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THE SIX "INS" OF CLIMATE-SMART AGRICULTURE: INCLUSIVE INSTITUTIONS FOR INFORMATION, INNOVATION, INVESTMENT, AND INSURANCE

Ruth Meinzen-Dick, International Food Policy Research Institute

Quinn Bernier, International Food Policy Research Institute

Eric Haglund, International Food Policy Research Institute

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CGIAR Systemwide Program on Collective Action and Property Rights (CAPRi)
C/- International Food Policy Research Institute, 2033 K Street NW, Washington, DC 20006-1002 USA
T +1 202.862.5600 • F +1 202.467.4439 • www.capri.cgiar.org

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ABSTRACT

This paper reviews the central role of institutions for climate-smart agriculture (CSA), focusing on the role of institutions in promoting inclusivity, providing information, enabling local level innovation, encouraging investment, and offering insurance to enable smallholders, women, and poor resource-dependent communities to adopt and benefit from CSA. We discuss the role of state, collective action, and market institutions at multiple levels, with particular attention to the importance of local-level institutions and institutional linkages across levels.

Keywords: climate change, climate-smart agriculture, collective action, institutions, property rights

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THE SIX "INS" OF CLIMATE-SMART AGRICULTURE: INCLUSIVE INSTITUTIONS FOR INFORMATION, INNOVATION, INVESTMENT, AND INSURANCE

Ruth Meinzen-Dick,[1] Quinn Bernier, and Eric Haglund

1. INTRODUCTION

Climate-smart agriculture (CSA) has emerged in recent years as a conceptual framework intended to align international efforts to increase agricultural productivity, mitigate greenhouse gas emissions, and reduce farmers' vulnerability to climate change. The Food and Agriculture Organization of the United Nations (FAO) defines CSA as "agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation) while enhancing the achievement of national food security and development goals" (FAO 2010, ii). A number of international actors working at the nexus of these issues, including the World Bank, the International Fund for Agricultural Development (IFAD), and the Consultative Group for International Agricultural Research (CGIAR), have contributed to the continuing development of CSA as a coherent concept and an agenda for policy and practice (Scherr, Shames, and Friedman 2012).

The CSA perspective highlights agriculture's contribution to global greenhouse gas (GHG) emissions as well as its vulnerability to climate change. Globally, agricultural emissions account for 31 percent of GHG emissions (Smith et al. 2007). The impacts of climate change on agriculture are far less certain since they depend on long-term changes in a wide range of variables such as weather patterns, population and income growth, and technological change. One result of a modeling exercise that projected 15 scenarios for global food security from 2010 to 2050 was that "the negative productivity effects of climate change reduce food availability and human well-being" for all regions of the world (Nelson et al. 2010, 49). Innovations that succeed in both mitigating agricultural GHG emissions and reducing agricultural vulnerability to climate change, such as those prioritized under CSA, are therefore immensely valuable.

Proponents of CSA have emphasized several key features that distinguish the CSA approach. First, CSA gives specific attention to risks, recognizing that the new risks associated with climate change interact with and magnify existing vulnerabilities (Grainger-Jones 2011; World Bank 2011). Second, the increased appreciation of the risks smallholders[2] face offers a strategic focus on practices and technologies that offer multiple benefits in the areas of adaptation, mitigation, and food security. Options that succeed in multiple areas should receive priority for promotion and scaling-up. Additionally, CSA allows smallholders access to previously unavailable sources of support for agricultural intensification, including climate finance (Grainger-Jones 2011).

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[1]Corresponding Author: (r.meinzen-dick@cgiar.org).

[2]Smallholder refers to small-scale agricultural producers in general, including farmers, livestock keepers, and fishers.

Much of the discussion around CSA has focused on introducing new agricultural technologies and practices at the farm level (Scherr, Shames, and Friedman 2012). These include, among others, conservation agriculture, improved livestock feed management, new crop varieties, water storage, rainwater harvesting, and improved post-harvest handling (Neufeldt et al. 2011). Table 1 presents a list of interventions that could be considered CSA. While the potential returns to these new practices and technologies may be high, this paper argues that CSA will only succeed in delivering its promised benefits to smallholders if inclusive institutions are in place to support such innovations.

Table 1: Possible CSA Interventions

Crop Management	Livestock Management	Soil and Water Management	Agroforestry	Integrated Food Energy Systems	Infrastructure	Access to Climate Information
Intercropping with legumes Crop rotations New crop varieties Improved storage and processing techniques Greater crop diversity Value chain and marketing	Improved feeding strategies Rotational grazing Fodder crops Grassland restoration and conservation Manure treatment Improved livestock health Animal husbandry improvements	Conservation agriculture Contour planting Terraces and bunds Planting pits Water storage (e.g., water pans) Alternate wetting and drying (rice) Dams, pits, ridges Improved irrigation Rehabilitation of degraded landscapes	Boundary trees and hedgerows Nitrogen-fixing trees on farms Multipurpose trees Improved fallow with fertilizer shrubs Woodlots Fruit orchards	Biogas Production of energy plants Improved stoves	Develop climate proof infrastructure for storage Retrofit rural infrastructure to cope with climate risks, such as flooding or water shortages	Use of climate analogues to predict future changes Support farmer exchanges Develop local expertise in climate science and agriculture Introduce forecasting and scenario planning

Source: adapted from (Neufeldt et al., 2011).

Institutions, for the purposes of this discussion, are defined as "[t]he rules of the game in a society or, more formally, the humanly devised constraints that shape human interaction" (North 1990). This definition encompasses state and market institutions, but also local-level and customary institutions that influence smallholders' decisions about how to use and manage their resources. Considerable evidence demonstrates the particular importance of the institutions of collective action and property rights in facilitating the adoption of many agricultural technologies or natural resource management practices (Meinzen-Dick et al., 2002), for risk pooling (McCarthy et al. 2000, 2004), and for enabling people to build assets that can help them withstand shocks (Di Gregorio et al., 2008). Local-level institutions serve important functions in information gathering and dissemination, resource mobilization and allocation, skills development and capacity building, providing leadership, and creating linkages between decisionmakers and

other institutions (Agrawal 2010). Furthermore, local level institutions play an instrumental role in enabling smallholders to transform coping capacity into adaptive capacity (Berman, Quinn, and Paavola 2012). However, scale and complexity of the challenge of climate change require institutional innovation at all scales and levels (Ostrom 2009, 2010).

Drawing on experiences and the literature from agricultural development, natural resource management, participatory community-led development, sustainable livelihoods, and disaster risk reduction, as well as the CSA agendas outlined by the World Bank and FAO, this paper identifies four key institutional functions that will be necessary to the success of CSA programs, projects, and practices. Institutions must:

- provide information about changing climatic conditions as well as possible responses;
- foster innovation to develop and disseminate new practices and technologies;
- encourage investment in physical infrastructure and/or in learning new ways; and
- provide insurance to cope with risks due to climate shocks and risks of adopting new practices.

In order to ensure that CSA deliver benefits in an equitable fashion, we further recommend a norm of deliberate inclusivity when considering institutions and program design. We summarize our perspective by arguing for the importance of the six "ins" of CSA: inclusive institutions for information, innovation, investment, and insurance.

In subsequent sections of this paper, we first examine what is meant by inclusivity and then review the role of institutions in providing information, fostering local-level innovation, encouraging investment, and providing insurance to enable smallholders, women, and poor resource-dependent communities to adopt and benefit from CSA practices, paying particular attention to the importance of local-level institutions and institutional linkages. We conclude by exploring the implications of a focus on institutional arrangements for future research and development projects to build adaptive capacity and enable smallholders to undertake and sustain CSA practices.

2. INCLUSIVITY

CSA efforts will require a focus on institutions to perform the key functions listed above, but even institutions that successfully deliver information, innovation, investment and insurance will not necessarily do so in ways that meet the demands and serve the interests of smallholders and marginalized groups and individuals. A long empirical literature identifies different ways that institutional arrangements can create barriers to full and equitable participation based on gender, social or ethnic differences, or other factors (Mwangi, Markelova, and Meinzen-Dick 2012; Cleaver, Cooke, and Kothari 2001; Agarwal 2001; Chambers 1997; Chambers 1983). A positive commitment to inclusivity is essential to ensure that institutions function equitably. More specifically, following Paavola and Adger's (2002) argument for

procedural as well as distributive justice in climate adaptation strategies, we argue that CSA initiatives should devote effort and resources toward the goal of inclusivity in both decisionmaking and in assessments of the costs and benefits of any particular program or policy.

Inclusivity in decisionmaking refers to decisions of all types and at all scales, including identifying problems and possible solutions, designing policies, and implementing programs. The multi-scalar nature of climate change—and its impacts and solutions—poses a challenge of how best to consider and balance local, regional, national, and global priorities, preferences, and perceptions (Ayers 2011; Adger et al. 2005). Moreover, vulnerability to climate change grows out of place-dependent socioeconomic and political contexts and relationships (Ribot 2010). Thus, capturing a full range of voices, perceptions, and identified solutions is necessary for crafting solutions that are place-specific and respond to characteristics that contribute to locally defined vulnerabilities (Byg and Salick 2009; Lebel 2013; Brace and Geoghegan 2011; Berkes 2009). The inclusion of these voices and perspectives may further contribute to the overall legitimacy of identified actions and solutions and may lead to improvements in the outcomes of implementation of climate change adaptation (Adger et al. 2005).

Distributive inclusivity is more focused on the benefits and costs of programs and policies. Inclusive processes of decisionmaking should help to produce equitable outcomes, but decisionmakers should aim for distributional equity in terms of costs and benefits irrespective of the inclusivity of the decisionmaking process. The question of whether state, market, NGO, and collective action institutions for CSA promote the inclusion of and encourage the equitable distribution of benefits to small-scale producers, marginalized ethnic groups (such as pastoralists), women, and youth should be an empirical question, rather than based on prior assumptions about each type of institution. Given the variability of the institutions involved, equity of outcomes should be a central focus of climate change adaptation and resilience (Thomas and Twyman 2005).

3. INFORMATION

While smallholders will require a range of information in order to adapt to climate change and to avail themselves of opportunities to participate in mitigation schemes, the costs of searching for information currently poses a significant barrier to smallholder adoption of CSA practices (McCarthy, Lipper, and Branca 2011). In the current context of smallholder vulnerability, scholars and practitioners argue for encouraging a switch away from viewing information solely as "packages" of technologies for farmers to adopt (Davis 2009) to providing targeted information and skills that can lead to informed decisionmaking by end users of climate advisory services as well as an increased focus on risk management (Levine, Ludi, and Jones 2011; Cooper et al. 2008). This section discusses the ways in which institutions and institutional arrangements structure how information is produced and the ways in which smallholders are able to access and use information.

State institutions have traditionally provided weather and technical information through government extension, research, and advisory services, as well as serving as facilitators of interaction between local institutions and other relevant market actors (Davis 2009). Much of this information, however, proves ill-suited for

local agroecological conditions, requires unaffordable expenditures, is not reliable, or is too narrowly focused (Levine, Ludi, and Jones 2011; Warburton et al. 2011; Newsham and Thomas 2011). Climate information provision has been marked by comparable failings, with a noted divergence between farmers' needs and preferences and the scale, format, accuracy, and content of available products (Vermeulen et al. 2012). In addition, information providers have shown little interest in understanding the information gaps—and differentiated information needs—of their users (Glendenning, Babu, and Asenso-Okyere 2010; Adolwa et al. 2012; Chaudhury et al. 2012), as well as the differing perceptions of the trustworthiness of different sources (Adato and Meinzen-Dick 2007; Chaudhury et al. 2012). Hansen et al. (2011) attribute the difficulty in meeting the information needs of famers to the fact that in many countries, international and national climate services, centers, and scientists have invited very little participation from the agricultural sector in determining the types of products and services produced. As a result, the agricultural sector has very little voice and ownership of climate services and products. Applying Cash et al.'s (2003) framework on how information is used and adopted, we see that these climate information providers have little incentive to ensure the salience (information relevant to the decision being made), credibility (believability of the information) , and legitimacy (perceived fairness and balance of the information provided).

For reasons of efficiency and ease of reaching larger audiences, development interventions often rely on social networks and group-based approaches to distribute information and make knowledge available to a wider public (see, for example, Crona and Bodin 2006; Denis, Pesche, and Bosc 2006). Yet groups and social networks produce highly differentiated results in terms of information and knowledge sharing and often fail to inspire collective action. In these local-level institutional arrangements, power and social dynamics may intersect, as knowledge and information may be a powerful political and economic resource (Arnall 2011; Plaff, Broad, and Glantz, 1999). In one study in Burkina Faso tracing access to climate forecasting, researchers found that in villages marked by social tensions over land ownership, political power, and administrative boundaries, half of the farmers did not receive the forecast information (Roncoli et al. 2008). In villages where these social tensions did not exist, the information reached a much larger percentage of the population. Understanding the circumstances under which group-based dissemination functions and can encourage collaboration, sharing, and learning among participants is important (Faysse, Sraïri, and Errahj 2012; Ludi et al. 2011). In the absence of formally organized institutions, informal social networks are important sources of information and technology transfer (Matuschke 2008; Newsham and Thomas 2011), but are susceptible to the same forces of exclusivity.

While knowledge and information may be important intangible assets, their use interacts with decisionmaking rules and power relationships that exist within a community (Di Gregorio et al. 2008). Social norms, processes, and relationships determine how costs and benefits are calculated and weighed, which sources of information are trusted and valued, and ultimately which resources are mobilized to take action (Roncoli et al. 2010b). In addition to norms and informal rules concerning use and access to resources, these decisions at the household and community level are influenced by resource and cognitive constraints, including lack

of access to credit, insecure tenure arrangements, opportunity costs, risk aversion, lack of access to infrastructure, and governance failures (McCarthy, Lipper, and Branca 2011; Roncoli et al. 2010a; Jones and Boyd 2011). Thus institutions, broadly defined, are important not only for the dissemination of information and knowledge, but also to enable individuals to transform information into usable resources, either tangible or intangible, that give them agency in their pursuit of livelihoods (Di Gregorio et al. 2008). Furthermore, the linkages among various institutions (institutional articulation) at different levels and scales affect the flow of information and resources (Agrawal 2010). For example, farmer cooperatives and organizations allow farmers to access markets, negotiate more favorable prices, and sources of information (Markelova et al. 2009). Since many CSA activities necessarily require coordination across multiple scales and at different organizational levels, program designers must pay special attention to these inter-institutional linkages and how they affect the flow of information relevant to their programs.

Information can be shared formally, through organized public meetings and trainings, or through informal sharing and networks, which intersect with social norms and practices. Formally organized sharing platforms, such as farmer field days, discussion groups, demonstration plots, and exchange visits, increase the linkages between different institutions and knowledge co-production, but may pose significant barriers to participation (see, for example, Hoang, Castella, and Novosad 2006). Knowledge co-production, as considered here, involves the creation of "new" knowledge through the interaction between people with local, contextual information and people with agricultural and scientific information, and requires careful attention to which knowledge is valued in the process and who participates in the co-production (see Newsham and Thomas 2011). In addition, a long literature suggests a gender bias in access to extension services; cultural practices and norms dictate women's access to information through other community institutions, such as community-based organizations, cooperatives, and groups (Meinzen-Dick et al. 2011; World Bank and IFPRI 2010). Those that are excluded from such formal organized methods may be forced to rely on informal networks and exchanges, which may limit the knowledge and information sharing. For example, in Kenya, Kiptot et al. (2006) found that farmers shared information about improved fallow and improved fallow seeds largely though kinship and informal social networks. Furthermore, these networks proved more effective at distributing seeds than ensuring the dissemination of accurate information.

Researchers highlight institutional structures and arrangements that encourage more open and two-way communication/interaction between farmers and researchers, and that recognize the creation of knowledge as a social process, as critical to overcoming these barriers to the production of salient, credible, and legitimate information (Hansen et al. 2011; Orlove et al. 2010). Importantly, they also highlight the need for information providers to transition from seeing their role as sources of information to that of facilitators of access to locally relevant information (Warburton et al. 2011; David and Asamoah 2011; Davis 2009; Newsham and Thomas 2011; Kristjanson et al. 2009) and to move towards engaging farmers in active experimentation to identify solutions and improve the farmers' capacity to respond (Suarez et al. 2014). Such co-produced knowledge has the benefit of being relevant not only to local agroecological conditions, but also

produces knowledge that complements the existing livelihood system, which has been proven to be crucial for adaptation of new interventions (Bayala et al. 2011).

These approaches require commitments of funding and capacity building on behalf of state institutions to provide facilitators and to incorporate and respond to community-level feedback and demands (David and Asamoah 2011). More importantly, they require a commitment to the polycentric production of information and knowledge, through trial and error and social learning, which ultimately improves learning outcomes and better reflects local priorities and needs (Ostrom 2010). Institutions need to take the management of the interface between knowledge and action seriously and put in place measures to increase accountability and to allow for the creation of collaborative efforts and outputs (Cash et al. 2003). A review of the CGIAR's Alternatives to Slash and Burn research program found that many of the mechanisms that increased accountability between local stakeholders, scientists, and policy makers were not legal accountability mechanism, but rather informal governance arrangements between trusted individuals and organizations (Clark et al., 2011). In addition, working collaboratively to develop a set of interventions, tools, and data that reflected and responded to local priorities instead of imparting a standard toolkit or set of practices improved the perception and participation of the various participants. At the very least, the voices of smallholders—male and female—must be represented in all stages of agricultural research and extension outreach (Meinzen-Dick et al. 2011).

4. INNOVATION

Innovation plays a central role in agriculture, for achieving economic, social, and environmental goals (Klerkx, Hall, and Leeuwis, 2009). Around the world, the ability to innovate and the capacity to foster innovation (and accept failure) varies greatly (Levine et al. 2011). Innovations are "workable" ideas, practices, products, or changes to processes or rules; they "involve the extraction of economic, ecological, and social value from knowledge" (Asenso-okyere, Davis, and Aredo, 2008, p.2). Donors, development agencies, and NGOs increasingly emphasize the development of innovation systems, the networks and relationships of individuals and organizations that bring new products, new processes, or new forms of organization into social and economic use. Innovation systems also include the policies and institutional arrangements that structure their relationships (Hellin 2012). The actors in innovation systems are linked by the exchange and production of knowledge (Spielman et al. 2010); smallholder farmers play a key role, often forgotten and overlooked, in this process (Meinzen-Dick et al. 2011).

Work on innovation systems highlights both the diversity and the number of actors and partners involved, including public, private, community, and individual actors. Each of these actors has their own interests and goals. Private sector interests likely invest in discrete technologies or inputs that can be sold, while public sector may invest more in formal research, on landscape-level adaptations, natural resource management practices, or other innovations with less excludability. Communities and individuals are likely to invest in new practices or new ways of organizing themselves or regulating systems. Several authors emphasize that innovations systems must take more seriously local-level innovation

processes (Poncet et al. 2010; Brooks and Loevinsohn 2011) and suggest that a key entry point for enabling local-level innovation is recognizing, valuing, and building off of locally adapted practices (Waters-Bayer et al. 2004). In the context of increasing variability and uncertainty, which is predicted for much of the developing world, viewing innovation as a dynamic and an ongoing process of negotiation and interaction between farmers, researchers, and other agricultural actors may help to reduce vulnerability and resilience (Leeuwis and Aarts 2011; Vermeulen et al. 2012).

Innovation systems, and the capacities to experiment, relate closely to extension systems that facilitate social learning (learning from others in a social context), incorporate feedback loops, and iterative interactions (Davis, Ekboir, and Spielman 2008) and employ different types of learning (learning by doing, learning by using, learning through formal means, and learning through self-education) (Asenso-okyere, Davis, and Aredo 2008). The Africa Climate Change Resilience Alliance, a consortium of development organizations and the Overseas Development Institute focused on improving adaptive capacity in Africa, suggests practices like these, which build local level capacity to experiment and critically reflect, help to facilitate local level innovations (Ludi et al., 2011).

Bringing together these actors to encourage social learning and exchange may require particular institutional arrangements. Innovation platforms, which create spaces to encourage exchanges between innovation systems actors, have been noted as one such arrangement to encourage this type of interaction (Kilelu, Klerkx, and Leeuwis 2013). Again, these require a restructuring in the interactions and a commitment of resources to support these processes (Dzeco, Amilai, and Cristóvão 2010), as well as a commitment to understanding the capacity needs for innovation at the local level.

Innovation may require resources beyond the reach of individuals, such as information or financial resources to overcome the costs of experimentation. Some scholars highlight the role of a network facilitator, a neutral intermediary who is able to connect communities and individuals to other actors and may play a key role in ensuring that communities have the necessary access to resources and information outside of their community (Klerkx et al. 2012). This seems similar to the role that bridging organizations can play (Folke et al. 2005). Other NGOs and practitioners make use of grants and loans to enable and support small-scale experimentation (Friis-Hansen and Egelyng 2007). Access to common property, as well as social protection programs that provide starter packs of seeds, access to credit, or asset protection, may also help to facilitate adaptation to climate change by enabling households to adopt new practices and diversify livelihood strategies, thus enabling innovation at the household level (Davies et al. 2009; Jones et al. 2010).

At the local level, social capital, networks, and linkages can help to facilitate and support innovation processes. For this, communities need social networks and linkages that are both "strong" and "weak," (Spielman et al., 2010); weak ties between institutions and individuals help in the search for information, while strong, dense ties are important for discussion of more complex subjects, experimentation, and exchange of ideas (Darr and Pretzsch 2008). However, as mentioned in the previous section, social cleavages and unequal access to these networks can create

and reinforce disparities in terms of access to these necessary elements for innovation.

At the local level, institutional arrangements such as property rights, cultural views towards innovation, and gender norms may inhibit the development of vibrant, local-level innovation systems by influencing who is allowed to innovate and who is not. At times, existing institutions, cultural norms, beliefs, and practices may impede the adoption of certain innovations and make it more difficult for individuals to experiment and try new activities. These include decisionmaking patterns, traditional authorities, gender biases, as well as traditional risk aversion behaviors. For example, gender norms and relationships may impede local level innovations. In Western Kenya, men suggested that traditionally and culturally, women were not innovative, making men less likely to support women's investment in changing farm practices or investing in income generating activities (Bernier et al. 2013). In Ethiopia, there is strong opposition to individuals changing the sowing dates in light of changing weather patterns (Levine, Ludi, and Jones 2011). In Indramayu District, West Java Province, Indonesia, farmers' collective decisionmaking concerning planting timing and varieties made it impossible for individual farmers to alter planting decisions that had been collectively decided by water user associations for irrigated fields; however, even in the rainfed fields approaches that targeted individual farmers to use seasonal forecasting did not succeed, for fear that crops that matured alone would be at greater risk from rats (Siregar 2010). In Zambia, traditional free grazing arrangements and field burning practices prevented smallholders from planting nitrogen-fixing fertilizer trees until researchers and communities appealed to traditional authorities for help in enacting changes to the bylaws to protect investments and enable communities to adopt these practices (Ajayi et al. 2012). These institutional innovations enabled the protection of vulnerable households, especially women and the poor. They also illustrate how cultural norms and behaviors are dynamic and evolving, creating opportunities and challenges to ensure inclusive benefit sharing. Understanding how communities can affect institutional change—and the institutional changes that impede innovation—will help researchers and practitioners scale-up CSA.

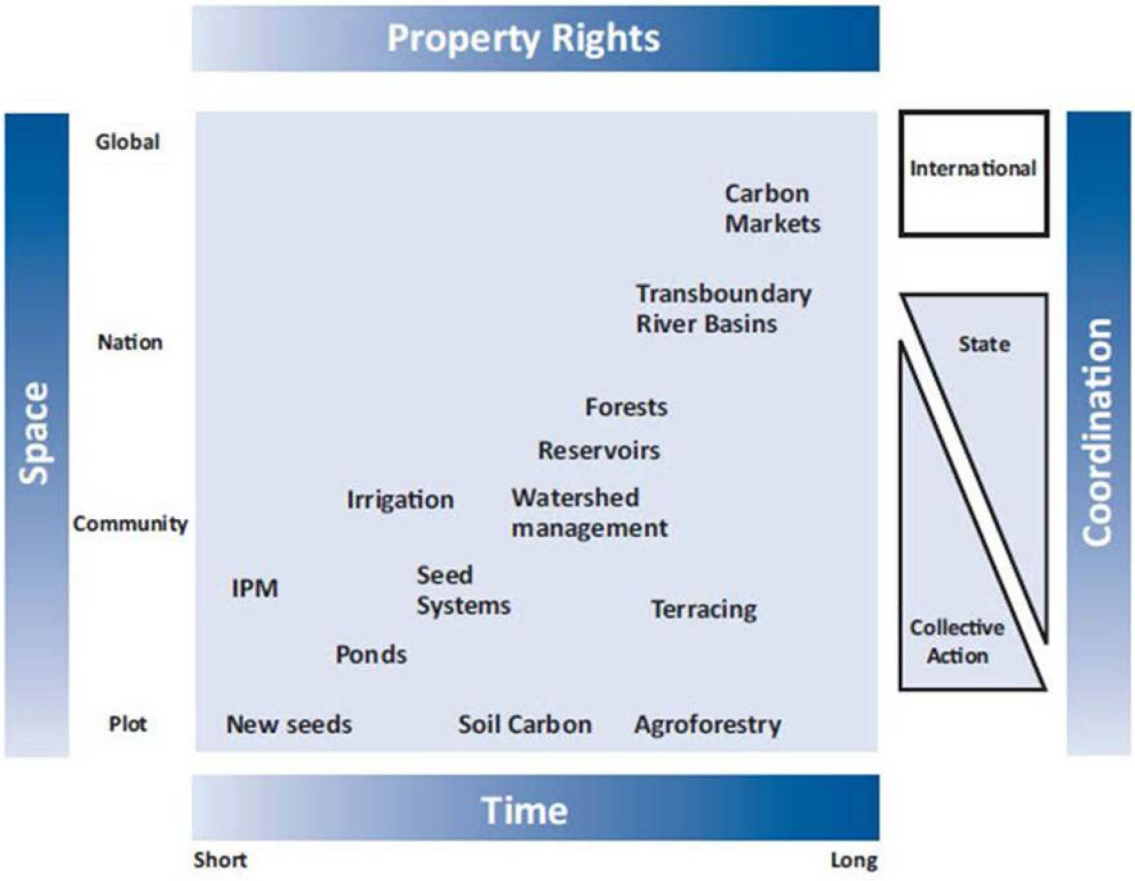
Moreover, CSA may offer new opportunities for smallholder farmers, through carbon finance, climate adaptation funding, or through improved agricultural productivity from climatic changes. In order to take advantage of such opportunities, new institutional arrangements are needed to connect smallholders with global markets, actors, and information. These new arrangements, particularly those that bring together local institutions to global actors or markets, face a number of challenges, including the need to link across scales and to overcome significant transaction costs while ensuring benefits for smallholders (see Shames et al. 2012a). A number of studies are tracking how these new opportunities and funding sources that can enhance livelihood diversification of smallholders are developing (Shames et al. 2012b; Gosset and Neufeldt 2012).

INVESTMENT

Adopting CSA practices requires some form of investment, from learning about the new technique to more substantial investments in technologies, infrastructure, and inputs. Whether smallholders can make these investments depends on the spatial scale, costs, and payback period of the investments. Each of these has institutional

implications, as illustrated in Figure 1. Actions at the individual level (such as planting a drought-resistant annual crop or building a farm pond) generally do not require much in the way of institutions for coordination. As we move up the scale to actions that operate at the group or community level (such as a small reservoir to serve a group or community), some form of coordination becomes necessary. At this local level, collective action institutions are often the most appropriate for such coordination, although some state institutions may also be relevant (for example, giving technical advice to a group of farmers digging or operating the reservoir). As we move higher on the spatial scale, local government or other state agencies become increasingly important for coordination (such as when the panchayats coordinate investment in watershed management or other public infrastructure in India), although collective action institutions may still be relevant (for example, Nepal's national federation of forest user groups). The relative roles of state and collective action are illustrated by the triangles on the right hand side of Figure 1. In general, if the relevant scale for policies or action is global, then international institutions are required, either employing existing arrangements (UN agencies, for example) or creating new institutions (such as the carbon credit exchanges formed after the Kyoto Protocol in 1997).

Figure 1. Role of institutions in climate change responses



Source: Meinzen-Dick, Markelova, and Moore 2010. Note: Location of climate change responses is approximate, and will vary depending on the exact nature of the CSA techniques as well as farm sizes.

Although not noted in Figure 1, markets can also play a coordination function, ranging from the global to the local. Examples include private sector distribution of new seed varieties and carbon markets and other mechanism as payment for environmental services. The question of when market institutions (rather than state or collective action) are appropriate depends not so much on scale but on issues of transaction costs and attitudes toward markets. Working with many small suppliers of carbon "services" entails higher transaction costs than working with a few large-scale suppliers, which means that markets tend to favor plantations, for example, over smallholder agriculture or forest communities. Asymmetrical information, either about the actions of farmers or the benefit streams they could tap, will mitigate against market-based coordination. Finally, the acceptability of private sector investment will depend on values and attitudes toward resources and toward markets. This has been especially evident in the recent debates over large-scale land acquisitions or "land grabs." The investment needed for many forms of agricultural development, along with purported economies of scale, have contributed to governments seeking private investors or investors seeking agricultural land in developing countries. However, the loss of land and lack of clear benefits for many of the existing land users have created opposition to these types of land deals in many countries (Anseeuw et al. 2012).

In practice, many investments require action at multiple levels and sectors. For example, the introduction of dairy goats in Kenya not only required that farmers invest in the goats, but also that a group of farmers shared a buck, and a federation of groups to ensure that the bucks circulated, along with public or private veterinary services and changes in feeding practices (Place et al. 2002). A range of central and local institutions, public and private, is therefore needed. Rather than focusing exclusively on any single type of institution, policies need to develop polycentric governance arrangements with in which multiple institutions each play a role (Ostrom 1999).

The time frame for actions also provides indications of the nature of institutional arrangements needed. In general, Knox, Meinzen-Dick and Hazell (2002) point out that agricultural investments that have a long time horizon require greater attention to property rights because those individuals or groups without tenure security will not have the incentive—or sometimes even the authority—to make the investment and to continue to track these results over time. These property rights—and the ability to access agricultural land—may vary according to gender (see Place 1994; Fortmann, Antinori, and Nabane 1997; Kiptot and Franzel 2011), which means that not all individuals will have the same authority and ability to implement CSA practices. Further, the security of tenure may be dependent upon the continual use of land (Fenske 2011), which means that certain CSA options, such as fallowing, may prove unattractive for some smallholders.

The investment requirements for CSA may be particularly onerous for women and the poor; the machinery requirements or necessary inputs may be beyond the reach of those with cash constraints (and no viable access to finance). In addition, some practices may pose significant opportunity costs, such as the value of lost products or increased labor that prove unaffordable for smallholders (Magnan, Larson, and Taylor 2012; Valbuena et al. 2012). In Morocco, Magnan, Larson, and Taylor (2012) calculated that the stubble from cereal production accounted for 25 percent of the total production value in a normal year and 75 percent in a dry year,

meaning that opportunity costs for maintaining that stubble as crop cover may prove prohibitive or unattractive. Even if resources are available at the household level, gender and social norms may make it difficult for women and youth to use them to invest in CSA.

Credit can help ease cash constraints for such investments, but formal credit institutions may not be available in rural areas or are unwilling to lend to smallholders. Microfinance institutions and rotating savings and credit groups provide alternatives but the latter require collective action, and are not always inclusive of the very poor. For example, participatory poverty assessments in Bangladesh differentiated among categories of the poor and extreme poor based on whether someone would be included in a microfinance group (Nabi et al. 1999). Where critical assets are required for investment, some form of external assistance to build those assets may be needed to enable the very poor, or women, to engage in CSA.

5. INSURANCE

Climate change increases the risks and shocks that smallholders face as weather becomes less predictable. Some form of insurance is required to help withstand the shocks, as well as to encourage innovation and investment. Downside risk is a recognized constraint to adoption of new technologies and practices (Binswanger, 1981; Feder, Just, and Zilberman, 1985), implying that people are more likely to take risks if they have some sort of fallback mechanism. The forms of insurance range from formal to informal. Crop or livestock insurance is not often available to individual smallholders, especially in developing countries, because of the high transaction costs of monitoring crop losses and avoiding moral hazard across many small holdings, but index-based insurance that is keyed to local weather stations has lower monitoring costs, and can be sold in varying amounts so that small-scale producers can buy in (McCarthy 2003; IFAD 2011; Barnett, Barrett, and Skees 2008; Alderman and Haque 2007). Even landless agricultural laborers—who are also hit by droughts or floods—can buy index-based insurance. Although these forms of insurance are still not widely adopted, these again illustrate the need for multisectoral and multilevel institutional coordination, bridging public and private financing.

Beyond such formal insurance, a variety of groups, social networks, assets, and public programs can provide alternative insurance mechanisms. Externally organized microfinance groups and locally organized groups may provide some sort of insurance. Dercon et al. (2012) examine how Ethiopian funeral societies (iddir) have expanded into providing health insurance. Quisumbing, McNiven, and Godquin (2012) examine the role of social and familial networks in cushioning shocks in the Philippines. Both note that these social institutions are capable of dealing with some idiosyncratic shocks (like illness). For covariate shocks that affect a whole community, a local group or network is unlikely to be able to provide much insurance because all the members would be affected, but social networks with others outside the community (such as migrant family members) are likely to be more effective.

Jodha, Singh, and Bantilan (2012) similarly find that in semiarid areas of India, the commons, and the resources it provides, has provided important fallback

for households, but with climate change and increasing demographic pressures, this important safety net is being eroded. Pastoral communities possess their own forms of spatial mobility and socially mediated "access options" that enable them to use the land and other resources of other groups (via reciprocal arrangements with other pastoralist groups or through exchange with agricultural communities), as well as carrying extra animals that have historically provided forms of risk mitigation for livestock keepers in many semiarid and arid regions (McCarthy et al. 2000). It is thus interesting to note that CSA moves away from such customary insurance mechanisms toward more intensive care of fewer animals with stall grazing or restricted animal mobility. In some cases, social capital may act as a deterrent to investing in more resource-intensive CSA practices; Di Falco and Bulte (2013) found that increased kinship ties reduced the incentives to invest in soil conservation in Ethiopia, as households are able to rely on community sharing and coping patterns in times of need. However, it is likely that the trends of covariate shocks from climate change will undermine the more traditional and informally based insurance trends; in these scenarios, public programs, such as disaster risk reduction and social protection, as well as insurance, will become increasingly important.

Assets serve as a form of insurance for many households. Irrigation reduces the vulnerability of cultivators to fluctuations in rainfall. Other assets may either protect against weather-related shocks (as through storage facilities) or can be liquidated as a coping strategy, as with sale of livestock or jewelry to cover expenses when crops are lost or illness strikes (see Quisumbing, Kumar, and Behrman, 2011). In addition, state (or international) social protection programs can serve as insurance mechanisms, providing guaranteed employment (like NREGA in India), or providing emergency food or supplies in disaster situations. Increasingly, scholars view social protection programs as having the potential to contribute to increased resilience to climate change by supporting smallholders in diversifying incomes and even transitioning away from agricultural production (Davies et al. 2009; Jones et al. 2010).

State, market, or collective action institutions can all assume insurance functions. The private sector is most likely to be involved in formal insurance programs, while the state and even the international system provide disaster relief, emergency coverage, and rural employment guarantees. Collective action institutions provide group-based insurance and social network support, but as noted above, these are more likely to be at the local level, and less able to insure against covariate risk.

Hybrid models and institutional arrangements to provide insurance may become important to meet these insurance needs. One experimental model in Ethiopia is attempting to link insurance provision with credit providers; the state is playing an active role in encouraging private sector involvement in this sector.[3]

The poor are the most vulnerable to climate change because even relatively small shocks can have severe consequences and they tend to lack the resources to self-insure. CSA can help reduce vulnerability by stabilizing or even increasing

[3]The intervention is still ongoing and results forthcoming. For more information, see: http://atai-research.org/projects/interlinking-weather-index-insurance-credit-alleviate-market-failures-and-improve-agriculture.

production, but in many cases very poor people cannot take the risk of adopting new approaches without some form of insurance to provide fallback mechanisms. Even many insurance mechanisms are biased against the poor: the high transaction costs and lack of cash of the poor makes them unattractive to formal private sector insurers; those with influence and political connections often receive priority in government programs such as disaster relief; and many social groups and networks exclude the very poor.

While no single form of insurance is likely to suffice, cultivating multiple forms of insurance is likely to offer the greatest extent of coverage for the poor. Moreover, multiple forms of insurance recognize that smallholders both perceive risk differentially and have different preferences for insurance and risk management options. Understanding risk perceptions—and insurance needs—will help state and market institutions create insurance forms that respond to and address the felt needs of vulnerable farmers.

6. IMPLICATIONS

CSA aims to increase the resilience of livelihoods and ecosystems through combinations of technologies and practices and is facilitated by access to information, support of innovation, mobilization of resources, and insurance against risks. Although the focus is often on the technical components of CSA, the institutional aspects are absolutely vital, both for the adoption of CSA and as a contribution to resilience in its own right. As Kasperson, Kasperson, and Turner (1995) and Adger (2003) note, financial, physical, human, and natural capital, social networks, and institutions are critical for resilience, providing support following a shock. As climate shocks become more extreme and unpredictable, these aspects of institutions and institutional arrangements will become even more important.

This paper has argued that institutions and institutional arrangements, as discussed above, play critical roles in the provision of information, enabling innovation, facilitating investment, and providing insurance—all necessary functions for climate-smart agricultural projects and programs. Our intention has been to broaden the focus of CSA beyond the rather narrow focus on developing new technologies to include a deeper understanding of the institutional foundations which underpin and enable technological success. The following conclusions draw on the discussion above and identifies key institutional considerations for CSA and highlight the need to for special attention to both procedural and distributive inclusivity in order to achieve pro-poor and gender equitable outcomes.

- In order to encourage the adoption of CSA practices, local institutions will potentially need to take on new roles and responsibilities. Funders, government organizations, NGOs, and other actors will also need to take on additional roles as network brokers, facilitating access to resources and information. Much investment is needed to build the capacity of all actors to fulfill these roles.
- The institutions producing and providing climate and agricultural information and insurance products must do a better job of including end

user and local-level perspectives in order to tailor their products to the reality and complexity of smallholder livelihoods.

- Social safety nets are important safeguards that may help smallholders take the necessary risks to innovate and adopt new practices. Smallholders need access to a range of insurance options bridging formal and informal approaches.
- Many CSA interventions occur over a large spatial scale or a long time horizon. They therefore require institutions to facilitate coordination among diffuse resource users and to secure their property rights.
- The new agricultural risks and opportunities associated with climate change require institutional change and innovation at all levels. Stakeholders should embrace a polycentric approach to these challenges rather than seeking to impose a single strategy from the top down.
- Better understanding what kinds of institutional arrangements facilitate adoption of CSA technologies and practices should be a high priority of the research agenda.

This paper has argued that successful CSA programs will require investments in not only understanding how the biophysical world is changing, but also resources to understand and learn about the existing institutional landscapes and how it must evolve to meet these challenges. Institutional change is necessary to support and enable CSA projects and programs to achieve their goals, but it will not occur without the concerted efforts of researchers, practitioners, farmers, and policymakers who understand institutions and are committed to making them effective and inclusive.

REFERENCES

Adato, M., and R. Meinzen-Dick, eds. 2007. *Agricultural research, livelihoods, and poverty: Studies of economic and social impacts in six countries*. Baltimore: John Hopkins University Press and International Food Policy Research Institute.

Adger, W. N. 2003. Social capital, collective action, and adaptation to climate change. *Economic Geography* 79 (4): 387–404.

Adger, W. N., N. W. Arnell, and E. L. Tompkins. 2005. Successful adaptation to climate change across scales. *Global Environmental Change* 15 (2): 77–86.

Adolwa, I. S., P. F. Okoth, R. M. Mulwa, A. O. Esilaba, F. S. Mairura, and E. Nambiro. 2012. Analysis of communication and dissemination channels influencing the adoption of integrated soil fertility management in western Kenya. *The Journal of Agricultural Education and Extension* 18 (1): 71–86.

Agrawal, A. 2010. Local institutions and adaptation to climate change. Chapter 7 in *Social dimensions of climate change: Equity and vulnerability in a warming world,* R. Mearns and A. Norton, eds. Washington, D.C.: World Bank.

Agarwal, B. 2001. Participatory exclusions, community forestry, and gender: An analysis for South Asia and a conceptual framework. *World Development* 29 (10): 1623–1648.

Ajayi, O. C., F. K. Akinnifesi, G. Sileshi, S. Mn'gomba, O. A. Ajayi, W. Kanjipite, and J. M. Ngulube. 2012. Managing conflicts over land and natural resources through collective action: A case study from rural communities in Zambia. CAPRi Working Paper No. 105. Washington, D.C.: International Food Policy Research Institute.

Alderman, H., and T. Haque. 2007. *Insurance against covariate shocks: The role of index-based insurance in social protection in low-income countries of Africa*. Washington, D.C.: World Bank.

Anseeuw, W., L. Cotula, and M. Taylor. 2012. Understanding the opportunities and risks at stake in Africa. Chapter 5 in *Handbook of land and water grabs in Africa: Foreign direct investment and food and water security*, T. Allan, M. Keulertz, S. Sojamo, and J. Warner, eds. New York and UK: Routledge Publishers.

Arnall, A. H. 2011. *Understanding adaptive capacity at the local level in Mozambique*. Africa Climate Change Resilience Alliance (ACCRA).

Asenso-Okyere, K., K. Davis, and D. Aredo. 2008. Advancing agriculture in developing countries through knowledge and innovation: Synopsis of an international conference. Washington, D.C.: International Food Policy Research Institute.

Ayers, J. 2011. Resolving the adaptation paradox: Exploring the potential for deliberative adaptation policy-making in Bangladesh. *Global Environmental Politics* 11(1): 62–88.

Barnett, B. J., C. B. Barrett, and J. R. Skees. 2008. Poverty traps and index-based risk transfer products. *World Development* 36 (10): 1766–1785.

Bayala, J., A. Kalinganire, Z. Tchoundjeu, F. Sinclair, and D. Garrity. 2011. Conservation agriculture with trees in the West African Sahel—a review. ICRAF Occasional Paper No. 14. Nairobi: World Agroforestry Centre.

Berkes, F. 2009. Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management* 90 (5): 1692–1702.

Berman, R., C. Quinn, and J. Paavola. 2012. The role of institutions in the transformation of coping capacity to sustainable adaptive capacity. *Environmental Development* 2: 86–100.

Bernier, Q., P. Franks, P. Kristjanson, H. Neufeldt, A. Otzelberger, and K. Foster. 2013. Addressing gender in climate-smart smallholder Agriculture. ICRAF Policy Brief 14. Nairobi: World Agroforestry Centre.

Binswanger, H. 1981. Attitudes towards risk: Theoretical implications of an experiment in rural India. *Economic Journal* 91: 867–890.

Brace, C., and H. Geoghegan. 2011. Human geographies of climate change: Landscape, temporality, and lay knowledge. *Progress in Human Geography* 35 (3): 284–302.

Brooks, S., and M. Loevinsohn. 2011. Shaping agricultural innovation systems responsive to food insecurity and climate change. *Natural Resources Forum* 35 (3): 185–200.

Byg, A., and J. Salickb. 2009. Local perspectives on a global phenomenon—Climate change in Eastern Tibetan villages. *Global Environmental Change* 19 (2): 156–166.

Cash, D. W., W. C. Clark, F. Alcock, N. M. Dickson, N. Eckley, D. H. Guston, J. Jäger, and R. B Mitchell. 2003. Knowledge systems for sustainable development. Proceedings of the National Academy of Sciences of the United States of America 100 (14): 8086–91.

Chambers, R. 1997. *Whose reality counts? Putting the first last.* London: Intermediate Technology Publications Ltd (ITP).

Chambers, R. 1983. *Rural development: Putting the last first.* London: Longman.

Chaudhury, M., P. Kristjanson, F. Kyagazze, J. Naab, and S. Neelormi. 2012. Participatory gender-sensitive approaches for addressing key climate change-related research issues: Evidence from Bangladesh, Ghana, and Uganda. CCAFS Working Paper 19. Copenhagen: CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS).

Clark, W. C., T. P. Tomich, M. van Noordwijk, D. Guston, D. Catacutan, N. M. Dickson, and E. McNie. 2011. Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR). Proceedings of the National Academy of Sciences of the United States of America. doi:10.1073/pnas.0900231108

Cleaver, F., B. Cooke, and U. Kothari. 2001. Institutions, agency and the limitations of participatory approaches to development. In *Participation: the new tyranny*? B. Cooke and U. Kothari, eds. London and New York: Zed Books.

Cooper, P. J. M., J. Dimes, K. P. C. Rao, B. Shapiro, B. Shiferaw, and S. Twonlow. 2008. Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Agriculture, Ecosystems and Environment* 126: 24–35.

Crona, B., and Ö. Bodin 2006. What you know is who you know? Communication patterns among resource users as a prerequisite for co-management. *Ecology and Society* 11 (2): 7.

Darr, D., and J. Pretzsch. 2008. Mechanisms of innovation diffusion under information abundance and information scarcity—on the contribution of social networks in group vs. individual extension approaches in semi-arid Kenya. *The Journal of Agricultural Education and Extension* 14 (3): 231-248.

David, S., and C. Asamoah. 2011. The impact of farmer field schools on human and social capital: A case study from Ghana. *The Journal of Agricultural Education and Extension* 17 (3): 239–252.

Davies, M., B. Guenther, J. Leavy, T. Mitchell, and T. Tanner. 2009. Climate change adaptation, disaster risk reduction and social protection: Complementary roles in agriculture and rural growth? IDS Working Paper 320. Brighton, U.K.: Institute of Development Studies.

Davis, K. E. 2009. The important role of extension systems. In *Agriculture and climate change: An agenda for negotiation in Copenhagen*, G. Nelson, ed. Washington, D.C.: International Food Policy Research Institute.

Davis, K., J. Ekboir, and D. Spielman. 2008. Strengthening agricultural education and training in sub-Saharan Africa from an innovation systems perspective: A case study of Mozambique. *The Journal of Agricultural Education and Extension* 14 (1): 35–51.

Denis, M., P. Pesche, and M. Bosc. 2006. Rural producer organizations (RPOs) for pro-poor sustainable development. A Report prepared for the 2008 World Development Report. Washington, D.C.: World Bank.

Dercon, S., J. Hoddinott, P. Krishnan, and T. Woldehanna. 2012. Burial societies in rural Ethiopia. Chapter 3 in *Collective action and property rights for poverty reduction: Insights from Africa and Asia,* E. Mwangi, H. Markelova, and R. Meinzen-Dick, eds. Philadelphia: University of Pennsylvania Press.

Di Falco, S., and E. Bulte. 2013. The impact of kinship networks on the adoption of risk-mitigating strategies in Ethiopia. *World Development* 43: 100–110.

Di Gregorio, M., K. Hagedorn, M. Kirk, B. Korf, N. McCarthy, R. Meinzen-Dick, and B. Swallow. 2008. Property rights, collective action, and poverty: The Role of institutions for poverty reduction. CAPRi Working Paper No. 81. Washington, D.C.: International Food Policy Research Institute.

Dzeco, C., C. Amilai, and A. Cristóvão. 2010. Farm field schools and farmer's empowerment in Mozambique: A pilot study. *Journal of Extension Systems* 26 (2): 116–124.

FAO. 2010. *"Climate-smart" agriculture: Policies, practices, and financing for food security, adaptation, and Mitigation*. Rome, FAO.

Faysse, N., M. T. Sraïri, and M. Errahj. 2012. Local farmers' organizations: A space for peer-to-peer learning? The case of milk collection cooperatives in Morocco. *The Journal of Agricultural Education and Extension* 18 (3): 285–299.

Feder, G., R. Just, and D. Zilberman. 1985. Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change* 33 (2): 255–298.

Fenske, J. 2011. Land tenure and investment incentives: Evidence from West Africa. *Journal of Development Economics* 95 (2): 137–156.

Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30 (1): 441–473.

Fortmann, L., C. Antinori, and N. Nabane. 1997. Fruits of their labors : Gender, property rights, and tree planting in two Zimbabwe villages. *Rural Sociology* 62 (3): 295–314.

Friis-Hansen, E. and H. Egelyng. 2007. Supporting local innovation for rural development: Analysis and review of five innovation support funds. Danish Institute for International Studies Report 4. Copenhagen: Danish Institute for International Studies.

Glendenning, C. J., S. Babu, and K. Asenso-Okyere. 2010. Review of agricultural extension in India: Are farmers' information needs being met? IFPRI Discussion Paper 01048. Washington, D.C.: International Food Policy Research Institute.

Gosset, L., and H. Neufeldt. 2012. Pro-poor biocarbon projects in eastern Africa: Economic and institutional lessons. Paper presented at the CAPRi/CCAFS workshop on Institutions for Inclusive Climate-Smart Agriculture, Nairobi, Kenya, September 10–13.

Grainger-Jones, E. 2011. Climate-smart smallholder agriculture: What's different? IFAD Occasional Paper No. 3. Rome: International Fund for Agricultural Development.

Hansen, J. W., S. J. Mason, L. Sun, and A. Tall. 2011. Review of seasonal climate forecasting for agriculture in sub-Saharan Africa. *Experimental Agriculture* 47 (2): 205–240.

Hellin, J. 2012. Agricultural extension, collective action and innovation systems: Lessons on network brokering from Peru and Mexico. *Journal of Agricultural Education and Extension* 18 (2): 141–159.

Hoang, L. A., J.-C. Castella, and P. Novosad. 2006. Social networks and information access: Implications for agricultural extension in a rice farming community in northern Vietnam. *Agriculture and Human Values* 23 (4): 513–527.

IFAD. 2011. *Weather index-based insurance in agricultural development: A technical guide*. Rome: International Fund for Agricultural Development.

Jodha, N. S., N. P. Singh, and C. S. Bantilan. 2012. The commons, communities and climate change. *Economic and Policy Weekly* 47 (13): 49–56.

Jones, L., and E. Boyd. 2011. Exploring social barriers to adaptation to climate change: Insights from the mid and far-western regions of Nepal. *Global Environmental Change* 21(4): 1262–1274.

Jones, L., S. Jaspars, S. Pavanello, E. Ludi, R. Slater, A. Arnall, and N. Grist. 2010. Responding to a changing climate: Exploring how disaster risk reduction, social protection and livelihoods approaches promote features of adaptive capacity. ODI Working Paper 319. London: Overseas Development Institute.

Kasperson, J. X., R. E. Kasperson, and B. L. Turner. 1995. *Regions at risk: Comparisons of threatened environments.* UK: United Nations University Press.

Kilelu, C. W., L. Klerkx, and C. Leeuwis, C. 2013. Unraveling the role of innovation platforms in supporting co-evolution of innovation: Contributions and tensions in a smallholder dairy development programme. *Agricultural Systems* 118: 65–77.

Kiptot, E., and S. Franzel. 2011. Gender and agroforestry in Africa: Are women participating? ICRAF Occasional Paper No. 13. Nairobi: World Agroforestry Centre.

Kiptot, E., S. Franzel, P. Hebinck, and P. Richards. 2006. Sharing seed and knowledge: Farmer to farmer dissemination of agroforestry technologies in western Kenya. *Agroforestry Systems* 68 (3): 167–179.

Klerkx, L., A. Hall, and C. Leeuwis. 2009. Strengthening agricultural innovation capacity: Are innovation brokers the answer? *International Journal of Agricultural Resources, Governance, and Ecology* 8 (5–6): 409–438.

Klerkx, L., M. Schut, C. Leeuwis, and C. Kilelu. 2012. Advances in knowledge brokering in the agricultural sector: Towards innovation system facilitation. *IDS Bulletin* 43 (5): 53–60.

Knox, A., R. Meinzen-Dick, P. Hazell. 2002. Property rights, collective action, and technologies for natural resource management: A conceptual framework. In *Innovation in natural resource management: The role of property rights and collective action in developing countries*, R.

Meinzen-Dick, A. Knox, F. Place, and B. Swallow, eds. Baltimore and London: Johns Hopkins University Press.

Kristjanson P., R. Reid, N. Dickson, W. C. Clark, D. Romney, R. Puskur, S. MacMillan, and D. Grace. 2009. Linking international agricultural research knowledge with action for sustainable development. *Proceedings of the National Academy of Sciences* 106(13): 5047-5052.

Lebel, L. 2013. Local knowledge and adaptation to climate change in natural resource-based societies of the Asia-Pacific. *Mitigation and Adaptation Strategies for Global Change* 18 (7): 1057–1076.

Leeuwis, C., and N. Aarts. 2011. Rethinking communication in innovation processes: Creating space for change in complex systems. *Journal of Agricultural Education and Extension* 17(1): 21–36.

Levine, S., E. Ludi, and L. Jones. 2011. Rethinking support for adaptive capacity to climate change: The role of development interventions. A report for the Africa Climate Change Resilience Alliance. London: Overseas Development Institute.

Ludi, E., M. Getnet, K. Wilson, K. Tesfaye, B. Shimelis, S. Levine, and L. Jones. 2011. Preparing for the future? Understanding the influence of development interventions on adaptive capacity at local level in Ethiopia. Africa Climate Change Resilience Alliance (ACCRA) Ethiopia Synthesis Report. London: Overseas Development Institute.

Magnan, N., D. M. Larson, and J. E. Taylor. 2012. Stuck on stubble? The non-market value of agricultural byproducts for diversified farmers in Morocco. *American Journal of Agricultural Economics* 94 (5): 1055–1069.

Markelova, H., R. Meinzen-Dick, J. Hellin, and S. Dohrn. 2009. Collective action for smallholder market access. *Food Policy* 34 (1): 1–7.

Matuschke, I. 2008. Evaluating the impact of social networks in rural innovation systems: An overview. IFPRI Discussion Paper 00816. Washington, D.C.: International Food Policy Research Institute.

McCarthy, N. 2003. Demand for rainfall-index based insurance: A case study from Morocco. EPTD Discussion Paper No. 106. Washington, D.C.: International Food Policy Research Institute.

McCarthy, N., C. Dutilly-Diane, B. Drabo, A. Kamara, J.-P. Vanderlinden. 2004. Managing resources in erratic environments: An analysis of pastoralist systems in Ethiopia, Niger, and Burkina Faso. Research Report 135. Washington, D.C.: International Food Policy Research Institute.

McCarthy, N., L. Lipper, and G. Branca. 2011. Climate-smart agriculture: Smallholder adoption and implications for climate change adaptation and mitigation. Mitigation of Climate Change in Agriculture Series No. 4. Rome: FAO.

McCarthy, N., B. Swallow, M. Kirk, and P. Hazell, eds. 2000. Property rights, risk, and livestock development in Africa. Washington, D.C.: International Food Policy Research Institute and International Livestock Research Institute.

Meinzen-Dick, R., A. Knox, F. Place, and B. Swallow, eds. 2002. Innovations in natural resource management: The role of property rights and collective action in developing countries. Baltimore: Johns Hopkins Press and International Food Policy Research Institute.

Meinzen-Dick, R., H. Markelova, and K. Moore. 2010. The role of collective action and property rights in climate change strategies. CAPRi Policy Brief 7. Washington, D.C.: International Food Policy Research Institute.

Meinzen-Dick, R., A. Quisumbing, J. Behrman, P. Biermayr-Jenzano, V. Wilde, M. Noordeloos, C. Ragasa, and N. Beintema. 2011. Engendering agricultural research, development, and extension. Washington, D.C.: International Food Policy Research Institute.

Mwangi, E., H. Markelova, and R. Meinzen-Dick, eds. 2012. *Collective action and property rights for poverty reduction: Insights from Africa and Asia*. Philadelphia: University of Pennsylvania Press.

Nabi, R., D. Datta, S. Chakrabarty, M. Begum, and N. J. Chaudhury. 1999. Consultation with the poor: Participatory poverty assessment in Bangladesh. Bangladesh: NGO Working Group on the World Bank.

Nelson, G. C., M. W. Rosegrant, A. Palazzo, I. Gray, C. Ingersoll, R. Robertson, S. Tokgoz, T. Zhu, T. B. Sulser, C. Ringler, S. Msangi, and L. You. 2010. *Food security, farming, and climate change to 2050: Scenarios, results, policy options.* Washington, D.C.: International Food Policy Research Institute.

Neufeldt, H., P. Kristjanson, T. Thorlakson, A. Gassner, M. Norton-Griffiths, F. Place, and K. Langford. 2011. ICRAF Policy Brief 12: Making climate-smart agriculture work for the poor. Nairobi, Kenya: World Agroforestry Centre.

Newsham, A. J., and D. S. G. Thomas. 2011. Knowing, farming and climate change adaptation in North-Central Namibia. *Global Environmental Change* 21(2): 761–770.

North, D. C. 1990. *Institutions, institutional change and economic performance.* Cambridge: Cambridge Univ. Press.

Orlove, B., C. Roncoli, M. Kabugo, and M. Abushen. 2010. Indigenous climate knowledge in southern Uganda: The multiple components of a dynamic regional system. *Climatic Change* 100 (2): 243–265.

Ostrom, E. 1999. Polycentricity, complexity, and the commons. *The Good Society* 9(2): 37–41.

Ostrom, E. 2009. A general framework for analyzing sustainability of social-ecological systems. *Science 325* (5939): 419–22.

Ostrom, E. 2010. Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change* 20 (4): 550–557.

Paavola, J. and W. N. Adger. 2002. Justice and adaptation to climate change. Tyndall Centre Working Paper No. 23. Norwich, UK: University of East Anglia School of Environmental Sciences.

Pfaff, A., K. Broad, and M. Glantz. 1999. Who benefits from climate forecasts? *Nature* 397: 645–6

Place, F. 1994. *The role of land and tree tenure on the adoption of agroforestry technologies: A summary and synthesis.* Madison, Wisconsin: University of Wisconsin Land Tenure Center.

Poncet, J., M. Kuper, and J. Chiche. 2010 Wandering off the paths of planned innovation: The role of formal and informal intermediaries in a large-scale irrigation scheme in Morocco. *Agricultural Systems* 103: 171–179.

Quisumbing, A. R., N. Kumar, and J. Behrman. 2011. Do shocks affect men's and women's assets differently? A review of literature and new evidence from Bangladesh and Uganda. IFPRI Discussion Paper 01113. Washington, D.C: International Food Policy Research Institute.

Quisumbing, A. R., S. McNiven, and M Godquin. 2012. Shocks, groups, and networks in Bukidnon, the Philippines. Chapter 4 in *Collective action and property rights for poverty reduction: Insights from Africa and Asia*, E. Mwangi, H. Markelova, and R. Meinzen-Dick, eds. Philadelphia: University of Pennsylvania Press.

Ribot, J. 2010. Vulnerability does not fall from the sky: Toward multiscale, pro-poor climate policy. In *Social dimensions of climate change: Equity and vulnerability in a warming world*, R. Mearns and A. Norton, eds. Washington, D.C.: World Bank.

Roncoli, C., C. Jost, P. Kirshen, M. Sanon, K. T. Ingram, M. Woodin, and L. Somé. 2008. From accessing to assessing forecasts: An end-to-end study of participatory climate forecast dissemination in Burkina Faso (West Africa). *Climatic Change* 92 (3–4): 433–460.

Roncoli, C., B. S. Orlove, M. R. Kabugo, and M. M. Waiswa. 2010a. Cultural styles of participation in farmers' discussions of seasonal climate forecasts in Uganda. *Agriculture and Human Values 28* (1): 123–138.

Roncoli, C., B. Okoba, V. Gathaara, J. Ngugi, and T. Nganga. 2010b. Adaptation to climate change for smallholder agriculture in Kenya: Community-based perspectives from five districts. Project

note from Adaptation of Smallholder Agriculture to Climate Change in Kenya Project. Washington, D.C.: International Food Policy Research Institute.

Scherr, S. J., S. Shames, and R. Friedman. 2012. From climate-smart agriculture to climate-smart landscapes. *Agriculture and Food Security* 1: 12.

Shames S., E. Wollenberg, L. E. Buck, P. Kristjanson, M. Masiga, and B. Biryahaho. 2012. Institutional innovations in African smallholder carbon projects. CCAFS Report no. 8. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

Siregar, P. R. 2010. Do farmers use climate forecast information to respond to climate variability? Lessons from Indramayu, Indonesia. In *Disaster risk reduction and climate change adaptation: Case studies from south and Southeast Asia*, N. J. Setiadi, J. Birkmann, and P. Buckle, eds. Bonn: United Nations University Institute for Environment and Human Security.

Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, and O. Sirotenko. 2007. Agriculture. In Climate change 2007: Mitigation. Contribution to Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, and L. A. Meyer, eds. Cambridge and New York: Cambridge University Press.

Spielman, D. J., K. Davis, M. Negash, and G. Ayele. 2010. Rural innovation systems and networks: Findings from a study of Ethiopian smallholders. *Agriculture and Human Values* 28 (2): 195–212.

Suarez, P., J. M. de Suarez, B. Koelle, and M. Boykoff. 2014. Serious fun: Scaling up community based adaptation through experiential learning. Chapter 9 in *Community-based adaptation to climate change: Scaling it up*, E. L. F. Schipper, J. Ayers, H. Reid, S. Huq, and A. Rahman, eds. London: Routledge.

Thomas, D. S. G., and C. Twyman. 2005. Equity and justice in climate change adaptation amongst natural-resource-dependent societies. *Global Environmental Change* 15 (2): 115–124.

Valbuena, D., O. Erenstein, S. Homann-Kee Tui, T. Abdoulaye, L. Clasessens, A. J. Duncan, and B. Gerard. 2012. Conservation agriculture in mixed crop-livestock systems: Scoping crop residue trade-offs in sub-Saharan Africa and South Asia. *Field Crops Research* 132: 175–184.

Vermeulen, S. J., P. K. Aggarwal, A. Ainslie, C. Angelone, B. M. Campbell, A. J. Challinor, J. W. Hansen, J. S. I. Ingram, A. Jarvis, P. Kristjanson, C. Lau, G. C. Nelson, P. K. Thornton, E. Wollenberg. 2012. Options for support to agriculture and food security under climate change. *Environmental Science & Policy* 15 (1): 136–144.

Warburton, H., R. Blake, S. Coupe, K. Pasteur, and E. Phillips. 2011. Bridging the gap between resource-poor farmers and extension services: The role of community-based extension systems. Presented at the International Conference on Innovations in Extension and Advisory Services, Nairobi, November 15–18.

Waters-Bayer, A., L. van Veldhuizen, C. Wettasinha, and M. Wongtschowski. 2004. Developing partnerships to promote local innovation. *The Journal of agricultural education and extension* 10(3): 143-150.

World Bank. 2011. Policy brief: Opportunities and challenges for climate-smart agriculture in Africa. Washington, D.C.: World Bank.

World Bank and IFPRI. 2010. Gender and governance in rural services: Insights from India, Ghana, and Ethiopia. Gender Governance Author Team. Washington D.C.: World Bank.

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