Food and Agriculture Organization
of the United Nations

ENABLING THE CAPACITY TO INNOVATE WITH A SYSTEM-WIDE ASSESSMENT PROCESS

OCCASIONAL PAPERS ON **INNOVATION IN FAMILY FARMING**

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ENABLING THE CAPACITY TO INNOVATE WITH A SYSTEM-WIDE ASSESSMENT PROCESS

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ABBREVIATIONS USED IN THE TEXT

ADII	Agriculture, Development and Innovation Index
AIS	Agricultural Innovation System(s)
APEGA	Peruvian Society of Gastronomy
BDRC	Bee Development and Research Centre
CDRF	Capacity Development Results Framework
CIAL	Comite de Investigacion Agricola Local
CIAT	International Center for Tropical Agriculture
CIP	International Potato Center
EADD	East African Dairy Development
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmer Field School(s)
ICDC	Innovation Capacity Development Cycle
ICT	Information and Communication Technolog(y/ies)
ILAC	Institutional Learning and Change
LLC	Limited Liability Company
NGO	Non-governmental Organization
OECD	Organisation for Economic Co-operation and Development
PIPA	Participatory Impact Pathway Analysis
PMCA	Participatory Market Chain Assessment
R&D	Research and Development
SNA	Social Network Analysis
SWOT	Strengths, Weaknesses, Opportunities and Threats [Analysis]
ToC	Theory of Change

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SUMMARY

Over the next thirty years, agriculture will need to provide food for 30 percent more people than it does now. In addition, it needs to both reduce the impact it has on the environment as well as provide a decent living for producers. This is the challenge of sustainable food security, and the basis for the call for innovation in agriculture. Previous approaches to technological change in agriculture have been based around supplying technology in a simplistic, top-down manner. These approaches had some success for relatively simple innovations in conducive settings. However, these simplistic approaches are not adequate for the task of meeting the complicated challenges facing agriculture today.

The Agricultural Innovation Systems (AIS) concept is a strategic framework that takes a demand-driven, interactive approach to technological and institutional change in agriculture. It emphasizes a continuing process of stakeholder interaction in a wider enabling environment to address constraints, thus inducing innovation. This capacity to innovate needs to be developed at the individual, organizational and enabling environment scales. It includes both technical capacity, such as learning a new grazing method, and functional capacity, such as being able to partner with others to effectively manage common pasture. A dynamic capacity development process is needed to create an enabling environment that enhances innovation capacity at a national level. This report lays out a general framework for an approach to assessing national-level capacities to innovate.

Innovation Platforms are an AIS-inspired technique that has been increasingly used to bring stakeholders together to address specific issues in a given value-chain or location. They can be effective in enhancing the capacity to innovate at a tactical scale by bridging often divergent perspectives amongst stakeholders to address collective issues. However, there is a need to address cross-cutting challenges that affect the agri-food system as whole. Innovation platforms focused on specific issues or value chain may not be capable of addressing such system-wide constraints. Assessments for innovation platform programmes will naturally be limited in their scope, making it difficult to rely on them for guiding interventions aimed at enhancing nation-wide innovation capacity.

Since conditions are constantly changing, assessment should be at the core of a national innovation capacity development process in order to guide interventions. However, an established approach to assessing national capacities to innovate is missing. High-level indicators are good for comparing progress across countries and through time but are not

practical for making informed interventions within a country. Assessment approaches focused on single value-chains or programs are too narrow in scope, shedding little light on the wider, country-level landscape.

The framework laid out in this report emphasizes an adaptable approach that fills the gap between international indicators and individual program assessment. It explores key areas that influence innovation processes, including stakeholders and their interactions, equality, and policies and trends that can influence the ability to innovate. The report also suggests methods and tools that can be used to analyse these areas and tie them all together in an actionable picture. Used to drive a dynamic capacity development process at the country-level, this approach can help develop and sustain the capacity to innovate in order to meet the challenge of sustainable food security.

CHAPTER 1

INTRODUCTION TO AGRICULTURAL INNOVATION

Food security for the nine billion people projected to be alive in 2050 requires a 'sustainable intensification' of agriculture in order to produce more food and get it to those who need it, without further degradation of the environment (Garnett *et al.*, 2013). To meet this challenge in a fast changing world, new tools, processes and ways of organizing—i.e. innovations—are needed to make agriculture more efficient in economic, social and environmental terms (Hall, Mytelka and Oyeyinka, 2006). Past efforts have tended to focus solely on technology. Historically, new agricultural technologies have been developed by public research organizations and then transferred to farmers by public extension services (Pant and Hambly Odame, 2006; Hall, Sulaiman and Bezkorowajnyj, 2007; Assefa *et al*., 2009). The emerging lesson is that the widespread adoption of new agricultural technologies and practices is a challenge that often requires more than knowledge transfer to increase the economic, social and environmental value created through agriculture.

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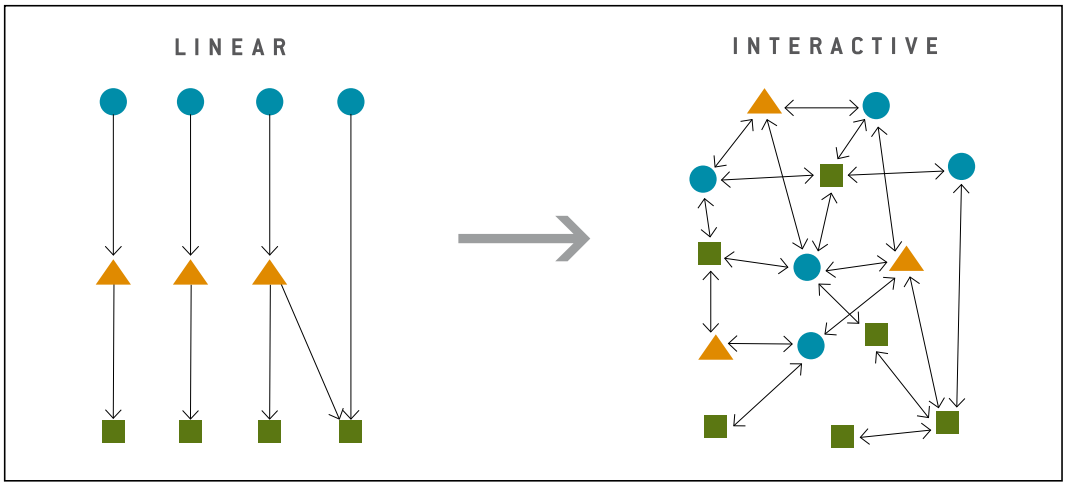
In the past two decades, the innovation systems concept has been applied to agriculture, leading to the development of the Agricultural Innovation System (AIS) perspective (Hall, Mytelka and Oyeyinka, 2006.). AIS vary widely by region and contextual dynamics, but typically comprise a range of actors, such as farmers, researchers, producer organizations, traders and extension agents. Their interactions move and improve the way food is brought from field to table, including the policies and institutions that shape this process (femkevdlee, 2012; Assefa *et al.*, 2009; World Bank, 2006). As depicted in Figure 1, the focus moves from a sequential 'pipeline' to a dynamic process of technical and institutional change through interaction at all levels of the agri-food system (Röling, 2009). Every individual and organization involved in this process is seen as an innovator (Spielman and Birner, 2008). Instead of one-way interaction between actors with clearly defined roles, interaction becomes more give and take.

Figure 1. A comparison of approaches to innovation. Note the blurred roles and bi-directional interaction in the systems-oriented, interactive approach.



Source: Adapted from Daane, 2010

An innovation is putting knowledge—be it in the form of technology, practice or a particular way of working—into use (Hall, Mytelka and Oyeyinka, 2006.). Only when knowledge is brought into use is it considered an 'innovation' (Hall, 2005). This involves not just one innovation that only end-users (historically farmers) adopt, but a number of innovations may be at stake, both technical, like new equipment, and institutional, or the 'rules of the game', that shape interactions (North, 1990, as cited in Kilelu, Klerkx and Leeuwis, 2013). This may include, for example, collaborative funding arrangements or negotiations embodied as new contracts adopted by all actors (Pant and Hambly Odame, 2009).

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In agriculture, it is now well documented that institutional innovations are essential for technological change to occur (Cleaver, 2002; Hall, Sulaiman and Bezkorowajnyj, 2007; Hounkonnou *et al.*, 2012; Kilelu, Klerkx and Leeuwis, 2013). The subsequent adoption of technology, can, in turn, drive institutional change, that then spurs further technological change. This 'packet of innovations' is important for understanding innovation system dynamics. This is evident in the East African Dairy Development (EADD) programme, which helps groups of small-scale dairy farmers tap into more commercial markets by forming Limited Liability Companies (LLCs) to purchase milk cooling and storage equipment. Kilelu, Klerkx and Leeuwis (2013) provide a good description of the interplay between institutional and technological innovations in their discussion of the programme's outcomes:

> *"The introduction of the dairy management software [technology] for records management introduced more transparency not only in the weighing of milk but also in systematically tracking [institutional] the various transactions relating to services used by each farmer, thus enhancing farmers' trust in the dairy company. Also, the establishment of dairy companies with improved governance and management structures [institutional], coupled with a credit guarantee provided through the EADD programme, enabled companies to secure credit from commercial banks [allowing more equipment to be purchased], which previously were wary of lending to farmers because of the perceived risk of agricultural enterprises."*

The AIS framework focuses on the process of innovation rather than on production (Hall, 2005). It allows for the exploration of the roles of various stakeholders and the way their interactions (a major part of innovation processes) are shaped by the institutional, economic and policy environment (Hall, Mytelka and Oyeyinka, 2006.) It is the interactions of stakeholders across scales that gives rise to innovation (Röling, 2009; Daane, 2010). The Papa Andina Initiative is a case in point (see Box 1) of how AIS spans multiple process dimensions, including detailed partnerships and combinations of traditional knowledge with modern scientific practices (Daane *et al.*, 2009; Pant *et al.*, 2008). The value chain begins in the field, linking up with supermarkets and hotels where changing urban demand and consumer preferences offer an opportunity for innovation in Andean native potatoes.

Box 1
PAPA ANDINA INITIATIVE IN PERU

Potatoes are an important staple crop with deep traditions in the Andean Highlands. With nearly 700 000 small-scale farmers involved in their production, pro-poor innovation that is tied into markets is an opportunity to improve the lives of low-income rural people.

The Papa Andina programme, run through an initial Research and Development (R&D) partnership between the International Potato Center (CIP) and the Swiss Agency for Development (SDC), used a multi-stakeholder Participatory Market Chain Assessment (PMCA) approach to identify market opportunities for small-scale farmers, and then enabling them to take advantage of these opportunities. Changing consumer demand in urban areas, seeking more local, traditional and safer food, was identified in the PMCA process as an innovation opportunity.

Through the formation and development of farmer organizations, market development, and partnerships with value-chain actors, several innovations were developed. Native potatoes were branded and sold in a major supermarket chain. Major hotel chains and food festivals embraced potato and tuber biodiversity. This entailed agreeing to new product standards between producer groups and retailers. A multinational food company sells a new variety of potato chips (crisps) made from native potatoes grown by small-scale farmers. Fair trade organizations export the snack foods. Linkages, with NGOs, chefs, wholesalers and retailers, as well as researchers, established during the PMCA process, have supported small-scale farmers in exploiting these opportunities. In Peru, this has led to a National Potato Day and an internationally acclaimed festival known as Mistura. These developments have helped increase widespread political interest in native potatoes and the socio-economic conditions of Andean communities. This, in turn, drives more demand for native potatoes, and thus more innovation opportunities for rural small-scale farmers in the Andes.

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Sources: Devaux *et al.*, 2007; Sarapura, 2012

Ultimately, AIS is a conceptual tool for achieving long-term national goals such as food security, or a broad improvement in living standards. It provides a framework for developing policies that influence the innovation process in agriculture, and possibly outcomes that go beyond the agricultural sector, including trade, finance, education and nutrition, affecting the way in which agricultural knowledge is generated, and how individuals and organizations interact to share and use that knowledge (Spielman *et al.,* 2011). This highlights the importance of individual and organizational capacities to not only to interact in, but also to shape, the wider environment to their advantage. Such capacities are a product of their environment, but also shape that environment as they emerge, develop and influence behaviour and collective practice. In other words, capacities for innovation operate at all three dimensions—individual, organizational and the enabling environment—simultaneously. As FAO's *The State of Food and Agriculture* 2014 states, "Capacity to innovate… must be promoted at multiple levels" and greater investment is needed to improve capacities at all levels to build collective capacity to innovate (FAO, 2014).

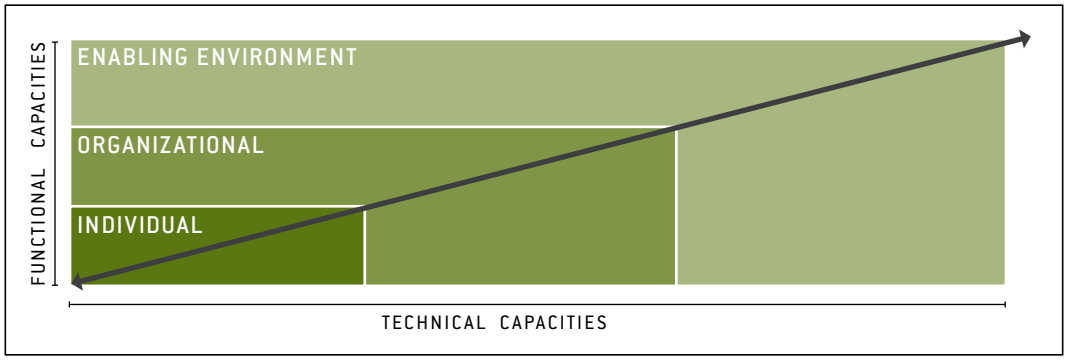
CHAPTER 2

INTERSECTION OF CAPACITY DEVELOPMENT AND AGRICULTURAL INNOVATION

Over the years, capacity development has had different meanings for different people (Morgan, 2006). In the past, it was often associated with training and organizational development that involved technical skills or knowledge development targeted at one particular type of trainee or organizational unit. Capacity development is now understood to link individual, organizational and enabling environments through a gradual realization of the need to move beyond technical skills at any one level, towards technical and non-technical skills and learning between dimensions (Bolger, 2000). Morgan (2006) states that capacity "is the ability to do something", and that this ability is collective because it cannot operate in isolation from the individual's relation to the wider environment and the influence of the system on the individual. Having strong capacities at any one level (or even all dimensions) is not enough without the inter-dimensional, collective "ability to do something" and to learn from it to inform future practice (OECD, 2006; Morgan, 2005). This inter-dimensional interaction component needs to be incorporated into initiatives aimed at developing capacity.

The FAO Capacity Development Framework (2010) adopts the OECD's definition of Capacity Development, namely that it is "the process of unleashing, strengthening, and maintaining of... capacity". As Figure 2 shows, this occurs in and across three interconnected dimensions:

Figure 2. Framework showing the two typologies of capacities that are required across the three nested dimensions of Capacity Development.



From Bolger, 2000; Hambly and Sarapura 2009; and FAO, 2010

the individual, the organizational and the enabling environment. Instead of only focusing on one 'dimension' and then trying to 'scale up' projects, efforts at capacity development need to occur in all 'dimensions' (Hambly and Sarapura, 2009). In this way, capacity development is inherently strategic (i.e. affects change in all 'dimensions' simultaneously). Furthermore, such efforts need to be owned by the people and organizations whose capacities are in the process of being developed (OECD, 2005, 2008; FAO, 2010).

For AIS, the focus is on developing a continuing ability to innovate. This capacity is dependent on the institutional and policy environment in which it arises, making it context specific (Hall, 2005). The FAO Capacity Development Framework identifies two types of capacities: technical and functional (FAO, 2010). Technical capacities are the knowledge, skills and behavior needed to carry out technical tasks, such as research, conservation tillage, or meet food safety standards. Functional capacities are the skills, knowledge and behaviour needed to effectively utilize technical capacities, including communication, leadership and management skills, as well as networking and planning. Functional capacities include the ability to influence and formulate policy, create and exchange knowledge, form effective partnerships, and implement effective initiatives. Despite disagreement on terms, there is general agreement that a balance of both types of capacity is needed to have the capacity to do something, in this case to innovate.

This paper adopts the FAO Capacity Development Framework and uses the concept of 'functional and technical capacities to innovate'. Returning again to the case of the Papa Andina Initiative in Peru, we can recognize how the capacity to innovate is evident in the emergence of Gastro Fairs in Peru.

GASTRO FAIRS IN PERU: CAPACITY TO INNOVATE ACROSS THREE 'DIMENSIONS'

Potatoes are the dietary and agricultural cornerstone for many in the highlands of Peru. Over the past decade, there has been a re-awakening of appreciation of the country's more than 3500 varieties of native potatoes, which have been grown and preserved by small-scale farmers, particularly resource-poor rural women. Their knowledge directly links to sustained biodiversity and cultural heritage (Sarapura, 2012). The health benefits and micronutrients of native potatoes, along with other factors such as identifying and addressing food safety concerns, has led to a marked increase in demand for these primitive varieties.

Local, regional and national food fairs now celebrate a number of aspects of traditional and healthy foods made from potatoes. These are well marketed, real-time 'Gastro Fairs' that use the virtual spaces of social media to network and create a wider community of followers and stakeholders. The Gastro Fairs have champions, such as Gastón Acurio, a leading chef who brings farmers, chefs, producer and culinary organizations, researchers and government bodies together. Combining culture and entertainment, food tourism and traditional and modern knowledge, these fairs have enhanced the capacity to innovate by and among individuals and organizations, creating an enabling environment that, in turn, facilitates further stakeholder interactions.

AT THE INDIVIDUAL LEVEL

Capacity development at the level of an individual entails the ability of people to function in a context that is likely to be constantly changing, and thus requiring both critical thinking and practical technical skills. In terms of agricultural innovation, this is the ability to understand and perform a role of putting knowledge into use. This may require, for example, the development of technical capacities such as learning about plant disease identification and management techniques, and functional capacities, such as interpersonal communication skills that develop self-awareness, as well as competencies that convey ideas and knowledge to others.

For example, at the fairs, farmers present and share their knowledge of native potato varieties and techniques with other farmers, researchers, chefs, consumers, marketing and retail businesses, mass media and a number of organizations. Farmers need to have the functional abilities to interact with others to share their technical skills. Partner organizations are working with farmers—both women and men—who are often illiterate, to gain skills in leadership, negotiation, experimentation and the use of information and communication technologies (Sarapura, 2012). By doing this, individuals develop self-confidence, which stimulates interest and enthusiasm about further sharing of experiences. Individual retailers, as well as researchers, restaurant owners and chefs, draw on their functional capacities to interact with and listen to farmers. These stakeholders need to have the capacity to apply what they learn from their interaction with one another as well as with farmers in order to meet personal and relational goals.

AT THE ORGANIZATION LEVEL

Capacity Development at the organizational 'dimension' considers an organization's ability to function in a given context. For agricultural innovation, this is primarily the ability of an organization to fulfil its role in bringing knowledge into use. As with the individual dimension,

this requires both technical and functional capacities to innovate. Technical capacities for an organization might include expertise and equipment. Functional capacities include set responsibilities among experts to, for example, work in a team or design, build, operate and maintain equipment. This organizational capacity is dependent on the capacities of individuals in the organization (such as a project manager or laboratory technician) but also depends on the capacity of the organization itself to make good use of people within or networked to the organization, including effectively managing other assets and resources.

At the Gastro Fairs, chefs' functional capacities to interact with producers and each other led them to find ways of incorporating these native potatoes into their cuisine. To do this they needed the capacity to function in their representative organization, the Peruvian Society of Gastronomy (APEGA), to articulate their technical needs. APEGA needs the organizational functional capacities to be able to act regarding the technical needs of its individual members (product standards). Functional capacities to interact and work with other organizations are also important. For example, APEGA collaborates with the National Association of Ecological Producers (which needs its own functional and technical capacities) to set product standards. These interactions begin to affect both individuals as well as the enabling environment.

AT THE ENABLING ENVIRONMENT LEVEL

Capacity Development in the enabling environment dimension influences how the wider environment of the system affects and is affected by the ability of individuals and organizations to function. For agricultural innovation, regulations, funding policies, standards, cultural debates, market structures and price trends are all typical ways in which the environment affects the ability of individuals and organizations to put knowledge into use. Technical capacities include laws, regulations and investments in infrastructure. Functional capacities include societal values and norms of collaboration.

The celebration of Peruvian cuisine and the emerging culture of collaboration that engendered the Gastro Fairs were possible because technical capacities in the form of new product standards were identified, understood and agreed upon by organizations whose members were rural producers, retailers and chefs. Public agencies invested in new or improved market facilities. Increased visibility, often through multi-agency communications campaigns, encouraged market demand and policy attention for native potatoes.

These product standards, originating from the Gastro Fairs, have an impact on the functional and technical capacities of the individual farmers and chefs, and their respective organizations,

while creating an opportunity to exchange experience within the system. For example, emulating the native potato activities, the anchovy industry of Peru has re-invented itself as a source of healthy, traditional food. The system can also work with diverse organizations to enhance the enabling environment, including initiatives that provide collaborative funding for new research or removal of obstacles that prevent knowledge being mobilized. In turn, organizations will need to draw on and adapt their functional and technical capacities, such as being able to interact with and understand the needs of farmers, thus directing research (that may need new equipment and associated skills) useful for end-users in the value-chain. Financing mechanisms, political momentum, labour policy, trust—the enabling environment—allow these aspirations opportunities to become reality.

CAPACITY TO INNOVATE

Like the idea of capacity itself, there is no accepted definition of what it means to have developed the capacity to innovate (Hall, 2005; Hall, Sulaiman and Bezkorowajnyj, 2007; Pound and Essegby, 2008). Pound and Egsby (2008) suggest that it has to do with a combination of skills and knowledge; networks and partnerships connecting knowledge and activities; the institutions that influence innovation; policies and incentives; and the potential to learn and use knowledge in better ways continually. In this paper, the capacity to innovate is defined as the continuing ability to combine and put into use different types of knowledge (Hall *et al.*, 2009; Hall, Mytelka and Oyeyinka, 2006; Edquist, 1997). The capacity needed for innovation is embedded in the institutional context (Hall, Sulaiman and Bezkorowajnyj, 2007). Various studies of the process suggest that innovation brokering goes beyond just generating and pushing out new technologies (Klerkx, Hall and Leeuwis, 2009).

First, it involves embedding general, often codified, knowledge into a specific context by merging it with end user's knowledge, usually tacit. Knowledge that has been encoded in some way, such as written down in a manual, is called codified knowledge (Pant *et al.*, 2008). This form of knowledge, referred to as 'know-what', can be easily shared through time and space and includes facts, principles and theories (Adler, 1995). In contrast, tacit knowledge is based on experience in a specific situation, and therefore this 'know-how' is difficult to share (Pant *et al.* 2008; Adler, 1995). Like reading a book on riding a bicycle and then actually riding the bicycle, someone can attend a class on tillage techniques for corn production, but it takes plenty of experience to know how soil that is too wet to plough feels while operating a tractor. Documenting that tacit knowledge allows it to be shared and accessed by others. Utilizing both forms of knowledge is important for innovation (See Box 2).

Box 2

BEEKEEPING EXTENSION IN HA TINH PROVINCE, VIET NAM

In Viet Nam, there is high demand for honey, with a premium placed on 'forest honey', meaning honey that comes from a rural environment and is not mass produced. Why is this demand not being met by rural small-scale producers as a way to boost income despite having an internationally respected Bee Development and Research Centre (BDRC) and a tradition of beekeeping?

Viewed from an AIS perspective, the issue is one of a capacity to innovate. There was an inability to combine codified knowledge from the BDRC with local tacit knowledge. Beekeeping training was originally conducted with extended lectures that were not focused on the practical application of the knowledge, the needs and concerns of beekeepers, nor the ability to manage bee colonies.

A multi-tiered Train the Trainers programme, formed around a long-standing friendship of Tam Quyet Dinh of BDRC and Gard Otis from the University of Guelph in Canada, was developed to introduce participatory extension and experiential learning techniques for beekeeping training in rural Viet Nam. Modern hives that allow for active management of colonies were introduced to, but not forced on trainees. Rural beekeepers have combined these modern hive designs with traditional hives to fit their situation and these ideas are now spreading rapidly to friends and relatives. This was made possible by the hands-on, practical training that met their needs and allowed them to combine their traditional knowledge with codified research knowledge.

The people who attended the informational meeting held in each commune chose among themselves who attend the training, hold regular bee club meetings in the commune, and represent them at district events. Through these meetings, knowledge is shared, enabling the beekeepers within each commune to be self sufficient. An issue perceived by all of the communes in which beekeeping training was provided is getting reliable access to the sheets of wax foundation that bees then build their combs on. To meet this concern, a foundation mill was purchased and training was provided in its use.

Other value-added activities besides producing honey have started to develop and thrive. With the improved management techniques enabled by moveable frame hives, beekeepers are producing additional hives of bees. In addition to increasing the numbers of hives they manage, beekeepers sell and give away hives. They often provide training to the people who receive their hives. Some small-scale beekeepers are now focused on raising queens and hives for sale, a high value activity that strengthens the small-scale beekeeping industry in the region.

This programme has led to positive outcomes for rural people. In the winter of 2007/08, losses of bees among Ha Tinh beekeeping trainees was 6 percent compared with 45 percent in a neighbouring region. Before the programme, the average profit from small-scale beekeeping and honey-hunting was $CAN35, and $CAN230 after (2008 GDP per capita in Ha Tinh was $CAN420). Several trainees had profits in excess of $CAN1 000 per year.

Sources: Sabljic, 2013; Otis *et al.*, 2009; CIDA, 2012

This implies a shift from developing 'one-size-fits-all' technology and practices, followed by attempting to prod farmers to change their practices to use the "improved" practices, towards participatory research and extension approaches, where farmers are intimately involved in developing and sharing technology they need, suited for their specific social, agro-ecological, economic context, as highlighted in Box 3. This requires both farmers and researchers to acquire new technical and functional capacities. Farmers need to develop research skills, and have the functional capacities to interact to share issues in farmer organizations, which in turn need to be able to articulate farmer demand for particular research. Researchers need to have a deeper understanding of local farming conditions, and the ability to guide and work with farmers on research projects. Research organizations may need to change their organizational structure, from one large centralized facility to smaller, localized stations, and these stations need to be able to communicate with each other.

Box 3
PARTICIPATORY RESEARCH IN HONDURAS

Small farmers in rural and marginal areas are often bypassed by mainstream research institutes, making it harder for them to innovate. This was the case in Honduras, which has a history of modern, export-oriented agriculture in the lowlands. The country's agricultural research system was geared for serving the needs of these farmers, leaving unmet the needs of small-scale farmers in remote, mountainous areas.

In the mid-1990s, the International Center for Tropical Agriculture (CIAT), began facilitating the formation of community research groups called Comite de Investigacion Agricola Local (CIALs) with partner NGOs. The process begins with the community deciding to form a research committee of roughly 10 people. Research priorities are set through participatory diagnosis of local agricultural challenges. After some research design training, the committee conducts controlled trials. The selection of new varieties takes place over 3 rounds. A single experiment cost ranges from US$25 to 50, and is provided through programme partners. These costs are recovered when successful product is sold.

Throughout the process, technical guidance is provided by researchers and agronomists. CIAL members take pride when agronomists approve of their work and the agronomists get satisfaction from witnessing the CIAL's achievements. Through this process, members are empowered to request additional support services and improved infrastructure.

Through the participatory development of varieties that meet the demands of the mountains, such as shorter stalks to reduce wind damage, farmers have seen an average 30 percent improvement in yields. Members of the CIALs have seen additional benefits, including working eight hours less per week on average, having four times as many cattle, and 5.53 times the number of chickens compared with their non-member peers.

Sources: Humphries *et al.*, 2000, 2005; Classen *et al.*, 2008

Second, developing embedded technology is one thing, but putting it into use is another thing. This is apparent in the case of new fodder seeds in India and Nigeria, described in Box 4. In this case, all the pieces were there: the farmers had the capacities to help develop new varieties and save seeds, the researchers had the capacities to partner with farmers, but that was not enough. There were systemic issues that revolved around being able act collectively, and it took the intervention of a third party to resolve this challenge. These systemic barriers to innovation require not only individual or organizational capacities to overcome them, but a systemic, collective capacity to innovate. This collective capacity depends on and emerges from interaction among individuals and organizations in a system (Hall, 2005; Morgan, 2005; Clark, 2006).

Box 4
SYSTEMIC BARRIERS TO ADOPTION OF FODDER SEEDS IN INDIA AND NIGERIA

Lack of fodder for livestock is a chronic issue facing livestock producers around the world. The International Livestock Research Institute (ILRI) partnered with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), both part of the Consultative Group for International Agricultural Research (CGIAR), to address this issue. Participatory research was conducted to select varieties of groundnuts in Andhra Pradesh, India. Despite farmers selecting a variety that was well liked by many farmers for its increased yields, it was not readily adopted by farmers.

One constraint was lack of seed. Though farmers had the technical skills to save seed, high cash demands at the time of harvest resulted in farmers selling their seed. The government subsidised seed, but the varieties available were not the varieties preferred and selected by farmers in the research trials. Private seed traders could not compete with the government's prices, which also served to obscure actual demand for the preferred varieties. Seed millers would not adapt their processes and equipment for the preferred seeds because the traders could not guarantee a market for the new seeds because they were not confident of farmer demand for the new varieties.

On their own, everyone had the capacities to innovate, but there were systemic barriers that prevented the collective application of knowledge. These barriers were the lack of trust in farmer demand for the seed varieties, and the market distortions caused by the subsidized seed.

There was a similar experience in Nigeria with new cowpea varieties. The project team stepped in to bridge the gap created by a lack of trust between actors in the value-chain by agreeing to pay half of the costs of the new equipment needed to produce the new seeds should demand not materialize.

Adapted from Hall, Sulaiman and Bezkorowajnyj, 2007

Innovation brings about change. Therefore, in addition to keeping up with external changes, such as in climate or economic conditions, there is a need to have a continuing ability to innovate that stems from the innovation process itself. Adoption of one part of an innovation package

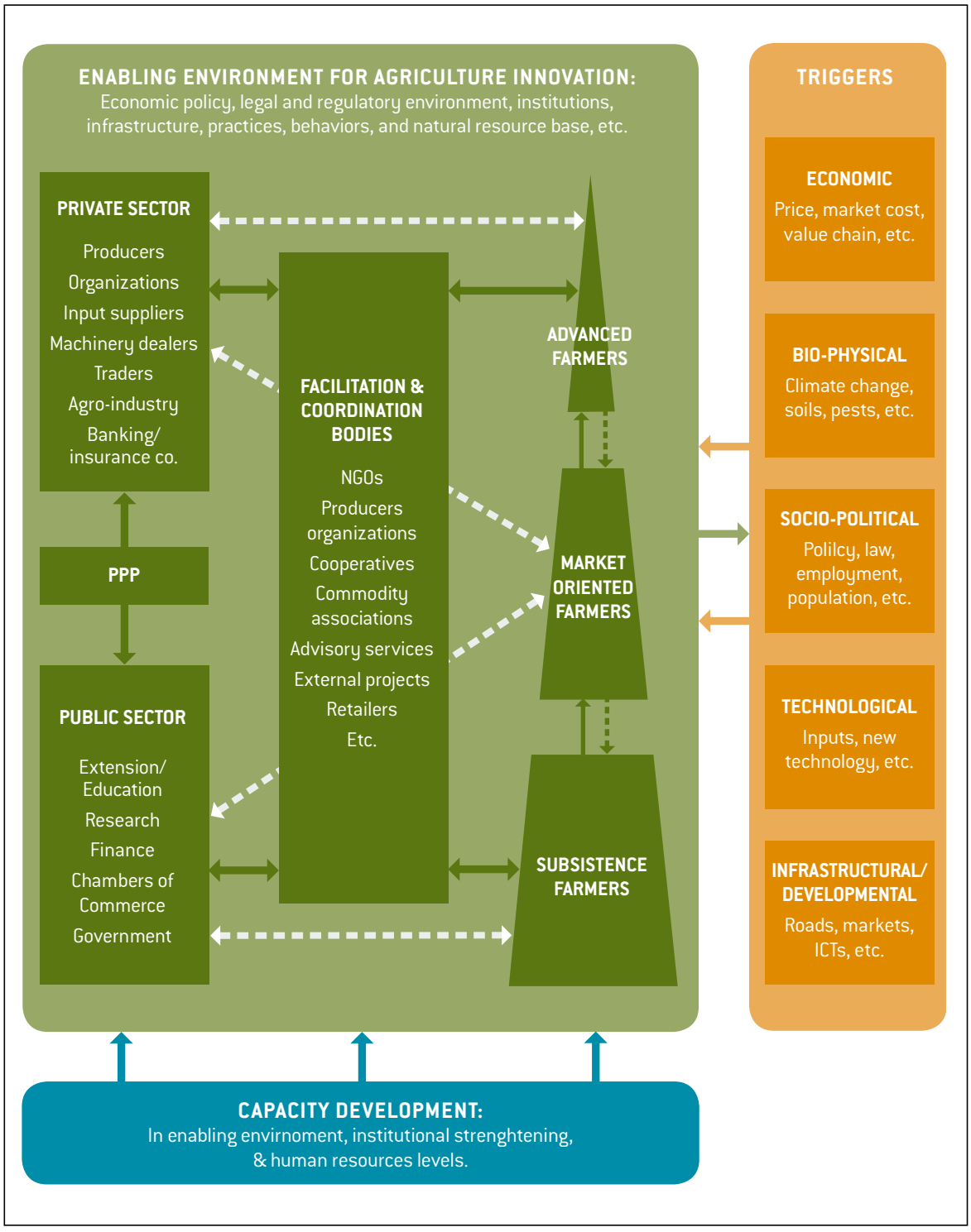
requires complementary innovations in that package to be also adopted. For example, new equipment is needed for conservation tillage, which needs to be repaired. Mechanics need to have the skills to repair that equipment, which may mean new training courses that anticipate this need. New financing schemes to purchase the equipment may be needed, which in turn may require new ways of organizing. Extension agents need to have the ability to continue to provide support services to farmers as new issues in weed control arise as a result of the new tillage practices. This continuing capacity to innovate is vital for a well functioning AIS.

TOWARDS INCLUSIVE INNOVATION

The technology transfer approach to innovation tends to benefit those who are in a position to be innovative, and these tend to be relatively wealthy farmers. This has the effect of excluding many people from opportunities to innovate, most of whom are poor, rural, women or small-scale farmers. Besides issues of social equity and justice, innovation in agriculture needs to become more inclusive in order to see an increase in agricultural productivity and meet long-term goals. For instance, gender inequalities limit agricultural productivity (World Bank, 2008). Seventy to eighty percent of farmers are women in many parts of Africa (FAO, 2013), so the lack of access to resources and opportunities to innovate prevent women from improving their lives and others in their communities, in addition to constraining agricultural productivity (Vigneri and Holmes, 2009).

Though AIS is not inherently pluralistic (Pound and Essegby, 2008), it allows for a more populist approach. People who were once excluded by past approaches to innovation, including small-scale farmers, rural and landless farmers, women and young people, are now considered important players in the AIS. This has several implications. Instead of developing generic technology and practices that can be more easily adopted by large, well connected producers and processors, technology and associated capacities should be developed in accordance with local people and situations. Also, it is necessary to target services and initiatives to a wider user group, with a consequent wider array of needs. For instance, advisory services for women should be tailored to better meet the specific needs of women. Also, as seen in Figure 3, government has a role to play in providing support services to subsistence and other types of farmers that are not able to access private sector services. An important part of pluralistic innovation capacity is developing the skills and abilities needed to form representative groups that can vouch for their constituents in the appropriate forums. This provides those once left behind with the capacity to create their own opportunities to innovate.

Figure 3. **FAO's analytical framework for Agricultural Innovation Systems (AIS)**



INSTITUTIONAL INNOVATIONS: PUTTING THE PUZZLE TOGETHER

Knowledge (in a variety of forms) and the capacities needed to innovate are spread among populations, organizations and institutions. Everyone has knowledge (proprietary, tacit, research, etc.) and something to contribute, be it pest management expertise, a biotechnology research programme, leadership skills, or a lifetime spent working a plot. However, the diverse actors involved in agricultural innovation see the puzzle and are motivated in different ways (Pant and Hambly Odame, 2006). This may lead to actors being wary of sharing knowledge and working together for fear of giving up any advantage that that knowledge may bring, such as an adapted processing method that reduces loss. This fear puts blinders on actors, only allowing them to see the short-term benefit of not sharing, when in the long term it is in their interest to collaborate with others. The key is in removing those blinders, and to harness and align the disparate knowledge, capacity, motivation and perspectives to innovate collectively. This stresses the importance of individual and organizational capacities to interact in the wider institutional environment in order to develop, share and use knowledge in novel ways.

Networks are the interaction of at least three individuals or organizations in relation to a common interest. Innovation is a social process that arises from the interactions of various actors in networks (Clark, 2006; Klerkx and Aarts, 2013). Having networks made up of a diversity of actors enhances innovation by providing connected constituents, with access to a wider array of resources, knowledge and political bargaining power (Fichter, 2009). Network formation and strengthening is a way of putting the puzzle pieces together and to begin to put the AIS concept into operation.

Institutions, including values, practices and laws, are not to be confused with organizations. The former shape the way organizations and individuals interact with each other in a given context, and, in a way, they are the human component of the context (Edquist, 1997; Hall, Mytelka and Oyeyinka, 2006.). This means that networks and capacities to innovate are context specific (Hall, Mytelka and Oyeyinka, 2006; Biggs, 2007). Taking this specificity into account is crucial for initiatives aimed at developing capacities to innovate, because they need to be tailored to institutional contexts (Hall, Sulaiman and Bezkorowajnyj, 2007). Network strengthening through institutional change at all levels is vital to harness and use agricultural knowledge that is spread over populations.

Institutional innovations often involve changing interactions and bringing people together, strengthening networks and developing the collective capacity to innovate. First developed in the late 1980s, Farmer Field Schools (FFS) (see Box 5) are an institutional innovation that enhances access to knowledge by strengthening farmer networks (Herbel *et al*., 2012b).

Groups of small-scale farmers with common agricultural interests meet regularly throughout the season to engage in hands-on learning in the field, discuss pest and weather challenges, share practices and test out new technologies *in situ*. FFS usually have some additional capacity development elements, including group building exercises, grant writing skills, and farm and financial management skills. After the season, many participants remain active in their groups, and sometimes form alumni associations. The sum of these activities can lead

Box 5
FARMER FIELD SCHOOLS IN UGANDA

Farmer Field Schools (FFS) are a practical, hands-on extension approach developed by FAO, whereby farmers with similar agricultural interests develop their own curriculum to learn about the "how and why" of a particular agro-ecosystem and strategies for growing in those conditions. It enables farmers to access and adapt new codified knowledge to their context.

In Uganda, the Farmer Field School model has been adapted from its rice integrated pest management beginnings to meet the challenges of the diverse small-scale farming systems found in the country. The Ugandan FFS model has been developed to meet three context-specific needs: improving food security and rural livelihoods; improving the agricultural productivity of internally displaced people and refugees; and increasing the resilience of communities facing the effects of climate change.

The two components in the FAO Uganda FFS are the farmer group learning activities, and community activities. The farmer groups identify their needs and develop the curriculum around farm practices and diversified livelihood strategies in the local agro-ecosystem. Organizational capacity development activities, such as leadership, formulating byelaws, and developing plans for the group, are a part of the group learning activities.

The community activities, involving local governments and institutions, are aimed at developing resilient communities through the farmer learning groups. They centre around taking action concerning collective goods. Activities include setting up community seed banks, community savings and loans programmes, rehabilitating and managing rangeland, managing catchments, and organizing animal health information and service programmes.

These community-level FFS groups are incorporated into a network with other community FFS, allowing innovations and information to spread faster and farther. In addition, these networks have helped manage conflicts over land and water resources between communities. Researchers and service providers now have a straightforward entry point to learn about the needs of a number of different communities.

Over the last decade, 3 900 Farmer Field Schools have been established in Uganda, directly benefiting 702 000 people and 117 000 households. In 2010, an empirically-based Household Economy Analysis study showed that after a decade of five prolonged dry periods, with near total crop failure that year, most agricultural households did not need external assistance.

Adapted from Okoth, Nalyongo and Ameny, 2013

to enhanced engagement in the wider community to address issues not directly related to agriculture (Pontius, Dilts and Bartlett, 2000).

Institutional change and the requisite self-development of individual and organizational capacities to bring about a change in the institutional environment is the essence of innovation capacity development (Hall, Sulaiman and Bezkorowajnyj, 2007). This requires more functional capacities across dimensions (Hall *et al.*, 2009) because these capacities are what enable technical capacities to be used in a given institutional context. The institutional context is being shaped and changed by the interactions of individuals and organizations, so as the context changes, so do the functional capacities needed to operate in it.

This view of innovation deviates from the historical capacity-building efforts, where technology and technical capacities were considered the main bottlenecks constraining innovation in agriculture (Hall, Sulaiman and Bezkorowajnyj, 2007; Coppock *et al.*, 2011). Now, in an AIS, functional capacities "provides [sic] the vision, desire, and opportunity to improve lives, and technology can then serve evolving aspirations" (Coppock *et al.*, 2011). Policy-makers should support this by creating "...a safe policy environment to experiment with new organizational structures and institutional set-ups so that stakeholders are willing to try new things..." (Pant *et al.*, 2008).

NETWORK STRENGTHENING THROUGH INNOVATION PLATFORMS

"Innovation Platforms" have been promoted as a practical approach to put the AIS concept into action (Spielman, 2006; Klerkx, Aarts and Leeuwis, 2010; Nederlof, Wongstchowski and van de Lee, 2011). An innovation platform is defined by Kilelu, Klerkx and Leeuwis (2013) as "a multi-actor configuration deliberately set up to facilitate and undertake various activities around identified agricultural innovation challenges and opportunities, at different levels in agricultural systems." First applied in natural resource management as a way to solve problems that require collective action among multiple stakeholders (Adekunle and Fatunbi, 2012; Kilelu, Klerkx and Leeuwis, 2013), platforms have been successfully used for this purpose in agriculture at a tactical scale by bringing together and providing a space for relevant stakeholders to interact (Box 6). This enables collective action by linking the technical and functional capacities of the individuals and organizations involved with the institutional environment, thus changing the patterns of interaction needed to support technological innovation (Kilelu, Klerkx and Leeuwis, 2013). This enhances the systemic capacity to innovate by aligning the knowledge and capacities that are scattered across diverse actors in different dimensions.

Box 6
PLATFORMS AT DIFFERENT SCALES

Oil Palm District Platform, Ghana

The Oil Palm Platform in Kwaebibrim District, Ghana, was set up to address constraints small-scale growers and processors face in producing palm oil for export and industrial markets. The platform itself is actually made up of two platforms: the *local-level platform* is focused on technology, and the *higher-level platform* focuses on institutional change. The local platform comprises an experimentation group that conducts participatory research on improving processing techniques to produce higher quality palm oil; the stakeholder group sets the agenda of the experimentation group. The high-level platform focuses on institutional constraints faced by the wider small-scale oil palm value chain. So far, they have stakeholders engaged in addressing value-chain issues, including in the district Assembly. Also, the platform has started getting interest and funding from the Ministry of Agriculture and research institutes.

Adapted from Adjei-Nsiah, Osei-Amponsah and Dawson, 2011

Plantain Regional Platform

Plantains are a valuable and important crop grown in many parts of western and central Africa, mostly by small-scale producers using traditional techniques. To increase production and improve livelihoods, the African Research Centre on Bananas and Plantains (CARBAP), a regional research programme, has set up eight multi-stakeholder platforms in four countries with the support of several regional partners. The platforms, two each in Benin, Cameroon, Gabon and Guinea, are made up of researchers, extension agents, value-chain actors and NGOs. They focus on conducting participatory research, and sharing of experiences among stakeholders regarding plantains. Since their inception, the platforms have helped develop new plantain chip [crisp] brands in Cameroon, and new hybrid varieties throughout the region.

Adapted from Tomekpe, 2012

e-Agriculture

The e-Agriculture Community is a global network with over 10 000 members. It functions through an online platform (www.e-agriculture.org) that is linked to various social media channels. This virtual presence allows all its members, 80 percent of which are in developing countries, to interact in a way that is not possible by non-digital means. e-Agriculture has become the leading global network for knowledge sharing and problem solving in the field of ICT for agriculture, fisheries, natural resource management, food security, etc. Its success has drawn in the support of several international and regional development organizations. The community has developed good practices to crowdsource experiences and solutions to pressing challenges, and to create actionable information resources from the collective learning and experiences. Individuals have participated in online crowdsourcing and knowledge sharing events with more than 50 000 participants over the past four years. Experiences and challenges are captured and consolidated in 11 multilingual policy briefs and other reports, and are disseminated by partner organizations and used as guides for project development.

Michael Riggs, e-Agriculture Team Leader, pers. comm.

Diverse composition is a key part of a platform. As Thiele *et al.* (2009) point out, a producer organization would not be a platform because it is made up of, and works only for the interest of, producers. In a similar vein, FFS are not necessarily platforms. While they may have linkages to other stakeholders, FFS do not have other types of actors, such as researchers or traders, explicitly involved in addressing issues shared by all stakeholders. Instead they focus on developing individual and organizational capacities of farmers. An FFS can lead to a platform if the farm group involved connects with other stakeholders to address issues facing all stakeholders, not just farmers.

Platforms are a special type, or feature, of a network, and are more focused and denser than other parts of networks. Whereas networks are loosely organized (usually by happenstance) around something where member actors may not necessarily know the other actors in the network, platforms are focused on a particular subject, are more intentional, and the members are aware of and have deeper interaction with other platform members. They often do not emerge autonomously, so there is a need for intermediation to develop the connections that form platforms (Kilelu, Klerkx and Leeuwis, 2013; Leeuwis and van den Ban, 2004; Röling and Higgins, 2000). The more formalized the operating structure of platforms, the more organization-like they become. This reinforces the idea, inherent in capacity development, that platforms need to develop their capacities in order to effectively enhance the innovation capacities in the wider network (Newton's Third Law of Motion: every force has an equal and opposite reaction).

PLATFORM ISSUES: TACTICALLY FOCUSED

An AIS is more than a single value chain, and innovation processes are shaped by more than a single policy. The implication is that policies and initiatives should be complementary (Hall, Mytelka and Oyeyinka, 2006.). While successful platforms are strategic in the capacity development sense, (i.e. effect change in individuals, organizations and the enabling environment) they tend to be tactically, rather than strategically, oriented in the wider agri-food system sense. Most platforms and the majority of AIS initiatives are focused on local-level innovation (FAO, 2013), and on specific commodities or technologies (Spielman and Birner, 2008), rather than innovation in the wider national system. They can all too easily exclude stakeholders with disadvantaged capacities, who tend to be poor, rural and female, and even be used to further exclude these groups. Platforms also tend to be transient (Nederlof, Wongstchowski and van de Lee, 2011), forming for a specific reason, and then dissipating, along with any future capacity, once the problem that drove them is addressed (FAO, 2013).

This tactical, issue-driven approach leaves outside of their often limited operating scope the coordination of proactive initiatives that shape the wider environment (Kilelu, Klerkx and Leeuwis, 2013). In addition, over-arching policy issues are not addressed; a platform based around a specific issue is not likely to be able to affect the many policies (if it has the ability to influence policy at all) that influence agriculture. This has led to duplication and uneven successes (see Box 7), and adds to existing worries over the application of the AIS concept (Hall, 2007; Spielman and Birner, 2008).

Box 7
UNEVENNESS IN INDIA'S MANGO EXPORT SECTOR

The agricultural research and extension system in India has not been able to keep up with the changing needs of the agriculture sector resulting from the liberalization of the economy in the 1990s. These challenges included increased international competition and demand, and changing demand from an increasingly urban domestic population. Extension funding and responsibilities have shifted from national to state governments, making service patchy. Private sector involvement in research and extension activities has increased over the last twenty years, but these services are geared more towards larger and more commercial farmers. This has led to an uneven AIS that works well in some locations, for certain producers, and for certain commodities, but is not effective in other contexts, especially for those who live in rural areas or have poor resources. The mango export sector is illustrative of this.

India is the largest producer of mangos, growing 43 percent of the global harvest. The country boasts superb agro-ecological conditions for mango production, and has ca. 650 varieties in cultivation. However, it has not been able to fully take advantage of high-end export markets, presenting a golden opportunity for small-scale producers to tap into high global demand for mangoes.

In a number of export markets, such as Japan, the European Union and the United States of America, consumers demand high quality products, and as a consequence there are stringent import requirements. For instance, the United States of America requires mangos to be irradiated, and Japan requires fruit to undergo Vapour Heat Treatment before they are imported. These regulations pose barriers to exploiting these lucrative export markets, especially for small-scale producers. India has a good research and extensions system, but seemingly oriented primarily for larger-scale producers. Actors in the small-scale and informal mango value chain were unable to take advantage of the services and research products, such as new varieties that produce fruit with longer shelf life, because their socio-economic background and situation precluded them from tapping into the formal research and extension system.

An organization (that bounced around from non-profit to cooperative) was set up to help small-scale producers access services, and hence export markets. However, this organization did not have the organizational ability to fulfil this role. It was unable to form the relationships with the formal sector needed to allow its constituents to tap into these opportunities. Also, the organization rarely met, and in essence existed only on paper. As a result, the mango export sector in India is still largely undeveloped.

Adapted from Pant *et al.*, 2008

CHAPTER 3

NATIONAL INTERVENTION: FILLING SYSTEMIC GAPS

AIS is a conceptual tool with practical implications that embrace long-term national goals, which may include food security, enhanced nutrition, increased production, or a broad improvement in living standards. As a systems approach, AIS may also facilitate local, grassroots, inclusive innovation. However, AIS recognizes that local innovation does not occur in isolation from the wider interplay of forces in political structures, the economy or society that may influence local innovation processes. From the AIS perspective, there is a need for a system-wide process that operates on a strategic scale to enhance local innovation by creating an enabling environment in which innovation can occur. Part of a national capacity to innovate is the ability to develop policies that "promote innovation as a systemic phenomenon" (Hall, Sulaiman and Bezkorowajnyj, 2007: 27). What is needed is a process to "reconfigure system architectures and strengthen system capacities" to enhance the enabling environment for innovation "through policy change" (FAO, 2013).

Key messages from FAO's *The State of Food and Agriculture* 2014 on Agricultural Innovation in Family Farming are that

> *"Capacity development for innovation should be based on a long-term strategy covering three interconnected dimensions: individual innovation capacity, organizational innovation capacity, and the creation of an enabling environment."*

and

> *"The creation of an enabling environment for innovation is essential. This means that policies, incentives and governance mechanisms must improve the capacity of all actors in the innovation system to respond to change."*

These statements reinforce the need for a national-level strategic approach for capacity to innovate.

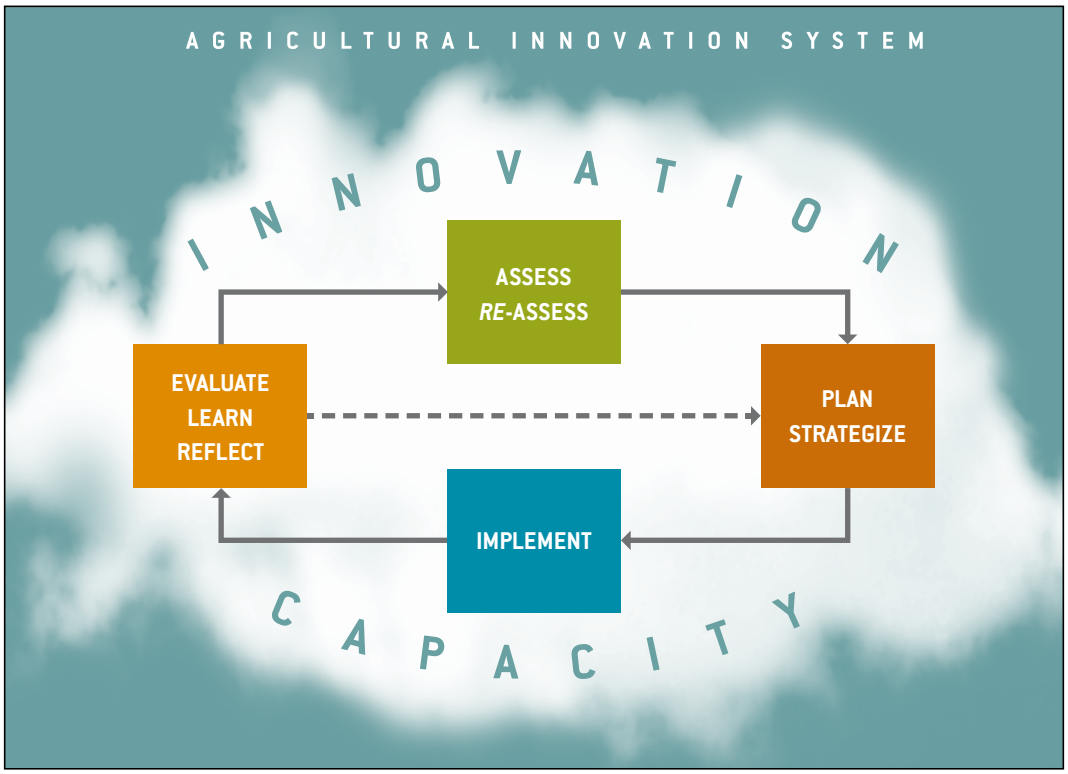
GUIDING PROCESS

By nature, innovation is all about change (Pardey *et al.*, 2010), implying that capacities to innovate need to adapt to constantly changing conditions. Like clouds, the capacities to innovate are always changing in quality and are influenced by many factors. Dew point, humidity and other environmental factors determine whether clouds develop and in what form. Capacities to innovate arise from the enabling environment, and in turn shape that environment. A wispy little cloud is easily tossed around by the wind and can be torn apart. But if the conditions are right, small clouds can merge into bigger and bigger clouds. This amalgamation of clouds into a thunderstorm can have significant impact and change the environmental conditions in which it arose (drop in temperature; a change in humidity). This then influences whether more clouds develop or not. Capacities to innovate are much the same.

The capacity cloud is made up of the individuals and organizations, and the ever changing institutional environment that shapes and is shaped by how they interact. As such, capacity development for innovation needs to be fluid enough to adapt to changing environmental conditions, and the changing needs this entails. In addition to being adaptable, capacities for innovation need to be guided by a long-term vision to be able to fully develop and ride the winds, rather than be buffeted by them. This requires an iterative process of capacity assessment and enhancement that has a wide enough scope to take into account and strategically influence the institutional and policy conditions that shape the way knowledge is generated, shared, and used (Hall, Sulaiman and Bezkorowajnyj, 2007)

To create an environment for developing dynamic capacities to innovate at a national level, a dynamic capacity development process is needed. The Innovation Capacity Development Cycle (ICDC) (Figure 4) is an iterative process of assessment, planning, implementation, and evaluation and re-assessment that is owned by the people and organizations that are developing their own capacities to innovate at the national level.

Figure 4. Analytical Framework showing the Innovation Capacity Development Cycle (ICDC) as the 'engine' of a national process that develops capacities to innovate.



Local-level innovations do not happen in isolation but are influenced by and in turn influence innovation at the national level, and occur in the midst of national innovation policy. Thus, owned by national stakeholders, this process of assessment, action and re-assessment of national capacities to innovate should not stifle local innovation, but rather enhance it by understanding issues at a local level, developing a plan and acting at a national, strategic level to foster innovation at all levels (see Box 8). Innovation should be fostered and supported wherever it occurs, especially innovation that will help adapt to future challenges. The intent is to kick up the dust, get processes started, make connections between local initiatives and

across sub-sectors, tie these efforts into regional and global networks and initiatives, and get everyone involved. The key is to do it again, periodically. The sustainable approach to capacity development is to make sure that the innovation capacity development cycle keeps turning, re-assessed and updated.

Box 8

EXAMPLES OF STRATEGIC AND TACTICAL INTERVENTIONS

The use of mobile technology in East Africa has taken off, especially in Kenya, where mobile banking has seen tremendous success: 17 million out of 19 million adults in the country use M-PESA, a mobile banking service (Economist, 2013). With this service and others like it, people who were not able to access basic financial services now have the ability to save, make transactions that are nearly corruption proof, and have improved access to information.

There are a number of ways mobile banking and mobile technology in general has been applied to address agricultural issues. One of which has been the development of mobile-based, weather-indexed, crop insurance (IFAD, 2011). With this scheme, farmers can purchase insurance covering inputs at the time the inputs are bought. Insurance payouts are based on how much weather varies from a set amount. For instance, if average rainfall for a given area is 50 cm, and a decent crop can be produced with at least 40 cm, insurance payouts, depending on the actual contract, are 'triggered' when 39 cm of rainfall is recorded. This is a simple, cost-effective, risk-management scheme that has allowed widespread access to options that reduce uncertainty.

Another intervention is the Market Transaction and Rumour Registration System, developed in partnership between FAO Kenya and the National Livestock Information System, where mobile phones are used to collect real-time market data that is accessible to farmers. This valuable information enhances farmer's access to markets and allows them to command higher prices for their goods (FAO Kenya, draft).

These interventions have been on a more tactical scale, dealing with specific issues, without affecting the wider enabling environment. However, the Kenyan government is working on taxing mobile transactions as a way to collect tax from informal markets (where much of the country's economic activity occurs) to fill budget gaps (Economist, 2013). This will have an impact on mobile banking and associated add-on applications.

A strategic intervention would be stakeholders, guided by a system-wide process, working with policy-makers to develop a solution where the benefits of mobile banking and the tactical interventions are not hindered by a new tax, yet the government is still able to effectively raise revenues to pay for public services.

CHAPTER 4
ASSESSMENT

Management specialist Peter Drucker once said "You can't manage what you don't measure." But what gets measured gets managed. The way performance is defined influences the way it is assessed, and consequently how it is managed. Another complication is that many of the desired results from an AIS have no clear finish line and need continuous adaptation (Daane *et al.*, 2009). You cannot just one day say, "we are sustainable" or "we are competitive" or "we are food-secure" and rest on your laurels. What you can say is "we are making good progress towards becoming food-secure" and "we are able to compete now, but what will we need to do to continue to do so?"

This is why assessment (the comparison of existing conditions with desired conditions; FAO, 2012a) is the keystone of the ICDC. It starts with assessment to understand current capacities and conditions, which will guide the planning and implementation stages of the cycle. Whereas traditional capacity building interventions often end at evaluating the implementation of technical skills training, the ICDC begins again with re-assessment, so countries can determine where they are in reaching these goals that have no clear finish lines. The questions are "What can be done at a national or strategic level to develop collective capacities for stimulating inclusive, dynamic innovation?" and "How is this helping us achieve our goals?" The assessment approaches and tools that they use should help them answer these questions. Assessment of factors that foster or hinder capacities to innovate should be the foundation of developing national capacity development plans and interventions that shape the institutional and policy environment to enhance the way agricultural knowledge is generated, shared and used.

ASSESSMENT: WHAT'S OUT THERE?

A theory of change* is a description of how some sort of initiative is going to bring about a desired change (Vogel, 2012). It answers the three questions of assessment: Where are we now? Where do we want to go? and How are we going to get there? (FAO, 2012a) The answers to these questions and the resulting theories depend on the specific contexts in which they are formulated. This section explores the work that has been done on applying various approaches to assessing AIS and capacities to innovate.

* Theory of Change is also a family of more flexible and participatory programme assessment tools, discussed later.

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For projects aimed at transforming national extension systems from centralized top-down structures to decentralized, farmer-demand-led systems, Swanson and Rajalahti (2010) offer a logic model template with performance indicators at the input, output, outcome and impact stages of a transformation project. They suggest useful areas to examine, including identifying major extension providers, and recommend useful tools such as Strengths, Weaknesses, Opportunities and Threats Analysis (SWOT) to aid in the development of the project logic model. Another method is the World Bank's Capacity Development Results Framework (CDRF). Based on Results-Based Management, the CDRF is presented as a universal, "step-by-step guide" for capacity development. In the Framework, the components of capacity are broken down and separated into three capacity factors: socio-politics, policies and organizational issues. Each has its own tools, and its own ready-made and standardized indicators of success. These are universal across projects, locations and time. Interventions are planned accordingly, and results chains are defined and "critical points in the change path identified" before the process begins (Otoo, Agapovitch and Behrens, 2009). CDRF also states that "Unknown elements of and risks to the change process should be clearly identified" so that programme managers can avoid the liabilities of operating in complexity (Otoo, Agapovitch and Behrens, 2009; Morgan, 2005).

Social Network Analysis (SNA) is a methodology that explores networks of relationships. Since innovation is a social process (Clark, 2006) and arises out of interactions through networks (Klerkx, Aarts and Leeuwis, 2010), this is a powerful tool for diagnosing and assessing AIS, and has been used to do so for specific interventions (see Box 9). There are several monitoring and evaluation tools that draw on the principles of SNA, such as Net-Map (Schiffer and Waale, 2008) and Participatory Impact Pathway Analysis (PIPA) (Douthwaite *et al.*, 2008), that have been applied to AIS. Net-map was used in Ethiopia as a tool to map the poultry sector to identify specific actors in the sector, their roles and influence, and the nature of their relationships (Spielman and Kelemework, 2009). They used expert opinion surveys to get data on sub-system characteristics. Expert assessments can be used to get at more qualitative aspects of agricultural innovation, and be converted into quantitative numbers using things like a Likert

Box 9

SOCIAL NETWORK ANALYSIS AS A MONITORING TOOL IN A BOLIVIAN COFFEE VALUE CHAIN

The coffee value chain in Caranavi, La Paz, Bolivia, is complex, with many different types of actors involved, including traders, small-scale producers, grower associations and NGOs. The International Center for Tropical Agriculture (CIAT) had several action research projects in Bolivia to increase the use of Information and Communication Technology (ICT) to improve small-scale producer access to information. Social Network Analysis (SNA) was used as a monitoring tool to identify information flows and needs in the supply chain.

The team focused on the actors and the content and information exchange mode. They asked actors about their relationships based around agricultural information, and used a snowball sampling technique where respondents suggest other potential respondents to the team. NetDraw software was used to analyse the data and draw network maps. The maps reflected the complexity of the value-chain, making it almost unintelligible. To overcome this, the team removed individual producers from the map. This allowed them to see that even though the map was still a "tangled mess" (something they say is a sign of a healthy information network), FECAFEB (Federation of Bolivian Coffee Exporters), a producer organization, is a major information hub. It also became apparent that an NGO that was trying to function in a similar way did not actually play a central role.

After some preliminary analysis, stakeholder discussions were held, with enthusiastic participation. Through these discussions, participants were able to discuss concerns. A rivalry between two producer organizations was overcome, allowing them to begin working together. Also, the NGO saw the position it was in and could adjust its strategy to better meet information gaps, rather than try to compete with FECAFEB. One participant said that "I have been working here 10 years and I could not have explained the problems facing the coffee sector as well as you just have with these maps".

Adapted from: Clark, 2006.

Scale (Pant, 2010; Spielman and Birner, 2008). This quantification of qualitative data is useful for bridging the gaps between more experiential, context-based assessment data and generic, comparable quantitative indicators.

Hall, Mytelka and Oyeyinka (2006) develop some rough guidelines for assessing agricultural capacities to innovate based around the combination of sector mapping and questions that cover areas like the history of the sector and how organizations interact. It begins with a sector timeline identifying where the triggers of the sector development lie and who are the main actors. Included are some suggestions for statistics like "value, size, growth rate, employment potential" (Hall, Mytelka and Oyeyinka, 2006: 19). Also explored are the competencies and practices of the organizations involved in the different areas of innovation systems. The last area briefly examined is that of policies affecting innovation. The FAO's "Capacity Development Learning Module 2: FAO Approaches to Capacity Development in Programming: Processes and Tools" is a guide for putting the FAO Capacity Development Framework into operation. The assessment approach described in the publication is based around gaining an understanding of the current situation ("Where are we now?"), agreeing on an end goal ("Where do we want to go?"), and determining the way that goal is going to be reached ("How are we going to get there?") (FAO, 2012a). It includes areas of capacities to be assessed across the three dimensions. For example, aspects of the enabling environment that the publication suggests assessing include the policy and legal frameworks, the policy commitment and accountability framework, the economic framework and national budget allocations, and governance and power.

For each of these dimensions, assessment tools are recommended, and describe how they can help answer the three guiding assessment questions (see above), such as stakeholder mapping, institutional and political economy scanning, and outcome mapping. Capacity assessment checklists are also included for guiding discussions among stakeholders, identifying needs and opportunities, and tracking changes. As with indicators, it is important to understand that a checklist only points to something deeper (i.e. capacity) but is not the thing itself. The Learning Module suggests using multiple methods to "triangulate" results in order to avoid mistaking the message for the meaning.

Moving away from projects towards indicators and indices that track trends across countries and through time, there has been some work on national performance indicators for AIS. These efforts stem from general, rather than specifically agricultural, innovation systems index work, such as the Organisation for Economic Co-operation and Development's (OECD) Science, Technology and Industry Scoreboard (OECD, 2011), the European Union's Innovation Union Scoreboard (EU, 2013), and the African Union's African Science, Technology and Innovation Indicators (NEPAD, 2011).

Some countries, such as Canada, have their own indicator framework that they use to compare innovation in their country with their peers (Conference Board of Canada, 2013).

Spielman and Birner (2008) applied these approaches to the agricultural sector and developed a prototype set of AIS indicators. They highlighted the difference between "classical indicators" such as research expenditure, with "AIS-oriented indicators" such as percent of research based on collaboration with other system actors. Spielman and Kelemework (2009) build on this by putting together the Agriculture, Development and Innovation Index (ADII). This is a "proof of concept" index that tries to incorporate "systems-oriented" indicators of innovation processes into the index by using "soft data" from expert opinion surveys in areas like responsiveness of organizations to innovation opportunities.

Indicator selection and aggregation into an index comes with challenges. Due to the widely agreed upon context-dependent nature of AIS, the indicators used to measure the performance of an AIS need to be context-specific, yet at the same time be comparable across countries, at least in the medium and long term (Daane *et al.*, 2009). For indicators to be valid and robust, Spielman and Birner (2008: 16) identify three requirements:

- first, the connection between indicators and innovation performance must be clear and based on theory;
- second, the indicators need to be measurable through time and space; and
- third, a common unit is needed for aggregating indicators into indices.

In addition, the way the data is collected needs to be valid so that what is being measured reflects the indicator (which then reflects innovation performance). For instance, the way wealth is perceived is not the same between a rural small-scale farmer in the Andes and a mango trader in India. This then needs to be standardized across countries and through time, and then aggregated into an index. There are several ways of aggregating indicators into an index, but each approach can yield widely differing results (Spielman and Birner, 2008).

Aggregated indicators, such as the OECD's Science, Technology and Industry Scoreboard, the European Union's Innovation Union Scoreboard, and the Agriculture, Development and Innovation Index are good for making comparisons across countries, but are of limited use for decision-makers when it comes to making informed interventions (Daane *et al.*, 2009). One issue with indices is the question of whether one number can really encapsulate the full meaning of 'innovation' (Spielman and Birner, 2008). Indices also put too much weight on technology innovation, and miss out on other types of innovation and on softer aspects of AIS (Daane *et al.*, 2009).

THE MISSING SYSTEM-WIDE VIEW

From a national, strategic level there has been little work on assessing capacities to innovate. As it stands, there is an assessment gap between local, tactical and value chain initiatives and general indicators and indices for tracking trends and marking progress towards international development goals across time and countries. There also needs to be greater country ownership of assessing capacities to innovate, for without country ownership of interventions there will not be the necessary long-term commitment needed for effective development of capacities to innovate (GFRAS, 2012). It is more empowering, and therefore effective, if countries diagnosis their own capacities to innovate, and strive to improve it. We propose an assessment approach that covers key areas that foster or hinder capacities to innovate. An assortment of tools that the can be used are also noted. Rather than prescribe fixed assessment models and methods, the approach lays areas that are important for countries to explore in their assessment and re-assessment of national capacities to innovate. This will help create an actionable picture of the national AIS and associated capacities to innovate. It will create an opportunity for countries to appraise and benchmark key elements of AIS, especially the subtler aspects. The resulting picture should then be tied into indicators for long-term goals, and international initiatives such as the Millennium Development Goals.

The integrated picture creates a legislative and budgeting framework that aids policy-makers when they are involved in the messy process of negotiating legislation and allocating budgets, so that innovation policy investments are more nuanced than simply “research spending”. Benchmarking and continual assessment will also help stimulate a drive (a functional capacity) to improve on previous scores. While the assessment data produced may not be directly comparable with other countries in the same way that well-developed indicators can be, because they introduce a broader perspective the scorecards and even the principles can still be used to compare countries for starting conversations and sharing ideas of what worked and what did not.

CHAPTER 5
ASSESSING CAPACITIES TO INNOVATE

The context-specific nature of capacities to innovate makes any set method or fixed model of assessment impractical. Information is expensive, both in the effort needed to collect it, and also the cost associated with the effect (perverse indicators) that collecting information has on a system. Set models of assessment can prescribe more information collection than is needed. If all the major stakeholders are already identified and know each other, then there is no need to waste time and financial and social capital by doing a stakeholder analysis. Those resources would be better spent on, say, identifying institutions that shape their interaction, or strengths of current partnerships and opportunities for future collaboration. Both qualitative and quantitative data are useful and are important to consider. Qualitative data play a large role contextual descriptions and it provides richer answers to the "why" and "how" questions that are central to assessing capacity to innovate. However, such qualitative information is often difficult to gather through a fixed approach. This is why, in this paper, a flexible approach is proposed, looking at broad key areas of capacities to innovate in agriculture.

ELEMENTS OF NATIONAL CAPACITY TO INNOVATE TO BE ASSESSED

The assessment of capacities to innovate at the national level should focus on the broad but critical areas of agricultural innovation that are left unexamined by local, tactical projects or international indicators, or both, and indices, in order to obtain a more complete map of national AIS.

The first parameter to consider is the actors involved in agricultural innovation. They include the various types of farmers, input suppliers, processors, traders, distributors, researchers, financers, extension agents, researchers, NGOs and ministry representatives. At the national level, many of these actors will be (or should be) represented by representative organizations, like the National Input Suppliers Association, or Producer Associations. Some aspects to explore are who they are and the ways they are involved in the process. Do they have the capacities needed to organize, form partnerships, and advocate for their interests at relevant levels? Do local actors and organizations have the capacity to engage with players at the national level and vice versa? How are regulations governing the formation of new companies affecting actor's capacity to organize? Are actors able to afford new equipment, or have access to affordable financing?

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The natural follow-up area to explore is the linkages between the actors. It is important to explore who is interacting with whom, in what way, and what influences that interaction. Redundant linkages should be identified. Also, whether those linkages adapt as needed to changing conditions is important to consider. Policies, regulations and institutions also influence the way stakeholders interact and develop networks, and consequently affects capacities to innovate. These need to be examined from the perspective of how they do this, and whether they are creating barriers to innovation and developing capacities. Some possible questions to explore are: Is there trust between actors? How does research policy affect the collaboration between researchers and end-users? How do intellectual property rights influence licensing agreements? Do all actors have the capacities or opportunities to develop capacities needed to form linkages? Some tools to explore stakeholders and their interactions include Stakeholder Analysis, Capacity Assessment Checklist, and Social Network Analysis tools like Net-map. For exploring the enabling environment, Institutional and Political Economy Scanning may be useful.

A key principle to explore is that of equality, including the inclusiveness of opportunities to innovate and inclusiveness of opportunities to develop capacities to innovate. A central

component of this is accessibility of information and markets. Access to information and markets are crucial for an inclusive (and well functioning) AIS. Farmers and other actors need to have the capacity to access, share and apply information as the situation demands. Information is a building block of innovation, and markets are a main driver of the innovation process and supplier of information. This includes examining how infrastructure, such as transportation, energy supply and telecommunications, affect individuals and an organization's ability to bring produce to market, exchange ideas and learn.

Policies and regulations also influence the inclusiveness of innovation opportunities and capacities to innovate. This includes education policy and how that affects access to formal and informal education and developing basic literacy and numeracy skills. An understanding of how policies and regulations, such as those for food safety, influence actors' ability to function in the innovation system. For instance, small-scale producers and processors are affected more than large-scale producers by food safety regulations. It is important that they have access to compliance assistance in the form of information and financial support to ensure that they are able to operate while keeping the food supply safe. An inclusive process for innovation policy formation is perhaps the most important aspect of an inclusive innovation system. All actors, be they individuals, organizations, or organizations representing individuals, need to have the functional capacity to influence policy formation. As mentioned earlier, this in turn requires polices and institutions that enable this, and the first step in developing inclusive innovation policies is exploring how existing policies influence capacities to innovate.

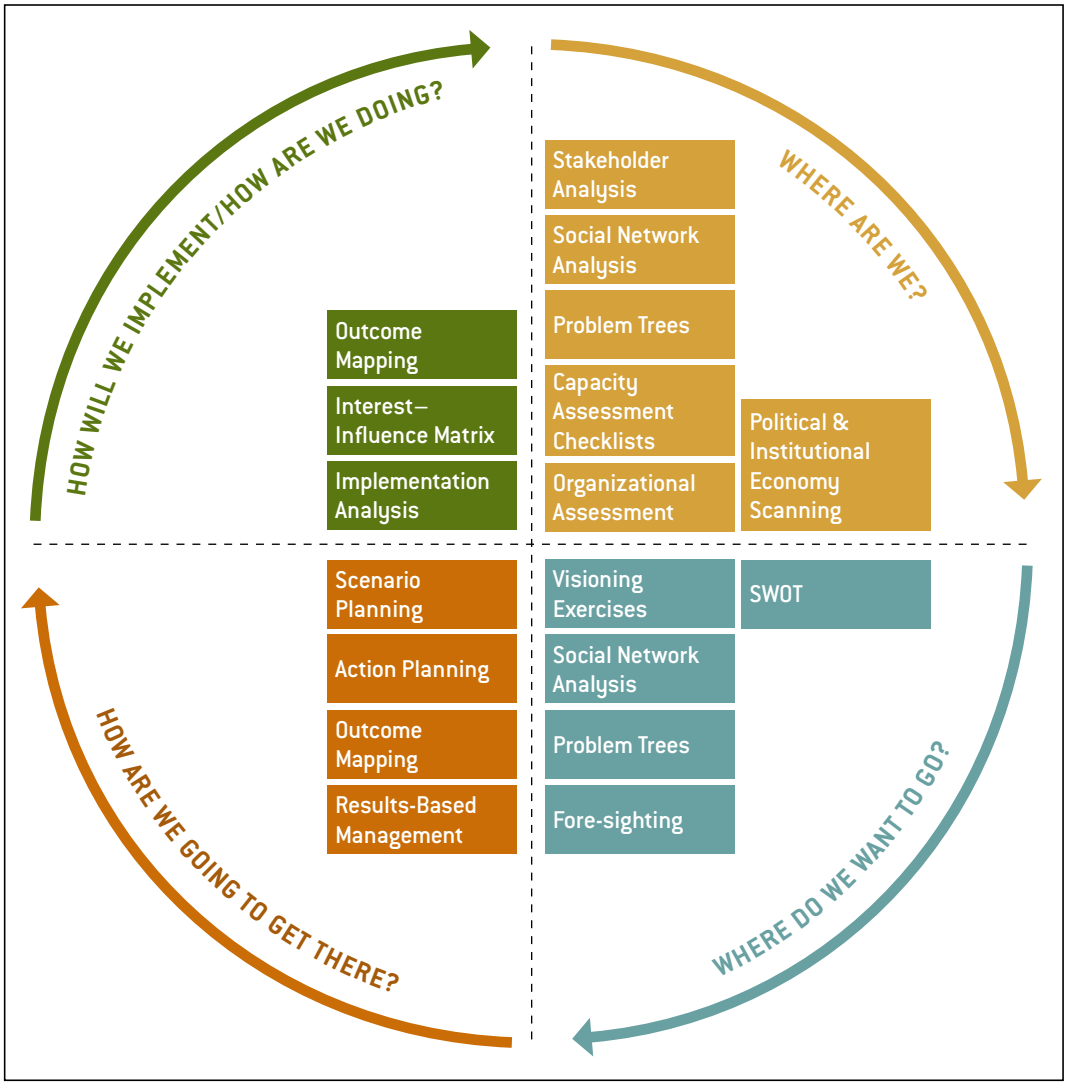
The successes and the things that are working well are another area that should be identified. These should be celebrated, and the lessons learned from them should be applied to relevant areas. While the focus should be on successes, bottlenecks to innovation and developing the necessary capacities should be identified as well. The trends of the sector and those influencing the sector should be identified. This is where more statistics should be used to cross refer to the qualitative data from the previous areas. This should be used to explore how trends are affecting individual, organizational and collective capacities to innovate. This can then be used to develop opportunities to leverage those trends.

A context-specific parameter is that of what information to collect and what questions to ask to explore elements of national capacity to innovate. This involves exploring technical and functional capacities in all three dimensions: individual, organizational and enabling environment.

METHODS AND TOOLS

There are many methods and tools that might be useful for each stage of the assessment process (see Figure 5). This section introduces some of the possible tools for the assessment of national AIS and associated capacities to innovate. These are introduced around Social Network Analysis (SNA), which is an approach to understanding relationships in complex systems (Butts, 2008). While the methods and tools used will depend on the situation, SNA is recommended as a way to form the assessment framework and organize the tools into an overall assessment picture. This is not meant to be an exhaustive list nor a how-to manual for the tools included, but rather a starting point for further exploration.

Figure 5. A selection of tools available during the different stages of the assessment process



Adapted from presentation by Hambly Odame, 2013

SNA can be used to map the sector and form the base layer in the assessment. Its emphasis on actors and the relationships linking them makes it a powerful methodology for exploring AIS. The map of the relationships between the major agricultural actors creates a framework (Clark, 2006) or 'picture' that can then be viewed with different 'filters' such as knowledge flows, finance, policies, political influence and institutions, to see how each of these things affect interactions. Net-Map is a tool used for SNA that has low overhead and can be conducted in a participatory manor (Schiffer and Hauck, 2010). At its core, participants map out a network using props that represent actors, links and drivers (Schiffer and Hauck, 2010). The participants can include any combination of stakeholders at one or multiple mapping sessions. This information can be used to answer questions like: Where do small-scale farmers get their extension services from? Do small-scale sheep producers have contact with research organizations? Do small- and medium-scale food processors have access to food safety compliance support? Where do people go for their information?

This can then be used in several ways. First, all of these filters can then be reviewed in terms of how all these things work towards achieving long-term, national goals, such as broad improvement in living standards or food security. In combination with indicators for these goals, the network maps can be used to answer questions like how has the increased access to knowledge that resulted from decentralizing advisory services affected rural people's ability to handle food price shocks? As this change occurred, has there been a positive change in food security indicators?

Second, other assessment methods can be incorporated to enhance the picture of the national AIS. Tools that examine stakeholder's capacities such as Stakeholder Analysis, Organizational Assessment, and Interest Influence Matrix can be used in conjunction with Net-map and other SNA tools (Prell, Hubacek and Reed, 2009). Stakeholder Analysis can be used to analyse stakeholder's interest in an issue, their ability to influence action on that issue, and the importance of that issue to them. These three areas are ranked on a scale from 1 to 3, which are then summed into a score (FAO, 2012a). This can be supplemented by an Interest-Influence matrix, which explores in more detail stakeholder interest in capacity initiatives and their ability to influence it (FAO, 2012a). Also, questions from the Capacity Assessment Checklists (FAO, 2012a) that are relevant to stakeholder can be used to assess stakeholders' functional and technical capacities. Questions might include: "Do policy staff have the required technical and managerial skills to operate effectively? (FAO, 2012a).

With the qualities and capacities of the stakeholders identified and their linkages mapped, tools for exploring the enabling environment and its effects on stakeholders and their interactions can be used. These might include a SWOT analysis for the sector, a specific sub-sector or value

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chain, gathered during group discussions or interviews with stakeholders. Institutional and Political Economy Context Scanning is a matrix that explores and ranks on a 4-point scale areas such as budget allocations, formal policies, cultural aspects and cooperation between organizations (FAO, 2012a).

Third, this emerging image of the national AIS can be used to guide interventions, be they working with policy-makers to amend food safety regulations, or for working with (or setting up) local innovation platforms to enhance producers' contact with researchers. A visioning exercise allows the coalition, and even non-coalition stakeholders, to develop an ideal national AIS based on a network map, and then to plot out the actions needed (and indicators of success) to be taken to develop the capacities to innovate that are needed to reach the target.

This is the idea behind Theory of Change (ToC) approaches, suc as outcome mapping and Participatory Impact Pathway Analysis (PIPA) (Connell and Kubish, 1998; Douthwaite *et al.*, 2008; Smutylo, 2005). With an ideal outcome agreed upon, stakeholders then map out the

necessary steps, changes and barriers to reaching that outcome. Attached to each of these 'waypoints' are indicators. Here the question is not "What can we attribute to an outcome?", as it is with logic models, but "What can we contribute to an outcome?" (Ramalingam, 2006). The emphasis on these indicators is on changes in behaviours, and are therefore more like 'rules of thumb' than mile-markers. Inputs and actions are the final part of the process. PIPA differs from outcome mapping in that participants make predictions of impact based on programme outcomes (Douthwaite *et al.*, 2008), whereas outcome mapping focuses on outcomes due to the unpredictability of impacts and their causes (Pant, 2010). ToC approaches focus on "how" and "why", and are more complex and adaptable than the pre-programmed simple causality of logic models (Connell and Kubish, 1998; Ramalingam, 2006).

Fourth, this picture of the national AIS and capacities to innovate can be used as a baseline for monitoring progress towards the adaptable ideal image of the innovation system. Even if there are no baseline data for a certain aspect of a certain value chain, the assessment picture, built around the network map, can be used to identify what data is needed. For example, if a coalition wants to develop the wool value chain in order to improve the living standards of rural pastoralists, then they should partner with stakeholders in the sector and assist them in creating a more focused network map of the wool value chain. Then there should be general agreement about what indicators will be used to determine success, and then baseline data should be collected. These indicators could be quantitative or qualitative; what is important is that there is agreement when answering the question "How are we going to know we are on a positive path?" Process indicators for the wool value chain might include a number of new partnerships between actors, such as research and farmer groups, and feedback on what is working well as the initiative unfolds. Outcome indicators might include change in income, change in time spent on certain activities, education, and reported quality of life.

As the assessment process unfolds, something to keep in mind is that, in this case, it is better to have an imperfect assessment than no assessment at all. While quality, validity and reliability are necessary goals, reaching those goals should not prevent assessment from taking place. Many of these tools are simple to use, and can be adapted to a wide variety of situational needs. While it might be good to have sophisticated SNA software (R, Social Networks Visualizer and Cuttlefish are open source options) that can execute interesting statistical tests, a lack of such software should not stop relationships between actors from being explored today. It could even be that the data are not the main objective of assessment, but rather the process along the way that can bring stakeholders together to work towards achieving collective goals.

CHAPTER 6
CONCLUSION

In an ever changing and complicated world, a dynamic capacity development process is needed to create an environment for developing capacities to innovate at a national level. Capacity today is not capacity tomorrow. Things change, new problems arise as old ones are addressed, creating a continued need for adapting capacities to address new issues. There is a need for a flexible national capacity development strategy for innovation in agriculture that allows for trends, whether positive or negative, to be turned into inclusive opportunities to adapt to changing needs. The Innovation Capacity Development Cycle, conducted by national stakeholders, is an iterative process of assessment, planning, implementation, and evaluation and re-assessment that is owned by the people and organizations that are developing their own capacities to put knowledge into use. This continuing cycle of capacity assessment and action at a strategic level enhances the ability of agri-food systems to meet the needs of society today, and adapt to the challenges of tomorrow.

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OCCASIONAL PAPERS ON **INNOVATION IN FAMILY FARMING**

The sustainable intensification of agriculture to achieve food security is a complex challenge that requires technological and institutional change. The Agricultural Innovation Systems (AIS) concept is a strategic framework that takes a demand-driven, interactive approach to innovation in agriculture. This report establishes the concept of the capacity to innovate, which depends not only on hard technical capacities, but also softer functional capacities across the individual, organizational, and enabling environment scales. It argues that developing country-level innovation capacity requires an iterative capacity development process based around assessment. After reviewing the relevant assessment methods and tools, a general framework for assessing the capacity to innovate is proposed and applicable tools are suggested that explore key areas that influence the capacity to innovate. Tailored to specific situations, this framework can enable a system-wide assessment process that guide interventions to develop and sustain the capacity to innovate in order to achieve sustainable food security.

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