OCCASIONAL PAPERS ON **INNOVATION IN FAMILY FARMING**

FACING THE CHALLENGES OF CLIMATE CHANGE AND FOOD SECURITY

THE ROLE OF RESEARCH, EXTENSION AND COMMUNICATION FOR DEVELOPMENT

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THE ROLE OF RESEARCH, EXTENSION AND COMMUNICATION FOR DEVELOPMENT

Based on a study carried out by
Cees Leeuwis (Wageningen University) and **Andy Hall** (UNU-MERIT)
Text revision **Willem van Weperen**
Edited by **John Preissing**

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CONTENTS

LIST OF ACRONYMS

CC	Climate Change
CCA	Climate Change Adaptation
ComDev	Communication for Development
CSDI	Communication for Sustainable Development Initiative
DFID	The UK's Department for International Development
FAO	Food and Agriculture Organization of the United Nations
GFRAS	Global Forum for Rural Advisory Services
ICT	Information and Communication Technologies
LINK	Learning Innovation and Knowledge network
NGO	Non-Governmental Organization
NRM	Natural Resource Management
OEK	Office of Knowledge Exchange, Research and Extension
OEKR	Research and Extension Branch, OEK, FAO
PES	Payments for Ecological Services
R&E	Research and Extension
T&V	Training and Visit extension approach
UN	United Nations
UNEP	United Nations Environment Programme
UNU-MERIT	United Nations University Maastricht Economic and Social Research and Training Centre on Innovation and Technology

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The present study is part of a series of occasional papers on Agricultural Innovation in Family Farming produced by FAO's Research and Extension Branch under the overall coordination of Andrea Sonnino, Chief. The document is based on an original study prepared by Cees Leeuwis (Wageningen University) and Andy Hall (UNU-MERIT) under the supervision of John Preissing, Senior Extension Officer, FAO and Mario Acunzo, Communication for Development Officer, FAO. A revision of the document was carried out by Willem van Weperen while John Preissing edited the final version of the text.

The study is based on literature review and a series of field case studies carried out in Africa, Asia and Latina America that have been implemented thanks to the support of the Communication for Sustainable Development Initiative (CSDI) – GCP/INT/048/ITA, an FAO project funded by the Italian Ministry for the Environment and Territory.

EXECUTIVE SUMMARY

In line with the Intergovernmental Panel on Climate Change (IPCC) this study defines climate change as any change in climate over time, whether due to natural variability or as a result of human activity.

Dealing with climate change

Upon request of the Food and Agriculture Organization of the United Nations' Research and Extension Branch, a study was carried out by the Wageningen University and the United Nations University. The study report "Facing the challenges of climate change and food security: the role of research, extension and communication for development institutions", authored by Cees Leeuwis and Andy Hall, was finalized in October 2010 and constitutes the basis for the present document.

The study report is based on case studies from Bangladesh (Sulaiman, 2010), Bolivia (Pafumi and Ulloa, 2010), DR Congo (Mbaye, 2010) and Ghana (Adjei-Nsiah and Dormon, 2010) which were carried out with the purpose of assessing needs and gaps with regard to the provision of innovation support services for climate change adaptation. It took the form of desk-studies complemented with key informant interviews. Research results showed that climate change adds urgency to the need for adaptation in its widest sense in the natural resources sphere (agriculture, forestry, natural resources management, livestock and fisheries). The main message from the study is that not only is technical change for farm-level adaptation and mitigation needed, but also a change of policy and institutional regimes that govern agricultural production, value chains and natural resource management.

This report is a shortened version of the final study report, produced on request of FAO. The purpose of the shortened report is twofold: (1) to serve as a planning document to sharpen the climate change focus of research, extension and communication for development institutions (including FAO's) in developing effective and relevant support activities for their partners and (2) to communicate the climate change support activities implemented by FAO in this field to potential partners and inform them about possible strategies and specific approaches that will enhance the role of extension, research and communication institutions and services for climate change adaptation (CCA). Besides introduction into the topic (section 1) the report discusses the context of climate change adaptation and its linkages with food security (section 2) and the analytical framework which has been used for the study (section 3). Subsequently, lessons learned from the case studies (section 4) are presented. A sketch of a new-style role for agriculture innovation support service agencies, including FAO (section 5) is provided. Finally, Annex 1 provides a more detailed conceptual framework linking agriculture innovation to the work of research, extension and communication for development.

Climate change adaptation as a metaphor for the future

It is becoming increasingly clear that climate change will have a profound influence on the agro-ecological conditions under which farmers and rural populations need to develop their livelihood strategies, manage their natural resources and achieve food security. Climate change can be regarded as being part of a 'complex' problem situation, characterized by uncertainty, unknown consequences and competing interests. It is amidst this complexity that appropriate human responses will have to be developed. In the context of this report, we label such responses as 'adaptation', and take this to include 'mitigation'. From the literature on climate change it is clear that adaptation may involve an array of both technical and institutional responses, which may be inspired by both local or outside knowledge and experience. Such as new crop varieties, adapted cropping systems, more efficient irrigation techniques, new forms of water harvesting, alternative ways of preserving soil fertility, novel forms of pest and disease control and alternative coastal protection infrastructures as well as improved technologies for early warning. Examples of institutional responses include the installment of new market mechanisms for carbon trade, the development of credit and payment mechanisms for ecosystem services, the introduction of alternative chains and certification schemes for 'climate proof' agricultural products and the use of procedures and methodologies in (public and private) research and extension systems to enhance collective adaptive capacity in communities, regions and countries.

Summary of the conceptual framework: the role of research, extension, communication in climate change adaptation

Climate change adds urgency to the need for adaptation in its widest sense in the natural resources sphere: agriculture, forestry, Natural Resources Management (NRM), livestock, aquaculture, fisheries. This does not just mean technical change for farm-level adaptation and mitigation. It also means adaptation of the policy and institutional regimes that govern agricultural production, value chains and natural resources management. Two critical features of this emerging adaptation agenda are: (1) the importance of negotiating new rules or institutional arrangements, often in a landscape of diverse stakeholders and (2) the importance of reconfiguring networks of activity to bring about change.

Any innovation support infrastructure should be able to support three essential processes: (1) Network building; (2) Social learning (3) Conflict management. Such support is likely to be a mix of "traditional" and newer communication strategies and services. Examples of these 'new' communication strategies are:

- Network brokerage;
- Demand articulation and knowledge brokerage;
- Process facilitation, including visioning;
- Interactive design and experimentation;

- Learning-oriented monitoring;
- Exploration of opportunities and constraints;
- Lobby and advocacy communication;
- Conflict management.

Both traditional and 'new' strategies may usefully involve a range of communication media, like interpersonal, mass media and Information and Communication Technologies (ICTs). In innovation processes, any actor or organization that carries out the tasks mentioned above is called an '*innovation broker*'. Responding to climate change demands new modes of operating for communication and extension professionals, as well as from researchers and scientists. To ensure that research contributes to the development of balanced technical and institutional innovations, interdisciplinary teams of scientists need to engage in collaborative research and experimentation with societal stakeholders.

Playing new intermediary roles in climate change adaptation processes would require a number of shifts:

- Expand from a focus on technology change to a focus on socio-institutional change;
- Expand from rural space to national space intermediation;
- Expand from public agencies to multiple agencies;
- Expand from a tactical to a strategic role;
- Expand from practice development to policy development;
- Expand from information diffusion to communication for development;
- Expand core expertise to further include facilitation skills.

Intermediation, in the context of agriculture extension mainly referring to brokering relations, is traditionally used in mediating research-farmer interactions, but can be used in a much wider sphere of activity. Research, extension and communication professionals could reorient their core expertise in intermediation toward these wider dimensions of the climate change adaptation task. This report provides a conceptual framework for this shift and makes suggestions on how these types of support services could be organized to help FAO member countries, as well as FAO's own needs for institutional learning and adaptation towards climate change.

Lessons from the case studies

Similarities and differences emerging from the four country case-studies are:

- There is a need for adaptation;
- Projects and programmes are organized around climate change;

- Ministries than other Agriculture seem to be taking the lead;
- Emphasis is on technological adaptation and the local level;
- Research and extension configurations are dynamic and stable at the same time;
- Interventions seem to be mostly problem driven — not opportunity-led;
- There is need for coordination and integration of activities;
- An institutional vacuum for innovation intermediation exists at the country level;
- An institutional vacuum exists for innovation intermediation at the level of international development organizations.

Repositioning international support for research, extension, and communication for development innovation support services

The analysis of case-studies and relevant literature has made clear that climate change adaptation is not only an issue of technological adaptation, but also one of institutional adaptation within and beyond the agricultural innovation system, including wider policy, regulatory and market regimes. The national case-studies indicate that there is a vacuum regarding the provision of the broader innovation support services that are needed to enhance adaptive capacity. To carry out these adaptations, (new) innovation intermediaries are required that provide a range of innovation support services.

An analysis of the landscape of international agencies and country case studies reveals that agencies playing the wider systems intermediation role are lacking and there is presently no international agency that has an explicit role in providing support and advice on multi-level techno-institutional adaptation. Hence there is certainly a role for FAO's Research and Extension Branch in this. Also, Climate Change could serve as a vehicle to introduce the new broad-based perspective into agricultural development services and the new approach might be attractive to investors interested in taking this agenda forward.

This may lead FAO as well as other organizations dealing with innovation support services to work with new strategic partners. At the same time, those working with current classical research and extension organizations will also benefit because they can:

- Provide extension and research organizations with up-to-date insights from innovation studies;
- Advise member country institutions on suggested human resource policy changes to job descriptions of field-level extension staff, and make senior extension officers responsible for facilitating the local institutional change process;
- Enhance diagnostic and visioning skills at regional extension offices;
- Conduct experiments with organizing interaction among relevant players in local level 'innovation systems'.

CHAPTER 1

INTRODUCTION

In 2010, a study was carried out to assist the Research and Extension Branch in FAO to position itself strategically in meeting needs and demands that arise as a consequence of climate change. The goal of the study was also to assist other global and national agencies meet these needs. This resulted in the report "*Facing the challenges of climate change and food security: the role of research, extension and communication institutions*" (Leewis and Hall, 2010). The need for this study emerged from the present challenges faced by Research and Extension (R&E) institutions around the globe, *vis-à-vis* climate change, and the FAO Research and Extension Branch's mission to contribute to the strengthening of inclusive agriculture innovation systems.

FAO KEY TASK: CONTRIBUTING TO REALIZING AGRICULTURE INNOVATION IN FAMILY FARMING

Conceptual framework

The study led to the development of a conceptual framework that would assist FAO to reflect on the new role of research and extension and to better support member countries in this field. Furthermore, the framework also served simultaneously to give direction to country case-studies that have contributed to this document[1]. The conceptual framework presented in Annex 1 , redefines the role of extension, communication and research based on contemporary thinking in innovation studies. In essence, the argument is that (a) climate change adaptation requires coherent technical and institutional innovations and responses across multiple societal levels and (b) bringing about such coherent responses requires the performance of a range of new intermediation and facilitation roles in addition to "classical" extension, research and communication for development services.

1 Four country case studies (Sulaiman, 2010; Pafumi and Ulloa, 2010; Mbaye, 2010; Adjei-Nsiah and Dormon, 2010) were carried out with the purpose of assessing which needs and gaps exist in actual practice with regard to the provision of innovation support services for climate change adaptation. In addition, an international landscape review was carried out to get a better view of what other international agencies do in the sphere of innovation intermediation.

INTERMEDIATION - FACILITATION ACCESS TO MARKETS

An organic promotion project (EPOPA) united 14 African export companies under the label Jambo Africa. Through project intermediation a new institutional arrangement between organic produce exporting companies was established, to get smallholder farmers access to Western export markets. Something the individual companies could never have achieved on their own. Project intermediation contributed towards increase of smallholder farmer income and improved the resilience of farming systems against climate change effects.

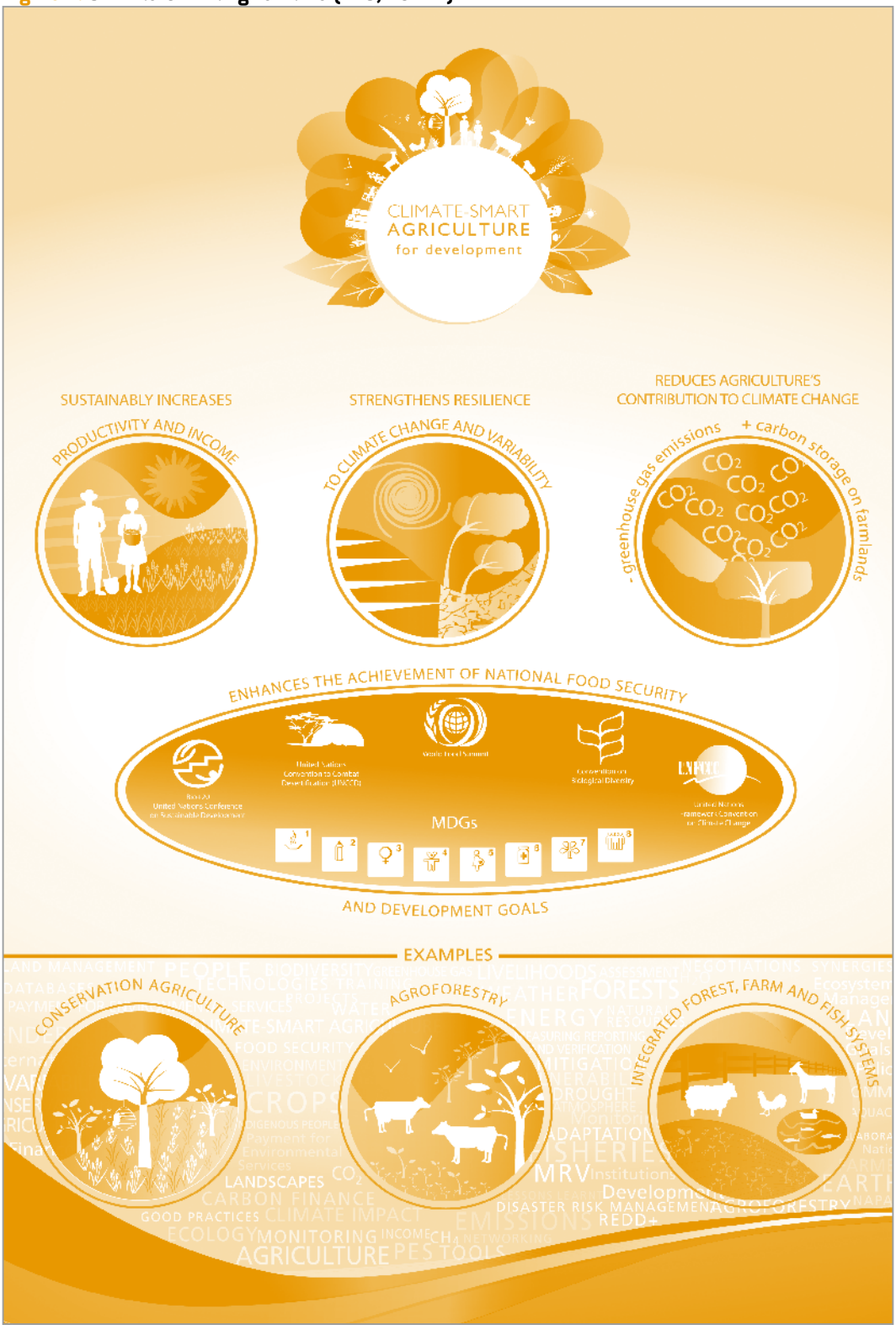
Intermediation

This implies that extension should not only be dealing with improving agriculture production performance through dissemination of knowledge, but should engage in a broader range of development tasks such as facilitating farmer access to inputs, credit facilities or markets, organizing producer groups, negotiating contracts between processors and producers, or linking producers to researchers and policy makers. All these intermediating tasks require additional skills sets, like facilitation, trust-building, networking or negotiation skills. Skills, which extension staff, recruited for transfer of technology tasks in a more traditional extension setting, may not necessarily have. Subsequently the emergence of new type of service providers can be observed, who develop these capacities and/or specialize in intermediary service delivery.

This document is a revised and shortened version of the study of Leewis and Hall. Its purpose is twofold: (1) to serve to sharpen the climate change focus of the Research and Extension Branch, FAO in developing effective and relevant support activities with its partners and (2) to communicate the need for new climate change support activities and promote possible strategies and approaches that will enhance the role of extension, research and communication institutions and services for climate change adaptation.

Besides the more explicit focus on climate change research, extension and communication needs, some practical examples were added in this revised edition of the report. It first discusses the context of climate change adaptation and its linkages with food security and the analytical framework which has been used for the study (chapter 2 and 3). Subsequently, it describes the lessons learned from the case-studies, followed by a sketch of a new-style agriculture innovation support services in the face of climate change and food security challenges (chapters 4 and 5).

Figure 1. **Climate-smart Agriculture (FAO, 2011a)**



CHAPTER 2

CLIMATE CHANGE ADAPTATION AS A METAPHOR FOR THE FUTURE

It is increasingly clear that climate change will have a profound influence on the agro-ecological conditions under which farmers and rural populations need to develop their livelihood strategies, manage their natural resources and achieve food security. Numerous publications by FAO and others point to this[2]. It has even led to new terms like 'climate smart farming' i.e. this includes "sustainable crop production intensification." In practical terms this means "Grow more food using less land, water, fertilizer and pesticides, which are scarce, and more labour, care and intelligence, which are abundant." (FAO, 2011c) By doing so the production system becomes less dependent on external resources, less harmful to the environment and more resilient.

CLIMATE CHANGE ISSUES ARE COMPLEX

In most contexts, climate change can be regarded as part of a 'complex' problem situation in several senses: (a) there is often considerable ***uncertainty*** about specific climatic and ecological dynamics at play; (b) climatic and ecological change have (initially unknown) ***consequences*** for several interrelated societal spheres (e.g. agriculture, forestry, fisheries, health, energy, economy, migration, etc.) and (c) it is likely that there are different and ***competing*** human ***interests*** and values at stake (e.g. between rich and poor, farmers and pastoralists, 'food' and 'fuel', economy and ecology, rural and urban communities, etc.).

THE EMERGENCE OF "CLIMATE SMART FARMING"

Climate smart farming is agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals.

Source: FAO http://www.fao.org/climatechange/climatesmart/en

2 Visit http://www.fao.org/climatechange/en

ENHANCING THE CAPACITY TO ADAPT

It is amidst this complexity that appropriate human responses will have to be developed. We will label such responses as *'adaptation'*, and take this to include *'mitigation'*. Working towards adaptation, then, poses specific challenges for research, extension and communication institutions and services. These challenges, however, are not unique to the context of climate change. From a wider perspective we can see that the world we live in is (and has been) characterized by continuous change, of which the pace seems to be accelerated by globalization, a phenomenon underpinned by international trade patterns and regulatory regimes, ICTs, enhanced transport facilities, and population growth. Hence, we can argue that enhancing the capacity to adapt to newly-emerging realities is going to require permanent attention from research, extension and communication institutions and is critical for realizing a range of millennium development goals.

TECHNICAL AND INSTITUTIONAL RESPONSES

From literature on climate change it is clear that adaptation may involve an array of both technical and institutional responses, which may be inspired by both local or outside knowledge and experience (FAO, 2010). New technologies and technical practices may, for example, include new crop varieties, adapted cropping (including agro-forestry) systems, more efficient irrigation techniques, new forms of water harvesting, alternative ways of preserving soil fertility, novel forms of pest and disease control and alternative coastal protection infrastructures, as well as improved technologies for early warning. Often it involves existing technologies farmers are adopting, resulting in a triple win: farmers getting higher yields, improved resilience and stronger soils that sequester more carbon (Warutere and Verkooijen, 2011).

Such technical responses need to be combined with, and embedded in, new institutional solutions, whereby the term 'institutions' refers to the formal and informal rules and organizational forms and policies through which society is ordered. Examples of possibly relevant institutional responses include the installment of new market mechanisms for carbon trade, the development of credit and payment mechanisms for ecosystem services like conserving farmland around aquifers, adapted land tenure arrangements and contracts, new organizational forms and laws for the management of water catchments, the introduction of alternative chains and certification schemes for 'climate proof' agricultural products, the re-organization of input supply and marketing arrangements for new cropping systems, and, last but not least, the use of alternative procedures and methodologies in (public and private) research and extension systems to enhance collective adaptive capacity in communities, regions and countries.

NEW INSTITUTIONAL ARRANGEMENTS; PAYMENT FOR ECOSYSTEM SERVICES (PES)

Perrier Vittel discovered it would be cheaper to invest in conserving the farmland surrounding their aquifers than to build a filtration plant to address water quality issues found in 1990. Accordingly, they purchased 600 acres of sensitive habitat and signed long-term conservation contracts with local farmers. Farmers in the Rhine-Meuse watershed in northeastern France received compensation to adopt less intensive pasture-based dairy farming, improve animal waste management, and reforest sensitive filtration zones.

Source: Forest Trends, The Katoomba Group and UNEP, 2008

CHAPTER 3

SUMMARY OF THE CONCEPTUAL FRAMEWORK: THE ROLE OF RESEARCH, EXTENSION AND COMMUNICATION IN CLIMATE CHANGE ADAPTATION

Climate change adds urgency to the need for adaptation in its widest sense in the natural resources sphere (agriculture, forestry, NRM, livestock, aquaculture, fisheries). This does not just mean technical change for farm-level adaptation and mitigation, it also means adaptation of the *policy and institutional regimes* that govern agricultural production, value chains and natural resource management. Two critical features of this emerging adaptation agenda are: (1) the importance of negotiating new rules or institutional arrangements, often in a landscape of diverse stakeholders and (2) the importance of reconfiguring networks of activity to bring about change. This framework is in alignment with what is formulated within the FAO-Adapt Framework Programme on Climate Change Adaptation (FAO, 2011b), which states that "adapting to climate change requires adjusting institutional structures and arrangements".

CLIMATE CHANGE EXTENSION AS NICHE

These two roles, negotiating new institutional arrangements and facilitating network reconfiguration, are both roles of intermediation. While extension has been traditionally viewed as intermediation between farmers and technology suppliers, adaptation to climate change also demands intermediation, but in a much wider sphere of activity and between different actors. The implication here is that the role of intermediation for adaptation for climate change is a niche role that extension professionals could feasibly fill, given their long-standing mandate of playing intermediary roles.

Table 1. Overview of communication strategies

'TRADITIONAL' COMMUNICATION STRATEGIES	'NEW' COMMUNICATION STRATEGIES
• Advisory communication • Horizontal knowledge sharing in support of innovation • Awareness raising • Training • Persuasive mass media campaigns • Information provision	• Network brokerage • Demand articulation and knowledge brokerage • Visioning • Process facilitation • Interactive design and experimentation • Learning-oriented monitoring • Exploration of opportunities and constraints • Lobby and advocacy communication • Conflict management • Organizing interaction and participation

INNOVATION SUPPORT PROCESSES

From a theoretical point of view any innovation support system infrastructure should be able to support three essential processes: (1) Network building; (2) Social learning and (3) Conflict management. Such support is likely to be a mix of 'traditional' communication strategies and services and 'newer' communicative strategies and services, focusing on innovation development.

It is important to realize that both 'traditional' and 'new' strategies may usefully involve a range of communication media, like interpersonal, mass media, ICT. In innovation studies, any actor or organization that carries out the tasks mentioned in the right column of table 1, is called an 'innovation intermediary', that is:

> *"An organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations."*

Source: Howells, 2006

TAKING ON INTERMEDIARY ROLES

As transpires from this definition, innovation intermediation involves a much broader set of activities and processes (i.e. a broader set of innovation support services) than those performed by classical extension.

Responding to climate change demands not only new modes of operating for communication and extension professionals, but also from researchers and scientists. In order to ensure that research contributes to the development of balanced technical and institutional innovations, interdisciplinary teams of scientists need to become more involved in collaborative research and experimentation with societal stakeholders.

INTERDISCIPLINARY AND COLLABORATIVE RESEARCH ENHANCING TECHNICAL AND INSTITUTIONAL INNOVATION FOR CLIMATE CHANGE ADAPTATION IN MOZAMBIQUE

The Nhambita Community Carbon Project is focused on the Nhambita Community, located in the buffer zone of the Gorongosa National Park in Mozambique. This project is based on building a community partnership through sustainable development, habitat restoration, bio-diversity and climate-change mitigation. More specifically, the Nhambita Community Carbon Project aims to:

- Improve the livelihoods of the very poor local community by introducing agroforestry systems that will generate significant carbon benefits and carbon finance income;
- Rehabilitate, over the next five years, a ten thousand hectare portion of the land adjoining the national park through initiatives that also create sustainable livelihoods and protect biodiversity;
- Provide fruit, timber, fodder and fuel wood to the local community and improve soil productivity. In addition, the community will benefit from improved organizational capacity, education and awareness about forest stewardship and conservation and the introduction of novel income streams through bee-keeping, cane rat production and craft making.

The project is a collaborative venture between the Nhambita Community Association, the Gorongosa National Park, the University of Edinburgh, Envirotrade Limited, the Edinburgh Centre for Carbon Management (ECCM) and ICRAF, with grant funding from the European Union and DFID.

Source: http://www.povertyandconservation.info/en/case/C0266.php

To summarize, playing new intermediary roles in climate change adaptation processes would require a number of shifts:

1. Expand from a single focus on technology change to also include a focus on socio-institutional change. Climate change adaptation requires a coherent package of technical and institutional responses, which together form a socio-institutional innovation.
2. Expand from rural space to national space intermediation. Climate change adaptation is about reconfiguring roles and networks between interdependent players at different levels, all the way from the national level to the rural space with farmers.
3. Expand from public agencies to multiple agencies. Reconfiguration of support services for climate change adaptation not only involves public research and extension services but others from subnational public agencies, civil society, community media and the private sector.
4. Expand from a tactical to a strategic role. Intermediation is no longer just a tool to deliver technology, but a tool to reconfigure systems architectures and strengthen system capacities.
5. Expand from practice development to policy development. Intermediation is no longer just about field methods and practice with farmers, but also about strengthening the enabling environment for adaptation through policy change.
6. Expand from information diffusion to communication for development. Communication becomes integrated in 'innovation intermediation' activities aimed at enhancing network formation, learning, negotiation and the building of relationships in new configurations of support and services for climate change adaptation.
7. Expand core expertise from service delivery to facilitation. The brokerage function between other agencies and organizations becomes much more important than that of actually providing services.

FOCUS NEEDED ON SOCIAL-ORGANIZATIONAL CHANGE

The project "Lack of resilience in African smallholder farming: exploring measures to pressures of climate change" in Ghana demonstrates the existing focus on technology change. The project facilitates resource constrained farmers to manage their production resources, particularly soils through collective action to increase their resilience to climate change and variability. However little attention is paid to social-organizational change such as marketing, land tenure and labour, which are important instruments in Climate change adaptation.

Source: Leewis and Hall, 2010

PRIVATE SECTOR INVOLVEMENT: THE UNILEVER SUSTAINABLE TEA INITIATIVE

The Sustainable Tea Initiative began at Unilever Tea Kenya (UTK) in 1999 with a series of pilot projects on its own tea estates aimed at better understanding sustainable tea production techniques. Unilever used the findings to develop good practice guidelines that would enhance productivity, market value, and environmental and social performance.

Unilever shares its good practice guidelines with suppliers through the distribution of two detailed manuals, one for large-scale growers and one for local farmers. The company works with local organizations to develop participatory learning schemes that help individual farmers implement these practices. The company is increasingly incorporating the guidelines into discussions and agreements with suppliers of tea for Unilever. The good practice guidelines produced by Unilever's Sustainable Tea Initiative have introduced tea suppliers to new farming methods to improve soil fertility, minimize soil erosion, produce crops with high yield and nutritional quality, implement Integrated Pest Management, enhance the biodiversity value of farms, increase efficiency of water use and energy utilization, improve the working environment and help local communities and the local economy.

Unilever has now extended its Sustainable Tea Initiative in Kenya to other tea-producing areas in India and Tanzania. It also runs similar sustainable agriculture initiatives for other key crops such as palm oil, spinach, tomatoes and peas. In 2006, Unilever entered into partnership with the Kenyan Tea Development Agency (KTDA), a cooperative of about 450 000 farmers that produces 60 percent of Kenya's tea, in an extension of its programme to provide best practice agricultural and management techniques to farmers.

Source: Jenkins et al., 2007

CHAPTER 4

LESSONS FROM THE CASE STUDIES

Four country case studies were carried out for the report with the purpose of assessing which needs and gaps exist in regard to the provision of innovation support services for climate change adaptation. Country studies were carried out in Bangladesh (Sulaiman, 2010), Bolivia (Pafumi and Ulloa, 2010), DR Congo (Mbaye, 2010) and Ghana (Adjei-Nsiah and Dormon, 2010). They took the form of desk-studies complemented with key informant interviews. In order to validate findings, a review process was implemented in each country engaging key stakeholders from local institutions and organizations. The similarities and differences that emerged from the individual studies are described below.

A. THERE IS A NEED FOR ADAPTATION

Climate change poses a number of issues and challenges to all four countries. The nature of these challenges differ from country to country as well as between regions in a country. This means there is indeed a need for combined technical and institutional innovation.

B. PROJECTS AND PROGRAMMES ARE ORGANIZED AROUND CLIMATE CHANGE

In all countries we see that there are a number of programmes and projects organized around the issue of climate change. Furthermore international donors seem to be influential in putting the issue on the agenda.

ADAPTATION NEEDS IN THE DEMOCRATIC REPUBLIC OF CONGO

Five major climate risks threatening the daily lives of people in the Democratic Republic of Congo are respectively: heavy rainfall, coastal erosion, floods, heat wave crisis and seasonal droughts. Torrential rains have a clear tendency to increase, causing casualties, destroying infrastructure and habitats particularly those in poor urban areas and generating erosion. The increasing heat waves kill young children and old people especially in urban areas, causes dehydration and disorders related to heat stress, various cardiovascular diseases and increase vulnerability related to waterborne diseases, malaria and trypanosomiasis. Seasonal droughts generate serious disruption of agricultural calendars within a rainy agricultural system

Source: Mbaye, 2010

C. OTHER MINISTRIES THAN AGRICULTURE SEEM TO BE TAKING THE LEAD

In all four countries, the impression is that Ministries other than those mandated with agriculture seem to be taking the lead. In Ghana, Bangladesh and Congo this is the Ministry of Environment; in Bolivia it was initially the Development Planning Ministry, but the Ministry of Environment (and Water) took over at a later stage. In all countries, however, projects and programmes exist that have an agricultural component or focus.

IN BANGLADESH MINISTRIES OTHER THAN AGRICULTURE RESPONSIBLE FOR ADAPTATION

One of the serious problems encountered when conducting agricultural extension work in Bangladesh is the presence of several ministry who are directly involved assisting the farmers but with very limited cooperation from the Ministry of Agriculture. The absence of functional and active participation of the local government is also a big problem in the extension system of the country.

Source: Sulaiman, 2010

D. EMPHASIS IS ON TECHNOLOGICAL ADAPTATION AND THE LOCAL LEVEL

The agricultural projects seem to be mainly focused on developing and/or disseminating new technologies for farmers (e.g., new varieties, water harvesting, changing cropping systems, etc.). Moreover, most extension and communication for development projects seem to be oriented towards innovation at a local level. There is relatively little attention to changing higher level framework conditions, which may be needed in order to create conducive conditions for technological change and adaptation.

E. RESEARCH AND EXTENSION CONFIGURATIONS ARE DYNAMIC AND STABLE AT THE SAME TIME

The case studies suggest that research and extension architectures undergo regular change. In most cases, however, these changes do not seem to be driven by a wish to improve the adaptive capacity of research and extension, or an explicit wish to establish more effective agricultural innovation systems. Instead, systems undergo reforms when donor-funded projects and programmes end and new programmes and donors come in, or — in the case of Bolivia — when political landscapes change radically. Bolivia is also a bit of an exception in the sense that the reform is based on an explicit philosophy of 'participatory innovation', with reference to innovation systems thinking. However, in the Bolivia case it must be mentioned that the system still operates in a rather centralized and linear manner, despite the change in rhetoric. Moreover, in Bolivia 'participatory innovation' seems to be highly grassroots-focused, thus ignoring required institutional and technical innovations at the above local level. The other case studies also suggest that conventional 'technology transfer' thinking is still very much alive.

F. INTERVENTIONS SEEM TO BE PROBLEM DRIVEN — NOT OPPORTUNITY-LED

Perhaps, not surprisingly, climate change projects and programmes seem to be primarily oriented towards solving problems that are associated with climate change. However, from an innovation systems perspective this (i.e., 'problems') may not be the ideal entry point, especially in situations where poverty alleviation and development are of prime importance. From a development and innovation perspective, one could argue that one would first and foremost have to identify new opportunities (e.g., producing soybean for the Chinese market; producing value-added food for idealistic consumers, etc.) and then take climate change and other constraints and barriers into consideration when developing adequate institutional and technical innovations and responses.

G. THERE IS NEED FOR COORDINATION AND INTEGRATION OF ACTIVITIES

All case studies signal problems that have to do with lack of coordination between interdependent actors. For example, between research and extension, between different ministries and sectors (water, environment, agriculture), between public and private spheres, between academic disciplines, between different projects and programmes and/or between interventions at different societal levels. While we do not believe that innovation trajectories can or should be 'coordinated' in the classical sense of 'central steering', it is essential that interdependent actors align their activities and plans in a synergistic manner. In this light there is a need for the new communicative 'innovation intermediation' roles and functions.

PARTICIPATORY COMMUNICATION PLANNING FOR AGRICULTURAL INNOVATION IN BOLIVIA

In Bolivia, FAO has promoted the use of *Planes Locales de Innovación y Comunicación* (PLICs) as a tool for participatory planning of agricultural services. Through consultative processes at the local level, the PLICs serve to identify priority agricultural issues and set common goals synthesizing the views of different rural stakeholders (smallholder farmers, producer organizations, extension service providers, research centers, local media, NGOs, etc.)

Source: Pafumi, 2009

H. INSTITUTIONAL VACUUM FOR INNOVATION INTERMEDIATION EXIST AT COUNTRY LEVEL

Despite the explicit attention to identifying new intermediary actors none of the case studies report the emergence of new innovation intermediaries as a response to the integration and coordination problems signaled above. While there may be poorly visible developments, like existing organizations, projects or NGOs taking on new roles, it is fairly safe to say that a vacuum seems to exist at country level. The absence of such innovation intermediaries is likely to hamper the emergence of effective innovation systems around climate change induced challenges, along with suboptimal performance of classical research and extension organizations.

I. AN INSTITUTIONAL VACUUM EXISTS FOR INNOVATION INTERMEDIATION AT THE LEVEL OF INTERNATIONAL DEVELOPMENT ORGANIZATIONS

The 'international landscape review' suggests that no international organization is currently taking the lead in supporting capacity development for innovation intermediation. Quite a number of agencies with overlapping mandates and unclear task division can be observed. Even though some agencies adopt the language of 'innovations systems' and 'institutional change' the overall picture is that most organizations focus on research or advisory services and not on supporting innovation intermediation. Many people are interested in the theme, but in view of their existing mandates, constituencies and funding mechanisms they find it difficult to adapt their organizations in this direction. This may be a challenge for FAO's Research and Extension Branch and others moving towards more holistic innovation support service development.

CHAPTER 5

CONTOURS FOR A NEW POSITIONING FOR AGRICULTURE INNOVATION SUPPORT SERVICES

GAP ANALYSIS

The preceding analysis of case-studies and relevant literature has made clear that climate change adaptation[3] is not only an issue of technological adaptation, but also one of institutional adaptation within and beyond the agricultural innovation system, including wider policy, regulatory and market regimes. It is argued that not only has institutional adaptation largely been overlooked in debates about technological responses to climate change, but that institutional adaptation needs to take place at all levels. The national case-studies indicate that there is a vacuum regarding the provision of the broader innovation support services that are needed to enhance adaptive capacity. At the same time we see that international development organizations do not take the lead in developing capacity for such new forms of innovation intermediation.

VACUUM EXISTS IN BROAD INNOVATION SUPPORT

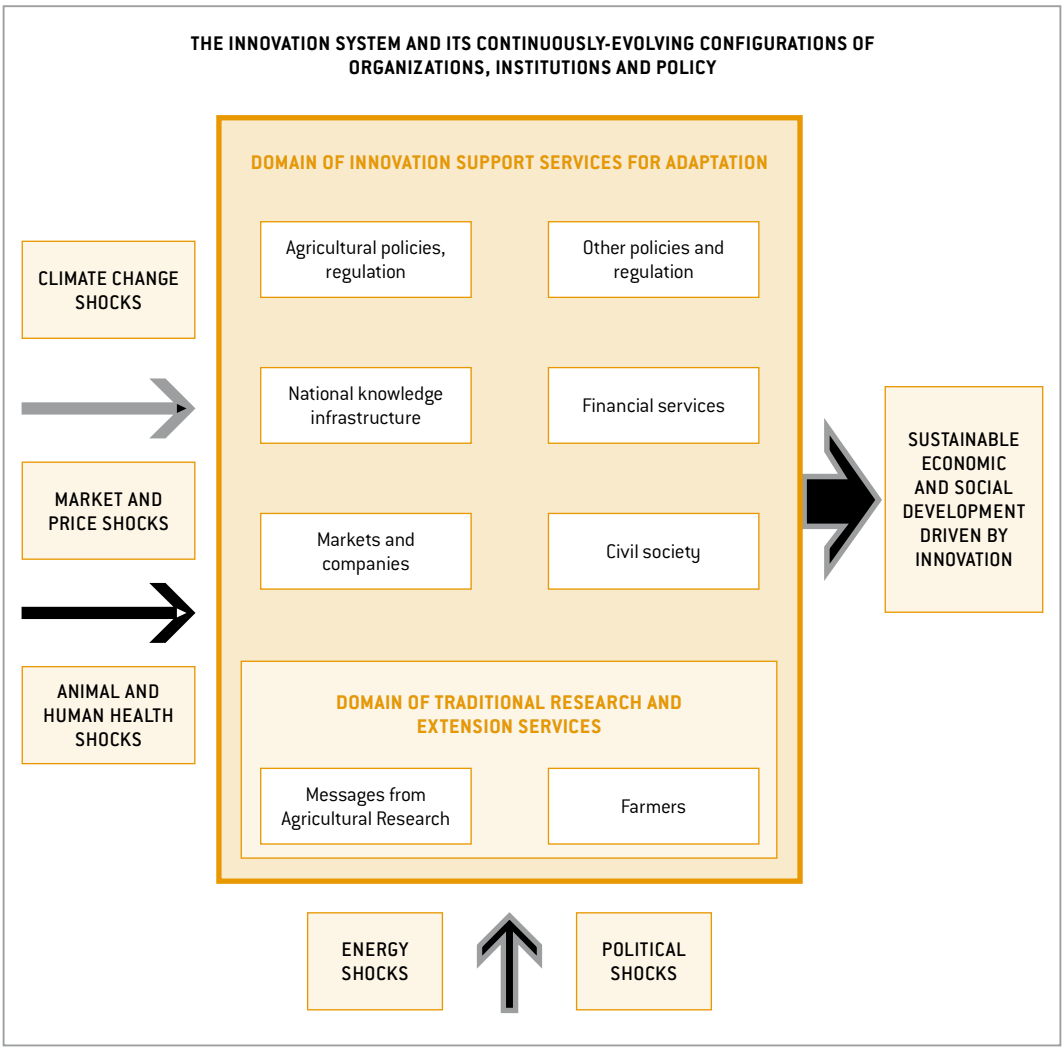
The national case-studies indicate that there is a vacuum regarding the provision of the broader innovation support services that are needed to enhance adaptive capacity.

INNOVATION SUPPORT SERVICE PROVISION

Figure 1 summarizes the expanded domain of innovation services in a dynamic, global environment. The diagram shows that adaptation is not only about realigning and adapting rural processes, but also of adaptation at higher levels of the national system of innovation. The service provision geared towards innovation is also called innovation brokerage.

3 Technical adaptation often means renewed attention for Sustainable Agriculture (SA) concept promotion, i.e. extension staff needs to become aware and of the importance of ecological principles, importance of growing traditional crops/keeping local breeds which are in alignment with the ecological zones, in order to enhance resilience, rather than merely replacing them with high input demanding high yielding varieties or breeds.

Figure 1. The expanded domain of innovation services in a dynamic, global environment



INNOVATION BROKERING

"Innovation brokering is a role that is neither involved in the creation of knowledge nor in its use in innovation, but one that binds together the various elements of an innovation system and ensures that demands are articulated to suppliers, that partners connect and that information flows and learning occurs."

Source: Klerkx et al., 2009

Intermediation is a task that extension professionals have traditionally played in communicative roles associated with technology development and promotion. This needs to be expanded to the wider innovation system, so as to allow multi-level institutional adaptation, which is a precondition for realizing effective technological responses to climate change.

Innovation intermediaries can play a number of roles and provide a range of communication strategies and innovation support services, such as:

- Network brokerage;
- Demand articulation and knowledge brokerage;
- Visioning;
- Process facilitation;
- Interactive design and experimentation;
- Learning-oriented monitoring;
- Exploration of opportunities and constraints;
- Lobby and advocacy communication;
- Conflict management;
- Organizing interaction and participation.

WIDER SYSTEMS INTERMEDIATION AND SUPPORT IS LACKING

An analysis of the landscape of international agencies and country case studies reveals that (1) intermediation functions are often being fulfilled at a rural level, but there is currently no agency or function that plays the wider systems intermediation role; and (2) in the international landscape there is currently no agency that has an explicit role in providing support and advice on multi-level techno-institutional adaptation in the networks that eventually shape agricultural production, rural livelihoods and the ability to adapt to climate change and other emergent challenges and shocks.

OPTIONS FOR AGRICULTURAL INNOVATION CAPACITY SUPPORT SERVICES

The above suggests that there is the need to enhance agricultural innovation systems and that FAO's Research and Extension Branch could support the development of new services. The role of these agricultural innovation capacity support services would be to assist national partners at the enabling environment level (i.e. policies and institutions) and the organizational set-up level to strengthen their ability to propose reconfiguration of institutions in response to climate change as well as a range of other emerging issues. The core of this support would be in strengthening and backstopping the innovation intermediation tasks outlined above as part of an agenda of

techno-institutional adaptation. How could support for the intermediation tasks outlined be bundled into a group of appropriate support services to be promoted at the international level? An operational programme could contain the following elements:

A. DIAGNOSIS AND VISIONING SUPPORT

This would involve supporting national partners to assess the intermediation priorities associated with specific themes and development opportunities. For example, this might be to help focus on disconnects between organizations relevant to an emerging theme, such as sustainable energy sources for agro-processing, and the identification of specific intermediation tasks needed to address these disconnects (in this case, connecting agricultural, industrial and energy pricing, policy and technical support). It may be about helping with a more general institutional analysis to identify areas where new ways of approaching problems may be needed. Finally it may be about helping develop different visions for agricultural sector development and exploring different patterns of reconfiguration under different development scenarios.

ACTOR ANALYSES

A network in the Netherlands has been working on generating energy from nature reserves in their own region for almost two years. They already made many contacts when working out the idea, for example with heating manufactures, drying houses, livestock farmers in the area, the forestry agency, municipal and provincial authorities. The participants gradually notice that the chief ambition they have is to get their idea off the ground in order to conserve the protected nature reserve. They see themselves chiefly as the devisers of the idea and lack the actual doers in their network. It becomes clear with a Network Analysis that in addition to being partners, they are also the link to all parties involved. How would it be if other parties also became a link? What if, for example, the province, an innovation broker or the forestry agency formed a link to potential buyers of natural biofuel? Even just the idea that such parties might be able to devote themselves to the realization of this innovation provides a new twist to the discussion about the network partners.

Source: Networks with free actors http://www.lei.wur.nl/uk/newsagenda/archive/news/2008/Networks_with_free_actors.htm

B. ESTABLISH AND SUPPORT NATIONAL AGRICULTURAL INNOVATION CAPACITY SUPPORT UNITS

This would involve working with national partners to establish and backstop specialized units to undertake intermediation tasks, with a specific focus on higher level institutional adaptation. The location of such a unit could be in an extension department, research institute or ministry of agriculture, although it may be more appropriate to locate it outside existing structures. Specific national and historical conditions need to be considered when defining the location of such units.

C. CHANGE MANAGEMENT SUPPORT

While intermediation is by definition a form of change management support, reorientation of working practices in large public organizations and bureaucracies brings with it special challenges. Change management is a well-developed professional field and is a specialized type of expertise that could be used to help national partners in cases where reconfiguration of systems and institutional adaptation requires major changes.

D. REFLECTIVE LEARNING SUPPORT

This would have two roles. The first would be in helping national partners systematically learn lessons about the effectiveness of programmes and initiatives and help with incremental institutional adaptation around emerging themes. Secondly, it would be an FAO function, to stimulate knowledge sharing and exchange of experiences across various institutions to develop generic lessons about techno-institutional adaptation from projects dealing with climate change and other topics.

E. SUPPORT TO INSTITUTIONAL LEARNING FOR TECHNICAL CHANGE EXPERIMENTS

This would involve assisting national partners to establish and learn from experiments that explore how institutional learning for technical change could be achieved. It might involve establishing a series of pilot initiatives and assisting with reflective learning and undertaking systematic research on change processes. Alternatively, it could involve establishing challenge funds to create opportunities for new modes of collaborative initiatives on selected themes with specific requirements for systematic learning from these experiments.

PILOTING NETWORK BROKERAGE, EXPLORING NEW OPPORTUNITIES AND ORGANIZING (LOCAL) INTERACTION AND PARTICIPATION TO SCALE UP AGRO-FORESTRY PRACTICES IN NIGER, WITH CARBON MARKET SUPPORT

Some practical examples of farmers responding to climate change deal with increased interest in Agroforestry; either as an adaptation or as a mitigation strategy. In Niger, foresters found that reforestation of degraded forest on hard laterite soils was difficult; but they observed in the 1980s that farmers managed trees on agriculture land if they were sure of the right to harvest. In some regions, farmers turned millions of hectares of agriculture land into "agroforestry parks" and the land can sustain an estimated 250 000 people – who harvest fodder and fuel wood for sale, to buy food in years of drought.

Yet, in the larger part of the country, farmers do not practice such beneficial agroforestry; they claim that trees are "too valuable and others will steal them" or "we never got a project". Some people figured that the emerging carbon markets might be a source of income for large-scale agroforestry support. Oxfam-Niger commissioned a study to find "all sources of support" for a nation-wide agroforestry initiative, varying from existing project expertise, to networks of NGOs, to national policy, to possible donor support. With local governments taking the lead to align existing expertise and experiences, local agroforestry initiatives can be initiated as part of the regular development agenda, with at least partly support by the carbon market.

Source: Governance for Green Agriculture http://www.govga.org

F. PROFESSIONAL DEVELOPMENT SUPPORT

This would involve helping strengthen the professional skills of national partners so that they could reorient their role towards intermediation for higher level institutional adaptation. This may involve a range of options, including developing short courses for professionals and policy makers, secondments, support to curriculum development in universities and even M.Sc. and Ph.D level training.

This could also mean filling in blind spots like role of private sector and gender aspects of climate change. Various studies have shown that especially poor rural women are vulnerable to climate change impacts (Angula, 2010). This is both because of inequalities between men and women and because of different positions and roles in society. In many African countries, 70-80 percent of the farmers are women. Despite the fact that there is recognition of gender differences in how climate change affects and impacts lives, climate funds and projects are often not thought to improve the lives of the rural women.

THE ROLE OF THE PRIVATE SECTOR IN CLIMATE CHANGE ADAPTATION

New opportunities are emerging from collaboration with private sector and entering green market segments. The last decade has shown a multitude of sustainability and fair trade labels coming into existence. In order to qualify for these labels, products need to fulfil certain production criteria, including addressing climate change. Example of such labels are Rainforest Alliance, 4C's and UTZ certified. Implementation of these certification programmes put a high demand on advisory services in terms of explaining, advising and coaching producers and facilitating new institutional arrangements.

CONCLUSIONS

Adopting the six support service area recommendations outlined would represent a bold step toward strengthening the role and orientation of research extension and communication for development in connection with climate change issues:

It would strengthen FAO's strategic relevance in agricultural development processes by aiming at the policy and institutional domain and this, in turn, would increase the scope of its activities for impact in the field of research, extension and communication for development;

It would underpin "theories of change" in line with innovation systems ideas. These ideas are gaining ground as a policy framework in international agricultural development. Member countries are likely to increasingly look for support within this new policy framework, this is partially of their own accord and partially because this perspective has been adopted by major donors and is increasingly part of the common development narrative.

There are also reasons why this new direction is opportune:

- It has already been argued that climate change as a topic is giving urgency to the need to adopt this interlinked techno-institutional adaptation agenda. Climate change could, therefore, be a vehicle to introduce this more broad-based perspective to agricultural development services. As a topic agricultural extension seems to be once again moving up the international development agenda with indications that large-scale investments are likely to happen in a range of extension-like activities. The establishment of the Global Forum on Agricultural Research and Advisory Services (GFRAS) and its regional networks is but one indication of this. While this brings with it the danger that this will push thinking back to strengthening advisory services from a technical perspective only, there are also a number of novel opportunities. Whilst there is much agreement that what went on before in extension planning and practice was inadequate, a new strategic direction has yet to solidify.

As outlined above, the proposal to reposition research, extension and communication for development in the face of climate change and other adaptation challenges may lead to working with new strategic partners. It is not likely that conventional extension organizations will develop into innovation intermediary organizations that work at multiple levels and in multiple arenas. But even within their current set-up conventional extension and research organizations might improve considerably. A number of small but meaningful changes are possible:

- Provide research and extension systems and organizations with up-to-date insights from innovation studies to make clear that all technical innovation requires re-organization of local institutions and social relationships;
- Provide research and extension systems with proposed changed job descriptions of above field-level extension staff, and make senior extension officers responsible for facilitating the local institutional change process;
- Enhance diagnostic and visioning skills at regional extension offices to facilitate future and opportunity-oriented extension programming;
- Conduct experiments with organizing interaction among relevant players in local level 'innovation systems' (e.g., local farmers, traders, processors, money lenders, chiefs, etc.,) in order to identify social and technical problems and opportunities.

Promote communication for development strategies and services to enhance knowledge sharing and intermediary functions in support of climate change adaptation and agricultural innovation.

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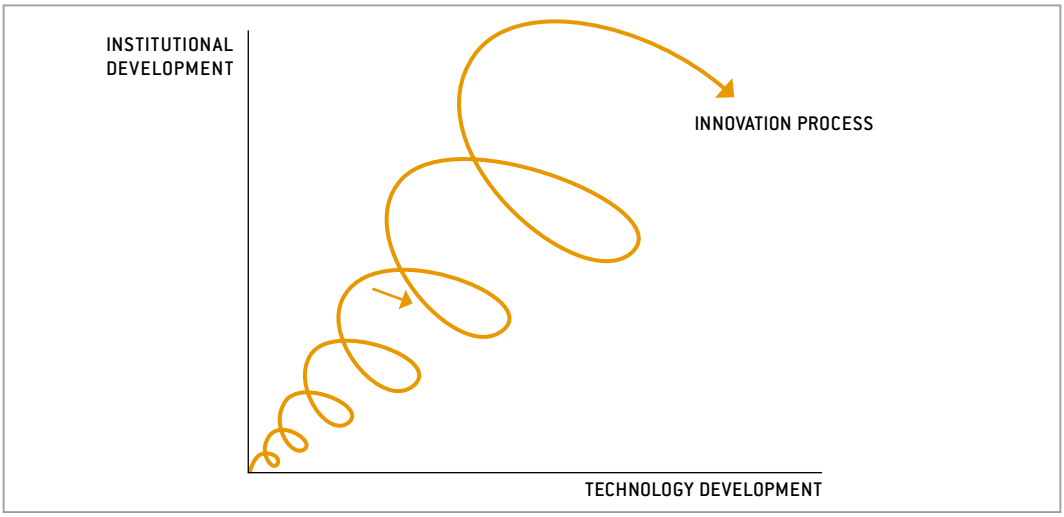
ANNEX 1

CONCEPTUAL FRAMEWORK: THE CHANGING ROLE OF EXTENSION, COMMUNICATION AND RESEARCH

1. ADAPTATION AS COMBINED TECHNICAL AND INSTITUTIONAL INNOVATION

From the literature on climate change it is clear that adaptation may involve an array of both technical and institutional responses. The idea that effective adaptation involves the use of a coherent set of technical and institutional responses and solutions is congruent with contemporary thinking in innovation studies. Nowadays innovation is no longer associated with technology only, but is looked at as a successful combination of 'hardware' (i.e., new technical devices and practices), 'software' (i.e., new knowledge and modes of thinking) and 'orgware' (i.e., new social institutions and forms of organization) (adapted from Smits, 2000, 2002; see also Leeuwis, 2004). Thus, climate change adaptation can be usefully regarded as a process of innovation.

Figure 1. Innovation as an iterative process in which novel connections are forged between technology and institutional arrangements



Source: Convergence of Sciences

It is important to recognize that coherent technical and institutional changes will be needed simultaneously across societal levels and arenas.

2. INNOVATION FOR ADAPTATION AS A PROCESS

It has become clear that adapting to climate change requires coherent responses from actors that operate at various levels (national, regional, local), in different sectors (agriculture, forestry, environment, industry) and of several kinds (e.g. public, private). In response to climate change (or other challenges) these parties are not in a position to realize change on their own. Whether they like it or not, therefore, actors (need to) interact with each other, and can be seen to be part of a network of interdependent actors. Although policy matters, it has become clear that change in networks cannot be engineered and steered in a centralized and top-down fashion (Scharpf, 1978; Dryzek, 1990; Rhodes, 1997; Healey 1997; Pierre, 2000).

Hence, we witness increasing attention on more interactive ways of fostering change, including 'network approaches' (Engel, 1995; Kickert et al., 1997; Rhodes, 2000), 'collaborative problem solving' (Gray, 1989), 'social learning' (Leeuwis and Pyburn, 2002, Wals, 2007) and 'consensual approaches' (Susskind and Cruikshank, 1987). In the context of (agricultural and non-agricultural) innovation studies, similar insights have been elaborated in the idea of fostering effective innovation systems (Edquist, 1997; Metcalfe, 1995; Hall ***et al***., 2001; Smits, 2002; Spielman, Ekboir, Davis, & Ochieng, 2008; Lenné, 2008). In innovation systems, networks of different players are transient and emerge around specific challenges and tasks at particular points in time. Public research and extension are among these players, but their value is as responsive elements of a network or system, rather than in their own right (Sumberg, 2005; Kristjanson ***et al***., 2009). Other players such as the private sector or civil society organizations have a prominent role, not just as passive knowledge users or transmitters, but as pro-active agents who are interdependent in working towards effective socio-technical innovations (Hall ***et al***., 2001; Leeuwis, 2004; Biggs, 2007).

Experience has taught us that it is a mistake to think in terms of an optimal 'one-size-fits-all' model for organizing research and extension in support of agricultural innovation and/or climate change adaptation (Sulaiman & Hall, 2008; Hartwich, Gottret et al., 2007). However, at a more abstract innovation theoretical level, we can say that any innovation support infrastructure should be able to support three essential processes. The first process is that of network building. We have seen that innovation inherently implies a re-configuration of relationships within and between networks, and possibly the formation of new networks and/or the demise of existing ones (Engel, 1995; Callon et al, 1986; Latour, 1987). A second key process is of supporting social learning. In different strands of thinking about innovation, learning is considered a critical process for developing a conducive fit between innovations and their environment (Geels, 2002; Rotmans, 2003; Smits & Kuhlmann, 2004; Hommels et al, 2007). Moreover, the development of congruent storylines and discourses (Hajer & Laws, 2006; Grin & Van de Graaf, 1996) requires that the parties involved slowly develop overlapping — or at least

complementary — perspectives on relevant models of reality, problems, goals and boundaries as a basis for identifying desirable, feasible and acceptable options for change. Dialectical debate and joint learning are proposed as the main route towards achieving this (Checkland, 1988). Several scholars have labelled this process 'social learning' (Dunn, 1971, Friedmann, 1984, Röling, 2002, Woodhill, 2002; Leeuwis, 2002). The third key process that needs to be supported is dealing with dynamics of power and conflict. The existence of competing human values and interests in complex problem settings implies that efforts to change the status quo are likely to lead to tensions and conflicts of various kinds. Moreover, the realization of change in one way or another involves the mobilization of power resources to overcome resistance. Our point here is not that dynamics and power and conflict must be prevented. Instead we argue that they are always at play, and that there are more and less productive ways of dealing with them.

3. THE ROLE OF EXTENSION AND COMMUNICATION IN INNOVATION PROCESSES: MULTIPLE MODES OF INTERMEDIATION

Theoretical and practical literature on learning, negotiation, participation and communication provide numerous insights and suggestions on how the three basic processes indicated in the previous section could (depending on a specific context) be facilitated and enhanced through communicative strategies. In Table 2 (derived from Leeuwis & Aarts, 2010) we list such strategies.

When resorting to more conventional terminologies used in the sphere of extension and communication literature, the kinds of activities mentioned in Table 2 still include well known strategies and services such as:

- Advisory Communication;
- Organizing horizontal exchange in support of diffusion;
- Persuasive mass media campaigns;
- Awareness raising;
- Training;
- Information provision.

Table 2. Examples of possibly relevant communicative strategies for enhancing the basic processes relevant to innovation support

NETWORK BUILDING	SUPPORTING SOCIAL LEARNING	DEALING WITH DYNAMICS OF POWER AND CONFLICTS
• Make an inventory of existinginitiatives, complemented with stakeholder analysis • Build on existing initiatives for change and the networks around these • Arrange contact between disconnected networks that may have compatible interests (e.g., Chinese consumers and African farmers) • Work towards 'coalitions of the willing' and exclude actors who do not feel interdependent • Mobilize pressures from outside (carrots and sticks) to enhance feelings of interdependence • Forge contact with outsiders and outside expertise	• Demonstrate and visualize interdependencies among stakeholder practices • Explore and exchange stakeholder perspectives (values, problems, aspirations, context, etc.) through discussion, role playing, dramatization, visits, filmed interviews, informality, humour, fun etc. • Visualize invisible bio-physical processes with the help of discovery learning tools or simulation • Explore past and current trends and likely futures if nothing changes • Use visioning tools and scenario analysis to imagine (and find common ground on) possible futures • Discuss institutional and other influences that reinforce existing patterns/problems • Organize contact with others who have encountered and managed similar problems • Elicit uncertainties that hinder change, and design collaborative investigation and experimentation to develop common starting points • Use practical actions and experiments as a source of reflection and learning, rather than organizing discussion and reflection only • Organize regular reflection on process dynamics and satisfaction with outcomes	• Identify and propose process facilitators who are credible and trusted by the stakeholders involved • Work towards process agreements, including dealing with media, mandates, etc. • Probe to explicate the interests and fears that underlie mobilized arguments and counter-arguments • Steer collaborative research activities (see other column) to questions relevant to less resourceful stakeholders • Make stakeholders talk in terms of proposals and counter-proposals • Ensure regular communication with constituents to take them along in the process • Translate agreed-upon problems and solutions into storylines and symbols that are likely to resonate in society • Use media and lobby tactics to influence societal agendas and advocate solutions (with the help of storylines/ symbols)

Sources: Pretty et al, 1995, Loorbach, 2007; Smits & Kuhlmann, 2004; Weisbord & Janoff, 1995; Aarts, 1998; Pruitt & Carnevale, 1993; Leeuwis, 2004

However, in order to make innovation happen in a network-like configuration, such classical activities need to be accompanied by (and embedded in) other communicative strategies and services (see Leeuwis, 2004; Klerkx & Leeuwis, 2009) such as:

- Network brokerage;
- Demand articulation and knowledge brokerage;
- Visioning;
- Process facilitation;
- Interactive design and experimentation;
- Learning-oriented monitoring;
- Exploration of opportunities and constraints;
- Lobby advocacy communication;
- Conflict management.

It is in the context of such 'new' communicative tasks and strategies in an innovation trajectory that 'old' strategies can become meaningful and appropriate, usually at later stages of an innovation trajectory. Moreover, it is important to realize that both 'old' and 'new' strategies may usefully involve a range of communication media (interpersonal, mass media, hybrid ICT, etc.).

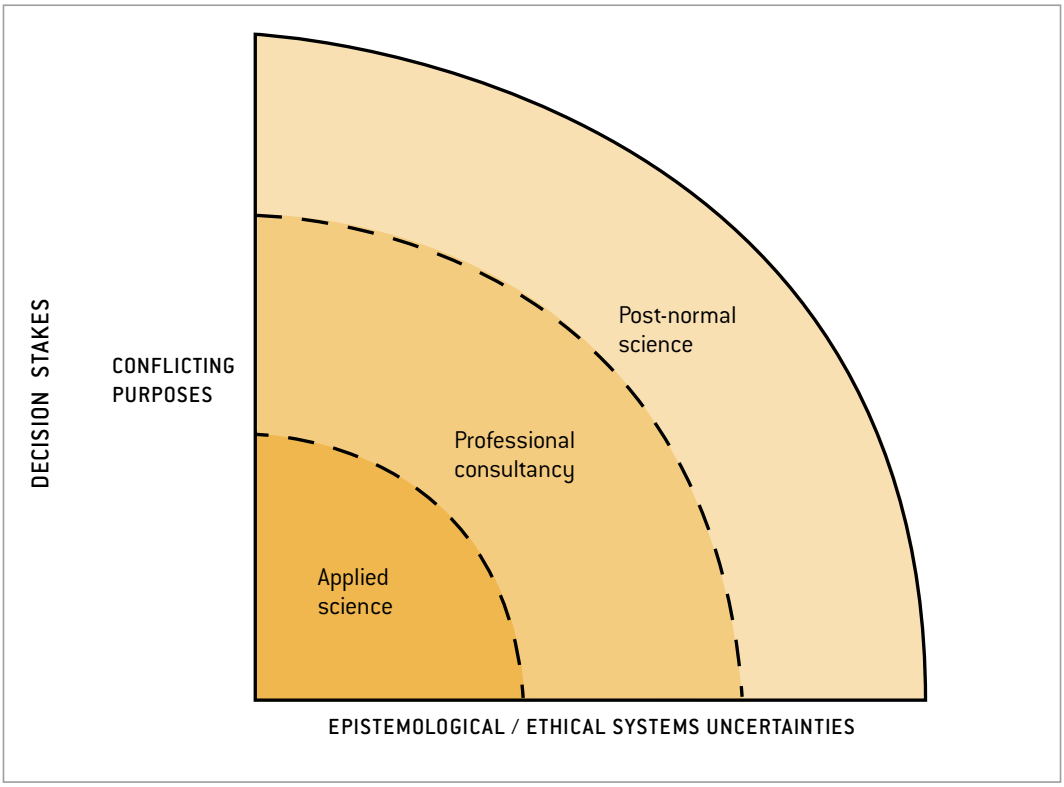
What we seen, in essence, is a broadening of the role of extension and communication professionals in innovation trajectories. While in the linear 'transfer of technology' model communication was primarily seen as an intermediary function between science and practice, we now see a much broader range of intermediary roles. As indicated in Table 2, these include, for example, mediation in conflict situations; network and knowledge brokerage; facilitation of exchange, learning and vision building among diverse communities; matching of supply and demand of innovation support services (e.g., research); etc. Moreover, the intermediary roles that we are discussing now happen at a range of interfaces that are situated within (and between) networks of stakeholders operating in different societal spheres. In terms of substance, such intermediary processes do not mainly address the qualities of given technologies in connection with assumed or proposed problems (as in the linear model), but rather centre on a range of human aspects and attributes that bear relevance to the building of networks and reaching agreement and coherence (Röling, 2002; Grin & Van de Graaf, 1996) within and between them. Such attributes include, for example, stakeholder characteristics, interests, perspectives, motives, agendas, fears, visions, uncertainties, questions, etc. In practice, we see that such broader intermediaries have indeed emerged in present-day innovation systems (see Smits & Kuhlmann, 2004; Howells, 2006; Klerkx & Leeuwis, 2008; Klerkx, Hall & Leeuwis, 2009), and complement the activities of classical intermediaries that focus on disseminating technology. At the same time a range of authors signal that there is

still considerable scope for strengthening the quality and position of such intermediaries in innovation landscapes (Hall, 2005; Smits & Kuhlmann, 2004; Klerkx, 2008). An important question here is whether agricultural extension organizations are willing and able to play broader roles. These organizations have always had the mandate to play an intermediary role in innovation processes and could, in principle, expand their activities to include those mentioned in Table 2. However, this would have to go along with considerable change in terms of staffing and organizational capacities (see Leeuwis, 2004). Partnerships with other services providers such as producers organizations, community media and NGOs may provide alternative paths.

4. THE ROLE OF RESEARCH IN INNOVATION PROCESSES FOR CLIMATE CHANGE ADAPTATION

In our introduction we have argued that climate change goes along with the emergence of complex problem situations. This has important implications for the role of scientists and research since different levels of complexity require different modes of operation by scientists (Funtowicz and Ravetz, 1993; Gibbons et al., 1994). In 'low complexity' situations where both uncertainty and decision stakes are low (i.e., goals are not contested), Funtowicz and Ravetz (1993) argue, scientists can suffice to act as *applied scientists* and engage in 'puzzle solving'. If uncertainty and stakes are moderate, scientists can act as *consultants*; scientific knowledge is then combined with context-specific expertise and tacit judgements. In case of high uncertainty and decision-stakes, scientists need to engage in *post-normal science*. They have to become intensely involved in societal interactions and collaborative forms of research in order to contribute to the development of shared views and value commitments (Figure 2). Societal stakeholders (or: the actors in an innovation system), then, become part of an 'extended peer community' (Funtowicz and Ravetz, 1993).

Figure 3. Different roles of science in relation to decision-stakes and uncertainties



Source: Functowicz and Ravetz, 1993

'Post-normal' innovation trajectories and innovation systems are not likely to be successful if they are scientist-owned and/or initiated (Leeuwis, 1999; Broerse & Bunders, 1999). In a learning and negotiation process, knowledge generated in various locations (e.g., research stations and farmers' fields) by different stakeholders (e.g., researchers and farmers), for dissimilar purposes (e.g., assessing the 'truth' and promoting stakeholder interests) and through different procedures of validation (e.g., scientific method and farmer experience) must be creatively articulated and integrated. In such innovation processes, then, scientists (in the broadest sense, so including consultants, technical experts, knowledge brokers, applied researchers, etc.) can be seen as resource persons who can play four basic roles during social learning and negotiation processes:

- **Help explicate implicit assumptions, knowledge claims and questions**: Discussions among stakeholders usually contain a range of implicit knowledge claims, assumptions and questions. Frequently, progress in social learning and negotiation processes is hampered when these remain implicit and do not become a point of explicit discussion and reflection. Such explication is far from easy and can never be complete. Nevertheless, not only process facilitators, but scientists from different disciplines can also play a useful role in this respect. From scientists one may expect a

special sensitivity for the assumptions, knowledge claims and questions that are hidden in what stakeholders say or do not say about their specific field of expertize. Hence, dialogue between stakeholders and scientists may contribute toward making explicit what was implicit previously, and result simultaneously in a coherent set of relevant natural and social science questions.

- **Joint fact-finding and experimentation**: Research can play a role in joint fact-finding geared towards answering shared questions and reducing uncertainties that affect the innovation process. The purpose of this type of natural and/or social science-research is not only to provide answers, but also to build confidence, trust and shared perspectives among stakeholders by working together on an issue in the first place (Van Meegeren & Leeuwis, 1999). Depending on the questions addressed such research may involve on-farm research, laboratory research by scientists, computer simulations etc., as long as it remains part of a commonly agreed upon — and preferably iterative (see Vereijken, 1997) — procedure. In the context of such research, scientists also need 'free space' to follow their own intuitions (see Van Schoubroeck & Leeuwis, 1999).
- **Feedback**: Results from research can serve as more or less confrontational feedback in order to induce learning, i.e., through the creation of new problem definitions. Such feedback from natural and/or social scientists may be provided by research data on the existing situation, but may also arise from comparison with totally different situations (including laboratories) or computer-based projections about the future (Rossing et al., 1999; Röling, 1999). This can also include comparison with radically new technological and organizational solutions. These latter kinds of feedback may serve to enlarge the space within which solutions are searched for.
- **Process monitoring**: Research can play a role in monitoring the social dynamics of the learning and negotiation process itself, in order to inform its organization and further facilitation. How are relations between stakeholders developing? Which new developments, questions, wishes and problems emerge? How do these affect progress, and what can be done about it? It is important to realize here that playing a role as outlined above requires different modes of operation by researchers than are currently dominant. It requires, for example, (a) intensive cooperation between stakeholders, change agents and researchers, (b) cross-disciplinary cooperation among scientists (as the solving of problems may well involve integration of insights from various disciplines), (c) greater emphasis on on-farm (or 'in-society') experimentation, (d) new procedures for setting research agendas, etc. (see also Bouma, 1999; Van Schoubroeck & Leeuwis, 1999; Vereijken, 1997; Klerkx & Leeuwis, 2008). Similarly, Gibbons et al (1994) argue that there is a need for scientists to shift from 'Mode 1' to 'Mode 2' science.

Table 3. Key differences between 'Mode 1' and 'Mode 2' science (Gibbons et al., 1994)

'MODE 1' SCIENCE	'MODE 2' SCIENCE
• Academic context	• Application-oriented
• Disciplinary	• Trans-disciplinary
• Homogeneous	• Heterogeneous
• Hierarchic and stable	• Heterarchic and variable
• Academic quality control	• Quality measured on a wider set of criteria
• Accountable to science	• Accountable to science and society

5. NEWLY EMERGING LANGUAGES AND PROFESSIONAL LANDSCAPES

As can be noted from the above the roles that change agents (i.e. extension staff and communication professionals) and researchers may play in supporting climate change adaptation (and/or in dealing with other complex problem settings) are broad and different from what we have been used to. Along with this, the terminology that is used to indicate these roles has evolved over time. Moreover, nowadays we see that there are many staff members within government bodies, private consultancies, civil society organizations, development NGOs, research organizations and private companies who use a variety of communication strategies in order to stimulate change and innovation. Many of these do not identify with (or may not even know) classic terms like 'extension' or 'communication for development'. In addition to the terms already presented earlier, we present a few terms below that are currently being used inside and outside the agricultural arena to characterize important dimensions of this professional field:

- Innovation capacity development;
- Innovation support services;
- Innovation brokerage and intermediation;
- Communication for innovation services;
- Change management;
- Governance of science and technology;
- Institutional learning and change;
- Facilitation of social learning;
- Multi-organizational partnership development.

Different terms have different origins and connotations. Several of these terms may better capture and convey what is needed for climate change adaptation than 'research, extension and communication for development'.

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