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# The role of knowledge in transitions to sustainable food systems: examples from institutional innovations

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## **ABSTRACT**

Knowledge is fundamental to our ability to change practices from unsustainable to sustainable ones (Grin, Rotmans and Schot, 2010). However, sustainability has often been described as a “wicked problem”, where the knowledge needed to make this transition is often inconclusive and contested (Batie, 2008; Levin *et al.*, 2012; Peters and Pierre, 2014). These “knowledge politics” (Baert and Rubio, 2012) suggest that we should be asking important questions as we develop policy advice, such as what types of knowledge and whose knowledge is taken into consideration in the development of sustainable food systems. If we look at food systems as the value chains and institutional arrangements that connect consumption and production, we see that different actors need different types of information and are willing to trust different types of knowledge about sustainable practices. Drawing upon results from an international survey of 15 institutional innovations in linking sustainable practices with markets that was carried out by FAO and INRA, we reflect upon how these innovations are placing an emphasis on different types of knowledge as the basis for the adoption of sustainable practices. These results shed light on the type of information and knowledge required by different actors in sustainable food systems.

## **INTRODUCTION**

Knowledge is fundamental to our ability to change practices from unsustainable to sustainable ones (Grin, Rotmans and Schot, 2010). As we know, sustainability is often described as a wicked problem (Batie, 2008; Levin *et al.*, 2012; Peters and Pierre, 2014), which means that it is a problem where there is significant uncertainty, not only about how to solve the problem, but actually about what the problem is in the first place. This means that it is a problem to be managed, which requires new knowledge (Peterson, 2013). Put differently, we must be willing to experiment with a number of different approaches to see what works in which context. We also know from some recent research that system

transformations happen when new practices and technologies are taken up as habitual practices (Shove and Walker, 2007, 2010). It is the process of normalization, or rather of making sustainable practices those that we do without really thinking about it. Now how to do that is the challenge, which is recognized by private actors, academics and policy-makers alike (Newson *et al.*, 2013).

As is evident in public international debate, sustainability is a multifaceted and highly contested topic, yet simultaneously brings together several different groups in competing regimes of knowledge that provide guidance on what form sustainable agri-food systems should take. The industrial agriculture sector, which relies upon cutting-edge biological, chemical and mechanical technologies, maintains a monopoly on the current agri-food landscape precisely because they have been able to dominate the scientific knowledge production and its resulting technologies (see Vanloqueren and Baret, 2009). The recent discourse on the “new green revolution” for Africa, based on science-driven agricultural research, is indicative of the shifting plates in global discourse around sustainability (Gates, 2012). On the one hand, there is the push by multinational agribusinesses to promote the intensification of agricultural research and experimentation into genetic engineering (GE) and innovations in synthetic inputs as a means to make industrial agriculture more sustainable (see Lyson, 2002). This requires “robust” scientific knowledge that has passed numerous laboratory and field “tests” as part of a process of standardizing the scientific knowledge used to develop these technologies and products.

On the other hand, the predominance of this input intensive paradigm has provided space for numerous alternative approaches to sustainable agriculture (Elzen *et al.*, 2012), many being restricted to socio-technical niches and a number of approaches based on the principles of agro-ecological knowledge to promote agro-ecosystem sustainability (Altieri, 1987; Gliessman, 2001). In these cases, the agro-ecological knowledge has also been standardized through on-farm experimentation, and also through the creation of auditable standards to ensure compliance with the principles of agro-ecology (e.g. Bain, Deaton and Busch, 2005; Bingen and Busch, 2006; Cashore, Auld and Newsom, 2004; Higgins, Dibden and Cocklin, 2008). At both ends of this spectrum of sustainable agriculture practices, we see a clear role for standardizable knowledge. One might characterize this standardization process of sustainable agri-food systems as an expression of a knowledge regime (Pestre, 2003) that fosters certain types of relationships between agronomic science and agricultural technology. As a result, these relationships shape the policy drivers that govern the inclusion or exclusion of certain regimes of sustainable agriculture knowledge and techniques. Therefore, it is important to be aware of the role of knowledge in these processes and how different types of knowledge can contribute to the ongoing transitions to sustainable food systems.

These “knowledge politics” (Baert and Rubio, 2012) described above suggest that we should be asking important questions as we develop policy advice, such as what types of knowledge and whose knowledge is taken into consideration in the development of sustainable food systems. If we look at food systems as the value chains and institutional arrangements that connect consumption and production, we see that different actors need different types of information and are willing to trust different types of knowledge

about sustainable practices. Drawing upon results from an international survey of 15 institutional innovations in linking sustainable practices with markets that was carried out by FAO and INRA, I reflect upon how these innovations are placing an emphasis on different types of knowledge as the basis for the adoption of sustainable practices. These results shed light on the type of information and knowledge required by different actors in sustainable food systems.

## **DIFFERENT TYPES OF KNOWLEDGE FOR UNDERSTANDING TRANSITIONS TO SUSTAINABLE FOOD SYSTEMS**

Modern agri-food systems are highly standardized with multiple layers of rules governing production practices, supplier contracts and distribution networks. For example, each country has baseline standards for health and safety of workers and of food items. On top of this one can find rules that define good agricultural practices (GAPs), good manufacturing practices (GMP), consumer protection laws that lay out the rules that are meant to protect consumers, rules about what can legally be included in contracts, who can hold contracts, and how these can be enforced. Layered above these rules are private standards defining the quantity and quality of food products that meet different market segments. These rule-based systems all rely upon different types of expert knowledge, which are mobilized at different points of the value chain to ensure that the rules are appropriate to the situations in which they are applied, and that they reflect robust “expert” knowledge about the content of the rules (Henson and Humphrey, 2009).

Like all rule-based systems, agri-food systems suffer from the twin problems of embeddedness and embodiment (Schrager, 1990). Embeddedness refers to the tacit social context that contributes to judgment, while embodiment refers to the tacit skills that make human beings able to solve practical problems. These two aspects are important because they influence how new technologies are taken up by users (Nelson, 1998; Rogers, 1962). Understanding how new technologies are adopted is fundamental to understanding how we are able to transition towards more sustainable agri-food systems (see Markard, Raven and Truffer, 2012), as knowledge for sustainability must be able to integrate the tacit knowledge of societal actors (Voß, Bauknecht and Kemp, 2006). This is particularly true in contexts where there are competing technologies, as is the case with sustainable agricultural technologies (Aerni, 2009; Schot and Geels, 2008).

Gorman (2002) combined these two insights with four types of knowledge in order to provide a framework for understanding how technology is transferred, even in the absence of explicit documentation and proposes that this is also why documentation alone is not sufficient for transferring technology and changing practices towards more sustainable ones (Figure 1). In each of these four types of knowledge there are both declarative (recalling facts) and explicit (can be told) and tacit and implicit (that which cannot be easily explained by words but through the way your body knows to do things).

The first type of knowledge is “information” or knowledge about “what”. Basically it is the knowing of facts – what exists, what can be done. But increasingly in our society there is so much information out there that it is nearly impossible for individuals to know all of the facts, so it is also about knowing where things are to be found, more than just knowing things.

The second type of knowledge is procedural. It is about skills and how things are done. This is the hands-on, extended practice of knowing and is often how things can be learned. These are often described as habits, what we do naturally, what works. The third type of knowledge is the judgmental knowledge, which requires knowing when something is appropriate. So basically it involves recognizing that a problem is similar to one whose solution is already known and knowing when to apply a particular procedure. This type of knowledge is commonly used



**Figure 1. Four types of knowledge**

*Source:* adapted from Gorman (2002).

by so-called “experts” and the creation of rules (and standards) can be helpful for developing this type of expertise. The fourth type is referred to as wisdom or knowledge of why we do something. It is related to judgment, but it is a different kind of judgment than the one usually used by experts because it is not necessarily knowledge based on already known facts and procedures. Rather it is the ability to reflect upon what one is doing and to question prevailing procedures, and to sometimes come up with new ones if necessary. Codes of conduct help facilitate wisdom, but it really requires a “moral” imagination or creativity – the ability to think outside the box.

The idea is that these different types of knowledge are important for different activities within food systems and have different roles in enabling change. In this paper this framework is adopted to analyse how different types of knowledge have been fundamental to the emergence of innovations around the promotion of agro-ecological technologies and institutional design that link small farmers with markets in developing countries. These examples come from a joint research project between the French National Institute for Agricultural Research (INRA), the Rural Infrastructures and Agro-industries Division (AGS) and the Plant Production and Protection Division (AGP) of FAO entitled: “Responsible innovation in sustainable agri-food systems: explorations of the intersections between voluntary standards and value chains” (Loconto, Santacoloma and Poisot, in press).<sup>1</sup> This study analyses 15 case studies of institutional innovations that span Latin America and the Caribbean, Africa and Asia.<sup>2</sup> Our main research question of the larger project is: how are voluntary standards encouraging the adoption of sustainable

<sup>1</sup> See the full publication for information about the methods used for data collection and analysis.

<sup>2</sup> The case study countries are Bénin, Bolivia, Colombia, Ecuador, India, Indonesia, Iran, Namibia, Nigeria, the Philippines, the United Republic of Tanzania, Thailand, Trinidad and Tobago, and Uganda (two cases).

practices? Our main thesis is that this happens through the institutional innovations that are constructed at multiple levels, which provide the mechanisms through which information is shared and changes in practices are supported. In this paper, it is suggested that one of the ways in which voluntary standards do this is through the knowledge that is mobilized around their implementation. In the following sections, examples from eight case studies are framed in the form of knowledge challenges that the innovators faced and their responses to this challenge. A brief informative summary of each of these cases is found in a dedicated box. This approach highlights the transformative nature of the role of knowledge in assisting each innovator's transition towards a more sustainable agri-food system.

### THE CHALLENGE OF INFORMATION: DEFINING SUSTAINABILITY LOCALLY

The first challenge is about information – or what do we know about sustainable practices? This draws upon the case studies from India and the Philippines to illustrate how information about sustainable practices is translated at a local level.

In the case from India (Box 1), the Participatory Guarantee System Organic Council (PGSOC) is a federation of over 500 local farmer groups who operate participatory guarantee systems that ensure the adoption of organic agricultural practices. The question of “what knowledge” or information was tackled through PGSOC's adaptation of generic organic standards to the particular Indian context – focused on ayurveda and unani medicine and on the need to conserve native seeds on their farms. The public national-level organic standard is the first instance of adaptation, as it integrates these aspects of traditional Indian agriculture into the legal norm. However, the PGSOC has developed its own system of certification and has placed a strong focus on the translation of the organic rules into the numerous local languages and insist that organic is a whole farm concept, not just a “parallel production” system. In this way farmers are able to define sustainable practices based on traditional approaches to agriculture and medicine, and based on locally available inputs.

In our case from the Philippines (Box 2), the local definition of sustainability was tackled through a different approach to defining what organic agriculture means. Here the Quezon Participatory Guarantee System (QPGS) has been promoted through the Farmer Scientist for the Development of Agriculture or MASIPAG. MASIPAG is a network of farmers, scientists and non-governmental organizations (NGOs) working towards sustainable

#### Box 1: Participatory guarantee system organic council (PGSOC), India

The agricultural practice used in this innovation is **organic agriculture** in order to achieve better health in terms of safe food. The mechanism implemented in the project is a **participatory guarantee system (PGS)**. The characteristic solutions emerging from the project are the native seed marketing and the focus on yields. The project has been developed in a framework of institutional support for organic agriculture and in the country there is a National Organic Law and a public PGS standard. This innovation uses a private PGS standard that is equally recognized by the institutions. Quality products are intended for both **short and long value chains**.

### **Box 2: Quezon participatory guarantee system (QPGS), Philippines**

The agricultural practice used in Quezon Participatory Guarantee System is **organic agriculture** in order to improve local livelihoods. To support this overall objective, the innovation has implemented a **participatory guarantee system (PGS)** that encourages farmer control over genetic and biological resources. In the Philippines, a National Organic Act regulates organic production and labelling, and private PGS standards are recognized by the state institutions. Quality products are marketed to consumers through **local markets** and **media utilization** (radio).

use and management of biodiversity through control of genetic and biological resources, agricultural production and associated knowledge. For example, the University of the Philippines Los Banos is working on developing what they call natural farming methods (NFM), a diversified cropping system and vermiculture production that is adapted to the conditions of the Philippines.

These two cases are illustrative of a broader trend across our 15 case studies. Basically, what we have found in all of our cases is that there is a clear challenge posed by translating international standardized knowledge about sustainability into locally relevant and understandable information. This was evident even within the organic movement, which is considered to have a rather stable definition of sustainability. It was clear that knowledge still requires local adaptation in order to become useful information. These cases also illustrate that there are numerous initiatives between farmers and scientists to further define what sustainability means at a local level, in order to provide more appropriate and understandable information to producers and consumers.

### **THE CHALLENGE OF SKILLS: “LEARNING BY DOING”**

The second knowledge challenge that we have observed in our case studies is based on how different actors know what sustainability means and how they acquire the skills necessary to be more sustainable. We find that in most of our cases there were indeed linkages with universities and the two cases given in Boxes 3 and 4 illustrate how training programmes based on “learning by doing” have become institutionalized.

In Bénin Republic (Box 3), the Songhai Centre is a youth training centre for “agro-entrepreneurs” that was established in 1985 and is based on the teaching of organic agronomic techniques based on an integrated production system. The focus is on increasing yields through simple techniques, without using pesticides or fertilizers, and while cutting production costs and protecting the environment. The main technique is encouraging “good bacteria” – “effective micro-organisms” (EM) present in the soil to maximize production without having to rely on chemicals. But students are also trained in all activities that are necessary for a sustainable food system, such as processing, transport, marketing, agribusiness management and hospitality and cooking. There are 20 000 visitors per year – 3 000 trained. A study carried out by FAO on the sustainability of this model found that the ex-trainees are practising the sustainable agricultural techniques that they learned, but not at the same level of complete integration as the demonstration site – which

### Box 3: The Songhai centre, Benin

The innovation focuses on **organic agriculture** in order to promote rural development. The Songhai Centre has created an **innovation platform (IP)** focused on research, training, agro-processing and development services in order to train youth agro-entrepreneurs and to spread sustainable practices. This project emerged from a framework of general principles affirmed by the state institutions but without a specific regulation on sustainable agricultural practices. At the same time, there is a rising consumer demand for quality products with an organic label.

has come about due to a lot of investment. But the key here is actually on the teaching approach that they have taken, which is focused on applied learning during the 18-month residence on the main Porto Novo training site, and additional training of about six months following this on a commercial farm. The philosophy of the training programme is to ensure that the youth gain knowledge of facts, but they also gain competencies and knowledge of how to do things. They must also learn a system of values that is used to discipline them in their work. The case of Bénin is rather interesting because it seems that finally, after almost 30 years of its existence, the Ministry of Education is interested in promoting this model as an accredited training model within the education system and is interested in promoting the creation of this type of training centre in each department of the country in order to increase access.

The Federal University of Agriculture, Abeokuta (FUNAAB) plays a pivotal role in the development of organic agriculture in Nigeria (Box 4). It founded the Organic Agriculture Project in Tertiary Institutions in Nigeria (OAPTIN) in 2004 to build capacities of higher education institutions managers, researchers and farmers in the country. The aim was to develop a more sustainable food production system. OAPTIN's stakeholders include university lecturers, students, scientists, farmers and processors. It developed a curriculum to teach organic agriculture at the bachelor's degree level in higher education institutions in Nigeria (UNAAB, 2008). The approach of FUNAAB is unique because it is working with surrounding communities to use farmers' land for productive experiments, the products from the experiments are sold in an organic kiosk on campus, and they are paying village youth to work on the farms alongside the students. This working together has actually transferred into these community youths having access to university education. In 2011/2012 a total of eight qualified prospective candidates seeking admission to FUNAAB from host communities were admitted for its various undergraduate degree programmes. The number was increased to 16 (100 percent increase) in the 2012/2013 session. This is an approach by FUNAAB to institutionalize the programme. Such candidates pay their school fees from the point they register through the period of their degree programmes. As a Federal Government University, FUNAAB fee of USD100 per session is reasonably low and affordable by the candidates. As FUNAAB students they can compete for their respective state governments' bursary allowances to further assist them.

In sum, these two examples illustrate how these innovations are transferring skills through hands-on training, which takes into consideration both the tacit and the declarative



#### **Box 4: The community based-farming scheme (COBFAS), Nigeria**

The Community Based-Farming Scheme promotes **organic agriculture** in order to encourage sustainable farming practices. The project is an **innovation platform (IP)** concentrated on youth training through a system of student farms and community outreach. The state institutions do not provide specific legislation on organic agriculture and international organic standards are utilized. The quality products and services are promoted through the **organic kiosk** on campus and through community engagement.

knowledge that is required to be able to implement sustainable practices. The need for training based on “learning by doing” is a common theme in all of our cases.

#### **THE CHALLENGE OF JUDGMENT: SOCIAL CONTROL**

Once one has defined what sustainability is, what information can be used and how one can learn to do it, there is a role for judgment. Basically, judgment means taking a decision about when some knowledge is more important than others and when a certain procedure is more appropriate than another. This concept is illustrated with two examples of “social control” that we have found in our cases.

The first example is in the United Republic of Tanzania where the tea industry is implementing Rainforest Alliance-certified tea (Box 5). In this particular case, we have a farmer group of about 15 000 members, each with about 1–2 hectares of tea. The context here is that Unilever, which is the biggest global buyer of tea, has committed to purchasing only Rainforest Alliance certified tea for its Lipton yellow bag blend. While Unilever is not the biggest buyer of Tanzanian tea, they have plantations in the country and are very influential within the tea industry. Moreover, following Unilever’s commitment, Tetley, Sara Lee, Twinings and a number of other smaller UK brands have made similar commitments. What is happening in Tanzania is that the local tea companies have decided to become certified by third-party certifiers, but this is a long process to get all smallholders certified, so they have started with those who were already ready and are moving towards getting all of the smallholders in the country certified within the next five years – which is actually the government commitment. What this particular company came up with was a way to deal with the need for traceability between certified and non-certified tea. Each farmer has an identification number and when the trucks come to pick up the tea at the weight station, the farmer provides his number and the digital scales that the drivers use tell the driver if this farmer is certified or not. The certified farmers receive these new yellow bags and the non-certified receive the other coloured bags. What this company is reporting is that farmers want to have the yellow bags and have been asking the yellow-bagged farmers what they have done to get them – and it is in this way that they have been able to identify those farmers who are ready to be included in the certification system.

The second example comes from Bolivia (Box 6), but the Bolivian case is representative of the six cases of participatory guarantee systems (PGS) in our study. A participatory guarantee system is a group of stakeholders who have decided to work together at the

### **Box 5: Public-private support for rainforest alliance certification of tea, United Republic of Tanzania**

The Tanzania Smallholder Tea Farmers innovation focuses on the **sustainability of a subsector** (tea), with the objective of improving farmers' livelihoods and guaranteeing worker health and safety. The mechanism implemented in the project is an **innovation platform (IP)** to develop new technologies, exchange knowledge and provide financing. The innovation is the institutional collaboration of governmental agencies, NGOs and private companies to support smallholder farmers to implement Rainforest Alliance-certified production practices. Quality products are designed to meet local and international **market requirements** for tea.

level of the farm in order to conduct the audits of the other farmers in the group. These groups are different from internal control systems that are used for group certification because they specifically seek to have consumers, researchers and government officials in the group that takes the decision. Moreover, the farmers themselves are the inspectors and the representatives of these groups. In the case of Bolivia, these groups are authorized in the national standard for organic agriculture as a valid form of certification for the local and domestic markets. The group representative must register the group with the food safety authority and municipal level officials are part of the certification committee. There is also an investment being made now with support from FAO to hire a municipal level extension worker who is trained in organic agricultural practices in each municipality. However, when I spoke with one farmer leader, she explained to me that in general, they do not really need an agronomic extension worker, they have enough experience now that they are resolving their own agronomic problems on their own – what is needed is marketing extension. Indeed, what we are finding is that the creation of these PGS are not only allowing farmers and consumers to judge when practices are or are not sustainable, but they are increasingly being used as collective marketing mechanisms.

These mechanisms for social control illustrate how peer review (or pressure) can work as a mechanism to enable groups of farmers to adopt sustainable practices. In each of these cases we see examples of highly standardized technologies in terms of the sustainable agriculture practices, but possibilities for flexibility of interpretation in how to enforce them. Each technique relies upon farmer judgment and thus farmer knowledge to ensure the adoption of the sustainable technologies.

### **THE CHALLENGE OF WISDOM: HEALTH AND DIET**

The final knowledge challenge that will be discussed is related to wisdom. This refers to the motivation or justification as to why sustainable practices are encouraged by both consumers and producers. From all of our 15 case studies, the most dominant response to this question of “why sustainably produced food” is based on health and diet. By health we refer to both producer health in terms of their status as workers, but also as consumers, because in most of our cases the farmers who are practising sustainable agriculture are consuming what they grow. Additionally, in our case study authors reported that they have

**Box 6: Ecofieras and PGS, Bolivia**

The agricultural practices used in this innovation are **agro-ecological**, with the objective of achieving food sovereignty and food safety both for consumers and for farmers. To support this overall objective, the project has implemented a **participatory guarantee system (PGS)** in order to ensure farmer compliance and create a local market for certified products. The Ecological Fairs have been developed in a framework of institutional facilitation due to a National Organic Law and PGS standards regulation. Quality products reach consumers mainly through **local fairs**.

**Box 7: Familia de la tierra PGS, Colombia**

The Familia de la Tierra innovation focuses on agro-ecology to achieve food sovereignty. The mechanism implemented is a **participatory guarantee system (PGS)** through which native seeds and agro-ecological products are cultivated and commercialized. The case has been developed within a framework of **organic agriculture**, in particular thanks to national associations focusing on this topic, but at present only an organic policy proposition exists. Quality products are mainly destined to **gourmet consumers** in the major cities.

been able to gain markets for their products because there are consumers who are looking for products that will improve their health and diet.

In Colombia (Box 7), we have a number of different ways in which we see health concerns as a driver of why sustainable food systems are taking hold. First, they are actually doing something quite similar to what Roberto Azofeifa (2014) explained from Costa Rica. They have linked up with a cooking school and a number of celebrity chefs in Bogota in order to teach them about native crops and the health benefits that they have. It seems that the chefs are quite interested in these crops, not only because of the health benefits, but also because of characteristics such as colour and taste, which enable them to create innovative (and traditional) dishes. Familia de la Tierra is able to provide this information to its buyers because they have been collaborating with the National University and also with the Nazareth Hospital in Sumapaz to do clinical trials on the health benefits of some of their native plants. For example, the hospital has been doing trials and actually treating its patients with *yakón*,<sup>3</sup> in order to slow down the onset of diabetes and to lower cholesterol.

In Uganda proposal (Box 8), we have an example of a PGS that is very consumer-focused and operates a box scheme in Kampala. Their consumers are mostly women who know each other and have been following diet trends. Using Facebook they have organized juicing clubs where they share information about which fruits and vegetables

<sup>3</sup> Yakón (*Smallanthus sonchifolius*) is a native Andean plant grown for its sweet, crispy, tuberous roots and for its leaves, which are used in infusions. The latter are purported to have prebiotic and antioxidant properties and in Colombia research is being conducted on its use in preventative treatment for diabetes and high cholesterol. See: Valentová and Ulrichová 2003.

### Box 8: Freshveggies PGS, UGANDA

The FreshVeggies PGS initiative promotes **organic agriculture** to achieve health and safety for both consumers and farmers. The innovation is a **participatory guarantee system (PGS)** that is used to increase access to local market outlets. FreshVeggies follows a regional organic standard (East African Organic Products Standard) and its PGS standard. Quality products and services reach urban consumers through **Facebook updates** and weekly deliveries.

provide certain vitamins, etc. So they are using the Internet and organizing themselves to gain access to often difficult to find fruits and vegetables. On the side of the farmers in this case, the PGS has built upon an existing savings and credit cooperatives (SACCO) consisting mostly of women, who all have small plots of land that they traditionally use for their kitchen gardens. They have been able to expand these in order to be able to produce extra fruits and vegetables, which they sell through box schemes, and also to supermarkets and other conventional buyers. Here specifically, the PGS has established the rule that each farm must grow three traditional crops, which are medicinal plants and whose leaves provide the basis for the Ugandan diet. In this way they are looking after the health of both the farmers and the consumers.

In all of our cases we find that there is a strong interest from consumers in sustainable food that emerges from a very basic concern over food safety. These customers do not trust the “conventional” food to be safe from the point of view of both the microbial and agro-chemical toxicity. This raising consumer awareness seems to come from increasing availability of information for urban consumers about current agricultural practices in rural areas and recent food scares that have been in the media. Indeed, FAO has noted that the basic food safety infrastructure in many countries needs improvement, particularly in terms of its ability to conduct the tests needed to determine food safety risks and to ensure that food safety standards are enforced (FAO, 2003). These infrastructural changes at the system level (Shove and Walker, 2010) are indeed fundamental to enabling individual consumer behaviour that can be influenced by product advertising (Newson *et al.*, 2013).

## CONCLUSION

The purpose of this paper was to illustrate, through examples from case studies of institutional innovations, how knowledge is important for transitions to sustainable food systems and why it is important to pay attention to the different types of knowledge that are needed in different situations. By focusing on how knowledge might be characterized as information, skills, judgment and wisdom, we were able to draw out insights from eight case studies that illustrate how both tacit and declarative knowledge are used by a variety of actors. Moreover, the innovations showed that different actors rely upon different types of knowledge to take decisions or motivate action at different places in the value chain. Finally, these examples show that both consumers and producers are using information that they receive, adapting it to their local contexts. In other words, different types of knowledge

pose different challenges to actors in the food system, but the need for these different types of knowledge also provide opportunities to innovate, particularly by farmers.

Specifically, we may take these challenges as points of departure for public policy interventions. For example, defining sustainability locally democratizes efforts to build up complex agri-food systems by communicating between global standards and local interpretation. Capacity building to change practices is needed that addresses the need to learn tacit knowledge as well as declarative knowledge. Programs that adopt applied training approaches have been effective in mobilizing knowledge for innovation. Traceability and control systems that rely upon farmer knowledge and peer-review illustrate that expert judgment is not always the job of external experts, but local experts who rely upon experiential knowledge also have a role to play in transitioning towards sustainability. Finally, it is clear that there are multiple drivers of knowledge needs, particularly in terms of why people are committed to more sustainable consumption and production. We find that collaboration and networks between farmers, and among farmers, consumers, scientists and other value chain actors, are fundamental to sharing knowledge and changing practices. This collaboration helps to build collective wisdom (at local, subnational, national, regional and international levels) that helps in the normalization process of sustainability transitions.

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