THE EMERGENCE OF ENVIRONMENTAL CONCERNS IN THE CAMARGUE ; RE-THINKING A REFERENCE NETWORK IN A LEARNING TOOL FOR STAKEHOLDERS

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Abstract

Faced with new environmental questions, agronomists acting in the Camargue for the last 15 years are driven to re-think the reference network they designed, in order to answer questions about economic ways of rice farming. Organic farming, as a prototype for an environment friendly production system, encounters several constraints in the Camargue although continuing the former way of production is more and more risky. Experience among farmers is scarce and does not spread easily. The economic viability of such a set of new practices is not yet secured and it lacks a formal set of norms to establish the stable frame of a specific commodity chain. Research outputs about those questions are unavailable. Agronomists are thus prompted to design a set of methods among which the reference network is a tool to be used in supplying a new content in interactions extended to new actors. Evolution, from an organised action system monitored by agronomists to a collective action system in which each actor contributes to the production of common knowledge, requires specific and articulated learning activities like simulation learning, group learning and multidisciplinary co-operation.

Key-words : organic rice, knowledge production, collective action, multidisciplinary research

Introduction

The aim of this paper, based on an empirical study, is to show how a technical reference network has to evolve towards a shared learning tool, contributing to local development construed as “the broadening of the repertoire of choices for purposeful action available to stakeholders” (Ison *et al*., 2000). Agronomic knowledge has been produced for ten years in the Camargue but agronomic questions have continuously been renewed. In any case, the rise of environmental concerns in rice cultivation in the Camargue questions agronomic research in a very specific way. Whereas the general former orientation was to adapt and articulate scientific and technical knowledge, it is now new knowledge that has to be designed and produced. This calls for re-thinking a research tool in a device connected with an heterogeneous set of actors, carrying out their cognitive project and contributing simultaneously to the collective learning process.

1. From technical findings to collective learning

1.1. From field to farm

Obviously, data production and the building of a relevant array of references is a chore question to agronomic sciences, seen as the sum of “theoretical knowledge useful for farming” (Deffontaines, 1993). Farming is a set of practices that are implemented on spatial structures among which the field is paramount. However, agronomic theory may look at the field in different ways. Eco-physiological models have been developed to study the functioning of the field seen as a production plot, a tight combination of climate, soil and

plant. In such an approach, data production is oriented towards a-biotic conditions and biological indicators linked to the elaboration of the yield (in quantity and quality). A reference network, made out of a sample of plots based on the diversity of agro-ecological conditions, is then meant to test the consistency of the models and to delineate (often spatially) the boundaries of its scope of validity. In gathering data through such a device, agronomists have always faced the diversity of farmer's practices and acknowledged that "most of their interventions cause the processes under study to change" (Duru, 1993). Nearly thirty years ago, resulting from the narrowing of relations between research and development agencies, the need to integrate the farmer's "good reasons" for his interventions appeared (Sebillotte, 1974). Due to the integration of operational concerns besides objectives of academic knowledge production in the research agenda, agronomic approaches to the field evolved towards new qualifications of the research object. It became a single unit of a wider activity system, the farm or the household (Chambers *et al*., 1989). At an even more encompassing level, triggered by societal questions that have lately appeared, it has also been seen as an element of a collective action system carried out in formal organisations, such as irrigation systems or co-operatives, or within informally negotiated social entities such as ecological systems, territories or even landscapes (Deffontaines, 1993). Naturally, data production pertaining to those approaches has to focus at relevant indicators highlighting the relations between the field and the other levels in the system under study. Consequently, a reference network has to be built as a set of farms, that is to say farmers and farming systems, interacting with their context. Functioning typologies have thus enabled the building of references for different farming systems.

1.2. From farm to farming decisions

So, the assessment of different system functioning and the progressive involvement of human sciences in the research process have highlighted the diversity of farmers' operational rules built through their interactions with their context. Finally, the models designed by agronomists, following an operational agenda to assess the functioning of the field unit, have progressively integrated those rules as specific constraints. Nevertheless, when it comes to the formulation of technical solutions, agronomists still face the remaining question of their relevance "in relation to the farmer's knowledge and reasoning when making technical decisions" (Cerf *et al*., 1993). This evolution in approach has taken place in a changing overall context. The fordist model of production has been challenged (Allaire, 1996) and agriculture is becoming a multi-purpose activity within a hectic economic environment. The relations between science and society have changed (Hubert *et al.*, 2000), and contribute to an overall development of uncertainty. More specifically, the nature of the former technology transfer between research, advisory centres and producers is under question. In the midst of these radical transformations, the knowledge to be produced concerning farming does not limit itself anymore to questions like "how to do things ?" but has to tackle questions related to "what is to be done ?" (Casabianca, Albaladejo, 1997)

1.3. Collective learning

Eventually, formulation of technical references is currently construed by some agronomists as but one element in the building of decision tools (Cerf *et al*., 1993). This transformation of the agronomist's viewpoint could be seen as the denaturalisation of the field and its related models (Hatchuel, 2000). Consequently, it stimulated the development of new research methodologies such as partnership research, action research, intervention research etc., wherein the cognitive phenomena are taken in account. These methodologies introduced a shift in the research focus and are mainly in use to highlight ongoing processes of change in

the practices rather than practices themselves. Fed by the outputs of sociology, management and cognitive sciences, most of them give special emphasis to collective action considered as "a simultaneous reconstruction of knowledge (values are a form of knowledge) and relations (organisation of the actor's positions and interdependencies)" (Hatchuel, 2000). For some scholars, this reconstruction is, in itself, the learning process that is, therefore, tightly linked with the context of change. On this point, the work of different but numerous scholars, in anthropology (Darré, 1996), management sciences (Checkland, 1990) or educational and extension sciences (Röling, 1994) have addressed the question of the facilitation of the learning process. Their achievements are increasingly taken in account in the design of reference networks with a collective learning objective. Along with the sociological trend, to account for the learning processes that are triggered in the Camargue by the rise of environmental concerns, we use a theoretical framework derived from i) structural interactionism, the concepts and methods of which have been particularly developed by H.C.White, and ii) sociology of organisation, drawing on the work of M.Crozier. In the work of White, society is seen as a network woven by interactions that trigger and participate in the building of dynamic "identities", individual or collective, the stabilisation of which is due to control (White, 1992). Within this context, extended to the boundaries of a territory, "La Camargue", agronomists have developed an organised action system aimed at the production of technical references. It associates shareholders of several identities; farmers, their representatives and scientists involved in a web of relations, that frame their own logic of action and put them in a situation of "strategic interdependency". The very nature of this device, and the rise of environmental concerns, call for a re-thinking of the initially designed reference network to use it as a learning tool "enabling the re-weaving of social ties, practices and sense-making in new frameworks of coherence" (Barbier, Lémery, 2000). It argues for the evolution of the current organised action system towards a collective action system wherein actors commit themselves to the production of a common good.

2. Actors on the rice stage

Contributing to the "Camargue" Identity, several organised action systems are struggling to endure through control of internal and external interactions. The study of such systems may be based on three analytical categories: i) the objects of action, ii) the actors, and iii) the coordination structures (Chiffoleau *et al.*, 1999). In the Camargue there exists a tight correlation between the different objects of action such as water, brackish water game, rice, durum wheat, weeds, fighting bulls, horses, salt,…. From our agronomist viewpoint, we focus on rice as the key object in the Camargue's complex set of interactions. So, presented below are the different categories of actors for which rice is the main, or one of the main, object(s) of their action, although each of them has got different ways of qualifying it (Boltanski, Thévenot, 1991).

2.1. Farmers and their representatives

The small number of rice producers (around 220) entails, nevertheless, a huge diversity as far as the importance of rice in their activity system is concerned. The size of the overall rice area, localisation in more or less salted parts of the territory, the combination with other activities such as animal husbandry, daily presence in the fields or remote management are as many factors that make rice producers an heterogeneous category. Moreover, they belong to different informal networks that can reach far beyond the boundaries of the Camargue like larger rice production areas in Europe (Italy, Spain). Hence, they build different sets of values and develop different relations towards the object of their action, rice. Farmers may qualify it as a mere production, as a source of income, as an element of social recognition, as an

intellectual challenge, etc.. Noticeably, a handful of producers (around 10) have been engaged in organic rice production for a dozen years. All rice producers belong to the French Rice Producer's Union, whose task is to provide support to them through revendicative action, lobbying, or technical advice. The French Centre for Rice (CFR) was created in 1986 by the Union, in order to carry out different activities of scientific and technical support for producers in an area where no extension agency existed. Elected decision-makers at the Union are also at the head of the CFR. Although they are also producers, rice is for them an element in the construction of their political position.

2.2. Upstream and downstream

Since 1999, the Union has integrated processors (14 firms) and wholesalers (8 firms). Whereas the CFR is meant to connect producers with the scientific world, these actors are a connection with the market. Here again, is a heterogeneous category, in size as in status, where rice is construed as a marketing commodity. The largest is a co-operative that collects the production of 150 members. The smallest are rice producers who have invested in storage and processing facilities. In that category also, some are entirely dedicated to rice that has been produced along organic farming principles, others have newly opened an organic rice branch (Pichon, 2000). Belonging to the Camargue rice production system, other important actors are agricultural input retailers. Producers widely refer to them as a source of technical information and advice, seriously overlapping the CFR mandate. One of them developed a network of farmers whom he uses to carry out trials.

2.3. Researchers

Researchers are also involved. Rice is for them a research object and the focus point of an empirical domain of investigation. They mostly belong to three institutions and several scientific disciplines and specialities : i) CIRAD mainly invested in genetics and rice selection, ii) the "biological station of La Tour du Valat", funded by a foundation dedicated to environmental issues, is often seen as "ecologists", they are located in the protected environmental area of the Camargue and manage a rice farm. iii) INRA, is represented until now by a handful of committed agronomists, scientific and technical staff, "the Camargue team". These three institutions sit on the scientific council of the CFR that funds a significative part of CIRAD and INRA research activities in the Camargue. Thus any scientific or technical debate about research agenda priorities may possibly evolve into a competition for resources.

3. The production of agronomic knowledge ; an organised action system

3.1. Historical background

The presentation of the different categories underlines the interdependency of actors caught in overlapping systems, co-operative, union, contracted networks, advice centres, funding agencies and research institutions. The team began to work in the Camargue in 1984 by carrying out a first diagnosis based on the analysis of a sample of plots encompassing a range of agro-ecological situations in different farms of the area. It underlined three bottlenecks : crop installation, weed control and fertilisation. Then, they carried out trials in "milieu contrôlé" concerning fertilisation fractionating techniques or preparation to facilitate crop installation. As far as weeds were concerned, agronomists limited themselves to carrying out an inventory of species present. In 1992, agronomists, less numerous at that time, entered a new area of investigation at the farm level. Indeed, once created, the CFR took charge of technical support and applied research at the field level. The CFR was not interested in work

organisation whereas agronomists, along with a common trend in their discipline (see above), started to construe that issue as a determinant one in the explanation of farming practices. The use of the computer based simulation model that resulted from the researchers work, although praised by farmers who experimented it, has never been appropriated by the CFR. According to its decision-makers, it was not proper agronomy, and that is why, in 1997, prompted by an ominous economic context (European markets and regulations) and an apparent fall in the rice yields, the CFR asked for more research in agronomy, to increase the yields that CFR extension activities did not succeed in sustaining. This task has then been bestowed on the already known Camargue team. During this period, their enduring presence in the Camargue had enabled agronomists to develop interactions with numerous farmers, to produce an important and longitudinal agronomic data base and to undertake an important learning process that produced the basic knowledge about farmers and objects of action that the team mobilised to design and implement the reference network in 1998. Noticeably, in 1995, a second diagnosis was carried out and pointed out the same three bottlenecks as those identified in 1984. However, since that date, farming conditions have changed. The rice area has nearly reached its maximum potentialand mono cropping is now a common practice. Laser levelling of plots has been generalised and water control efficiency has increased. At the same time, weed control has developed as a totally new question since each year new chemicals have appeared and others have been discarded. Moreover, when farmers had to compute quantities measured by litres, they now face chemicals that are weighted per grams. Finally, with the general change in varieties, from high straw round grain ones to short straw long grain ones, a new weed has been identified as a problem, although it existed before. Wild rice is such a problem that a specific European scientific network, funding research programmes, has been set up. Agronomists decided to participate in and benefit from these funds to focus part of their investigations on this weed about which little is known. Very akin to domesticated rice, there are no available chemicals homologated for rice cropping. Moreover, wild rice seeds are present, although at a very low rate, in the commercial seeds, in accordance with Italian and European standards. However, one must not underestimate the aggressiveness of other weeds, protected as part of the natural environment, that surround plots where rice cultivation has been introduced at its most northern ecological limit. Indeed, the use of chemicals is heavy (30% of input costs) and their excess outflows are collected naturally in the laguna located in the National Natural Park, where water quality is controlled by the NNP staff. The problem is so acute that the CFR advice changes very often and it has even prescribed non-homologated chemicals.

3.2. the reference network

Since 1998, the reference network was established. It is seen as an organised action system wherein the chore object is a set of observation plots in rice fields. Farmers and agronomists are associated in data production through more or less tacit working agreements. Beyond them, farmers representatives, other scientists, wholesalers and input retailers are also caught in its web as they participate formally or informally in its evaluation or its funding. All those categories are in a situation of interdependency, struggling to get the best out of the technical, economic and sociological co-ordinations that frame their action. The number of plots oscillated between 1998 and 2001, from 40 to 20 back to 40. Among them the number of organic farming plots jumped from 5 to 16 due to the overall evolution of the context in society and inside the research institution (see below) and due to the fact that the three bottlenecks identified in the diagnosis, and specially weed control, were much more problematic in organic farming than in the other ways of farming. Farmers involved in the network are visited three times a year. The first meeting is meant to identify the technical programme of the farmer in order to be able to explain the data collected later on. This first

meeting of the year also enables a comparison with the previous year's programme and the assessment of changes and of their reasons. The second meeting is dedicated to a comparison between prevision and actual implementation and to the assessment of the state of the crop. The third meeting is a feedback session where results are presented. In each visit the exchange of information works both ways. Researchers collect information that they will partially use to explain their data and get a better understanding of the farming systems wherein the plots are located. At the same time, farmers get useful information for their farming decisions. Finally, this reference network is also completed with a presentation of the findings of each campaign to the scientific council of the CFR, once a year, and, to all the rice farmers belonging to the union during an annual meeting (attendance around 25%). All farming information is given anonymously, as required by participants in the network. As an organised action system initiated by questions rather by the identification of a potential solution, the reference network can be construed as a data production device in which information is bartered between farmers and researchers, where a better mastering of their production unit is sought by farmers, political approval by fund providers and scientific recognition by researchers. The development of the team's research programme has thus stimulated the rise of a complex network of interactions between heterogeneous actors initially interested in the design of more economical ways of farming. However, this question has then been transformed.

4. A change in the question

4.1. Environmental concerns ; a social learning process

Since 1997, the question addressed by the socio-technical device described above has progressively evolved from an interrogation about more economical ways of farming towards an interrogation about the economic and technical feasibility of environment friendly farming. This evolution occurred amongst farmers as well as amongst other stakeholders, and specially researchers. Among farmers, the initial question, driven by economic uncertainty still stands. Hence, some of them, observing the price of organically farmed products on the consumer market, higher than that of conventional ones, are prompted to look closer at this new way of farming, potentially input cost saving. Moreover, uncertainty about environmental impacts of conventional ways of farming may cast a doubt on the economic sustainability of other on-farm activities and incomes that developed during the nineties, linked with hunting or tourism. Besides these economic issues, health and environmental concerns are growing reflecting the trend in the society, and an increasing number of farmers are concerned by the pin-pointing of agriculture as the main polluting sector. This growing uncertainty and related questions have also instigated widespread criticism of the CFR and the advice it diffuses. Lately, several farmer representatives have been fined by the State administration for having used non-homologated weedicides on rice plots. Newspapers largely echoed this fraud and the overall image of the Camargue as a natural and protected area has been weakened. For many farmers, to keep on cropping in the same way seems more and more risky. This change in the questions raised by farmers shows how much their concerns, that is to say their values and their understanding of phenomena, have been transformed by their mere embeddedness in Society, thus illustrating the impact of a social learning process.

4.2. Organic farming ; an innovation process

When focussing on organic farmers, the growing uncertainty described above eased the conversion of conventional producers (from 1997 until now) to organic farming practices, early adopters ten years after the typical innovators. The latter, less than ten farmers, are not present in the reference network except one farmer who experimented organic farming in 1993, failed and did not keep on organic farming. Although not participating in the network,

innovators play an important role in the Camargue because some of them have integrated wholesaler and processor activities on the specific organic rice commodity chain. Moreover, their experience is highly valuable although still out of reach for most of the early adopters whose connection with them is limited to the sale of their organic rice wherein technical exchanges seem not to be present. Their relations with agronomists are also very scarce. Among researchers, the concern for environmental issues has quickly developed after the design of a development plan for organic farming by the French Ministry of Agriculture in 1997. Organic farming is seen as a new prototype to serve conventional farming in a sustainable development perspective. In the matter of weed control for instance, the constraints faced by O.F. may stimulate alternative solutions that could be integrated in conventional technical processes and make them more sustainable. Hence, notwithstanding the lack of strong support from the CFR, agronomists of the Camargue team progressively gave a bigger place in the network to organic farmers.

4.3. A need for a collective action system

The wide uncertainty that veils the different organic farming issues shatters the classical and implicit way of trading information. For farmers, agronomists are no more the last recourse for technical problems. It is no longer shameful to acknowledge that other farmers may know better and that pooling each other information may facilitate the production of organic rice farming knowledge in Camargue, seen as a common good. For agronomists, organic farmers are conducting trial and error learning processes that constitute the only seeds of a totally new agricultural prototype. They are also driven to co-operate with other disciplines, stimulated by the same new orientations of various scientific institutions. Downstream actors on the commodity chain are no more only concerned by the building of economic niches. They have to ensure that new ways of farming are possible (in quantity as well as in quantity) and that the common knowledge that is produced concerning it, is translated into a set of adapted norms. It suits the framework of a collective action system where rice is the object qualified in relation to different perspectives by actors acting “together” for the production of a common good (Livet *et al*., 1994).

5. The design of a learning tool.

For farmers, to belong to the reference network is an opportunity to get data (e.g. soil analysis), and an outside overview of their own activity and situation. But for an increasing number of them, a major breakthrough in decision making has been made ; one has to change and to find other ways of farming. The network becomes then an element contributing to their building up of representations of change within ill-defined situations. Routine is challenged at the field level as illustrated by the limited efficiency of conventional chemical management of weeds.

At the farm level, work organisation has also to be rethought. It also raises issues related to other actors of the Camargue rice system, such as getting clean seeds and cultivars adapted to these new practices. Moreover, the sustainability of innovation is linked to the search for a profitable outlet for the final product and the co-ordination with stakeholders along the commodity chain is at stake. This is not only related to organic rice but also to all the products that could be included in a rotation such as durum wheat, sunflower, soybean or other legumes. Thus appears the need to extend the interactions organised around the set of observation plots beyond their current limits. Other farmers have to be associated as well as other stakeholders, individual or collective. However, this could be achieved only if effective knowledge is produced, if learning processes are effectively triggered.

5.1. Simulation, a learning tool for dynamic situations

From a cognitive viewpoint, farmers can be seen as actors engaged in dynamic situations characterised by complexity, uncertainty, interactivity. Complexity means that the situation is an indivisible whole, uncertainty emphasises the impossiblity of programming a sequence of elementary actions and interactivity underlines the fact that actors modify the situation by acting. Didactic experiments show that learning about such dynamic situations, all the more so as they call for the construction of anticipation strategies, has much to benefit from the use of simulation activities (Pastré, 2000). A first attempt to build a model of the situations faced by farmers has already been successfully carried out. Nevertheless, to the farmer's regret , the model focused on work organisation and did not integrate bio-physical and economic aspects (Barbier, Mouret, 2000). Indeed, although a rather important volume of data has been collected by agronomists year after year, it has not yet been compiled for use in the modelling of rice development. Moreover, a data base related to organic farming management is still non-existant. Hence, in order to build a tool contributing to the farmers' learning process, research programmes have to use the reference network to feed a bio-physical and economic data base and design a more encompassing model than the one already tested. On farm trials have been already implemented concerning mechanical weed control on several plots of the network. Their results could enable to extend a data base still limited by the relative small numbers of plots and even smaller number of technical processes in use. This stands for other experimentation activities that could be carried out according to the progressive identification of new problems related to the farmers' situations. Noticeably, Pastré stresses the fact that, in training activities using simulation, elicitation of what happens is a key issue in the learning process. In his sense, it is a specific moment of objectification that allows the transformation of tacit knowledge to a set of functional variables, action parameters and indicators that can be opposed, verified or exchanged. Hence, to overlook this moment may hinder the efficiency of the contribution of simulation to the overall learning process and a special attention has to be given to it by researchers.

5.2. Open spaces for sense-making and social relations

In any case, models cannot fully reflect the complexity of reality which can not be reduced to the aspect of a linear learning process driven by strategic rationality. Questioning simultaneously the different levels where change is in demand underline the radicality of the phenomenon. In addition to the difficulties inherent to any kind of radical change, organic farming in the Camargue presents specific constraints which weigh on learning as a "singular, socially situated and mediated, path-dependent experience" (Barbier, Lémery, 2000). Innovators, who have been kept on the sideline for years, have secured (at least some of them) an economic niche that they protect jealously. Thus, early adopters lack relevant exchanges with the latter. These exchanges are all the more needed as farmers are raising questions related to their project and their situation, acting conformably to a situated learning process wherein the "structure of cognition is widely distributed throughout the social and physical environment" (Ison et al., 1999). Precisely, the physical environment is not the less important specificity. Inundated rice nearly does not exist elsewhere in France and other rice production areas in the world are located at lower latitudes. Hence, reference for conventional production is limited or biased. Moreover, agronomic research about organic farming in general is weak in France (Bellon et al., 2001) and Europe and references in rice organic farming do not exist. Finally, farmers are relatively isolated in their search for general orientations as well as for precise technical answers to practical problems. In this respect, the reference network could be used as a tool for farmers to restore the sense-making convergence and the social stability that fit their quest for technical solutions. This definitely could not be facilitated solely by

face to face interaction with agronomists during individual simulation activities or on field observations. Indeed, farmers are entangled in social relations, but those relations, historically built, are not always helpful to design answers to their current questions, to carry out their actual learning process (Chiffoleau, 2001). So, researchers' intervention has to include a specific dimension dedicated to the analysis of social relations and their knowledge content and the promotion of social spaces wherein peers may acknowledge each other and engage in collaborative learning processes towards collectively formulated problematic issues (Darré, 1996) or wherein different categories of stakeholders could meet, confront their actions or negotiate and ease their conflicts (Röling,1994). Within these social spaces, data produced within the reference network, the results of the different trials and simulation models are intermediary objects that could ease the convergence process (Rogers, Kincaid, 1981) between farmers, non farmers and researchers of different disciplines.

5.3. A multidisciplinary system

Indeed, re-thinking the use of a reference network within a set of other intervention research methods, aiming at the broadening of the actors repertoire of choices, calls for the association of agronomists with other disciplines. Among them, new ecological concerns push ecology into first place, its role being to collect the related data in the reference network, and to establish indicators enabling the measuring of the impact of farming on the environment. The weed issue is such an important bottleneck in organic farming that specialists in this domain will have to keep on monitor the weed dynamics related to the different farming practices and the range of techniques experimented on trial plots. Agronomists will have to extend their observations to the other crops that are associated in rotation systems. Finally, plant breeders will have to identify relevant criteria to perfect the selection of cultivars adapted to new ways of farming. In addition to these disciplines, human sciences have an important part to play. Micro-economists should contribute to the evaluation of the efficiency of the different practices in use in the reference network and integrate these results in wider economic computations and analyses, at the level of the activity system. Findings are meant to feed the design of simulation models. Social sciences are needed to analyse and facilitate the interactions that contribute to the learning processes, among which researchers' intervention is included. This could be centered on the farmer category but may also investigate the commodity chains, downstream (rice markets) and upstream (seed supply). Associated with economists, they can build enough material to contribute to the decision-making of other stakeholders. Indeed, the idealistic use of a reference network designed to ease the local learning processes necessitates tight co-operation between different disciplines. This cannot be achieved without a common interest towards change, the willingness of each discipline to keep abreast with what is going on in the fields, among actors. Whereas, each discipline can legitimately direct part of its research towards less contingent topics, it must also investigate the current state of that part of the reality their knowledge is meant to highlight. This disciplinarian commitment to the reality is stimulated and fuelled by the encounter with the other scientists, eliciting and seeking elicitations about each other's research practices and findings. It cannot work informally as the team used to do in earlier days. Formal meetings have to create the relevant social spaces for the more numerous scientists to feed each other's researches. This organised and collective reflexive analysis is the condition for an agronomic reference network to produce a learning tool for stakeholders and, more specifically, a learning tool for researchers.

Conclusion

A reference network has been designed by agronomists to answer questions about economic ways of farming. This organised action system has benefited a small number of farmers but is not efficient enough, because of its scope and of its functioning, to cope with the wide uncertainty that emerged parallel to changes in society. Organic farming calls for the transformation of the network into a learning tool for different stakeholders. The system has to evolve towards a collective action system that reshapes the nature and the content of interactions between actors. In the Camargue, the ratio of farmers engaged in organic farming , around 10% is much higher than the French average, although their number is very small, 20 out of 200. Hence, high proportion and small size make rice production a convenient laboratory to study and contribute to the on going learning processes triggered by the rise of environmental concerns among the different stakeholders, including researchers. Observation, enquiries, experimentation, modelling, simulation, historical investigation, facilitation and reflexive analysis are the main methodological elements that have to be co-ordinated in a multidisciplinary research Identity. Thus, researchers are enabled to build a relevant form of social capital, relative to their project (Chiffoleau *et al.*, 2001.), the carrying out of the three tasks on INRA's research agenda concerning organic farming (Bellon *et al.*, 2000); description of practices and phenomena, adaptation of what may be of any use, formulation of new questions.

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