African Journal of Rural Development, Vol. 1(1): 2016: pp. 35 - 49

Date received: 10 December, 2015 Date accepted: 25 March, 2016

A critical review of the follow-the-innovation approach: Stakeholder collaboration and agricultural innovation development

K. AMANKWAH[1,3], A. SHTALTOVNA[2,3], G. KELBORO[3] and A.-K. HORNIDGE[4,3]
[1]Kwadaso College of Agriculture, Academy Post Office, PMB, Kwadaso, Kumasi, Ghana
[2]Centre for International Studies (CÉRIUM), University of Montreal, Canada
[3]Center for Development Research (ZEF), University of Bonn, Germany
[4] University of Bremen & Leibniz-Center for Tropical Marine Ecology, Bremen, Germany
Corresponding author: kojo116@yahoo.com

ABSTRACT

Technological innovations have driven economic development and improvement in living conditions throughout history. However, the majority of smallholder farmers in sub-Saharan Africa have seldom adopted or used science-based technological innovations. Consequently, several scholars have been persistently questioning the effectiveness of intervention models in smallholder agriculture. Following the agricultural innovation systems framework (AIS), this paper reviews a participatory framework known as the 'Follow the Innovation' (FTI) approach, which was developed in the research project 'Economic and Ecological Restructuring of Land and Water Use in Khorezm' (2001 - 2012) and employed in an ongoing BiomassWeb project 'Improving food security in Africa through increased system productivity of biomass-based value webs' (2013 - 2018). The review shows a need for a broader definition of innovation as an outcome of collaborative or collegiate participation of multi-stakeholders processes requiring scientists, extensionists, local communities and other stakeholders to perform five key tasks jointly. Salient implications of this review are highlighted for transdisciplinary research (such as in the BiomassWeb project) aiming at agricultural innovation development in complex environments.

Key words: Coordination, dialogue, evaluation, innovations, monitoring, shared purpose, sub-Saharan Africa

RESUME

Les innovations technologiques ont entraîné le développement économique et l'amélioration des conditions de vie tout au long de l'histoire. Toutefois, la majorité des petits exploitants agricoles en Afrique subsaharienne ont rarement adopté ou utilisé les innovations technologiques fondées sur la science. Par conséquent, plusieurs universitaires ont constamment remis en question l'efficacité de modèles d'intervention dans l'agriculture paysanne. À la suite du cadre des systèmes d'innovation agronomique (AIS), cet article examine un cadre participatif, connu sous le nom d'approche "suivre l'innovation" (FTI), qui a été élaboré dans le projet de recherche "restructuration économique et écologique de l'utilisation des terres et des eaux de Khorezm" (2001 - 2012) et affecté à un projet BiomassWeb continu "Améliorer la sécurité alimentaire en Afrique grâce à l'accroissement de la productivité du système de valeur fondés sur la biomasse webs" (2013 - 2018). L'examen montre la nécessité d'une définition plus large de l'innovation comme le résultat du processus de collaboration ou de participation collégiale de multiples intervenants requérant scientifiques, vulgarisateurs, collectivités locales et autres intervenants pour effectuer cinq principales tâches conjointement. Les implications saillantes de cette revue sont mises en évidence pour la recherche transdisciplinaire (comme dans le projet BiomassWeb) visant à l'innovation agricole dans des environnements complexes de développement.

Mots clés : Coordination, dialogue, évaluation, innovations, surveillance, but partagé, Afrique sub-saharienne

INTRODUCTION

Innovations, mainly in the form of technological changes, have been the driving forces behind economic development and increases in human productivity throughout history (Ness, 1970; Röling, 2009). However, the majority of smallholder farmers in sub-

Saharan Africa, characterised by complex and often rain-fed agricultural environments, have rarely adopted or used technologies in spite of substantial research and development interventions (Röling, 2009). For example, the application of synthetic pesticides is the dominant control method of capsid insects (Hemiptera: Miridae) in cocoa recommended by the Cocoa Research Institute of Ghana (CRIG). Nationwide surveys showed extremely low adoption rates (between 0.4-1% and 3.5%) by farmers for the recommendation (Ayenor, 2006; Ayenor *et al*., 2007; Röling *et al.,* 2007). Similarly, after 70 years of research on fodder technology development across sub-Saharan Africa, there has been very little uptake and implementation of the recommendations (Sumberg, 2002). These examples of mostly low rates of technological changes in smallholder agriculture have raised issues about science-for-impact pathways.

Consequently, several scholars have been persistent in calling for a critical review of intervention models in smallholder agriculture (Chambers and Jiggins, 1986; Douthwaite *et al*., 2001; Röling, 2002; Douthwaite *et al*., 2009; Röling, 2009; Jiggins, 2012). The issues raised include the realisation that research organisations are not the only source of innovation - as portrayed in the linear model (Chambers and Jiggins, 1986) - that smallholders are rational and implement technologies which are useful to them (Douthwaite *et al*., 2001; Douthwaite *et al*., 2009) and that differences in opportunities account mainly for the persistence of low productivity by smallholder farmers (Röling, 2002; Röling, 2009; Jiggins, 2012). Following the agricultural innovation systems framework, this paper reviews the 'Follow the Innovation' (FTI) approach which has been employed recently in smallholder farming systems in Uzbekistan (Hornidge *et al*., 2011).

Based on the experience of joint innovation implementation in Uzbekistan, the FTI framework was developed further and is currently applied to improve food security through biomass production and utilisation in Ghana, Nigeria and Ethiopia under the research project 'BiomassWeb' (from 2013 to 2018). This review therefore aims at shedding light on how the FTI process can be adapted as a framework for a collaborative transdisciplinary and stakeholder dialogue process for innovation development in the BiomassWeb project and in future interventions. In the next section, the evolution of agricultural innovation is summarised, and this is followed by an overview of the background of the FTI, after which an analysis of how the FTI is applied in Uzbekistan (Hornidge *et al.,* 2011) and its application in the BiomassWeb project is presented. Finally, we reflect on the FTI process within the context of recent literature on innovation and then conclude.

Evolution of agricultural innovation

Over the years, five main conceptual frameworks have been employed to study and organise agricultural innovation. From the 1960s through the 1980s, agricultural innovation was deemed a vital requirement as a result of the hunger and chronic under-nutrition of low-income, poverty-stricken people around the world, who lacked access to the food they needed for adequate sustenance (Benor and Baxter, 1984). The general response to low food production trends in Africa was that smallholder farmers needed access to science-based agricultural technology – very much in the same way as farmers in Asia and Latin America had received previously (Borlaug and Dowswell, 1995).

The conceptual framework that informed interventions was based on Rogers' (Rogers, 1995) notion that innovation is a new technology that is developed by research scientists, transmitted by extension organisations and then adopted by farmers. This framework, which is known as "transfer of technology" (ToT), or the linear model, had been employed as an organising principle for interventions for several years; for instance, it informed the training and visit (T & V) system of extension implemented in the 1970s and 1980s in countries experiencing the Green Revolution in Southeast Asia and Latin America, as well as most sub-Saharan African countries, where the approach did not work (Benor and Baxter, 1984; Röling, 2009).

The main instructional approach at the farmer level boiled down to field testing and demonstrating new technology that would help in increasing major crop yields (Borlaug and Dowswell, 1995). Learning was defined as an adoption process whereby farmers would encounter an external innovation, then gain additional knowledge and finally decide to adopt or reject the innovation (Rogers 1995; Röling and Jiggins, 1998). Monitoring and evaluation focused on a number of adopters or farmers 'following all, or part, of the newly recommended practices on at least part of their fields'(Benor and Baxter, 1984). The ToT model has been widely discredited after years of failure in rain-fed conditions in SSA in particular, yet most policymakers, researchers, extension organisation managers and field staff have minds set in technology transfer and continue to stick to using it (Rivera and Sulaiman, 2009; Röling, 2009; Chambers, 2015; World Development Report, 2015).

The farming systems development (FSD) approach emerged in the 1970s and 1980s in response to reports that available technology did not fit the needs and interests of local or rural people (Axinn, 1988). There has been a lack of success in developing relevant technologies in SSA, principally because climatic conditions are often not favourable (i.e. too much or too little rainfall and limited amounts of irrigation), soils are generally poor, the production environment is very heterogeneous and poor, input and output markets are inadequately developed and the farmers themselves are resource-poor (Norman *et al*., 1995). The FSD aimed at providing technology tailored to meet the needs and interests of local farming system conditions, by understanding farms as a system. This required taking into account all the components of the farming system, including plants, animals and people, as well as soil type, climate, topography, labour organisation, land tenure arrangements, access to markets, price policies, - and any other relevant factors. In practice, interdisciplinary research teams visited the farms, listened to farming men and women and collaborated with them, and then, together with extensionists, tried to understand these farms as a system. Teaching and learning activities included analysis and field trials in the farmers' fields and homes, and monitoring and evaluation focused on measuring the extent to which the farmers adopted and continued to use the technologies they helped to develop in the programme. A central critique was the high cost incurred in funding the interdisciplinary team of researchers (Axinn, 1988).

Similar to the FSD approach, participatory research methods emerged in the 1980s in opposition to the dominant transfer of the technology framework (Chambers *et al*., 1989). Little or no involvement of local people in rural development programmes was highlighted as a major limitation in interventions based on the ToT model, and it was recognised that scientists alone cannot generate technologies that are site-specific for a range of diverse conditions in poor countries and the world at large. In response, participatory approaches proliferated methods of analysis (e.g. participatory rural appraisal techniques) that would enhance an understanding of the local situation through farmers' maximum participation, increased awareness and self-confidence in improving their own situation (van Veldhuizen *et al*., 1997). The participatory research methods established that innovation could derive from multiple sources (including farmers) (Röling, 2009). Studies on indigenous agricultural change in West Africa, for example, showed that smallholders actively and continuously experimented with and managed their local environment, before making changes based on thorough analysis (Richards 1985; Richards, 1994). Moreover, the agendas and resources of different stakeholders shaped the innovation process as well as the relevance of the new technologies developed (Chambers and Jiggins, 1986; Leeuwis, 2004). These, among other studies, backed the claim that farmers had substantial indigenous knowledge that could be built upon through interactive and iterative experiential learning circles, along with extension workers and researchers, to yield appropriate technologies.

The methodologies employed to organise the majority of participatory interventions (including follow-the-technology) were based on experiential and/or discovery learning principles. Kolb's (1984) experiential learning cycle, which informed most of the participatory methods, comprises: (1) experience, (2) making sense and drawing conclusions, (3) planning for implementation, and (4) taking action which begins another iterative learning process (Kolb, 1984). In practice, the participatory interventions entailed group activities looking at problem diagnosis, planning, experimentation and evaluation (van Veldhuizen *et al*., 1997). Similarly, discovery learning implied engaging groups of people in experimentation, observation and measurement, among others, to allow the participants to draw their own conclusions (Röling and Jiggins, 1998).

The meaning of participation has often been taken for granted in many interventions. In this regard, (Biggs, 1989) differentiates a continuum of four levels of participation in research: 1) contractual (farmers are contracted for money, but they have no influence on the research process), 2) consultative (researchers interact with stakeholders to identify issues, but then they solve them alone: "I solved it for you"), 3) collaborative (researchers work together with stakeholders as equal partners in all stages of the research process), and 4) collegiate, researchers support stakeholders to take the lead in research, with the researchers becoming colleagues. In agriculture this would mean farmer-led research. The levels of participation raise the issue of how much freedom stakeholders have and how much control researchers maintain in any intervention. Participation tends to be defined normatively in projects, in order to reflect on the collegiate idea (van Veldhuizen, 2014).

Participatory monitoring and evaluation (PM&E) was employed to give farmers the main role of monitoring and evaluating their own activities, while impact assessment examined the extent to which participatory methods strengthen farmers' self-management in technology development and diffusion (van Veldhuizen *et al*., 1997). One of the important critiques of participatory methods and techniques is that the promotion of technological innovations persisted as the main role of R&D in interventions (Rivera and Sulaiman, 2009). Additionally, the participatory methods were organised as learning processes and were not responsive to differences in background and interests or in disagreements and conflicts that might emerge between stakeholders whenever any meaningful change was attempted (Leeuwis, 2004). It has also been argued that participation has become a buzzword in the development discourse and that the rhetoric of participation differs from the reality in many interventions (Okali *et al*., 1994).

There was increasing recognition in the 1990s that transforming conventional agriculture required facilitating collective or social learning in complex interlinked networks of interdependent actors. However, many conventionally trained researchers and extensionists lacked the competencies for facilitating decision making among multi-stakeholders, stimulating group learning processes, fostering discussion, engaging in exercises and creating learning experiences, among others (Röling, 1994; Röling and Jiggins, 1998). In response, the Agricultural Knowledge and Information Systems (AKIS) framework and the Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) methodology were proposed, to help coordinate diverse actors such as scientists, extension agents and farmers in order to help them understand their common purpose and benefit from mutually articulated activity (Röling, 1994). It was posited that when actors come to see themselves as an articulated whole and become interdependent, they can then be regarded as being part of a system with emergent properties. This means that knowledge management (for agricultural innovation development, for example) entails four main tasks: 1) elaborating shared goals, 2) agreeing on boundaries, 3) making feedback indicators visible and 4) sharing learning about bottlenecks and likely successful courses of action (Röling 1994, Röling and Jiggins, 1998).

Based on both empirical and theoretical works, the AKIS researchers posited that innovation development could not be achieved at the farm level only but required creating conditions at the higher than farm level for collective action and coordination based on shared perspectives and negotiated agreements. Innovation development was appraised to require learning groups, whereby concepts, norms and acceptable behaviours would be established by the collective. This meant that an important requirement was the facilitation of the group process; therefore, scientists and extensionists were expected to create learning experiences which would enable farmers to draw their own conclusions (Röling and Jiggins, 1998). PM&E focused on the process of decision making and how multiple stakeholders come to realise that they are part of a 'soft system' (Röling, 1994). Recently, critics have pointed out that the AKIS framework unduly focused on the three principal stakeholder groups in agriculture, i.e. researchers, agricultural educationists and extensionists and farmers, and institutions were not problematized or adequately addressed in the AKIS framework (Hall *et al*., 2006).

Since the early 2000s, there has been increasing application of the AIS framework in agriculture. Under the AIS framework, salient problems are grounded in higher than farm-level organisational, institutional and policy environments. Recent studies of agricultural innovation, particularly in West and East Africa indicate that innovation goes beyond adopting new technologies to include alternative ways of organising, for example, markets, labour, land tenure and the distribution of benefits (Hounkonnou *et al*., 2012; Klerkx *et al*., 2012; Kilelu *et al*., 2014) . These studies point to the simultaneous evolution of different parts of production systems and of the institutional environment in which they are embedded (such as the value chain, the market, the policy environment), in order to enable innovation, which requires interactions among multiple actors (Hall *et al*., 2006, Geels and Schot, 2007; Ochieng, 2007). The key components of the AIS framework are the interactions of different actors, the institutions (the rules and principles) that regulate individual and organisational actors and an evolving learning agenda which is responsive to new social arrangements and specific local contexts (Rivera and Sulaiman, 2009). Similarly, Klerkx *et al.* (2012) describe the essence of the AIS framework as involving multiple stakeholder interactions and structures (infrastructures, policies, institutions) that may enhance innovations through the coordination of innovation systems.

In an AIS framework, the role of R&D goes beyond agricultural production to help rural producers organise, link to markets, play a brokering role with diverse service providers and organise actors to advocate for change in constraining institutions (Rivera and Sulaiman, 2009). Three main functions that are needed for building networks and partnerships for innovation development have been identified (Klerkx *et al*., 2012): 1) demand articulation: by means of problem diagnosis and foresight exercises, articulate innovation needs and visions and the requisite demands with respect to technology, knowledge, funding and policy, 2) network composition: facilitate linkages between relevant actors by, for example, scanning, scoping, filtering and matchmaking potential cooperation partners, and 3) innovation process management: enhance alignment in heterogeneous networks composed of stakeholders with differences in frames of reference, for example in norms, values, incentives and reward systems. A number of facilitation tasks required in innovation process management include building of trust, establishing working procedures, fostering learning, managing conflict and intellectual property management (Klerkx *et al*., 2012). Changes in the patterns of interaction or linkages in AIS are the main focus of PM&E (Odame, 2014).

The previous section provides a number of pertinent patterns in the evolution of agricultural innovation. The 'solution' to the problem of low agricultural production has shifted from the need to provide 'science-based technology' to ensuring opportunities in relation to reconfiguring organisational and institutional settings (Röling, 2009; Amankwah *et al.*, 2012). Understanding innovation as a new idea has given way to the consensus that it is an outcome of the collaborative or collegiate participation of multi-stakeholders in planning and implementation processes, thereby generating and combining scientific and local perspectives which change over time and in space, changing the pattern of interaction, as well as the reconfiguration or adaptation of embedded informal and formal institutions. Frameworks for the study and practice of agricultural innovation have changed from a linear research-extension-farmer continuum model to a model of coordinating multi-stakeholder interactions and structures (Leeuwis, 2004; Klerkx *et al.*, 2012). The role of R&D has shifted from an emphasis on agricultural production to forging linkages between farmers and a broad spectrum of individual and organisational actors, including marketers, service providers and policymakers (Rivera and Sulaiman, 2009). This new role of R&D, namely stakeholder engagement and coordination, is deemed a crucial part of innovation development. Consequently, increasing numbers of research organisations have appropriated this new role in their intervention efforts (Klerkx *et al.*, 2012). Furthermore, monitoring and evaluation have shifted away from an emphasis on adopting innovation packages by farmers, to changes in patterns of linkages among multiple stakeholders. In the next section, we employ previously discussed patterns in agricultural innovation development to examine the case of the follow-the-technology (FTT) approach, and its adaptation as a transdisciplinary, follow-the-innovation model that was employed in an intervention in Uzbekistan and underpins the ongoing BiomassWeb project.

Follow-the-technology and follow-the-innovation approaches

The earlier sections showed that participatory research methods were developed in response to shortcomings in the ToT framework. The follow-the-technology (FTT) approach, developed by Douthwaite *et al.*, 2001), was one of the participatory frameworks. The FTT was articulated in response to the evidence that the prevailing models for development and provision of high-yielding varieties were found inadequate for enhancing adoption of technologies by smallholders. The FTT aimed to integrate knowledge and interests across disciplines and provide a common working framework for both technical ("hard") and social ("soft") scientists in engaging with societal stakeholders in order to improve uptake of technologies. It assumes a learning selection (LS) process for bringing technologies into practice. The main proposition of the LS process is that a new technology (released by research organisations) is a "plausible promise" which diverse stakeholders experiment with in iterative experiential learning cycles entailing novel forms of generation, selection and promulgation. The key terms employed in the FTT and LS approaches are explained as follows. According to Douthwaite *et al.* (2001), a 'plausible promise' convinces potential stakeholders that the new technology can evolve into a tool or process that they really want. Thus, a new technology or an "invention" serves as an entry point into a complex situation to mobilise the innovative potential of local people, which is necessary to scale up from pilot projects into widespread use. The term "technology" refers to the application of knowledge for practical purposes, and it has two components, namely a hardware aspect, or tools in the form of material or physical objects, and a software aspect, or information on how the tool is used.

The FTT approach is organised as an LS process with four elements: 1) creating awareness of opportunities, 2) deciding to try out options, 3) learning, adaptation and selecting and 4) sustaining and/or promulgating selections (Douthwaite, Beaulieu et al. 2009). The supporting empirical works include soil fertility improvement interventions using leguminous cover plant (for example a plant called '*Mucuna pruriens*') in Benin, wind turbine development in Finland, Linux operating system development and the introduction of a mechanical rice harvester in the Philippines in 1983 (Douthwaite *et al.*, 2002). Elements in the LS also serve as indicators for PM&E (Douthwaite *et al.*, 2009).

Follow-the-innovation (FTI) approach in the ZEF-UNESCO project

The FTT approach was adapted as an FTI process in a recent intervention, namely the ZEF-UNESCO project 'Economic and Ecological Restructuring of Land and Water Use in the Khorezm Region (Uzbekistan).' Compared to the FTT, the FTI approach includes both technical and institutional innovations in its problem statement (Hornidge *et al.*, 2011). Institutions refer to rules or standards that induce conformity as well as changes, and innovation is defined as the use of new ideas, new technologies or new ways of doing things by significant numbers of people who have not used it before (Hornidge *et al.*, 2011). The problem statement deals with how the low adoption of many innovative ideas and technologies generated through research is related to the failure of most of the technologies to address real-life complexities faced by farmers. The key proposition of the FTI approach is that the interaction and adaptation of 'innovation packages' or 'plausible promises' in real-life settings are crucial factors that influence adoption (Ul-Hassan *et al.*, 2011). The FTI conceptual framework, or the detailed sequence of steps in implementing FTI, has been outlined by Ul-Hassan *et al.* (2011):

I) Initiation
   a. Choosing promising innovations
   b. Transdisciplinary team formation and team building
   c. Team planning

II) Joint experimentation and learning
   a. Stakeholder analysis and initial selection
   b. Systematic stakeholder engagement towards agreeing to collaborate
   c. Putting the planned steps and strategies into action, following agreed roles and responsibilities

III) Follow-up
   a. Strategic communication and communication of key findings on innovations and the FTI process
   b. Creating favourable conditions for the continued use of the innovation and FTI

At the initiation phase of the FTI intervention in 2008, a full-time facilitator and external consultant, both experienced in participatory and transdisciplinary research approaches, were engaged. The facilitator guided the whole FTI process. The consultant was tasked with organising a series of five training workshops and two review meetings aimed at developing capacities of the project's scientific staff. Topics included team building events, communication skills, and group facilitation. An average of 20 scientific staff attended each workshop.

In addition to the scientific staff, three stakeholders attended the first review meeting, and seven stakeholders attended the second meeting. During the second training workshop, seventeen innovations were suggested out of which five were selected by the participants as plausible promises or potential innovations: 1) conservation agriculture (CA) for irrigated areas; 2) strengthening water user associations through a social mobilization strategy (WUA); 3) express salinity assessment with the mapping tool EM38 (SA); 4) flexible irrigation scheduling (FIS); and 5) afforestation of marginal farmlands (AF). The participants formed four interdisciplinary teams around the selected innovations. Since soil salinity is closely related to the issue of water availability, SA and FIS were combined and addressed by one team (Hornidge and Ul Hassan, 2010). The selected plausible promises formed the basis of the empirical scientific work of PhD candidates (Ul-Hassan *et al.*, 2011).

In the joint experimentation and learning phase, the interdisciplinary teams were linked with the stakeholders to constitute transdisciplinary teams. The linkages that were established made it possible to test and adapt/adjust potential innovations in real-life local community settings. Farmers constituted the primary stakeholders in three of the four teams (WUA, CA, and AF), but higher level salinity mapping organizations were identified as partners of the fourth team (SA). The teams held several rounds of discussion with the farmers about joint experimentation, division of responsibilities and roles. The farmers expressed their interests or concerns over the course of discussions. For example, the WUA farmers were interested in a broader approach of strengthening WAU, undertaking minor refurbishment of the WAU office, provision of bicycles to enhance mobility of the water supervisors, and procurement of computer and printer for record keeping. The project obliged to these requests, and in turn, the farmers took responsibility for a number of activities including to undertake social mobilisation exercises and routine operation and maintenance tasks. Similarly, the AF farmers were concerned about obtaining permission to grow trees on lands which was actually saline but had been designated as productive by the state. The project approached the state officials and sought for and obtained the requisite permission (Hornidge and Ul Hassan, 2010).

The joint effort to try out potential innovations under field conditions pertinent to the stakeholders was the main driving force of the FTI process. However, the joint experimentations provided limited opportunities for adaptation in accordance with farmers' needs. As an illustration, the CA farmers compared conventional agronomic practices with experimental plots using CA practices. In this case, crop residue management was striking. The farmers were used to planting wheat on cotton fields; therefore, they did not see any difference between their practice and the researchers' suggestions. In another case, the SA team tested the EM 38 equipment and conventional methods at 20 locations at the research station (SANIIRI). After analysing the data, the SANIIRI experts were cautious in accepting the EM38 as valid tool for rapid assessment of salinity over average soils. They noted that further calibration for sandy soils was needed and proposed to do further tests at other locations (Hornidge and Ul Hassan, 2010; Hornidge *et al.*, 2011). After reviewing all four joint experiments, Hornidge and Ul Hassan (2010) surmised that efforts were made to some degree to incorporate the points of view of the farmers in the innovations.

However, the 'participatory innovation adaptation' that was aimed at turned out to be 'participatory innovation validation.'

In the follow-up phase, each team implemented its monitoring system. For example, the WUA submitted a brief monthly progress report to the project partners, and collected data on water availability, distribution and use and provided these to the WUA members. Both the CA and SA teams employed scientific evaluation by identifying and assessing indicators of technical parameters. The AF's monitoring system involved monthly visits by one team member to monitor activities and discuss observations with the farmers (Hornidge and Ul Hassan 2010). The follow-up activities also included efforts to create a conducive and wider environment for government policies, regulations and other factors to support the continued use of innovations and rolling out of the FTI process and the promising innovations that were found to work for the stakeholders in real-life conditions (Hornidge *et al.*, 2011, Ul-Hassan *et al.*, 2011). The main challenges encountered in the four FTI processes have been categorised as 1) knowledge creation and dissemination in rural Uzbekistan, 2) administrative challenges, 3) scientists' versus farmers knowledge, 4) team composition, and 5) contested transdisciplinary cooperation (Hornidge *et al.*, 2011).

Follow-the-innovation (FTI) approach in the BiomassWeb project

The lessons learned and experiences made by implementing the FTI-process in Uzbekistan informs the ongoing BiomassWeb project. The BiomassWeb project[1], a joint African-German transdisciplinary project, started in 2013 with the aim of enhancing innovations in biomass-based value webs of cassava, maize, banana, plantain and ensete, as well as biomass derived from natural vegetation and agroforestry systems in Ghana, Nigeria and Ethiopia. BiomassWeb employs a 'web perspective' and is used as a multi-dimensional methodology to identify and quantify potential opportunities to extract or create value. Within the web, each player adds value and exerts specific leverage with respect to product development or market share. The objective of BiomassWeb is 1) to cooperate systematically with biomass web decision-makers on "plausible promises" developed in the project, with the aim of developing the biomass webs further. As part of this transdisciplinary research on 'plausible promises', 2) the institutional spaces for innovation development and adaptation in the value webs will be identified, reflected on and strengthened in a series of capacity development events for innovation-based change adaptation (Hornidge, 2013).

In practical terms, what is researched in the BiomassWeb project is decided through systematic joint cooperations with local stakeholders, i.e. farmers, manufacturers and traders as well as regional, national and international decision makers and researchers. In so doing, the project creates a network of stakeholders and partners that facilitates research and learning that not only generates new knowledge, products or technologies, but also promotes the use of research outputs. In this way, the project will ensure that the research is developed together with stakeholders from the very beginning until the end of the project. Such a multi-stakeholder process is expected to build capacities in the innovation support system by developing an institutional network that can continue to function after the duration of research projects. From this observation, BiomassWeb aims to contribute to the strengthening of biomass-based value webs in Sub-Saharan Africa (SSA) by increasing their local adaptability and productivity jointly with local stakeholders in systematically fostered, collaborative, transdisciplinary and stakeholder dialogue processes in relation to innovation development.

Reflections

In this section, we reflect on five key tasks in the innovation development process: 1) create a collaborative transdisciplinary and stakeholder dialogue group (or innovation platform) for innovation development and orient group members in participatory and stakeholder engagement principles, 2) undertake broad system diagnosis, to understand opportunities and challenges as well as stakeholders' claims or points of view and their underlying reasons, 3) identify a shared purpose and accommodate points of view through dialogue and deliberations between relevant stakeholders, 4) develop joint technical and non-technical solutions, by understanding the interconnected nature of the whole system, and by creating and maintaining linkages or networks to address problems identified and prioritised through stakeholder interaction processes, and 5) guide the participatory monitoring and evaluation of stakeholders' practices and processes in terms of responsiveness. Each of the key tasks is illustrated with real stories from the SSA region, and then we conclude by suggesting that the FTI process can be adapted as a framework for collaborative transdisciplinary and stakeholder dialogue processes in relation to innovation development.

1) Create a collaborative transdisciplinary and stakeholder dialogue group (or innovation platform) for innovation development and orient group members in participatory and stakeholder engagement principles

Many interventions that have been designed and implemented within the agricultural innovation systems framework have created innovation platforms (IPs) either at the beginning or in the course of the project. An IP defines a needs-based network that brings together stakeholders from different interest groups, sectors and organisations to collaborate in solving common problems. IPs aim at providing space for dialogue on joint actions: the joint identification of issues and interventions; improving linkages between actors, increasing community participation in planning processes and co-designing interventions aimed at improving local livelihoods and environmental conditions and meeting the needs of different stakeholders. IPs are created by means of stakeholder analysis to identify key actors, relationships between actors and their areas of influence (Adjei-Nsiah *et al.*, 2014, Cullen *et al.*, 2014).

As a forum for multi-stakeholder interactions, IPs are characterised by a number of dynamics. Perhaps the most salient relates to power dynamics, as illustrated in the Nile Basin Development Challenge (NBDC) project which aimed at improving the resilience of rural livelihoods in the Ethiopian highlands through a landscape approach to natural resource management (NRM). The stakeholders included district administrators, experts from the Bureau of Agriculture, extension agents, researchers from national research institutes, staff from local universities, NGO representatives and community leaders (Cullen *et al.*, 2014).

In all three NBDC platforms that were formed, the following were observed: i) a lack of common understanding about NRM issues between platform members, leading to competing agendas and conflicting ideas about potential solutions; ii) problems in ensuring adequate community representation within platforms, particularly how to ensure that community members were not dominated by more powerful actors; and iii) a need for systematic facilitation to address power imbalances within the innovation system and to work with actors to change these dynamics' (Cullen *et al.*, 2014). The preceding experiences led Cullen *et al.* (2014) to conclude that 'platforms give the illusion of participation, and may replicate and reinforce existing dynamics rather than enable innovative solutions.' Hence, they suggest the need to acknowledge and address power dynamics within IP processes; otherwise, it may affect the priority given to issues, the selection of entry points and the design and adoption of interventions.

2) Undertake broad system diagnosis to understand opportunities and challenges as well as stakeholders' claims or points of view and their underlying reasons

This review indicates that another essential task in an intervention aiming at innovation development relates to examining opportunities and challenges and understand multi-stakeholders' claims or points of view and their underlying reasons, which are often based on their experiences and interactions in real-life settings. In other words, it is of primary importance to listen to and understand the claims or arguments of multiple stakeholders, because all people – whether scientists or farmers – want to be validated (Winfrey, 2003). The stakeholders or people involved in an intervention are intentional sense-makers; thus, stakeholders' reasons for their practices are most useful for understanding their behaviour as humans. In this respect, an intervention forging innovation development contrasts with conventional research, which aims at finding the causes of problems (Röling and Jiggins, 1998). Examining the reasons behind the prevailing practices of stakeholders often leads to exploring the underlying institutional, social, cultural, economic and political factors which define opportunities and challenges for these multi-stakeholders (Leeuwis, 2004).

Recent innovation studies show that agricultural problems are complex, i.e. they are multi-dimensional in the sense that technical and non-technical aspects (such as social, political and institutional factors) are interlinked (Amankwah *et al.*, 2012, Schut *et al.*, 2015). For example, in an intervention to promote agroforestry and to improve soil fertility in the Forest Transition Zone of Ghana (a technical problem), migrant farmers assessed the technology favourably, but they were reluctant to adopt the practice due to concerns about land tenure arrangements (Adjei-Nsiah *et al.*, 2008). Similar observations have been made about how concerns about institutional arrangements limit the adoption of technically proven soil fertility improvement practices in Benin (Hounkonnou *et al.*, 2012) and fodder technologies in livestock production in West Africa over the past 70 years (Sumberg, 2002). Studies under the Convergence of Sciences project in West Africa over the past 10 years have provided ample grounds for interventions to seek to understand and address joint technical and non-technical constraints simultaneously (Röling, 2009; Hounkonnou *et al.*, 2012).

Recent projects using the AIS framework have conducted broad system diagnoses using several methods. For example, the Forum for Agricultural Research in Africa (FARA) conducted a broad system diagnosis as part of the sub-Saharan Africa Challenge Programme (SSA CP) in the Lake Kivu Pilot Learning Site (LKPLS) located alongside the boundaries of north-western Rwanda, the Kivu region of the Democratic Republic of Congo (DRC) and south-western Uganda. The SSA CP identified challenges and constraints affecting productivity and profitability, in order to understand research and development possibilities in the LKPLS. Detailed information was obtained from literature reviews, secondary data, key informant interviews, focus group discussions, case studies, market chain analyses, institutional capacity assessments, spatial analyses and expert information (Adekunle *et al*., 2013).

A number of books outline both quantitative and qualitative procedures for examining the reasons stakeholders attribute to their actions and inactions (Foddy, 1995; Ritchie and Lewis, 2003). The principle of finding out respondents' (or stakeholders') points of view and their underlying reasons is well-ingrained in the literature on survey research (Foddy, 1995). Asking for reasons also drives research towards collaborative innovation development. Schut *et al.* (2015), for instance, outlined methods and tools for examining the interactions and structural reasons hindering innovation development, while Leeuwis (2004) and Leeuwis and Aarts (2011) described a model of basic variables that explained or gave reasons for farmers' practices and responses to proposed alternatives.

With regard to the FTI process in Uzbekistan, "probing for reasons" was problematic, largely due to the single disciplinary orientations of the PhD candidates, which limited to a great extent interaction with other disciplines and stakeholders. The way in which the FTI process was structured and implemented in Uzbekistan meant that scientists played a greater role in diagnosing problems and selecting the so-called "plausible promise" before engaging other groups of stakeholders or representatives of the eventual users of the innovation. This unequal role is likely to be counterproductive; for example, in the ZEF-UNESCO project, farmers opted to implement laser levelling out of a number of elements employed in more conventional agricultural practices (Hornidge *et al*., 2011). Furthermore, several studies show that farmers cherry-pick those elements in an intervention which they find useful (Long, 1992; Douthwaite *et al*., 2001; Douthwaite *et al*., 2009). If scientists and extensionists are not sensitive to this selection process but instead stick to a predetermined agenda and do not involve all the relevant groups of stakeholders or their representatives from the conception phase of intervention, it may lead to ineffective results (PMBOK, 2008; Amankwah, 2013). Besides, participatory models and interventions have shown that the minimum amount of collaborative participation by relevant stakeholders, from the outset of interventions, is a requisite for enhancing their sense of ownership of the process and any outcomes (van Veldhuizen *et al*., 1997; Figueroa *et al*., 2002). Thus, the key to improving the effectiveness of interventions or projects is the collaborative or collegiate participation of relevant stakeholders from the conception phase. This suggestion supports work which advocates for building interventions on broad system diagnostics (Jiggins, 2012) and value web analysis (Virchow *et al*., 2014), and then building these skills with scientists and extensionists despite the higher cost and time requirements this may involve for projects.

3) Identify a shared purpose and accommodate points of view through dialogue and deliberations among relevant stakeholders

The third essential task in innovation development relates to helping relevant stakeholders to identify a shared purpose and to arrive at agreements about the way forward. This requires bringing stakeholders together in dialogue and to deliberate on complex agricultural problems of common concern. In this paper, dialogue is defined as a process of 'turn-taking (or talking to one another) in which each participant seeks to clarify what others believe and understand as well as one's own understanding and beliefs. The assumption behind dialogue is that all participants are willing to listen and change not just one of the parties' (Figueroa *et al*., 2002). The intention in dialogue is not to advocate, argue or convince each other, in order to reach a one-sided outcome; rather, the intention is to inquire, explore and to discover. Similarly, deliberation refers to talking together and reasoning by carefully weighing up the costs and consequences of options for taking action. Deliberations focus on trying out a range of promising options that factor in complexity, and thus they go beyond the simplistic choice of experts (Thomas, 2004). Furthermore, dialogue and deliberations aim at discovering answers that integrate the interests of all relevant stakeholder groups; in essence, they boil down to understanding and taking into account stakeholders' points of view and the underlying reasons for actions. However, the important functions of dialogue and deliberation are too often overlooked in interventions, due to a number of reasons such as scarce resources and unfamiliarity with the essence of and methodologies for promoting stakeholder involvement (Röling and Jiggins, 1998; Thomas, 2004).

Increasingly, the available evidence suggests that many well-resourced stakeholders tend to feel superior to their counterparts in IP settings (Cullen *et al*., 2014). For example, many scientists in the ZEF-UNESCO project held the viewpoint that 'their discipline offered "the best" solution to the environmental/economic issue at hand and that the context should change to fit the innovation, rather than the innovation to fit the context' (Hornidge *et al*., 2011). The scientists failed to appreciate that in multiple stakeholder teams, dialogue, consensus decisions or negotiated agreements work out better than technically correct or superior recommendations (Röling and Jiggins, 1998). Similarly, scientists elsewhere posited that bio-physical and socio-economic factors were constraining the adoption of fodder legume technologies in sub-Saharan Africa, but then Sumberg (2002) argued that contextual factors are fundamental system properties that should be incorporated into the design specification of innovations. The joint technical and institutional problems which are addressed in participatory interventions require a transdisciplinary approach, i.e. a concerted analysis of a number of disciplines in collaboration with societal stakeholders over time (Osei-Amponsah, 2013). Hence, collaborative or collegiate participation and transdisciplinary and stakeholder dialogue and deliberations as frames of reference for multi-stakeholders are crucial for the effectiveness of IPs and innovation development processes. This suggestion reflects on the shift from transmission and persuasive models to the convergence model that conceptualises communication as horizontal information sharing, mutual understanding and mutual agreement. It also supports the few participatory models and forms of democracy that are organised as dialogue and deliberation processes (Figueroa *et al.*, 2002; Leeuwis, 2004; Thomas, 2004).

4) Develop joint technical and non-technical solutions, by understanding the interconnected nature of the whole system and by creating and maintaining linkages or networks to address problems identified and prioritised through stakeholder interaction processes

IPs provide an avenue for the mutual understanding of the complexity of agricultural problems. For example, FARA operationalised its integrated agricultural research for development (IAR4D) framework through the successful establishment of IPs, which serve as multi-level and multi-stakeholder forums, allow participants to identify, understand and address complex challenges and emergent issues. The mutual learning that occurs becomes the basis for mobilising members to achieve an agreed vision. Thus, the IAR4D differentiates itself from the ToT model of conventional agriculture by engaging multi-stakeholder actors mainly from along the commodity value chains. Moreover, it relies on ongoing interactions between actors to identify, analyse and prioritise problems, as well as to find and implement solutions using feedback, reflection and lesson-learning mechanisms from different processes (Adekunle *et al.*, 2013). Another example of joint analysis is the case of a project that aimed at promoting conservation agriculture (CA) in Zambia. A report based on a joint analysis indicated that even in years of good rainfall, the majority of smallholder farmers were food-insecure. It went on to state that conventional cultivation practices were leading to declining productivity, increasing food insecurity, increasing poverty and serious environmental degradation, not only in Zambia but also in the region as a whole. The formation of national stakeholder platform enabled the sharing of experiences, which have since enabled district stakeholder groups including Government extension organisation and NGOs to interact (Adekunle *et al.*, 2012) .

Coordinating technical and non-technical changes, and creating and maintaining linkages or networks, is another essential task in innovation development interventions. Integrating scientific and local knowledge can be illustrated through a project in Kisii, Kenya, that aimed to establish a self-sustaining system of production, distribution and utilisation of tissue culture (TC) banana packages. It was recognised that farmers in Kisii had a vast amount of local knowledge in relation to growing various traditional banana varieties, but they nevertheless faced declining yields in their old banana orchards, due mainly to soil-borne pests such as banana weevils and burrowing nematodes. The farmers' needs were addressed by bringing together scientific and local knowledge, involving a wide range of actors with different roles and interests who learned to play a complementary role. In the course of deploying the TC banana technology to the farmers' fields, the project encountered challenges which could only be addressed through partnerships with both public and private sector actors. One of the results of the banana initiative was that the farmers formed the Banana Growers Association (BGA), which lobbied a bank to provide micro-credit. The credit facility then enabled the farmers to expand into dairy production (Odame, 2014).

Linking farmers to markets and other relevant service providers is arguably a significant aspect of innovation development. This was evident in the case study of a project in Zambia that was concerned about the role of conservation agriculture (CA) in increasing agricultural productivity and supporting the diversification to other crops, particularly legumes. To ensure commercial viability of CA, the project linked farmers with markets, reduced transport costs, and improved extension. The National Conservation Agriculture Association of Zambia (CAAZ) was recently formed to link stakeholders, and it supports the project's initiatives to scale-up CA further (Adekunle *et al.*, 2012). The preceding cases support the observation that innovation, as already explained, requires changes not only at the level of technology or farm practice, but also at the level of the surrounding organisations and institutions (Leeuwis, 2004; Rivera and Sulaiman, 2009; Klerkx *et al.*, 2012). The linkage tasks that characterise innovation development interventions go beyond strengthening linkages in the traditional research-extension-farmer continuum (Rivera and Sulaiman, 2009), in that it aims to enhance complementary practices or synergies between different groups of stakeholders (Röling, 1994; Röling, 2009).

5) Guide participatory monitoring and the evaluation of stakeholders' practices and processes for responsiveness

The last but by no means the least important task in innovation development relates to the participatory monitoring and evaluation (PM&E) of stakeholders' practices and processes in relation to responsiveness. Conventional monitoring and evaluation focuses on accountability, but PM&E's principal objective is about learning and improving programmes or projects (van Veldhuizen *et al*., 1997; Njuki *et al*., 2009). Also, in the context of innovation development, PM&E employs process documentation to provide detailed data about how intervention clearly works, and this strategy is useful as a basis for social mechanism explanation about how effect actually comes about (Befani, 2012). Various conceptualisations, such as reflexive monitoring and empowerment evaluation, show the shift in emphasis of PM&E. Reflexive monitoring means that the set of multiple stakeholders involved in any intervention have to develop new ways of acting simultaneously as the institutional context changes (Van Mierlo *et al*., 2010; Arkesteijn *et al*., 2015). Similarly, empowerment evaluation involves the application of evaluation concepts, techniques and findings to foster improvement and self-determination (Fetterman, 1994), and it is an approach that seeks to enhance the probability of achieving results through the use of practical tools for assessing, planning, implementing and evaluating programmes. In addition, it aims at "mainstreaming" evaluation as part of programme planning and implementation (Wandersman *et al*., 2005).

We shall now cite a case that illustrates empowerment evaluation in PM&E (Njuki *et al*., 2009). The Kenya Agricultural Research Institute (KARI) implemented a training project to build a cohort of over 100 scientists and extensionists in PM&E, most of whom regarded monitoring and evaluation as separate and marginalised activity meant to make them accountable and which was conducted only by outsiders and project managers. Therefore, the training comprised a cycle of workshops to broaden understanding of PM&E concepts, tools and practices, followed by fieldwork to collect evidence and data from stakeholders, and then a reflection on what was working – or not – based on the data collected. The cycles of learning, action and reflection prompted the realisation that achieving improvement required changes in the practices, procedures and behaviours of the individuals and their organisation. The cycles led to changes and adjustments to plans within existing projects. The experiences gained also led to the inclusion of PM&E in planning other new projects and in working with communities. The conclusion drawn was that shifting from monitoring and evaluation by outsiders and managers towards PM&E aimed at learning and improvement depends heavily on a long-term partnership-building process and intensive capacity-building for organisation staff to conduct the process and to integrate and mainstream it within the broader research programme (Njuki *et al*., 2009).

The PM&E system in the FTI process in Uzbekistan was not categorised in the available reports (i.e. as an empowerment evaluation, responsive evaluation, reflexive monitoring and so on). In designing the Uzbek PM&E system, the relevant stakeholder groups identified and agreed on indicators for the objectives they wanted to monitor. Process documentation forms for recording interactions were discussed and clarified, and responsibilities were assigned for recording and analysing accumulated data as well as for sharing any findings. The findings from the transdisciplinary teams form the basis to improve the approach. In the ongoing BiomassWeb project, process documentation on stakeholder interaction is filled out and submitted by PhD candidates on a bi-monthly basis. The research cluster responsible for collating the completed forms had not secured the cooperation of some of the PhD candidates. Since BiomassWeb is a research and development intervention, training PhD candidates on PM&E, and embedding the principles in the project, is likely to improve process documentation, feedback and data for causal mechanism explanations (Befani, 2012).

CONCLUSIONS

Based on critiques of the FTI approach discussed earlier, it is being developed further and adjusted to local African contexts, as part of the BiomassWeb project. The BiomassWeb project builds upon the FTI model, which posits that interactions between multi-stakeholders and innovation packages are necessary inputs into innovation development. The complexity and co-evolutionary nature of innovation processes call for moving beyond the FTI model.

This review has unpacked the general concept of interaction by identifying collaborative or collegiate participation and dialogue and deliberations as a fruitful frame of reference for multi-stakeholders who engage in interactions or IPs for innovation development. These attributes are the fundamentals of participatory development, but they have been taken for granted in contemporary agricultural innovation system frameworks. The case studies that were reviewed show that the tendency of some stakeholders groups, either scientists or local people, to vouch for their point of view and to dominate interactions – indications of their sense of superiority – has not disappeared in the innovation system era. Thus, there is a need to fall back on the basics of participatory development. The innovation systems literature, on the other hand, shows that innovation entails combining technical and non-technical changes through coordination on several fronts, including joining scientific and local knowledge, linking smallholder farmers or local people with markets and other service providers and changing the informal and formal institutions or rules that regulate patterns of interactions and practices. Thus, the collaborative transdisciplinary and multi-stakeholder dialogue process is vital from the very beginning, if we are to understand the system and develop joint technical and non-technical innovations for widespread use. In this way, innovation development involves engagement with multi-stakeholders, to diagnose jointly the system's opportunities and challenges and to understand claims or points of view and underlying reasons (of stakeholders including scientists, extensionists, farmers, traders and policymakers among others). In addition, it forges a shared purpose through dialogue and deliberations, coordinates technical and non-technical changes as well as networks and linkages and monitors and evaluates practices and processes for responsiveness.

This review has a couple of salient implications for transdisciplinary research. The main claim was that success in innovation development in complex environments requires investing the bulk of the time and resources in linking together stakeholders to collaborate in aligning technical and non-technical practices over time and space. Multi-stakeholders often do not collaborate without someone or some organisation – the so-called innovation brokers – dedicated to linking them (Adjei-Nsiah *et al*., 2014) in dialogue and deliberation processes. Projects have soft lifecycles, therefore, investing resources in building capacity of local coordinating organisations is a worthwhile effort. Moreover, multi-stakeholder interactions are often unproductive in the absence of critical reflection on minds set and practices and their determinants. Training multi-stakeholders in participatory and facilitation methods are in order but higher-level transformative learning and changes in minds set is a necessity for systemic changes (Mezirow, 2000; Hornidge and Ul Hassan, 2010; Arkesteijn *et al*., 2015, Chambers, 2015, World Development Report, 2015). Thus, transdisciplinary research needs to take into account dedicated coordinators over the long haul beyond the short life cycle of projects and couple it with regular critical reflections on development practices by all relevant stakeholder groups.

ACKNOWLEDGEMENT

This article has benefited from an earlier review by Till Stellmacher before publishing it as as a ZEF Working Paper 138.

FUNDING

This paper was developed within the framework of the BiomassWeb research project funded by the German Federal Ministry of Education and Research (BMBF).

STATEMENT OF NO CONFLICT OF INTEREST

We the authors of this paper hereby declare that there are no competing interests in this publication.

REFERENCES

Adekunle, A. A., Ellis-Jones, J., Ajibefun, I., Nyikal, R.A., Bangali, S.F.O. and Ange, A. 2012. Agricultural innovation in sub-Saharan Africa: Experiences from multiple-stakeholder approaches Accra, Ghana, Forum for Agricultural Research in Africa (FARA).

Adekunle, A.A., Fatunbi, A.O., Buruchara, R. and Nyamwaro, S. 2013. Integrated agricultural research for development: from concept to practice. Accra, Ghana, Forum for Agricultural Research in Africa (FARA).

Adjei-Nsiah, S., Leeuwis, C., Giller, K.E. and Kuyper, T.W. 2008. Action research on alternative land tenure arrangements in Wenchi, Ghana: Learning from ambiguous social dynamics and self-organized institutional innovation. *Agriculture and Human Values* 25:389-403.

Adjei-Nsiah, S., O. Sakyi-Dawson and Klerkx, L. 2014. Facilitating institutional change in West Africa: The CoS–SIS experience Innovation in smallholder farming in Africa: Recent advances and recommendations. Proceedings of the International Workshop on Agricultural Innovation Systems in Africa (AISA), 29–31 May 2013, Nairobi, Kenya Montpellier: CIRAD.

Amankwah, K. 2013. Enhancing food security in Northern Ghana through smallholder small ruminant production and marketing. PhD Thesis, Wageningen University.

Amankwah, K., Klerkx, L., Oosting, S.J., Sakyi-Dawson, O., van der Zijpp, A.J. and Millar, D. 2012. Diagnosing constraints to market participation of small ruminant producers in Northern Ghana: An innovation systems analysis. NJAS - Wageningen *Journal of Life Sciences* 60-63:37-47.

Arkesteijn, M., van Mierlo, B. and Leeuwis, C. 2015. The need for reflexive evaluation approaches in development cooperation. *Evaluation* 21(1):99-115.

Axinn, G.H. 1988. Guide on alternative extension approaches. Rome, Italy. Food and Agricultural Organization (FAO).

Ayenor, G. K. 2006. Capsid control for organic cocoa in Ghana. Results of participatory learning and action research. PhD Thesis PhD Thesis, Wageningen University and Research Centre.

Ayenor, G.K., Röling, N., van Huis, A., Padi, B. and Obeng-Ofori, D. 2007. Assessing the effectiveness of a local agricultural research committee in diffusing sustainable cocoa production practices: The case of capsid control in Ghana. *International Journal of Agricultural Sustainability* 5(2-3): 109-123.

Befani, B. 2012. Modes of causality and causal inference. A review prepared as part of the DFID study broadening the range of designs and methods for impact evaluations. Report of a study commissioned by the Department for International Development. Stern, E.N. and Stame, M.J. London, DFID 38.

Benor, D. and Baxter, M. 1984. Training and visit extension. Washington, D.C., The World Bank.

Biggs, S.D. 1989. Resource-poor farmer participation in research. A synthesis of experiences from nine agricultural research systems. On-Farm Client-Oriented Research (OFCOR), Comparative Study No. 9. The Hague, International Service for National Agricultural Research (ISNAR).

Borlaug, N.E. and Dowswell, C.R. 1995. Mobilizing science and technology to get agriculture moving in Africa. *Development Policy Review* 13:115-129.

Chambers, R. 2015. Minds set in Washington DC." Retrieved 1 June 2015, from http://www.communityledtotalsanitation.org/blog/minds-set-washington-dc.

Chambers, R. and J. Jiggins 1986. Agricultural research for research poor farmers: A parsimonious paradigm. Discussion Paper 220. Brighton, England, Institute of Development Studies, University of Sussex.

Chambers, R., Pacey, A. and Thrupp, L.A. 1989. Farmer first: Farmer innovation and agricultural research. London, Intermediate Technology Publications.

Cullen, B., Lema, Z., Tucker, J., Snyder, K. and Duncan, A. 2014. Navigating power dynamics in innovation platforms: Lessons from the Blue Nile Basin, Ethiopia. Innovation in smallholder farming in Africa: recent advances and recommendations. Proceedings of the International Workshop on Agricultural Innovation Systems in Africa (AISA), 29–31 May 2013, Nairobi, Kenya. Triomphe, B., Waters-Bayer, A. and Klerkx, L.(Eds.). Montpellier: CIRAD.

Douthwaite, B., Beaulieu, N., Lundy, M. and Peters, D. 2009. Understanding how participatory approaches foster innovation. *International Journal of Agricultural Sustainability* 7(1):42-60.

Douthwaite, B., Keatinge, J.D.H. and Park, J.R. 2002. Learning selection: an evolutionary model for understanding, implementing and evaluating participatory technology development. *Agricultural Systems* 72(2):109-131.

Douthwaite, B., de Haan, N.V., Manyong, V. and Keatinge, D. 2001. Blending "hard" and "soft" science: the "follow-the-technology" approach to catalyzing and evaluating technology change. *Conservation Ecology* 5(2): Art. 13 [Online] Available from: http://www.consecol.org/vol15/iss12/art19/ Accessed 10 March 2014.

Fetterman, D.M. 1994. Empowerment Evaluation. *Evaluation Practice* 15(11):1-15.

Figueroa, M.E., Kincaid, D.L., Rani, M. and Lewis, G. 2002. Communication for social change: An integrated model for measuring the process and its outcomes. New York, The Rockeffeller Foundation.

Foddy, W. 1995. Constructing questions for interviews and questionnaires. Theory and practice in social research. Cambridge, Cambridge University Press.

Geels, F.W. and Schot, J. 2007. Typology of sociotechnical transition pathways. *Research Policy* 36(3):399-417.

Hall, A., Mytelka, L. and Oyeyinka, B. 2006. Concepts and guidelines for diagnostic assessments of agricultural innovation capacity. Working Paper Series, no. 2006-017. Maastricht, The Netherlands, United Nations University, UNU-MERIT.

Hornidge, A.-K. 2013. Work Package 7.1, Follow the innovation: Collective learning, change adaptation and transition mamgement. Impoving food security in Africa through increased system productivity of biomass-based value webs (BiomassWeb). ZEF and FSC. Bonn, Center for Development Research (ZEF), University of Bonn and Food Security Center (FSC), Univerisyt of Hohenheim.

Hornidge, A.-K. and Ul Hassan, M. 2010. From "plausible promises" to transdisciplinary innovation research in Uzbekistan - process outline and lessons learnt. Rural Development News 2/2010: 1-11.

Hornidge, A.-K., Ul Hassan, M. and Mollinga, P.P. 2011. Transdisciplinary innovation research in Uzbekistan - one year of 'Follow-the-Innovation'. *Development in Practice* 21(6):834-847.

Hounkonnou, D., Kossou, D., Kuyper, T.W., Leeuwis, C., Nederlof, E.S., Röling, N., Sakyi-Dawson, O., Traoré, M. and van Huis, A. 2012. An innovation systems approach to institutional change: Smallholder development in West Africa. *Agricultural Systems* 108:74-83.

Jiggins, J. 2012. Diagnostic research in support of innovation. NJAS - *Wageningen Journal of Life Sciences* 60-63:115-121.

Kilelu, C.W., Klerkx, L. and Leeuwis, C. 2014. How dynamics of learning are linked to innovation support services: Insights from a smallholder commercialization project in Kenya. *The Journal of Agricultural Education and Extension* 20(2): 213-232.

Klerkx, L., van Mierlo, B. and Leeuwis, C. 2012. Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions. Farming Systems Research into the 21st Century: The New Dynamic. I. Darnhofer, D. Gibbon and B. Dedieu. Dordrecht, Springer Science+Business Media.

Kolb, D.A. 1984. Experiential learning: Experience as a source of learning and development. Englewood Cliffs, New Jersey, Prentice Hall.

Leeuwis, C. 2004. Communication for rural innovation: rethinking agricultural extension. Oxford, Blackwell.

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

Long, N. 1992. From paradigm lost to paradigm regained: the case of actor-oriented sociology of development Battlefields of knowledge: The interlocking of theory and practice in social research and development. N. Long and A. Long. New York, Routledge: 16-43.

Mezirow, J. (Ed.). 2000. Learning as transformation. Critical perspectives on a theory in progress. San Franscisco, Jossey-Bass.

Ness, G.D. 1970. The sociology of economic development: A reader. New York, Harper & Row Publishers.

Njuki, J., Kaaria, S., Sanginga, P.C., Murithi, F., Njunie, M. and Lewa, K. 2009. Building capacity for participatory monitoring and evaluation: Integrating stakeholders' perspectives. Innovation Africa. Enriching farmers' livelihoods. Sanginga, P.C., Waters-Bayer, A., Kaaria, S. and Njuki, J. London Earthscan.

Norman, D.W., Worman, F.D., Siebert, J.D. and Modiakgotla, E. 1995. The farming systems approach to development and appropriate technology generation. FAO. Rome, Italy.

Ochieng, C.M.O. 2007. Development through positive deviance and its implications for economic policy making and public administration in Africa: The case of Kenyan Agricultural Development, 1930-2005. *World Development* 35(3): 454-479.

Odame, H. 2014. Where's the innovation? Harnessing biotechnology for Kenyan smallholders. Dynamics of rural innovation: A primer for emerging professionals. Pyburn, R. and Woodhill, J. Amsterdam, Royal Tropical Institute.

Okali, C., Sumberg, J. and Farrington, J. 1994. Farmer participatory research. Rhetoric and reality. London, Intermediate Technology Publications.

Osei-Amponsah, C. 2013. Improving the quality of crude palm oil: Transdisciplinary research on artisanal processing in Kwaebibirem District, Ghana. PhD Thesis, Wageningen University.

PMBOK. 2008. A guide to the project management body of knowledge. Newtown Square, PA, Project Management Institute.

Richards, P. 1985. Indigenous agricultural revolution. London, Hutchinson.

Richards, P. 1994. Local knowledge formation and validation: The case of rice production in central sierra Leone. Beyond farmer first. Rural people's knowledge, agricultural research and extension practice. I. Scoones and J. Thompson. London, Intermediate Technology Publications.

Ritchie, J. and Lewis, J. 2003. Qualitative research practice. A guide for social science students and researchers. London, Sage Publications Limited.

Rivera, W. and Sulaiman, R.V. 2009. Extension: Object of reform, engine for innovation. *Outlook on Agriculture* 38(3):267-273.

Rogers, E.M. 1995. Diffusion of Innovations. New York, The Free Press.

Röling, N. 1994. Agricultural knowledge and information systems. Extension handbook. Blackburn, J.D. Toronto, Canada. Thompson Educational Publishers. pp. 57-67.

Röling, N. 2002. Beyond the aggregation of individual preferences. Wheelbarrows full of frogs: Social learning in rural resource management. C. Leeuwis and R. Pyburn. Assen, The Netherlands, Koninklijke Van Gorcum.

Röling, N. 2009. Pathways for impact: scientists' different perspectives on agricultural innovation. *International Journal of Agricultural Sustainability* 7(2):83-94.

Röling, N. and Jiggins, J. 1998. The ecological knowledge system. Facilitating sustainable agriculture. Participatory leaent in times of environmental uncertainty. N. Röling and M. A. E. Wagemakers. Cambridge, Cambridge University Press. pp. 283-307.

Schut, M., Klerkx, L., Rodenburg, J., Kayeke, J., . Hinnou, L.C., Raboanarielina, C.M., Adegbola, P.Y., van Ast, A. and Bastiaans, L. 2015. RAAIS: Rapid Appraisal of Agricultural Innovation Systems (Part I). A diagnostic tool for integrated analysis of complex problems and innovation capacity. *Agricultural Systems* 132:1-11.

Sumberg, J. 2002. The logic of fodder legumes in Africa. *Food Policy* 27(3):285-300.

Thomas, P. 2004. Where's the public in these democracies? Dialogue and deliberation: Mechanisms for exercising civic engagement. International Mediation Conference. Guatemala City, Guatemala.

Ul-Hassan, M., Hornidge, A.-K., van Veldhuizen, L. and Akramkhanov, A. 2011. Follow the Innovation: Participatory testing and adaptation of agricultural innovations in Uzbekistan - Guidelines for researchers and practitioners, Universität Bonn, Zentrum für Entwicklungsforschung (ZEF), University of Bonn, Center for Development Research.

Van Mierlo, B., Regeer, B., Van Amstel, M., Arkesteijn, M., Beekman, V., Bunders, J., De Cock Buning, T., Elzen, B., Hoes, A.C. and Leeuwis, C. 2010. Reflexive monitoring in action: A guide for monitoring system innovation projects. Wageningen/ Amsterdam, Communication and Innovation Studies, WUR/Athena Institute, VU.

van Veldhuizen, L. 2014. Basic issues in participatory research: critical reflections Participatory research in BiomassWeb. Introduction Workshop March 19, 2014. Bonn, Center for Development Research (ZEF).

van Veldhuizen, L.A., Waters-Bayer, A. and De Zeeuw, H. 1997. Develpoing technology with farmers. A trainer's guide for participatory learning. London, Zed Books.

Virchow, D., Beuchelt, T., Denich, M., Loos, T.K., Hoppe, M. and Kuhn, A. 2014. The value web approach - so that the South can also benefit from the bioeconomy. *Rural* 21-03: 16-18.

Wandersman, A., Snell-Johns, J., Lentz, L., Fetterman, D.M., Keener, D.C. and Livet, M. 2005. The principles of empowerment evaluation. Empowerment evaluation principles in practice. Fetterman, D.M. and Wandersman, A. New York, Guilford.

Winfrey, O. 2003. Larry King live program. Georgia, Atlanta, Cable News Netwotk (CNN).

World Development Report. 2015. Mind, society and behaviour. Washington, D.C., World Bank.