

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



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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.

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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 an 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., 2012). 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 and 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 (Lundvall, 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, Adekunle and Fatunbi, 2012, Hounkonou et al., 2012, Kabambe et al., 2012) 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 confirm 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 (Hounkonou et al., 2012).

At the same time, as Klerkx and Leeuwis (2009b) point out, focusing on farmers' connection with different sources of knowledge may lead to undervalue the importance of peer networks. The importance of

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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 are 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 (CoPs)* (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 re-production 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, 2005). 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 influencers* (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 dialog 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 bonded 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 dialog other than 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 et al., 2010 and Klerkx 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 deal with the role of discursive space in technological change (Pesch, 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 (Pesch, 2015). For Darré (1987), alternative storylines find their way into CoPs through membership of farmers in other dialog groups; they can be mobilized in the ongoing 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 (Pesch, 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 dialog, 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., 2012). 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 (Pesch, 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 dialog (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 (Fig. 1). In the following section we present how we applied our framework in Tunisia.

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 ha, 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 vegetable crops 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-vegetables 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

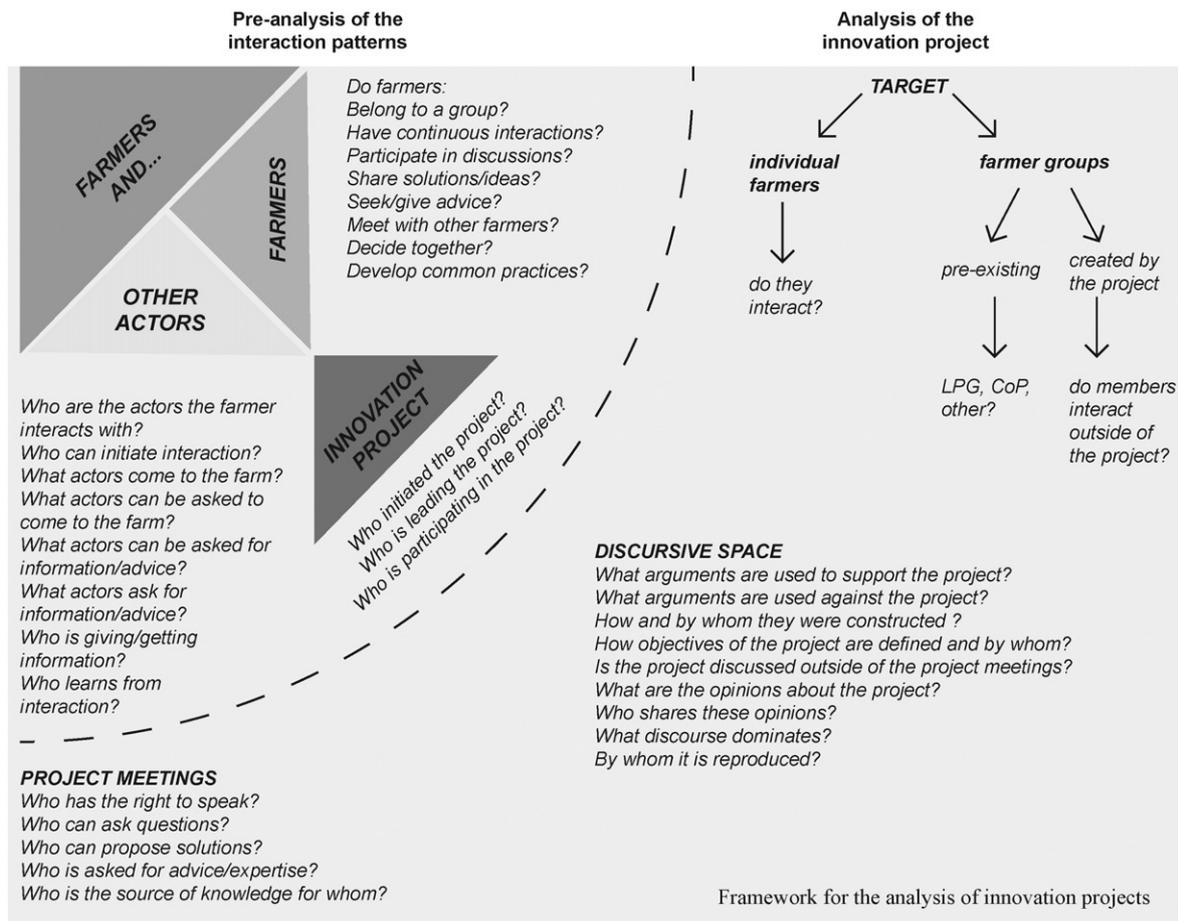


Fig. 1. Framework for the analysis of innovation projects.

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 km 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 are 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 are 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, dialog 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", and "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, similar to what was suggested by Chiffolleau (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" the 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 Brahmi (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 ha (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 about how he was traveling 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 pesticide 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 smallholder 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 (CoP3) — 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 a 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 that 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 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 dialog between different groups of farmers, these different discourses do not have a chance to be negotiated.

4.2.2. *On-farm concentrate feed production*

The high price and unreliable quality of the industrial concentrate feed were identified as some 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

Table 1
Narratives about no-till technique.

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 Big farmers (farmer leaders and their acquaintances)	Machine is not necessary. Machine is not a must but it is necessary on a big surface.	Adaptation of the technique to the manual seeding Putting the purchase of the machine in the program of the cooperative project
INGC	Machine is necessary.	Starting a project of constructing an affordable machine from local materials
CTV OEP	Machine is necessary. Machine is necessary.	Do not talk about the technique with smallholder farmers. Do not talk about the technique with smallholder farmers. Supporting a cooperative project of farmers to collectively purchase the machine

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 is 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). 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 for them. Also one of the innovator's neighbors told us that he was considering starting his own production in the near future, based on the same formula (that the innovator shared with him).

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 a 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

Table 2
Narratives about mixing concentrate feed on-farm.

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)
CoP3	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 agent	No intention to try

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 participants 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 3).

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 consistent 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 et al. (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). Leeuwis (2000) reminds us, and the example of Adel confirms, that working with individual actors can be also a strategic choice, in particular for 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.).

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

Main objective of the cooperative	<ul style="list-style-type: none"> Facilitate access to agricultural inputs and machines; Operate a cooperative milk collection center; Produce concentrate feed; Provide access to training and innovation.
Starting strategy	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Cooperative will serve interests of big farmers; Cooperative will serve the interests of smallholder farmers.
Attitude towards cooperation	<ul style="list-style-type: none"> 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.

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 et al., 1989, Richards, 1985, Waters-Bayer et al., 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 Hounkonou 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 dialog 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 did 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, he 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 a 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'. 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 et al., 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 farmer 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 conducive 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.

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