

Chapter 8

Contribution of Research to Innovation Within Agri-Chains

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Historically, the linear model of knowledge creation and technology transfer has dominated the conceptions of agricultural development (Hermans et al. 2013). Agricultural knowledge originated within universities and research centres and was disseminated through advisory and support mechanisms, funded primarily by States or by development projects driven by international cooperation. The assumption was that the technologies proposed by the researchers were based on an optimal comprehension of the dynamics of production systems and agri-chains or filières, and that factors of adoption were relatively well-understood (Leeuwis and Van den Ban 2004). Even though this linear model of technology transfer has allowed an unprecedented increase in production and productivity, it has, however, been called into question. Its responses to the issues of sustainability and development pertaining to the multifunctionality of agriculture in rural areas have been found wanting (IAASTD 2009). Following the observation that agricultural innovation is not necessarily linked to the direct application of research results, new approaches focused on supporting innovation have been proposed. These approaches allow a more in-depth examination of the processes underpinning technical, social, and institutional changes in a perspective of increased sustainability of and productivity in agricultural systems (Touzard and Temple 2012). It then becomes a matter for the research community to see how its activities and its products can facilitate or initiate these changes (Röling 2009).

Much of the research conducted at CIRAD has been focused for some time now on producing knowledge on agri-chains in countries of the South, with a strong

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commitment to capacity building of local actors. These research efforts have led to an evolution of practices, most notably with the creation of socio-technical devices and modalities of multi-actor partnerships for innovation, now essential components of most research and development projects. Their effects on innovation and development processes are, however, not always properly understood and internalized (see examples in Chap. 9). To improve understanding of their benefits and limitations in supporting innovation processes within agri-chains, we will describe the theoretical foundations of the links between innovation processes, organizations of agri-chains, and capacity building.

We present first a systemic approach to innovation which allows the reconsideration of the role of knowledge production and dissemination mechanisms in multi-actor interactive processes. We then present the theory of transition that allows a rethinking of the support for dynamics of development in the agri-chains, most notably the scaling up of local innovations. Once these concepts are presented, we specify the characteristics of innovation processes in agri-chains in the South and discuss the contributions of research.

8.1 Innovation Systems and Socio-technical Transitions: Key Elements in Rethinking Support for the Development of Agri-Chains

8.1.1 Innovation System, Capacity Building, and Incentives to Innovate

Agricultural innovation can be seen as a process of co-evolution between technical, social, economic, and institutional changes (Klerkx et al. 2012). It is now widely accepted that agricultural innovation is a result of an interactive process that involves many public actors (State services, public research institutes, universities, etc.) and private ones (businesses, banking services, etc.), even from domains of activity outside of agriculture (Alter 2005). In a comprehensive perspective, the agricultural innovation system is then defined as all individuals, institutions, organizations, and networks, formal or informal, interacting around the implementation of new technologies, products, processes, services, or forms of organization (Hall et al. 2006). In this perspective, learning plays a key role in generating innovations by helping build up individual skills or promoting organizational changes in pursuit of greater efficiency of the institutions involved (Lundvall 1992; Malerba 2002). The types of actors involved and their modes of interaction determine the efficacy of the learning processes – and whether learning is even possible – and thus of innovation (Hermans et al. 2013). The existence of trading, learning, and cooperation mechanisms (platforms, partnerships, networks) seems to be a factor for facilitating and incentivizing innovation (Spielman and von Grebmer 2006). While public research and advisory and support services are no longer regarded

as the driving forces behind these mechanisms, they remain actors able to fulfil essential functions pertaining to the creation and dissemination of new knowledge, identification of the need for new technologies, orienting and guiding the design of the innovation, and building up of the capacity to innovate of the actors involved (Spielman et al. 2008).

8.1.2 Innovation Niches, Socio-technical Transitions, and Lock-In Effects

The theory of transition – a recent concept – helps explain how innovations can spread beyond the framework in which they were designed and create significant impacts on development at much larger scales (Rip and Kemp 1998; Schot and Geels 2008). Three analytical levels can be distinguished, ranging from the local to the global: innovation niches, socio-technical regimes, and the socio-technical landscape.

Innovation niches are places where new solutions are tried out in a given local context. They are considered the potential starting point for significant changes in the dominant socio-technical system, leading also to social changes. They thus correspond to incubator communities isolated from normal operation of the dominant regime and protected from potential market selection effects (Kemp et al. 1998). Disruptive innovations that lead to radical changes first appear at these microlocal scales.

The concept of the socio-technical regime allows the interweaving of social and technological effects to be translated into the definition of a set of rules, procedures, arrangements, and routines that govern the choices and activities of the different actors who are together involved in designing an innovation. For its part, the socio-technical landscape corresponds to the environment outside the influence of local and national actors (the effects of globalization, cultural or historical factors).

Transition refers to the evolution from one socio-technical regime to another. It depends on the interactions between the processes taking place at these three levels of organization, i.e., niche, regime, and landscape. A technological paradigm (such as intensive input use) can be a real lock preventing a transition, even if a more useful or more efficient technology exists (such as agroecological techniques). Studies have shown how such a lock-in situation may discourage actors from adopting organizational and production methods that do not conform to existing standards. There are even so-called self-reinforcing mechanisms that strengthen the initial technological choice, such as increasing returns of adoption, technological compatibility, and the actors' organizational structure (Meynard et al. 2013).

In working with institutionally different standards and rules, the innovation niches allow learning and the construction of economic networks capable of supporting innovation in agri-chains at the level of their different links. By

structuring themselves, these niches can facilitate the unlocking and overcoming of the self-reinforcing effects of the standard socio-technical regime.

8.2 The Features of The Innovation Process in Agri-Chains in the South

In countries of the South, support for innovation processes in agri-chains must take into account four key structural elements that can represent barriers and opportunities.

8.2.1 The Value Chain's Organizational Structure

The process of emergence of an innovation within a niche requires coordination between actors. The value chain, the entirety of financial and contractual links that determine the rules for sharing value between the upstream and the downstream, is a privileged space for coordination (Fares et al. 2012). This coordination between actors of the value chain's different links can be apprehended by the degree of vertical integration, i.e., the degree of contractual, financial, or property relations between entities (Porter 1998). The integration, or quasi-integration, helps reduce information asymmetries between actors (Hennessy 1996) and can thus help overcome problems caused by the lock-in effect. Fares et al. (2012) however show that a value chain's organizational structure may also constitute in itself a lock-in mechanism when it restricts the upstream distribution of the value realized from the marketing of processed agricultural products and, in this way, may reduce the innovation capacity of some actors.

8.2.2 The Role of Businesses and Entrepreneurial Dynamics

While it is widely recognized that the entrepreneur can play a key role in innovation by creating commercial activities (Schumpeter 1934), this is always not so easy in the agrifood sector in the context of the South due to:

- difficulties in fostering entrepreneurship. The creation of a commercial activity begins with an initiative, a readiness to take on a challenge requiring a low aversion to risk. But in the South, there are few measures taken at the national level to reduce such risks and thus encourage entrepreneurship. Chiffolleau and Prevost (2012) have shown, however, that short food supply chains offer an excellent opportunity for entrepreneurship in accompaniment with social innovation in agriculture;

- difficulties entrepreneurs have in identifying and grasping existing opportunities. In some cases, they are unable to respond to changing consumer needs or to identify opportunities for modernizing farms. For example, in many African countries, investment in the adaptation of agricultural or agrifood equipment to the constraints of small family farms is sorely lacking even though the need certainly exists (Havard and Side 2013);
- difficulties in bringing products to market that meet the challenges of ecological intensification and food security at competitive prices.

8.2.3 The Importance of Territorial Anchoring

In agri-chains, territorial aspects are of foremost importance. As studies on localized agrifood systems have shown (Courlet 2002; Muchnik et al. 2007; Perrier-Cornet 2009), the leveraging of local resources and the mobilization of local actors around these resources constitute drivers of innovation. Conversely, the territory can also impose limitations on innovation. This is the case, for example, of the impacts of pesticide pollution that influence changes in agricultural practices (Jannoyer-Lesueur et al. 2012).

The relationship with all that is local and the differentiation of networks of actors intervening across territories help in the consolidation or emergence of different models of agricultural development. These models are each backed by specific coalitions of actors, sometimes also involving researchers, and serve as technical and policy references for the agri-chain's actors. These models can coexist, compete, or hybridize between themselves at different territorial levels.

8.2.4 Asymmetries Between Actors of the Agri-Chains and Public Policies

In contexts in which agri-chains are still inadequately structured or are sometimes 'captured' by some actors, public policies have an important role to play by, for example, pairing the support for farmer innovations, through capacity-building actions and measures, to incentive policies (through subsidies, taxes, regulations, etc.). Thus, in certain agri-chains where the downstream is highly industrialized, the technological constraints of these industries can exert lock-in effects on technical innovations in the upstream part, as may be the case for varietal changes or modifications of cropping systems (de Lapeyre de Bellaire et al. 2010).

8.3 Contributions of Research

The research community continues to be a major actor in the innovation process, both through its involvement in the provision of resources necessary for the innovation process (new knowledge, new products, or skills) and in the design of new socio-technical devices for supporting innovation processes.

8.3.1 *Renewing Knowledge on the Functioning of Agri-Chains with the Actors*

So far, there existed four ways through which research could contribute to knowledge concerning the innovation process (Morand and Manceau 2009):

- Fundamental research. It is not directly related to innovation but can enrich a knowledge base that can be mobilized for innovation (knowledge of genetic and/or physiological mechanisms of plants and animals, studies of technological processes, macro-economic or sociological trends, etc.);
- Applied research. It aims to acquire knowledge for a practical application (studies of the effect of environmental conditions, of the impact of pests and cultivation practices on the functioning of plants; effects of a process on a product's characteristics, etc.);
- Experimentation. It leads to the development of a technique or process to achieve an expected effect (development of a technique to fight a particular disease, development of a technological process for manufacturing a food product, development of an industrial prototype, etc.);
- Technological adaptation. It helps in adapting a technique or method to specific contexts (adaptation of a pest or disease control method to a particular context, adaptation of an existing technological process to a new product, adaptation of an agricultural technology to a new group of actors).

With the linear model of knowledge and technology transfer being called into question, mechanisms for co-construction with the actors of knowledge for managing new agricultural and food systems have come into focus (Barbier and Goulet 2013). The human and social sciences have thus found a more prominent place in research on agri-chains for devising and experimenting with new approaches for co-designing innovation. Participatory approaches and modelling for the design of new production systems (Andrieu et al. 2012), mechanisms for farm support that take household strategies into account (Terrier et al. 2013), and social experiments to promote inclusion (Chiffolleau and Prévost 2012) are all methodological and organizational innovations to facilitate changes in pursuit of increased sustainability. The mobilization of expert and common knowledge in these mechanisms calls for a re-examination of knowledge production processes, the tools used, and the

relationships between researchers and actors of development (Fofiri et al. 2015; Goulet et al. 2015).

8.3.2 Mobilizing and Disseminating Knowledge: The Importance of Expert Appraisals at the Request of Actors of Agri-Chains

The expert appraisals undertaken by CIRAD are part of a privileged form of knowledge mobilization and dissemination and lead to a mutual enrichment between development and research. They are conducted in response to diverse requests from individuals, private companies, producer organizations, development agencies, institutional funding entities, or governments. The different actors of agri-chains find CIRAD's knowledge base structurally attractive because this knowledge has, in general, been obtained over long periods and across several agri-chains and territories. Furthermore, CIRAD is also a repository of knowledge shared and enriched through dialogue between groups of specialists (agronomists, specialists of diseases and pests, geneticists, technologists, economists, etc.), and this multidisciplinary expertise can be pooled in response to a request. CIRAD's expertise can be individual, collegial, or institutional.

The application of the knowledge base in new contexts (partners, terrains, adaptations of existing technology, etc.) typically adds back to the available experience and knowledge, and thus makes them more robust. In addition, the diagnosis undertaken usually allows scientific inquiry to be brought to bear on a reality that is undergoing continuous renewal.

Thus, through requests of the various actors of the agri-chain, the expertise available allows the research community to respond to the needs of the moment and produce immediately usable results, while using the knowledge base to renew research issues from the necessary perspective (Fig. 8.1). This feedback loop allows, at the same time, to stimulate innovation, to tailor innovative products to different contexts, and to renew the demand for innovation addressed to the researchers by the agri-chain.

8.3.3 Contributing to Capacity Building

When individuals, communities, or organizations acquire or implement new capacities and skills, changes can take place: changes in policy, practices, or products, which ultimately contribute to innovation, or even to development. Capacity building involves the acquisition of new knowledge or new skills, usually over periods long enough to allow time for learning cycles to unfold.

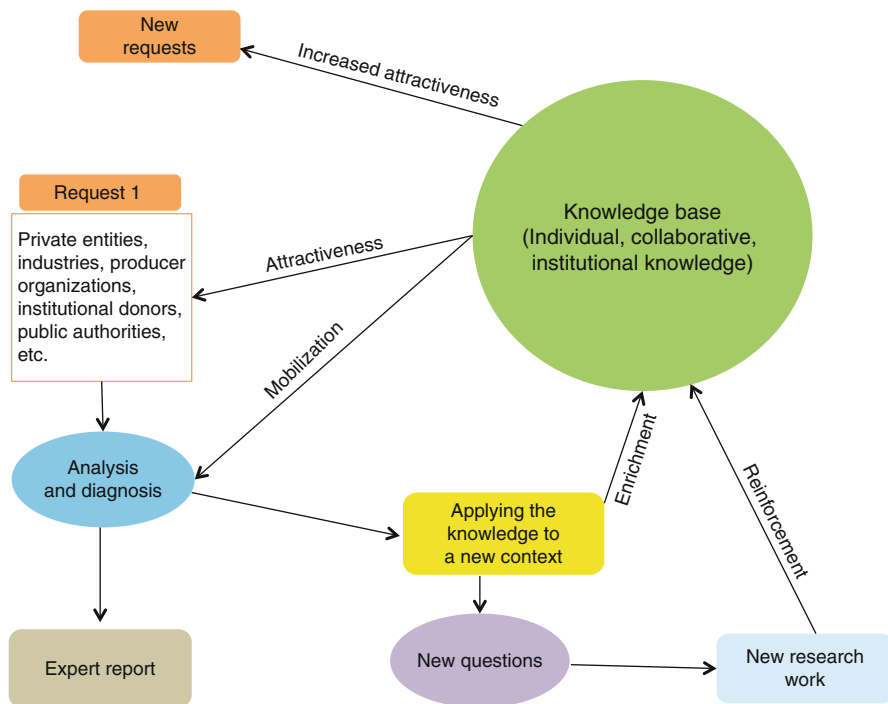


Fig. 8.1 Reciprocal contributions of expertise to research and development through production and the provision of knowledge

Research activities generate different resources that help this capacity-building process: socio-technical devices and learning materials and aids.

8.3.3.1 Socio-technical Devices

Socio-technical devices are arenas for collaboration between researchers and actors of development, supported by financial and human resources, which allow learning cycles to take place through knowledge sharing, discussion, experimentation, and evaluation, with the aim of providing answers to problems, to introduce changes, or to innovate. Examples include mechanisms for action research in partnership (Faure et al. 2010) or multi-actor platforms (Kilelu et al. 2013). However, their effectiveness is not systematic. Jatoe et al. (2013) show that intense interactions around a shared goal in a formalized framework are not necessary to the development of certain agri-chains.

8.3.3.2 Learning Materials and Aids

Learning materials and aids include scientific courses designed for students and researchers, as also professional training for agricultural advisers, technicians, and staff of development organizations and private firms (Box 8.1). In the case of CIRAD, these courses are offered in a variety of areas (plant science, crop protection, product technology, etc.) and can include technical guides (books, data sheets, CD-ROMs, films). Many of these documents have become key information sources for practitioners and are the only ones of their type available to them. Thus, for the cotton chain, a comprehensive series of technical manuals has been published and is updated regularly: identification guides to cotton pests and diseases in sub-Saharan Africa (Cauquil and Vaissayre 2004) and in Brazil; an economic approach to cotton chains (Nubukpo 2011); a manual on the quality of cotton chains in the eight West African countries belonging to the UEMOA monetary union, which covers aspects ranging from production to marketing (Crétenet et al. 2006; Chanselme et al. 2006; Amadou and Bachelier 2006; Gourlot et al. 2006; Diop and Bachelier 2006).

Box 8.1 Training of Sofitex Agricultural Advisers in Burkina Faso

Pierre Rebuffel

As part of its cotton revival programme (1996), the Burkina Faso Textile Fibre Company (Sofitex) scaled up its field presence, increasing its staff strength from 31 to 400 between 1993 and 1998. At the core of its field strategy were 130 cotton correspondents recruited with a high level of initial training (engineer level).

Between 1999 and 2002, Sofitex conducted training programmes for these cotton correspondents with the support of CIRAD in order to better respond to changing demands for support of cotton farms. This programme consisted of two components:

- training in overall farm analysis, so that agents could better apprehend the variety of producer expectations;
- an action-training component to help agents acquire methods and tools so that they could support producers in taking major farm-management decisions.

Even though the Burkinabe cotton sector was subsequently privatized (2004), the new cotton companies (Sofitex in the west of the country, Faso Cotton in the centre, and Socoma to the east) continue to rely upon these skills. They still form the basis of the support mechanism for producers supplying these companies.

8.4 Conclusion

Many innovations emerge independently of any involvement of public or private research (for example, agroecology and organic farming when they began in France, direct seeding in Brazil). Other innovations originate mainly from research: new varieties, new inputs, new sanitary control technologies, and new forms of organization. The role of the various actors, and therefore of research, in the innovation process varies, both in content and in intensity.

The innovation system approach is a framework that permits the conditions that impede or facilitate the innovation process to be analyzed. It is also conducive to a rethinking of the modalities of intervention by research based on the functions that it fulfils within innovation systems. While research does sometimes contribute significantly to innovation, it is not its sole preserve; other actors can also play a fundamental role, with or without interaction with research. It is therefore not always easy to specify the innovation that stems from research activities, especially because innovation always incorporates technical, organizational, institutional, and social dimensions.

Furthermore, every innovation does not necessarily contribute to development in exactly the way various local and national actors expect it to. Microlocal innovations, at the level of ‘niches’, which is the research community’s preferred level of intervention, are not all viable and undergo a process of selection (Nelson 1993). The transition theory approach can be used to reveal the different possible trajectories of innovations and the multiplicity of levels at which research can intervene, as intermediary, facilitator, leader, or just a partner. In Chap. 9, we will see different examples of the ways in which research at CIRAD contributes to innovation processes within agri-chains and the various forms of partnership that this involves.

Monitoring and assessing the impacts of research on development in general, especially that of agri-chains, represent a major new challenge for cooperation for development. International public research is being increasingly called upon to show how it contributes to solving major challenges of food security, climate change, and agroecological transitions (Gaubert et al. 2015). In this perspective, CIRAD has invested its resources in developing impact assessment procedures tailored to contexts of the South and in different innovation processes in which it is involved (Triomphe et al. 2015). The knowledge produced should be able to help researchers and other stakeholders cast a critical and reflective look at the effectiveness of practices of research in partnership and, at the same time, improve the contribution to the processes of innovation themselves.

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