knowledge exchange

The horizontal knowledge exchange between small farmers is very weak. The only space where farmers can communicate in groups are the two cafes in the perimeter. This communication is often limited to exchanging problems rather than exchanging solutions. A predominating attitude can be described as "everyone has their own ideas" or "everyone works for themselves". The neighborhood relations do not seem to play a significant role in the knowledge exchange.

Even though we identified farmers that are more innovating than others, some of them leading self-initiated experiments on their parcels, these cases remain isolated. There is no farmer-to-farmer exchange that would follow.

We identified farmers who are leaders in terms of the choice of the new cereal varieties. These farmers who are willing to take a risk of testing new varieties are later followed by others.

We identified an existing community of practice – a small group of around ten dairy cattle breeders, all of them with technical background, who meet on a regular basis to share experiences and discuss about the challenges of their profession.

The members of a newly (10 months ago) formed farmer's union (also mostly agricultural technicians) are another group who meets on a regular basis to discuss topics such as organization of commodity value chains, market access and new challenges that the farmers are facing.

Collective action

There is very little evidence of collective action among farmers, however we were able to find single examples of cooperation between farmers to collectively purchase inputs and collectively sell products. These are to be verified.

Some collaboration is initiated by necessity: the farmers who share a single valve have to collaborate to divide and execute water payments. Another example are farmers who filed a joint complaint against a tomato processing plant after they have been provided with bad tomato seeds.

Farmers strategies and innovative solutions

Innovative solutions around the dairy cattle breeding

An innovation that is being successfully tested in the perimeter is no-till farming technique. The tests are conducted under the lead of the INGC. The main obstacle to the uptake of this technique is the cost of the no-tillage seeder but the INGC is currently working on a prototype of a locally manufactured low-cost seeder. The farmers interested are mainly the dairy cattle breeders (no-till forage), but some of them use this technique also on cereals. There seem to be examples of local adaptation of the technique in one neighborhood, but it is to be further investigated what is the relation with the INGC program and whether farmers develop this collectively or individually.

Growing cost of the concentrate for dairy cattle (connected to the price of soya on the world market) gives incentive to look for innovative solutions. Local dairy cattle breeders started to introduce new cultures, mainly corn, for silage. We also found an example of an in-farm concentrate production, a cost-effective solution that was introduced on one of the big commercial farms in the perimeter.

Farmers strategies to improve soil quality

Many farmers in the perimeter decide to rent a part of their land for tenants who can introduce a crop that they themselves cannot afford to cultivate and that can improve the quality of soil (mainly the tomato for industrial use), installing a kind of shared-rotation system.

Despite the negative cost/benefit rate of the sugar beet production for farmers, the sugar factory signed contracts on 800 ha of sugar beet in the perimeter. Possibly, farmers opt for this crop to improve soil quality.

Farmers strategies to sell their products

Contracts with the industry. Many farmers opt for contracts with the (mainly private) industry: tomato processing plants, sugar plant, potato seed multiplication. The end of the state monopole on cereals opened the door for the private contracts on cereal production (by a pasta producer, for example). The contracts with industry differ in the level of assistance provided and farmer's own input (from the full service contracts when the company provides the necessary inputs and the technical follow up and

assures purchase to different kinds of forward contracts) but always contain incentives for farmers, and in the farmers' own words "assure security".

Vente sur pied. A number of farmers decide to opt for the *vente sur pied* (mainly for onion, potato and tomato) as it solves the problem of the workforce shortage and market access and can be economically beneficial.

Timing. Some farmers use their skills to aim for harvest in the optimal moment when they know they would be able to sell their products for a better price (before or after the peak of production of a given crop in the perimeter). They use information on other actors behavior to pick the optimal timing.

Local innovation we would like to support

During the EAU4Food workshops in June the organization of farmers was chosen as one of the priority topics that needed to be addressed to improve the production in the perimeter. We identified an emerging project of collective action in el Brahmi initiated by a small group of farmers interested in creating a (dairy)farmers' cooperative. This innovation emerges around a group of dairy cattle breeders. These farmers have already taken some steps: they contacted the research (INGC) and the administration (CRDA in Jendouba) looking for support, a preliminary budget study was made with the assistance of the CRDA, they organized some information meetings and collected names of farmers potentially interested to join. They struggle to start the process with the farmers, to mobilize them, to build awareness, to overcome their doubts and fears towards collective action. They are asking for facilitation of the process.

This is an organizational innovation that aims at creating space for further innovations in terms of farming techniques (creating a space for knowledge exchange and learning, facilitating cooperation with research actors, facilitating access to equipment, connecting small farmers to existing networks and creating new networks) and market access (reorganizing dairy supply chain).

Examples of locally innovative practices in dairy farming exist, but are mostly individual and isolated. We would like to design and implement a tool that would make it possible for dairy farmers to share these ideas with others and to possibly test them (in simulation environment), as well as to test collective action solutions.

Annex 2. Grille d'entretien – agriculteurs

HISTORIQUE DE CHANGEMENT
Depuis combien de temps vous travaillez sur cette exploitation ?
Est-ce que vous avez introduit des changements depuis ?
Pourquoi ?
D'où vous avez eu cette idée ?
Comment vous avez su/appris à faire ça ?
Est-ce que ça a marché pour vous ? Pourquoi ?
Est-ce que vous connaissez d'autres personnes qui ont fait la même chose ? Qui ?
Vous en avez parlé ? Avant/après ?

<table>
<tr><th colspan="3">ETAT PRESENT</th></tr>
<tr><td colspan="3">SI PROBLEME SIGNALE</td></tr>
<tr><td colspan="3">ETAT DE CONNAISSANCE SUR LE PROBLEME / EXPERTISE</td></tr>
<tr><td colspan="3">Comment ça marche ? Pourquoi ça se passe comme ça ?</td></tr>
<tr><td colspan="3">Comment on peut prévenir ce problème ?</td></tr>
<tr><td colspan="3">Quelle est la meilleure solution possible ?</td></tr>
<tr><td colspan="3">Qui est responsible ?</td></tr>
<tr><td colspan="3">SOURCE D'EXPERTISE</td></tr>
<tr><td colspan="3">Comment vous le savez ? Comment vous l'avez appris ?</td></tr>
<tr><td colspan="3">Qui d'autre s'y connait ?</td></tr>
<tr><td colspan="3">ACCES A L'INFORMATION</td></tr>
<tr><td colspan="3">Est-ce que vous avez toutes les informations nécessaires pour essayer de trouver une solution à ce problème ?</td></tr>
<tr><td colspan="2">(oui) Quelles sources d'information avez-vous utilisé ?</td><td>(non) Où on peut trouver les informations nécessaires ?</td></tr>
<tr><td colspan="2" rowspan="2">Quelle source d'information était la plus utile ?</td><td>Pouvez-vous accéder à ces informations ?</td></tr>
<tr><td>(non) Est-ce qu'il y a quelqu'un d'autre qui peut ?</td></tr>
<tr><td colspan="2">Avez-vous partagé cette information avec quelqu'un ?</td><td>Pouvez-vous demander à cette personne de chercher l'information pour vous ?</td></tr>
<tr><td>(oui) Dans quelles circonstances ?</td><td>(non) Pourquoi ?</td><td>(non) Pourquoi ?</td></tr>
<tr><td colspan="3">CONNECTIVITE /COMMUNICATION</td></tr>
<tr><td colspan="3">Est-ce que vous êtes seul à avoir ce problème ?</td></tr>
<tr><td colspan="3">(oui) Avez-vous parlé de ça avec eux ?</td></tr>
</table>

(oui) A quelle occasion ?		**(non)** Pourquoi ?
Qu'est-ce qu'ils font pour trouver la solution?		
Savez-vous s'ils ont parlé avec les autres ?		
MOBILISATION DES RESEAUX		
Avez-vous fait venir quelqu'un dans votre exploitation pour diagnostiquer le problème ? Pourquoi ? Est-ce que quelqu'un a intervenu pour vous aider à résoudre ce problème ?		
(oui) Qui ?		**(non)**
Comment vous l'avez fait venir ?		Qui est-ce que vous pouvez informer ?
		Qui est-ce que vous pouvez faire venir ?
Comment il a intervenu ?		Comment il pourrait intervenir ?
Etes-vous content de cette intervention ?		**(pas de réponse)** Est-ce qu'il y a quelque chose qui pourrait vous aider à résoudre ce problème ?
Est-ce qu'il y a quelque chose d'autre qui pourrait vous aider à résoudre ce problème ?		
CONFLIT D'INTERET POTENTIEL		
Est-ce qu'il y a quelqu'un à qui cette situation (de problème) convient ?		
Y a-t-il des solutions possibles mais inaccessibles ou incompatibles avec votre pratique ?		
LA REPONSE		
Jusqu'à maintenant qu'est-ce que vous avez fait pour améliorer la situation?		
Quel est l'effet ?		
Est-ce que l'effet est comme vous l'avez souhaité ?		
(oui) Est-ce qu'il y a quelqu'un à qui cette solution ne convient pas ?		**(non)** Pourquoi ?
COMMUNICATION		
Avez-vous partagé ce résultat avec quelqu'un ?		Avez-vous demandé le conseil de quelqu'un ?
Quel sera votre prochain pas ?		
EVALUATION		
Votre solution est-elle optimale ?		
(Oui) Connaissez-vous quelqu'un qui a trouvé une autre solution au même problème ?	**(Non)** Quelle serait la meilleure solution ?	
(Oui) Qui ? Laquelle ?	**(Je ne sais pas)** Qui peut connaitre la réponse à cette question ?	**(Donne une solution)** Pourquoi il n'est pas possible de l'introduire ?/ Qu'est-ce qu'il faudra faire pour l'introduire?
Pourquoi vous n'avez pas introduit cette solution chez vous ?		Connaissez-vous quelqu'un qui a trouvé une autre solution au même problème ?
POTENTIEL DE L'ACTION COLLECTIVE		
Est-ce que vous avez besoin de l'aide ou support des autres acteurs ?		

<table>
<tr><td colspan="2">Est-ce que agir ensemble avec les autres pourrait vous aider à le résoudre ?</td></tr>
<tr><td>(oui) Lesquels ?</td><td rowspan="4">(non) Demander explication</td></tr>
<tr><td>Qu’est-ce qu’ils pourraient faire pour vous ?</td></tr>
<tr><td>Etes-vous dans la mesure de les mobiliser ?</td></tr>
<tr><td>(non) Si vous agissez ensemble avec les autres seriez vous dans la mesure de mobiliser ces acteurs ?</td></tr>
</table>

Annex 3. EAU4Food project report. Overview of the activities on site (El Brahmi). Ola Dolinska, Lisode.

Objective	Activity	number	Participating <u>farmers</u> from El Brahmi
Period I (September/October 2012)			
<u>Objectives:</u> • Analyzing how knowledge is produced, shared and used • Identifying local innovation dynamics	Individual interviews	31	22
Period II (March-June 2013)			
<u>Objectives:</u> • Collecting information on the topics of ***dairy farming*** and ***dairy farmers' organization*** • Collecting data to design a simulation game on innovation in dairy farming	Individual and group interviews (formal)	36	24
	Informal exchanges and meetings	45	11
*Activities around the innovation theme "**farmers' organization**"* <u>Objective:</u> • to accompany farmers' project of creating a local dairy farmers' cooperative	Support to a farmer leader in organizing a meeting on the topic of dairy farmers' cooperative	1	1+9
	Accompanying a farmers' representative (by farmers' invitation) in a meeting organized by CRDA on the topic of farmers' cooperative	1	1 (+ farmers from other areas)
	Organizing and facilitating a meeting with a committee of farmers interested in creating a farmers' cooperative	1	4
*Activities around the innovation theme "**dairy farming**"* <u>Objective:</u> • to accompany farmers' innovation in dairy farming	Test of a simulation game with INRGREF researchers	1	0
	Implementation of a simulation game with dairy farmers	1	7
Period III (September 2013)			
<u>Objective:</u> • evaluation of the impact of the simulation game after three months	Individual interviews	7	6

Annexe 4. Le jeu “Laitconomie” - les changements dans la démarche face au terrain

Le groupe visé

La première mission de terrain a permis d’identifier un groupe de travail potentiel – les éleveurs réunis autour du projet de la création d’une société mutuelle de services agricoles (une coopérative). Le groupe, formé autours de trois leadeurs du projet, comportait une vingtaine de personnes qui ont toutes signé le document du projet préparé par un membre de l’administration. Travailler avec les agriculteurs réunis autour d’un projet commun, restant déjà dans une dynamique collective, semblait un bon choix. Cependant pendant cinq mois la situation sur le terrain a changé et n’a pas pris la direction souhaitée. Même si le projet coopératif a avancé (ouverture d’un compte bancaire pour la future société, la promesse de l’appui matériel de la part de l’administration), le groupe initiale s’est dispersé et même les leadeurs ne travaillaient pas ensemble. Ils ont continué à parler de la coopérative avec les agriculteurs de Brahmi mais n’ont pas dépassé l’étape de sensibilisation de petits groupes d’agriculteurs, en mobilisant les nouveaux groupes pour les petites réunions ponctuelles improvisées dans les cafés du village de Brahmi. En même temps, les agriculteurs associés au projet au début en ne voyant aucun avancement concret ont perdu l’intérêt pour le projet.

Difficultés de former un groupe de travail

L’option de s’appuyer sur un groupe des éleveurs réunis autour du projet coopératif a été finalement abandonnée. Il fallait former un groupe de travail. Les éleveurs, très ouverts et collaboratifs quand il s’agissait de visites individuelles chez eux, n’étaient pas enthousiaste pour participer dans des réunions de travail en groupe. Un collègue d’un autre projet réalisé sur le même terrain a signalé les difficultés de mobiliser les agriculteurs pour venir aux réunions – il a du rapporter, voir annuler quelques ateliers faute de participants malgré leurs promesses de venir. Les ateliers du projet EAU4Food ont confirmé cette tendance – la participation des agriculteurs étaient minime malgré le changement du lieu des ateliers à un à proximité des agriculteurs. Interrogés sur la question de leur absentisme, les agriculteurs ont avoué que les réunions ne les intéressaient pas et qu’ils n’avaient pas envie de quitter leurs activités agricoles pour venir aux réunions qui ne leur apportaient rien de concret. Même si une réunion a été organisée le jour qu’ils ont choisi eux-mêmes et sur lequel tout le monde s’est mis d’accord (dimanche matin), dans le lieu qu’ils ont choisi eux-mêmes et sur le sujet qui leur intéressait (la coopérative), très peut d’entre eux sont venus pour participer.

En même temps, il est devenu clair que l’attitude des agriculteurs par rapport à la recherche était négative – déçus par le fait que le projet ne leur a pas apporté jusqu’à maintenant aucun résultat concret et par

l'absence des chercheurs sur le terrain, les agriculteurs se sont désengagés. Beaucoup d'entre eux ont exprimé l'opinion que la recherche « n'apporte rien » et qu'ils en avaient assez de discuter et voulaient des résultats concrets.

La nécessité de convaincre les agriculteurs que mon projet peut leur apporter quelque chose était primordiale. Ça m'a provoqué de réfléchir sur comment renforcer l'effet l'appui à la décision de jeu et de concrétiser les résultats. Un simple simulateur informatique a été introduit dans le jeu pour montrer la relation que les décisions prises par les joueurs avaient sur leur facture de lait. Je comptais aussi que ça pourrait leur intéresser assez pour qu'ils veuillent continuer le travail avec moi sur le développement d'un modèle plus complet.

Il restait toujours le problème de mobiliser un groupe pour un atelier. L'expérience des ateliers EAU4Food a permis d'avoir quelques pistes - la participation était plus importante quand l'invitation venait de la part d'une institution présente dans la zone que de la part des chercheurs de Tunis. Aussi l'atelier où étaient présents les membres de l'administration a attiré plus de personnes.

Suivant ces pistes, j'ai réussi à gagner l'appui d'un représentant de l'Office d'Elevage, connu sur le terrain et réçu positivement par les agriculteurs. Les conversations que j'ai eu avec lui ont révélé son attitude positive par rapport au travail de terrain et son intérêt à outils innovants. Il s'est intéressé à l'idée du jeu et a proposé son aide à l'organisation de l'atelier. Nous sommes partis sur le terrain ensemble pour inviter les éleveurs. Il a participé au choix des éleveurs et ses suggestions étaient se sont avérées très valables.

Le changement d'élément déclencheur des stratégies collectives

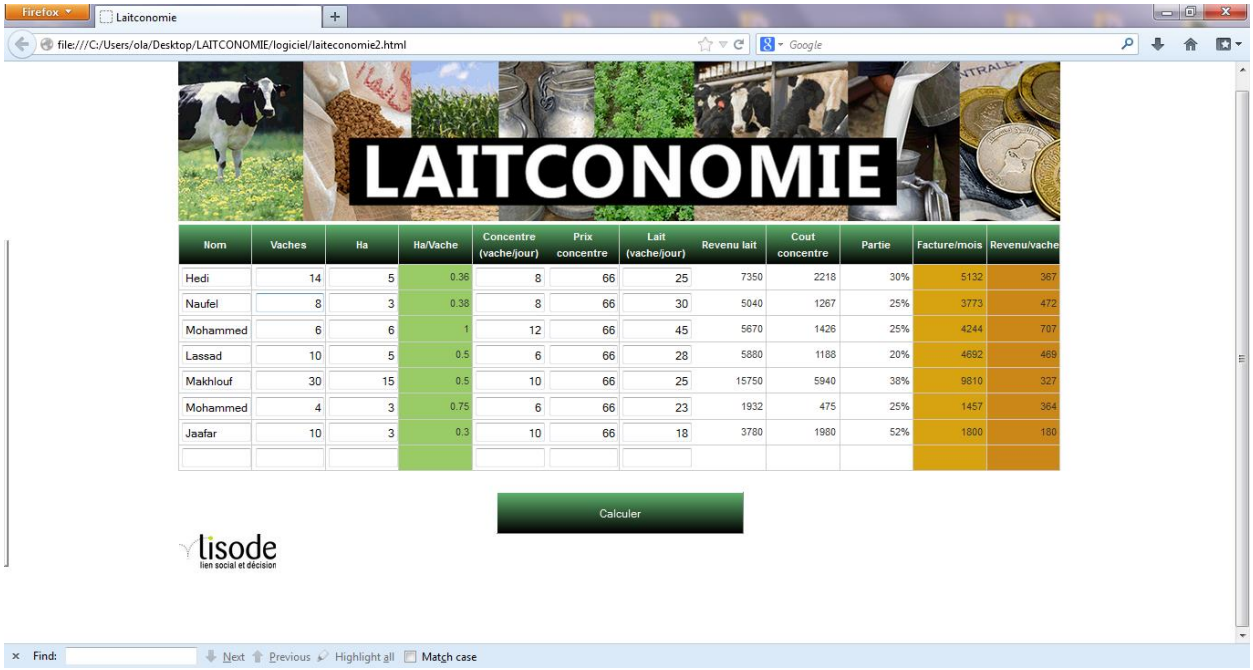
La première version de jeu comportaient deux étapes : la production et la vente de lait. L'étape de la vente prévoyait plusieurs options : la vente individuelle à un centre de collecte, la vente collective à petite échelle et la vente collective à grande échelle. Chaque option était plus profitable que la précédente et demandait la participation de plus grand nombre d'éleveurs. Une telle construction de jeu a été proposée sur la base des entretiens conduits pendant le premier séjour sur le terrain dans lesquels quelques acteurs ont mentionné ces options. Cependant, les nouveaux entretiens avec les acteurs de la filière lait ont montré qu'en réalité une seule option existait sur le terrain (la vente à un centre de collecte) et que même si l'option de vente directe à l'usine n'est pas illégale, en pratique elle n'est pas possible. Il fallait donc identifier un autre élément qui pourrait être introduit dans le jeu pour remplacer l'option de vente collective.

Les entretiens avec les éleveurs ont permis d'identifier la solution. La procuration du concentré a été choisie comme un élément pour remplacer la vente de lait dans le jeu. Trois options ont été préparées

pour les joueurs – procuration dans le centre de collecte (option la plus pratiquée : la facture de concentré est déduit de la facture de lait à la fin du mois), fabrication du propre concentré par un éleveur individuel, mélangé manuellement à partir d'ingrédients achetés collectivement (option accessible à partir d'un certain nombre de joueurs) et fabrication du concentré de bon qualité, mélangé avec un broyeur spéciale qui pourrait être mise en place par une société de services (un nombre plus grand de joueurs formellement organisés). La deuxième option permettait de dimnuer considerablement le cout de la production laitière, la troisième diminuait le cout et augmentait la production (grace à la bonne qualité de mélange). Ces options ont été acceptées comme réalistes, les deux existant sur le terrain (un éleveur qui mélange manuellement et une ferme privée qui utilise la machine).

La préparation de la nouvelle version de jeu

Les supports de jeu ont été préparés et validés (les photos des cultures) par un petit groupe d'agriculteurs. Le logiciel a été préparé pour simuler la facture mensuelle de centre de collecte à partir de nombre de vaches, de la production moyenne par vache et de la quantité moyenne de concentré par vache (les chiffres et unités utilisées par les agriculteurs). Le calcul de centre de collecte – la facture mensuelle ou la somme due pour la quantité du concentré acheté dans le centre et déduit de la facture pour le lait vendu – est dans la plupart des cas le seul calcul que font/voient les éleveurs. Le logiciel calculait aussi la superficie fourragère par vache, la partie du revenu de lait laissée dans le centre pour payer le concentré (le pourcentage) et le revenu final par vache (pour permettre la comparaison entre différents joueurs, tous ces éléments étant dépendant des décisions prises par les joueurs pendant les tours de jeu.

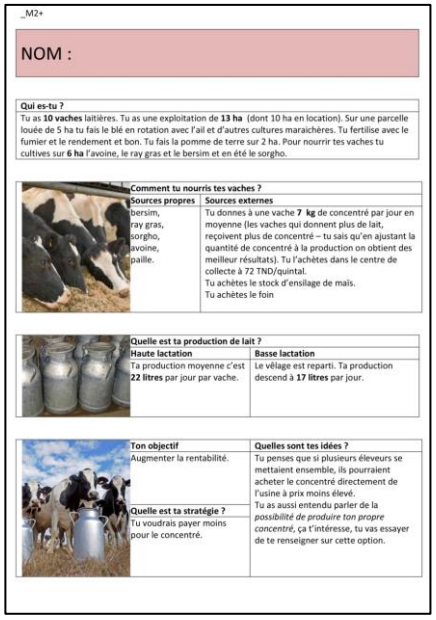


Logiciel accompagnant le jeu « Laitconomie »

Le test de jeu – communauté de pratique à l'INRGREF (31/05/2013)

Le test de jeu dès le début a posé le problème car le jeu repose fortement sur les pratiques des éleveurs et leurs connaissances sur l'alimentation des vaches. Finalement, les fiches acteurs détaillés ont été préparés spécialement pour le test, aussi bien que les fiches caractérisant différents types de fourrages pour faciliter le jeu pour les non-éleveurs. Le test a été réalisé à l'Institut National de Recherche en Génie Rurale et Forêt, le partenaire local du projet EAU4Food avec 6 participants (dont 3 chercheurs tunisiens impliqués dans le projet). Les retours des participants ont permis d'améliorer le jeu au niveau de l'organisation de l'espace de jeu (la dispositon des supports, la création des plateaux de jeu pour chaque joueur, la matérialisation de différentes options pour le concentré). Le test a également permis à l'animateur arabophone de se familiariser avec le jeu et son déroulement. Le simulateur et la manière d'annoncer les résultats des simulations ont été vérifiés. L'option de donner les fiches de rôles détaillées aux éleveurs (proposée avant par un collègue de Lisode comme la manière de rendre le jeu accessible pour n'importe quel joueur) a été finalement abandonnée. La durée de test avec six joueurs a suggéré de fixer le nombre maximal de joueurs au niveau de huit.

Le test de jeu à l'INRGREF



_M2+

NOM :

Qui es-tu ?

Tu as **10 vaches** laitières. Tu as une exploitation de **13 ha** (dont 10 ha en location). Sur une parcelle louée de 5 ha tu fais le blé en rotation avec l'ail et d'autres cultures maraichères. Tu fertilise avec le fumier et le rendement et bon. Tu fais la pomme de terre sur 2 ha. Pour nourrir tes vaches tu cultives sur **6 ha** l'avoine, le ray gras et le bersim et en été le sorgho.

Comment tu nourris tes vaches ?

Sources propres	Sources externes
bersim, ray gras, sorgho, avoine, paille.	Tu donnes à une vache **7 kg** de concentré par jour en moyenne (les vaches qui donnent plus de lait, reçoivent plus de concentré – tu sais qu'en ajustant la quantité de concentré à la production on obtient des meilleur résultats). Tu l'achètes dans le centre de collecte à 72 TND/quintal. Tu achètes le stock d'ensilage de mais. Tu achètes le foin

Quelle est ta production de lait ?

Haute lactation	Basse lactation
Ta production moyenne c'est **22 litres** par jour par vache.	Le vêlage est reparti. Ta production descend à **17 litres** par jour.

Ton objectif	Quelles sont tes idées ?
Augmenter la rentabilité.	Tu penses que si plusieurs éleveurs se mettaient ensemble, ils pourraient acheter le concentré directement de l'usine à prix moins élevé. Tu as aussi entendu parler de la *possibilité de produire ton propre concentré*, ça t'intéresse, tu vas essayer de te renseigner sur cette option.
Quelle est ta stratégie ? Tu voudrais payer moins pour le concentré.	

Une fiche de rôle

Enfin, les participants de test m'ont demandé de complexifier le logiciel et d'offrir aux joueurs un modèle plus complet de l'activité d'élevage. J'espérais avoir une réaction similaire de la part des éleveurs le jour où le jeu sera joué sur le terrain.

La session de jeu de rôles « Laitconomie » à El Brahmi (05/06/2013)

Deux jours avant l'atelier de jeu à Brahmi j'ai fait un tour sur le terrain avec M. Touati de l'Office d'Elevage pour inviter les participants que nous avons choisi auparavant. Nous avons invité huit personnes dont la moitié est venue, un éleveur nous a appelé pour s'excuser, un autre s'est déplacé dans le lieu d'atelier le matin pour s'excuser et expliquer pourquoi il ne pouvait pas participer, deux ne sont ni venus ni appelés (c'étaient les deux personnes invitées par téléphone). En même temps, un des participants a amené trois autres avec lui ce qui nous a permis de réunir sept participants.

	Eleveurs invités	**Nr. Tél.**	**Remarques**
1.	Haythem Abidi		Il a participé
2.	Mohammed Thammaoui		Il a participé.
x	Lased Dridi		Il a appelé pour s'excuser.
x	Nouredine Chihi		Il n'est pas venu (invité par téléphone).
3.	Mehdi Zaidi		Il a participé
4.	Abdessattar Zaibi		Il a participé
x	Semi Ouesleti		Il n'est pas venu (invité par téléphone).
x	Charf Eddine Touati		Il est venu pour s'excuser.

	Participants invités par d'autres participants	**Nr. Tél.**	**Remarques**
5.	Aimen Abidi		Invité par Haythem
6.	Chamuddin Saidani		-
7.	Abdelaziz Abidi		Invité par Haythem

Déroulement de l'atelier

- Présentation du projet EAU4Food
- Présentation du travail d'Ola
- Explication des objectifs du jeu
- Brise glace : Les participants se présentent en se positionnant à la fois sur la carte du périmètre irrigué El Brahmi

Les participants se positionnent sur une carte du périmètre.

- Explication de règles de jeu
- La session de jeu
- Le débriefing

Déroulement de jeu

1. Les participants reçoivent leurs fiches avec le nombre de vaches et la superficie de leur exploitation déterminées. Les différentes combinaisons de ces deux éléments représentent différentes types d'exploitations identifiées sur le périmètre au cours d'entretiens.

Les participants en train de planifier leurs exploitations.

Une fiche de joueur. Celui a 8 vaches et 4 hectares.

2. Les participants planifient leurs exploitations (cultures dont les cultures fourragères) et choisissent l'alimentation des vaches :
    - La quantité moyenne de concentré par vache par jour
    - D'autres aliments (à part de concentré) de sources extérieures ou produits sur exploitation
3. Les participants estiment leur production laitière.
4. Ils remplissent les fiches.
5. Chacun présente ses choix et son estimation. Leur estimation de la production est discutée avec les autres joueurs et avec l'expert de l'office d'élevage, si les agriculteurs demandent son avis.
6. Les données sont introduites dans le logiciel qui calcule la surface fourragère par vache, le pourcentage de revenue de la vente de lait qui a été dépensé pour le concentré et le revenu final par vache pour permettre les comparaisons. Les résultats sont présentés dans un grand tableau.

Les résultats des joueurs dans le logiciel et dans le grand tableau.

7. On annonce l'objectif de jeu qui est d'améliorer la pratique d'élevage.
8. Les joueurs introduisent des changements et le cycle recommence.

Après avoir joué quelques tours, si l'option de la fabrication du concentré n'apparait pas, on l'introduit.

Il y a deux niveaux : on peut mélanger le concentré manuellement (à partir de 25 vaches) ou avec un broyeur (à partir de 40 vaches).

Les choix et les stratégies de joueurs

Vaches / ha	Vaches	Superficie	Superficie fourragère	Concentré	Production	Option coopérative	Dernier tour
4/3	Achat 10	Location 3 ha	1/3→5/6	+ 1 kg	22→25→28	oui	Changements dans le choix et la conduite des fourrages.
20/30	Achat 10	--	1/2→1/2→2/3	--	25→22→25	oui	Augmentation de la superficie fourragère, changement des cultures
8/3	-- Achat 2	--	2/3→100%	+2kg +2kg	25→30→35	oui	Changement des cultures fourragères, achat de 2 vaches
8/10	Achat 2 Achat 5	--	0,3→0,5→0,7	--	20→28→28	oui	Augmentation de la superficie fourragère, achat de 5 vaches
3/10	Achat 3 Vente 100%	-- Location 2ha	0,3→0,6	-3 kg	--	non	Vente de vaches, changement de la spéculation (engraissement, location 2 ha, abandon fourrages
4/1,5	-- Achat 2	Location 1,5ha	100%	-2 kg +4 kg	23→23→25	oui	Achat 2 vaches, augmentation de quantité de concentré
12/3	Vente 2	--	100%	--	16→18→20	oui	Amélioration de conduite des fourrages

Tout les participants sauf un ont choisi l'option coopérative. Un a choisi d'abandonner l'élevage laitier pour l'engraissement de veaux. Pendant le débriefing il a expliqué qu'il a vu que l'union était la seul option et il ne voulait pas travailler avec le groupe. C'est un résultat d'autant plus intéressant que ce participant est engagé dans le projet coopératif dans le périmètre et il est membre de comité multi-acteur qui s'est constitué dans le cadre du projet EAU4Food pour travaillant sur la question coopérative.

Un participant se déplace pour joindre la coopérative

Le groupement de fabrication du concentré

Quelques joueurs ont choisi d'augmenter leur troupeau même si ça ne permettait pas d'augmenter considérablement leur revenu. Ils ont expliqué l'intérêt que représentait pour eux avoir plus de vaches.

Après avoir utilisé les options offertes par le jeu, les joueurs entraient dans les discussions plus techniques avec le représentant de l'Office d'Elevage sur la conduite de différentes cultures fourragères et leur stockage afin d'augmenter le rendement et la production laitière. Ils ont introduit les nouveaux éléments dans le jeu pour expliquer leurs résultats : la race de vache, les maladies de vaches et l'intervention vétérinaire, la location de parcelle, la vente et l'achat de vaches, la qualité du concentré industriel.

Evaluation (quelques propos des joueurs)

Sur la méthode :
C'est la première fois que je voie une méthode comme ça, c'est très intéressant.
Le jeu permet de mieux comprendre les résultats ne nos choix.
C'est une bonne idée, ça permet de bien communiquer comment bien faire l'élevage.
Ça permet de comprendre comment mieux produire, c'est une bonne approche.
Le temps de la session n'était pas genant, il a passé très vite.
Le jeu est facile à comprendre dès le début, il n'est pas lourd.
Le tableau que nous avons eu à remplir est très bon pour tracer nos objectifs.
Le tableau comme ça aide beaucoup à maitriser le travail.
Sur l'expérience :
Je suis vécu un rêve de passé, quand l'élevage était un plaisir. J'ai senti la nostalgie.

Nous sommes sortis de nos activités quotidiennes, nous avons tout oublié pour quelques heures.
C‘est bien pour notre travail.
Au lieu de rester dans le café, c’est mieux de venir d’apprendre des choses avec madame Ola.
Sur les résultats :
On se rend compte que la situation nécessite le changement.
On voit bien que l’organisation, l’union des agriculteurs est une bonne solution.
Tout ça nous amène vers une coopérative.
Sur le rapport avec la réalité :
En réalité il y a beaucoup plus des couts.
A ce moment là les gens ne sont pas prêts à s’organiser.
C’était plus facile dans le jeu que dans la réalité.
Sur la communication pendant le jeu :
Chacun a travaillé seul, en échangeant peut-être avec son voisin. Quand nous avons décidé de se réunir pour produire le concentré nous avons travaillé ensemble.

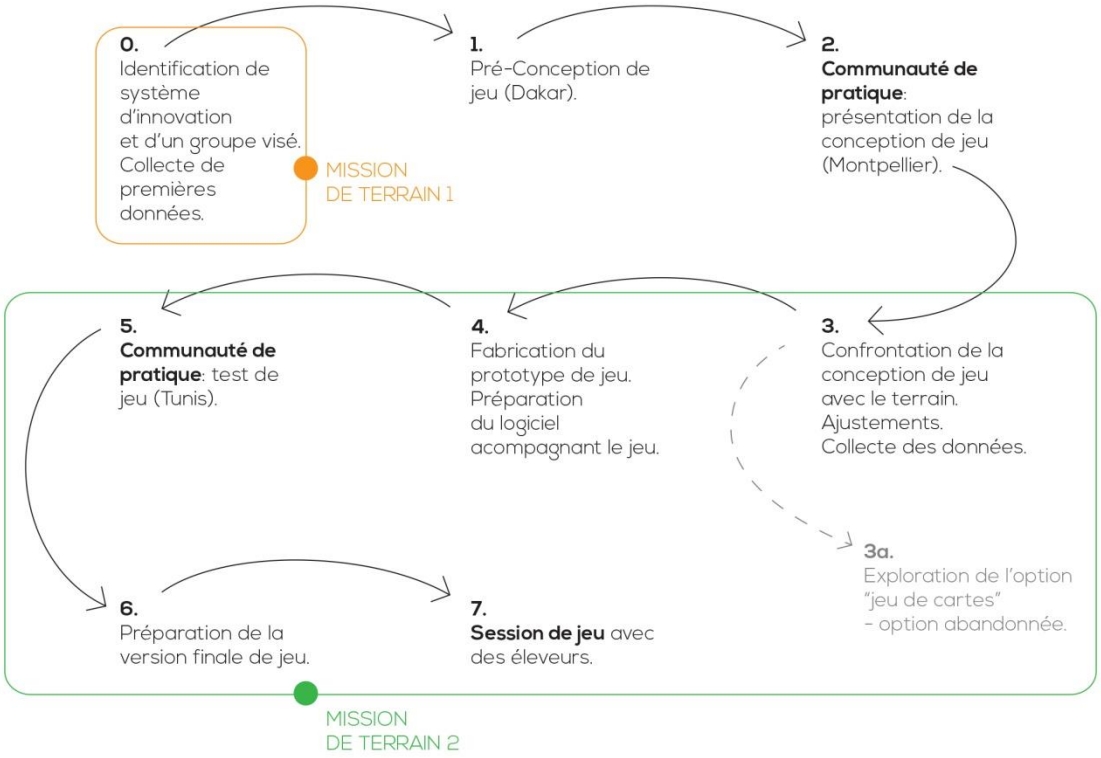
La continuation potentielle de travail

Pendant le débriefing les participants ont parlé des éléments (les couts) qui n’ont pas été représentés dans le jeu et ont exprimé leur intérêt à s’engager dans une démarche de co-construction d’un modèle qui serait plus complet afin de permettre la simulation des changements dans les stratégies d’élevage. Ils ont exprimé leur volonté de continuer le travail avec moi. Le représentant de l’Office d’Elevage y a été également favorable et a aussi proposé d’organiser un atelier de jeu dans une autre zone de leur travail (hors de périmètre Brahmi).

Observations

- Les participants sont immédiatement entrés dans le jeu et se sont appropriés leur personnages – ils ont ajoutés plusieurs éléments et ils ont entré dans le dialogue avec le centre de collecte (critique sur les primes du lait). Ils se sont vendu les vaches entre eux.
- Le représentant de l’Office de l’Elevage s’est excusé au début de devoir partir tôt a cause d’une autre réunion mais après qu’il a vu le déroulement de jeu il a appelé son bureau pour annuler sa participation dans cette réunion et il a resté avec nous jusqu’à la fin.
- Les participants ont resté jusqu’à la fin (sauf un qui est partie à la fin de débrifieng pour chercher son enfant à l’école).

- Un participant a demandé s'il pouvait prendre quelques cartes comme souvenir et pour montrer aux autres.
- Après le jeu quelques participants ont demandé les informations plus précises sur l'option de la fabrication du concentré (le prix du broyeur, où on peut l'acheter, etc.) et ont abordé quelques questions pratiques (il faut avoir un local pour installer la machine).



Processus de conception de jeu « Laitconomie »

Annex 5. Les idées des joueurs pour le développement potentiel du jeu (à partir des entretiens d'évaluation après 3 mois)

Agriculteurs

- On pourrait intéresser le centre à nos problèmes on les faisant jouer le jeu.
- Le prix de concentré augmente et surtout il y a des retours – le problème c'est que le centre ne fait pas d'analyse sur place, ce serait mieux. On pourrait mettre ce problème dans le jeu.
- Intégrer la banque dans le jeu – tout le monde a déjà des prêts.
- L'élément qu'on pourrait intégrer dans le jeu : machinisme.
- Dans le jeu on est comme un docteur qui fait le diagnostic. Mais il faut maintenant guérir. Il faut donner nos idées qui viennent du jeu aux décideurs.

Representant de l'OEP

- On pourrait accompagner le jeu avec des visites commentées, soit chez un éleveur dans la zone (autre que les joueurs), soit dans une société mutuelle dans une autre région pour parler des questions de la coopération des agriculteurs.
- On pourrait associer les intervenants du secteur:
  - Un vétérinaire
  - Un inséminateur
  - Un centre de collecte
- J'ai parlé du jeu à mes collègues. Au moins un est intéressé à participer à une session.
- Je peux imaginer que dans le futur on anime le jeu tout seuls.

Annex 6. Retour d'une réunion sur le thème « création d'une société de services à El Brahmi »

Dimanche, 5 mai, 10h00, l'hangar à coté de GDA à Brahmi

En faisant les entretiens avec les nouveaux éleveurs à Brahmi j'en ai rencontré plusieurs qui n'ont pas entendu parler du projet coopératif mais qui ont montré un intérêt dans un tel projet aussi bien que quelques idées sur les avantages d'une société. J'ai proposé à Charf Eddine Touati qu'il organise une réunion pour ces agriculteurs pour leur présenter le projet et partager les idées. Le lieu et le temps de la réunion ont été consultés au préalable avec les agriculteurs, qui, tous, ont indiqué dimanche matin comme le meilleur moment de la semaine pour organiser une réunion. Les agriculteurs ont aussi préféré le hangar à côté de WUA que le café de Brahmi comme le lieu de la réunion, comme étant plus « sérieux ». La date a été fixée pour mai 5. La CTV a été informée de cette réunion et n'avait rien contre, en étant partisante de l'idée de la création de la société mutuelle. Le gardien a été instruit de nous laisser entrer, et la CTV nous a laissé des tableaux qu'on pouvait utiliser pendant la réunion. Charf Eddine, le leadeur du projet coopératif, a loué les chaises.

Malgré les invitations téléphoniques les participants n'étaient pas nombreux. Seulement six agriculteurs parmi ceux que j'ai invités sont venus. Il y avait aussi deux autres participants que je ne connaissait pas (dont un de la zone voisine), et un (Fathi Askri, le propriétaire d'un centre de collecte et éleveur) qui est passé trop tôt quant la porte a été toujours fermée (il a appelé un des participants après).

Les agriculteurs de Brahmi qui ont participé dans la réunion :

- Adel Tbini
- Mohsen Ben Farhat Tbini
- Kamel Mejri
- Lased Tbini (sa femme n'est pas venue)
- Semi Ouesleti (le voisin de Lamine)
- Lamine Khmiri
- Charf Eddine Touati

Lamine Khmiri, qui pendant ma première visite de terrain a été identifié comme un des leadeurs du projet, mais qui récemment n'a pas été très actif, n'a pas participé dans l'organisation de cette réunion. Initialement, je l'ai identifié comme le partenaire potentiel, mais il n'a pas été intéressé par un projet de recherche mais par l'appui financier pour le projet coopératif qu'on ne peut pas offrir. Charf Eddine a

pris en charge son invitation mais finalement il ne l'a pas appelé. Nous avons invité Lamine la dernière minute, le matin. Le troisième leadeur, Nohmen Ochi, qui travaille en collaboration avec Charf Eddine, n'a pas pu venir.

Mon rôle dans la réunion était d'appuyer Charf Eddine dans l'organisation et, d'une manière plus limitée, le déroulement. Charf Eddine n'a pas voulu essayer de « faciliter » la réunion tout seul (avec un tableau, des cartons, une méthodologie précise), même si je lui ai offert de pratiquer avec lui avant. Il a vu des méthodes de facilitations pendant un atelier EAU4Food et il les a jugés pratiques mais il n'a pas voulu tenter. Il a préféré de parler librement aux agriculteurs et les laisser parler librement, mais il a été d'accord qu'une structuration de la réunion aussi bien qu'une visualisation et une trace écrite de ce qui est dit seraient utiles.

Il a été convenue qu'il commence par expliquer le projet aux participants (qui n'ont jamais participé à une réunion sur ce thème et voulaient se renseigner) et initier une discussion pendant laquelle nous (le traducteur M'Sallah et moi) listeront des avantages possibles du projet aussi bien que les craintes/les doutes potentielles exprimées par les participants par rapport au projet. Dans le deuxième temps nous allons prioriser des activités possibles de la société et, si les participants sont intéressés, établir un plan d'action pour le futur.

Charf Eddine a commencé ses explications. Il a décrit la situation des agriculteurs et a parlé d'avantages de créer une société mutuelle. Les participants posaient des questions, notamment sur le fonctionnement de la coopérative et exprimaient leurs attentes/idées par rapport à une société. Le traducteur, M'Sallah, écrivait les points principaux sur les cartons et les affichait sur le tableau, en faisant sa première expérience d'animation.

Charf Eddine a mentionné les autres projets coopératifs de la région qui, malgré le fait qu'ils ont commencé plus tard, ont déjà collecté l'argent et trouvé des adhérents.

Lamine Khemiri, qui est arrivé en retard, a coupé cette discussion, en disant que le projet à Brahmi a déjà dépassé le stade de parler des avantages de la société, et qu'il était temps de passer à l'action, écrire une stratégie concrète pour la société. Nous avons remarqué que les gens présents n'ont pas encore entendu parler de la société et qu'ils méritaient une introduction et toutes les explications nécessaires, mais il n'a pas voulu poursuivre ces échanges.

Les points intéressant ont été discutés, notamment :

- Que les besoins des petits et grands agriculteurs par rapport à la société ne sont pas les mêmes, par exemple, les petits agriculteurs ne seront pas tellement intéressés par les machines et plus par l'approvisionnement en intrants et possibilité d'écoulement de leur production ;

- Que l'activité qui réunit les agriculteurs de Brahmi c'est l'élevage laitière et que la société devait reposer sur cela ;
- Qu'il y a deux options de démarrage concurrentes – de commencer par organiser la collecte de lait, comme une activité la plus rentable, pour gagner l'argent pour les autres activités et la deuxième option – de commencer par les activités moins couteux et basiques sans défier les centres de collecte pour l'instant ;
- Que comment la société démarre sera cruciale pour son futur. Si ça marche bien et donne les bons résultats, les gens vont adhérer massivement. Cela est lié au fait que les agriculteurs de Brahmi sont retissant à tester les nouveautés et attendent les résultats des autres avant d'essayer eux-mêmes ;
- Que les membres du conseil d'administration de la société auront un pois plus important et l'accès aux institutions que ne sont pas accessible aux agriculteurs individuels.

J'ai encouragé Lamine et Charf Eddine à réfléchir sur pourquoi le projet à Brahmi ne peut pas démarrer et quels sont les éléments qui les bloquent. Ils ont parlé des deux choses – la « mentalité » des gens qu'ils ont décrit comme manque de confiance entre les gens et le manque de personnes qui pourraient faire bouger les choses par consacrer leur temps à faire le porte à porte pour recruter les agriculteurs. Tout le monde était d'accord qu'il est très difficile à convoquer les réunions à Brahmi, parce que les agriculteurs, même invités individuellement, ne viennent pas. Les deux initiateurs du projet ont dit de ne pas avoir le temps à consacrer pour cette tache. Un des agriculteurs présents, Kamel, a offert son aide pour informer les gens, et les autres ont dit qu'ils pouvaient aussi parler aux gens qu'ils connaissaient.

Ensuite, les participants ont pris quelques décisions sur le cours d'action

- Lamine et Charf Eddine dans la semaine à venir vont chercher et trouver deux personnes (de préférence jeunes et de la zone, ingénieurs) qui vont s'occuper de la préparation de démarrage du projet. Les quatre vont constituer un petit comité du projet.
- Les deux personnes, formées par Charf Eddine et Lamine vont circuler pendant un mois dans le périmètre et faire porte-à-porte pour expliquer l'idée de la société et recruter les adhérents.
- Le petit comité va se réunir pour discuter la stratégie de la société.
- Cette stratégie concrète sera présentée pendant une grande réunion plénière. La présence à cette réunion sera obligatoire pour tous qui veulent adhérer à la société.

Annex 7. EAU4Food: Field trip report. Chokwé 31.05-09.06.2015

Ola Dolinska, Lisode

Objectives

- To evaluate the project from the point of view of the methodological input from Lisode (1. The CoP concept, 2. Methodology of the participatory planning workshop with 21 de Maio)
- To evaluate the potential of the dissemination of the composting technique in relation with the innovation dynamics within the 21 de Maio Association.

Participants

- Lisode: Ola Dolinska
- CSIC-CEBAS: Maite Sanchez-Reparaz, Gonzalo Gonzales Barbera
- Eduardo Mondlane University : Higino Tamele

Program

Lundi 01/06/2015	Maputo	- Arrivée à Maputo (départ 31/05/2015) - Visite à l'Université Eduardo Mondlane, rencontre avec Sebastiao Famba

		- Voyage à Chokwé
Mardi 02/06/2015	Chokwé	- Visite chez trois associations, participants au projet (champs) - Visite à ISPG, partenaire local du projet, avec l'objectif de : • faire un point sur le stage EAU4Food ; • faire un point avec le traducteur ; • discuter sur la continuation possible du projet.
Mercredi 03/06/2015	Chokwé	- Réunion de planification de travaux avec 21 de Maio (champs de l'association) - Entretiens agricultrices 21 de Maio (champs)
Jeudi 04/06/2015	Chokwé	- Visite dans la direction du Parc National de Limpopo pour discuter sur une possibilité de futurs projets (prospection)
Vendredi 05/06/2015	Chokwé	- Collection de soil samples 21 de Maio (champs) - Application du compost avec 21 de Maio (champ de l'association) - Continuation entretiens agricultrices (champs)
Samedi 06/06/2015	Chokwé	- Collection de soil samples chez l'association Muzumuia (champs) - Rencontre président Muzumuia (chez lui) - Rencontre présidente 21 de Maio (chez elle) - Visite Dam sur Limpopo - Voyage à Maputo
Dimanche 07/06/2015	Maputo	- Rédaction de rapport de mission
Lundi 08/06/2015	Maputo	- Retour en France (arrivée 09/06/2015)

Results

We arrived at the time when farmers were collecting rice, so we found them quite busy with the work. Nevertheless we interviewed 10 farmers directly involved in the EAU4Food project, on the common

plot of the association or at their individual plots. The interviews were translated from Shangana to English by a professional translator recommended to us by ISPG. All our interlocutors, except one, participated in the EAU4Food meeting except one, who was sick at that time, but joined the compost experiment later. The president of the association was not present in the field as she was taking care of her son (who was ill) at home. Still, she helped us organize the work, we visited her twice.

Observations

- The size of the compost heap indicated that a part of compost have been used. We found out that farmers conducted a spontanous test (not planned in the project) applying compost on a garden plot (courgette). They left a part of compost on its initial position (the compost heap was moved to protect it from the rain) and made a small plot of courgette seeding them on the compost.
- The rice residue on the common plot of the association has beed entirely burned during our stay in the field. As the rice residue is necessary to prepare compost this suggests that the association does not plan to prepare new compost for the coming season (despite their claims).
- Only half of the farmers involved in the project presented themselves on the field the day of compost application and we could not complete the work. We were assured that the other half of the group would follow with the work the following day.

Interpretation of the results of the interviews

Participatory method used during project workshops

The farmers did not recall the participatory method used during the workshops, it seems it has left no particular trace in their memory. They described the project as one that « came to teach us about compost", in the technology transfer manner, even though the choice of the fertility management technique was made on a participatory workshop. In their account, it was the president who made the decision that the association would test the compost, and the president who decided about the planning of the work. At the same time they admitted holding association meetings where they discussed with the president whether to adhere to the project activities. This is related to the internal dynamics of the association, where the president is a central figure when it comes to knowledge management (and work management) and is leading all the association activities. In the EAU4Food project she was also the principal interlocutor.

This said, the farmers appreciated the fact that they have been « listened to » and that they "could give their own ideas (coming from their experience)" to the project team. One farmer mentioned the fact that project provoked a lot of collaboration between the association members and that the researchers were "pro-active". Asked directly about the participatory aspect of the project, one farmer said that she had

not known it was a participatory project but that it had been indeed, explaining that now all the association members (even those who were not selected to participate) know the project and are positive about it..

The effect of the « learning through practice » in the project (CoP)

The elements that affected the participants the most were:

- The fact that the experiment was conducted directly on their common plot (comparing to other projects that some of them had a chance to participate in, where experiment were conducted on demonstration fields).
- They could prepare the compost themselves « on the spot ».

This demonstrates the power of « learning by doing » approach present in the "practice" element in the Community of Practice – all interviewed farmers declared that they could prepare compost themselves without external guidance (again comparing it to other projects where they have been only « shown how to » make something). It can be illustrated by the response of one farmer to the question if she could now prepare compost herself: "What do you mean if I know how to prepare it? I have already prepared it, here it is ».

The interviews clearly show that the farmers feel that a competent human resource was built by the project in the association – a group of farmers who know how to make compost and can guide the others in the future. This represent s the aspect of « knowledge repository » in a CoP.

Potential of dissemination of the compost technique

Innovation dynamics in the 21 de Maio association

21 de Maio association is well organized when it comes to knowledge sharing. The new ideas (according to them, these are not frequent) are typically shared with other members, but most of all, when an opportunity arises for some of the members to participate in an external project (like EAU4Food), the restitution is organized and the participants share (and teach) the others what they have learned. This happened to the composting technique that was disseminated to all the association members. The participants used the results of their spontaneous compost application test to convince the others of the positive potential of the technique.

The farmers clearly expressed their will to use the compost not only on the common plot but also on their individual fields, however only one declared she would keep the rice residue unburned. Another one was convinced that she could apply a part of the compost already produced on her individual plot. She said that after applying the compost on the common plot, some farmers would share what is left

between them. In reality, the ammount of compost available is not sufficient to use it beyond the common plot.

Dissemination outside the association

The 21 de Maio members share knowledge both inside and outside of the association. In the case of the composting technique experimented with the EAU4Food project, another association was invited by the 21 de Maio president and thought about the compost. The 21 de Maio farmers demonstrated as well the positive results of their spontanous test. The other association expressed their interest in testing the compost and announced they would come to pick up the rice residue necessary to do it (however as noted before, the rice residue has been burned on the common plot and many individual plots).

Factors potentially hampering the innovation dissemination

The availability of manure is mentionned by the farmers as a factor that can block the future production of compost. Unlike what we initially thought, this is not due to the fact that manure needs to payed for (the farmers claim they were able to secure the necessary funds) and transported (as animals are not allowed in the scheme to protect irrigation infrastructure). Three of the interviews farmers talked about the beliefs of animal owners that allowing someone to get hold of animal excrements gives the person the power over the animal's reproduction. According to our interlocutors, the animal owners, fearing the potential witchcraft practices of the women famers, refuse to sell them the manure. This was confirmed by another farmer who explained to us why she could not use the animal urine to spray her palm trees (even though she was convinced of the method's positive results) – the animal owners refused to share it for the same reasons. The interviewed farmers did not dismiss these believes, one admitted sharing them.

Quite unexpectedly, the availability of the rice residue may also be problematic. The farmers are reluctant to keep them on the field for too long as they are afraid of the invasion of rats that could be attracted by the residues. Aparently, in 2014, the association members suffered a great loss of crops destroied by the rats. As noted before, we observed burning of the rice residues within 1-2 days after the rice was collected, both on the common and on the individual plots.

Conclusions

- The participatory methodology of the meetings was left unnoticed by the participants whose perception of the project is rather “top-down”, as they see project activities as bought by the project and decisions as being taken by their president. However, the participants appreciated the fact that they have been “listened to” and not only “thought” by the researchers.
- The “on the spot practice” component of the project had a very positive role in the project assuring the appropriation and the sense of the ownership of the composting technique by the participants.
- The composting technique got disseminated by the participants among the other members of the association (non-participants in the EAU4Food project) who, according to the interviewed farmers, largely appreciated it.
- The composting technique got disseminated outside of the association (to another farmers association).
- A spontaneous test of the compost application undertaken by the participants further suggests their ownership of the project.
- Despite the fact that the majority of the interviewed farmers declared they wanted to repeat the compost production, another part of interviews and the observation suggest that this is not going to happen in the season following the project.
- The unavailability of ingredients may hamper the further dissemination of the composting technique:

- The rice residues are being rapidly burned as the farmers are afraid of rats who apparently get attracted if the rice residues stay on the field for too long
- The manure cannot be easily obtained. This is due not to the financial or logistical barriers (that, according to the association members can be overcome), as we previously thought, but to the beliefs of animal owners who refuse to sell manure to the women farmers, afraid of their possible witchcraft practices that could affect the animals' reproduction.

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Ecole Doctorale ABIES

Title : Designing intervention to support endogenous agricultural innovation process in the South: identifying conditions for its effectiveness. The case of an irrigated scheme in Tunisia.

Keywords : innovation systems, endogenous innovation, participatory methods, knowledge co-construction, companion modeling, community of practice

Abstract :

African farmers are under pressure to innovate. In the field of agricultural innovation studies, the growing dissatisfaction with the linear model of innovation transfer in which the innovation is conceived by researchers, transferred by extension agents and then adopted by farmers, pushed the researchers to look for alternatives. The recognition of actors not belonging to the scientific world as sources of innovation, the growing focus on the role of farmers and their knowledge in the innovation process and the recognition of different dimensions of innovation (beyond just new technology) influenced the way in which the academics now study innovation. In the innovation systems approach, innovation defined as a social or economical activity useful for the agricultural development, emerges in a complex system of heterogeneous actors as a result of the social learning that takes place during their interactions. This change of approach entails change in the position of farmers who are now, equally to other actors, recognized as sources of innovation. But what is really the position of farmers in the most common operationalization of the AIS approach, innovation platforms? We are focusing our interest on farmers for two reasons: they are recognized as key actors for food security and they are the ultimate users of agricultural innovation, those who put it in practice. Thus the analysis of the effects of different types of interactions, learning processes and power relations on the position of farmers in the innovation process is central for this thesis. On the basis of the analysis that we conducted in the study area – the irrigation scheme El Brahmi in North West Tunisia – we designed a tool to mobilize the innovation capacity of local farmers. The proposed methodology includes elements of companion modeling, and is based on the "self-design" principle. We developed a simulation game that is co-constructed by players – dairy farmers – while they play. They develop, discuss, negotiate and test innovative solutions to reach objectives that they themselves define. While doing it, they mobilize local knowledge and become co-authors of their own learning and of the method to support their innovation process.

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Ecole Doctorale ABIES

Titre : L'accompagnement des processus d'innovation agricole endogène au Sud : Quelles conditions pour son effectivité et efficacité ? Le cas d'un périmètre irrigué en Tunisie.

Mots clés : systèmes d'innovation, innovation endogène, méthodes participatives, co-construction des connaissances, modélisation d'accompagnement, communauté de pratique

Résumé :

Les agriculteurs africains sont sous la pression d'innover. Dans la domaine de l'innovation agricole l'insatisfaction croissante avec le modèle linéaire de transfert de l'innovation technologique dans lequel l'innovation était conçue par les chercheurs, disséminée par les vulgarisateurs puis adoptée – ou non – par les agriculteurs a incité la recherche des modèles alternatifs au model linéaire. La reconnaissance des sources d'innovation hors du monde de la recherche, l'intérêt croissant au rôle des agriculteurs et leur expertise dans le processus d'innovation et la conceptualisation de l'innovation comme combinaison des plusieurs dimensions (et non seulement une nouvelle technologie) ont influencé la façon dont les académiques étudient les processus d'innovation. Dans cette thèse nous utilisons l'approche de systèmes d'innovation dans laquelle l'innovation émerge dans un système complexe des acteurs hétérogènes comme le résultat de l'apprentissage social qui a lieu pendant leurs interactions. Ce changement d'approche change la position des agriculteurs qui sont désormais reconnus comme une source d'innovation au même titre que les autres acteurs. Mais dans l'opérationnalisation de l'approche, les plateformes d'innovation, est-ce vraiment le cas ? Nous nous intéressant aux agriculteurs, d'une part comme acteurs clé pour la sécurité alimentaire et d'autre part comme les usagers finaux de l'innovation agricole, ceux qui la mettent en pratique. Ainsi l'analyse des effets de différents types d'interactions, des processus d'apprentissage et des jeux de pouvoir sur la position des agriculteurs dans le processus d'innovation est centrale pour cette thèse. A la base de l'analyse dans la zone d'étude – un périmètre irrigué El Brahmi au Nord Ouest de la Tunisie – nous avons construit un outil visant à mobiliser la capacité d'innovation des agriculteurs locaux. La méthodologie proposée contient des éléments de la modélisation d'accompagnement, et notamment s'appuie sur le principe de « self-design ». Nous avons proposé un jeu de rôle que les joueurs co-construisent en le jouant. Ils développent, discutent, négocient et testent des solutions innovantes pour atteindre les objectifs qu'ils définissent eux-mêmes. Ainsi ils mobilisent leurs connaissances locales et deviennent les co-auteurs de leur propre apprentissage et de la méthode d'appui à leur processus d'innovation.