

## Chapter 14

# MAKING SENSE OF INNOVATION PROCESSES IN AFRICAN SMALLHOLDER AGRICULTURE

**Bernard Triomphe<sup>1</sup>, Anne Floquet<sup>2</sup>, Geoffrey Kamau<sup>3</sup>, Brigid Letty<sup>4</sup>, Conny Almekinders<sup>5</sup> and Ann Waters-Bayer<sup>6</sup>**

<sup>1</sup> CIRAD UMR Innovation, France.

Email: [bernard.triomphe@cirad.fr](mailto:bernard.triomphe@cirad.fr)

<sup>2</sup> Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, Bénin.

<sup>3</sup> Kenya Agricultural Research Institute Headquarters, Kenya.

<sup>4</sup> Institute of Natural Resources, South Africa.

<sup>5</sup> Knowledge, Technology and Innovation Group, Wageningen University and Research, The Netherlands.

<sup>6</sup> Educational Training Consultancy Foundation, The Netherlands.

### Abstract

The European-funded Framework Programme 7 project, Joint Learning in Innovation Systems in African Agriculture (JOLISAA), assessed agricultural innovation experiences focused on smallholders in Benin, Kenya, and South Africa. Fifty-six cases were characterized through review of grey literature and interviews with resource persons, according to a common analytical framework inspired by the innovation systems (IS) perspective. Thirteen of the cases were assessed in greater depth through semi-structured interviews, focus group discussions and multi-stakeholder workshops. The cases covered a wide diversity of experiences in terms of types, domains, scales, timelines, initiators of innovation and stakeholders involved. Findings revealed multiple triggers and drivers of innovation. For external stakeholders, key triggers included likelihood of offering a technological fix to an existing problem and availability of funding. For local people, access to input and output markets was a powerful trigger and driver. Market types and dynamics varied greatly. Developing functional value chains and accessing markets proved particularly challenging, especially for poorer and weakly organized farmers. Over long periods, determinants of innovation changed dynamically and often unpredictably, including motivations of key stakeholders, triggers, drivers and stakeholder arrangements. The direction of innovation evolved, often moving from a technology entry point to more organizational or institutional issues. A recurring challenge for fostering innovation is whether and how to build on local initiatives and knowledge, and how to sustain externally driven innovation processes beyond the project time frame. A major conclusion from JOLISAA is that innovation has to be seen as a continuously evolving process of 'innovation bundles' (a combination of different types of innovation) of various kinds, rather than as a pre-planned, and usually, narrowly-defined technical intervention. Consequently, open-ended, flexible approaches to innovation are needed with the

potential to engage meaningfully over a long time with local stakeholders and bearers of local innovation dynamics, so that they take full charge of the innovation process and direction.

**Keywords: Analytical framework, Flexible, Triggers, Drivers, Local innovation, Markets**

### **Introduction and Objectives**

Using an IS approach or perspective has become fashionable both for understanding and fostering agricultural innovation. Over the past two decades, scholars, development professionals and a wide array of organizations have increasingly paid attention to innovation and how it can best be nurtured in different contexts (World Bank, 2006; Geels and Schot, 2007; Waters-Bayer et al., 2011; Adekunle et al., 2012; Hounkounou et al., 2012; Klerkx et al., 2012; World Bank, 2012; Touzard et al., 2014). Creating and maintaining a dynamic innovation scene seems essential to adapt to a fast-changing world in which climate change, food security, increasing urbanization, globalization, or environmental concerns, all contribute to re-assessing the values, performance and current practices of economic actors and sectors (Malerba, 2007).

Yet the IS concept remains fuzzy, and its application is not without problems. Furthermore, relatively little is documented about how innovation processes unfold in smallholder agriculture. Numerous studies have revealed that innovation takes place within heterogeneous networks of researchers, farmers, private entrepreneurs, non-governmental organizations (NGO), government agents and other stakeholders (Hall and Clark, 2010). In such networks, stakeholders interact in a non-linear, iterative and non-predictable fashion to solve pressing problems, adapt to new conditions or take advantage of new opportunities. The focus and outcome of such interactions usually consist of a mix of technical, organizational and institutional innovations developed and refined 'on the go', often quite different from what the initiators envisaged. Hounkounou et al. (2012) further stressed the primary importance of institutional factors in hindering innovation in a developing country context such as in West Africa.

Within such a background, the EU-funded JOLISAA<sup>1</sup> project endeavoured to assess recent innovation experiences in smallholder farming in Benin, Kenya and South Africa involving multiple stakeholders (Triomphe et al., 2013). The aim was to find out how innovation unfolds, what roles different stakeholders play, what knowledge and other resources each of them contribute, what effects the innovations bring, and what conditions favour or impede innovation processes. Based on such an understanding, JOLISAA developed concrete recommendations for policy, research and practice.

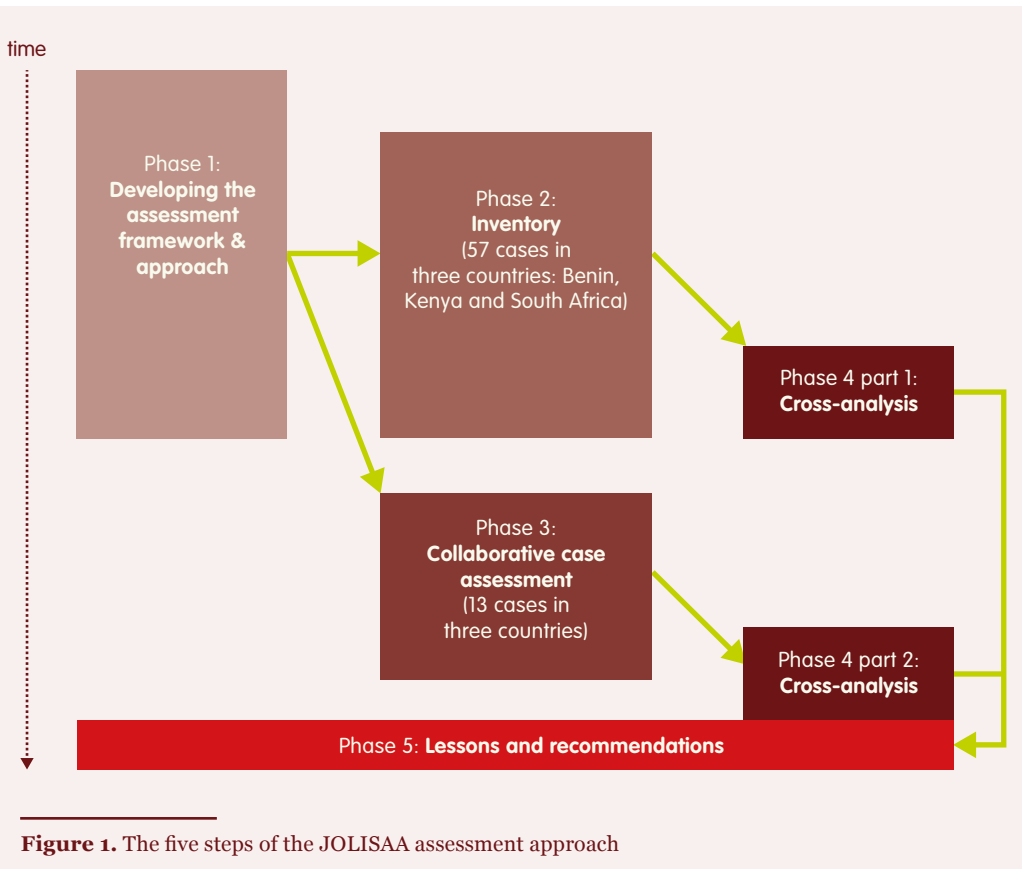
This chapter tries to make sense of the added value and challenges of applying an IS perspective by summarizing the key insights about innovation processes gained from an initial analysis of the results produced by the JOLISAA project. It also draws lessons and recommendations about how best to assess and support innovation.

---

<sup>1</sup> See [www.jolisaa.net](http://www.jolisaa.net) for a comprehensive overview of the project's approach and results

## Materials, Methods and Data Sources

JOLISAA undertook its assessment in five major, partly overlapping, phases (Figure 1): 1) development of an analytical framework; 2) inventory of innovation cases; 3) collaborative case assessment; 4) cross-analysis of cases; and 5) development of policy recommendations.



**Figure 1.** The five steps of the JOLISAA assessment approach

### *Analytical Framework*

To facilitate subsequent cross-analysis among cases and countries, JOLISAA started by developing a common analytical framework for describing and assessing the various experiences. The framework was divided into two successive sets of guidelines and instruments; one for the inventory and one for the collaborative assessment (see below). It draws on the IS concept and perspective (Hall et al., 2003; World Bank, 2006; World Bank, 2012) and actor-network theory (Latour, 2005). Among others, it focuses on: innovation type, nature and domain; stakeholders, their roles and interactions; innovation triggers and drivers; innovation history; and results and outcomes obtained (Table 1). For the collaborative case assessment (phase 3), whenever possible, concrete suggestions were developed for contributing to a possible way forward in terms of how the innovation process could be boosted/pursued. However, given its short duration and resource limitations, JOLISAA did not engage in actual action-research.

**Table 1.** Main categories and variables used in the assessment framework

Theme/dimension/variable	What JOLISAA wanted to know about it
Local innovation context	General agro-environmental and socio-economic information
Innovation: type, nature, domain	What was the diversity of innovations addressed?
Stakeholders' roles and interactions	Who have been leading or active stakeholders? What type of coordination took place among stakeholders?
Role of local knowledge	What role has local knowledge played?
Innovation triggers and drivers	What have been the key triggers and drivers of the innovation process?
Innovation dynamics	What have been the key phases the innovation process went through?
Scale at which innovation is taking place	Did the innovation process take place mainly at local, regional or national scale, or at several scales?
Results and 'impact' obtained	What have been the effects so far, positive or negative, intended or not, in the different dimensions?

*Source: Adapted from Triomphe et al. (2013)*

### *Inventory of Innovation Experiences*

The main criteria for considering cases for inclusion in the three national inventories of agricultural innovation experiences were: 1) smallholder and other resource-poor rural stakeholders actively involved; 2) at least three different types of stakeholders involved; and 3) at least 3 years' experience beyond the initial stages of innovation. Cases were sought through: a literature search; interactions with resource persons in universities, research institutes and networks within the national agricultural innovation landscape; drawing on JOLISAA national team members' prior knowledge of specific innovation cases; and seeking innovation within a given region, area or farming system in each country. Field visits were also made to supplement the available documentation. The products of the inventory are two-fold: short qualitative semi-structured narratives describing the 57 cases, and a Microsoft Excel database in which each case is characterized through a series of semi-quantitative descriptors.

### *Collaborative Case Assessment of Selected Innovation Cases*

Out of the 57 cases inventorised in the three countries, the JOLISAA team selected 13 for collaborative case assessment (CCA), in which representatives of local stakeholders were involved alongside JOLISAA researchers and MSc students. The cases selected (Table 2) represented the seemingly richest and most complementary sets of experiences, as well as the ones that had been the most dynamic over recent years and had key stakeholders interested in joint learning about their respective cases. These cases were assessed with respect to the actual roles and contributions of the different actors, the nature of linkages between them, the history and dynamics of the innovation process over time in relation to external factors, and the role of local knowledge and creativity. The assessment was also forward-looking: it identified specific recommendations for moving the innovation process forward.

**Table 2.** Diversity of cases selected for collaborative assessment within the JOLISAA project framework

Country	Domain: natural resource management	Domain: new value chains
<b>Benin</b>	<ul style="list-style-type: none"> <li>• Integrated soil fertility management for new high-value products (~ 15 years)</li> <li>• Indigenous intensification in aquatic agricultural <i>hwedo</i> system through chilli pepper (several decades)</li> </ul>	<ul style="list-style-type: none"> <li>• Parboiled rice value chain (~ 10 years)</li> <li>• Soybean food multiple value chains (~ 40 years)</li> </ul>
<b>Kenya</b>	<ul style="list-style-type: none"> <li>• Using by-products for soil rehabilitation and securing access to lime (10 years)</li> <li>• Prosopis management for charcoal and fodder value chains (~ 30 years)</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis of the innovation process linked with the activation of a natural resource in Baringo, Kenya (~ 30 years)</li> <li>• Gadam sorghum for beer and other processed food (~ 8 years)</li> <li>• Mango production, processing and marketing (~ 20 years)</li> <li>• Solar cooling of milk (~ 5 years)</li> </ul>
<b>South Africa</b>	<ul style="list-style-type: none"> <li>• Rainwater harvesting techniques for field and vegetables crops (~ 10 years)</li> <li>• Soil fertility management experimentation through development of an innovative participatory extension approach (~ 15 years)</li> </ul>	<ul style="list-style-type: none"> <li>• Bulk buying combined with credit and saving groups (4 years)</li> </ul>

*Notes: years indicate time frame considered for assessing the innovation process.*

*See [www.jolisaa.net](http://www.jolisaa.net) for access to individual case study reports*

CCA methods used included, among others, a mix of collective and individual semi-structured interviews, focus group discussions with key stakeholders, multi-stakeholder assessment workshops, direct observations and a bibliographic review of grey literature related to the cases.

### *Challenges for Assessing Innovation Experiences and Implementing an IS Perspective in Practice*

During the assessment process, and notwithstanding significant resource limitations, which affected the choice of methods and the duration and intensity of the assessment phase, the JOLISAA partners faced several major challenges which affected the outcome in various ways.

For one, it proved to be a major challenge to develop a common understanding of innovation-related concepts and an ability to use proposed case assessment methods based on an IS perspective. Despite JOLISAA's efforts, success was only partial. Their different disciplines and professions led those who interacted within the JOLISAA framework to use such concepts as innovation processes and systems, stakeholders, enabling environment, and local knowledge in different ways, and this translated into a sizeable heterogeneity in the way cases have been assessed. Furthermore, limited generic research and IS skills (especially among young professionals), and high turnover rates of staff within national and case-specific assessment teams, also made appropriation and application of concepts and methods challenging.

In addition, capturing the detailed history of an innovation case over a fairly long period, rather than drawing a static picture, was not always possible: it would have involved prolonged and

sophisticated data collection. In addition, the data collection instruments for drawing a rich historic picture of innovation processes, and the subsequent data analysis tools, were beyond the reach of the JOLISAA project.

## Results and Discussions

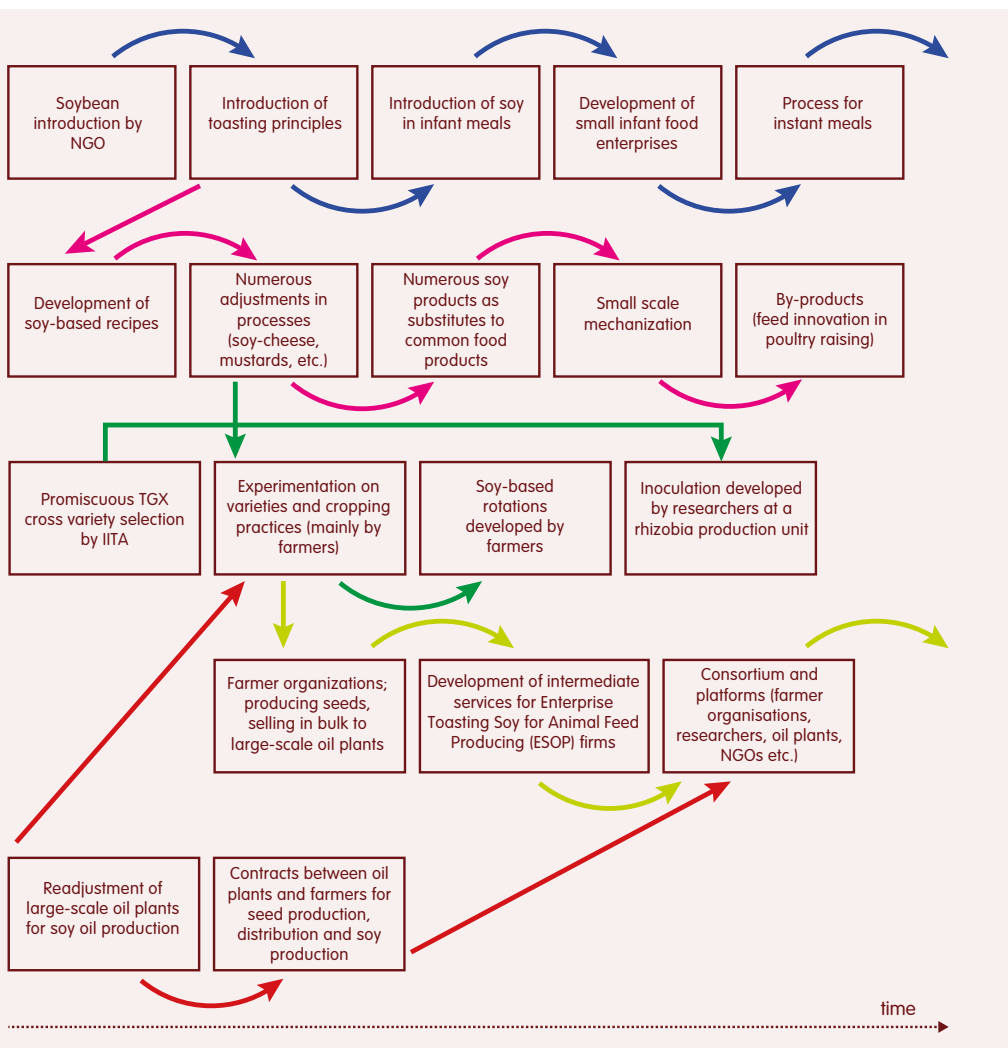
Between them, the 57 cases inventorized and the sub-set of 13 CCAs covered a wide diversity of experiences in terms of type (technical, organizational, institutional), domain (cropping, live-stock-keeping, fishery, processing, marketing), scale (local, national, regional) and duration of the innovation process (a few years to several decades) (Table 1). Several key features are discussed below: the diversity of stakeholders involved in innovation; the diversity of innovation triggers and the occurrence of market-driven innovation; the typically long timeframes of innovation processes; the common occurrence of 'innovation bundles'; and the often close relationship between innovation processes and externally-funded projects.

The stakeholders in innovation typically included a mix of individual farmer-innovators, one or more community-based or farmer organizations (some of them externally triggered for innovation purposes), researchers, extension services, NGOs, private entrepreneurs, government, and externally-funded projects (usually as an umbrella/coordinating body). Depending on the specific case and phase of innovation, leading and active stakeholders varied. For instance, researchers, an NGO, or a project might be very active in the initial stages (on-farm experimentation, building capacity, facilitating interactions, etc.), while farmers and their organizations or a business stakeholder tended to become more active in later phases. In many cases, one of the stakeholders (typically an externally-funded project) played the role of intermediary (Klerkx and Leeuwis, 2008) to facilitate interaction among the stakeholders. Formal research did not usually initiate or play a leading role in many innovation cases; rather, ideas and initiatives came from different sources, including farmers. Policymakers and private sector actors were seldom among the active stakeholders. This may reflect that 'conventional' actors still dominate initiatives focusing on smallholder agriculture, as well as the relative scarcity of specific pro-innovation public policies in the three countries. It could also reflect a sample bias, due to the limited connections of national JOLISAA teams with 'non-conventional' partners. In any case, this topic would require further inquiry to understand better if and why this has indeed been the case. In addition, JOLISAA found few truly farmer-led innovation processes, probably because such cases were less visible and less likely to be documented.

Most cases had a mix of different triggers for innovation. Degradation of natural resources (e.g. declining soil fertility, dwindling supply of water, disappearing forest) was a common trigger. Others included seizing a local or global market opportunity, creating or improving a value chain, and introducing an improved technology or practice (e.g. new livestock breed, new way of processing rice). Changes in policy were rarely mentioned as triggers, yet they played a significant role as drivers (positive but also negative) of the overall process.

In many (if not most) cases, the relevant time frame for understanding the innovation process easily spanned at least one, and often, several decades. Over time, the innovation processes

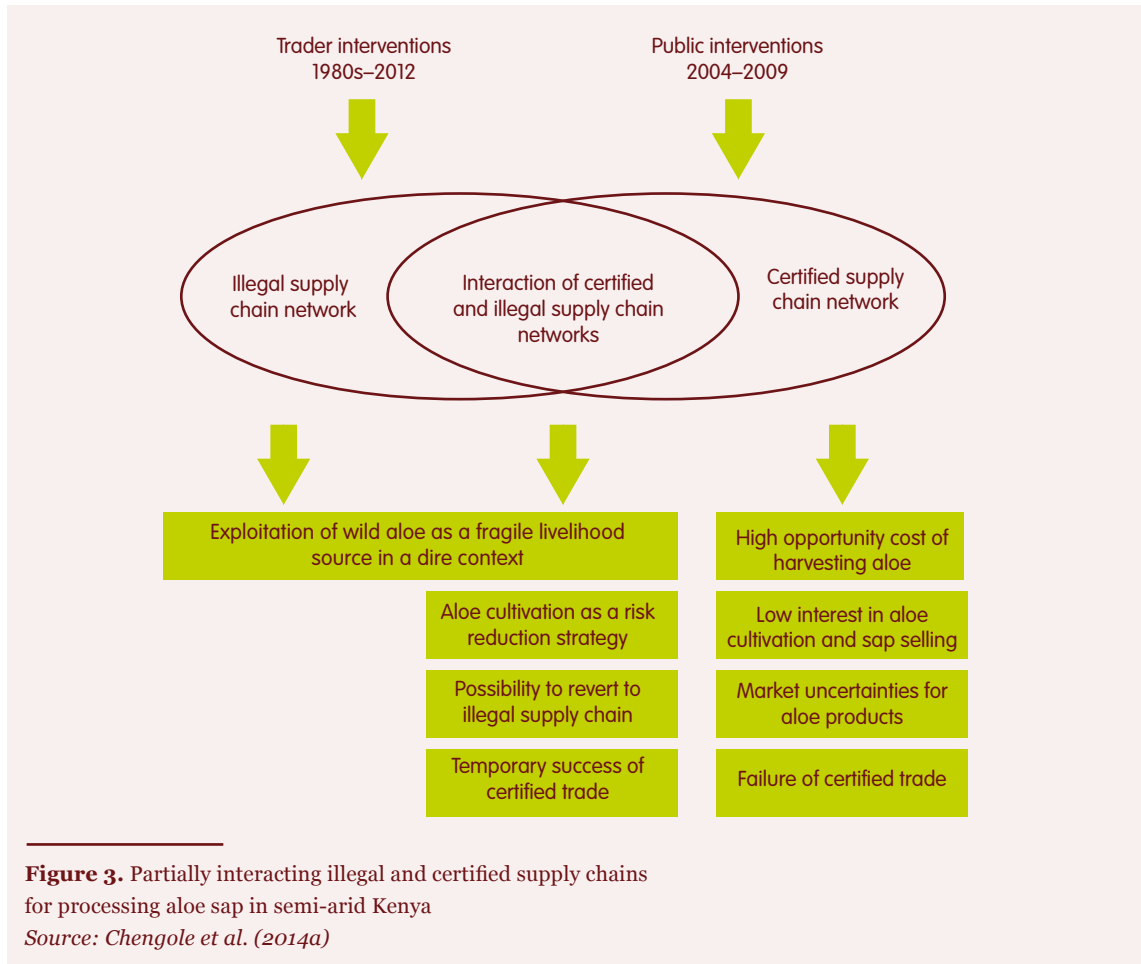
often seemed to go through successive phases (Figure 2) at an uneven pace – sometimes very rapid, sometimes almost dormant – under the influence of external and internal factors (e.g. resource availability, constantly changing drivers in the overall environment, or key individuals and stakeholders coming in and out of the innovation scene). Consequently, innovation stories tend to be rather complex (more so than what the initial inventory had uncovered), with different stakeholders having different perceptions of what has happened and why. The soybean case in Benin (Floquet et al., 2014) illustrates the intricate intertwining of innovation types and phases over time, as well as the wildly evolving nature of innovations developed by different stakeholder groups, prominently including small-scale women processors (Figure 2).



**Figure 2.** Technical, organizational and institutional innovations inducing each other within the soy innovation process in Benin

Source: Floquet et al. (2014)

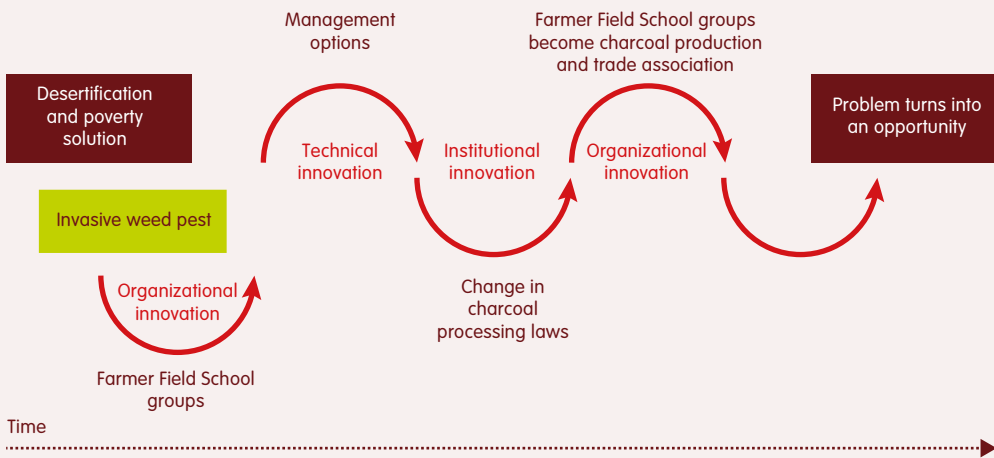
Another issue is how much publicly supported and funded innovation processes take into account the local innovation landscape and dynamics. In the aloe case in Kenya, the effort to build a certified aloe value chain, driven by external research and development (R&D) actors, interacted only a little with the locally-driven aloe innovation process for a number of reasons, despite the notable achievements of the latter (Figure 3) (Chengole et al., 2014a).



**Figure 3.** Partially interacting illegal and certified supply chains for processing aloe sap in semi-arid Kenya  
 Source: Chengole et al. (2014a)

Outcomes resulting from a given innovation process typically exhibited several interwoven and interdependent dimensions: technical (e.g. a new variety), organizational (e.g. farmers acting collectively to acquire inputs or sell their produce), and institutional (e.g. new coordination mechanism), as the ‘simple’ prosopis case illustrates (Figure 4) (Chengole et al., 2014b). These various dimensions emerged organically over time as the innovation process unfolded from a specific entry point (often a new technology). New dimensions usually resulted from new stakeholders coming on board, or from stakeholders starting to change their practices and, in so doing, needing to make other transformations or wanting to take advantage of the evolving environment in which they operated. We refer to these combinations as ‘innovation bundles’.





**Figure 4.** Sequencing of technical, organizational and institutional innovation in the Prosopis case in Kenya

Source: Chengole et al. (2014b)

Many innovation cases that were well documented and well known had a strong link with externally funded projects. The chaotic abundance, and succession of ‘projects’, aiming to stimulate innovation is typical for developing countries. As public funding for innovation is scarce across Africa, public institutions and NGOs depend heavily on external support to carry out innovation-related activities, while smallholders are usually too poor to pursue innovation at a significant scale on their own. Projects can be important for creating innovation dynamics embedded in a temporary favourable environment, shielding the process from the usual inhibiting or disabling factors and drivers. In doing so, they may thus allow a minimum critical mass to be reached or initial bottlenecks to be overcome. However, projects often artificially promote short-term use of technologies that may not be sustainable, trigger opportunistic behaviour from some stakeholders, lead to an aid mentality and overlook more endogenous, low-cost, and potentially more sustainable, innovation pathways and outcomes. Projects may also have difficulties in formulating objectives and designing activities that are truly in line with the demands and needs of local stakeholders. Finally, most projects typically seem to underestimate what it takes to implement an exit strategy to prevent the collapse of the emerging, yet fragile, innovation process the project has nurtured. Another unexpected consequence of this overabundance of projects is that researchers and other formal agricultural research and development actors tend to be relatively blind to innovations that have happened outside formal projects and arrangements. Yet, such innovations might be essential for understanding the eventual success of an innovation process and for sustaining its momentum, as illustrated by the diverse fortunes of the various aloe exploitation routes (whether or not they were undertaken with support from the public R&D actors) in the Baringo district of Kenya (Chengole et al., 2014a).

## Conclusions, Recommendations and Implications

Altogether, the results of JOLISAA confirm that in the three African countries of study, many diverse multi-stakeholder innovation initiatives have taken place in recent years or are still ongoing, something others have also observed (Adekunle et al., 2012; Hounkounou et al., 2012). By actively engaging with a broad range of actors beyond conventional research and extension, smallholder farmers acquire new capacities and skills, and receive stimulation and support to pursue innovation, leading to improved production, income and livelihoods, and to better management of natural resources. Despite the associated challenges, many of the actors with whom farmers collaborate seem increasingly aware of the need for, and benefit from, tighter and better collaboration with farmers and their organizations, as well as with each other, and have started to acquire the corresponding attitudes, skills and approaches. Strengthened and more extensive collaboration allows innovation initiatives to deal with complex problems and challenges that cannot be effectively handled otherwise, such as sustainable production and processing, secure access to new markets, climate change, food security and poverty reduction.

The assessments conducted under the JOLISAA framework also provide useful lessons for policymakers, researchers and development practitioners about what innovation dynamics and processes are all about, how to assess them, and how to support them in ways that build upon the knowledge, creativity and existing linkages of smallholders. In doing so, the aim is to render smallholders more resilient to rapid and even sudden changes. Some major specific lessons and recommendations drawn by JOLISAA include:

- **Build on innovation ‘in the social wild’:** With little or no support from public R&D institutions, many smallholders actively innovate individually and collectively to solve problems, improve their farming and income, and grasp opportunities. Yet many such initiatives take place ‘under the radar’, ‘in the social wild’ (Sherwood et al., 2012) and are ignored by state, non-state, the private sector and even farmer organizations trying to develop and diffuse agricultural technologies (Figure 2). Local innovations that fit the wide variety of contexts of African agriculture need to be better recognized, valued and encouraged. Interventions should build on them and on the associated local knowledge and energies as a starting point for fostering sustainable, locally-led and locally-supported innovation processes.
- **Support unpredictable innovation processes:** Innovation cannot be planned from the outset, as it evolves in unpredictable and often unexpected ways over long periods of time and is specific to a changing context. In supporting innovation, formal R&D actors should make use of highly flexible, open-ended and iterative approaches adapted to local conditions. Moreover, innovation does not happen in a linear way. JOLISAA studies show that innovation pathways took new and unexpected directions over many years, or even decades, as they unfolded within and mostly outside the framework of external interventions. Any attempt to foster innovation processes through public intervention should hence recognize such unexpected deviations and act accordingly. This asks for less emphasis on rigid pre-planned prescriptions about what to do and more readiness to adjust priorities, approaches and modalities of support along the way in an iterative and flexible manner, reflecting changing dynamics and opportunities.

- **Address the multiple dimensions of innovation:** JOLISAA cases show that beyond new technologies, innovation has important social and organizational dimensions that are closely intertwined and cannot be addressed in isolation from each other, if innovation is to be successful. Social and institutional change (such as new ways for farmers to organize themselves and access markets, or new rules and policies) is always needed so that new technologies can be fully integrated into local practice. Consequently, taking a holistic view of innovation gives a better chance of producing outcomes that are more relevant for smallholder farmers and other local actors. In addition to generating and transferring technology, support should therefore go to enabling and accompanying organizational and institutional changes that make innovation possible and successful and may drive large-scale diffusion and adaptation of technological and social innovations.

Such lessons and recommendations are being shared widely and add to those already found by other programmes such as Conversion of Science-System of Innovation (Jiggins et al., 2016), or the Research Into Use programme funded by the UK Department for International Development (Clark, 2016). Our hope is that, eventually, some of them may help change the approaches of donors, governments and public or not-for profit R&D institutions for the better.

Finally, JOLISAA results also show the value of using an IS perspective in uncovering key factors related to the nature and dynamics of ‘real’ innovation processes, even though implementing such an approach on a large scale may prove challenging. The hope is that more researchers and practitioners will be willing and better able to prepare themselves to meet and overcome such challenges in the future. Acquiring such capacity is key to increasing the detailed knowledge of the dynamics of contemporary African agriculture and with it, the potential to improve the pace, relevance and reach of many innovation initiatives.

### Acknowledgements

This work was carried out as part of the JOLISAA project ([www.jolisaa.net](http://www.jolisaa.net)) under Framework Programme 7 of the European Commission. The opinions expressed herein are the sole responsibility of the authors. The authors thank other JOLISAA consortium members (Jolanda van den Berg, Bernard Bridier, Todd Crane, Roch Mongbo, Teresiah N’gan’ga, Nicolienne Oudwater, Gerrit Rootman, Nour Selemna, Joe Stevens, Rigobert Tossou, and Davo S. Vodouhe) and their partners in Benin, Kenya, and South Africa for providing data and useful comments on the many intermediary reports and documents which were used for developing content for this paper.

### References

- Adekunle, A.A., Ellis-Jones, J., Ajibefun, I., Nyikal, R.A., Bangali, S., Fatunbi, O. and Ange, A.** 2012. Agricultural Innovation in Sub-Saharan Africa: Experiences from Multiple-Stakeholder Approaches. Forum for Agricultural Research in Africa (FARA), Accra.
- Chengole, M., Belmin, R., Welimo, M., Kamau, G. and Triomphe, B.** 2014a. Understanding the innovation system in aloe domestication and exploitation in Baringo County, Kenya. p.72-75. In: B. Triomphe, A. Waters-Bayer, L. Klerkx, M. Schut, B. Cullen, G. Kamau and E. Le Borgne (eds.), *Innovation in Smallholder Farming in Africa: Recent Advances and*

- Recommendations. Proc. International Workshop on Agricultural Innovation Systems in Africa (AISA), Nairobi, Kenya 29-31 May 2013. CIRAD, Montpellier.
- Chengole, J.M., Welimo, M., Belmin, R., Ng'ang'a, T. and Kamau, G.** 2014b. From a desired to a despised and later desired tree: The case of *Prosopis* introduction and management in Marigat, Baringo County, Kenya. p.76-79. In: B. Triomphe, A. Waters-Bayer, L. Klerkx, M. Schut, B. Cullen, G. Kamau and E. Le Borgne (eds.), *Innovation in Smallholder Farming in Africa: Recent Advances and Recommendations*. Proc. International Workshop on Agricultural Innovation Systems in Africa (AISA), Nairobi, Kenya 29-31 May 2013. CIRAD, Montpellier.
- Clark, N.** 2016. The use of innovation systems in a technology development aid programme: The case of Research Into Use (RIU). p.53-60. In: J. Francis, L. Mytelka, A. van Huis and N. Röling (eds.), *Innovation Systems: Towards Effective Strategies in Support of Smallholder Farmers*. Technical Centre for Agricultural and Rural Cooperation (CTA) and Wageningen University and Research (WUR) Convergence of Sciences-Strengthening Innovation Systems (CoS-SIS) programme, Wageningen.
- Floquet, A., Vodouhê, G. Michaud, A., Bridier, B. and Vodouhê, S.D.** 2014. How innovation processes unfold along unexpected trajectories: The case of soy in Benin. p.105-110. In: B. Triomphe, A. Waters-Bayer, L. Klerkx, M. Schut, B. Cullen, G. Kamau and E. Le Borgne (eds.), *Innovation in Smallholder Farming in Africa: Recent Advances and Recommendations*. Proc. International Workshop on Agricultural Innovation Systems in Africa (AISA), Nairobi, Kenya 29-31 May 2013. CIRAD, Montpellier.
- Geels, F.W. and Schot, J.** 2007. Typology of socio-technical transition pathways. *Research Policy* 36:399-417.
- Hall, A. and Clark, N.** 2010. What do complex adaptive systems look like and what are the implications for innovation policy? *Journal of International Development* 22:308-324.
- Hall, A., Sulaiman, V.R., Clark, N. and Yogoband, B.** 2003. From measuring impact to learning institutional lessons: An innovation systems perspective on improving the management of international agricultural research. *Agricultural Systems* 78:213-241.
- Hounkonnou, D., Kossou, D., Kuyper, T.W., Leeuwis, C., Nederlof, S., Röling, N., Sakyi-Dawson, O., Traoré, M. and van Huis, A.** 2012. An innovation systems approach to institutional change: Smallholder development in West Africa. *Agricultural Systems* 108:74-83.
- Jiggins, J., Essegbey, G., Klerkx, L., van Paassen, A., Pyburn, R. and Tossou, R.** 2016. The uses of research: Action researching in and across nine agro-enterprise domains. The experience of the Convergence of Sciences-Strengthening Innovation Systems programmes in Benin, Ghana and Mali. p.101-123. In: J. Francis, L. Mytelka, A. van Huis and N. Röling (eds.), *Innovation Systems: Towards Effective Strategies in Support of Smallholder Farmers*. Technical Centre for Agricultural and Rural Cooperation (CTA) and Wageningen University and Research (WUR) Convergence of Sciences-Strengthening Innovation Systems (CoS-SIS) programme, Wageningen.
- Klerkx, L. and Leeuwis, C.** 2008. Matching demand and supply in the agricultural knowledge infrastructure: Experiences with innovation intermediaries. *Food Policy* 33:260-276.

- Klerkx, L., van Mierlo, B. and Leeuwis, C.** 2012. Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. p.457-483. In: I. Darnhofer, D. Gibbon, B. Dedieu (eds.), *Farming Systems Research into the 21st Century: The New Dynamic*. Springer, Berlin.
- Latour, B.** 2005. *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford University Press, Oxford.
- Malerba, F.** 2007. Sectoral systems of innovation: A framework for linking innovation to the knowledge base, structure and dynamics of sectors. *Economics of Innovation and New Technology* 14(1-2):63-82.
- Sherwood, S.C., Schut, M. and Leeuwis, C.** 2012. Learning in the social wild: Encounters between farmer field schools and agricultural science and development in Ecuador. p.102-137. In: H.R. Ojha, A. Hall and R. Sulaiman (eds.), *Adaptive Collaborative Approaches in Natural Resources Governance: Rethinking Participation, Learning and Innovation*. Routledge, London.
- Touzard, J.M., Temple, L., Faure, G. and Triomphe, B.** 2014. Systèmes d'innovation et communautés de connaissances dans le secteur agricole et agroalimentaire. *Innovations* 1(43):13-38.
- Triomphe, B., Floquet, A., Kamau, G., Letty, B., Vodouhé, D.S., N'gan'ga, T., Stevens, J., van den Berg, J., Selemna, N., Bridier, B., Crane, T., Almekinders, C., Waters-Bayer, A., Oudwater, N. and Hocdé, H.** 2013. What does an inventory of recent innovation experiences tell us about agricultural innovation in Africa? *Journal of Agricultural Education and Extension* 19(3):311-324.
- Waters-Bayer, A., van Veldhuizen, L., Wongtschowski, M., Wettasinha, C., Triomphe, B., Mekonnen, F. and Fenta, T.** 2011. Farmer-managed innovation funds drive multi-stakeholder learning processes. p.15-18. In: *Proceedings of the International Conference 'Innovations in Extension and Advisory Services: Linking Knowledge to Policy and Action for Food and Livelihoods'* Nairobi, Kenya 15-18 November. Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen. Available at: [www.cta.int/en/publications/publication/1773/](http://www.cta.int/en/publications/publication/1773/).
- World Bank.** 2006. *Enhancing Agricultural Innovation: How to go Beyond the Strengthening of Research Systems*. World Bank, Washington, D.C.
- World Bank.** 2012. *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, D.C.