

## **ENHANCING INNOVATION IN LIVESTOCK VALUE CHAINS THROUGH NETWORKS: LESSONS FROM FODDER INNOVATION CASE STUDIES IN DEVELOPING COUNTRIES**

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### **Introduction**

In developing countries, livestock can be an important pathway out of poverty (FAO 2009; McDermott et al. 2010a; Rich et al. 2011). Over one billion people depend on livestock, which provide power and manure for crop production, contribute to food and nutritional security, and are a form of savings for many poor people. Livestock also make major contributions to the agricultural GDP, export earnings, and employment. According to the “livestock revolution” thesis (Delgado et al. 1999; McDermott et al. 2010a), the sector is driven primarily by rising incomes and urbanization in developing countries like China and India, where demand for products such as meat and milk has been soaring. However, livestock are also responsible for adverse impacts on land, water, biodiversity, and climate change (Steinfeld et al. 2006; FAO 2009). Despite the conflicting paradigms, many, including McDermott et al. (2006), argue that, given appropriate policies to address social and environmental effects, livestock provide opportunities for millions dependent on them.

There are, however, challenges to enhancing market success for livestock-dependent people, including fodder<sup>1</sup> scarcity and weak farm-to-market links (McDermott et al. 2010b; IFAD 2006). The micro evidence we generated from Ethiopia, Syria, and Vietnam shows that fodder scarcity is severe. For example, in Syria during the dry season (December to February) many farmers face 50–60 percent fodder shortfalls (Larbi, Hassan, and Abdullah 2010). Fodder shortages reduce productivity and production and, as we noted in Ethiopia, may also damage community relations by provoking conflict over

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1 *Fodder* refers to plants grown for feeding animals. It includes *food–feed* crops, grown for human consumption but whose residues and by-products are fed to livestock; grass, legumes, and tree species (see Hall, Sulaiman, and Bezkorowajnyj 2007).

grazing lands. We found complex causes of scarcity, including limited and erratic rainfall, shrinking grazing lands due to competition for land for crops, and changing land-use patterns favoring urbanization and settlement.

Over the past four decades, research and development programs have looked into the fodder-scarcity challenge, with some success in developing and promoting food and feed crops like cowpea; and improved grasses, legumes, and fodder trees (Lenné and Wood 2004; Kristjanson et al. 2005; Franzel and Wambugu 2007; Horne et al. 2005). Despite these efforts, many researchers found “limited” evidence of adoption of fodder technologies (IFAD 2006; de Haan et al. 2006; Hall, Sulaiman, and Bezhorowajnyj 2007). Limited adoption was attributed, among other factors, to farmers’ limited knowledge of technologies and low technical support provided to them, low government priority given to fodder compared to staple crop technologies, and limited availability of fodder seeds (IFAD 2006). For Hall, Sulaiman, and Bezhorowajnyj (2007), fodder scarcity has less to do with a shortage of information or technology per se than with “capacity scarcity” to innovate. Addressing scarcity entails the development of an “innovation capacity,” which consists of “*the context specific range of skills, actors, practices, routines, institutions and policies needed to put knowledge into productive use*” (Hall 2005, 625). Innovation-capacity development comes under the rubric of an innovation system approach which stipulates innovation as an outcome of interactive learning in networks (World Bank 2007; Rajalahti, Janssen, and Pehu 2008).

This chapter is based on case studies drawn from the Fodder Adoption Project (FAP) (<http://fodder-adoption-project.wikispaces.com/>; Duncan et al. 2011) implemented in Ethiopia, Syria, and Vietnam from 2007 to 2010.<sup>2</sup> The FAP was motivated by the innovation-systems approach, and aimed at a better understanding of the factors and processes influencing fodder innovation (the successful introduction and integration of fodder technologies and related knowledge in livestock-production systems).<sup>3</sup> A small team consisting of a research scientist and support staff coordinated networks in each country to initiate and diffuse fodder innovation in nine learning sites (villages and districts): four in Ethiopia, three in Syria, and two in Vietnam. The chapter

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2 The International Livestock Research Institute (ILRI) acted as the implementing agency, on behalf of the CGIAR Systemwide Livestock Programme. It was administered by a consortium of centers: ILRI, International Center for Tropical Agriculture (CIAT) and International Centre for Agricultural Research in the Dry Areas (ICARDA). FAP in Syria concluded in 2011.

3 Besides fodder technological innovation, in some sites FAP also promoted organizational innovations such as formation of farmer groups and coordination of value-chain actors and activities.

synthesizes the lessons learned. It pays particular attention to documenting and analyzing innovation processes in different local and national contexts. This analysis highlights the importance of learning on farms and in networks, and that sustained improvement to fodder availability occurs when broader livestock value-chain issues are addressed.

The next section discusses innovation-system and value-chain approaches as tools of understanding, organizing, and implementing agricultural development initiatives. It also outlines the methodology of the study. The third section describes and characterizes the national and local innovation environments. The fourth section discusses the innovation processes and outcomes thereof. Focusing on a meat value chain, it also discusses the factors that enhance fodder innovation in a sustained manner. The fifth section draws lessons and provides the conclusions.

## **Contemporary Approaches to Agricultural Development and Study Methodology**

### **Innovation System and Value-Chain Approaches to Agricultural Development**

Along with Spielman, Ekboir, and Davis (2009), the World Bank (2007), and others, we understand (agricultural) innovation as a successful introduction and exploitation of knowledge and technologies for social and economic benefits. The use of such knowledge and technologies brings about positive changes in how people make or do things, and ultimately improves their livelihoods. The linear research–development–extension approach has been much criticized for being hierarchical, top-down, and supply-driven, and for its limited impacts on the generation and diffusion of relevant knowledge and technologies. The thinking behind the approach has been that scientific research is the driver of innovation, but often disregards different sources of knowledge and demand (see Lundvall et al. 2002; World Bank 2007; Rajalahti, Janssen, and Pehu 2008). The more recent paradigm for knowledge generation and use is the innovation-system approach (Lundvall et al. 2002; Clark et al. 2003; World Bank 2007; Rajalahti, Janssen, and Pehu 2008; Spielman, Ekboir, and Davis 2009), described as a network of private- and public-sector organizations whose interactions produce, diffuse, and utilize economically useful knowledge. For innovation-systems thinkers, innovation of different kinds (technical, institutional, etc.) follows a nonlinear process and uses multiple sources of knowledge. Networks coordinate and facilitate interorganizational

interactions and knowledge, and information flows; allow the exploitation of complementary capabilities; and open up opportunities for exploiting synergies within networks (Pyka and Koppers 2002; Howells and Edler 2011).

The “system” capacity depends on the “density and quality of relationships” between the innovation-producing and -using agents, and the support institutions (Altenburg, Schitz, and Stamm 2008). The more diverse the actors the better the opportunity to combine complementary capabilities. Interaction and learning also depend on actors’ “proximity”—including the physical distance, the institutional environment that shapes trust-based relationships, and actors’ capacity to absorb new ideas. The stronger the proximity, the better the flow of (particularly tacit) knowledge that cannot be coded and “transferred” (Boschma 2005; Clifton et al. 2010). However “more links” and “denser network ties” could also produce “lock-in failure,” where inward-looking tendencies block diverse and open relationships and stifle innovation (Boschma 2005; Clifton et al. 2010; Howells and Edler 2011). Facilitation by “intermediary” organizations also enhances networking and interaction, as such organizations, acting as brokers, help find advice and funds to support innovation (Klerkx and Leeuwis 2008). In the cases discussed here, the institutional environments provided a limited number and diversity of actors, and barely any network facilitators, making the demand for innovation-capacity development more challenging.

The innovation-systems approach assumes that learning in networks leads to learning by individual market-chain actors and farmers, producing innovation. Evidence from the case studies reported in this chapter shows that, before acceptance, farmers learn on-farm a great deal about the performance and suitability of fodder technologies to farming systems; and the sustainability of input and product markets. Johnson (1992) noted that of all types of learning (like imprinting or searching) the most economically worthwhile and useful in increasing the stock of knowledge is “learning by producing” or “learning by doing,” which we interpret to mean learning on-farm. Further relevant innovation capacities reside in networks and partnerships, in organizations, and in individuals (Ayele and Wield 2005). The chapter, therefore, links network- and farm-level learning arenas (with institutional support) as central to innovation.

The literature on value chains and innovation systems shows many common and complementary features (for example, Anandajayasekaram and Gebremedhin 2009). A value chain is understood to include all the actors and activities from production to consumption, and the dynamic relationships between actors involved in a chain (Rich et al. 2011; McDermott et al.

2010b). Key to both approaches is the mapping and characterization of actors and their interactions. As discussed above, an innovation-systems approach focuses on knowledge generation and use at a particular stage of a value chain, while the value-chain approach is more about value creation and market opportunities and linkages across a chain. With few exceptions (such as Anandajayasekeram and Gebremedhin 2009; McDermott et al. 2010b), an integrated innovation-system and value-chain approach to developing, implementing, and evaluating agricultural-development initiatives has received limited attention among researchers and practitioners, arguably resulting in suboptimal outcomes. Fodder is important, but only as a single input in livestock production, hence sustainable return to improved fodder depends on the efficiency of a whole value chain. We argue that an integrated approach provides, first, a better framework to address market failures such as high transaction cost, insufficient market information, and the exercise of market power that are inherent in the smallholder livestock system (Rich et al. 2011). Second, it allows for the optimization of gains from innovations in interrelated inputs and services. In relation to the latter, for example, McDermott et al. (2010b: 156) cite 300 percent gains to smallholders due to combined use of breed and feed improvements (which otherwise would not have been achieved).

### **Study Methodology**

The case studies reported in this chapter are described and analyzed against the backdrop of the above conceptual literature and an integrated innovation-systems and value-chain approach. The innovation-systems framework emphasizes, among other things, the totality of actors and factors required to bring about innovation and growth (World Bank 2007). Following this framework, the study identifies and characterizes the main actors in the study sites, such as knowledge and technology providers and users; their roles; interaction among actors; and their habits and practices that influence joint learning and innovation. It also evaluates the enabling environment for fodder innovation and livestock development. It describes and analyzes FAP's fodder-innovation processes, and the capacities developed and technological options introduced and adopted. Using the value-chain tool (Kaplinsky and Morris 2001; McDermott et al. 2010b), the study identifies and assesses site-specific livestock-production value-chain activities and actors and their roles, production quality standards, and opportunities for improving the chain. The tool is employed to evaluate the integration of fodder innovation into smallholder livestock production, and the linking of the latter with markets. The chapter

uses empirical data collected from six of the nine learning sites over 2009–10 from multiple sources, including extensive semi-structured interviews with FAP county-team members, partners, and participating farmers; and FAP internal reports (three learning sites, one from each country, were not covered in the analysis as insufficient data emerged at the time of fieldwork). It also draws on close observation of actors' interactions and learning.

## **Background to Fodder Innovation Case Studies**

### **FAP Origin and Approach**

The idea for the FAP originates from debates in 2001–2002 among multi-disciplinary researchers on ways of addressing fodder scarcity (Lenné, Fenandez-Rivera, and Blümmel 2003; de Haan et al. 2006). At about the same time, the International Livestock Research Institute (ILRI) and partners began developing project ideas for implementation in countries where a large number of people depend on livestock. This led to the design and implementation of the Fodder Innovation Project in two phases over 2002–2009 in India and Nigeria ([www.ilri.org/ilrinews/index.php/archives/tag/fodder-innovation-project](http://www.ilri.org/ilrinews/index.php/archives/tag/fodder-innovation-project)). FAP followed in 2007. As an approach, FAP country teams focused on three levels of interaction and learning, innovation, and diffusion: farm, district, and region/national levels. First, farmer and farm-level learning were considered central for improvement of livestock production, which generally happens at farm level, with farmers learning by themselves and from each other, testing and integrating new ideas within existing practices. Second, where a network of actors was weak or nonexistent, strengthened actor networks at district level were thought to enhance the innovation processes and outcomes. Finally, engaging higher-level (regional or above) policymakers in dialogs over fodder and livestock matters was also thought to improve the enabling environment for innovation, such as improved policy on fodder-seed production and distribution.

### **Innovation Environments in Different National Contexts**

Table 5.1 provides selected country indicator data for Ethiopia, Syria, and Vietnam. In Syria, livestock (predominantly sheep) contribute 34 percent to the agricultural GDP (Shomo et al. 2010). Some 85 percent of the country receives less than 350 mm rain per year. The humid areas, accounting for 15 percent of the country, receive more than 350 mm rain per year. Across Syria, grazing provides the most important source of fodder for

ruminants, but the supply of fodder is insufficient and seasonal (Shomo et al. 2010). In contrast to Syria, Ethiopia is largely high tableland, highlands above 1,500 meters comprise 43 percent of the country, while the rest of the country consists of lowlands where pastoral and agropastoral systems dominate. The maximum mean annual rainfall reaches 2,000 mm in the southwestern parts of the country, while the lowest mean annual rainfall is below 250 mm in the northeastern and southeastern lowlands. Agriculture is the mainstay of Ethiopia. It accounts for 43 percent of the country's GDP and employs 85 percent of the labor force. Its livestock population consists of over 50 million cattle and over 45 million sheep and goats. Livestock also provide power and manure in crop production.

Vietnam's agriculture and forestry sectors are main sources of livelihood for the rural poor who accounted for 74 percent of an estimated 86 million people in 2008. The country has two fairly equal dry and wet seasons, and the central highlands (including FAP learning-site area, Ea Kar district in Daklak province) altitude ranges from 300 m to 2,000 m above sea level; rainfall is in the range 1,500–2,000 mm per year. While keeping pigs is important nationally, many Vietnamese farmers also keep cattle (Khanh et al. 2009). The FAP Vietnam team estimates 40 percent fodder shortage during February and March; and 20 percent during November and December.

The structure and authority of different levels of governments in the three countries vary, with implications for the emerging innovation architectures. For example, unlike in Syria or Vietnam, Ethiopia has autonomous regional states that have the power to determine their social, economic, and cultural affairs. Likewise, NGOs have more visibility, particularly in the implementation of development projects, in Ethiopia than in Syria and Vietnam. While livestock development is largely a private activity, governments in all three countries play a role in providing animal health and extension services. In all three countries, the role of the private sector in generating and diffusing agricultural technologies is limited. Fueled by growing urbanization and incomes, all three countries have been enjoying a growing domestic and foreign market for livestock products. In Vietnam and Syria, livestock development has been supported by a relatively developed infrastructure including roads (see Table 5.1). The national environment (agricultural, ecological, and institutional factors) guided the FAP teams to select partners and learning sites.

### **Partner and Learning Site Selections**

In selecting learning sites, FAP in Ethiopia focused on market opportunities for livestock products and agroecological and socioeconomic challenges

**TABLE 5.1** Basic indicators of Fodder Adoption Project (FAP) countries

Indicator	Ethiopia	Syria	Vietnam
Total land area (km <sup>2</sup> ) <sup>a</sup>	1,104,300	185,180	329,310
• Arable land (percentage of land area) (2007) <sup>a</sup>	13.0	26.5	21.3
Human population (total, millions) (2008) <sup>b</sup>	81	21	86
• Rural population (%) (2005) <sup>a</sup>	84.0	49.4	73.6
Gross domestic product (GDP) (US\$ million) (2008) <sup>b</sup>	26,487	55,204	90,705
Value added as percentage of GDP (2008)			
• Agriculture	43	20	20
• Industry	13	35	42
• Services	45	45	38
Gross national income per capita (US\$) (2008) <sup>b</sup>	280	2,090	890
GDP average annual growth rate (2000–2008) <sup>b</sup>	8.2	4.4	7.7
Road density (km of road per 100 km <sup>2</sup> ) (2000–2006) <sup>a</sup>	3.6	51.6	71.7
Livestock population (total in millions) (2009) <sup>c</sup>			
• Cattle	50.88	1.08	6.10
• Goats	21.96	1.51	1.48
• Sheep	25.98	12.38	–
• Pigs			27.63

Sources: <sup>a</sup> World Bank (2009); <sup>b</sup> World Bank (2010); and <sup>c</sup> FAO (2011).

to improve food security. First, the team identified a key collaborating partner running the Improving Productivity and Market Success (IPMS)—a project located within ILRI operating in ten pilot learning *woredas* (districts) across Ethiopia. It selected four IPMS learning sites (two highland *woredas*, Ada'a and Atsbi Woberta, and two from the lowlands, Alamata and Mieso). Alamata and Atsbi Woberta *woredas* are in Tigray Regional State, in northern Ethiopia, where livestock productivity is severely affected by fodder shortages caused by frequent droughts. Mieso and Ada'a are located in Oromia Regional State. In Mieso, livestock are major contributors to livelihood. The area is semiarid, and frequently affected by water shortages and drought. Ada'a is close to the capital Addis Ababa and has fairly developed industry and infrastructure; it has access to relatively large market opportunities for its produce, notably the cereal crop teff. It has a growing smallholder dairy-production system with strong milk-marketing and farmers' service cooperatives, but limited and erratic rainfall and expanding urbanization have been reducing traditional sources of fodder such as open grazing lands. The *woredas* thus provided the setting for the emerging innovation networks. Within each *woreda*,

learning sites were narrowed down to one or more *kebeles*—farmers’ neighborhood associations—where 50 or more willing participant farmers (who owned livestock and land, and who tend to be model farmers and opinion leaders) were experimenting with new fodder options. At the national level, a fodder platform was set up, consisting of stakeholders from Oromia and Tigray regional states, federal government units, NGOs, and donor organizations, to deliberate on relevant policy matters and ways of up-scaling successful practices.

The FAP team in Syria started with a consultation process at the national level for identifying potential partners. The Ministry of Agriculture and Agrarian Reform (MAAR) became its core partner. With MAAR support, a national project-inception workshop was held to engage a wider set of stakeholders in FAP implementation. The inception workshop also constituted a Steering Committee led by the head of the MAAR Extension Directorate. Province- and site-selection criteria were: high livestock population density (notably sheep); rainfed and mixed crop–livestock systems that allow the application of different fodder technologies of tree crops and food–feed crops; and experiences of relevant departments in livestock production and extension. As in Ethiopia, farmer selection focused on their willingness, and ownership of livestock and land. The innovation architecture consisted of (1) a national steering committee—to provide leadership and a mechanism for scaling up and replicating lessons in other sites; (2) three innovation networks—El-Bab (Aleppo province), Salameih (Hama province), and Tel Amri (Homs province)—to engage farmers, develop and implement options, and monitor and evaluate outcomes; and (3) on-farm experimentation and learning. At all levels, consideration was given to ensure the participation of women and of policymakers.

Unlike in Syria and Ethiopia, the Ea Kar site in Vietnam was a continuation of previous research for development projects: Forages for Smallholders Project (2000–2002), and Livelihood and Livestock Systems Project (2003–2005). Key players in both projects were the International Center for Tropical Agriculture (CIAT), Tay Nguyen University (TNU), and the National Institute of Animal Husbandry (NIAH). In partnership with the district extension and agriculture and rural development workers, the projects developed forage technologies with smallholder farmers in Daklak province, and succeeded in introducing and evaluating a variety of fodder options such as napier grass (Khanh et al. 2009). Building on experiences from these projects, in 2007 FAP inherited the existing network of actors, and focused on the strengthening of value-chain actors, including extension, research, traders,

and government. The country team also established a new site, Ky Anh in Ha Tinh province. As an approach, the FAP team started with key volunteer farmers who had land and animals, and were able to organize hired or household labor to work on their farm. Around each key farmer, a fodder group, composed of at least ten farmers, was set up to identify and introduce fodder options and jointly evaluate performance.

The preceding description of learning sites and partner selection, and the innovation architectures that emerged showed no regularity and varied from top-down to bottom-up approaches. It showed the various ways of organizing innovation networks in different socioeconomic, institutional, and agro-ecological contexts. Selected sites also showed varied conditions: in Syria they started anew, in Ethiopia they piggy-backed on an ongoing project, and Ea Kar in Vietnam they built on previous projects that ran for over five years. Appreciating these differences, our next aim is to understand whether networking enhanced learning and innovation (the following analysis and discussion does not include Atsbi Wobera, Ethiopia; Tal Amri, Syria; and Ky Anh, Vietnam learning sites, as insufficient data emerged at the time of fieldwork).

## **Results: Developing Innovation Capacity and Fodder Options**

### **Developing Innovation Capacity**

As the innovation systems approach would suggest, FAP teams and partners diagnosed relevant policies, institutions, and infrastructure; and actors and their roles, attitudes, and practices. Participatory assessment of farmers' needs, causes, and extent of fodder scarcity were also conducted; and with FAP facilitation a set of actors were engaged to "respond to the fodder challenge." Table 5.2 shows that, besides farmers, seven or more actors were involved in networks in Ethiopia, but the number and diversity of actors were fewer in Syria and Vietnam. Despite encouraging policies, there was an element of mistrust among some government officials in all three countries of organizations operating for "private gain." As they often "come and go," the continuous participation of nonlocal NGOs in networks was also seen as uncertain. Government departments for agriculture and rural development feature in all networks, providing infrastructure for disseminating knowledge and information, and supporting learning on farms. They are, however, insufficiently resourced and have a "limited culture of collaboration." Any engagements in collaborations were guided by official directives and plans,

**TABLE 5.2** Summary of actors' networks, actors' roles, and interactions by sites

Actor name and type, scope of operation, and degree of interaction in network in 2010	Core activities
<b>Ada'a, Ethiopia</b>	
Ada'a Dairy Coop (private) <sup>a</sup>	Milk collection, processing, and marketing
Cooperative Promotion Office (govt.—regional) <sup>b</sup>	Information dissemination
Crop Grow (private) <sup>b</sup>	Production and marketing of feed- and foodcrops
Debre Zeit Agricultural Research Centre (government—federal) <sup>a</sup>	Research, evaluation, and training
Eden Field Agri Seeds Enterprise (private) <sup>a</sup>	Producer and supplier of forage/fodder seeds
Ethiopian Meat & Dairy Technology Institute (government—federal) <sup>a</sup>	Training, source of improved breeds
FAP—ILRI: Fodder Adoption Project—International Livestock Research Institute (international research) <sup>a</sup>	Network facilitation, providing access to planting materials, and joint learning; research
IPMS—Improving Productivity and Market Success Project (ILRI—Government of Ethiopia—international research) <sup>a</sup>	Research for development (R4D); facilitate access to information and knowledge
Land O'Lakes (NGO) <sup>b</sup>	Training, technology transfer
Office of Agricultural & Rural Development (government— <i>woreda</i> ) <sup>a</sup>	Seed multiplication and distribution; extension and training
Farmers <sup>a</sup>	Testing and joint evaluation of fodder technologies
<b>Alamata, Ethiopia</b>	
Abergelle Livestock Int. Trading Plc (private) <sup>a</sup>	Cattle fattening, supply of farm inputs; training
Ethiopian Sheep and Goats Project (NGO) <sup>a</sup>	Research and extension
FAP—ILRI (international research) <sup>a</sup>	Network facilitation, providing access to planting materials, and joint learning; research
IPMS (ILRI—Government of Ethiopia) <sup>a</sup>	R4D; facilitate access to information and knowledge
Office of Agricultural and Rural Development (government— <i>woreda</i> ) <sup>a</sup>	Training and technical support, seed multiplication
Alamata Agricultural Research Institute (government— <i>woreda</i> ) <sup>a</sup>	Research, technical backstopping
World Vision Ethiopia (NGO) <sup>a</sup>	Provision of bull service and fodder seeds
Farmers <sup>a</sup>	Testing and joint evaluation of fodder technologies
<b>Mieso, Ethiopia</b>	
Adami Tulu Agricultural Research Centre (government—regional) <sup>b</sup>	Research; supply of forage seeds; training
FAP—ILRI (international research) <sup>a</sup>	Network facilitation, provide access to planting materials, and joint learning; research
Food Security Office (government—regional state) <sup>b</sup>	Support seed multiplication (including paying for laborers)
IPMS (ILRI—Government of Ethiopia) <sup>a</sup>	R4D; facilitate access to information and knowledge

Actor name and type, scope of operation, and degree of interaction in network in 2010	Core activities
Melakassa Agricultural Research Centre (government—federal) <sup>b</sup>	Research; supply fodder seeds; technical backstopping
Office of Pastoral and Rural Development (government— regional state) <sup>a</sup>	Fodder-seed multiplication and distribution; extension; training; coordination, monitoring, and evaluation
<i>Woreda</i> Administration Council (government) <sup>a</sup>	Follow-up and guidance; link to higher offices
Farmers <sup>a</sup>	Testing and joint evaluation of fodder technologies
<b>Salameih, Syria</b>	
Aga Khan Foundation (international NGO) <sup>a</sup>	Rural development, extension, technology transfer
FAP–ICARDA (International Centre for Agricultural Research in the Dry Areas) (international research) <sup>a</sup>	R4D; facilitation of joint learning, providing access to planting materials; training
Office for Agricultural Research (government—provisional) <sup>a</sup>	Research and evaluation
Office for Extension and Animal Resources Administration (government—provisional) <sup>a</sup>	Extension
Farmers <sup>a</sup>	Testing, joint evaluation of technologies and practices
<b>El Bab, Syria</b>	
FAP–ICARDA (international research) <sup>a</sup>	R4D; facilitation of joint learning, providing access to planting materials; training
Office for Agricultural Research (government—provisional) <sup>a</sup>	Research and evaluation
Office for Extension and Animal Resources Administration (government—provisional) <sup>b</sup>	Extension
Farmers <sup>a</sup>	Testing, joint evaluation of technologies and practices
<b>Ea Kar, Vietnam</b>	
FAP–International Center for Tropical Agriculture (international research) <sup>a</sup>	With TNU, coordinated FAP Vietnam activities, provide technical support
Tay Nguyen University (TNU, national university) <sup>a</sup>	Research, capacity development, technical support, facilitate stakeholder interaction
National Institute of Animal Husbandry (government—national) <sup>b</sup>	Link to national policymaking
District Extension (government—district) <sup>a</sup>	Facilitation and evaluation of on-farm testing and dissemination of technologies and information
District Agriculture and Rural Development (government—district) <sup>a</sup>	Dissemination of technologies, liaise with policymakers
Farmers and farmer fodder groups <sup>a</sup>	Testing, joint evaluation of technologies and practices; participate in meat value chain
Small and large cattle traders (various contributions)	Buy cattle, provide market information, etc.

**Source:** Authors.

**Notes:** <sup>a</sup> An “active” actor that participates in more than 50 percent of all meetings, and provides input such as technological knowledge on fodder innovation and livestock development to a network; <sup>b</sup> A “moderately active” actor that is a member of a network, but not a regular and active participant.

hence slow to respond to other actors' needs. National and international research organizations were also drawn into the networks as knowledge and technology providers or capacity developers, but some were wary of getting bogged down in "development work" that might adversely impact on their capacity to produce "public goods" (publications) and maintain their reputation in research. While the vision to improve the livelihoods of smallholder farmers united the different actors, collaboration was also hampered by a lack of network facilitators. The FAP teams took the facilitation role and embarked on various types of innovation capacity development.

#### **STRENGTHENING WEAK INTERACTOR TIES**

Before networking began, there were either "no" or "weak" actor interactions because of a limited culture of collaboration and trust, or lack of facilitators. However, networking allowed regular meetings (on average four times a year in networks) where actors discussed fodder scarcity, policy and market issues, as well as their potential contributions. Less formal and more frequent one-to-one and small-group meetings were also reported across the sites. Actors made cross-site and within-site visits, and participated in fodder field days, etc., which facilitated information and knowledge exchanges. These efforts paid off, and by 2009 and 2010 actor interactions significantly improved from largely "no" or "weak" to "strong" and "moderately strong" interactions (Table 5.2).

#### **FILLING ORGANIZATIONAL GAPS**

Where the local institutional landscape did not provide actors with necessary capabilities, actors were nonetheless brought into networks from further afield (for example, Eden Field in Ada'a, and Adami Tulu and Melkassa research centers in Mieso).

#### **STRENGTHENING FODDER-SEED SUPPLY SYSTEM**

Where capacity to produce fodder seeds was weak or nonexistent, farmers and development agents were trained. A series of one- to three-day training sessions was given on fodder-seed multiplication, evaluation, etc. for 562 participants in Ethiopia (Duncan et al. 2010); 50 in Syria (Larbi, Hassan, and Abdullah 2010); and 115 in Ea Kar and Ky Anh sites in Vietnam (Anh et al. 2010).

### INTERACTING WITH POLICYMAKERS TO IMPROVE POLICIES

Besides regular interactions with policymakers, FAP teams produced training and communication materials like guide booklets, videos, and posters to inform actors of their activities and document lessons for replication in other areas of the respective countries. In summary, networking helped relevant knowledge and information flows, strengthening and coordinating complementary capabilities for joint learning and innovation.

### On-Farm Learning and Implementing Fodder Options

The purpose of the networking described above was to foster learning and produce innovation. Table 5.3 shows that, supported by the respective networks, farmers in all the learning sites selected and implemented novel technological solutions. Before acceptance, farmers experimented and learned about the performance and suitability of improved fodder options for farming conditions; the need for (re)allocation of resources like land and water; and sustainability of seed supply. Fodder innovation was thus found

**TABLE 5.3** Fodder options implemented by learning sites

Learning site	Key technological interventions	Participating farmers			Area planted (ha, estimated)		
		2008	2009	2010	2008	2009	2010
Ada'a (Ethiopia)	Oats–vetch, maize–lablab, napier, alfalfa; pigeon pea, sesbania, and fodder beets	44	84	204	11	21	51
Mieso (Ethiopia)	Cowpea, lablab, pigeon pea, napier, and alfalfa	40	80	160	10	20	40
Alamata (Ethiopia)	Cowpea, lablab, alfalfa, napier, pigeon pea, sesbania, Rhodes, buffel grass, and Panicum	20	20	35	5	5	9
Salameih (Syria)	Barley, common vetch, narbon vetch, and grass pea for grain, straw, or hay production; integrating forages into olive-tree systems to improve feed and soil productivity; vetch grain-based mixed rations for dairy production and lamb fattening	67	187	188	28	109	384
El-Bab (Syria)	Various combinations of barley, common vetch, narbon vetch, and grass pea (as in Salameih above)	5	67	107	15	92	191
Ea Kar (Vietnam)	Various types of green fodder, mainly napier, Pennisetum hybrid/VA06 and guinea grass	n/a	n/a	> 3,100	n/a	n/a	n/a

Source: Authors.

through interactive learning in networks and on farm. The new technologies fitted farmers' food–feed requirements (for example, by combining food and feed crops in areas of food scarcity: maize–lablab, cowpea), or rainfed versus irrigation options, seasonal availability, performance, or ease of intercropping requirements. The number of adopting farmers and area planted grew fast, particularly in Ada'a, Salameih, and Ea Kar, where actors' interaction was much more consistent and on-farm technical support was provided by FAP. Following experimentation with a basket of options, farmers adopted fewer but more suitable and high-performing fodder options (typically oats–vetch in Ada'a, and cowpea in Mieso and Alamata).

Fodder availability improved for innovating farmers. Some farmers were storing enough fodder to sustain the shortage season. Farmers also consistently stated that improved availability of fodder increased productivity and production: quantity and quality of milk increased; and small and large ruminants were fattened in shorter time. In Ethiopia, animals are sources of draught power, hence improved fodder also positively impacted crop production. Farmers also noted that the increase in production was consumed on farm, improving the food and nutritional requirements of households, and/or sold on the market, improving their income. However, it was clear to the stakeholders that the sustainability of fodder availability and the derived benefits depend on factors such as the dynamics of networking and joint learning, availability of complementary innovations that optimize returns, and access to market opportunities and linkages.

Several key developments promised sustainability to the emerging networking and joint learning culture. For example, coached by FAP teams, extension workers, who gained network-facilitation skills, showed an interest in incorporating the innovation-systems approach in their routines to facilitate the networks as FAP exited. To this end, Ea Kar's experience in farmer organization and fodder management was used in the new Ky Anh site with considerable progress made in fodder adoption in a shorter period (Anh et al. 2010). Moreover, improved fodder technologies were increasingly reaching nonparticipating farmers around the sites; for example, a Syrian farmer was noted to have been copied by seven farms in his neighborhood. Interviewees were confident that the political support for fodder innovation would continue. For example, a senior Syrian government official showed interest in “building on [FAP's] successful experiences in upcoming projects.” The Eden Field Agri Seed Enterprise has been expanding across Ethiopia, becoming a viable fodder-seeds supplier. That said, uncertainties remain—due to high turnover of staff in the Ethiopian public sector, it was

unsure whether “key individuals capable of network facilitation will remain in their positions.”

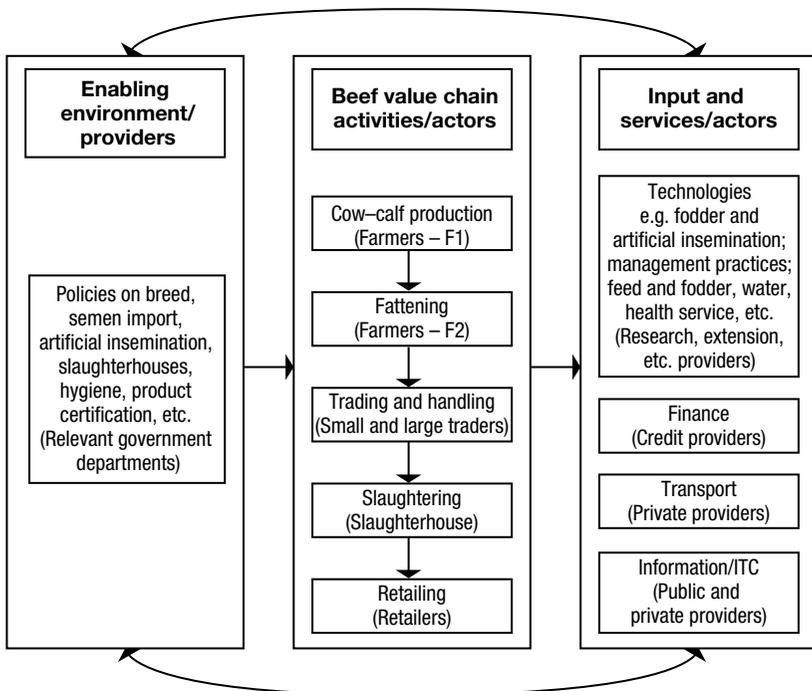
In Mieso and Alamata in particular, farmers operate in weak livestock value chains, which, according to the partners, could undermine the sustainability of fodder availability: “some farmers may have been growing fodder but progress so far has not been life changing to them nor can be guaranteed to sustain.” These farmers were “feeding improved fodder to low milk or meat producing animals” as improved breeds were hardly available. Consequently, the productivity gain was significant but limited (farmers reported increase in milk production from around 1.5 to 2 liters per cow per day). The “surplus milk” from these sites did not get to the market for lack of milk-collection points and access to market. However, farmers sold animals to local consumers and traders but at a “low price,” as they lacked information on market price or they faced high transaction costs or limited marketing skills to sell animals in distant cities.

In response to these and similar challenges, FAP teams identified the respective livestock value chains for potential interventions, but progress was mainly seen in the more established Ea Kar site (see below). In Syria, taking advantage of the growing market opportunity, many FAP-participating farmers were fattening and selling sheep on an existing local market. A formal coordination of value-chain actors such as traders, transporters, and slaughterhouses was not pursued due to limited project time and inadequate expertise in value-chain organization. Faced with similar limitations, in Ethiopia chain-linkage developments showed modest progress only in the market-opportune Ada’a site. The Ada’a Dairy Cooperative has been experiencing falling milk supplies largely due to shortages of fodder. The Cooperative’s interest in the fodder network was derived from the prospect of increasing milk supply from farmers participating in FAP. Many farmers claimed that improved availability of fodder boosted milk production and sale, some farmers earning as much as 1,000 birr (around US\$60) per month. However, as many of the farmers keep local breeds, yield was lower. The FAP network responded to this issue by catalyzing the procurement of small numbers of crossbred cows by farmers with the support of the District Department for Agriculture and Rural Development over 2009–2010. Below, the Ea Kar case is discussed separately for the exemplary approach taken to address the above challenges and develop a thriving meat sector.

### Integrating Fodder Innovation in a Meat Value Chain: Experience from Ea Kar, Vietnam

According to Stür and Khanh (2010), Ea Kar’s conventional value chain was characterized as farmers growing and selling all types and sizes of animals at local markets without being able to meet the growing demand for quantity and quality of meat. Through FAP-participating farmers, two production lines emerged: farmers with less potential to keep animals for fattening (labeled F1 in Figure 5.1) started a “cow–calf” production system to raise crossbred calves for sale. The second system was beef production where farmers (F2 in Figure 5.1) fatten and sell animals. The FAP Vietnam team worked by steps to strengthen the meat value chain (Stür and Khanh 2010): first, fodder was planted to stimulate farmers’ interest in increasing productivity. Realizing that they were occasionally paid twice as much for their fatter cattle on the local market (compared to conventionally raised animals), farmers adopted a “buy thin—sell fat” strategy. Second, new

**FIGURE 5.1** Simplified meat value chain, Ea Kar, Vietnam



Source: Authors.

markets were identified and developed for fat cattle in provincial urban centers such as Buon Ma Thuot. This led to producing and marketing meat for city markets and restaurants. Third, chain actors negotiated and introduced standards to ensure that fattened animals would be less than three years old, more than 300 kg at slaughter weight, and generally healthy. To meet the standards, farmers improved their animals' feed and fodder intake, shelter, and health services. They kept information on each animal's weight, breed type, and health conditions. These measures helped farmers receive better and relatively stable prices. Handlers were able to make direct and regular contacts with farmers and were able to purchase animals on farm; they in turn sold the animals to large traders and slaughterhouses. The government provided support in areas such as breed improvement and regulation of meat slaughterhouses.

By the end of 2010, the Ea Kar meat value chain was growing (Stür and Khanh 2010):

- 44 farmer clubs were established in the district with a focus on cattle production, and 3,100 households (30 percent of cattle producers in the district) planted forages;
- 532 households were fattening cattle for urban markets, and 800 households produced crossbred calves;
- 3 farmer clubs had contracts with city traders, and cattle and beef were sold to local, provincial, and several other city markets across the country.

FAP's approach started impacting on the livelihoods of many participating farmers in Ea Kar. One of the fodder groups in the district is in Ea Kmut commune, located in the neighborhood of Ea Kar town. The fodder group had 13 household members in 2009, and each household was fattening, on average, 32 animals per year (eight animals per three-month cycle). After covering their costs, farmers on average made a net US\$69 per month or US\$828 per year (according to the farmers, income from sale of fattened animals made up about 70 percent of their total income). The income was spent on farmers' basic needs and children's education, and the head of the farmer group noted a "bright future for beef production" in his commune. Farmers in Ea Pal commune were also able to benefit from the applied approach. However, they were facing some challenges like poor access roads and inadequate water to grow forage all year round. Ea Pal commune farmers noted that it was difficult to sell the animals on time for lack of easy reach to markets, and small traders were colluding with large traders to cut prices. Like farmers in Ea Kmut

commune, they noted that raising capital to buy and fatten animals was also a major problem:

yes we earn more money now from fattening than two years ago ...  
but our capacity is still limited to raise capital as high as 10 million  
Vietnamese dong [about \$520] to buy an animal. We don't get bank  
credit because of tight collateral conditions (head of farmer fod-  
der group).

At the time of data collection (2009–2010), FAP partners were looking into these challenges. Despite the challenges, FAP Vietnam team and partners stressed that the approach helped produce rewarding and sustainable outcomes; and that the technological options and institutional arrangements introduced fit the local context and met local needs, and were supported by the local and national governments. As summed up by Stür and Khan (2010), in 2010 the Ea Kar learning site was changing from “traditional” cattle management to a “refined” cattle-production system, where farmers moved from feeding animals on naturally available resources to planted forage, from free grazing to confined animal keeping, from extensive production to defined production like fattening, and from production not linked to markets to market orientation.

## Discussion

More, and increasingly diverse, actors would provide the ideal complementary capabilities for innovation, but the real world of the case studies presented networks with a limited number and heterogeneity of actors, and the networks had to be triggered and facilitated through an external research-for-development project. Actors outside the “current systems” were drawn in and different types of capacity were developed. Sustained interactive learning in networks, and on farm, brought about fodder innovation in all sites. The integration of improved fodder in production processes also resulted in promising productivity gains, with improvements in farmers’ food and nutrition, as well as income.

The study reported in this chapter shows that fodder technological innovation is sustainably enhanced when linked with other innovations and market-oriented activities that optimize productivity. Testimony to this was the Ea Kar learning site, where a thriving meat value chain emerged. Key features of the success are worth stating here. First, once fodder innovation was found, dynamics were built into networking for continuous learning and

innovation. To make fodder innovation more rewarding, it was integrated into interrelated innovations (notably breed and animal management) and value-chain activities. Benchmarks were developed for keeping and fattening animals so that quality was consistent, and this helped farmers earn better value for their produce. Second, a new organizational innovation—a farmer group—was created to learn and innovate, and to support farmers' engagement in markets. Small and isolated farmers often suffer, therefore farmer groups became key instruments to improve marketing efficiency and profitability by reducing transaction costs. The need and organization of such groups, however, cannot be legislated as it depends on the value chains that innovating farmers are in (meat, dairy, or the species they keep), farm sizes, availability of infrastructure, etc. In summary, the Ea Kar site demonstrated that fodder innovation triggered technological and socioeconomic changes where actors' behavior were changing from an isolated to a more collaborative and interactive learning and innovation, where interrelated innovations were incorporated in production processes, and where smallholder farming was changing from extensive and subsistence-based farming toward an intensive and market-oriented business.

Some of the factors that influenced innovation outcomes relate to time and contexts—notably whether learning sites were started anew or built on previous projects. Sites with more favorable conditions (such as those where the facilitators or partner organizations have worked before, and where there are good prospects for market development) produced more successful results than those with less favorable conditions. In Ea Kar, it took more than five years for farmers to learn about potential benefits and risks of fodder technologies, and effectively engage in markets. This suggests that, as underlined in studies involving science and technology partnerships (Chataway et al. 2006), time and patience, and the necessary support are required to take success from simply producing inputs to the level of meeting long-term objectives like improving livelihoods. Another key lesson was that farmers select and deselect fodder options appropriate to them based on technical, socioeconomic, and agroecological criteria. Fodder options attuned to farmers' local contexts led to successful adoption. Hence it is critical to understand farmers' needs and constraints, and support them to have a range of technological options to deal with the challenges they face. As FAP concludes, the innovation capacity developed in the networks and on farm is likely to support farmers to select and adopt fodder and related livestock technologies. Transferring lessons beyond learning sites and countries,

however, entails making necessary adjustments to fit into farmer circumstances and local and national contexts.

The present study highlights the importance of policy for innovation in value chains. For example, meat production was expensive for some farmers in Vietnam and might require credit. The supply of improved breeds of cattle and milk-collection points were inadequate in Ethiopia. Where such constraints prevail, governments need to support innovations and livestock-based businesses by facilitating the provision of credit, improved breeds, etc. Second, due to market manipulation by some cattle traders, some farmers were selling animals for less than market prices, therefore governments and other stakeholders need to step in and prevent such destructive behavior. Third, networking is best facilitated by local and dedicated “intermediary” organizations (Klerkx, Aarts, and Leeuwis 2010), but this seems a long way off in the sites studied—hence public investment is required to support local NGOs and public organizations to develop facilitation capacity. Finally, the weak and often missing actor in local networks was the private sector, hence governments should nurture the sector so that it plays its due roles, particularly in disseminating agricultural knowledge and technologies.

## Conclusion

The study shows that fodder innovation is successfully triggered and integrated in livestock production by actors interacting and learning in networks, and on farm. However, fodder is one among many inputs in livestock production. The success of fodder innovation, and for that matter innovation in other livestock technologies, depends on other inputs, institutions, and markets. The key lesson is that fodder can be an entry point, but real improvement occurs when broader value-chain issues are addressed in a holistic manner.

## References

- Altenburg, T., H. Schmitz, and A. Stamm. 2008. “Breakthrough? China’s and India’s Transition from Production to Innovation.” *World Development* 36 (2): 325–344.
- Anandajayasekeram, P., and B. Gebremedhin. 2009. *Integrating Innovation Systems Perspective and Value Chain Analysis in Agricultural Research for Development: Implications and Challenges*. Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project Working Paper 16. Nairobi: International Livestock Research Institute.

- Anh, N. N., N. T. Mui, V. T. Thin, H. D. Hieu, T. T. Khanh, V. T. Dung, N. V. Ha, et al. 2010. "Options for Effective Delivery Systems Including Innovative Communication Strategies and On Farm Interventions to Improve Fodder Supply." Paper presented at FAP end of project workshop, Luang Prabang, Lao PDR, November 15–19. Accessed July 14, 2011. <http://fodder-adoption-project.wikispaces.com/>.
- Ayele, S., and D. Wiled. 2005. "Science and Technology Capacity Building and Partnership in African Agriculture: Perspectives from Mali and Egypt." *Journal of International Development* 17 (5): 631–646.
- Boschma, R. A. 2005. "Proximity and Innovation: A Critical Assessment." *Regional Studies* 39 (1): 61–74.
- Chataway, J., J. Smith, and D. Wield. 2006. "Science and Technology Partnerships and Poverty Alleviation in Africa." *International Journal of Technology Management and Sustainable Development* 5 (2): 103–123.
- Clark, N., A. Hall, R. Sulaiman, and G. Naik. 2003. "Research as Capacity Building: The Case of an NGO Facilitated Post-Harvest Innovation System for the Himalayan Hills." *World Development* 31 (11): 1845–1863.
- Clifton, N., R. Keast, D. Pickernell, and M. Senior. 2010. "Network Structure, Knowledge Governance, and Firm Performance: Evidence from Innovation Networks and SMEs in the UK." *Growth and Change* 41 (3): 337–373.
- de Haan, N. C., D. Romney, P. Bezkorowajnyj, and O. Olufajo. 2006. "Feeding Livestock Through Partnerships." *Knowledge Management for Development Journal* 2 (3): 123–135.
- Delgado, C., M. W. Rosegrant, H. Steinfeld, S. Ehui, and C. Courbois. 1999. "The Coming Livestock Revolution." *Magazine of Food, Farm & Resources* 14 (4).
- Duncan, A., K. Ergano, A. Adie, and A. Tedla. 2010. "Enhancing Livelihoods of Poor Livestock Keepers Through Increasing Use of Fodder: Ethiopia Report on Output 1 & 3." Paper presented at FAP end of project workshop, Luang Prabang, Lao PDR, November 15–19. Accessed July 14, 2011. <http://fodder-adoption-project.wikispaces.com/>.
- Duncan, A. J., W. Stur, A. Larbi, and T. Tiemann. 2011. *Enhancing Livelihoods of Poor Livestock Keepers through Increased Use of Fodder: Programme Completion Report*. Nairobi, Kenya: International Livestock Research Institute. Accessed January 31, 2012. <http://cgspace.cgiar.org/handle/10568/12497>.
- FAO (Food and Agriculture Organization of the United Nations). 2009. *The State of Food and Agriculture 2009: Livestock in the Balance*. Rome.
- . 2011. FAOSTAT (2008/2009). Accessed March 9. <http://faostat.fao.org/>.

- Franzel, S., and C. Wambugu. 2007. "The Uptake of Fodder Shrubs among Smallholders in East Africa: Key Elements that Facilitate Widespread Adoption." In *Forages: A Pathway to Prosperity for Smallholder Farmers*. Proceedings of an International Symposium, edited by M. D. Hare and K. Wongpichet, 203–222. Ubon Ratchathani, Thailand: Ubon Ratchathani University.
- Hall, A. 2005. "Capacity Development for Agricultural Biotechnology in Developing Countries: An Innovation Systems View of What it is and How to Develop it." *Journal of International Development* 17 (5): 611–630.
- Hall, A., R. Sulaiman, and P. Bezkorowajnyj. 2007. *Reframing Technical Change: Livestock Fodder Scarcity Revisited as Innovation Capacity Scarcity*. Accessed October 5, 2016. [www.merit.unu.edu/publications/working-papers/abstract/?id=3019](http://www.merit.unu.edu/publications/working-papers/abstract/?id=3019).
- Horne, P. M., W. W. Stur, P. Phengsavanh, F. Gabunada Jr, and R. Roothaert. 2005. "New Forages for Smallholder Livestock Systems in Southeast Asia: Recent Developments, Impacts and Opportunities." In *Grasslands: Developments, Opportunities, Perspectives*, edited by S. G. Reynolds and J. Frame, 357–382. Rome: Food and Agriculture Organization of the United Nations.
- Howells, J., and J. Edler. 2011. "Structural Innovations: Towards a Unified Perspective?" *Science and Public Policy* 38 (2): 157–167.
- IFAD (International Fund for Agricultural Development). 2006. *Technical Agreement Grant: Enhancing Livelihoods of Poor Livestock Keepers through Increasing Use of Fodder*. Rome. Accessed July 14, 2011. <http://fodder-adoption-project.wikispaces.com/>.
- Johnson, B. 1992. "Towards a New Approach to National Systems of Innovation." In *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, edited by B-Å. Lundvall. London and New York: Pinter.
- Kaplinsky, R., and M. Morris. 2001. *A Handbook for Value Chain Research*. Brighton, UK: Institute for Development Studies. Accessed October 5, 2016. [www.ids.ac.uk/ids/global/pdfs/VchNov01.pdf](http://www.ids.ac.uk/ids/global/pdfs/VchNov01.pdf).
- Khanh, T., W. Stür, N. V. Ha, and A. Duncan. 2009. "Developing Innovation Capacity Through Effective Research and Development Partnerships." Paper presented at the Innovation Asia Pacific Symposium, Kathmandu, Bhutan, May 4–7. Accessed October 5, 2016. [www.prolinnova.net/iaps/media/6.%20Khanh%20-%20Developing%20innovation%20capacity%20Vietnam%20-%20for%20website.pdf](http://www.prolinnova.net/iaps/media/6.%20Khanh%20-%20Developing%20innovation%20capacity%20Vietnam%20-%20for%20website.pdf).
- Klerkx, L., and C. Leeuwis. 2008. "Matching Demand and Supply in the Agricultural Knowledge Infrastructure: Experiences with Innovation Intermediaries." *Food Policy* 33: 260–276.

- Klerkx, L., N. Aarts, and C. Leeuwis. 2010. "Adaptive Management in Agricultural Innovation Systems: The Interactions between Innovation Networks and their Environment." *Agricultural Systems* 103: 390–400.
- Kristjanson, P., I. Okike, S. Tarawali, B. B. Sigh, and V. M. Manyong. 2005. "Farmers' Perceptions of Benefits and Factors Affecting the Adoption of Improved Dual-Purpose Cowpea in the Dry Savannas of Nigeria." *Agricultural Economics* 32: 195–210.
- Larbi, A., S. Hassan, and M. Abdullah. 2010. "Enhancing Livelihoods of Poor Livestock Keepers Through Increasing Use of Fodder: Syria Report & Project Output 3." Paper presented at FAP End of Project Workshop, Luang Prabang, Lao PDR, November 15–19. Accessed July 14, 2011. <http://fodder-adoption-project.wikispaces.com/>.
- Lenné, J. M., and D. Wood. 2004. "Is There a 'Logic of Fodder Legumes' in Africa?" *Food Policy* 29: 565–585.
- Lenné, J. M., S. Fernandez-Rivera, and M. Blümmel. 2003. "Approaches to Improve the Utilization of Food–Feed Crops—Synthesis." *Field Crops Research* 84: 213–222.
- Lundvall, B.-Å., B. Johnson, E. S. Andersen, and B. Dalum. 2002. "National Systems of Production, Innovation, and Competence Building." *Research Policy* 31: 213–231.
- McDermott, J. J., S. J. Staal, H. A. Freeman, M. Herrero, and J. A. Van de Steeg. 2010a. "Sustaining Intensification of Smallholder Livestock Systems in the Tropics." *Livestock Science* 130: 95–109.
- McDermott, J., K. Rich, B. Gebremedhin, and H. Burro. 2010b. "Value Chains and Innovation." In *The Role of Livestock in Developing Communities: Enhanced Multifunctionality*, edited by F. Swanepoel, A. Stroebel, and S. Moyo, 151–170. Wageningen, the Netherlands: Technical Centre for Agricultural and Rural Cooperation. Accessed March 9, 2011. <http://mahider.ilri.org/bitstream/10568/3003/1/roleLivestockFarming.pdf>.
- Pyka, A., and G. Kuppers, eds. 2002. *Innovation Networks: Theory and Practice*. Cheltenham, UK: Edward Elgar Publishing.
- Rajalahti, R., W. Janssen, and E. Pehu, eds. 2008. *Agricultural Innovation Systems: From Diagnostics Towards Operational Practices*. Agriculture and Rural Development Discussion Paper 38. Washington, DC: World Bank.
- Rich, K. M., R. B. Ross, A. D. Baker, and A. Negassa. 2011. "Quantifying Value Chain Analysis in the Context of Livestock Systems in Developing Countries." *Food Policy* 36 (2): 214–222.
- Shomo, F., M. Ahmed, K. Shideed, A. Aw-Hassan, and O. Erkan. 2010. "Sources of Technical Efficiency of Sheep Production Systems in Dry Areas in Syria." *Small Ruminant Research* 91 (2/3): 160–169.

- Spielman, D. J., J. Ekboir, and K. Davis. 2009. "The Art and Science of Innovation Systems Inquiry: Applications to Sub-Saharan African Agriculture." *Technology in Society* 31: 399–405.
- Steinfeld, H., P. Gerber, T. Wassenaar, V. Castel, M. Rosales, and C. de Haan. 2006. *Livestock's Long Shadow: Environmental Issues and Options*. Rome: Food and Agriculture Organization of the United Nations.
- Stür, W., and T. T. Khanh. 2010. "Linking Fodder to Livestock Markets in Vietnam—The Ea Kar Experience." Paper presented at FAP Symposium on Feed in Smallholder Systems, Luang Prabang, Lao PDR, November 18–19. Accessed July 14, 2011. <http://fodder-adoption-project.wikispaces.com/>.
- World Bank. 2007. *Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems*. Washington, DC.
- . 2009. *World Development Report 2009: Reshaping Economic Geography*. Washington, DC.
- . 2010. *World Development Report 2010: Development and Climate Change*. Washington, DC.