Final Report

ICTs and small-scale agriculture in Africa: a scoping study

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on behalf of the

International Development Research Centre (IDRC)

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Finally, I acknowledge with gratitude Mr. Anthony Wairago for assistance in compiling information on past, on-going and planned initiatives on information and communication technologies (ICTs) and small-scale agriculture in Africa.
### Acronyms and abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AARINENA</td>
<td>Association of Agricultural Research Institutions in the Near East and North Africa</td>
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<tr>
<td>ACP</td>
<td>Africa, Caribbean and the Pacific</td>
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<td>AGOA</td>
<td>Africa Growth and Opportunity Act</td>
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<td>APP</td>
<td>Agricultural Productivity Project</td>
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<td>ATIRI</td>
<td>Agricultural Technology and Information Response Initiative</td>
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<td>ASARECA</td>
<td>Association for Strengthening Agricultural Research in Eastern and Central Africa</td>
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<td>ASIP</td>
<td>Agricultural Sector Improvement Programme (ASIP)</td>
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<td>ASMP</td>
<td>Agricultural Sector Management Programme (ASMP)</td>
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<tr>
<td>CAADP</td>
<td>Comprehensive African Agriculture Development Programme</td>
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<td>CCK</td>
<td>Communication Commission of Kenya</td>
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<tr>
<td>CGIAR</td>
<td>Consultative Group of International Agricultural Research</td>
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<tr>
<td>CIAT</td>
<td>International Centre for Tropical Agriculture</td>
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<td>CIDA</td>
<td>Canadian International Development Agency</td>
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<td>COMESA</td>
<td>Common Market for East and Southern Africa</td>
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<td>CORAF/WECARD</td>
<td>Conseil ouest et centre africain pour la Recherche et le développement Agricole / West and Central African Council for Agricultural Research and Development</td>
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<tr>
<td>CTA</td>
<td>Technical Centre for Agricultural and Rural Cooperation</td>
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<tr>
<td>DATICS</td>
<td>District Agricultural Training and Information Centres</td>
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<tr>
<td>DFID</td>
<td>Department for International Development</td>
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<tr>
<td>EACAPAPA</td>
<td>Eastern and Central Africa Programme for Agricultural Policy Analysis</td>
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<tr>
<td>E-mail</td>
<td>Electronic mail</td>
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<td>ERSP</td>
<td>Economic Recovery Strategy Paper</td>
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<td>EU</td>
<td>European Union</td>
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<td>FAAP</td>
<td>Framework for African Agricultural productivity</td>
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<td>FARA</td>
<td>Forum for Agricultural Research in Africa</td>
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<td>FAO</td>
<td>Food and Agriculture Organisation of the United Nations</td>
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<td>GCC</td>
<td>Ghana Communication Commission</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GTZ</td>
<td>Gesellschaft für Technische Zusammenarbeit (Germany)</td>
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<tr>
<td>ICM</td>
<td>Information and communications management</td>
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<td>ICRAF</td>
<td>World Agroforestry Centre (formerly International Centre for Research in Agroforestry)</td>
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<td>ICM</td>
<td>Information and Communication Management</td>
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<td>ICT</td>
<td>Information and Communications Technology</td>
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<td>IDG</td>
<td>International Development Goals</td>
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<td>IDRC</td>
<td>International Development Research Centre (Canadian)</td>
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<td>IFAD</td>
<td>International Fund for Agricultural Development</td>
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<td>IFPRI</td>
<td>International Food and Policy Research Institute</td>
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<td>IICD</td>
<td>International Institute for Communication and Development</td>
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<td>IOC</td>
<td>Indian Ocean Commission</td>
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<td>INASP</td>
<td>International Network for the Availability of Scientific Publications</td>
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<td>Acronym</td>
<td>Full Form</td>
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<td>IWMI</td>
<td>International Water Management Institute</td>
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<td>KARI</td>
<td>Kenya Agricultural Research Institute</td>
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<td>MDG</td>
<td>Millennium Development Goals</td>
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<td>MISTOWA</td>
<td>Market Information System and Trade Organisations in West Africa</td>
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<td>NARO</td>
<td>National Agricultural Research Organization (Uganda)</td>
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<td>NEPAD</td>
<td>New partnership for Africa’s Development</td>
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<td>NGO</td>
<td>Nongovernmental organization</td>
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<td>NORAD</td>
<td>Norwegian Aid for Development</td>
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<td>PDA</td>
<td>Personal digital assistant</td>
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<td>PEAP</td>
<td>Poverty Eradication Action Plan</td>
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<td>PMA</td>
<td>Plan for Modernization of Agriculture</td>
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<td>PRSP</td>
<td>Poverty Reduction Strategy paper</td>
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<td>RAIN</td>
<td>Regional Agricultural Information Network of ASARECA (Entebbe)</td>
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<td>RCDF</td>
<td>Rural Communication Development Fund</td>
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<td>SADC</td>
<td>Southern African Development Community</td>
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<td>SADC-FANR</td>
<td>SADC’s Food, Agriculture and Natural Resources Directorate</td>
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<td>SSA</td>
<td>Sub-Saharan Africa</td>
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<tr>
<td>UCC</td>
<td>Uganda Communication Commission</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UN CST</td>
<td>Uganda National Council for Science and Technology</td>
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<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
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<tr>
<td>VERCON</td>
<td>Virtual Extension Research and Communication Network</td>
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<td>WFS</td>
<td>World Food Summit</td>
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<td>WSSIS</td>
<td>World Summit on the Information Society</td>
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<td>WTO</td>
<td>World Trade Organization</td>
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Executive Summary

Agriculture plays a very important role in the social and economic development of most African countries and is the main contributor to economic growth and stability. The sector not only contributes to the national Gross Domestic Product (GDP) and employment creation, but is also a source of foreign exchange earnings. In Africa agriculture contributes to poverty alleviation and food security and thus serves as the engine for economic growth and improved livelihoods. Small-scale agriculture and the harvesting of natural resources provide livelihoods for over 70% of the African population. However, most small-scale farmers are resource-poor and face many challenges. It has been pointed out that emerging technologies and new materials are key success factors in addressing the challenges of small-scale farmers. There are also new opportunities for Africa through new markets, high value products, access to biotechnology and improved information and communication technologies (ICTs). Information and knowledge are considered prime productive resources and play a key role in ensuring food security and sustainable development.

Involvement of the International Development Research Centre’s (IDRC’s) Acacia Programme

The International Development Research Centre’s (IDRC’s) Acacia Programme has developed a new Strategic Plan (2006-2011). ICTs and small-scale agriculture, including environment and NRM, are a key focus under the Plan, and falls under the research theme on economic development and opportunity. Against this backdrop, the Acacia Programme commissioned a researcher, Mrs. Hilda Munyua, to conduct a scoping study on ICTs and small-scale agriculture in Africa to explore the opportunities presented by ICTs in small-scale agriculture, including environment and natural resources management. The study aimed to provide working definitions for small-scale agriculture, environment and natural resources management and provide justification of as to why the focus on this sector; provide an overview of emerging issues in small-scale agriculture in Africa; identify implementers and innovative ICT applications; factors that influence the use of ICTs; and identify the key players in ICTs and small-scale agriculture and natural resources in Africa and options for developing an Africa-wide initiative to address the spelt out needs.

Methodology and scope of the study

The present study was carried out through a mix of methods. A desk research was carried out to review secondary sources. The desk study was augmented by findings from field observations and individual and group interviews with key informants in the agricultural sector. A checklist was developed to guide interviews, and field visits were made to Botswana, Ghana, Kenya and Uganda. Observations were made during field visits, which took place during the months of February and March 2007. Where it was not possible to conduct face-to-face interviews, the checklist was e-mailed to respondents and responses were received by e-mail, through telephone interviews and / or Skype. Informal discussions were held with respondents in South Africa (Pietermaritzburg) during a separate visit by the researcher.

The breadth of scope of the study - ICTs and agriculture, natural resources management and the environment, and the geographical coverage of Africa was very broad and was not attainable within the available time and resources. Field visits were not made to Francophone West Africa and North Africa. The study, therefore, focuses more on Sub-Saharan Africa.
About 40 institutions and a total of 66 respondents provided feedback. Of the respondents, about 38% were female and 62% were male. This study has brought out a number of important findings that could be addressed through the use and application of ICTs:

**Some key issues and challenges facing small-scale farmers**

Small-scale farmers in Africa have small farm sizes leading to diseconomies of scale and a weak knowledge-base. They practice subsistence agricultural production systems and use mainly traditional tools. They do not use adequate agricultural inputs which leads to declining agricultural productivity. Small-scale farmers have a poor market infrastructure and inadequate marketing experience. The prices offered for farmers’ produce are poor and there is poor access to credit and weak backward and forward links between agriculture and other sectors. There are challenges of food insecurity, poor storage facilities, inadequate value addition, natural resource and environmental degradation, and declining soil fertility. Other challenges include inadequate security in land tenure, poor water resources management, low irrigation infrastructure, poor extension services, poor access to agricultural knowledge, information and technologies, inappropriate technologies for the circumstances of farmers, poor rural infrastructure (roads, electricity, and telecommunications), HIV/AIDS, illiteracy and high poverty levels. Improved technologies do not filter down to farmers and indigenous knowledge on natural resources management (NRM) is not passed on to younger generations. Small-scale farmers are often threatened by globalization and unfair trade practices. Further, they are exploited by middlemen and lack subsidies. They mainly rely on family labour and seldom practice irrigation.

**Emerging agricultural issues**

Several agricultural issues are emerging as important including the application or biotechnology, commercialization of subsistence farming and formation of focal points of interaction. Although it is controversial in some African countries, biotechnology has opportunity for increasing agricultural productivity and the potential to yield high value agriculture that has the capacity for enhancing incomes of small-scale farmers and reducing poverty. Transformation of subsistence agriculture and/or the adoption of commercial agricultural practices in response to market requirements have been widely viewed as potential sources of income that can be used to address poverty. There is, however, an overarching need to create focal points of informal or formal interactions, in form of consortia, associations or networks, to address issues of improved marketing - including access to markets and gathering and sharing market intelligence.

**Emerging ICTs and their potential in revitalizing and/or promoting the growth of small-scale agriculture**

Some of the emerging ICT applications in small-scale agriculture in Africa include Geographic Information System (GIS), Decision Support Systems (DSS), market information system (MIS), distance learning, databases, land use planning, public access facilities, mobile applications, restructuring of extension and personal digital assistants (PDAs). Precision farming is currently practised by large-scale farms that can afford the high investment, skills and expertise required. These modern ICTs could play a major role in communicating knowledge and information to rural agricultural communities, delivering education modules, accessing inputs, markets and market prices, credit, conducting business, facilitating networking and strengthening partnerships, scaling up inter-linkages of development interventions and increasing agricultural productivity. Media such as the internet, web-based means, mobile telephony, video, audio cassettes, CD-ROM, radio, fax and computer-mediated networks among others are being used in a number of initiatives in Africa to provide development solutions. Examples of these applications are presented in Annex 2. A number of organizations including the Kenya Agricultural Commodity Exchange (KACE) and
DrumNet in Kenya and the Busoga Rural Open Source and Development Initiative (BROSDI) in Uganda plan to use GIS applications to link farmers to markets and to forecast harvests.

Precision Agriculture (PA), described as the “next great evolution in agriculture”, adapts to variability and ensures sustainable natural resources for future production, optimum sowing density, efficient use of inputs such as fertilizers, irrigation and pesticides. This increases profitability through optimum recommendations and environmental protection. PA is largely used by large-scale farmers who have low labour inputs and resources. While PA was until recently virtually unknown in Africa, it is now being introduced and practiced in a few countries including South Africa, Mauritius and Sudan. PA has the potential to revolutionalise farming and farming systems Africa, for the good of the resource poor-rural producers.

Arguably, Africa’s greatest success story to date in telecommunications is the swift spread of mobile telephony throughout the continent. Africa’s mobile market has been the fastest growing of any region over the last five years, and has grown twice as fast as the global market, chiefly due to the slow pace of fixed-line liberalization. The cellular phone is now considered one of the most promising emerging ICTs that has not only revolutionized the manner in which business is transacted in Africa but also enabled a large constituency of agricultural producers to access markets and market information using phone-in and Short Messaging Service (SMS). Some of the initiatives that use the SMS to access market information include Tradenet.biz, Foodnet, KACE, DrumNet, Malawi Agricultural Commodity Exchange (MACE), National Livestock Information System (NaLIS), Kenya and BROSDI, among others. Safaricom Limited and Celtel Limited have introduced direct money transfer by cell phone to transfer credit in Kenya. Indeed as one respondent in the present study observed ‘the focus is not computers but cell phones.’

The Frequency Modulated (FM) radio stations, which are mostly private sector initiatives and are a result of liberalized airwaves in Africa, have become handy tools in improvement of small-scale agriculture in rural areas. These FM stations are being applied to facilitate access to markets, electronic trading and accessing up-to-date and timely agricultural and market information. Integrating rural radio and cellular phone being used by the ‘Soko Hewani’ initiative in Kenya has demonstrated emerging roles of FM and community radio in revolutionising communication and agricultural trade. Initiatives by the Panos Institute of West Africa (PIWA), FAO, UNESCO and CTA, among others, have demonstrated the convergence of radio and internet technology and how these technologies can provide new opportunities for rural development. It was observed such opportunities can be best exploited through sharing of knowledge and information resources, provided that they are adapted to suit local conditions and requirements in terms of content, level, format and language.

The Radio Frequency Identification (RFID) technology has been used for livestock identification and traceability in South Africa and Botswana. The RFID captures data on individual animals which is transmitted to a central database as a repository of information for livestock farmers, state veterinary services and health authorities. This technology has enabled South Africa and Botswana to meet the traceability condition (a prerequisite for entry into lucrative meat markets) imposed by the European Union, Saudi Arabia and other trading blocks.

The WorldSpace satellite radio is considered appropriate for disadvantaged rural areas as it enables rural communities to download development content where there is no internet connectivity. A number of initiatives and organizations including the Open Knowledge Network (OKN) in East and
West Africa, BROSDI in Uganda, the Arid Lands Information Network (ALIN) - East Africa and AfriAfya in Kenya are using the technology to disseminate agricultural related information to rural communities. Based on cost and practicality, a balanced mix of FM, RFID, WorldSpace satellite radio and internet connectivity could be considered by organizations and initiatives supporting or working with small-scale farmers to enhance rural development by facilitating access to markets and up-to-date and timely agricultural and information and knowledge.

World over, the internet, e-mail, web-sites and web-based applications are becoming increasingly important for sharing and disseminating agricultural information and knowledge, marketing of goods and services and for trading purposes. In Africa DrumNet in Kenya is developing a web-based system to facilitate small-scale farmers to access information, markets, credit, inputs and some trading transactions while Tradenet.biz in West Africa, Foodnet in East and Central Africa, KACE in Kenya and MACE in Malawi have developed electronic trading platforms.

**Key findings**

*Addressing key issues and challenges facing small-scale farmers*

- Small-scale farmers in Africa could utilize their small farms more efficiently and effectively by adopting commercial agricultural practices, high value crops and technologies such as biotechnology in response to market requirements. This would earn them more money through increased productivity and improve their livelihoods. Information on these new and improved technologies could be accessed through use ICTs such as WorldSpace satellite radio, internet, community and FM radios and videos among others.

- There is, however, an overarching need to create focal points of informal or formal interactions, in form of consortia, associations or networks, to address issues of improved marketing - including access to markets and gathering and sharing market intelligence.

- ICTs could be used to exploit training opportunities on new or improved technologies such as biotechnology and high value crops through distance learning. Intermediaries could participate in such training and in turn train the various farmer groups they work with.

- There are a number of market information systems using various combinations of ICTs such as internet, interactive radio and cellular phone. These include Tradenet.biz, MACE, KACE, Foodnet and others. These could be promoted more widely to ensure small-scale farmers have access to markets, price and market information.

- Available micro-finance models using ICTs such as the use of the cell phone in sending and accessing credit such as M-PESA, could be rolled out to other countries in Africa to benefit small-scale farmers. Different institutions and projects working with small-scale farmers could also be encouraged to promote this and similar models developed in other countries to provide credit services to small-scale farmers to enable them improve their farming practices (e.g. through purchase of inputs, transportation of produce to markets).

- ICTs have been effectively used for disseminating innovation in some African countries such as the case of BROSDI in Uganda. There is a wealth of information on new and improved technologies and innovation being generated in Africa. The challenge of improved technologies not filtering down to farmers could be addressed through increased use of ICTs such as the internet, chat, radio, print, knowledge fairs, DVDs and other audio-visual tools as well as inter-personal interactions.

- Likewise, challenges pertaining to indigenous knowledge not being passed on to younger generations could be addressed by developing knowledge bases and web-sites that capture existing indigenous knowledge. Appropriate ICTs such as video, DVDs and audio tapes and
print could also be used to capture, preserve and disseminate indigenous knowledge to small-scale farmers.

**Exploiting emerging ICTs and their potential in revitalizing / promoting the growth of small-scale agriculture**

Based on cost and practicality, a balanced mix of FM, RFID, WorldSpace satellite radio and internet connectivity could be considered by organizations and initiatives supporting or working with small-scale farmers to enhance rural development by facilitating access to markets and up-to-date and timely agricultural and information and knowledge. IDRC and other development partners could support initiatives employing emerging ICTs such as GIS, DSS, MIS and distance learning among others.

Specifically, IDRC and other development partners could support initiatives employing mobile applications and PDAs to improve extension services among small-scale farmers in Africa. Precision farming is described as the “next great evolution in agriculture”. Although the technology is not affordable to small-scale farmers, development partners and research institutions could work with small-scale farmers’ groups to attain optimum recommendations and environmental protection.

IDRC and other Development partners could support further research into the cellular phone that has proved promising in rural areas. Successful initiatives such as Tradenet.biz, Foodnet, KACE, DrumNet, MACE, NaLIS and BROSDI could be promoted to ensure small-scale farmers are aware of and use these systems for improved markets and access to / transfer credit.

The RFID technology could be promoted to other African countries to ensure they meet the traceability condition that enables them access lucrative meat markets.

**Some factors influencing use of ICTs as support tools in small-scale agriculture**

Despite the high potential of ICTs in improving small-scale agriculture in Africa, there are low usage patterns and anecdotal adoption. This situation is mainly due to the fact that ICT initiatives are scattered and uncoordinated. Consequently, there is high cost of available technologies, inadequate infrastructure and ICT skills, poor and expensive connectivity, inappropriate ICT policies, language barriers, high cost of ICT technologies and telecommunication, low bandwidth, inadequate and / or inappropriate credit facilities and systems. Further, there is poor involvement of women and other disadvantaged groups, inadequate appropriate local content, weak institutions and inadequate collaboration and awareness of existing ICT facilities and resources, a poor information sharing culture and low awareness of the role of ICTs in development at all levels. IDRC and other development partners could work together to produce an inventory of ongoing initiatives with links to the specific organisations implementing the initiatives. This would provide help the sharing of ideas, innovations and lessons learned by the respective initiatives. Likewise, IDRC and other development partners could promote ICT initiatives that target women and other disadvantaged groups such as the youth.

**Policy issues that impact on production, productivity and marketing opportunities of small-scale farmers**

There are a number of continental, subregional and national policy regimes and ICTs that relate to agriculture and small-scale farmers in Africa including agricultural and natural resource management policies, land reform policy and institutional framework.
At continental level, the New Partnership for Africa’s Development (NEPAD) is focusing on seven priority areas, including agriculture and has developed the Comprehensive Africa Agriculture Development Programme (CAADP) to help address the plight of rural producers. CAADP sets Africa’s agricultural agenda and forms the bedrock for assisting the attainment of the Millennium Development Goals (MDGs) related to poverty, hunger and ensuring environmental sustainability. The Forum for Agricultural Research in Africa (FARA) supports the CAADP pillar on agricultural research, technology, dissemination and adoption including capacity building in research and extension. FARA has developed the Framework for African Agricultural Productivity (FAAP) to make research more relevant and form linkages with key agricultural actors including small-scale farmers, extension workers, NGOs and private sector.

At sub-regional level, there are several sub-regional organizations (SROs) and agricultural policy frameworks that focus on improving productivity and competitiveness of smallholder agriculture, implementation of a common regional market and adaptation of external trade regime. CAADP implementation is facilitated through SROs such as the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the Conseil ouest et centre africain pour la recherché et le développement Agricole / West and Central African Council for Agricultural Research and Development (CORAF / WECARD) and the Southern African Development Community / Food, Agriculture and Natural Resources Directorate (SADC-FANR). Networks within SRO such as the Eastern and Central Africa Programme for Agricultural Policy Analysis (ECAPAPA) have also spearheaded the rationalization and harmonization of policies e.g. the seed trade policies in Eastern Africa. SADC/FANR indicated it is working towards the development of a common agricultural policy for the Southern Africa region.

At national level, the Poverty Reduction Strategy Programmes (PRSPs) guide country intervention strategies and investment programmes. Among the challenges for CAADP at country level is the translation of policy into national strategies and programmes.

On ICT policies, most participating institutions and respondents indicated that most national policies do not clearly and adequately address the use and application of ICTs for rural communities. It was observed that most national PRSPs and other sector policies such as the Agricultural Sector Improvement Programme (ASIP) do not pay sufficient attention to the role of land access and land distribution in rural poverty and the inequalities between small-scale and large-scale farming sectors in Africa. A review of the literature in this area suggests that there was a mis-match between the stated policy statements and plans, and resources allocated for implementation. Most respondents echoed the same view, and they further observed that although African governments had made some good progress in addressing the issue of ICTs and development, existing ICT policies / drafts do not adequately cater for the needs of the small-scale farmers. Respondents suggested the need to ‘listen’ to small-scale farmers more. Some of the on-going efforts made to bring about policy change include organizing farmers in groups, associations and federations, forming development committees and ensuring participation of these groups in policy making. In Botswana, the ‘Kgotla’ system has been used to bring in the views of rural communities to policy making, while ‘Community Parliaments’ have been used in Kenya. IDRC and other development partners could work with the relevant national bodies and grassroots systems and structures in reviewing existing policies to ensure the needs of small-scale farmers were catered for and that adequate resources (human and financial) were allocated for implementation of ICT policies in Africa.
Potential effects of ICTs in restructuring and improving effectiveness and efficiency of extension services

Over the years agricultural extension services in Africa have either collapsed or failed to operate altogether. Where they operate, they have not effectively and efficiently addressed the problems of small-scale farmers. As a result there has been a shift in the extension process and focus is now on the facilitation and brokerage of information, knowledge, communication and advocacy services and providing broader services that improve rural livelihoods. An appropriate blend of ICTs could be used to free time for extension workers and cut down the number of change agents required and the associated costs. Thereby freeing resources to implement activities that directly impact on production, productivity and marketing agricultural produce by small-scale farmers in rural areas.

One successful initiative employing ICTs to offer extension services and training to small-scale farmers is the Farmersneeds.org (FARNO) in Nigeria. Other initiatives that have employed ICTs to restructure extension services in Africa include Farmer Field Schools (FFS), Coalition for Effective Extension Delivery (CEED), Hallo Engineer in West Africa, Private extension services in Benin and Zimbabwe, the Machobane Farming System (MFS) in Lesotho, KENDAT’s Community Parliaments in Kenya, the Agricultural Technology and Information Response Initiative (ATIRI), and the Linking Local Learners (LLL) initiative in Kenya, the Virtual Extension Research and Communication Network (VERCON) in Egypt, the National Agricultural Advisory Services Programme (NAADS) in Uganda, the Agricultural Research and Extension Network (ARENET) in Uganda and the District Agricultural Training and Information Centres (DATICS) in Uganda. IDRC and other development partners could support the initiatives described above and promote their rollout to other countries. Other initiatives that could be supported to strengthen extension services include those providing distance education and training for the change agents / frontline workers and small-scale farmers. Initiatives using PDAs and touch screens could also be supported to facilitate the collection and dissemination of critical agricultural information and knowledge for small-scale farmers.

E-commerce and micro-finance models and the potential of improving rural livelihoods

E-commerce in Africa is still at its infancy stages and needs supportive policy, legal and institutional frameworks and adequate infrastructure to work efficiently and effectively. There are a few models that have been used by small-scale farmers that allow sourcing of markets, ordering and invoicing, but a number of transactions are conducted off-line. Some of the initiatives that have adopted different models include the telecentre model, B2B e-commerce model in South Africa, Tradenet.biz in West Africa, ‘Soko Hewani’ and KACE’s electronic trading floor in Kenya, Foodnet in Uganda and MACE in Malawi.

There are various micro-finance models that are being employed to support small-scale farmers in Africa, including M-PESA model in Kenya using the cellular phone, the village bank model, the cooperative model, the African model, the revolving fund or ‘merry-go-round’ or self-help model being practised all over Africa, the Posta model, the commercial bank model, the Grameen model, the Pride Africa model and the Agricultural Sector Programme Support (ASPS) model in Uganda. IDRC and other development partners could support e-commerce and e-microfinance initiatives and promote them to other African countries so they can benefit small-scale farmers.

Information exchange and sharing and its role in improving production, productivity and marketing of small-scale agriculture

Africa has a large cumulative body of agricultural information and knowledge, know-how and practices that need to be shared continent-wide and applied for improved livelihoods and
sustainable development. Most of the institutions implementing initiatives on ICTs and small-scale agriculture in Africa have developed local agricultural information and knowledge resources in English and/or French and in some cases in local languages. Nevertheless, information in local languages is scattered and hard to find.

Traditional communication channels including messages captured in videos and DVDs, have proved extremely powerful in communicating agricultural messages to small-scale farmers. Content has been captured in form of manuals, handbooks, radio programmes, television programmes, CD-ROMs, chat sessions, audio-cassettes, pamphlets, newsletters, market information and web sites. Some of the issues for information exchange using ICT applications include skills and capacity to repackage content, translations, sharing of existing content and cost of information exchange.

Some of the organizations such as BROSDI in Uganda are sharing knowledge, information and experiences with their target audiences through project reports, newsletters, meetings, websites, Listservs, D-groups, communities of practice, networks, radio, billboards, exchange visits, trainings, school clubs, and publications produced by the projects and initiatives. IDRC and other development partners could support initiatives on local content development and the development of an e-repository of existing knowledge and information that ensures wide access to existing resources.

A number of suggestions were advanced on how synergies and linkages within the different ongoing and planned initiatives could be enhanced. Among the suggestions is that FARA and the SRO coordinate the different initiatives and facilitate them to share information, best practices and lessons learnt on the FARA-RAILS platform and through face-to-face meetings. Respondents also suggested that expertise from different regions be shared and inter-organizational projects be developed to build on strengths of different organizations. The idea of having a ‘basket funding’ approach was also suggested. Respondents further suggested the need for some form of mechanism to facilitate the sharing of information and knowledge and to exchange ideas on the activities of the different initiatives and projects in Africa. Other suggestions were to use networking tools such as e-mail, internet, D-groups and the development of a portal or platform that links the different initiatives.

**Organizations currently implementing and/or funding projects on ICTs and small scale agriculture**

There are many organizations and institutions including government ministries, national research organizations, universities, non-governmental organizations, private sector, regional and international bodies that are implementing research projects on ICTs and small-scale agriculture in Africa. Some of these organizations include:

- **International:** FAO, CTA, IFAD, CABI, ILRI, ICRAF, ICIBE, CIRAD, ZADI, One World International and SDNP;
- **Regional and sub-regional:** NEPAD, FARA, Africa Agricultural Technology Foundation (AATF), AARINENA, ASARECA, CORAF/WECARD, SADC/FANR, ALIN,- East Africa and MISTOWA. Others include the Regional Economic Communities (RECs) such as the Common Market for Eastern and Southern Africa (COMESA), the Inter-Governmental Authority on Development (IGAD), the East African Community (EAC), the Economic Community of West African States (ECOWAS), the Economic Community for Central African States (CEMAC), the Indian Ocean Commission (IOC), the South African Development Community (SADC) and the Arab Maghreb Union (AMU) that focus in all
aspects of cooperation (horizontal, upstream and downstream). These often focus on trade facilitation including creation of monetary unions, modernization of customs, and simplification of export and import procedures. The regional association for regulators attached to these RECs such as the East African Associations for Regulators, Post and Telecommunications Operators (EARPTO), the Telecommunication Regulators Association of Southern Africa (TRASA), the West African Telecommunications Regulators Association (WATRA), and a recently established Association of Regulators of Information Technology and Communications in East Africa (ARICEA) play a significant role in promoting cooperation and harmonization in the telecommunications and ICT sectors in their respective regions and

- National and NGOs: Ministries of Agriculture, Women of Uganda Network (WOUGNET), BROSDI, Kenya Agricultural Research Institute (KARI) and other national agricultural research organizations, DATICS, NAADS, UNFFE, Ghana Agricultural Information Network System (GAINS), KENFAP, KENDAT, AfriAfya, Sacred Africa, Ghana Information Network for Knowledge Sharing (GINKS), Ghana National Association of Farmers and Fishermen (GNAFF) and similar organizations in other countries and ministries of agriculture.

Some of the organizations funding initiatives on ICTs and small-scale agriculture include IDRC, USAID, DFID, EU, Hivos, FAO, CTA, International Institute for Communication and Development (IICD), GTZ, World Bank, Rockefeller Foundation, One World International, African Development Bank, Agriterra, CIDA, SIDA, Development Bank of South Africa, Gatsby Foundation, German Trust Fund, Hans Sidel Foundation, International Centre for Soil Fertility and Agricultural Development (IFDC), Kilimo Trust, Netherlands Organization for International Development (NOVIB), OXFAM, PAN Germany, Plan (Netherlands), RABO Bank Foundation, Sankofa Foundation, SDC Switzerland, Syngenta Foundation for Sustainable Agriculture (SFSA), African governments and the private sector. These organisations could form a forum for discussing the possibility of establishing an “ICTs for small-scale agriculture basket fund” to support worthy initiatives. This would avoid competition among development partners and streamline funding allocated to small unsustainable initiatives.

**Some key questions that need to be addressed through a research agenda in support of small-scale farmers**

Based on the findings of the present scoping study a number of research questions are suggested to determine how ICTs can be best used to address the challenges that small-scale farmers in Africa face. Some key questions that could be addressed in the research agenda in support of small-scale farmers include:-

- **Baseline studies / surveys / needs assessment**
  - What are the best practices for ICTs and small-scale agriculture?
  - What are the agricultural knowledge and information needs of small-scale farmers?
  - What are the benchmarks on ICTs and small-scale agriculture in Africa?

- **Markets and market research**
  - What is the pathway for information flow through the value chain?
  - How can farmers be linked to markets (standards, requirements and certification)?

- **Information / knowledge management exchange, sharing and dissemination**
- Which is the most effective way of reaching farmers with timely agricultural information and knowledge (indigenous and external)? (Is it telephone, radio, FM radio stations, print, SMS, or internet, among others)?
- How can the potential of FM radio stations and digital telephony be harnessed to communicate agricultural information to farmers?
- How should agricultural information and knowledge be synthesized or repackaged for small scale farmers?
- Is there a role for an e-repository (of local agricultural content) in Africa in disseminating local agricultural content?

- **Institutional building and infrastructure development**
  - What is the role of public-private partnerships in promoting ICTs to small-scale farmers?
  - How is regional agricultural information and knowledge for small-scale farmers assimilated in the respective regions?
  - How could the participation of women and the youth in initiatives on ICTs and small-scale agriculture be improved?

- **Training, capacity building and strengthening**
  - What is the minimum literacy level required by small-scale farmers to use available ICTs?
  - What ICTs could be used to share and exchange agricultural information, knowledge and innovation among illiterate small scale farmers?
  - What is the role of distance learning in improving uptake of new / improved agricultural technologies?

- **Technology development / adaptation**
  - How can existing systems e.g. Soko Hewani and Tradenet.biz be improved? What lessons have been learnt and based on the lessons learnt, what should be done to increase adoption?
  - What is the role of open source tools in developing applications for small-scale farmers?
  - Which is the best e-commerce / e-micro-finance model for small-scale farmers in Africa? How could the mobile phone technology be further exploited for the benefit of small-scale farmers?

- **Usage studies**
  - What is the usage of the agricultural information and knowledge by small-scale farmers? What is the usage of systems such as Tradenet.biz, Soko Hewani and decision support tools? i.e. who is using the system, what impact has this had on users? Does sensitisation and education increase their uptake?
  - In terms of community informatics and use of ICTs within communities, what technologies are available, how does the community share resources, how is agricultural information and knowledge created, captured, preserved and shared? Is digitization being carried out?

- **Impact studies**
  - What is the impact of ICTs in small-scale agriculture? i.e. What is the impact of agricultural messages on radio, sms and internet e.g. on markets, production?
  - What is the impact of existing information and knowledge systems such as Tradenet.biz, Soko Hewani, Foodnet, KACE on small-scale farmers?

- **Policies**
  - In regard to supporting small-scale agriculture, what gaps exist in the available ICT policies and how could these be improved to cater for the needs of small scale farmers?
  - How could the voices of small-scale farmers in Africa be heard at the policy making table?
Recommendations

Based on the present scoping study findings, the following recommendations are made:

1. **Challenges of small-scale farmers**

**Recommendation 1.1** - The problems of small-scale farmers in Africa are many, complex and multi-faceted. These problems need to be addressed in a holistic manner through a joint approach of establishing priorities and a research agenda by both African countries and their development partners. The problems of small-scale farmers could also be addressed by providing a ‘package’ or ‘basket’ solution that could be rolled out in a variety of ‘mixes’ (such as e-microfinance, access to agricultural and market information, agricultural inputs, technologies and innovations, training, local knowledge and e-commerce) in different countries and regions. In as far as is practical, regional approach to problem solving is encouraged as most problems in the respective regions share common causes and possible solutions. It is recommended that IDRC and other development partners support regional initiatives on ICTs and small-scale agriculture.

**Recommendation 1.2** - Some of the envisaged solutions include the adoption of appropriate ICTs and the evolution of supportive policy, legal and institutional frameworks. It is only through finding solutions to the identified challenges that small-scale farmers can break the poverty trap and attain meaningful development. Small-scale farmers need to be assisted to adopt some of the emerging agricultural practices to help them increase agricultural production, productivity and storage, enhance incomes and access improved markets that offer better prices for their products. IDRC and other key donors supporting ICTs and small-scale agriculture should forge alliances or partnerships with organizations implementing ICT initiatives and chart out a road-map and priorities for Africa. It is recommended that IDRC plays the lead or catalytic role in bringing the various actors together.

2. **Emerging ICTs and small- scale agriculture**

**Recommendation 2.1** - Emerging ICTs such as GIS, PA, mobile mapping and hand held computers have a great potential in addressing the challenges faced by small-scale farmers, hence, there is need to promote them. Although technologies such as PA are considered the ‘next great revolution in agriculture’, it is too expensive and not affordable to small-scale farmers. More importantly, the present ICT infrastructure in most rural areas in Africa cannot support PA. There are, however, organisations and research partners that plan to use these tools such as GIS and mobile mapping. These could work with farmers practising intensive or commercialisation or high value crops to experiment with these tools and their specific role in small-scale agriculture. PDAs are more affordable and hold great potential for small-scale farmers and could be used to improve extension services and deliver agricultural information and collect farmers’ questions from the field. These would then be sent to a central decision support system that would provide solutions to farmers. It is recommended that IDRC and other partners support such initiatives employing GIS, mobile mapping and PDAs to enable small-scale farmers to benefit from these ICTs that address a number of challenges that small-scale farmers face.
Recommendation 2.2 - The cellular phone has become pervasive in Africa. However, challenges such as cost of connectivity, ‘air time’, and charging of phones needs to be addressed. The integration of community radio or FM stations with cellular phone and the internet also needs to be further explored. More effort should be devoted to integration of conventional ICTs with newer ICTs. It is recommended that IDRC and other development partners support capacity building for ICT innovations such as the mobile technology to improve access to markets and increase agricultural productivity.

Recommendation 2.3 - The RFID technology facilitates meat exports in Botswana and South African to EU and Middle East markets. It is recommended that this technology be promoted in other countries to provide a trace back system in compliance with new regulatory procedures.

Recommendation 2.4 - It is further recommended that further research support be provided to initiatives applying appropriate emerging ICTs in small-scale agriculture such as RFID, WorldSpace satellite radio, cellular phone, interactive and FM radio, and the internet in order to harness the benefits of these technologies. Efforts should be made to promote the rollout of such ICTs and initiatives should strike a mix of appropriate emerging technologies that facilitate access to markets, uptake of improved technologies, innovation and up-to-date and timely agricultural knowledge and information.

Recommendation 2.5 – The WorldSpace satellite radio technology has proved to be appropriate and very effective in most rural areas where the telecommunications infrastructure is inadequate or lacking. Effort should be increased in promoting the technology and lobbying to make the technology more accessible and affordable by resource poor small-scale farmers.

Recommendation 2.6 – There is a need for Africa to learn from other developing regions such as Asia and replicate (and adapt) holistic models such as the Bank for Agriculture and Agricultural Cooperative (BAAC) model in Thailand that uses various ICTs to provide financial, information and other services to farmers, access agricultural information and decision making tools. This would enable small-scale farmers in Africa to move out of the poverty cycle and advance beyond subsistence farming through adoption of new improved technologies and use of agricultural inputs such as improved seed varieties and fertilizers.

3. ICTs as an input to small-scale agriculture

Recommendation 3.1 – Due to the complexity of factors and resource constraints, not all the factors influencing ICTs as an input to small-scale agriculture can be adequately addressed. However, IDRC and other development partners could support in the development of mechanisms for sharing agricultural knowledge and information on the different initiatives and programmes scattered all over the continent. This would enable the projects and initiatives to share experiences, best practices and lessons learnt, and address some of the challenges by small-scale farmers encountered jointly.

Recommendation 3.2 - It is also recommended that national governments and development partners facilitate information-sharing forums, meetings or workshops to prioritise research areas
and gaps could and agree upon questions for a research agenda for Africa. This would then be followed by the development of national, regional and continental research agendas.

4. Policy and legal framework issues

Recommendation 4.1 - Supportive policy, legal and institutional frameworks are crucial in ensuring success of any agricultural and/or ICT interventions. There is a need to support policy initiatives, and legal frameworks that ensure farmer empowerment and active involvement and participation by small-scale farmers to influence policy review/development and institutional reforms in Africa. There is a need for development partners to support policy-making bodies (local, national and regional) to ensure that policy and legal frameworks are supportive of initiatives such as rural connectivity, e-commerce and e-microfinance that will benefit a large constituency in the rural areas. It is recommended that IDRC and other development partners work closely with NEPAD and SRO in Africa in the area of ICT policies in areas relating to small-scale farmers.

Recommendation 4.2 – It is recommended that IDRC and other development partners support initiatives that facilitate existing grassroots institutions, structures and systems such as farmer groups, associations, networks federations and cooperatives; ‘community parliaments’ in Kenya and the ‘Kgotla’ system in Botswana in bringing about policy change in Africa.

5. Information exchange and sharing

Recommendation 5.1 - Based on the views of most respondents, there is a need for national governments and development partners to facilitate sharing of agricultural related information, knowledge, experiences, best practices and lesson learnt on different initiatives and projects on ICTs and small-scale agriculture in Africa. Such sharing would enhance the setting of priorities to address the challenges raised through focused projects at national or regional level. However, existing information and knowledge needs to be captured and be appropriately packaged before it can be shared. It is recommended that IDRC and other development partners support local content development initiatives and facilitate the development of an inventory of existing information resources that are relevant for small-scale farmers and the development of an e-repository that can be accessed Africa-wide.

Recommendation 5.2 – The present scoping study identified various gaps such as inadequate skills in the use and application of ICTs, inadequate human resources with the capacity to generate, repackage and digitise local content that need to be bridged to enhance skills and facilitate the exchange and sharing of information and knowledge. It is recommended that IDRC and other development partners support initiatives such as RAINS’s capacity building programme in agricultural information and communication management that responds to the training needs assessment carried out in 2004-2005 to ensure there is a critical mass of people that can work with key agricultural actors including small-scale farmers.
1.0 Introduction

1.1 Background

Most African economies are dominated by agriculture, which contributes about 17% to the Gross Domestic Product (GDP), 40% of exports, employment creation and has the potential to reduce poverty. The agricultural sector has been described as the engine for economic growth and improved livelihoods in Africa (World Bank 2006b:11,135; Diao et al. 2007:5,9). The majority of the population in Sub-Saharan Africa lives in rural areas and depends directly or indirectly on agriculture (Diao et al. 2007:1).

While Africa is considered one continent, however, despite the great potential for agricultural production in Africa, about 73% of the poor people living in rural areas subsist on less than a dollar a day (UNDP 2005:16). About 200 million of the world’s hungry people are found in the continent (Millennium Development Goals (MDGs) Technical Support Centre 2004) and available statistics suggest that about one third of Africa’s population is malnourished (UNDP 2005). Africa has the highest proportion of people living in extreme poverty in the world and is the only continent where food production has been falling over the years. Available statistics suggest that about 26% of Africa’s population is malnourished. There has been underinvestment in the rural areas; inadequate access to markets and unfair market conditions; inadequate access to advanced technologies; weak infrastructure, high production and transport costs, conflicts, HIV/AIDS, natural disasters, deforestation, environmental degradation, loss of biodiversity and dependency on foreign aid.

The characteristics in Sub-Saharan Africa vary compared with North Africa (Algeria, Egypt, Libya, Morocco, Mauritania, Sudan and Tunisia) and the economies of the latter are more influenced by oil, especially Algeria and Libya. The service sector contributes most to the GDP growth in the region, followed by industry, then agriculture. While there has been an increase in industrial production, this has been to the detriment of the service and agricultural sectors. However, the region has noted the need to improve provision of agricultural services to the poorer sections of the population (ECA 2006a). In Central Africa (Democratic Republic of Congo, Equitorial Guinea, Cameroon, Chad) growth was underpinned by higher oil prices. The mining sector also contributed to this growth (ECA and African Union 2007).

The number of people living below the poverty line in Sub-Saharan Africa (SSA), which is over 180 million, and is expected to exceed 300 million people by the year 2020. In addition, the per capita food production has continued to decline in SSA. It has been pointed out that the key to reversing this trend is to develop agriculture and industry through science, technology and innovation (ECA 2005). There is a general lack of accurate information on prices and markets for agricultural products (IICD 2006).

The United Nations (UN) Hunger Task Force strategy to overcome hunger and fight against poverty lays emphasis on restoring budgetary priority to agriculture, empowering women, hunger reduction actions at community level, boosting agricultural production, improving nutrition, developing rural markets and infrastructure, and promoting environmental sustainability. Africa has also undertaken a regional approach through the New Partnership for Africa’s Development
(NEPAD), which has developed a Comprehensive Africa Agricultural Development Programme (CAADP) (MDG Technical Support Centre 2004).

It has been argued that there is need for a new approach in understanding and finding solutions to the great challenge facing African agricultural development. In this regard, Jones (2006) suggested that technical innovation be accompanied by institutional change, where all stakeholders, including farmers, would be involved and where all efforts would be harmonised to work in synergy and add value to each other’s efforts. This author emphasized that increases in agricultural production must come from application of new knowledge and innovations. He pointed out that institutions such as the African Union, NEPAD, regional and sub-regional organizations should provide structures within which all stakeholders can contribute effectively and collectively to improve the livelihoods of farmers.

Small-scale agriculture and the harvesting of natural resources provide livelihoods for over 70% of the African population. About 70-80% of this population lives in the rural areas and is predominantly women. Research, civil society, government and private sector organizations have developed innovative technologies and best practices to modernize small-scale agriculture but most of these technologies do not get to the intended beneficiaries. The old extension service delivery system that was meant to pass on research outputs to farmers in Africa has proved inefficient, and most of these institutions have inadequate machinery and capacity to share and disseminate outputs widely to small-scale farmers and other actors (Madukwe 2006; Richardson 2006).

Small-scale farmers have little experience in the marketing of their produce (Mukhwana, Nyongesa and Ogemah 2005). Although natural resources are public goods whose benefits should be shared widely by community members, they have been over-exploited and mismanaged. There is therefore, a need to protect natural resources from powerful interest groups with short-term interests aimed at personal gain.

Researchers have argued that new discoveries and the application of technologies will drive agriculture, medicine, income growth and new materials in the 21st Century. Forecasts and predictions suggest that by 2020, emerging new technologies such as precision agriculture and sophisticated computer technologies will become possible in Africa (ECA 2005). Juma and Yee-Cheong (2005:15) defined new technologies as including new applications regardless of whether the technologies have been used in other parts of the world and include the use of emerging technologies such as information and communication technologies (ICTs), biotechnology, nanotechnologies and new materials. The United Nations Conference on Trade and Development (UNCTAD) (2007:...) further emphasised this point and stated that “technological advances in small-scale agricultural production and trade are often critical in initiating a catching-up process”.

Information and knowledge play a central role in rural agricultural development. In describing the role of women and men in agricultural and rural development, Balit (1999:1) stated that “information, knowledge … are essential if women and men are to respond to opportunities and major challenges of the coming century”. In emphasising the role of information and knowledge, (Mbeki 1995b cited in Van Audenhove 2003:4) described as information and knowledge as the prime productive resources. The Food and Agriculture Organization of the United Nations (FAO)
(2000) emphasised this and asserted that “information and knowledge play a key role in ensuring food security and sustainable development”. Various ICTs have been used for sharing agricultural information and knowledge by farmers.

According to the World Bank (2002 Strategy Paper on ICT cited in IICD 2006), ‘information and communication technologies are a key input for economic development and growth. ICTs have been used in some of the large-scale farms and the commercial sector to tap opportunities and address some of the challenges facing farmers. However, relatively little attention has been paid to their potential benefits to small-scale farmers and the associated upstream and downstream actors. The focus by the International Development Research Centre (IDRC) on ICTs and small-scale agriculture is therefore timely, and it will contribute to the efforts of other players for effective global, regional and national partnerships. Jensen (2001) also pointed out that most local farmers cannot obtain up-to-date market information thus affecting the manner in which traders negotiate prices.

Small-scale farmers, and other actors and rural communities, in Africa need space to contribute towards their own development. ICTs could help address some of the issues and challenges they face and enhance communication and delivery of critical knowledge, information and service.

1.2 Rationale and scope of this study
The choice to work on small-scale agriculture in Africa was influenced by the major role the agricultural sector plays in poverty alleviation and ensuring food security in Africa. ICTs and small-scale agriculture, including environment and natural resources management (NRM), are a key focus under the new strategic plan of IDRC’s Acacia Programme. They fall under the research theme on economic development and opportunity. The Acacia Programme plans to fund research on an Africa-wide initiative that seeks to understand ICTs and small-scale agriculture, and natural resources and environmental management in order to satisfy real needs of small-scale farmers and exploit opportunities. There are various initiatives going on in Africa but these are either not widely known or information on them is not readily available. To support the implementation of this programme as well as other IDRC programmes, the Acacia Programme commissioned a researcher, Mrs. Hilda Munyua, to conduct a scoping study on ICTs and small-scale agriculture in Africa. The scoping study, therefore, provides an important input to documenting the on-going activities and providing specific answers to research questions spelled out in Annex 1.

1.3 The objective of the study
The objective of the study was to explore the opportunities presented by ICTs in small-scale agriculture including environment and natural resources management.

The specific objectives were to answer a set of research questions as follows:-
1. Provide working definitions for small-scale agriculture, environment and natural resources management and provide justification of why the focus on this sector.
2. Provide an overview of emerging issues in small-scale agriculture in Africa. The study will identify implementers and innovative ICT applications (overview of projects/programmes/initiatives in the field) that are currently ongoing in the small-scale agriculture and natural resources sector in Africa.
3. What are the factors that influence the use of ICTs as an input into small-scale agriculture? (assess the prevailing policy regimes and ICTs as they relate to agriculture, including agricultural policy, land reform policy and institutional framework that empower small scale-
farmers, ICT policy reform activities and other related policies such as environment and natural resources policies. This also included examining the effects and potential of ICTs in restructuring of extension services and other government departments, as well as the need for broadband services). What are the most successful models of the use of ICTs to support e-commerce and micro-finance applications in this largely informal sector?
4. Identify the key players in ICTs and small-scale agriculture and natural resources in Africa.
5. Discuss different scenarios on how best to put together an Africa-wide initiative in this area.

1.4 The expected outputs
The expected outputs of the scoping study on ICTs and small-scale agriculture, including environment and natural resources management include:-
1. Terminologies of key terms and justification for focusing on small-scale agriculture, environment and natural resources clarified.
2. Key issues in small-scale agriculture, environment and natural resources identified.
3. Inventory of innovative applications of ICTs and small-scale agriculture, environment and natural resources produced and opportunities for intervention identified.
4. Key players in ICTs and agriculture, and environment and natural resources identified and assessed (including funding agencies).
5. Options for developing an Africa-wide initiative to address spelled out needs.
2.0 Methodology

2.1 Study design
This study was carried out through a desk study to review secondary sources of information, field visits, observations and individual and group interviews with key informants in the agricultural sector. The results of the study were meant to guide funding decision by the IDRC’s Acacia Programme and to provide input into the development of an Africa-wide initiative on ICTs and small-scale agriculture.

2.2 Population and sample
The population of the study comprised technical staff of local, national, regional and international institutions and development partners working in the agricultural sector and applying ICTs in Africa. Institutions were purposively selected to reflect national and regional views. Efforts were made to collect data from regional and sub-regional organizations such as the Forum for Agricultural Research in Africa (FARA), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the Southern African Development Community/Food Agriculture and Natural Resource Department (SADC/FANR), the Conseil Ouest Africain Pour la Recherche et le Developpement Agricole/West and Central African Council for Agricultural Research and Development (CORAF/WECARD), and the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA).

2.3 Data collection
This research was informed by a desk-based study on a wide range of ICT-related experiences and initiatives. The data was collected through visits, electronic consultations and using secondary information. Additional data was collected from a few development partners that were supporting agricultural-related ICT initiatives. Searches were conducted on the internet and library resources were consulted to establish the emerging ICTs in agriculture and initiatives on ICTs and small-scale agriculture in Africa as well as institutions implementing and development partners supporting such initiatives. Visits were made to selected institutions but due to time and resource limitations, only four countries were visited. The criterion for selection of the countries to be visited was based on scope, regional and national initiatives targeting small-scale farmers as follows:-

Botswana (Gaborone)
Botswana hosts the regional body, SADC, and a node for an agricultural Question and Answer service.

Ghana (Accra)
Ghana hosts FARA, the Market Information System and Trader Organisations in West Africa (MISTOWA), Tradenet.Biz, a national network - the Ghana Agricultural Information Network System (GAINS) and the regional office of the Food and Agriculture Organization of the United Nations (FAO). Ghana also has experience with community radio and a number of ICT initiatives focusing on small-scale farmers.

Kenya (Nairobi)
The researcher was based in Kenya, which hosts a number of international organisations, private sector initiatives such as the Kenya Agricultural Commodity Exchange (KACE), networks such as AfriAfya and the Arid Lands Information Network (ALIN) – East Africa and other government, private and civil society initiatives.
Uganda (Entebbe and Kampala)
Uganda hosts a regional agricultural association with research networks on agriculture and natural resources management - the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA); Foodnet, Regional Agricultural Information Network (RAIN), the African Highlands Initiative (AHI), the Technology Uptake and Upscaling Support Initiative (TUUSI) and the Eastern and Central Africa Programme for Agricultural Policy Analysis (ECAPAPA), a decentralized extension service targeting small scale farmers – the National Agricultural Advisory Services (NAADS) and ICT initiatives targeting small scale farmers being implemented by public, private and civil society organizations.

South Africa (Pietermaritzburg)
Although South Africa was not part of the scheduled visit countries, the researcher took advantage of a personal visit to Pietermaritzburg and held informal discussions with individuals involved in ICT initiatives at the University of KwaZulu-Natal.

A checklist was developed to guide individual and group interviews. During the field visits observations were made at sites where initiatives were being implemented and individual and group interviews were conducted. Where it was not possible to conduct face-to-face interviews, the checklist was e-mailed to respondents and responses returned by e-mail. Telephone interviews were conducted with key informants and where possible Skype was used. In South Africa (Pietermaritzburg), informal discussions were held. Questionnaires were also mailed to a number of respondents but most were returned late. About 40 institutions and a total of 66 respondents provided feedback. Thirty eight percent (38%) of the respondents were female and 62% were male (Annex 2).

2.4 Limitations of the study
One of the challenges encountered in implementing this study was the breadth of the scope of the study - ICTs and small scale agriculture, environment and natural resources management, and the broad geographical coverage of Africa. The general benchmark was rural Africa and the study focused more on Sub-Saharan Africa. Due to time and resource constraints, field visits did not cover Francophone West Africa and North Africa.
3.0 The importance of agriculture, natural resource management (NRM) and environment and definitions

This section looks briefly at the importance of agriculture, environment and natural resources management in Africa and definitions of terms used.

3.1 Agriculture and its importance in Africa

3.1.1 Agriculture

Agriculture is multi-disciplinary and over time, agricultural science has grown to address real life’s multi-faceted problems. Agricultural science includes environment and natural resources management, among other disciplines. Agriculture is defined as the production, processing and distribution of food, fish, forest products and fibre (USDA 2007). The Oxford English Dictionary defines agriculture as ‘the science and art of cultivating the soil; including the allied pursuits of gathering of crops and rearing livestock; tillage, husbandry and farming (in the widest sense).’ Agriculture has also been defined as ‘the science or art of cultivation of the soil or the culture of plants or animals in water systems and associated activities that may be required to produce, harvest, and market useful crops and/or to raise animals for profit (e.g. farm layout, community relations, compliance with cultural values and relevant laws and regulations, the use of agricultural chemicals such as fertilizers, herbicides, and pesticides, irrigation, and pollution control)’ (Lewis 2002:55). Agriculture “comprises value added from forestry, hunting, and fishing as well as cultivation of crops and livestock production” (World Bank 2006b:134).

Agriculture is considered critical to social, economic growth and poverty reduction and has been described as the backbone of the economies of most African countries and the main economic base for small-scale farmers in Africa. However, a different school of thought argued that despite the long held thinking regarding the role of agriculture in development, emphasis was shifting towards opportunities in non-agricultural growth that are perceived to have potential to reshape development strategies in many African countries. Nevertheless, a study carried out by Diao et al. (2007) concluded that “despite recent scepticism, agricultural growth is still important for most low-income African countries”. Empirical evidence from various country case studies conducted in Africa indicated that “pro-growth and pro-poor performance of agriculture will continue to depend on the broad participation of smallholder farmers, and that food staple growth generates more to poverty reduction than other agricultural subsectors” (Diao et al. 2007:). About 2/3 of developing countries depend on agriculture for their livelihood and 75% of these farmers are small-scale farmers (Bunders and Broerse 1991). About 3/4 of Africa’s population is found in rural areas and 60-90% of the total labour force is employed in the agricultural sector. According to the Economic Commission for Africa and the African Union, agriculture employs about 70 per cent of the work force and generates on average 30 per cent of Africa’s GDP (ECA and African Union 2007:47). In sub-Saharan Africa, small-scale farmers constitute about 73% of the rural poor (European Commission 2002).

Agriculture is linked to food security and will remain a primary source of growth and means of poverty reduction and backbone of rural economy in Africa (IFAD 2001). The agricultural sector could also be the main contributor to poverty reduction (UNECA 2005 cited in ECA and African Union 2007:79). Diao et al. (2007:1) posited that linkages between agriculture to the rest of the
economy can generate employment and intensive patterns of development. However, the ability of agriculture to reduce poverty and generate growth varies across and within countries. Africa has battled with food insecurity and agricultural production for a long time. It is noteworthy that although poverty levels have fallen globally, Sub-Saharan Africa is the only developing region where there has been a decline in per capita food-grain output and where the number of people living below poverty line has doubled over four decades. About 46% of the population live on less than a dollar a day (UNDP 2005; ECA 2006b). Less than 6% of Africa’s arable and permanent crop land is irrigated (ECA 2005) and most of the land on agriculture is not arable. Nevertheless, some positive growth in agriculture in Africa was registered from 2002; for example in Eastern Africa growth in the agricultural sector increased from 2.5% in 2003 to 5.8% in 2004 (ECA 2005). Africa, like the rest of the world, needs to attain the United Nation’s Millennium Development Goals (MDGs) and the World Food Summit (WFS) goals, with the aim of reducing the number of hungry people from 790 million to 400 million by 2015. To attain the goal of reducing poverty by 50% by 2015 the African economies need to grow at 7% per annum. Another target set required that a current national strategy for sustainable development be in place in every country by 2005 to ensure current trends in the loss of environmental resources including forests, fisheries, fresh water, climate, soils, biodiversity, stratospheric ozone, the accumulation of hazardous substances and other major indicators are reversed at both national and global levels by 2015 (ECA 2005). The MDGs, WFS goal and other goals are, therefore, key driving forces of Africa’s agricultural sector. As stressed by the World Bank (2006b:11), Africa needs to make agriculture more productive and sustainable, connect poor people to markets, enhance human development, get services to poor populations (especially women) and use natural resource assets well if the MDGs are to be achieved. There are a number of initiatives at the continental, regional, sub-regional, national and local levels working towards increasing agricultural productivity in Africa. All these indicators make initiatives on ICTs and small-scale agriculture in Africa urgent if the set milestones are to be achieved.

3.1.2 e-Agriculture

The Food and Agriculture Organization of the United Nations (FAO) defines e-Agriculture as "an emerging field in the intersection of agriculture informatics, agricultural development and entrepreneurship, referring to agricultural services, technology dissemination and information delivered or enhanced through the internet and related technologies. More specifically, it involves the conceptualization, design, development, evaluation and application of new (innovative) ways to use existing or emerging information and communication technologies (ICTs)" (FAO 2006). e-Agriculture promotes the integration of agricultural stakeholders and technology with multimedia, knowledge and culture, and aims to improve communication and learning processes.

The World Summit on the Information Society (WSIS) Plan of Action emphasized two key areas on e-Agriculture namely:-

a) ‘ensuring the systematic dissemination of information using ICTs on agriculture, animal husbandry, fisheries, forestry and food in order to produce ready access to comprehensive, up-to-date and detailed knowledge and information, particularly in rural areas.’

b) public-private partnerships that seek to maximise the use of ICTs as tools to improve production, marketing and food safety standards (FAO 2006).
3.1.3 Small-scale farmer / agriculture

The term ‘farmer’ describes sedentary producers, agro-pastoralists and pastoralists. Small-scale agriculture embraces both family-based and communal production. Hirst et al. (1988) observed that there is no universal definition of small-scale farm in developing countries. However, the development literature describes any farm less than five hectares as ‘small’. Small-scale farmers derive their livelihood from holdings of less than 2-5 hectares (usually less than 2 hectares); and around 10 to 20 heads of livestock (although often they have less than 2 or none at all). Small-scale farmers may practice a mix of commercial and subsistence production (in crops or livestock) or either, where the family provides the majority of labour and the farm provides the principle source of income (Narayanan and Gulati 2002 cited in Nagayets 2005; Davis, 2006). The World Bank (2003) defined smallholders as farmers with a low asset base, operating less than two hectares of cropland.

Some respondents in the present scoping study shared the views of Hirst et al. (1988) and argued that ‘small’ does not merely depend on size but on the ecotype and the economic margins relative to environment and production unit. There were variations in different countries and among respondents, but in principle they all agreed that ‘smallholder’ is not attached to land size. The respondents argued that a hectare of irrigated land in high potential areas could not be compared to 100 hectares in dry and arid land in low potential areas. Other respondents considered farmers with 5 acres of land and less and those who produce small quantities of highly varied quality products to be small-scale farmers.

About 80% of the farms in Africa are smallholdings (Nagayets 2005). An agricultural sample survey conducted in Ethiopia showed that 64.5 % of the farming households have one or less hectares of land and that female-headed households have smaller holdings (CSA 2000). In Egypt, 3/4 of all farmers are smallholders (Nagayets 2005). In Kenya, the smallholdings range from 0.2 to 12 hectares and produce 3/4 of agricultural output (Obara 1988, Oxfam (GB) 2000). Most smallholders in Africa find it difficult to access good markets and earn good incomes, and cannot access affordable credit. As posited by the UNDP (2005:65) “the global epicentre of extreme poverty is the smallholder farm”. The Food and Agriculture Organization of the United Nations (FAO) further pointed out that “of the 850 million people living in chronic hunger, smallholder farmers constitute half the number (FAO 2004 cited in UNDP 2005:65). Consequently, they cannot re-invest and face challenges of declining production and productivity. Small-scale farmers practice more subsistence than commercial farming, and they are often trapped in the vicious poverty cycle.

Hirst et al. (1988) and respondents of the present study indicated that small-scale agriculture has backward and forward linkages to on-farm and off-farm activities such as labour wages, agro-processing, fishing and collection of wild fruits that contribute towards improving livelihoods. Most small-scale farmers have more than one plot of land; they have limited assets and are poor; they derive their livelihoods from the small farms which provide the principle source of income; they practice a mixed subsistence farming (crops and/or livestock, fishing), labour is provided by the family and plot sub-division continues to affect production and productivity due to diseconomies of scale. In addition, they are vulnerable to drought, floods, environmental degradation and falling agricultural productivity. Furthermore, they have uneven access to agricultural advice, extension services and most are not adequately educated.

Small-scale farmers, and especially women, contribute towards employment, food production and enhanced food security. A significant amount of Africa’s economic activity rests in the hands of women. Time allocation studies in Sub-Saharan Africa indicate the important role that women
play in agriculture. Empirical evidence from Uganda suggests that women contribute about 50% of the country’s GDP (World Bank 2006b:13). However, production has been declining over the years and small-scale farmers need support to be able to link to global value chains. This could be done through support to farmers groups, irrigation schemes for horticultural crops, strengthening of institutional arrangements, provision of extension services and market information and adherence to global standards. It has been argued that in their present form, small-scale farmers cannot meet social standards and other market requirements such as sanitary and phytosanitary measures (SPS) which have become critical if producers are to access regional and international markets. Important areas of intervention include replenishing soil nutrients, managing water resources, using improved plant varieties and animal breeds, and teaching modern agricultural practices (UNDP 2005:67).

3.1.4 Small-scale fishermen

These are described as fishermen who use small mechanised or non-mechanised boats for subsistence fishing and often do not have their own processing facilities (Davis, 2006). They are also referred to as artisanal fishermen.

3.2 Natural resources management (NRM)

A number of areas are considered in NRM including integrated land and water management for sustainable food production; direct sowing; mulch-based agriculture and conservation tillage; integrated pest management for sustainable agro-ecosystems; agro-ecosystems and human interactions for sustainable agriculture in peri-urban and coastal areas; sustainable forestry and agroforestry management; climate change; sustainable animal production systems; biodiversity protection using conventional and non-conventional feed resources and indigenous knowledge. It is therefore apparent that agriculture cannot be divorced from environment and NRM. There are many evolving definitions for natural resources and NRM as presented in Box 1.

Box 1: Definitions of natural resources and natural resources management

- The responsible and broad-based management of land, water, forest and biological resources base (including genes) needed to sustain agricultural productivity and avert degradation of potential productivity (TAC 1997).
- NRM is an approach to research that aims at improving livelihoods, agro-ecosystem resilience, agricultural productivity and environmental services. NRM is multi-faceted and aims to enhance social, physical, human, natural and financial capital through solving complex real problems interfering with natural resources in agro-ecosystems (CGIAR Inter-Centre Working Group on INRM 2000).
- NRM is the practical application of ecosystem management, habitat conservation, and sustainable land management towards protecting, conserving, and using natural resources. ‘Natural’ resources are biotic organisms (flora and fauna) and abiotic material (water, air, soil, and minerals) (Afcee 2006).
- Natural resources are naturally occurring substances (supplied by nature) that are valuable in their relatively unmodified form. Natural resources may be renewable (living resources e.g. fish, coffee, forests that can restock and if sustainably managed, can be harvested indefinitely) or non-renewable. Renewable resources (non-living resources e.g. soil and water (Wikipedia 2007).
- Natural resources such as land, fish, wildlife, air, water, biota, among others can be used to create wealth and are managed in trust or controlled by government or community (DOI 2007; Investorwords 2007).
NRM integrates technical skills and knowledge about biophysical processes as well as the social component, i.e., negotiation of rules and sanctions, policy formulation, organization development, land use planning, conflict and information management. It is multi-faceted and focuses on improving production of commodities such as crop, livestock, forest or fish as well as incorporating integrated water and watershed management, social forestry, living aquatic resource management and soil management. Small-scale farmers need to be involved in the process of managing NRM through innovative and participatory methods. Research in NRM has focused on poverty reduction, food security, environmental sustainability and farmer participatory research. Most development partners are demanding impacts through development-oriented research that benefits small-scale farmers. Topics covered by the CGIAR for example include soil and water management, crop/livestock management, agroforestry, integrated pest management, conservation of biodiversity, and watershed management (IDRC 2007).

Small-scale farmers continue to ‘mine the natural resources’ but they are not capable of adequately conserving or replenishing the resources. This leads to degradation of the environment and natural resources. Increasing population growth has led to degradation and depletion of Africa’s natural resource base. Tyler (2006) argues that the poorest people live in marginal rural areas where they continue to damage and deplete the natural resource base in order to improve their livelihoods. Barret et al. (2002) point out that there has been rampant deforestation in Africa to create more farming land. This has led to high soil degradation (erosion, desertification, fertility decline) and low uptake of sustainable natural resources strategies especially so among small-scale farmers. Other challenges caused by mismanagement of natural resources include water scarcity, low water quality, siltation, deforestation, overgrazing, over-exploitation of marine resources, and loss of biodiversity, water logging, salinity and degradation, among others. This has affected climate and agricultural productivity.

In Africa, tree crops are a key source of income, food, medicine, fuel wood, construction materials and fibre for small-scale farmers. The livelihoods of small-scale farmers can be further enhanced by the conservation of the natural resource base including fisheries, forest products, eco-tourism and agricultural bio-diversity. Rational management of natural resources ensures sustainable agricultural development and sustainable supplies of water, food and biodiversity. There is a need, however, for sharing and adopting improved NRM practices (Napier and Pretty 1995 as cited in Barret et al. 2002). However, these authors noted that there are problems of weak information transfer, which have and will continue to hinder rapid agricultural development, and environment and NRM.

### 3.3 Environment

#### 3.3.1 Environment

Environment has been defined as ‘the complex of all external entities, conditions and circumstances that affect life generally..... the entire complex of chemical, physical and biotic factors (materials, processes, circumstances and conditions) that may act upon, be perceived by, or otherwise affect or potentially affect a living organism, a type of organism, population, community or ecosystem ... a major habitat type (e.g. marine, terrestrial, rain forest, desert, lake)’ (Lewis 2002:332).

Environmental management plays a crucial role in the livelihoods of small-scale farmers. Environmental degradation is, however, eroding the natural resource base and threatening biodiversity, affecting marine life and coastal ecosystems, causing deforestation and soil deterioration (UNDP 2005:26,90). Improved agricultural practices and investment in soil health
and sustainable water management could lead to improved environmental quality and thus agricultural extensionists (frontline workers or change agents) should be trained to promote good farming practices (UNDP 2005:91). Results of a continent wide survey suggested that climate change has had an impact on African agriculture and net revenues of farmers in dryland crops/livestock have been declining due to global warming. However, farmers have partly addressed this problem by irrigating crops which has seen them post increased revenues (Kurukulasuriya et al. 2006).

### 3.3.2 e-environment

The International Telecommunications Union (ITU) (2005) defined e-environment as the role of telecommunications and information technologies in the protection of the environment such as environment management systems. ITU advocated for better understanding of the inter-relations between problems and possible solutions using new tools and instruments such as Geographic Information Systems (GIS) and modelling. ICTs play an important role in environmental management by providing spatial information collected by satellite or remote sensing related to particular geographic areas. This helps technocrats and planners to understand the capability of the land to support given economic activities and promote efficient water utilization, thereby, ensuring that natural resources are efficiently and sustainably used. (Juma and Yee-Cheong 2005:59).
4.0 Key issues of small-scale farmers

This section captures the key issues of small-scale farmers such as the challenges and emerging agricultural issues. Secondary information and interviews carried out with respondents highlighted some of the key challenges that small scale farmers face (Box 2). Whereas not all the challenges have been addressed, a few have been tackled and new issues are emerging.

4.1 Challenges of small-scale farmers

Small-scale farmers in Africa face many problems that are complex and multi-faceted including: very high transport costs, high transactional costs, small markets, low agricultural productivity, low levels of irrigation, erratic rainfall, vulnerability to high seasonal and inter-annual fluctuations, high rates of evapo-transpiration and very slow adoption of technology (UNDP 2005:148-49). There are also weak knowledge-based subsistence agricultural production systems, inadequate agricultural inputs and poor market infrastructure, weak backward and forward linkages between agriculture and other sectors, increased food insecurity, natural resource and environmental degradation, poor management of water resources and low irrigation infrastructure (ECA 2006b). Other challenges include limited access to animal and mechanical power, reduced availability of labour due to the rural-urban migration, inefficient markets, weak information systems, a poor regulatory framework that does not facilitate investment and specialisation in new and high value products, inadequate market information and lack of information (Kidane, Maetz and Dardel 2006:xiv,55). There is, therefore, a need for addressing the small-holder problems in a holistic manner and providing a ‘package’ or ‘basket’ solution. Finding solutions to these challenges that small-scale farmers face will help break the poverty trap and attain meaningful development.

It is worth noting that small farmers and producers living in less-accessible areas have been hardest hit by these challenges and as concluded by Kidane, Maetz and Dardel (2006:48), “unless SSA countries create a condition for smallholder farmers to improve their labour productivity through technological change and enhanced capital assets, and / or invest in the development of labour-saving technologies, it is difficult to envisage a significant production increase through area expansion”.

Box 2: Challenges faced by small scale farmers in Africa

<table>
<thead>
<tr>
<th>Respondents</th>
</tr>
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<tbody>
<tr>
<td>The use of traditional low cost technologies that offer environmental benefits and conserve the environment for future generations e.g. the use low or no external inputs and organic farming.</td>
</tr>
<tr>
<td>The project approach to activities for small-scale farmers make farmers go for short-term benefits and then revert to their old traditional practices.</td>
</tr>
<tr>
<td>Improved technologies do not filter down to small-scale farmers.</td>
</tr>
<tr>
<td>Indigenous knowledge on NRM and sustainable agriculture is not passed on to the younger generations.</td>
</tr>
</tbody>
</table>
• They face challenges in applying traditional coping mechanisms and in the face of inadequate linkages between research and development.
• Low agricultural production that cannot sustain market demands.
• Lack of or limited value addition to agricultural produce (they sell raw or unprocessed products).
• Poor on-farm and off-gate prices. (i.e. they market their produce locally).
• High poverty levels (especially women) and reliance on the small farm for earnings.
• War and conflicts.
• They use local knowledge and information in their production processes.
• They are mainly subsistence farmers who practice mixed farming.
• Poor storage facilities and high post harvest losses.
• They have poor access to markets, market intelligence and opportunities.
• They have poor access to external information and knowledge on agricultural technologies, production, credit and markets.
• They lack access to appropriately packaged local content.
• They have poor access to inputs, credit and markets.
• Poor and high cost of basic infrastructure including transport, market, electricity and telecommunication and inefficient distribution systems and farmer organizations.
• They face quality and quantity challenges and they do not have economies of scale.
• Low soil fertility, land degradation and declining productivity.
• They face alienation in that they are not connected to the agricultural system.
• Rural-urban migration.
• Problems of security in land tenure.
• Limited access to micro-credit, assets and markets.
• Limited social and technical means for managing natural resources.
• Limited incentives at farmer level.
• Use of marginal or unsuitable land for agriculture leading to environmental degradation.
• Use of inappropriate technologies.
• Inadequate involvement of farmers and their organizations in planning and priority setting.
• Inadequate application of irrigation.
• Diminishing farm sizes that have contributed to low economic and social development, poor soil and water management and climate change.
• Markets that have long transaction chains between farmers and consumers, high transaction costs, and poor access to reliable and timely market information.
• They face many complicated challenges such as low labour, declining yields and incomes
• They are exploited by buying monopolies e.g. tobacco growers in Uganda (BAT Uganda Limited).
• They are threatened by globalization as they cannot compete effectively with imported products.
• There is over-exploitation of fish stocks, which is a major concern in regard to sustainability. The problem is compounded by increasing pollution and contamination of water masses and pests such as water hyacinth and other weeds.
• Have poor access to technical and market information, poor market systems and marketing infrastructure, which lead to weak negotiation power
• Most small scale-farmers in Africa are very poor, especially women, and fall in the poverty trap that is characterised by low productivity, low saving rates, low tax revenues, low foreign investment, conflicts, environmental degradation, and brain drain, among others
• They have inadequate knowledge on pricing.
From secondary sources

- Small volume of agricultural produce of varied quality and poorly structured and inefficient markets (Mukhebi 2007).
- Inadequate experience with marketing of produce (Mukhwana, Nyongesa and Ogemah 2005).
- Are vulnerable to devastation caused by conflicts and ‘natural’ disasters and are prone to risks related to drought, floods, pests, diseases and adverse weather. (Bunders and Broerse 1991).
- HIV/AIDS is pandemic in Sub-Saharan Africa and has had very adverse effects on agricultural production. It has led to loss of family labour, change in farming system, and reduced agricultural production. It is estimated that HIV/AIDS affects 40 million people in Africa and is emerging as one of the greatest threats to human health and productivity. Income earned by smallholders is eroded by expenditures on medication for suffering family members and funeral expenses, which are comparatively quite high. HIV/AIDS has caused some family members to sell available assets such as livestock to raise money to spend on illnesses (Abate 2001; Negin 2004, Yamano and Jayne 2004). This calls for care by other members of the family, which further limits labour and working capital on small-scale farms. Women tend to be more vulnerable to the disease and are mostly the caregivers (ECA 2005).
- Small-scale farmers receive very low prices e.g. coffee farmers receive only 30% of sales proceeds (Oxfam Great Britain 2000).
- They grapple with unfavourable policies and trade practices (Bunders and Broerse 1991).
- Poor linkages between producers, processors, markets, researchers, extension workers and farmers.
- Inadequate knowledge and skills on optimum methods of management and modern farming techniques.
- Storage difficulties e.g. for fish and vegetables (ICTARD 2007).
- Limited access to productive factors, especially among women, which prevent them from responding to change (UNECA 2004b; Winters, McCulloch and McKay 2004).
- Farmers who adopted non-traditional export crops increased their income (ECA 2005:210).
- Land sub-divisions leading to diseconomies of scale and decreased productivity (Hirst et al. 1988).
- Small-scale farmers do not produce much surplus hence they are easily affected by unfavourable climate, pests and diseases (Bunders and Broerse 1991).
- They face challenges related to climate change, economic globalization, HIV/AIDS and population growth (Douthwaite et al. 2006).
- Uptake of research products is constrained by poor governance, counter productive policies, insufficient investment in market infrastructure and HIV/AIDS (Jones 2006).
- They face challenges of food insecurity, gender inequality and environmental degradation (IFAD 2002; UNDP 2005).
- Inappropriate macro and micro-economic and sectoral policies (Spencer 1995).
- They grapple with inadequate of subsidies and unfair trade (Karaan 2006).
**4.2 Emerging agricultural issues in small-scale agriculture**

Some of the emerging agricultural issues in small-scale agriculture in Africa include new opportunities through the potential to access new markets, high value products, access to biotechnology and improved information and communication technology (ECA, 2006). Other emerging issues for small-scale farmers are discussed below:-

### 4.2.1 High value agriculture

Some of the emerging agricultural issues in small-scale agriculture include access and adoption of biotechnology and high value agriculture (HVA). HVA products are products with high monetary value with emerging and expanding markets globally (Temu and Temu 2005). These include cut flowers, fresh mushrooms, vegetables, fruits such as mangoes, oranges and pineapples; milk, meat, fish and non-timber products (GFAR 2005; Temu and Temu 2005; Davis 2006). Davis (2006) argued that high-value agricultural activities have the capacity to provide real opportunities for enhancing small-scale farm incomes and reducing poverty. HVA products enjoy developed country markets all year round and generate income for farmers (GFAR 2005) and the degree to which poor farmers participate in the production of HVA commodities will be critical in terms of its impact on poverty. It is apparent that farmers with the resources and skills to produce these HVA commodities stand to earn higher incomes now and in the future (Birthal, Joshi and Gulati 2005).

Improvement in productivity by small-scale farmers necessitates that farmers use improved technologies, seed, fertilizer, pesticides and water. Humphreys (2005) pointed out that imports of fresh peas and beans from Sub-Saharan Africa to the European Union (EU) countries rose by 270% in the period 1988-2003, and the price per ton of these exports also rose by 13.5%. These trends were confirmed by data collected by Weinberger et al. (2005) in five developing countries which showed that net farm incomes were substantially higher in HVA horticultural smallholder farms than for non-horticultural smallholder farms.

### 4.2.2 Commercial agriculture

Commercial agriculture is defined as “market-orientated farming production”. Production is primarily for the market and is considered important in most developing countries and is a major source of GDP and foreign exchange earnings (Pary n.d.). A survey conducted in Ethiopia, Kenya, Rwanda, Mozambique and Zambia indicated that the poor are geographically scattered throughout all regions of a country, and there are serious disparities in incomes and land ownership at the local level. Farm sizes have been observed to decline over time and landlessness and near-landlessness is emerging as an important social and economic problem with the rural people not having sufficient land to eke a living (Jayne 2001). The findings from the present study suggest that existing agricultural technologies are not appropriate for tackling poverty in Africa, and points out that small-scale farmers with relatively more land could tap ‘smallholder commercial agriculture’ opportunities and related assets in response to market requirements for improved earnings.
4.2.3 Improved markets and marketing

Africa has to contend with many modern market challenges due to globalization and withdrawal of subsidies. There is, thus, a need to integrate small-scale growers into the production and supply chains. Small-scale farmers need innovation and entrepreneurship skills that influence products, services and the ability to impact on consumer need preferences and consumption patterns in order to be competitive. In South Africa for example, efforts to support emerging and small farmers in supplying to supermarkets has not been very successful because of preference by large buyers for larger and more efficient and entrepreneurial firms. The National African Farmers Union (NAFU) in South Africa indicated that poor farmers were worst affected by unfair trade and rich country subsidies. Survival strategies that have been advanced include government regulatory measures that facilitate involvement of small-scale farmers in markets on a concessionary basis; support for institutional development that encourages establishment of co-operatives, buyer groups, consortia, associations, agents, among others; access to requisite business intelligence and information flows that are integrated into private networks and other business intelligence systems, rural infrastructure and training, among others (Karaan 2006).

4.2.4 Biotechnology

Juma (1999 cited in ECA 2006b), pointed out that the biotechnology revolution holds great promise for Africa in increasing agricultural production and productivity. Biotechnology has potential for increasing agricultural productivity and enriching food crops with nutrients and to produce disease-free planting stock. Crops have been genetically modified to enrich them with nutrients and some are being promoted to small-scale farmers. This technology is, however, still controversial and some have argued that the introduced foreign genes may cause gene-to-gene or gene-to-environment interactions that are ecologically unsound (Juma and Yee-Cheong 2005:68).
5.0 ICTs and small-scale farmers

This section looks briefly at emerging ICTs such as GIS, decision support systems, mobile mapping, handheld personal computers or personal digital assistants, precision agriculture, mobile (cellular) phone applications, Frequency Modulated (FM) / community radio stations, radio frequency identification, WorldSpace satellite radio and internet and web-based applications and their application in small-scale agriculture. The section also discusses factors influencing use of ICTs as inputs in small-scale agriculture, and some research questions and gaps relating to ICTs and small-scale farmers.

It has been stated that modern ICTs play a key role in communicating knowledge and information to rural agricultural communities (Richardson 1997; 1999; Norrish 1998; Lukeeram et al. 2000; Harris 2004; Kweku 2006). ICTs include technologies and media that capture, store and disseminate data and information, and they include tools such as video, teletext, voice information systems, radio, mobile telephony, fax and computer-mediated networks among others (Warren 2002). ICTs are considered drivers of change for rural and agricultural development. They are efficient tools for reaching rural and remote communities and improving agricultural productivity (Richardson 1997). ICTs can speed up the extension of development services in areas such as healthcare, education and agriculture (Van Audenhove 2003). Further, they help strengthen partnerships and provide a framework for shared learning, and have led to increased use of networked information environment and development of platforms for better sharing and exchange of information and knowledge. This has helped to achieve competitiveness (Benkler 2006). This author pointed out that although a networked information economy cannot in itself solve poverty, hunger and disease, it provides new avenues for offering a more attractive cultural production system, tapping economic opportunity and sharing and disseminating scientific outputs and innovative linkages between farmers, scientists and other actors.

Small-scale farmers need information on improved farming practices, technical information, technologies, credit, agro-processing, markets and marketing opportunities. Technological changes have led to social, economic and cultural transformation. ICTs play a key role in enhancing networking and sharing of knowledge and information. ICTs provide development solutions and have been described as one of the main enablers of poverty reduction. They enhance economic growth and income, improve communication and the exchange of knowledge and information, facilitate networking and scaling up inter-linkages of development interventions; and strengthen and create new social and economic networks (Juma and Yee-Cheong 2005:48-49). ICTs have also been used in Africa to deliver education modules on farming practices which are delivered by audio/radio, web-based means, CD-ROM, video and print format under the CERP Project (Pye et al. 2003). In Burkina Faso, the TV Koodo is broadcasted monthly to provide farmers with agricultural and pricing information on grain and livestock. Another innovative project in Burkina Faso is the Boutiques d’information, which facilitates farmers to access production and marketing information through the internet and other ICTs (Annex 3).

In agriculture, ICTs are being used for accessing agricultural information, financial information, market information, surveys and agribusiness (Akiiki 2006; May, Karugia and Ndokweni 2007). Maru (2004) pointed out that the use of ICTs is ubiquitous in national agricultural research systems in Sub-Saharan Africa, while Grimshaw (2005) observed that there was consensus that ICTs play an important role in development by linking users to up-to-date information, skills and markets. This
was in agreement with earlier findings by Stiglitz (1999), who concluded that ICTs had improved access to explicit knowledge. In Uganda, ICTs are used to disseminate local agricultural information and knowledge to small-scale farmers (Munyua and Adupa 2002; Akiiki 2006) while in Senegal, women are using telecentres (linked to the internet via mobile phones) to access market prices (Hafkin and Odame 2002:24 cited in May, Karugia and Ndokweni 2007).

There are a number of initiatives all over Africa on the application of ICTs and small-scale agriculture as presented in Annex 3.

5.1 Emerging ICTs and their application in small-scale agriculture

There are a number of emerging ICTs being applied in small-scale agriculture in Africa including:- GIS, decision support systems, precision farming, market information system, distance learning, databases, land use planning, public access facilities, mobile applications, restructuring of extension and personal digital assistants (PDAs).

5.1.1 GIS, decision support systems

Geographical Information System (GIS) is an information technology that links activities in the field and the office, and allows for comparisons between different types of agricultural data. GIS helps establish relationships between data sets and produce maps and charts that visualise and present results. The spatial variability determined allows for unique treatments for certain locations and analysis of post harvest variation in crop yield measures. Yields of previous years are analysed to guide present and future management decisions. The GIS details include maps and additional information associated with coordinates and time, and these are all linked in a computer database that can be further analysed. GIS provides a holistic view of the production system and helps make precision agriculture practical and useful even for small-scale farmers (GIS Development 2007).

The International Livestock Research Institute (ILRI) has applied GIS and remote sensing on the Small Dairy Project and for mapping fences in the livestock-wildlife ecosystem in Kenya. The International Small group and Tree Planting Alliance (TIST) is training farmers in Kenya and Uganda in community-based reforestation projects to use PDAs and Global Positioning System (GPS) technology to gather reforestation data, which is then uploaded to an online database (Annex 3). The Kenya Agricultural Commodity Exchange (KACE) plans to use GIS in the near future to develop commodity patterns / seasonal patterns e.g. map of the country showing seasonality of different crops, what is being produced, geographical coverage, among others. This would help estimate supply and expectations, and prepare markets before harvest and provide a dispersion distribution and productivity pattern. The supply forecast and market potential would help forecast prices and plan for exports and local market sales. In South Africa, the GenARDIS project used GIS applications in natural resources management in the Rooibos tea lands and in exploring the spatial dynamics of gender in rural areas (Annex 3). DrumNet in Kenya plans to apply GIS and has acquired GPS technology to help map out where farmers are located, collection points, easy ways of accessing transportation, cell phone accessibility, roads and cell phone connectivity, among others. The Busoga Rural Open Source and Development Initiative (BROSDI) in Uganda also plan to use GIS to link farmers to markets.

GIS could be applied in land surveys and registration systems e.g. in Philippines (www.pafid.org). With support from the International Fund for Agricultural Development (IFAD), the Philippine Association for Intercultural Development (PAFID) has worked with communities using
sophisticated ICTs and household tools to refine rough maps by preparing three dimension mapping to shed light on ancestral domains and rights of indigenous communities. Boundaries are verified by Global Positioning System (GPS) and ground surveys. The 3-D models are then joined into a GIS.

5.1.2 Mobile mapping
Mobile mapping is a concept and system with the ability to collect field data, including unique geospatial time tags and attributes, for integrating into / updating a GIS. Mobile mapping remembers what was already recorded, when it was recorded and where it was recorded, and allows for addition or expansion to the stored data. Mobile mapping provides the freedom to collect data anytime, anywhere and in any manner (GIS Development 2007).

5.1.3 Handheld Personal Computer (HPC) or Personal Digital Assistants (PDAs)
A Handheld Personal Computer is a device that can be held in one hand and operated by the other. The HPCs are small, light, robust and compatible with personal computer synchronization. Data is entered through a touch screen, pen, handwriting recognition, and/or attachable keyboard. Synchronization is through serial or Universal Serial Bus (USB) ports. One can communicate through some HPCs using wireless technology and the devices are durable, survivable and sunlight viewing. Handheld devices have been used for mobile mapping (GIS Development 2007).

KACE in Kenya plans to use handheld devices to transmit information directly to a decision support system where diagnosis will be done and the farmers receive solutions promptly before the problem(s) escalate(s). HPCs have pervasive reach and will make it possible to provide extension services to areas that would otherwise not be reached. The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and its Regional Agricultural Information Network (RAIN) in collaboration with CABI plan to use PDAs to deliver agricultural information in the East and Central Africa region. The team will work with a private information technology firm, Virtual City, to pilot the idea using ASARECA networks. In Tanzania, the Family Alliance and Development Cooperation (FADECO) is using a range of ICTs including PDAs to access agricultural information.

5.1.4 Precision Agriculture (PA)
Precision Agriculture (PA) is a technology that has been described as the ‘next great revolution in agriculture’. Taylor and Whelan (n.d.) defined PA as ‘an integrated information and production-based farming system that is designed to increase long-term, site-specific and whole farm production efficiency, productivity and profitability, while minimizing unintended impacts on wildlife and the environment’. PA can be viewed as ‘the ability to manage land by the square metre instead of the square mile’. It is an agricultural system that offers flexibility and was previously adopted by large-scale farmers but now has been adopted by some small-scale farmers who use it routinely. According to the Wikipedia (2007), PA is an agricultural concept relying on the existence of in-field variability that requires the use of new technologies, such as Global Positioning System (GPS), sensors, satellites or aerial images, and geographical information management tools to assess and understand variations.

PA adapts to variability (spatial – changes across farm; temporal – season to season and predictive – difference between predicted and actual results) in agriculture and ensures sustainable natural resources use for future production (Wikipedia 2006). Variation information gathered is used to evaluate optimum sowing density, estimate fertilizers and other inputs needs, and to accurately predict crop yields more accurately. PA avoids blanket practices across the field, depending on
soil/climate conditions at different areas of the farm. Local situations of disease or lodging are assessed to enable the farmer to optimize use and vary the rate of inputs, such as fertilizer, across the field based on the need identified by GPS guided grid sampling.

PA may be used to improve a farm from agronomic perspective (e.g. better fertilizer management), technical perspective (e.g. planification of agricultural activity), environmental perspective (e.g. better estimation of crop nitrogen needs and limitation of nitrogen run-off) and economical perspective (e.g. lower cost of nitrogen fertilization practice). PA also helps the farmer monitor his/her farm practices and results, helps decision-making and traceability requirements, which is becoming a key requirement in developed countries. Satellite positioning and navigation have played a catalytic role in the evolution of PA and GPS. Mobile mapping make it possible to gather information for decision-making.

PA encompasses four key information technologies namely location determination (via GPS), GIS, computer-guided controllers for variable rate application (VRA) of crop inputs, and sensing technologies for automated data collection and mapping. Among the four, GPS and GIS have been more widely established and used. The major PA practices that farmers have adopted include nutrient management, which involves spatially referenced soil sampling and this is often linked to VRA fertilizer spreading and yield monitoring - usually tied to yield mapping (Swinton and Lowenberg-Deboer 2001).

Regardless of the agricultural system used, the quantity of soil, plant, water and air used determines the production of food, feed and fibre. For yields to remain sustainable, natural resources will have to be protected. PA aims at increasing productivity while decreasing production cost and minimizing adverse environmental impacts. PA provides an effective forum for disseminating research and experience and assessing natural resources variability such as soil and landscape variability, digital elevation models, soil mapping, geo-statistics, GIS, microclimate, weather forecasting and remote sensing. It helps manage variability through sampling techniques, site-specific nutrient and crop protection chemical recommendation, crop quality, tillage, seed density, seed variety, yield mapping and remote sensing, which helps to increase profitability through technology including computers, positioning systems, tillage, planting, nutrient and crop protection implements, manure, irrigation and weed/pest mapping, among others. This ensures optimum recommendations and environmental protection. Resources applied and agronomic requirements are adjusted based on the variability of the farm/field (site-specific or prescription (GIS Development 2006).

PA has many components including soil sampling, variable rate application (of nutrient or chemical needed) and yield monitoring making the practice economically and environmentally justifiable and technologically feasible. Improving the agricultural process can maximize financial return and increase the stewardship of land, water, and related natural resources. The information age brings the potential for PA to reduce production cost and increase the potential for greater yields. PA has been used for row crops, hay production, pasture management, animal grazing and other agricultural systems, but because of the investment required, most applications have been on large-scale farms (GIS Development 2006; Preagro 2006). Swinton and Lowenberg-Deboer (2001) point out that the technology has been unevenly adopted in developed countries and in a few African countries. It is predicted that PA will be adopted where the technology makes more efficient use of scarce productive resources. PA has been adopted largely by large-scale producers, especially where labour is costly but land and capital are less costly. Adoption of PA is also tied to replacement of expensive machinery required. PA is virtually unknown in Africa except in South Africa and a few other countries (Swinton and Lowenberg-Deboer 2001).
Some examples of PA in large-scale farms in Africa include:-

**Mauritius**
The Mauritius Sugar Industry Research Institute (MSIRI) has adopted PA at experimental level in sugar cane production. The MSIRI has put emphasis on PA research with special focus on intensified mechanization. The reform process in the sugar industry in Mauritius was accelerated by the ACP-EU sugar protocol and the proposed 39% reduction of sugar prices. MSIRI started evaluating a yield mapping system in 2001 to produce maps that show yield variability, which led to improved management of cane loading operations, avoidance of overloading and over-spilling, improved transport scheduling of trucks and verification of contractual work (Autrey, Ramasamy and Ng Kee Kwong 2006; Jhoty and Autrey n.d.).

**Sudan**
Golder, an international company, has been working with ASBNACO - a Sudan-based company that manages the Agadi Farm and the Arab Authority for Agricultural Investment and Development (AAAID), to introduce commercial mechanised farming. The GPS and GIS technology have been introduced to help improve farm productivity while conserving the environment. The farm has acquired an auto-steer tractor fitted with a GPS satellite guidance system that controls tractor steering, which has helped cut down the planting time on the farm by 60% compared with two previous seasons. Spatial yield monitoring using GPS field monitors have also been installed in combine harvesters to monitor yield variations within each field and produce yield maps so farmers can identify high and low productivity areas on their farms. The maps also guide fertilizer, seed and agro-chemical applications.

Controlled traffic farming’ (CTF) has also been introduced using GPS-based self-steering tractors, which limit movements of tractors to selected rows within the field to reduce soil compaction and erosion. A GIS-based farming information and management system was being developed and the project plans to introduce infra red photography and Variable Rate Application (VRA) technology to identify weed infestations, and water stress or crop pest outbreak areas. This allows targeting of chemical applications and reduces wastage associated with conventional blanket spraying. VRA allows efficient use of fertilizers, chemicals and seed based on results of previous seasons’ production and chemical soil analyses. Furthermore, it prevents unnecessary groundwater contamination.

Key challenges faced by the Agadi Farm include the need for ensuring reliable operation and maintenance of highly specialized equipment under harsh and remote conditions; training in the use of PGS equipment and GIS software for local technicians; and assessing the adoption / integration of precision farming systems into current practices. It is anticipated that wide acceptance of PA in Africa will enable the potential of PA to be fully exploited. PA requires adequate funding for high-tech farming applications, which small scale farmers cannot afford as individuals (Goder 2006; AAAID 2006; Howcroft 2006).

**South Africa**
Variable Rate Application (VRA) fertilization is practised in isolated plantations where yield monitors are also used (Swinton and Lowenberg-Deboer 2001). Water resources are precious in most of Africa which is mostly water deficient. Water used for irrigation is either surface or ground water. In order to protect and conserve the resource, farmers in South Africa using groundwater for irrigation practice precision irrigation, which is an aspect of PA. Precision irrigation provides a sustainable and efficient system of using water and entails application of optimum quantities of water over the area being irrigated based on variability in terms of soil type, soil water capacity, potential yield and topography (Dennis and Nell n.d.).
5.1.5 Mobile (cellular) phone applications

The cellular phone has provided market links for farmers and entrepreneurs and most of the recent growth in ICTs has involved mobile phones. Growth in SSA has tripled between 2000 and 2004. This has reduced transaction costs, broadened trade networks and facilitated searches for employment (Guislain et al. 2006:3,6). Bertolini (2004) observed that the “telephone is the only ICT used (if any) by the majority of farmers in Africa”. Some of the respondents considered the cellular telephone applications such as the Short Messaging Service (SMS) to be one of the most important emerging ICT applications in Africa. The cellular phone applications have shown the fastest growth in Africa, making the mobile phone the key source of communication. The cellular market in Africa is expected to grow by 28% in 2007, making it the fastest growing (http://cgap.org/portal/site/portfolio/Feb2007Data/). The mobile phone technology and especially the SMS are catching up quickly in Africa and the potential of the technology has been shown by many organisations including the Kenya Livestock Marketing Council, Malawi Agricultural Commodity Exchange (MACE), Foodnet of ASARECA, Tradenet.biz in West Africa and Pride Africa.

People in Africa share phones through different arrangements. Some of the unexploited potentials of the mobile phone technology include voice, images and video applications. In Kenya, KACE is collaborating with the Interactive Media Services Limited and is offering market information through Interactive Voice Response (IVR), a service that uses voice mail for information delivery. KACE, in partnership with Safaricom, has established a cell phone service, the ‘Kilimo Hotline’, for trade information via SMS. Callers can receive market information on who is selling what, at what price, who is buying; extension messages or place advertisement to buy or sell agricultural commodities through the service. In some villages, farmers have formed partnerships and are sharing cell phones. In Senegal, Manobi has developed a platform of services whereby Senegalese fishing professionals can access via a PC, Wireless Application Protocol (WAP) or Personal Data Assistant (PDA) fishing commercial-oriented or sea safety-oriented data information. Farmers that subscribe through the telecoms firm can also access real-time information on agricultural and fish prices on their cell phones (Annex 3). Fishermen in Ghana and elsewhere in Africa are using mobile phones to communicate information on where to fish, weather condition, prices, among others. Farmers, however, experience challenges with mobile phones due to poor infrastructure such as electricity to charge phones, while solar chargers are still too expensive. One respondent observed that ‘the focus is not computers but cell phones.’ There is also demand for fixed telephones and according to the World Bank (2006b:129), the unmet demand is about 46% of existing capacity.

5.1.6 Frequency Modulated (FM) / community radio stations

Radio is an important mechanism for disseminating knowledge and information in different languages and formats (Girard 2003). Harris (2004) posited that radio has achieved impressive results in the delivery of useful information to poor people. FM radio stations have become handy tools in small-scale agriculture in rural areas and in facilitating marketing and dissemination of market information. This technology was used by most of the respondents. UNESCO has supported a number of community radio stations in Africa to help disseminate development information, including agriculture, and generate revenue to sustain the telecentres. Kweku’s (2006) findings indicate that radio is the most highly used media in accessing development and agricultural information. The convergence of ICTs such as the internet with rural radio can provide a powerful support for harnessing and communicating knowledge for development. It can also ensure wider access to information in rural areas.

Connection of radio to the internet has brought down telephone bills in West Africa and encouraged participation and communication with community members. The internet revolution
has opened new opportunities for radio development. Most African countries have liberalized airwaves. The Panos Institute of West Africa (PIWA) supports a new paradigm in broadcasting that provides training and technical assistance to the radio stations, and produces and distributes programmes through an internet-based option (alternative to shipping CDs, cassettes and mail). The internet enables the radio stations to broaden their knowledge and improve their programmes. Radio stations are able to upload and download programmes free-of-charge. This has served radio stations in ten French speaking West African countries (Attias and Deflander 2003).

The CTA Rural Radio Programme supports national and regional ACP rural radio producers through development of curricula and training in producing rural radio packs and sharing information content, tools and processes through the internet. In Zambia, the Radio Farm Forum (RFF), a government initiative, showed that radio was an important ICT for addressing the common needs and problems of resource-deficient rural farmers. The programme was produced by the National Agricultural Information Services (NAIS) in Zambia in the 1960’s to improve communication between the Ministry of Agriculture and the agricultural service staff. A 30-minute radio discussion programme on agricultural problems and techniques was aired, and radio listening groups discussed the problems and their solutions, after which they implemented the various techniques within their local communities. Feedback was communicated back to the Ministry of Agriculture (Bobbili et al. 2006).

There are many other development agencies supporting rural radio programmes such as FAO, UNESCO and 4R Network. Local radio has stimulated dialogue and debate on various issues affecting small scale farmers. The broadcasts are recorded on tape and these are shared with other target audiences including women and the youth. Farmers organise themselves in groups to listen to the taped message and discuss the content such as Kenya’s Ministry of Agriculture’s Agricultural Information and Resource Centre (AIRC) works with KARI and the Kenya Broadcasting Company (KBC) to produce programmes which are broadcast on national radio. Some of the innovative programmes include an agricultural soap opera - ‘Tembea na Majira’ in Kenya and the KACE model of ‘Soko Hewani’, which is exploiting the potential of community broadcasting. The Business Services Market Development Project (BSMDP) is also tapping this potential and broadcasts a weekly interactive radio programme “Mali Shambani”, which integrate radio and mobile telephony. Tradenet.biz in West Africa and Foodnet of ASARECA are also using radio and internet to disseminate market information (see initiatives on radio in Annex 3). In Senegal, the Radio Farm Forum has seen the establishment of radio listening groups that listen to and discuss radio programmes then implement the techniques country-wide. Feedback is provided to the Ministry of Agriculture. Real-time information on agricultural and fish prices is provided to subscribers who pay a fee and receive information on radio (Annex 3).

### 5.1.7 Radio Frequency Identification (RFID)

RFID captures data on individual livestock and this is transmitted to a central database as a repository of information for livestock farmers, state veterinary services and health authorities. RFID has been used in Botswana and South Africa for livestock identification purposes under the livestock information trace back system in compliance with new regulatory procedures required by the European Union. RFID and bar coding is also being applied in a number of African countries including Kenya for stock control and tracking of perishable goods that are being transported (May, Karugia and Ndolweni 2007).

### 5.1.8 WorldSpace satellite radio

WorldSpace satellite radio was considered appropriate for disadvantaged rural areas in that it enables rural communities to download development content where there is no internet.
connectivity. However, one respondent indicated that the WorldSpace office in Nairobi, Kenya had indicated that a fee of US$25,000 per year had been imposed for every institution using the technology for outreach services. This fee was considered prohibitive and could affect many users of this technology. WorldSpace satellite radio has been used by a number of non-governmental organisations (NGOs) in Africa such as FADECO and sub-regional initiatives such as the Open Knowledge Network (OKN) and projects to upload and download development content including agriculture in rural Africa (Annex 3).

5.1.9 Internet and web-based applications

The internet, e-mail, web sites and web-based applications are becoming increasingly important for sharing and disseminating agricultural information. Efforts are on-going to re-structure DrumNet with the hope that telecommunication costs will come down. DrumNet hopes to work with more partners including funding organisations such as the Gates Foundation. It is believed that the ICT web-based system being developed with a private company partner will increase the number of contracts. The system will use Open Source Software (Sourceforge) and users will be encouraged to use and improve on it. A small commission will be imposed for services offered.

Other applications include the KACE electronic trading floor, the Foodnet platform, the Tradenet.biz market information and trading platform and the Agricultural Research and Extension Network (ARENET) project in Uganda that aims to strengthen the information and communication linkages among research and extension services in Uganda. ARENET uses a virtual platform and web portal to provide information services and a question and answer service to small scale farmers (Annex 3). However, the power crisis in Africa is considered a real hindrance to the use of internet in rural areas. In Burkina Faso the Manegbzanga Association is implementing a project that uses the internet to contribute towards increased computer and internet access by women. The project equips women with skills on how to use the computers and basic literacy (how to read and write in French). In Benin, farmers’ groups, extension agents and NGOs are using a web platform to pose questions and receive responses from scientific experts. Internet cafes are used by rural information brokers to publish the questions and answers and these are shared widely on the web (Annex 3). Women fish farmers have established a cooperative and have developed a web site for members to market and negotiate prices with international buyers (Jensen 2001:99).

In Cameroon, the Songtaab-Yalgré association of women producers of karité (shea butter) is using the internet to access market and marketing information of their produce using small information centres (MIPROKA). In Mali, telecentres and local information and communication centres (LICC) have been equipped with multimedia including internet and radio in underserved communities to facilitate access of new technologies to improve their livelihoods through access to health, education and agriculture information. In Uganda, the Collecting and Exchange of Local Agricultural Content (CELAC) project is implemented by the Busoga Rural Open Source and Development Initiative (BROSDI), which has developed a web-based platform that facilitates the sharing of knowledge and management of local agricultural content using various information and communication technologies. The project which targets female farmers has established resource centres with ICT facilities and has chat rooms where farmers ask agricultural related questions (Yahoo and Skype) and have a conference. BROSDI also moderates C3Net <www.chreenet.net> which collects and exchanges local agricultural content. In Mali and Senegal, PROFEIS - a sister program of PROLINNOVA in West Africa, has identified innovations and innovators and organised farmer innovator networks using e-mail and internet (Annex 3).
5.1.10 Other emerging ICT applications

Other emerging ICT applications include distance learning, which has been used in training applications and could be used by agricultural practitioners, offline applications and databases, land-use planning and land re-distribution and public access facilities for rural extension officers and farmers such as telecentres, knowledge centres, access points and market information points for training and information access. Respondents suggested the creation of ‘one-stop centres’ for training and linking farmers to markets, and restructured extension services that work with farmer groups for improved agricultural production and exchange of information. CD-ROMs, DVDs, videos and audiotapes are also being used for training and exchange of information. Heeks (2007) argued that in recognition of the important role that science and technology plays in development, ICTs ought to be put back on the G8 agenda. In Cameroon, the La voix du Paysan ‘Farmers Voice’ - a monthly newspaper is used as a platform for providing rural farmers with agricultural and development information and training (Annex 3).

5.2 Factors influencing use of ICTs as inputs in small-scale agriculture

The respondents and national and regional organizations in Africa have identified a number of factors that limit the use of ICTs. Harris (2004) contended that evidence in support of the use of ICTs remained anecdotal and explained that ICT initiatives were scattered and uncoordinated. Although ICTs have been used as tools to serve small-scale farmers in Africa to provide effective communication, information and knowledge services, these efforts have been in form of projects, which have been dis-jointed and uncoordinated (Kalusopa 2005). A priority setting exercise in the Eastern and Central Africa region identified a number of challenges including poor infrastructure, inadequate ICT skills, poor and expensive connectivity, the absence of appropriate ICT policies and language barriers (Munyua et al. 2003).

May, Karugia and Ndokweni (2007) observed that one of the key factors affecting use of ICTs in agriculture was inappropriate ICT policies especially those addressing rural communities and rural development. Other barriers cited were low teledensities in rural areas, language barriers, poor information sharing culture, and the fact that not all people in rural areas have radios. Maru (2004) observed that although ICTs were widely used in Sub-Saharan Africa, there were major weaknesses in infrastructure, skills, connectivity, capacity to generate digital information content, application and effective use of ICTs. Richardson (2006) identified a number of constraints including poor connectivity in rural areas, inadequate skills and resources, and privatisation of services. Studies designed to assess the usage of modern ICTs for accessing agricultural knowledge and information in Africa revealed low usage patterns amongst small scale farmers (Mosia and Ngulube 2005; Kweku 2006). Guislain et al. (2006:8) observed that access to ICTs in Africa was unequal between and within countries. Guislain et al. (2006) added that though the internet was available, it was mainly available to the better-off groups. On the other hand, Stilwell (2000:188-89) highlighted the challenges on the need to ‘ground’ and develop ICT initiatives based on ‘rural information provision’ and achieve synergy with local knowledge. Stilwell (2001) further stressed the need to repackage information to better address issues related to low literacy levels and tone down technical language such as the popular television edutainment Soul city. The key challenges and factors influencing use of ICTs identified by respondents and secondary information sources included, but were not limited to:-
5.2.1 Inadequate or poor ICT infrastructure

Access to ICTs has been increasing since 1990 but SSA still has low connectivity (UNDP 2005) (Appendix 1). Most rural and disadvantaged areas do not have adequate ICT infrastructure (Munyua and Adupa 2002; Kalusopa 2005). A baseline study on agricultural information in East and Central Africa identified the need to improve the ICT infrastructure in rural areas (Mook, Munyua and Nampala 2005). This finding was in line with Heeks (2002), who pointed out that challenges of poor technical and human infrastructure were a common cause of failure of most information systems projects in developing countries.

Mukhebi (2007) pointed out that agricultural markets in Africa did not work efficiently for poor small-scale farmers because of long transaction chains between farmers and consumers, and poor access to reliable and timely information. The situation is compounded by the fact that the government marketing boards can no longer guarantee smallholders a market for their produce. Thus under the current circumstances, ICTs offer an opportunity for the small-scale farmers to access export and other markets in urban areas. The poor infrastructure and inadequate skilled human resource have led to a wide digital divide between urban and rural areas. Most respondents considered the electricity and telecommunication infrastructure in rural areas to be inadequate for application of emerging ICTs that had potential to improve agricultural production and productivity. The respondents observed that where internet access was available, speeds were low and that there were security challenges. Some countries such as Botswana face special challenges with infrastructure and because of its low population (1.8 million) make the cost of infrastructure development in rural areas high. It is worth noting that there has been massive rollout of basic information communication infrastructure and that the introduction of cellular technology has led to dramatic reduction in subscriber costs and telecommunication services in most African countries. African governments have also supported initiatives in under-served areas through subsidizing the lowest competitive bidder and universal access funds that have been used to fund disadvantaged areas (World Bank 2006a).

5.2.2 High cost of ICTs and telecommunication

Information technology is expensive and most small-scale farmers cannot individually afford the necessary investment. Most African countries pay high telecommunication and ICT costs (Kalusopa 2005), largely due to inadequate infrastructure and incomplete liberalization of the telecommunication sector, which paves way to monopolies. Most respondents observed that although a number of African countries had liberalised their ICT sector, the actors were still very few and in most countries monopolies and oligopolies had led to high prices for services. The presence of few actors has also meant that investment in the sector is inadequate hence the African continent does not have significant connectivity (Appendix 1).

For example, the Edge technology of Safaricom Limited in Kenya is considered too expensive by small-scale farmers and other users, even with the concession provided. Respondents called for strengthening of rural infrastructure to facilitate access and enhance affordability. Respondents in Botswana reported that telecommunication costs were high with about 8% of the costs being paid to a neighbouring country that facilitates external communication.

5.2.3 Low bandwidth

Currently, most of Africa is served through expensive satellite infrastructure that is not affordable to the majority and it often offers poor quality of services. Most respondents in all the countries visited cited low bandwidth as a major challenge. Most countries in the region do not have modern backbone infrastructure which is compounded by the fact that some of them do not have direct access to terrestrial and global networks. This situation deprives African countries of job creation opportunities and the ability to expand trade within and without the continent.
The World Bank in collaboration with eight development partners (AfDB, AFD, DBSA DFID, EIB, EU, KFW and SIDA) has proposed a Regional Communications Infrastructure Program (RCIP) to leverage private sector participation to help overcome these challenges. The initiative will provide infrastructure, finances, strengthen policy and regulatory environments and improve access to international connectivity. It is hoped that this will provide affordable and quality telecommunication services, develop transparency and improve efficiency of e-government applications. Countries that will benefit from RCIP include Angola, Botswana, Burundi, Comoros, DRC, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, Somalia, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe (World Bank 2006a).

There are other opportunities to increase bandwidth and reduce costs of ICTs including the submarine and terrestrial cables that are being laid out in Africa. The submarine and terrestrial cables being laid include the East African Submarine Cable System (EASSy) fibre optic project, which will be extended to Mauritius and Europe; its parallel project, the East African Marine Systems (TEAMS) and the regional information and communication technology broadband network (RICTB). In Ghana, Ghana Telkom is providing broadband services, while in South Africa, the private sector plans to launch an alternative cable to stimulate economic growth and improve bandwidth.

Satellite and wireless technologies are also becoming pervasive in Africa, as they offer practical connectivity solutions for disadvantaged rural areas that do not have adequate telecommunication infrastructure. All the respondents considered broadband services to be necessary in their regions. The respondents argued that increased bandwidth would ensure improved speeds when uploading and downloading files, lower the cost of internet and telecommunications, allow sharing of information with images and multimedia, i.e. e-transmission of content such as audio and graphic content. Such broadband services would allow for downloading of multi-media learning materials that has been shown to very appropriate for farmers training.

5.2.4 Inadequate and/or weak ICT policies / non implementation of policies

It has been emphasized that women play a very important role in the agricultural sector. A study conducted in Burkina Faso revealed that shifting resources to women’s plots from men’s plots from the same household could increase agricultural output by 10-20%. Further, empirical evidence from Kenya concluded that provision of agricultural inputs to female farmers with similar education levels as their male counterparts yielded 20% more output. Provision of better services to women could lead to higher yields and improved quality of life (World Bank 2006b:13,15). Despite their preponderant role, women are often not included in policy making.

Most African countries have developed national agricultural policies and liberalized the communications sector, which has led to more players in the market adopting ICT services in rural areas. But weak ICT policies and poor implementation capacity are among the biggest obstacles to adoption of ICTs and there is a need to improve ICT policies and strategies (Guislain et al. 2006:14). National efforts are augmented by regional and Pan-African organizations that have developed continental and region-wide polices and strategies. The treatment of small-scale farmers in some of these policy and strategy documents is, however, not explicit enough. Respondents in the present scoping study suggested that the policies should be crafted such that they increase the independence of small-scale producers and allow them to take charge of their affairs. Such policies should also facilitate the securing and enlarging of local, regional and international markets for agricultural produce and non-timber forest products of small-scale farmers. Bertolini (2004)
suggested that policy makers and actors from extension systems need to be made aware of ways in which appropriate ICTs can help influence agricultural practices.

Some respondents argued that although ICTs have the potential to enhance the efficiency of governments in formulating and implementing their agricultural policies, most national ICT and agricultural policies in Africa do not clearly address the use and application of ICTs for rural communities with the importance it deserves. A few countries in Africa have ICT policies or drafts such as Egypt, Rwanda, Tanzania, Uganda and Kenya. However, interviewees suggested that the evolving policies have not been matched with the necessary resources required for implementation.

Respondents felt that national policies needed to be strengthened to support development in rural areas. One respondent from Botswana observed that gender policies remained a challenge to uptake of ICTs. This respondent stated that although efforts had been made to include more women in the agricultural sector and gender had been mainstreamed in all programmes, there were no policies on ICTs and gender. Consequently, the number of women using ICTs was still very low.

5.2.5 Skills gaps and illiteracy
A study conducted by ASARECA-RAIN in 2006 revealed that most African universities did not have graduates with adequate capacity to integrate ICT in communicating agricultural knowledge and information. A training needs assessment carried out in 2004-2005 identified a number of training interventions that require urgent attention (RAIN 2006). Experience on a number of ICT rural initiatives suggested skills gap in using modern ICTs to access and disseminate agricultural information and knowledge. The situation in made worse by the fact that most small-scale farmers do not have the skills to practise modern or improved farming and require training on new technologies, value addition and farming as a business. There is, therefore, a need, for projects and initiatives to incorporate a training component to equip users with skills to use ICTs made available to them.

A number of organizations in Africa have conducted business training for small-scale farmers including the District Agricultural Training and Information Centres (DATICs), the National Agricultural Research Organization (NARO), Uganda National Council for Science and Technology (UNCST) and KACE. Language and illiteracy also influence the use of ICTs in small-scale agriculture especially where content is too technical and available in English only.

5.2.6 Weak institutions and poor collaboration
Most small-scale farmers in Africa do not have the resources to operate independently hence, they face the challenge of diseconomies of scale. Bahiigwa (2006) argued that small-scale rural farmers may not benefit much from domestic and international markets unless they are organized and trained to meet the quality standards demanded by markets and consumers. Supermarkets have offered an opportunity to small-scale farmers to market their produce, but most farmers do not meet the quality specifications and standards required. Neven and Reardon (2004) observed that farmers in Kenya and South Africa were now selling their produce to supermarkets after meeting standards set by the buyers. Farm Concern in Kenya and Tanzania, supported a project that linked farmers to supermarkets whereby farmers used cell phones to access supermarkets and ‘sokos’. Market information and linkage mechanisms are essential for improving markets and providing intelligence on where to buy agricultural inputs.

Examples of new innovations include the establishment of franchised market resource centres of KACE in Kenya which is franchising Market Information Points (MIPs) and Market Information
Centres (MICs) to entrepreneurs to improve access to markets and linkages to agro-services by small-scale farmers. The market resource centres will also serve as transport brokers, and provide warehousing, storage, quality control and financial services, and plan to sell farm inputs (Mukhebi, 2007). Establishment of a mechanism to facilitate the sharing of information and knowledge of networks such as MISTOWA in West Africa will strengthen the efforts of farmers in marketing their agricultural produce.

Among the key recommendations of South Africa’s White Paper on Agriculture are that small scale farmers be given more attention to ensure equitable access to markets, broadening of agricultural financing to include disadvantaged people and beginner farmers, and that that farmers be assisted to identify and use their comparative advantages (Department of Agriculture 1995). Initiatives such as the Broadening Access to Agriculture Thrust (BATAT) and the Farmer Support Programmes have thus been established to support small scale farmers.

5.2.7 Inappropriate local content

Although there is a lot of excitement about computers and related ICTs in rural areas, there are challenges related to availability of appropriate local content in appropriate formats and language. Most of the content available on the web is too technical for farmers and it is largely in English. Lallana and Uy (2003) suggested four content related barriers – local information barriers, literacy barriers, language barriers and cultural diversity barriers and pointed out that farmers rarely find relevant information on the internet. The African Development Forum (1999) observed that much of the information on the Internet is not oriented toward rural populations and there were only a few applications relevant to farmers, natural resource managers, women, youth and rural people in Africa. Stiglitz (1999) noted that content should be useful and meaningful to the local situations. A study conducted by Stefano et al. (2005) in KwaZulu-Natal in South Africa among small-scale organic farmers showed that there was a critical need for appropriately repackaged print materials in local languages. Farmers cited various advantages of print materials including access to the permanent record that can be consulted from time to time. Where farmers have inadequate ability to read, the print materials could also be passed on to children who would read for them.

Findings of a study in Uganda on the Electronic Delivery of Agricultural Information project supported by IDRC indicated that farmers preferred print and electronic materials (Munyua and Adupa 2002). Morris and Stilwell (2003) suggested that small-scale farmers should be involved in the development of information products as they are the best determinants of whether the information product meets their needs or not. To this end, Madukwe (2006) suggested the need for special emphasis on developing and disseminating local content and improving the relevance of the information.

5.2.8 Inadequate involvement of women in ICT-related initiatives

Although most farmers in rural areas are women, they are often not involved in ICT initiatives (Akiiki 2006; May, Karugia and Ndokweni 2007). This point was further stressed by a number of respondents. This calls for a deliberate effort to involve women and the youth in ICT-related initiatives. A
respondent from Botswana observed that gender policies remained a challenge to uptake of ICTs and stated that although efforts had been made to include more women in the agricultural sector and gender had been mainstreamed in all programmes, there were no policies on ICTs and gender and the number of women using ICTs was still very low.

5.2.9 Other factors
Other challenges cited by respondents and in secondary literature include not being able to effectively and efficiently use the technologies available; poor of awareness of existence of ICT facilities and resources and poor of information sharing culture (Akiiki, 2006).

5.3 Some research questions and gaps relating to the use of ICTs in small-scale agriculture

A number of research questions are presented by May, Karugia and Ndokweni (2007). A number of research questions and gaps were suggested by respondents and in secondary sources. These have been categorised below under different sub-titles. More gaps are provided in Annex 3 under challenges.

5.3.1 Baseline studies / surveys / needs assessment

Gaps
• Baseline study on ICTs used by small-scale farmers and an inventory of regional and continental initiatives on ICTs and small-scale agriculture through SRO and FARA-RAILS. This would include good practices from different initiatives and promoting them.
• Needs assessment of small-scale farmers in Africa.

Questions
• What are the best practices for small-scale farmers and how are ICTs used to promote the best practices?

5.3.2 Markets and market research

Gaps
• Conduct a value chain analysis with small-scale farmers.
• Research on markets for small-scale farmers and linkages to markets.

Questions
• What are the market needs and requirements for different commodities that link production to markets and increased efficiency? This would help understand value chain analysis and market requirements, both internal and external, and help set up efficient channels.
• What is the pathway for information flow through the value chain? Understanding this would make the value chain faster, more reliable and timely and reduce transaction costs. ICTs as tools for creating linkages between farmers and markets would, therefore, be more effective.
• How could farmers be linked to markets (standards, requirements and certification procedures)?

5.3.3 Information / knowledge management exchange, sharing and dissemination

Gaps
• Integration of web-based technologies with traditional tools for conveying farmer messages.
The Smallholder Horticultural and Marketing Programme of the Ministry of Agriculture in Kenya that is funded by IFAD did not fully address information dissemination and communication. There is a gap on ICTs and information and communication management. Research could be conducted to complement the initiative on horticultural information and knowledge management.

- Preparation of guidelines on ICT applications in small-scale agriculture.
- Research in improving ICTs for accessing agricultural knowledge and information e.g. cellular phones to target the needs of small scale farmers such as cost of technology and equipment, illiteracy and culture. Voice could for example be experimented in place of text (sms) and touch screen computers could be used with audio visual facility instead of purely text content.
- Research in the establishment of a platform that facilitates the sharing best practices, technologies and farming systems models.
- Research on innovative application of agricultural knowledge and information to attain economic and social development.
- Research on models or platforms for sharing agricultural knowledge and information to foster and stimulate innovation from all actors / stakeholders.
- Research in building capacity for sharing of ideas, innovation, knowledge and information among small-scale farmers through social network mapping – an analysis to provide farmers and service providers with an understanding of networks of relationships and the information / knowledge flow. How can these network maps be used to motivate participation of members in the network?
- Research on farmer field schools (FFSs) as a model for sharing knowledge and information and learning through discovery.

Questions

- Which is the most effective way of reaching farmers with timely information? Is it land lines or cellular / digital telephony, AM or FM radios, print, SMS, or internet, among others? What is the role of community radios in disseminating agricultural information?
- What is the role of an e-repository of local content for small-scale farmers in Africa (i.e. digitization of local content) in sharing and disseminating available local content?
- How should existing information be synthesized, packaged and disseminated to farmers? Which is the cheapest / most efficient way of repackaging information and technologies? What skills are required in repackaging agricultural information?
- How can indigenous knowledge be repacking (multimedia with voice and images) for wider dissemination?
- Is there a market for agricultural information in Africa? Can small-scale farmers afford it? What is the value of this information? What is the return on investment? What is the value of indigenous agricultural knowledge in improving farm productivity?
- How much information is held by agricultural input suppliers, and how does this vary from what is recommended?
- Can quality of information be quantified? In terms of quality criteria, how is quality of local content developed determined?

5.3.4 Institutional building and infrastructure development

Gaps

- Research aimed at improving linkages between farmers, extensionists, researchers, traders, NGOs and other actors in the agricultural sector from production to consumption
- A study on ICT infrastructure in rural areas, peri-urban, towns and cities in Africa.
- Establishing the e-readiness of rural communities to embrace use of ICTs to improve their livelihoods.
• Establishing the drivers of ICT application in rural livelihood improvement.
• Research on approaches that ensure adoption and adaptation of ICTs by small-scale farm pilot studies on ICTs using alternative sources of energy such as solar.
• The need for a central repository to address the challenge of local content in local languages and to be able to share and exchange existing resources.
• The need to address microfinance considering that interest rates are very high and small-scale farmers are considered high risk by financial institutions. There is a need to explore / assess different micro-finance models in Africa and link small-scale farmer projects to credit. Financial institutions should also be encouraged to start innovative products for farmers.
• Tapping indigenous and tacit knowledge on agriculture, NRM and environmental management through local content creation and preservation i.e. e-repository for wider access.
• Intellectual property rights on indigenous knowledge to protect local innovations.
• Research on strengthening of the fisheries and farmer organizations and associations at grassroots level and in particular, women’s’ organizations.
• Research on the small scale farmer ‘group’ models (formal and informal), including associations, cooperatives and federations. This would help address the problem of diseconomies of scale and provide bargaining power to small scale farmers who would purchase inputs collectively, bulk their produce to ensure large quantities and sell their produce jointly for negotiating power and better prices.

Questions
• What is the role of public-private partnerships in promoting ICTs to small-scale farmers?
• Should African governments have a role in providing credit or facilitating access to credit by small-scale farmers?
• Is there a need to develop software that translates content into local languages? Is the market large enough to sustain the market for the software? How can challenges in loading relevant agricultural content and maintaining it on websites be met?
• What ICTs work best in rural areas and are accessible and affordable?
• Are there opportunities for introducing subsidies for ICT services? What are the best subsidy models for rural communities?
• How can agricultural information relevant for farmers be collected?
• How can the private sector link better with small-scale farmers?
• How can local innovation processes be enhanced and scaled up?
• How can scientists best support the processes and innovations of small-scale farmers?
• How could a one-stop-shop be attained that provides information and services to farmers on technologies, markets, processing and packaging technologies?
• Why are few farmers working with NAADS? How are farmers selected?
• How should farmers be brought together to address issues of NRM such as soil erosion? What is the role of policy makers and planners in involving small-scale farmers?
• How is regional information and knowledge assimilated in the respective region?

5.3.5 Training, capacity building and strengthening

Gaps
• Support to on-going initiatives on capacity building such as the RAIN capacity building programme.
• Linking of initiatives on ICTs and small scale agriculture.
• A study on the capacity of farmers to use different ICTs.
• An assessment of training needs of small-scale farmers.
• Developing training resources including e-learning for small-scale farmers and sensitizing farmers and training them on how to use ICTs.
• Training on portal development.

Questions
• What is the minimum literacy required to use available ICTs by small-scale farmers?
• How much investment should be made in empowering farmers with knowledge, e.g. Farmer Field Schools (FFS), farmer groups, training? i.e. assess the cost of empowerment verses the return on investment. Is this the way to go?
• Has research on distance education been focusing on the wrong target group? Is there need to build an e-learning platform to train farmers in grades, standards and compliance, and pesticide residues?
• What is the effectiveness of distance learning?

5.3.6 Technology development / adaptation

Gaps
• Development or adaptation of ICT tools to suit the needs of Sub-Saharan Africa i.e. making ICTs more appropriate and user friendly for the clientele, taking into consideration literacy levels and oral culture of Africa – integration of voice, images and text to enhance messages sent out to small-scale farmers.
• Experimentation with GIS, PDA and interactive voice response applications and other emerging ICTs in the context of small-scale farmers.
• The Smallholder Horticultural Marketing Programme in Kenya is for example currently using old techniques of counting yields per tree / plant and extrapolating yields based on acreage. Use of GIS would help find markets before harvest period.
• Improvement of the Tradenet.biz platform to incorporate audio and voice in addition to text messages to make it interactive; add RSS data feeds (radio) and facilitate sharing and learning.
• Use of GIS applications in characterising the current status of small-scale farmers and trends over time.
• Setting a scaling of technologies.
• Development of an application / portal that ‘pushes’ information on HIV/AIDS.
• Research on the convergence of the internet and cell phone technology i.e. cell phone server.

Questions
• How can the existing systems be improved e.g. how can the Soko Hewani system / Tradenet.biz, Foodnet be improved?
• What new tools could be developed to improve access to market?
• What alternative energy sources are appropriate for rural communities in facilitating use and application of ICTs?
• What is the role of PDAs in small-scale agriculture in Africa? How can hand held sets be used to link to the radio, decision support systems?
• What friendly interfaces are available for developing systems?
• Why the cellular phone technology is so widely adopted in Africa? What makes the technology attractive and what lessons have been learnt? What should be done regarding other ICTs, based on the lessons learnt, to increase adoption? What is the potential of the telephone in availing market information to farmer groups?
• What mechanisms ensure decision support tools are ‘alive’ i.e. enabling factors to ensure utilization and feedback?
• How could open source tools be used to develop applications for small-scale farmers?
5.3.7 Usage studies

**Gaps**
- Analysis of users of different virtual trading floors e.g. *Soko Hewani*.
- Research into use of ICTs by small-scale farmers.
- Tracking users to establish what information they asked for and what level of information they required.
- Assessing empowerment with special reference to whether farmers could search for information by themselves.
- Action research on access and utilization of ICTs to study the dynamic nature of interrelations.
- Assess and evaluate how farmers are using cellular phones and their appropriateness.
- Usage of ICTs by different user segments such as the illiterate, women, disabled and the youth in rural communities.

**Questions**
- How can uptake of innovative ICT applications be accelerated?
- What is the usage of decision support tools by farmers, extension workers and researchers? What is the usage of the agricultural information? Is internet being used to access information? Who is using the Tradenet.biz system, what impact has this had on users?
- Does sensitisation and education increase the uptake of ICTs for development?
- How are ICTs being used to improve livelihoods?
- How can community informatics be used to assess the use of ICTs within communities i.e. what technologies are available, how do they share resources, how do they create, capture and preserve local content i.e. digitization?

5.3.8 Impact studies

**Gaps**
- MISTOWA has collected some data and has focused on some 14 associations who are reporting their trade deals. These need to be followed through to assess impact.
- Development of impact assessment tools for modeling of scenarios using ICTs to guide decision-making and impact of the different ICTs being applied to improve access to markets. Identifying appropriate ICTs and improvements required adapting them to rural areas?
- A comparative study of the effectiveness of SMS for accessing market information.
- Compilation of case studies / documentation of successful and innovative initiatives on ICTs and small-scale agriculture.
- Evaluation of television soap operas and radio programmes from an agricultural context.

**Questions**
- What is the impact of ICTs in agriculture? What are some of the success stories? What is the impact of agricultural messages on radio, television and internet (e.g. on markets, production, usage by extension workers, intermediaries and farmers)? And what is the impact of agricultural messages on the Winneba community served by Radio Peace in Ghana?

5.3.9 Policies

**Gaps**
- Support the CAADP challenges through translation of policy into implementable national strategies and programmes.
- Support in updating regional and national policies that need to be harmonized with the pillars and priorities of CAADP.
• Harmonization of regional and national agricultural and ICT policies and synchronizing their implementation.
• A supportive ICM/T policy for rural areas.
• Research on policies that have worked and empowered small-scale farmers.
• Research on regulatory frameworks in the agricultural value chain and how ICTs could be used to improve regulatory structures.
• Policies for channeling resources for SMEs / small-scale farmers to be included in statistical methods for measuring GDP.
• Revision of continental, regional and national policies that impact on ICTs and agriculture to incorporate priorities of small-scale farmers.
• Policy for capacity building and sensitization of ICTs by Government.
• Sessions with small-scale farmers to feed into policy reform processes.
• Creating a conducive environment for e-commerce in Africa including e-transactions.

Questions
• How do ICTs influence the policy process?
• What are the developed countries doing to promote e-commerce that what could Africa learn from their experience?
• What are some of the on-going national / regional and continental policy initiatives and how could these be strengthened to incorporate the needs of small-scale farmers in rural areas?

5.3.10 Others
• Disposal of ICTs.
• Post harvest technologies to increase shelf life.
• Bulking in times of plenty and storage methods of small-scale farmers.
• Provision of total services that address farmers’ complex problems in a holistic manner.
• Climate change in relation to NRM and conservation.
• Training and capacity building in value addition and agro-processing.
• An analysis of markets and market information i.e. which markets, which areas, what is the market demanding, when to sell.
• Value addition. What do farmers need to add value to their produce and fetch more money?
• Integration of micro-credit. How can farmers be facilitated to access credit to improve farming practices?
• Action research on remodelling the research-dissemination model to ensure research benefits small-scale farmers.
• Biotechnology and bio-safety innovation.
• Research on improving storage and transportation facilities for small scale farmers (including fishermen).
• Research on financial products and micro-credit models that are appropriate for the needs of small scale farmers and traders.
• Driving forces behind exports of different commodities such as fish, fruit, vegetables and high value crops.
6.0 Policy and ICTs as they relate to agriculture

This section addresses agricultural, environment, natural resources management and ICT policies in Africa at continental, regional and national levels. The section also discusses the different systems that facilitate the participation of small-scale farmers in bringing about policy change, the potentials and effects of ICTs in restructuring extension services and models of ICTs that support e-commerce and micro-finance applications.

About half of the respondents indicated that small-scale farmers have not been provided with the capacity to influence policy. They suggested that there was a need to work with farmer groups, farmer forums and farmer central committees to address barriers and challenges that small-scale farmers face. Farm Africa (2002) asserted that policies have not adequately addressed the needs of small-scale farmers and their Chief Executive noted that “there is a failure to listen to small-scale-farmers and also a failure in government policy to support commitments to international development”.

6.1 Policy regimes

There are a number of policy regimes and ICTs that relate to agriculture, environment and natural resources and that empower small-scale farmers in Africa at different levels such as agricultural policies, land reform policies and institutional frameworks.

6.1.1 Continental level

At continental level, the New Partnership for Africa’s Development (NEPAD) focuses on agriculture as one of its seven priority areas for policy reform in recognition of the importance of agriculture as the engine for growth in Africa. The Comprehensive Africa Agriculture Development Programme (CAADP) was launched by the African Union (AU) and NEPAD, and was endorsed by African heads of state. CAADP is NEPAD’s implementation programme for agricultural development in Africa and it is a response to the African agricultural crisis and provides a common Africa-wide framework to restore agricultural growth, eliminate poverty and hunger and ensure food security and forms the bedrock for assisting the attainment of the MDGs related to poverty, hunger and ensuring environmental sustainability (CAADP 2006; NEPAD 2006). CAADP has other cross cutting elements such as knowledge systems and some of the thrusts it focuses on include increasing food supply, reducing hunger, improving technology dissemination and adoption.

6.1.2 Regional level

Africa has regional agricultural policy frameworks such as Politique agricole de l’UEMOA (2001), ECOWAS (2005), COMESA’s Agricultural Strategic Framework and ECCAS/CEEAC. ECOWAS has developed a common agricultural policy that focuses on improving productivity and competitiveness of smallholder agriculture, implementation of a common regional market and adaptation of external trade regime. COMESA has developed a compact proposal to improve food security, agricultural sector competitiveness, expansion of markets and increased adoption of improved technologies -including irrigation- and improved environment and agricultural policy. The proposal closely follows the four pillars of CAADP.

Several of the regional policies require updating to be in synchrony with CAADP priorities. The African Union Commission implements CAADP through six technical agencies. The TerrAfrica
(www.terrafrica.org) initiative supports the land and water management pillar, while the Forum for Agricultural Research in Africa (FARA) supports the pillar on agricultural research, technology, dissemination and adoption including capacity building in research and extension. FARA has developed a strategic document, the Framework for African Agricultural Productivity (FAAP), to make research more relevant through linkages with key agricultural actors including small-scale farmers, extension workers, NGOs and the private sector. Among the objectives of FAAP are a) empowering farmers so that they can participate in setting the research and development agenda and be active partners in implementation and quality control; b) strengthening farmers’ support services so that they will be able to access technologies and improve their own livelihoods through having the ability to continuously innovate and improve their production systems and out-scale innovations and c) strengthening agricultural technology generation for enabling and underpinning progressive smallholder and pastoral agricultural communities.

CAADP implementation is also facilitated through SRO such as the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA), ASARECA, CORAF / WECARD and SADC-FANR. These SROs have developed strategies that guide agricultural research priorities and activities in their respective regions and further offer opportunities for technology spill over effects from one country to another such as the work of ECAPAPA on the rationalization and harmonization of seed trade policies in Eastern Africa and at the planned SADC initiative towards the development of a common agricultural policy for the southern Africa region. Preliminary findings suggest that there are national agricultural policies, but these have not been implemented because resources to support the plans have not been made available.

The North Africa sub-region has witnessed a deregulation of the ICT sector and this has led to an explosion of mobile phone and digital subscriber line (DSL) services and seen the teledensity increase from 5.28 per cent in 2000 to over 45 per cent in 2005. The region is looking towards working jointly to address e-commerce regulation and content development to ensure synergies (ECA 2006a).

### 6.1.3 National level

The Poverty Reduction Strategy Papers (PRSP) guides implementation of policies at the national level. The challenges for CAADP include revision and translation of policy into national strategies and programmes.

ICTs could enhance the efficiency of governments in formulating and implementing their agricultural policies. However, most national ICT and agricultural policies in Africa do not clearly address the use and application of ICTs for rural communities with the importance it deserves. In addition, most government policies have omitted statements that could give due significance to rural communities and binding statements regarding improving ICT infrastructure in rural areas is often not contained in policy documents. Jayne (2001) pointed out that many of the Poverty Reduction Strategy Papers pay insufficient attention to the role of access to land and land distribution in rural poverty. The strategy papers also do not redress the inequalities between small-scale and large-scale farming sectors in Africa.

There are sector-wide reforms in most African countries and most have the Agricultural Sector Management Programme (ASMP), the Agricultural Sector Improvement Programme (ASIP), the Poverty Reduction Strategy Paper (PRSP), and the Economic Recovery Strategy Paper (ERSP).
They all spell out agriculture as a key priority; address creation of employment through agricultural and rural development; highlight empowering resource poor farmers and increasing institutional efficiency; strengthening extension services, increasing smallholder access to credit and revamping the co-operative movement, among others. Bahiigwa (2006) observed that although the PRSPs and agricultural sector development plans have been developed, commensurate resources and infrastructure have not been matched to ensure implementation. Hence, the policies remain as good statements on paper.

Governments in Africa have made reforms in the areas of agricultural extension services, research and rural financial services, investments in physical infrastructure (roads, energy, and telecommunications) and markets to stimulate agricultural growth. In Uganda for example, the Poverty Eradication Action Plan (PEAP) provides a comprehensive development framework that hinges on creating a framework for rapid economic growth and structural transformation, ensuring good governance and security, increasing the ability of the poor to raise their incomes, and increasing the quality of life of the poor. All sector-wide plans in Uganda such as the Modernisation of Agriculture (PMA) and NAADS are derived from PEAP (NAADS 2000; 2006a; 2006b).

The World Summits on the Information Society (WSIS) encouraged developing countries to adopt e-strategies intended to promote and coordinate in-country ICT investments and provide legal and regulatory framework. Although many countries have made good progress, more effort is needed to make ICTs effective tools for development (Guislain et al. 2006:11,12).

Although some respondents indicated that they had not read the ICT policy, most respondents argued that ICTs have been superficially treated in these policy documents and that the ICT policies and drafts do not spell out agricultural applications. Respondents also pointed out that African governments did not match these statements with adequate resources required for their implementation. Some felt that the policies were not interpreted to include small-scale farmers. A few respondents were of the opinion that African governments were making efforts to promote ICTs in rural areas. In Kenya for example, the proposed ICT digital villages are envisaged to make services more accessible for rural communities and support institutions. Part of the services to be offered through these digital villages could be agricultural services including information and extension. It is expected that the work of the on-going national task forces on agricultural extension and research would feed into reforming the national agricultural policy.

In Ghana, the government plans to establish community information centres and it has established District Agricultural Information Centres in rural areas. Some of the policy challenges cited as needing attention are intellectual property rights, inadequate security with e-commerce and addressing the culture of not sharing information. One respondent from Botswana indicated that the Government of Botswana has plans to connect smaller villages and provide rural telephony and the new phase of ‘Ntelesa’, meaning ‘call me’, will connect villages with a significant population. The Government of Botswana has established pilot Community User Information Systems, based on the telecentre concept, under the Botswana Technical Centre and satellite centres in three villages. The Government plans to rollout about 24 telecentres that will adopt the post office model to improve access to ICTs.

The current context in Africa provides an opportunity for the agricultural sector to take advantage of ICTs and the international community. The United States of America government has renewed commitment to support agriculture and food security in Africa. It has started initiatives such as the Africa Seeds for Hope Act, the Africa Growth and Opportunity Act (AGOA) and the Africa Food Security Initiative, and it supports micro-credit finance, agricultural research (biotechnology), extension,
institutional building and small-scale farmers, among other programmes. Through bilateral support, the US government is also supporting gender equality through support to women programmes on health, agriculture, micro-credit, business and leadership, and enhancing women opportunities to increase agricultural productivity and contribute to food security in Africa (USAID 2002).

The EU has developed an approach that recognises the important role of agriculture in economic growth, poverty reduction, food security and resource management; the need for development of effective agricultural policies and strategies that link into the PRSPs and the need to integrate agricultural development into a broader framework on rural development; the need for research that is responsive to demands of small-scale farmers and their organizations and linkages to training and extension, among others. The European Union Strategy for Africa has developed a range of communication and policy guidelines that provide a policy framework towards supporting African agriculture (EU 2006).

A number of African countries are implementing the Agricultural Productivity Project (APP), which addresses technology invention, repackaging, dissemination and adaptability, among others. In Kenya, the Agricultural Technology and Information Response Initiative (ATIRI) works with partners to respond to farmers’ demand for technology, knowledge and information. In Uganda, the Plan for Modernization of Agriculture (PMA) drives poverty reduction. There has further been a shift from subsistence to market-oriented and commercial farming, and to this effect, the National Agricultural Advisory Services Programme (NAADS) was established in 2001 to empower farmers to modernize agriculture (NAADS 2005; 2006). NAADS empowers farmers to access fee-based agricultural advisory services and market information. According to the respondents, the ICT policy in Uganda recognizes the need for ICTs to play a greater role in rural development and provides the necessary framework to support application of ICTs.

Most countries in Africa are adopting e-governance as a way for empowering people and strengthening good governance. E-governance could lead to more efficient delivery of service and pave way for two-way communication that makes it possible for small-scale farmers to contribute and participate in the decision-making and policy formulation processes. Some respondents argued that there had not been adequate deliberate effort on the part of African governments to target small-scale farmers when delivering public agriculture and agricultural-related services. This was despite the fact that they form over 70% of the population of Africa. It is a fundamental right of small-scale farmers in Africa to receive public agricultural information, access markets, inputs and extension services through ICTs. Some of the on-going and planned initiatives are presented in Annex 3.

African countries have established regulatory bodies such as the Communications Commission of Kenya (CCK), Uganda Communication Commission (UCC) and Ghana Communication Commission (GCC). These bodies address monopolistic practices in the telecommunications sector that leads to unfair trade practices. Some like UCC have set up a Rural Communication Development Fund (RCDF) to improve the ICT infrastructure in rural areas to make telecommunications services more accessible. Taxes have been removed on ICTs in most African countries to stimulate higher adoption and application in development.

Africa is also beginning to realise benefits of integrated networks and companies such as Celtel and Safaricom have launched integrated networks. These reform activities have led to reductions in telecommunication and introduced uniform rates across the region, and enhanced the sharing of agricultural information, knowledge and related services in the region e.g. the usage of Foodnet and KACE in the Eastern Africa market.
6.2 Participation of small-scale farmers in bringing about policy change.

About half of the respondents argued that small-scale farmers have not been provided with the capacity to influence policy. They suggested that there was an urgent need to work with farmer groups, farmer forums and farmer central committees to address barriers and challenges that small-scale farmers face. Farm Africa (2002) asserted that policies have not adequately addressed the needs of small-scale farmers and their Chief Executive Officer noted that ‘there is a failure to listen to small-scale farmers and also a failure in government policy to support commitments to international development ...’

Respondents suggested a number of innovative ways in which small-scale farmers and related groups have participated or could participate in efforts to bring about policy change and reform in both the agricultural and information and telecommunications sectors. Most respondents felt that there was a need to empower small-scale farmers to participate more in efforts that enable them to contribute to policy change. Hirst et al. (1988) argued that policies should lead to increased independence of small-scale producers and allow them to take charge of their affairs. Respondents in the present study suggested that there was need for more empowerment of small-scale farmers through training on the role and application of ICTs to facilitate them to influence policy. Farmers also need to be deliberately engaged in policy discussions at all levels. Some of the innovations are presented in Box 3.

**Box 3: Small-scale farmer participation in bringing about policy change in Africa**

- Small-scale farmers in Africa are being organized / self-organizing themselves into formal and informal groups, associations, co-operatives and federations, to voice their views and demand for services (Madukwe 2006). Mutua-Kombo (2001) noted that women farmers had formed such groups in order to overcome their agricultural problems collectively. Some of these farmer groups (formal groups) are being represented at different levels of policy formulation. This has provided them the ‘muscle’ to lobby and be recognised by policy-making organs.
- In Tanzania, farmers were in the past able to influence policy, decision-making and formulation of by-laws through formation of ‘Development Committees’. This helped address the challenges brought about by the top-down approaches. Local institutions need to be strengthened and their rules, norms and beliefs need to be brought into modern ways of policy formulation.
- Farmer organizations and federations are representing small-scale farmers at policy-making forums. In Ghana, the Ghana National Association of Farmers and Fishermen (GNAFF) and the Ghana Agricultural Producers and Traders Organization (GAPTO) played a key role in responding to the Ghana Economic Recovery Program and represents small-scale farmers and micro-food processors at the policy formulation. GNAFF sits in various boards and commissions to air the voices of farmers. The CTA-GNAFF project has also helped re-organise agricultural producers into a strong dynamic front to effect policy initiatives. The Zimbabwe Farmers Union (ZFU), Uganda National Farmers Federation (UNFFE) and other bodies in different African countries participate in policy change and reform processes. UNFFE, for example, sits at the NEPAD APRM Committee and carries the voices of farmers at that level. The Kenya National Federation of Agricultural Producers (KENFAP) participates in location and district committees and national executive council meetings. A study carried out by KENFAP indicated that there were many enlightened and literate farmers who could be involved in policy reform and formulation processes. There were mixed views about the involvement of farmers in the policy process. Some respondents in Kenya felt that the government-facilitated ICT policy draft did not provide an opportunity for small-scale farmers to contribute towards the draft. Some, however, pointed out that the Food Security and Nutrition Strategy that was developed by consultants provided opportunity for grassroots communities to discuss and their inputs...
were incorporated. One challenge cited was the translation of policy to action by spelling out implementation and allocating a matching budget.

- Respondents in Botswana indicated that small-scale farmers were consulted adequately in the policy formulation process. Botswana has a ‘culture of consultation’ and used the Kgotla system (the chief’s court/meeting place), which have been formalised into modern structures, and grassroots communities are also among stakeholders invited to the national ICT policy stakeholder conferences.

- In Uganda, BROSDI has mobilized farmers to establish district farmer networks in 16 districts. About seven of these are legal entities that have been empowered through training, refresher training, registration and income-generation activities, so they are respected. The district farmers’ networks provide a ‘voice of the district’ on policy, development and welfare issues.

6.3 Potential and effects of ICTs in re-structuring extension services

IFAD (2002) observed that extension services in Africa have failed to address the needs of small-scale farmers. According to Richardson (2006), agricultural extension services that provided agricultural information do not work effectively in Africa. There has been a shift in the extension process and focus was now on the facilitation and brokerage of information, communication and advocacy services, and providing broader services that improve rural livelihoods. ICTs could be used to restructure extension services by facilitating dissemination of information and advisory services to farmers to be able to produce more efficiently. Agricultural information on input supply, use, product marketing, and value addition could be transmitted through ICTs, thus cutting down the need for travel and visitations by extension workers. ICTs could also free time for extension workers and cut down the number of change agents required and training by providing ‘distance extension’ through telecentres and other public access points.

Due to the limited number of extension workers, farmers are using the phone to seek advisory services. Extension information could also be shared through a website and PDAs could be used to collect and disseminate critical agricultural information that farmers need. Cutting down the face-to-face contacts can reduce telecommunication and transport costs drastically. Farmers would, however, require training and a change of attitudes to enable them access information and advisory services through ICTs to make the services affordable and effective. Use of ICTs would also provide for more content diversification, provide links inputs, microfinance, information, knowledge and markets. ICTs could further ensure a wider reach.

E-forums could also be used similar to the e-choupal model in India to reach farmers through public access centres such as telecentres, knowledge centres and access points. The challenge, however, will be the high illiteracy levels and inadequate skills on how to use computers and other ICTs. Other challenges include poor telecommunication infrastructure and electricity, computer viruses, inadequate technical expertise in rural areas, expensive equipment, and availability of hardware and software. Respondents suggested touch screens as a solution to high illiteracy levels in rural areas. A number of public access sites such as telecentres, rural resource centres, knowledge centres, market information points and information kiosks have been established by development partners, private sector and non-governmental organizations (NGOs) for providing access to agricultural knowledge and information (Benjamin 2001; Harris 2002; Mayanja 2002; Ilbuodo 2003). Examples of some of the on-going and planned initiatives to restructure extension services are presented in Box 4. Details on these initiatives are provided in Annex 3.

Box 4: Some initiatives to restructure extension services in Africa.
Hallo Engineer. This is an innovative question and answer service of the Technical Centre for Agricultural and Rural Co-operation (CTA) for rural farmers in West Africa. Farmers use cell phones and beep or flash an agricultural expert or engineer, who in turn calls back the farmer to discuss a problem and explain an answer. Farmers express themselves in local languages and express their local issues. Cameroon is currently the regional node and surrounding countries use it. About 700 queries have been responded to since December 2003. Plans are under way to expand the service to 6 countries in Southern Africa. It is expected that by the end of 2007, the service will be available in 15 African countries.

In Benin, private extension services have been set up and farmers’ local organizations have been established to ensure technologies are effectively diffused to farmers. Service providers, known as village observers, visit and advise farmers on appropriate techniques and deliver knowledge and information related to the technology. Farmers pay for the service directly (Moussa 2006).

In Kenya, a National Task Force on Agricultural Extension was recently established and the use of ICTs and knowledge management are some of the areas being discussed to reform extension services. KACE plans to use hand held devices to transmit information directly to a decision support system where the diagnosis is done and the farmer receives a solution promptly before the problem escalates. Hand held devices have pervasive reach and could be used to provide virtual extension services to areas that would otherwise not be reached due to poor infrastructure and at more cost-effective manner.

One NGO in Kenya, the Kenya Network for Dissemination of Agricultural Technologies (KENDAT), has established ‘community parliaments’ as their entry point. The community parliament comprises of different stakeholder groups in the community including single mothers, the youth, government representatives, farmers, church representatives and members of parliament. The ‘parliament’ meets monthly to deliberate on the development needs and where necessary, the Minister is invited to attend to respond to the issues raised. Various issues including infrastructure and policies have been discussed and aired to the relevant organs through the community parliament. The community parliament encourages farmers to form groups and new agricultural technologies are discussed and their benefits presented. Techno centres have also been established to provide advisory services to farmers. Experts are invited to provide advice and guidance to the groups. Farmer groups in Mwea, have through this channel, introduced silk farming and exchange visits have been organized. Horticultural farmers have also been trained on certification and EUROPGap standards and are now exporting their produce to Europe. The digital villages planned to be introduced in Kenya could be linked to the community parliament and could operate as techno centres. Community groups have also been formed to increase the catchment area and field days, demonstrations, training, seminars and treatment of animals by veterinary officials and community animal health workers is handled through the groups.

In Kenya, the Kenya Agricultural Research Institute (KARI) launched an innovative initiative, the Agricultural Technology and Information Response Initiative (ATIRI), which works with partners to respond to the farmers’ technology and information demands. ATIRI uses participatory approaches to ensure that improved technologies and knowledge are adopted and disseminated to farmers, respectively, to enhance their rural incomes and improve their livelihoods. KARI centres network are involved in ATIRI and exchange experiences with partner organizations (KARI 2006).

In Uganda, the National Agricultural Advisory Services Programme (NAADS) is empowering farmers to modernize agriculture. NAADS is a 25 years government-facilitated programme that is supported by development partners. It increases farmers’ access to information, knowledge and technology through effective, efficient, sustainable and decentralized extension service. NAADS is implementing the Integrated Support to Farmer Groups (ISFG) and farmers
have been mobilized, educated and re-orientated. The NAADS Programme has organised farmers into groups to access microfinance, bulk storage and marketing of farmers’ produce and provides effective agricultural advisory services. NAADS involves the private sector, mainly NGOs, consulting firms and individual professionals, who enhance the delivery of information, technology and knowledge that are relevant and appropriate in improving the livelihoods of the rural poor and women by increasing agricultural productivity and profitability. NAADS provides demand-driven access fee-based agricultural advisory services and market information to small-scale farmers through farmers groups. Internet, e-mail, video, radio and print are some of the ICTs used to share and disseminate agricultural information and advisory services (NAADS 2000; 2006).

- NAADS, the National Agricultural Research Organization (NARO) and the Food and Agriculture Organisation of the United Nations (FAO) are looking at ICTs as an option to create the infrastructure for improving extension services and interaction with other players including private service providers, local government, farmers and civil society organizations. The Agricultural Research and Extension Network (ARENET) project is being implemented (Annex 2) to improve extension services and linkages.

- Farmer training centres have also been established in Uganda under PMA and District Agricultural Training and Information Centres (DATICS) have been established to provide training and education, strengthen rural youth farms and linkages between research, NAADS and other stakeholders. This district-focused centres train and support farmers, and produce well qualified small-scale farmers who can transform from subsistence to commercial farmers. The centres also provide agricultural-related information materials and disseminate information to farmers and hold demonstrations, conducts trials, and seed multiplication, among others. DATICs work with research institutes, NGOs and Agricultural departments and private sector in a number of activities including drip irrigation, improved goat rearing, high value crops, organic farming, animal traction, variety trials and horticultural gardening. The training curriculum is based on the needs of farmers.

- In Egypt, the VERCON pilot project has been tested and ICTs have been used to link different actors, deliver technical and market information and access better markets. Plans are under way to expand. PDAs could provide virtual extension services that are more cost-effective and accessible to areas where infrastructure does not permit extension workers to serve.

- In Ghana, the Cocoa Research Institute and CABI had farmers empowered by organising them into Farmer Field Schools (FFS) to increase productivity and improve the quality of their cocoa. Participatory research and training methods were used. Farmers were also trained in the production of video films that communicate the principles of improved cocoa cultivation, which they used to train other farmers.

- The Coalition for Effective Extension Delivery (CEED) is an extension model that ensures effective services from research and extension are delivered to farmers. The model focuses on empowering small-scale farmers through capacity building and facilitation (Duveskog, Mburu and Critchley 2002).

- Farmer Field Schools (FFS) have also been established and these have proved to be incredible in sharing and disseminating agricultural knowledge, information and advisory services. The FFS have networked farmers from different regions and countries in Africa and have arranged exchange visits, which have proved excellent learning channels. The FFS process is based on learning through discovery and empowering small and marginalized farmers through improving their understanding of the determinants of farm performance and their awareness of technical options for improvement (IFAD 2002).

- In Lesotho, the Machobane Farming System (MFS) is being promoted due to limited land resources, usually about 0.5 hectares. This system provides for growing of several crops together in a relay/intercropped system to meet the immediate and long-term needs of rural
poor smallholder farmers. It uses low inputs and recognizes the importance of using locally available natural resources including indigenous knowledge as inputs. The MFS has helped dispel hunger, address the challenge of unemployed women and is important in the management of HIV/AIDS (IFAD 2002). The MFS, thus, does not require extension services and local knowledge (tacit and explicit) is available amongst farmers.

- In Zimbabwe, the potential for establishing a private, fee-for-service extension system has been explored to provide demand-driven knowledge system that addresses the relevant needs of farmers. Foti et al. (2006) indicated that demand for private extension services are low and suggested that issues such as the degree of commercialization of farm enterprises, farmer income, farmer location (whether urban, rural or commercial), farm size, and risk attitude of the farmer would significantly affect the demand for private fee-for-service extension. The authors suggest that private extension services should target high value crops and livestock enterprise and free services should be offered to resource poor farmers.

- Linking Local Learners (LLL) is an initiative in Kenya targeting rural farmers that links coordinators and keeps them in touch through computers and internet connectivity. Intermediaries access agricultural information and convey messages to farmers.

- In Nigeria, Farmersneeds.org (FARNO) is providing agricultural extension services through a help desk that responds to farmers’ questions and facilitates learning. FARNO provides a question and answer service to farmers and community leaders and uses a two-way radio that facilitates audio and text communication. Other ICTs such as internet, sms and interpersonal means are also used.

6.4 Model(s) of ICTs to support e-commerce and micro-finance applications

E-commerce in Africa is still at its infancy and needs supportive policy and legal framework and adequate infrastructure to work efficiently. E-commerce entails obtaining current information on market prices, developing products for small markets and marketing them directly to consumers or traders in distant areas (FAO 2006). E-commerce is the buying and selling over the internet or any transaction that is effected through an information network (Lallana and Uy 2003). E-commerce is also defined as defined as “any business transaction conducted over computer-mediated networks … encompasses more than actual purchase of a good or service: it also includes both transaction preparation and transaction completion activities … all actions related to the marketing, advertising and exchange of information associated with the sale of a product … all ordering, invoicing, payment and logistics actions required to transfer ownership of a product from the seller to the buyer (Paré 2001 cited in Tregurtha and Vink 2002). Some of the e-commerce types include business-to-business (B2B), business-to-consumer (B2C), business-to-government (B2G), consumer-to-consumer (C2C) and mobile commerce (m-commerce) (Lallana and Uy 2003). Harris (2004) stated that m-commerce using wireless mobile phones and PDAs for selling of goods and services was growing rapidly. Most countries cannot make payments online due to national ICT policies, security risks and inadequate infrastructure such as low bandwidth to support e-commerce, inadequate skills to use e-commerce, legal status of e-mail communication and telecommunication costs. In Africa, e-commerce has not advanced much among the agricultural sector and a number of transactions are conducted off-line (Tregurtha and Vink 2002). Most institutions visited and literature reviewed did not, however, reflect real e-commerce where all transactions were carried out online. Some of the reasons for not adopting e-commerce are given as “lack of applicability and little incentive to change business models when returns are not clear”, poor trust in e-transactions, legal protection, privacy and security and shortage of ICT-skilled labour (Qiang, Clarke and Halewood 2006:66). Findings on e-commerce survey in South Africa and other cases suggested a number of
challenges to using e-commerce include the need for face-to-face interaction, data privacy and security issues, customers do not use the technology, inadequate staff with e-commerce expertise, costs of implementing e-commerce, making organizational changes, low levels of internet usage, non-supportive business laws and inadequate legal protection (Moodley 2002 cited in Qiang, Clarke and Halewood 2006:66). Respondents suggested different models of ICTs to support e-commerce and micro-finance applications in the context of small-scale farmers. These are presented in Box 5 and 6 respectively.

**Box 5: Some e-commerce models applied in the agricultural sector in Africa**

- **Telecentre model.** Respondents suggested that African governments should work with rural communities to establish ‘telecentres’ or knowledge centres or access points or rural public calling offices (PCOs), or internet points that could act as a one-stop-shop for agricultural information, advisory services, marketing services, microfinance services and other related services. The telecentres should be equipped with modern and traditional ICTs that facilitate e-commerce and e-microfinance in conjunction with offline transactions.

- **KACE’s Soko Hewani model using cellular phone and an electronic trading floor.** After linking the buyer to the seller via radio, other transactions are carried out off-line. KACE also has a trading engine that is internet based that links buyers and sellers of commodities and provides market information (see Annex 3 for details).

- **Tradenet.biz model - Tradenet.biz is using a web-based model that allows users to access market information, access markets, place orders and offers online.** The trading platform links producers to traders and allows for some online transactions such as securing of markets and ordering of produce. Payment transactions are done off-line (see Annex 3 for details).

- **Foodnet model - this model also provides an electronic trading floor that links farmers to markets via internet or sms.** Payments are transacted off-line (see Annex 3 for details).

- **B2B e-commerce model – in South Africa, the horticulture sector and the flower industry has developed e-commerce platforms that allow growers to send price information to clients.** Other transactions are carried out off-line (Tregurtha and Vink 2002).

- **In Burkina Faso, the Business Intelligence Trade Points model is used for the agro-business sector to address socio-economic exclusion of small-scale farmers.** The project collects and disseminates market information for local producers and facilitates trading through e-commerce which is growing slowly (Annex 3).

- **In Rwanda the Sustainable Partnership for Rural Enterprise Agricultural Development (SPREAD) is using ICTs to sell coffee internationally and to monitor the international coffee auction through an innovative partnership that links SPREAD, Texas &M University and Michigan State University.** This trading model facilitates direct access to new markets and introduced international quality standards via the internet.

Micro-finance entails the provision of savings, credit and/or other financial products and services to customers who are primarily poor and who most financial institutions do not consider being credit worthy candidates. The potential candidates also need to be able to save and pay the high interest rate required to cover credit transaction costs. Transactions are done electronically. Governments, private sector, NGOs, co-operative-type institutions and informal lenders provide micro-finance. Other retail outlets include land banks, agricultural credit boards, parastatals, post office outlets, village banks, co-operatives, commercial banks, retail stores and the informal sector (Coetzee n.d.). Small-scale farmers need to access credit to enable them move out of the poverty cycle and advance beyond subsistence farming. Farmers need credit to acquire agricultural inputs (tractor / labour hire, seeds, fertilizers, pesticides, herbicides) and employ additional labour. Most financial institutions do not favour farmers, as they are considered ‘risky’ and where available,
interest rates have been very high. Some of the e-microfinance models that have been applied in small-scale agriculture are presented in Box 6.

**Box 6: Some micro-finance models applied in the agricultural sector in Africa**

- **M-PESA model** facilitates online money transfer through a mobile phone (Safaricom Ltd.). Farmers can now sell their produce and be paid on the spot. Customers of the service can use their cell phones like a bank account and debit card. Accounts are credited at the local air-time dealer and can be transferred to another person’s phone or make a loan repayment or redeem it as cash. The system allows customers to pay for a wide range of goods and services without using cash. KACE indicated that they were exploring the cash transfer model with Safaricom and planned to use the market resource centres (MRCs) to transfer cash to individuals / banks and extend short-term funding using mobile telephony. Funds could for example be transferred through the MRC to facilitate farmers to transport their produce to the market and this would be paid back through the MRCs after the transaction is completed.

- **The revolving fund or ‘merry-go-round’ model** that is considered more user/borrower friendly. Members of a group contribute funds on a regular basis and members may borrow from the group fund at a small interest.

- **Posta Pay.** This model is being used in Kenya to transmit funds to pay farm workers in rural areas. Funds are remitted and paid through the post office network in the country.

- **Commercial bank model.** Although most commercial banks do not consider small-scale farmers as worth lending money to, some commercial banks have began to offer them loans. In Uganda for example, the Centenary Rural Development Bank (CERUDEB) started as an MFI that serves the rural poor. CERUDEB extends credit to farmers operating micro and small enterprises (Kato 2006)

- **The Grameen model.** The Grameen Bank model from Bangladesh is one of the best known examples of a micro-finance institution. Members organize themselves into groups in their villages to form collective security and borrow from a micro-finance institution with members of the groups standing surety for them. The Grameen model is the best known group-lending model and it targets women. Repayments under this model have proved very successful. Members also save money with the micro-finance institution. MISTOWA/IFDC and BusyLab plan to add a micro-finance component with Ecobank to the Tradenet platform to provide group loans and operate along the principles of the Grameen Bank. This will leverage the Tradenet platform and database to reach the ‘under-banked’ via cell phones. This is expected to take effect from the second quarter of 2007.

- **Village Bank (VB) model.** Village banks are a form of savings and credit co-operative that operate in remote rural areas. In South Africa, three pilot banks were established in North West Province in 1994 with support from the International Fund for Agricultural Development (IFAD) (more information <www.ifad.org/ruralfinance>). The VB model has a board governed by rules and policies and has diverse representation. Members of VB are mostly unemployed adults. The community determines the interest rate to charge to members. Community members purchase shares with a goal of mobilising savings and an account is opened with a link bank that provides access to formal financial system. VB provide social and economic benefits, community participation and democracy, community empowerment, representation of diverse interests and provides for conflict resolution (Dallimore 2003). In Egypt, the rural population is being encouraged to save and the village bank model is being adopted. In Kenya, there is a VB model with Equity Bank and farmers can transact and access information on their accounts using mobile phones. VBs can also invest their savings into business ventures on behalf of the group. FarmAfrica has established a number of VB in various rural areas in Bomet and Vihiga in Kenya, where impressive amounts of money are mobilised. In Uganda, the Zirobwe Savings and Credit Co-operative Society (ZISACCO), a
village bank established to help farmers save and access loans, lends money to individuals and groups (individuals present collateral but groups do not). The produce of the farmer is bought by ZISACCOs and interest on loans is about 3% per month (Kato 2006). In Uganda, a local NGO, Uganda Microfinance Union (UMU), has partnered with MTN to provide the rural poor with loans to buy phones that have enabled farmer groups buy village phones on loan basis and become rural phone operators.

- **Co-operative model.** This model adopts the savings and credit system practised by credit unions, co-operatives and farmers’ co-operatives. Under this model, savings are collected and short-term credit is provided at a small interest and at times, collateral may be required (GDRC 2007). In Uganda, USAID/Rural SPEED has held discussions with bankers on warehousing receipt and hedging strategies. Cotton farmers collect their produce, which they deliver to a warehouse and get paid in the bank. The cotton is sold in bulk, which provides for economies of scale and therefore gets bigger buyers offering more competitive prices (Atuhwere 2006).

- **The African model.** In Uganda, Bwende in Jinja District has adopted the African Model. This model advocates for ‘living together and for each other as two peas’ and targets the marginalised groups especially women and the youth. Members have formed a savings and credit group that falls under the Asonkera Savings and Credit Co-operative (ASACCO), which is an umbrella organisation with over 559 members, both individuals and groups. ASACCO, which is funded by the Uganda Co-operative Alliance, has five Sub-Counties and has formed its own bank where members can deposit and withdraw funds. ASACCO has led to an improved savings culture. Pay back is usually within a month and this proves ‘unfriendly’ to most farmers. ASACCO plans to introduce long-term loans and extends additional technical services to active farmers such as tractor hire (Atuhwere 2006).

- **Self-help group association model.** Under the self-help group model, members of the group collect funds from members and establish a revolving fund from which its members can borrow at a small interest. Variations of self-help group models are the ‘merry-go-round’ or rotating savings and credit associations, where members contribute money regularly and a lump sum is given to each member of the group on a rotating basis. Most of the self-help group associations are female organizations (GDRC 2007). In Zimbabwe, the Self-help Assistance Program (ASAP Africa) is working with rural communities and helping in the establishment of rural savings clubs that facilitate the pooling of resources among other agricultural and related activities to improve their own lives (ASAP 2006).

- **Pride Africa Credit Model.** Pride Africa arranges for credit product partnership with local banking institutions, which integrates well with the needs of small farm businesses such as for farm inputs, flexible repayment tied to harvest cycles, and a reliable place to save. Farmers can also save their earnings with the micro-finance company and interact / access information such as account balances through SMS, loan payment history, personal pricing and marketing history; investment in seeds, fertilizers, agro-chemicals, equipment, transportation and labour, which are beyond the means of most smallholder farmers. Farmers can only access credit in form of inputs (cashless). Under the refined Pride Africa model, DrumNet is doing repayments. This model has shown guaranteed repayments by farmers.

- **The Agricultural Sector Programme Support (ASPS) Model.** The Agricultural Business Development Component (ABDC) of the ASPS II in Uganda supports farmer activities that increase productivity and markets. Services of ABDC are available in 6 districts including Soroti, Lira, Arua, Kapchorwa, Hoima and Masindi. Kisoro is expected on board soon. Farmers receive support to micro small and medium enterprises to develop their businesses by identifying new market opportunities, accessing new / improved technologies or accessing ABDC has partnered with DFCU Limited and Uganda Micro Finance Limited (UMF) in a micro-leasing scheme. Equipment or assets to lease are identified and assessed, but farmers must demonstrate the ability to pay back. Repayments are expected at production and harvest seasons (Kato 2006).
• **Bank for Agriculture and Agricultural Cooperative (BAAC) model.** In Thailand, the Bank for Agriculture and Agricultural Cooperative that was established in 1966 by the Government provides financial services to Thai farmers. The Bank is decentralized and has branches that enable farmers in rural areas to access services and uplift their livelihoods. BAAC is collaborating with GTZ, Japan Bank of International Cooperation and EU to implement: Social Support project (EU). BAAC has harnessed the potential of ICTs and is providing innovative and timely services to customers through use of internet and intranets; the Agricultural Information Network (AIN) – an internet-based portal that enables farmers, policy makers and extensionists to access agricultural information (feasibility study carried out with funding from CIDA). AIN has GIS and decision making tools and uses radio broadcasts, web TV, telephones, computers, call centres, ATMs, PDAs, field offices and telecentres; the Crop information system – that aimed at developing a database for farmers and agricultural cooperatives and facilitate easy access to information on crops, weather, pests and diseases, market prices and crop diversification opportunities; The Special Assistance for Project Sustainability was funded by JBIC; the Crop and Village Information System – that was to be a nation-wide model with community-based rural development plan, data collection using pocket PCs, farm data record system, technical advice and credit services; plans and procedures for implementation. There are plans to establish a regional network for Asia (Nattaradol 2002).
7.0 Initiatives on ICTs and small-scale agriculture

This section presents some on-going and planned initiatives on ICTs and small-scale agriculture as well as their sustainability strategies.

7.1 Some on-going and planned initiatives

There are a number of on-going and planned initiatives on ICTs and small-scale agriculture and related fields addressing some of the issues and challenges that small-scale farmers in Africa experience. Since the list is long, the projects, implementers, development partners, partners, impact and challenges are detailed in Annex 3. Maru (2004) also presents a number of national, regional and international partners implementing projects on ICTs and agriculture that could be part of the proposed initiative. The International Institute for Communication and Development (IICD 2006) also presents a number of initiatives on ICTs and small-scale agriculture. There are also regional initiatives such as the Information Society Technologies in Africa ("IST-Africa"). This multi-stakeholder initiative that focuses on reducing the digital divide in Sub-Saharan Africa and has several objectives including the development of training modules for ICT for agriculture (IST-Africa 2007).

7.2 Sustainability strategies of initiatives on ICTs and small-scale agriculture

Sustainability of ICT initiatives and public access points has been identified as a problem in most initiatives in Africa (Benjamin 1999; Holmes et al. 1999; Heeks 2002; Mayanja 2002; Munyua 2003; Kalusopa 2005; Asaba et al. 2006). Some of the sustainability strategies used include charging for some services, strategic partnerships, diversification of services, awareness creation and promotion of services. Some initiatives have adopted entrepreneurial strategies where the initiative was run as a business while others had public-private partnerships because some of the services offered were considered public goods. Initiatives on ICTs and small-scale agriculture in Africa have adopted different sustainability strategies to ensure the activities continue after the project phase. Some of the models employed are presented in Box 7.

Box 7: Sustainability strategies used by some of the on-going and planned initiatives

- **Entrepreneurial models.** The telecentre / resource centre / knowledge centres have adopted a strategy of diversification of services and charging for some of the services offered such as telephone, photocopier, lamination, internet searches, watching of news, football and news on television and training among others. This generates revenue for the projects. Some initiatives such as the Online Information for Non-Chemical Pest Management in the Tropics (OISAT) pilot project sell inputs at the resource centres.
- **The NAADS model.** The NAADS model pays a fee for services offered to farmer groups. The funding is provided from a basket fund from various development partners. It is hoped that during the project period, the farmers will have been empowered and will afford to pay for the services.
- **The private sector approach.** Some of the initiatives have adopted a private sector approach and they charge a fee for services to generate income. Examples using this model include the KACE and the Malawi Agricultural Commodity Exchange (MACE), which charge a commission for services offered. The clientele for these initiatives is still small and services are designed and developed to cater for the users' affordability levels. Additional support is obtained from development partners.
• Partnerships and alliances. Sustainability by others is through building partnerships and working with other organizations through forward and backward linkages. Examples of initiatives using this strategy include the FICOM project that works in partnership with MTN to provide village phones, and the Uganda Micro Finance Union (UMU) that provides farmer groups with loans to buy village phones.

• Leasing / franchising of facilities. In Kenya, the government plans to establish digital villages to provide access to rural communities to access government services and development information and knowledge. These facilities could be leased out in the night to operate as call centres. KACE is also franchising its Market Information Points (MIPs) and Market Information Centres (MICs) to entrepreneurs to improve access to markets and linkages to agro-services by small-scale farmers.

• Promotion of services model. This model aims at promoting the services widely to ensure there is a critical mass of users of the service and ownership of the initiative. Services are initially free, as they are paid for by a donor, and it is hoped that once users are hooked to the services, they will pay for them. Initiatives using this strategy include the Tradenet.biz initiative.

• Multi-stakeholder model. This model adopts the strategy of involving several organizations in a project and tapping on their strengths and expertise. Other strategies include use of volunteers, charging membership fee.

• The Market Information System and Trader Organisations in West Africa (MISTOWA) or RESIMAO model that links regional traders, producers and farmer organisations using internet, cellular phones and radio has established Agrobusiness Information Points (ABIPS) and charges a small commission for transactions. The project expects at least 25 ABIPs to break even by September 2007 (Annex 3).
8.0 Information exchange and sharing

This section presents types of information and knowledge resources used by small-scale farmers, key issues for information exchange and use of ICT applications and organisations implementing projects on ICTs and small-scale agriculture. The section also discusses options for enhancing synergies within the different on-going and planned initiatives and linkages that could be made between different initiatives.

8.1 Information and knowledge resources being used

Africa has a cumulative body of agricultural information and knowledge, know-how and practices that need to be shared continent-wide and applied for improved livelihoods and sustainable development. Although there is a lot of information relevant to small-scale farmers, this is scattered and hard to find. Most of the institutions implementing initiatives on ICTs and small-scale agriculture in Africa have developed local agricultural information and knowledge resources in English, and in some cases, in local languages (Box 8). Details on resources produced under the different initiatives are presented in Annex 3. Bertolini (2004) noted that most farmers in Africa rely on intermediaries such as NGOs, extensionists and producer organisations to access and exchange of information about innovations in crop varieties, pest management, soil fertility, weather forecasting and irrigation among other.

Traditional communication such as demonstration plots, cultural events, drama and song, market plays and puppets has been widely used. Drama has been extremely powerful in communicating agricultural messages to small-scale farmers and challenging them to make decisions. There is a need to provide targeted information to the different audiences and help them find information. This is the demand side and it is crucial because the farmer wants information fast and requires dialogue and questioning.

Box 8: Information and knowledge resources developed by initiatives on ICTs and small-scale agriculture

- A number of NGOs, national, regional and international institutions implementing projects and initiatives have developed information and knowledge resources that can be shared widely. For example, the Agricultural Information and Resource Centre (AIRC) under Kenya’s Ministry of Agriculture developed local content for use by farmers in English, Kiswahili and local languages, which is packaged as radio programmes, videos, manuals and booklets. The Ministries of Agriculture in Botswana and Zambia produced print and radio programmes for farmers. NARO and CABI (EDAI project funded by IDRC), small-scale organic farmers project in KwaZulu Natal, Farmersneeds.org initiative in Nigeria and PROLINNOVA in West, East and Southern Africa have developed local content that meets the needs of its users in print and electronic format. NGOs such as BROSDI (CELAC project), KENDAT, ALIN, DATICS and AfriAfy have developed local content resources in English and local languages in print (books, manuals, pamphlets, newsletter, brochures) and electronic format. Radio programmes have been prepared and they are aired on national radio and WorldSpace satellite radio, video, CD-ROM and on the web. NARO, DATICS and NAADS are developing an inventory of agricultural information in Uganda, which will provide details on what content is held at the respective organizations and in what language. Telecentres or knowledge centres or resource centres established are equipped with agricultural information, some of which include locally packaged content for small-scale farmers. In Kenya, the KAINet initiative is developing a central e-repository of agricultural information on Kenya and helping participating institutions to digitize their institutional publications. Various community and FM radios have also developed local content in English and local languages.
• The market information initiatives for example Tradenet.biz, MISTOWA, Foodnet, MACE and KACE have developed electronic market platforms that collected market information on commodity offers, bids, prices and trends that are current and up-to-date. This information is posted on their respective web sites and it is also disseminated via community radio in local languages and in English. It is also disseminated via Short Messaging Services (sms) on mobile phones. Notice boards and print are also used to disseminate information to farmers. These initiatives have also collected information on farmer organisations and their community interests, input suppliers, commodity traders / brokers and other marketing services (storage, transport, and credit), providers, trade policies and tariffs, and export quality requirements for different markets. Some like KACE have developed an Internet-based database, RECOTIS, for disseminating market information. RECOTIS is an electronic database of clients interested in buying, selling, importing, exporting or distributing agricultural commodities.

• International organizations working on initiatives on ICTs and small-scale agriculture have produced information resources for farmers and intermediaries. Most of this information is in English. For instance, CABI in collaboration with partners, developed products such as the compendia series on crop protection, animal production and health, aquaculture, invasive species and environment. These are available on the internet and on CD-ROMS. CTA and partners have produced the rural radio content, tools and processes in English that are available on the internet and CD-ROM. Other players supporting rural radio programmes include FAO, UNESCO, PANOS and 4R Network. These packs can be downloaded and adapted to local conditions and local languages. Farmers and other agricultural actors often pose questions that are responded to by experts. These questions and answers are available on archives on the internet and can be downloaded by others with similar questions. Organizations such as FAO (ASK FAO) and ZADI (RUN) maintain these archives on their websites. CTA has a virtual library, ANANCY, which provides online access to agricultural publications by agricultural stakeholders. The Open Knowledge Network initiative works with local institutions, NGOs and community members, and has developed local content that is uploaded centrally and is widely disseminated through WorldSpace satellite radio. The content can be downloaded on local computers using the same technology. The OISAT initiative has developed a web-based information system to provide information on crop production, pest prevention and how to ecologically minimise pest damage.

8.2 Key issues for information exchange and use of ICT applications

Respondents suggested a number of issues for information exchange and use of ICT applications that could be addressed collectively. These included issues on skills and capacity, content management and content sharing as presented in Box 9.

Box 9: Issues for information exchange and use of ICT applications that could be collectively addressed

Skills and capacity
• Capacity to package local content and to do translations into local languages.
• Illiteracy barriers e.g. reading and writing SMS, hand held devices and options for using voice technology.
• Language barriers and translation services and costs.
• Development of an information and communication strategy and policy.

Content management
• Content quality, currency and timeliness.
Establishment of an e-repository of all local content relevant to small-scale farmers in Africa.
- Packaging of agricultural content for farmers.
- Translation and co-ordination of local content initiatives.
- Development of a central information databank.
- Establishment of a common platform where databases, meta-data and e-repository could be hosted and shared.

Content sharing and related issues
- Accessibility, affordability and cost of information exchange.
- Exchange tools i.e. their capacity to send/receive.
- Cost of information exchange.
- Impact of agricultural information.
- Dissemination of agricultural technologies to small-scale farmers
- Content sharing and usage of agricultural information i.e. what works and what synthesis is required.

8.3 Organizations implementing projects on ICTs and small-scale agriculture

There are many organizations implementing projects on ICTs and small scale agriculture in Africa including government ministries, national research organisations, universities, non-governmental organizations, private sector, regional and international bodies that are implementing research projects on ICTs and small scale agriculture in Africa. Some of the organizations implementing initiatives on ICTs and small scale agriculture include:-

a) International
FAO, CTA, IFAD, CABI, ILRI, ICRAF, ICIPE, CIRAD, ZADI and One World International;

b) Regional and sub-regional
NEPAD, FARA, Africa Agricultural Technology Foundation (AATF), COMESA AARINENA, ASARECA, CORAF/WECARD, SADC/FANR, Arid Lands Information Network (ALIN) East Africa and MISTOWA and

c) National and NGOs
Women of Uganda Network, BROSDI, Kenya Agricultural Research Institute, National Agricultural Research Organization, DATICs, NAADS, UNFFE, Ghana Agricultural Information Network, KENFAP, KENDAT, AfriAfya, Sacred Africa, Ghana Information Network for Knowledge Sharing (GINKS), Ghana National Association of Farmers and Fishermen (GNAFF) and similar organizations in other countries and ministries of agriculture. Details on the specific organizations implementing projects are presented in Annex 3.

Some of these organizations are sharing knowledge, information and experiences with their target audiences through project reports, newsletters, meetings, websites, Listservs, WorldSpace satellite radio, billboards, exchange visits, trainings, school clubs, and publications produced by the projects and initiatives. Some organizations are networks such as the Ghana Agricultural Information Network (GAINS) and Kenya Network for Dissemination of Agricultural Technologies (KENDAT), and these share information with members of the network through newsletters, listserv, reports, meetings and websites. Some organizations are, in addition, sharing information, knowledge and experiences through D-groups. Some projects/initiatives have established listenership groups for discussing, sharing and exchanging agricultural knowledge and information.

The GAINS network caters for the need of a broad range of stakeholders including researchers, educators,
change agents, farmers, processors and marketers. GAINS co-ordinates a number of services with agricultural stakeholders country wide including grass roots communities. It offers a number of services including agricultural databases of conventional and indigenous literature, a current awareness service, referral services, a tailored Selective Dissemination of Information (SDI) services, a QAS service that is supported by CTA and uses the internet, e-mail, the web, radio (including FM stations) and agricultural extension activities. The QAS service ‘connects’ people with similar interests in the region and beyond. The GAINS website provides access to a number of services and products for stakeholders. To reach farmers, GAINS specifically uses community radio and manuals on video cassettes. Respondents indicated that there is very little or no sharing between initiatives and most often, one initiative does not know what the others are doing.

8.4 Enhancing synergies within the different on-going and planned initiatives

Respondents in the present study made a number of suggestions on how synergies within the different on-going and planned initiatives could be enhanced. For example, FARA works with the four sub-regional groups in Africa that include AARINENA, ASARECA, CORAF-WECARD and SADC/FANR. FARA is also working with NGOs in Sub-Saharan Africa and a NGOs consortium on agriculture and rural development has been established. The group met in early 2007 in Accra, Ghana and brought together stakeholders from West and Central Africa, Eastern Africa and Southern Africa. This event suggested that initiatives of the different NGOs could be brought under FARA-RAILS through the consortium and through the sub-regional organizations.

Given that FARA is already facilitating the implementation of CAADP, the four SROs in Africa (Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the Southern African Development Community/Food Agriculture and Natural Resource Department (SADC/FANR), the Conseil Ouest Africain Pour la Recherche et le Developpement Agricole/West and Central African Council for Agricultural Research and Development (CORAF/WECARD), and the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA)), and the NGOs consortium on agriculture and rural development in Africa, it follows that FARA could take the lead in linking the different initiatives on ICTs and small-scale agriculture to facilitate the sharing of knowledge and information, best practices and lessons learnt. Each of the SRO would in turn facilitate the sharing and exchange of knowledge and information of initiatives on ICTs and small-scale agriculture in countries that fall within the specific regions. The sharing could be done face-to-face and / or virtually. Expertise from different regions could be shared and inter-organizational projects tapping on strengths of different organizations could be developed. An alternative would be to work with the FAO regional office for Africa in Ghana and North Africa to could carry through subsequent activities. A third option would be to identify a charismatic leader that to be attached to IDRC or any other organization with the necessary infrastructure to steer the phases ahead.

One respondent cautioned that enhancing synergies between some organizations would be difficult because they would wish to guard their commercial activities and individual identity. However, the respondent felt there was potential for collaboration. Other respondents pointed out that competing donor initiatives fatigue local partners and farmers, which hinders development as a result of duplication of effort and wastage of resources. Stroud and Hagmann (2006) shared this observation and noted that “the funding environment continues to promote competition and not integration and partnership”. Respondents supported the efforts of IDRC of getting the different initiatives to ‘talk to each other’ and work together towards addressing the needs of the small-scale farmers. More than half of the respondents interviewed were of the opinion that a mechanism to facilitate the sharing of ideas, information and knowledge on projects and initiatives on ICTs and small-scale agriculture should be established. Suggestions by respondents are presented in Box 10.
On-going projects and completed research have demonstrated that ICTs offer avenues for networking and tools such as e-mail, internet, and D-groups have been exploited. Due to the many benefits of networks, there are a number of networks and associations in Africa focusing on the agricultural sector. These have helped to ‘build bridges’ to connect key agricultural stakeholders including farmer associations and groups. Networking initiatives in Africa have provided platforms for better and wider sharing and exchange of information and knowledge to achieve competitive advantage. Facilitating the sharing of information and knowledge between initiatives in rural communities would enable local people to do much more for themselves. Expertise and resources available could be ‘pooled’ together and shared wherever needed. This would create synergy and reduce duplication of effort and cut down costs. Exchange programmes could also be arranged.

**Box 10: Suggestions on enhancing synergies within different initiatives**

- Establish a network of organizations and projects working on ICTs and small-scale agriculture initiatives. (16 organizations suggested the establishment of a network).
- Work through regional bodies such as FARA, NEPAD and the CGIAR to co-ordinate initiatives.
- Work through sub-regional organizations.
- Use a common platform to network all initiatives on small-scale farmers in Africa and facilitate the sharing and exchange of information and knowledge.
- Build integrated teams with different strengths, backgrounds and from different organizations to tap synergies.
- Establish multi-institutional partnerships.
- Establish committees.
- Integration of all who share the same vision.
- Start with development partners e.g. IDRC could link up development partners and stakeholders.
- Create a forum or develop a portal to guide people who share the same dream.
- Establish portals, communities of practice (CoP) and D-groups, and utilise stakeholder workshops.
- Run joint projects to avoid duplication of effort and facilitate synergy.
- Adopt a ‘basket funding’ approach to strengthen collaborative projects, have multi-stakeholder partnerships and share information.
- Complement each other instead of competing. There is a need to work in partnership, exploiting each others’ strengths.
- Establish forums that bring together different players to share what they have and facilitate cross exchange and learning.
- Establish a hub or platform that allows sharing of resources but allows each project / institution independence to manipulate their data.
- Establish commodity-based or agro-ecological networks adopting the GAINS model to share good practices and lessons learnt.
- Always keeping impact orientation in mind and establishing the impact chain and actors to establish who does what and when. This would result in better outcomes and impacts.

**8.5 Linkages that could be made between different initiatives**

A number of suggestions were advanced on how linkages could be made between the various initiatives and how they could be initiated. These are presented in Box 11. Most respondents felt that there was an urgent need to stimulate dialogue among the different target groups and agricultural actors to facilitate learning, leveraging of experiences and sharing of information and knowledge. Linking of researchers, extension workers, development workers and farmers could give rise to ‘public good’ products that are required by small-scale
farmers in Africa to improve food security and reduce poverty. Linkages could be attained through the establishment of mechanisms to facilitate the sharing of information and knowledge, or through tools such as D-groups, CoP, ListServs. Websites and portals could also be used along with face-to-face forums such as training, meetings, workshops and conferences. Another option would be to create agricultural knowledge and information for small-scale farmers “marketplace” where different countries in Africa could share and exchange information in an open space. Groups could then explore together opportunities for support and solutions to common problems.

Box 11: How linkages could be made between different initiatives

- Tradenet.biz in Western Africa, ACE, MACE in Malawi, Foodnet in Uganda and KACE in Kenya and other related players offering market information could meet to exchange information. Modalities could then be put in place for them to share information via the internet. A portal could be developed to link all the market information initiatives where each initiative would be responsible for inputting and updating their system. Likewise, other initiatives on ICTs and small-scale agriculture can be brought together to work out best linkage models.
- The GAINS model could be adopted. GAINS has carried out an information needs analysis to establish what information and support is required to support linkages between research institutes and extension services; to provide insight into the Research-Extension-Farmer Linkages Committees (RELCS); to facilitate flow of information between stakeholders and to strengthen linkages.
- Studies looking at Agricultural Knowledge and Information systems (AKIS) could be carried out in different African countries to determine how to strengthen and build linkages between agricultural stakeholders and initiatives.
- Establish an e-repository where resources developed by different projects and initiatives can be accessed by farmers from all over Africa.
- Organise a round-table with partners to share what is going on.
- Establish electronic and face-to-face linkages that provide for openness in discussing issues and where people’s views are respected. This would link together initiatives and share information and knowledge aimed at helping small-scale farmers.
9.0 Development partners

This section deals with key development partners supporting initiatives on ICTs and small-scale agriculture in Africa.

There were few development partner respondents and those interviewed indicated that they would only comment on initiatives that they were involved in. The response rate to checklists e-mailed to development partners was poor. There are, however, a number of development partners supporting initiatives on ICTs and small-scale agriculture in Africa. The respondents from USAID and CTA indicated a keen interest in the development of a research agenda for ICTs and small-scale agriculture initiative in Africa. Respondents felt it would be good for IDRC to attend the FARA meeting in South Africa in June 2007 and the FAO meeting on e-agriculture on 22nd-28th September 2007. The main development partners cited by respondents and in secondary literature include IDRC, USAID, DFID, European Union, Hivos, FAO, CTA, International Institute for Communication and Development (IICD), GTZ, World Bank, Rockefeller Foundation, One world International, African Development Bank, Agriterra, CIDA, SIDA, CTA, Development Bank of South Africa, Gatsby Foundation, German Trust Fund, Hans Sidel Foundation, International Centre for Soil Fertility and Agricultural Development (IFDC), Kilimo Trust, Netherlands Organisation for International Development (NOVIB), OXFAM, PAN Germany, Plan (Netherlands), RABO Bank Foundation, Sankofa Foundation, SDC Switzerland, Syngenta Foundation for Sustainable Agriculture (SFSA), African governments and private sector. Although the donor community and financial institutions play an important role in financing information communication infrastructure projects and have a catalytic effect, it has been observed that in terms of volume, the private sector plays a more important role in external financing (World Bank 2005). Other foundations funding initiatives on ICTs and small-scale farmers include the Gates Foundation and the Ford Foundation.

The European Commission supported the Information Society Technologies in Africa (IST-Africa) Programme six (which focuses on promoting dissemination of IST results in Southern Africa, adapting relevant research results and developing training modules including e-learning, ICT for agriculture and ICT sensitization and deliver training in selected African countries and develop national case studies in selected African countries among others (IST-Africa 2007).

The United Nations (UN) is supporting initiatives on ICTs and development and the UN Secretary-General has made efforts in forging alliances and initiated the Global Alliance for Information and Communication Technologies and Development (GAID) initiative in 2006. This was a result of worldwide consultations with governments, the private sector, civil society, the technical and Internet communities and academia to provide a global platform for addressing cross-cutting issues related to ICT in development. GAID works through a multi-stakeholder global forum to address policy and advocacy and by catalyzing multi-stakeholder partnerships (GAID 2007).

Although farmers in sub-Saharan Africa are struggling to adapt to the various agricultural challenges, support for the agricultural sector is declining. A case in point is the SADC member states indicates that the proportion of total aid dropped from 20% in the early 1980s to 8% by 2000 (Practical Action 2007). Support in the ICT sector goes hand-in-hand with support in the agricultural sector, for the overall agricultural sector to improve and work more effectively.
10.0 Conclusions and recommendations

This section presents the conclusions of the scoping study, some key questions that need to be addressed through a research agenda in support of small-scale farmers and key recommendations.

10.1 Conclusions

The present scoping study solicited information from individuals who were implementing and/or funding initiatives on ICTs and small-scale agriculture. To enrich the interviews secondary sources of information were used to provide understanding on ICTs, small-scale agriculture and e-natural resources management in order to satisfy real needs of small-scale farmers and exploit opportunities that address the issues and challenges identified. To achieve sustainable small-scale agriculture in Africa, an integrated approach is crucial. The present study documents on-going and planned initiatives on ICTs and small-scale agriculture in Africa and provides answers to specific questions detailed in the terms of reference. These answers and the documentation are expected to inform funding decision by the Acacia Programme of IDRC and provide the necessary detail to develop a broader proposal based on the needs of small-scale farmers. The key conclusions of the present study include:-

1. Although improving smallholder agriculture was central to poverty alleviation, the problems of small scale-farmers have not received much attention
2. Interest in ICTs has steadily grown in Africa and ICT policies have been rolled-out by various countries but it is acknowledged that there are still constraints including market and regulatory regimes, bandwidth, high license fees and inadequate local content (Heeks 2007) and matching the policies with the necessary resources required for implementation.
3. Training, information and knowledge are important ingredients for increasing production and productivity, value addition and improving access to markets. Agricultural information and knowledge, therefore, need to reach small-scale farmers in Africa. Farmers need to be trained and need knowledge and information on agriculture, forestry, fisheries, nutrition, inputs, markets, credit, new improved technologies such as high value crops, commercial farming and other aspects of rural development. While small-scale farmers cannot afford some of the technologies such as precision agriculture, PDAs and GIS they have a role in ensuring improved and efficient agricultural production. Others ICT options such as the use of cellular phone, community and FM radios are providing the much needed and crucial support for small-scale farmers and related businesses in rural areas (Guislain et al. 2006:6), hence could be promoted.
4. Implementers of initiatives on ICTs and small-scale agriculture in Africa expressed the need:-
   • for the provision of affordable and accessible ICTs,
   • for interventions to improve infrastructure,
   • to provide alternative energy sources,
   • to address the prevailing inadequacy in ICT skills and capacity,
   • to develop local content that is relevant to the needs of farmers,
   • to address the high cost of technologies and low bandwidth,
   • to provide an enabling institutional, policy and legal framework for the establishment and development of microfinance and e-commerce and
   • to genuinely address gender inequalities, language diversity and media preferences.
5. There is great potential in using ICTs to restructure extension services and other government departments/services. However, there is low capacity and usage of ICTs and the ICT infrastructure in rural areas remains a major problem. Addressing some of these issues would require policy intervention and supportive legal frameworks.

6. Most investment in telecommunication infrastructure projects is private-sector led (World Bank 2005). Most African governments are now taking an interest in implementing CAADP through regional and national agricultural policies, strategies and programmes and have or are in the process of developing ICT policies. An analysis of secondary information suggests that some African governments have supported initiatives in disadvantaged areas through subsidizing the lowest competitive bidder and using universal access funds (World Bank 2005). Nevertheless, formulation of ICT policies and strategies should ensure participation of rural communities in order to capture and incorporate the needs of disadvantaged rural groups such as small-scale farmers, women and the youth.

7. Emerging ICTs such as the online money transfer through a mobile phone has demonstrated great potential in transferring funds or making loan repayment, and holds great potential for small-scale farmers. Other regions of the world have developed holistic models such as the Bank for Agriculture and Agricultural Cooperative (BAAC) model in Thailand that provides financial services to farmers, access to services, access agricultural information and decision making tools.

8. Policy makers need to address the issue of inequalities within and across countries in accessing information and communication services.

9. The findings of the present study further suggested a need to restructure and reorganize small-scale agricultural producers into formal groups and to build their capacity to enable them contribute effectively and constructively to policy development.

10. In most countries, there is a need to seek policy intervention to improve and increase uptake of e-commerce and e-microfinance among small-scale farmers.

11. There are many initiatives on ICTs and small-scale farmers in Africa. However, these were disjointed and in most cases, information about the different initiatives was not shared. Available information on the different initiatives was therefore not easily accessible.

12. Most of the initiatives are in form of projects supported by development partners, but there were a few private sector initiatives mainly on modern market mechanisms for marketing agricultural products. Respondents suggested the need to establish some form of network or forum to co-ordinate activities of the different initiatives and projects, set priorities and develop a research agenda for Africa.

13. A review of the literature indicated that a number of African governments have / plan to establish community information centres or ‘digital villages’ in rural areas. These centres could act as focal points for providing extension, advisory and information services to small-scale farmers. There is a need to look at the options available and to identify the most appropriate means of reaching community members.

14. Although not all interviewees responded to the question regarding how the ongoing and planned ICT initiatives could share knowledge and responses, 16 of the organizations that responded suggested the formation of a network that facilitates the sharing and exchange of information, experiences and best practices.

15. The development partners funding ICT initiatives in Africa and the implementers of projects and initiatives could form a forum to prioritize research questions and gaps suggested by this study and this could be used to inform funding decisions in a synergistic manner.

16. Funding ICTs should go hand-in-hand if poverty is to be reduced in Africa. This suggests the need for mainstreaming ICTs in the agricultural sector.

17. Considering its central role and existing links with SROs in North Africa, West and Central Africa, Southern Africa and Eastern and Central Africa, FARA is well placed to
take the lead in a follow-up phase of study. Plan B would be to work with FAO’s Regional Office for Africa and North Africa. An alternative option would be to identify a visionary self-driven and innovative leader to take forward subsequent activities.

10.2 Some key questions that need to be addressed through a research agenda in support of small-scale farmers

Based on the findings of the present scoping study a number of research questions are suggested to determine how ICTs can be best used to address the challenges that small-scale farmers in Africa face. Some key questions that could be addressed in the research agenda in support of small-scale farmers include:-

- **Baseline studies / surveys / needs assessment**
  - What are the best practices for ICTs and small-scale agriculture?
  - What are the agricultural knowledge and information needs of small-scale farmers?
  - What are the benchmarks on ICTs and small-scale agriculture in Africa?

- **Markets and market research**
  - What is the pathway for information flow through the value chain?
  - How can farmers be linked to markets (standards, requirements and certification)?

- **Information / knowledge management exchange, sharing and dissemination**
  - Which is the most effective way of reaching farmers with timely agricultural information and knowledge (indigenous and external)? (Is it telephone, radio, FM radio stations, print, SMS, or internet, among others)?
  - How can the potential of FM radio stations and digital telephony be harnessed to communicate agricultural information to farmers?
  - How should agricultural information and knowledge be synthesized or repackaged for small scale farmers?
  - Is there a role for an e-repository (of local agricultural content) in Africa in disseminating local agricultural content?

- **Institutional building and infrastructure development**
  - What is the role of public-private partnerships in promoting ICTs to small-scale farmers?
  - How is regional agricultural information and knowledge for small-scale farmers assimilated in the respective regions?
  - How could the participation of women and the youth in initiatives on ICTs and small-scale agriculture be improved?

- **Training, capacity building and strengthening**
  - What is the minimum literacy level required by small-scale farmers to use available ICTs?
  - What ICTs could be used to share and exchange agricultural information, knowledge and innovation among illiterate small scale farmers?
  - What is the role of distance learning in improving uptake of new / improved agricultural technologies?

- **Technology development / adaptation**
  - How can existing systems e.g. Soko Hewani and Tradenet.biz be improved? What lessons have been learnt and based on the lessons learnt, what should be done to increase adoption?
  - What is the role of open source tools in developing applications for small-scale farmers?
- Which is the best e-commerce / e-micro-finance model for small-scale farmers in Africa? How could the mobile phone technology be further exploited for the benefit of small-scale farmers?

**Usage studies**
- What is the usage of the agricultural information and knowledge by small-scale farmers? What is the usage of systems such as Tradenet.biz, Soko Hewani and decision support tools? i.e. who is using the system, what impact has this had on users? Does sensitisation and education increase their uptake?
- In terms of community informatics and use of ICTs within communities, what technologies are available, how does the community share resources, how is agricultural information and knowledge created, captured, preserved and shared? Is digitization being carried out?

**Impact studies**
- What is the impact of ICTs in small-scale agriculture? i.e. What is the impact of agricultural messages on radio, sms and internet e.g. on markets, production?
- What is the impact of existing information and knowledge systems such as Tradenet.biz, Soko Hewani, Foodnet, KACE on small-scale farmers?

**Policies**
- In regard to supporting small-scale agriculture, what gaps exist in the available ICT policies and how could these be improved to cater for the needs of small scale farmers?
- How could the voices of small-scale farmers in Africa be heard at the policy making table?

### 10.3 Recommendations

Based on the present scoping study findings, the following recommendations are made:

1. **Challenges of small-scale farmers**

Recommendation 1.1 - The problems of small-scale farmers in Africa are many, complex and multifaceted. These problems need to be addressed in a holistic manner through a joint approach of establishing priorities and a research agenda by both African countries and their development partners. The problems of small-scale farmers could also be addressed by providing a ‘package’ or ‘basket’ solution that could be rolled out in a variety of ‘mixes’ (such as e-microfinance, access to agricultural and market information, agricultural inputs, technologies and innovations, training, local knowledge and e-commerce) in different countries and regions. In as far as is practical, regional approach to problem solving is encouraged as most problems in the respective regions share common causes and possible solutions. It is recommended that IDRC and other development partners support regional initiatives on ICTs and small-scale agriculture.

**Recommendation 1.2** - Some of the envisaged solutions include the adoption of appropriate ICTs and the evolution of supportive policy, legal and institutional frameworks. It is only through finding solutions to the identified challenges that small-scale farmers can break the poverty trap and attain meaningful development. Small-scale farmers need to be assisted to adopt some of the emerging agricultural practices to help them increase agricultural production, productivity and storage, enhance incomes and access improved markets that offer better prices for their products. IDRC and other key donors supporting ICTs and small-scale agriculture should forge alliances or partnerships with organizations implementing ICT initiatives and chart out a road-map and priorities for Africa. It is recommended that IDRC plays the lead or catalytic role in bringing the various actors together.
2. Emerging ICTs and small-scale agriculture

Recommendation 2.1 - Emerging ICTs such as GIS, PA, mobile mapping and hand held computers have a great potential in addressing the challenges faced by small-scale farmers, hence, there is need to promote them. Although technologies such as PA are considered the ‘next great revolution in agriculture’, it is too expensive and not affordable to small-scale farmers. More importantly, the present ICT infrastructure in most rural areas in Africa cannot support PA. There are, however, organisations and research partners that plan to use these tools such as GIS and mobile mapping. These could work with farmers practising intensive or commercialisation or high value crops to experiment with these tools and their specific role in small-scale agriculture. PDAs are more affordable and hold great potential for small-scale farmers and could be used to improve extension services and deliver agricultural information and collect farmers’ questions from the field. These would then be sent to a central decision support system that would provide solutions to farmers. It is recommended that IDRC and other partners support such initiatives employing GIS, mobile mapping and PDAs to enable small-scale farmers to benefit from these ICTs that address a number of challenges that small-scale farmers face.

Recommendation 2.2 - The cellular phone has become pervasive in Africa. However, challenges such as cost of connectivity, ‘air time’, and charging of phones needs to be addressed. The integration of community radio or FM stations with cellular phone and the internet also needs to be further explored. More effort should be devoted to integration of conventional ICTs with newer ICTs. It is recommended that IDRC and other development partners support capacity building for ICT innovations such as the mobile technology to improve access to markets and increase agricultural productivity.

Recommendation 2.3 - The RFID technology facilitates meat exports in Botswana and South African to EU and Middle East markets. It is recommended that this technology be promoted in other countries to provide a trace back system in compliance with new regulatory procedures.

Recommendation 2.4 - It is further recommended that further research support be provided to initiatives applying appropriate emerging ICTs in small-scale agriculture such as RFID, WorldSpace satellite radio, cellular phone, interactive and FM radio, and the internet in order to harness the benefits of these technologies. Efforts should be made to promote the rollout of such ICTs and initiatives should strike a mix of appropriate emerging technologies that facilitate access to markets, uptake of improved technologies, innovation and up-to-date and timely agricultural knowledge and information.

Recommendation 2.5 – The WorldSpace satellite radio technology has proved to be appropriate and very effective in most rural areas where the telecommunications infrastructure is inadequate or lacking. Effort should be increased in promoting the technology and lobbying to make the technology more accessible and affordable by resource poor small-scale farmers.

Recommendation 2.6 – There is a need for Africa to learn from other developing regions such as Asia and replicate (and adapt) holistic models such as the Bank for Agriculture and Agricultural Cooperative (BAAC) model in Thailand that uses various ICTs to provide financial, information and other services to farmers, access agricultural information and decision making tools. This would enable small-scale farmers in Africa to move out of the poverty cycle and advance beyond
subsistence farming through adoption of new improved technologies and use of agricultural inputs such as improved seed varieties and fertilizers.

3. ICTs as an input to small-scale agriculture

**Recommendation 3.1** – Due to the complexity of factors and resource constraints, not all the factors influencing ICTs as an input to small-scale agriculture can be adequately addressed. However, IDRC and other development partners could support in the development of mechanisms for sharing agricultural knowledge and information on the different initiatives and programmes scattered all over the continent. This would enable the projects and initiatives to share experiences, best practices and lessons learnt, and address some of the challenges by small-scale farmers encountered jointly.

**Recommendation 3.2** - It is also recommended that national governments and development partners facilitate information-sharing forums, meetings or workshops to prioritise research areas and gaps could and agree upon questions for a research agenda for Africa. This would then be followed by the development of national, regional and continental research agendas.

4. Policy and legal framework issues

**Recommendation 4.1** - Supportive policy, legal and institutional frameworks are crucial in ensuring success of any agricultural and / or ICT interventions. There is a need to support policy initiatives, and legal frameworks that ensure farmer empowerment and active involvement and participation by small-scale farmers to influence policy review / development and institutional reforms in Africa. There is a need for development partners to support policy-making bodies (local, national and regional) to ensure that policy and legal frameworks are supportive of initiatives such as rural connectivity, e-commerce and e-microfinance that will benefit a large constituency in the rural areas. It is recommended that IDRC and other development partners work closely with NEPAD and SRO in Africa in the area of ICT policies in areas relating to small-scale farmers.

**Recommendation 4.2** – It is recommended that IDRC and other development partners support initiatives that facilitate existing grassroots institutions, structures and systems such as farmer groups, associations, networks federations and cooperatives; ‘community parliaments’ in Kenya and the ‘Kgotla system in Botswana in bringing about policy change in Africa.

5. Information exchange and sharing

**Recommendation 5.1** - Based on the views of most respondents, there is a need for national governments and development partners to facilitate sharing of agricultural related information, knowledge, experiences, best practices and lesson learnt on different initiatives and projects on ICTs and small-scale agriculture in Africa. Such sharing would enhance the setting of priorities to address the challenges raised through focused projects at national or regional level. However, existing information and knowledge needs to be captured and be appropriately packaged before it can be shared. It is recommended that IDRC and other development partners support local content development initiatives and facilitate the development of an inventory of existing information resources that are relevant for small-scale farmers and the development of an e-repository that can be accessed Africa-wide.
**Recommendation 5.2** – The present scoping study identified various gaps such as inadequate skills in the use and application of ICTs, inadequate human resources with the capacity to generate, repackage and digitise local content that need to be bridged to enhance skills and facilitate the exchange and sharing of information and knowledge. It is recommended that IDRC and other development partners support initiatives such as RAINS’s capacity building programme in agricultural information and communication management that responds to the training needs assessment carried out in 2004-2005 to ensure there is a critical mass of people that can work with key agricultural actors including small-scale farmers.
11.0 References


Annex 1: Checklist - ICTs and Small-Scale Agriculture

1 General

1.1 Male ☐ Female ☐
1.2 Name ______________________________
1.3 Position ____________________________
1.4 Institution __________________________
1.5 Email ______________________________
1.6 Phone _______________________________

2 Terminology

2.1 Please describe the challenges currently facing small-scale agriculture generally (including environment and natural resources management)? (Probe for the key issues, challenges and research questions).

3 Key issues

3.1 What are the emerging ICT applications and opportunities for small-scale agriculture in your region/organisation? (probe for applications for voice, radio, GIS, Decision support systems, precision farming, market information systems, distance learning, databases, land use planning, public access facilities, mobile applications, restructuring of extension, others)

3.2 What are the main research questions relating to the use of ICTs in small-scale Agriculture?

4 Factors Influencing use of ICTs as an input into small-scale agriculture

4.1 What are the prevailing policy regimes on ICTs as they relate to agriculture (agricultural policy, land reform policy and institutional framework) that empower small-scale farmers in your region? (Probe for ICT policy reform activities and other related policies such as registration procedures, environment and natural resources management policies, government projects and plans).

4.2 How can small-scale farmers and related groups participate in efforts to bring about policy change in both the agricultural information and telecommunications sectors?

4.3 What do you see as the potential and effects of ICTs in restructuring extension services and other government departments/services?

4.4 Is there a need for broadband Internet services in your region? If yes state why.

4.5 What do you consider to be the most successful model(s) of the ICTs to support e-commerce and microfinance applications in the context of small-scale agriculture? (obtain URL for further information).

4.6 Do you know of any applications where community radio or TV broadcasting is being combined with ICTs in improving information delivery to the farming community?

4.7 What sustainability strategies does your organisation have in place for initiatives (on-going and planned) on ICTs and small-scale agriculture?
Initiatives / Key players in ICTs and small-scale agriculture in Africa

5.1 Do you have any on-going / planned initiatives on ICTs and small-scale agriculture/NRM? If yes, please provide brief description of your activities in this area (initiative, focus, funding level and duration, funding agency/source, key partners).

5.3 What technologies are you using and how are they being applied?
<table>
<thead>
<tr>
<th>Technology</th>
<th>Application e.g. agricultural information delivery, market information, e-learning and training, e-commerce geographical information, electronic monitoring etc.</th>
<th>Partners (international, regional, national, local)</th>
<th>Key Challenges</th>
<th>Impact</th>
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<td>Others (please list)</td>
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</table>
6 Information exchange / sharing

6.1 What information / knowledge resources and applications are currently being used relating to ICTs and small-scale agriculture in Africa? (international and local)

6.2 What information / knowledge resources and applications are currently being developed with relevance too ICTs and small-scale agriculture in Africa?

6.3 Are any of these resources using local languages and has localization needs for any of these tools, been established? What is available and is being accessed?

6.4 What do you consider to be the key issues information exchange and use of ICT applications that need to be collectively addressed?

6.5 What other organisations are implementing projects on ICTs and small-scale agriculture in Africa? (probe for national research organisations who could help define research agenda - university departments, agricultural research institutions, public sector institutions, non-governmental organizations) (Probe for how these examples are sharing knowledge and experiences)

6.6 With regard to the common interest, how can synergies within the different on-going and planned initiatives be or have been enhanced?

6.7 What linkages could be made and how should linkages between the various initiatives be initiated? What models work?

7 Development Partners

7.1 Please describe any focal points within the organisation that relate to small-scale agriculture and NRM?

7.2 Is your institution supporting any activities in the area of ICTs in this sector? Either in Africa or elsewhere? If so, please provide brief description of your activities in this area (initiative, focus, funding agency, key partners, and research components.)

7.3 Does the organisation have an interest in the development of a research agenda for ICTs and small-scale agriculture in Africa initiative?

7.4 Are there specific aspects that the organisation may be interested in supporting?

7.5 Are there other donors / development partners that are supporting ICTs and small-scale agriculture in Africa?

7.6 General comments / questions you may have in regard to the implementation of the ICTs and small-scale agriculture initiative.
## Annex 2  Respondents of the scoping study on ICTs and small-scale agriculture

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<tr>
<th>Institution</th>
<th>Interviewee</th>
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Annex 3  Initiatives on ICTs and small scale agriculture, development partners and implementers

(See spreadsheet)