Innovation Transfer into Agriculture - Adaptation to Climate Change (ITAACC)

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Result B: Assessment of the Demand-Supply Match for Agricultural Innovations

Africa (Kenya)

Final Report

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65760 Eschborn, Germany

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Your contact person
within GFA Consulting Group GmbH is

Lennart Woltering

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Address

GFA Consulting Group GmbH
Eulenkrugstraße 82
22359 Hamburg
Germany

Phone +49 (40) 6 03 06 – 356
Fax +49 (40) 6 03 06 – 119
E-mail lennart.woltering@gfa-group.de

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Lorenz Bachmann- Team Leader, Gießen, Germany

Lennart Woltering- Deputy Team Leader, Hamburg, Germany

Tom Apina- East Africa regional expert, Nairobi, Kenya

Brigid Letty- Southern Africa regional expert, Pietermaritzburg, South Africa

Jean Nyemba- West Africa regional expert, Yaoundé, Cameroon

Benasser Alaoui- North Africa regional expert, Rabat, Morocco

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ACRONYMS

AATP	African Agricultural Technology Platform
AEZ	Agro-ecological Zones
AVRDC	Asian Vegetable Research and Development Centre
BEAF	Advisory Service on Agricultural Research for Development
BMZ	The German Federal Ministry for Economic Cooperation and Development
CAADP	Comprehensive Africa Agriculture Development Programme
CAWT	Conservation Agriculture With Trees
CCAFS	CGIAR Research Programme on Climate Change, Agriculture and Food Security
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CLUSA	Cooperative League of the USA
CRP	CGIAR Research Program
DG	Director General
EIARD	European Initiative for Agricultural Research for Development
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FO	Farmer Organization
GCARD	Global Conference on Agricultural Research for Development
GDP	Gross Domestic Product
GFAR	Global Forum for Agricultural Research
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IARC	International Agricultural Research Center
icipe	International Centre of Insect Physiology and Ecology
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRAF	World Agro Forestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
Intermed.	Intermediaries (NGO, government services, and private sector)
IPCC	Intergovernmental Panel on Climate Change
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
ITAACC	Innovation Transfer into Agriculture – Adaption to Climate Change; Innovationstransfer in die Agrarwirtschaft – Anpassung an den Klimawandel
KARI	Kenya Agricultural Research Institute
M&E	Monitoring and Evaluation
NAADS	National Agriculture Advisory and Development Services
MLN	Maize Lethal Necrosis
NAES	National Agricultural Extension Services
NARS	National Agricultural Research Systems

NEPAD	New Partnership for Africa's Development
NGO	Non Governmental Organization
OPV	Open Pollinated Varieties
PROLINNOVA	Promoting Local Innovation in Ecologically Oriented Agriculture and Natural Resource Management
RAILS	Regional Agricultural Information and Learning Systems
VIP	Virtual Information Platform

SUMMARY

The “Innovation Transfer into Agriculture – Adaptation to Climate Change (ITAACC)” -program (04/2013-03/2018) aims at bridging the gap between research outcomes of the CGIAR, the Asian Vegetable Research and Development Centre (AVRDC) and the International Centre of Insect Physiology and Ecology *(icipe)* and their implementation in the agricultural sector in Africa. This report presents the findings of an assessment of the match between the demand and supply for agricultural innovations. The assessment was undertaken over nine months by a team of six consultants.

Quantitative and qualitative information from a wide range of stakeholders in the innovation system was collected using structured questionnaires. The method focused on capturing the needs of smallholder farmers expressed by farmer organizations (152 interviews) and intermediaries (141 interviews), such as government and non-government organizations and the private sector. The assessment of the supply side included 94 innovations that had been selected by regional representatives of International Agricultural Research Centers (IARCs) based on their positive impact on the livelihoods of the rural poor. Twelve hypotheses were formulated to structure the questionnaire and the analysis. These hypotheses went beyond the need-supply match, aiming at capturing views on the adoption of innovations, information exchange, extension and climate change. Five workshops were organized to discuss and validate the preliminary results. This enabled a continuous sharing and learning with all stakeholders. Even though more than 400 interviews had been carried out in over 17 countries, the results reported should not be considered representative of the African agricultural sector. After all, it is almost impossible to obtain “the” demand for innovations considering the huge heterogeneity of smallholder farms (crop diversity, natural resource base and rainfall) in Africa. In addition, the interviews focused on obtaining the perceptions of stakeholders on a range of issues and not on testing the validity of their statements. The study findings provide interesting insights into existing problems and allow for a constructive discussion of possible solutions.

The results indicate that, even though a large number of research outputs matches with the farmer needs, the most important problems of farmers are not met by research. These problems include access to good and affordable inputs and services (seeds, planting materials, advice, etc.). They are, however, outside the mandate of the centers. This illustrates the need for partnerships with governments (extension) and others to improve the impact of agricultural research. Most innovations focus on improving traits of crop varieties and a small but growing number of innovations tries to understand markets and to add value to production. Assessing the resource status, input application level and cost of innovations, it is estimated that only one-third of the IARC innovations are affordable to smallholder farmers. The data shows that farmers and scientists share a similar view on the most important criteria for innovation development: big comparative advantage, medium profitability, affordability and up-scaling potential. This was, however, contested during the workshops. Some farmer organizations raised that scientists did not interact enough with farmers and therefore did not know the farmers’ reality well enough to start designing innovations. Since women make up half of the workforce in agriculture, actors agreed that gender should, and could, be considered in the design of innovations or dissemination programs. For example, by re-engineering technologies in production, processing and marketing to account for the capacity of women to handle certain tools and equipment. There was a general consensus that face-to-face interaction (training, demonstration, farmer exchanges) was the best way to share information with farmers. Yet, the messages are still not always reaching the intended recipients. This also becomes clear when looking at the collaboration and complementarities between the different actors in the innovation system.

The analysis of the perceptions the various stakeholder groups have in regard to one another, shows that there is considerable room to improve trust, understanding and true partnerships to support smallholder farmers. According to the Farmer Organizations (FOs) and intermediaries, farmers are not satisfied with the services of the National Agricultural Extension Services (NAES), claiming that even though they are knowledgeable about staple crops, they are generally poorly resourced, hardly present in the field and the staff is not skilled enough to add value to their farming enterprise. Non-Governmental Organizations (NGOs) and private sector are said to provide good services, especially when it comes to training and exposure to innovations, but access to those services is difficult. In addition, farmers tend to mistrust the private sector citing many examples of cases where they felt exploited. The majority of FOs and intermediaries think that the approach of the IARCs does not meet farmer needs, stating that IARCs focus more on the research methodology than on impact. FOs appreciate the training opportunities and high quality standards of IARCs. Intermediaries appreciate the willingness to share and test germplasm, and the opportunities provided for networking and fund acquisition through IARCs. The IARCs, on the other hand, prefer to work with National Agricultural Research Systems (NARS) and NGOs for up-scaling of their innovations. IARC collaborate considerably less with the NAES justifying this with NAES’ lack of

resources to maintain quality standards. Most of the top innovations have not reached more than 5000 households each, and the diffusion potential of a considerable number is rather limited. The respondents assign this largely to poor partnerships for up-scaling, thereby also reflecting on their own approach to collaboration and up-scaling. A constraint to successful up-scaling of technologies from IARC can also be found in the fact that scientists are largely evaluated by the number of articles they publish rather than on their engagement with farmers or extension agents. 28% of the top innovations selected by the IARC could be linked, to a variable extent, to past funding from BMZ which is quite significant considering the large number of donors supporting IARC.

The majority of actors feel that climate change has an impact on farmers; in particular yield losses due to increased occurrence of drought and more erratic rainfall were mentioned. Despite the fact that a range of coping mechanisms are already promoted, research on better coping mechanisms is necessary. IARCs can certainly contribute by developing better and more robust drought and flood tolerant crop varieties and by maintaining a diversity of resilient traditional varieties. This will be a key to keep up with an expected increased global warming, and its consequences for smallholder farming in Africa.

It is concluded that the main bottleneck for adoption of innovations by farmers is not that the innovations do not match with their needs, but that farmers do not have access to the innovations. Farmers are poorly informed about existing innovations and they suffer from poor infrastructure and poor support services. Nevertheless, if the IARCs are committed to their goal of reaching impact, these problems need to be tackled. The ITAACC project is advocating for a shift towards innovation system thinking which focuses on the interaction between diverse actors as key to changing agricultural practices. Therefore, it is important to realize that IARCs are not the single most important driver or initiator of agricultural innovations. IARCs can do even more to help farmers advance with their own innovations, or broker partnerships in multi-stakeholder processes to support innovation from the grassroots. For example, IARCs' innovation platforms, where a range of stakeholders come together to solve a problem, have shown promising results, especially in Southern Africa. The centers should move beyond farmer participation towards more farmer control and leadership of innovation processes. This will require a different way of managing research projects, with, for example, more funds for partners (FOs, intermediaries) than it is currently the norm. This may help to ensure that research will be done based on true farmer needs.

However, the responsibility for improving livelihoods of smallholder farmers does not lie with IARCs alone. Also development partners have an important role to play. To strengthen these links, ITAACC and the Advisory Service on Agricultural Research for Development (BEAF) initiated the formulation of the "Feldafing Principles for Enhancing Agricultural Innovation Systems" which were jointly elaborated with partners from development agencies and the IARCs. This already starts with the project design, for example by having long-term projects that can be phased to balance the influence of research and development. Room for failure and flexibility in budgets are a prerequisite for success of such projects.

The study method used to assess the demand and supply match is useful as a learning tool for a wide range of stakeholders and it can influence public spending on IARCs. It immediately helps to guide investments for promotion and piloting selected innovations through GIZ development programs, ITAACC and BEAF. However, due to the scope of the assessment, it is probably most valuable as an instrument to validate the functioning of the innovation system every five to ten years.

The ITAACC project continues until 2018, and it is recommended that the respondents to the questionnaires will receive feedback on the results, but also on potential solutions for the problems expressed. Project proposals are currently developed to set-up a dissemination team that provides feedback through local platforms. The data of the surveys will be made available on the ITAACC website so that people can do their own analysis of the data. A potential avenue would be through the Virtual Information Platform (VIP) within the African Agricultural Technology Platform (AATP), or through ten innovation centers funded by BMZ that will be setup in Africa soon. Finally, the findings of this study have provided entry points for identified needs that can be investigated further by, for example, GIZ and an IARC to develop a project that aims at bridging the gap between that particular need and supply.

SUMMARY IN GERMAN

Das Programm "Innovationstransfer in die Landwirtschaft - Anpassung an den Klimawandel (ITAACC), (04/2013- 03/2018) zielt darauf ab, die Lücke zwischen Forschungsergebnissen der CGIAR, AVRDC und *icipe* und deren Umsetzung in der landwirtschaftlichen Praxis in Afrika schließen zu helfen. Dieser Bericht schildert und bewertet die Ergebnisse des Abgleichs von Angebot und Nachfrage für landwirtschaftliche Innovationen. Diese Untersuchung wurde von einem Team aus sechs GFA-Consultants über einen Zeitraum von neun Monaten durchgeführt.

Von zahlreichen Akteuren im Agrar-Innovationssystem wurden mit Hilfe von strukturierten Fragebögen quantitative und qualitative Informationen gesammelt. Die Methodik beinhaltete die Erfassung der Probleme der Kleinbauern (Nachfrageseite) über Bauernorganisationen (152 Interviews) und Intermediäre wie Nichtregierungsorganisationen (NRO), GIZ-Projekte, Nationale Agrarforschungs- und Beratungsinstitute sowie die Privatwirtschaft (141 Interviews). Die Bewertung der Angebotsseite erfolgte über 94 Topinnovationen, die von den jeweiligen Direktoren oder deren regionalen Vertretern der Internationalen Agrarforschungszentren (IAFZ) ausgewählt wurden. Hauptkriterium der Auswahl war die größtmögliche positive Wirkung der Innovationen auf die Verbesserung der Lebensgrundlagen der ländlichen Armen.

Aufbauend auf ein Literaturstudium der weltweit aktuellsten Bewertungskriterien für Agrarinnovationen wurden zwölf Hypothesen formuliert, die anschließend in vier Fragebögen für die Hauptakteure übersetzt wurden. Die Fragestellungen gingen über den Angebots- und Nachfrageabgleich hinaus und erfassten darüber hinaus auch die Bereitschaft der Bauern, Innovationen anzunehmen, den Informationsaustausch zwischen den Akteuren und die Eignung der Innovationen im Bezug auf den Klimawandel. Ergänzend wurden fünf Workshops organisiert, die dazu beigetragen haben, die Ergebnisse mit den Beteiligten zu diskutieren und zu validieren. Doch auch angesichts der Tatsache, dass mehr als 400 Interviews in 17 Ländern durchgeführt wurden, können die Ergebnisse nicht als repräsentativ für die afrikanische Landwirtschaft als Ganzes angesehen werden. Auf Grund der großen Spannbreite der kleinbäuerlichen Betriebe in Afrika (Kulturpflanzenvielfalt, Ressourcenbasis, Niederschläge, sozioökonomische Rahmenbedingungen) ist es unmöglich, die reale Nachfrage komplett zu erfassen. Darüber hinaus zielte die Methodik darauf ab, die unterschiedliche Wahrnehmung der Probleme aller Akteure abzubilden. Somit schaffen die Ergebnisse einerseits einen guten Überblick über die vorhandenen Probleme und ermöglichen andererseits eine konstruktive Diskussion über mögliche Lösungsansätze.

Ein Hauptergebnis der Untersuchung ist, dass - obwohl eine große Anzahl von Forschungsergebnissen die Bedürfnisse der Bauern aufgreift - die wichtigsten Probleme der Landwirte doch nicht hinreichend erfüllt werden. Genannt werden muss hier insbesondere der Zugang zu guten und bezahlbaren Dienstleistungen wie Saatgut, Pflanzgut, Agrarberatung, etc. Diese Dienstleistungen sind jedoch als Marktschwächen in erster Linie außerhalb des Mandats der Forschungszentren angesiedelt. Um die Effektivität der Agrarforschung zu verbessern ist es also folglich notwendig, das weitere Umfeld (Länder, Beratungsorganisationen, Märkte) einzubeziehen. Die meisten Innovationen zielen auf die Verbesserung der Eigenschaften von Sorten; eine kleinere aber wachsende Zahl von Innovationen versucht Marktinnovationen zu entwickeln. Unter Berücksichtigung der Ressourcen, der Höhe des Einsatzes von Betriebsmitteln und der Kosten für Innovationen wurde geschätzt, dass etwa ein Drittel der IAFZ-Innovationen für Kleinbauern erschwinglich sind.

Die Ergebnisse zeigen weiterhin, dass Landwirte und Wissenschaftler über die Frage, welches die wichtigsten Kriterien für die Innovationsentwicklung sind, weitgehend übereinstimmen: große komparative Vorteile, mittlere Rentabilität, Erschwinglichkeit und Adoptionspotenzial. Dieses Befragungsergebnis wurde während des Abschlussworkshops hingegen von einigen Teilnehmern bestritten. Vertreter der Bauernverbände beklagten, dass Wissenschaftler nicht genug mit den Bauern zusammenarbeiten, und daher die Realität der Bauern nicht hinreichend kennen, um Innovationen zu entwickeln. Angesichts der Tatsache, dass Frauen mehr als die Hälfte der Beschäftigten in der Landwirtschaft stellen, stimmten alle Akteure überein, dass Gender bei der Entwicklung von Innovationen eine breitere Rolle spielen sollte. Zum Beispiel durch Veränderungen in Anbau, Verarbeitung und Vermarktung, können Verbesserungen für Frauen und andere benachteiligte Gruppen erzielt werden. Weiterhin herrschte Konsens darüber, dass direkte Bauernberatung (Schulungen, Feld Demonstrationen) die beste Möglichkeit darstellt, um Informationen an die Bauern weiterzuleiten. Nichtsdestotrotz erreichen viele Beratungsinhalte die Bauern nicht. Dies wird insbesondere aus der Analyse der Zusammenarbeit zwischen den Akteuren im Innovationssystem deutlich. Die Auswertung der Wahrnehmungen der verschiedenen Akteure untereinander hat gezeigt, dass Vertrauen geschaffen und die Zusammenarbeit verbessert werden muss, um die Kleinbauern besser unterstützen zu können. Nach Angaben der Bauernverbände und Intermediäre sind die Landwirte nicht mit den Leistungen der nationalen landwirtschaftlichen Beratungsdienste (NAES) zufrieden. Angeführt wird vor allem, dass die

geringe Mittelausstattung zu einer sehr geringen Präsenz im Feld führt. Positiv wird in der Regel das Wissen der Berater über Grundnahrungspflanzen beurteilt.

Nicht-Regierungsorganisationen (NGO) und die Privatwirtschaft werden bezüglich ihrer Ausbildungsaktivitäten gut beurteilt. Gleichzeitig wird bemängelt, dass es nur sehr wenig Angebote dieser Art gibt. Die Landwirte zeigen ein ausgeprägtes Misstrauen gegenüber der Privatwirtschaft und führen viele Beispiele von Betrug als Begründung an (falsches Saatgut, überhöhte Preise, fehlerhafte Waagen, etc.). Einerseits vertreten eine große Anzahl der Bauernorganisationen die Auffassung, dass die Forschung der IAFZ ihre Bedürfnisse nicht erfüllt, insbesondere konzentrieren sich die Forscher zu sehr auf die Forschungsmethodik und zu wenig auf Wirkung für die Bauern. Andererseits schätzen viele Bauernorganisationen die Ausbildungsmöglichkeiten und hohen Qualitätsstandards der IAFZ. Die Intermediäre schätzen vor allem den Austausch von Varietäten als auch die Offenheit zum Networking und die Kooperationsmöglichkeiten bei der Mittelakquisition.

Die IAFZ ihrerseits bevorzugen die Zusammenarbeit mit den Nationalen Forschungseinrichtungen bezüglich der Verbreitung ihrer Innovationen. IAFZ kooperieren deutlich weniger mit den Nationalen Beratungsorganisationen, da sie deren Mittelausstattung als zu gering ansehen und weiterhin bemängeln, dass sie notwendige Qualitätsstandards nicht aufrecht erhalten können.

Die meisten der untersuchten Topinnovationen haben bislang jeweils weniger als 5.000 landwirtschaftliche Haushalte erreicht. Die Wissenschaftler führen dies weitgehend auf die zu schlechten Partnerschaften mit Beratungsorganisationen zurück, reflektieren aber auch ihren eigenen Forschungsansatz und die Verbindungen mit Partnern. Ein Grund für die relativ erfolglose Verbreitung der Technologien der IAFZ können auch in der Tatsache begründet liegen, dass die Karriere der Wissenschaftler nach wie vor auf der Grundlage der Anzahl der wissenschaftlichen Artikel bewertet wird, während die Zusammenarbeit mit Landwirten nur an letzter Stelle der Kriterienliste Beachtung findet.

28% der Top-Innovationen standen in direktem oder indirektem Zusammenhang mit Fördergeldern des BMZ. Angesichts der großen Anzahl der IAFZ Geldgeber ist dies sicherlich ein gutes Ergebnis für die Auswahl der Forschungsprojekte.

Die Mehrheit der Akteure teilt die Auffassung, dass der Klimawandel starke Auswirkungen auf Landwirte hat. Insbesondere Ertragsverluste und Tierverluste aufgrund des erhöhten Auftretens von Dürre oder Überflutungen wurden erwähnt. Trotz der Tatsache, dass bereits zahlreiche Forschungen in diese Richtung gehen, wird eine weitere Fokussierung auf dieses Thema notwendig sein. IAFZ können insbesondere durch die Entwicklung besserer, stresstoleranter Sorten zu einer Ergänzung der traditionellen Sorten beitragen. Dies könnte ein wichtiger Beitrag werden, um mit den Problemen des Temperaturanstiegs in Afrika Schritt zu halten. In diesem Zusammenhang sei darauf verwiesen, dass mit einer zusätzlichen Erwärmung zu rechnen ist.

Das Hauptproblem für die Übernahme von Innovationen durch die Landwirte ist nicht, dass die Innovationen nur unzureichend ihren Bedürfnissen entsprechen, sondern zum wesentlichen Teil, dass die Innovationen nicht zugänglich sind. Weiterhin sind die Landwirte unzureichend über das Angebot an Innovationen informiert. Aus diesem Grund müssen sich die IAFZ verstärkt diesem Problem stellen. Um Wirkungen auf der Ebene der bäuerlichen Zielgruppen zu erzielen, ist dies eine unbedingte Voraussetzung.

Über die Durchführung von Workshops hat sich ITAACC besonders für eine stärkere Zusammenarbeit der verschiedenen Akteure mit einem Fokus auf Systemansätze als Schlüssel zur Veränderung landwirtschaftlicher Praktiken konzentriert. Es wichtig festzustellen, dass die IAFZ nicht die einzige Quelle für landwirtschaftlichen Innovationen darstellen. Innovative Bauern liefern oft ebenso gute Ansatzpunkte. Zukunftsweisend wird die Fähigkeit sein, verschiedene Partner zusammen zu bringen, und in diesem Prozess neue Ideen zur Praxisreife zu führen. IAFZ sind bereits an einer Reihe von Innovationsplattformen beteiligt, die insbesondere im südlichen Afrika gute Ergebnisse erzielt haben. Die Zentren sollten insbesondere eine stärkere Beteiligung der Bauern ermöglichen und diesen auch mehr Kontrolle des Forschungsprozesses überlassen. Dies würde einen stärkeren Problembezug der Innovationen ermöglichen. Für Innovationsplattformen werden aber auch flexible Finanzierungsmechanismen benötigt, die eine stärkere Berücksichtigung der Bauern, ihrer Organisationen und anderer beteiligter Akteure notwendig machen.

Die Verantwortung für die Verbesserung der Lebensbedingungen von Kleinbauern liegt nicht allein bei den IAFZ, alle Entwicklungspartner haben wichtige Beiträge zu leisten. Um gerade dieses fehlende Bindeglied zu stärken, haben ITAACC und BEAF zusammen mit NRO und den IAFZ eine Reihe von guten Grundsätzen, die sogenannten "Feldafing Prinzipien" zur Verbesserung landwirtschaftlicher Innovationssysteme, erarbeitet.

Wichtige Prinzipien sind zum Beispiel, dass die Projektplanung langfristiger ausgelegt sein sollte, um Raum für einen Ausgleich von Forschung und Beratungsanpassung zu geben. Ebenso sind Raum für Fehler und Flexibilität weitere wichtige Voraussetzungen für den Erfolg der Innovationsentwicklung und Praxiseinführung.

Die vorliegende Methode des Abgleichs von Angebot und Nachfrage nach Agrarinnovationen kann als Information und Lerninstrument für verschiedene Akteure genutzt werden sowie als Hilfsmittel zur Steuerung der öffentlichen Ausgaben für IAFZ dienen. Weiterhin unterstützt es unmittelbar die Entscheidungsfindung für Pilotmaßnahmen von ITAACC und der Beratungsgruppe Entwicklungsorientierte Agrarforschung (BEAF). Der Umfang der aktuellen Studie ist allerdings sehr groß und die Kosten für Wiederholungen entsprechend hoch. Deshalb erscheint es sinnvoller, die Methode nur in längeren Intervallen, alle fünf bis zehn Jahre, einzusetzen

Das ITAACC Projekt läuft noch bis zum Jahr 2018 und es wird empfohlen, die Ergebnisse der Studie an alle Befragten weiterzuleiten. Derzeit werden Projektvorschläge entwickelt, um die Ergebnisse weiter bekannt zu machen. Die Daten der Studie werden auf der ITAACC Website zur Verfügung gestellt, so dass verschiedene Nutzer die Primärdaten zu eigenen vertiefenden Analysen einsetzen können. Weiterhin wird erwogen, die Daten auf der virtuellen Informationsplattform (VIP) im Rahmen der afrikanischen Agrartechnik-Plattform (AATP) oder durch zehn neu entstehende Innovationszentren verfügbar zu machen. Abschließend könnten die Ergebnisse dieser Studie Ansatzpunkte für Kleinprojekte geben, die konkrete Bedürfnisse der Bauern mit Lösungsansätzen der IAFZ exemplarisch verknüpfen.

SUMMARY IN FRENCH

Le programme intitulé « Transfert de l'Innovation vers le secteur agricole – Adaptation au changement climatique (ITAACC) » (04/2013-03/2018) a pour but de surmonter le hiatus existant entre les résultats de recherche obtenus par CGIAR, AVRDC and *icipe* et leur mise en œuvre dans le secteur agricole en Afrique. Ce rapport présente les résultats d'une évaluation ayant pour objet la concordance entre l'offre et la demande pour des innovations agricoles. L'évaluation a été faite sur une période de neuf mois par une équipe composée de six consultants.

Les informations d'ordre quantitatif et qualitatif, collectées auprès d'un large éventail de parties prenantes opérant au sein du système d'innovation ont été recueillies au moyen de questionnaires structurés. La méthodologie utilisée s'attache à restituer les besoins de petits exploitants agricoles, besoins exprimés par des organisations d'agriculteurs (152 entretiens) et des organes intermédiaires, comme les organisations non gouvernementales, le gouvernement et le secteur privé (141 entretiens). L'évaluation du volet Offre a englobé 94 innovations, celles-ci ayant été choisies par des représentants régionaux de l'IARC sur la base de leur impact positif sur les moyens de subsistance des populations pauvres dans les zones rurales. On a élaboré douze hypothèses, celles-ci structurant le questionnaire et l'analyse. Cette démarche est allée plus loin que la simple concordance de l'offre et de la demande, puisqu'elle souhaitait restituer des prises de position sur l'adoption d'innovations, l'échange d'informations, la diffusion et le changement climatique. On a programmé cinq ateliers pour discuter et valider les résultats préliminaires, cette démarche permettant de mettre en place un échange et un apprentissage permanents avec l'ensemble des parties prenantes. Bien que plus de 400 interviews ont été menées dans plus de dix-sept pays, les résultats dont il est fait état ne peuvent cependant pas être considérés comme représentatifs pour le secteur agricole en Afrique. Si l'on tient compte de la formidable hétérogénéité des petits exploitants en Afrique (diversité des cultures, base des ressources naturelles et pluviosité), il est finalement presque impossible de cerner « la » demande d'innovations. Les entretiens se sont en outre attachés à dégager la manière dont les parties prenantes perçoivent toute une série de questions et non pas à tester la validité des déclarations faites. Les résultats de l'étude ont révélé d'intéressants aperçus sur les problèmes existants, permettant d'engager un débat constructif sur la mise en œuvre de solutions possibles.

Les résultats montrent que même si un grand nombre de résultats de recherche correspondent aux besoins des agriculteurs, celle-ci n'est cependant pas en mesure de trouver une solution aux problèmes majeurs rencontrés par les agriculteurs. Parmi ces problèmes, on peut citer l'accès à des intrants et des services de qualité, et ce à un coût abordable (semences, matériels de plants, conseil, etc.), ceci ne constituant cependant pas la part essentielle du mandat dont sont investis les centres. Cette situation montre la nécessité de mettre en place des partenariats avec les gouvernements (diffusion) et d'autres acteurs/entités afin d'améliorer l'impact de la recherche agricole. La plupart des innovations mettent l'accent sur l'amélioration des propriétés des variétés de cultures et seules quelques rares innovations, innovations dont le nombre tend toutefois à augmenter tentent de comprendre les marchés et ont pour objectif de créer une plus-value au niveau de la production. Évaluant l'état des ressources, le niveau d'application des intrants et le coût des innovations, on a estimé qu'un tiers des innovations de l'IARC était abordable pour les petits exploitants agricoles. Les données recueillies révèlent que les fermiers et les chercheurs/les scientifiques partagent la même vision qu'un grand avantage comparatif, la rentabilité à moyen terme, l'accessibilité financière et la mise en échelle potentielle constituent les principaux critères pour le développement de l'innovation ; mais dans le cadre des ateliers, ce point de vue a été contesté. Certaines organisations d'agriculteurs ont signalé le fait que les chercheurs/les scientifiques n'interagissent pas suffisamment avec les fermiers et que par conséquent, ils ne connaissent pas assez bien leur réalité pour élaborer des innovations. Dans la mesure où dans le secteur agricole les femmes représentent la moitié de la main d'œuvre, les acteurs estiment que la question du genre doit et peut être prise en considération dans le processus d'élaboration d'innovations ou au niveau des programmes de diffusion, par exemple, au moyen de la restructuration des techniques utilisées dans le domaine de la production, du traitement/de la transformation et du marketing, et ce afin de tenir compte de la capacité des femmes à manier certains outils et à utiliser certains équipements. Il y a un consensus général sur le fait qu'une interaction en face à face (formations, démonstrations, échanges de fermiers) constitue la meilleure façon pour partager l'information avec les exploitants agricoles. Cependant, les messages n'atteignent pas encore toujours leurs destinataires. Ce fait apparaît également lorsque l'on regarde la collaboration et les complémentarités existant entre les différents acteurs opérant au sein du système d'innovation.

L'analyse de la perception que les différents groupes de parties prenantes ont les uns des autres a révélé qu'il existait une grande marge pour renforcer la confiance, la compréhension et pour mettre en place de véritables partenariats afin d'aider les petits exploitants agricoles. Aux dires des organisations

d'agriculteurs (OA) et des organes intermédiaires, les agriculteurs ne sont pas satisfaits des services prestés par les National Agricultural Extension Services (NAES), déplorant que s'il est certes vrai que les personnels sont bien informés sur les cultures vivrières, ils disposent cependant généralement de faibles ressources, sont peu présents sur le terrain et ne sont pas assez compétents pour générer une plus-value au niveau des entreprises agricoles. Les organisations non gouvernementales (ONG) et le secteur privé sont réputés fournir des services de grande qualité, en particulier en termes de formation et d'attention aux innovations, mais l'accès à ces services est difficile. Par ailleurs, les agriculteurs ont tendance à ne pas faire confiance au secteur privé, citant de nombreux exemples où ils se sont sentis exploités. La plupart des organisations d'agriculteurs et des organes intermédiaires estiment que l'approche de l'IARC ne répond pas aux besoins des agriculteurs, signalant le fait que l'IARC met trop l'accent sur la méthodologie de la recherche au détriment des effets. Les organisations d'agriculteurs apprécient les formations dispensées et l'application de normes de qualité sévères de l'IARC, les organes intermédiaires appréciant également l'idée de partager et d'essayer du matériel génétique et les opportunités pour le réseautage et la levée de fonds via l'IARC. D'un autre côté, l'IARC préfère travailler avec NARS et des organisations non gouvernementales pour procéder à une mise en échelle de leurs innovations. L'IARC travaille nettement moins souvent avec les NAES, imputant ce fait à l'absence de ressources pour pérenniser les normes de qualité. Prise chacune pour soi, la plupart des meilleures innovations n'ont pas atteint plus de 5000 foyers, et le potentiel en termes de diffusion d'un grand nombre d'innovations est limité. Dans une large mesure, les personnes interrogées en voient la raison dans la faiblesse des partenariats d'élargissement, réfléchissant du coup également sur leur propre approche pour la collaboration et l'élargissement. Une entrave à un élargissement réussi de techniques émanant de l'IARC peut également résider dans le fait que les chercheurs/les scientifiques sont davantage jugés sur la base de leurs dossiers de publications et moins sur leurs engagements avec des agriculteurs ou des agents de vulgarisation. 28% des meilleures innovations choisies par l'IARC ont pu d'une manière ou d'une autre être rattachées à un financement passé, assuré par le Ministère fédéral allemand de la Coopération et du Développement [BMZ] ; ce fait est significatif si l'on connaît le grand nombre de donateurs aidant l'IARC.

La plupart des acteurs estiment que le changement climatique a un impact sur les agriculteurs. On a dans ce contexte en particulier mentionné les pertes de rendement dues à la multiplication de périodes de sécheresse et à une pluviosité devenue plus irrégulière. Malgré le fait que l'on ait déjà encouragé l'utilisation de toute une série de mécanismes d'adaptation, il faut absolument poursuivre la recherche afin de les améliorer. L'IARC peut sans aucun doute y contribuer en développant des variétés de cultures de meilleure qualité et qui sont plus résistantes à la sécheresse et aux inondations et en maintenant une diversité de variétés de cultures traditionnelles résistantes. Ceci est la solution pour faire face au réchauffement climatique prévu et son impact sur les petits exploitants agricoles en Afrique.

On a abouti à la conclusion que le principal obstacle pour que les agriculteurs adoptent des innovations ne réside pas tant dans un décalage entre les innovations et leurs besoins que dans le fait que les agriculteurs n'ont pas accès aux innovations. Les agriculteurs sont très mal informés sur les innovations existantes et ils sont pénalisés par la faiblesse de l'infrastructure et des services d'assistance. Nonobstant, et dans la mesure où l'IARC s'engage à atteindre son objectif, visant à créer un impact, ces problèmes doivent être résolus. Le projet ITAACC plaide en faveur de l'adoption d'une approche de système d'innovation, celle-ci mettant l'accent sur l'interaction entre les différents acteurs, conçue comme un moyen ayant vocation à changer les pratiques agricoles. Il est donc important de comprendre que l'IARC n'est pas le seul moteur ou le seul initiateur majeur de l'innovation dans le secteur agricole. L'IARC peut faire plus pour aider les agriculteurs à faire progresser leurs propres innovations ou pour initier/établir des partenariats dans le cadre de processus multi-intervenants afin d'encourager l'innovation, et ce en partant de la base. Par exemple, les principales plateformes d'innovation de l'IARC, plateformes réunissant un large éventail de parties prenantes pour résoudre un problème ont obtenu des résultats prometteurs, en particulier en Afrique australe. Les centres doivent dépasser la simple participation des agriculteurs pour mettre davantage l'accent sur un renforcement du contrôle et du *leadership* des agriculteurs dans le cadre de processus d'innovation. Cette démarche présuppose un changement au niveau de la gestion de projets de recherche, prévoyant par exemple la levée de fonds pour les partenaires (organisations d'agriculteurs, organes intermédiaires) dans une ampleur plus importante que cela ne se fait actuellement. Cette démarche garantit que la recherche est faite sur la base des demandes réelles des agriculteurs.

Ce n'est pas uniquement l'IARC qui porte la responsabilité pour améliorer les moyens de subsistance de petits exploitants agricoles, les partenaires de développement ayant également un rôle important à jouer. Afin de renforcer ces liens, l'ITAACC et BEAF ont initié conjointement avec des partenaires des agences de développement et de l'IARC la formulation de Feldafing Principles for Enhancing Agricultural Innovation Systems. Cette démarche s'applique dès l'élaboration de la conception du projet, par exemple lors du développement de projets sur le long terme, ceux-ci pouvant être mis progressivement

en place afin de créer un équilibre de l'influence entre la recherche et le développement. Prévoir une marge de manœuvre pour des erreurs et la flexibilité en termes de budgets sont des conditions préalables à la réussite de tels projets.

La méthodologie de l'étude appliquée pour faire une évaluation de la concordance entre l'offre et la demande est utile dans la mesure où elle peut opérer comme outil d'apprentissage pour un large éventail de parties prenantes et qu'elle peut exercer une influence sur les dépenses publiques pour l'IARC. Dans l'immédiat, elle permet d'orienter les investissements, destinés à la promotion et au pilotage d'innovations choisies via les programmes de développement de GIZ, l'ITAACC et le Advisory Service on Agricultural Research for Development (BEAF). En raison de l'envergure de l'évaluation, il est probable qu'elle opère surtout comme un outil destiné à valider le fonctionnement du système d'innovation tous les cinq à dix ans.

Le projet ITAACC va se poursuivre jusqu'en 2018, et on recommande que les personnes remplissant les questionnaires reçoivent un retour d'information sur les résultats mais également sur les solutions éventuellement apportées aux problèmes évoqués. Des propositions contenues dans le projet sont actuellement développées afin de pouvoir mettre en place une équipe chargée de la diffusion, cette équipe assurant le retour d'information via des plateformes locales. Les données de l'enquête seront rendues accessibles sur le site Internet de l'ITAACC, de telle sorte que les parties concernées puissent faire leur propre analyse des données. Une voie possible consiste dans l'utilisation de la Virtual Information Platform (VIP) au niveau de l'African Agricultural Technology Platform (AATP) ou via dix centres d'innovation, ceux-ci étant financés par le Ministère fédéral allemand de la Coopération et du Développement [BMZ] et devant être créés en Afrique incessamment. Et enfin, les résultats de cette étude ont dégagé des points d'entrée pour les besoins identifiés, ceux-ci pouvant faire l'objet d'une analyse future, par exemple au niveau de la GIZ et d'un centre IARC afin d'élaborer un projet destiné à combler le décalage existant entre un besoin particulier et sa satisfaction.

1 INTRODUCTION

1.1 Project context

Agriculture is of critical importance to the development of Africa. 80% of the population is involved in agricultural production, and it accounts for 30% of GDP on the continent. Agricultural production in Africa is largely rain-fed and run by smallholder families. A rise in productivity will contribute directly to food and nutritional security, and poverty reduction. However, climate change projections indicate that agricultural productivity will decrease between 10 and 20 % due to more frequent heat stress, droughts, floods and shifts in agro-ecological zones. In addition, the population is expected to reach 2 billion people by 2050[1]. On top of that, urbanization and increased international trade demands a more market-oriented agricultural sector. This means that farmers and support services need to adapt their ways of operation to keep up with these changes.

Agricultural research centers, such as the ones of the Global Agricultural Research Partnership of the CGIAR have the mandate to generate new and better technologies, practices, institutions and policies for the rural poor. The World Bank (2011) stated that returns on investments in CGIAR agricultural research have generally been very good, ranging conservatively from a 175% return on investment to almost 900%, and much of the success in meeting global food needs can be attributed to these investments. The German Federal Ministry for Economic Cooperation and Development (BMZ) is a founding member of the CGIAR and has been supporting its 15 research centers as well as the World Vegetable Center (AVRDC) and the International Centre of Insect Physiology and Ecology (*icipe*), see Figure 1, with about 20 Million Euro per year. In 2008 the CGIAR embarked on a major reform process to make international agricultural research more focused on farmers' needs, partnerships and development outcomes, among other goals. Once focused on the 'production of knowledge', the international agricultural research system now puts added emphasis on ensuring that this knowledge is useful and taken up (Gildemacher and Wongtschowski, 2013)[2]. Effective partnerships are found essential in achieving the desired scale of impact (CGIAR, 2011).

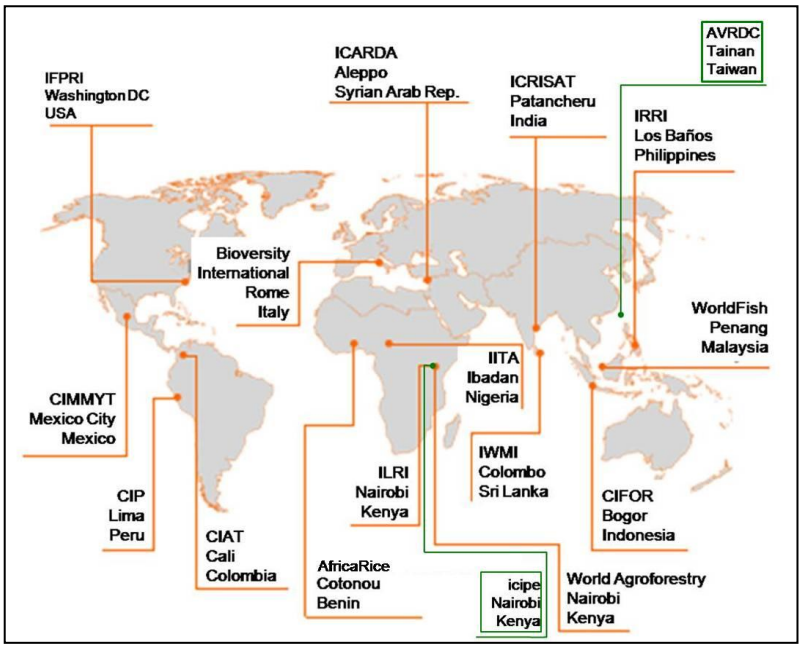

Figure 1: Headquarters of the AVRDC, *icipe* and 15 CGIAR agricultural research centers

1.2 Goals and objectives

The "Innovation Transfer into Agriculture – Adaptation to Climate Change (ITAACC)" -program is being implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of BMZ between April 2013 and March 2018. It aims at bridging the gap between research outcomes of the CGIAR, AVRDC and *icipe* and their implementation in the agricultural sector in Africa. The program has four intervention areas:

A. Establishment of a knowledge transfer platform,

B. Assessment of the *demand-supply* match for agricultural innovations,

C. Financing of selected pilot projects based on a competitive granting process,

D. Capitalization on lessons learnt.

[1] UN Population Fund http://www.unfpa.org/public/

[2] The GFA Feldafing workshop report includes a short review of selected literature relevant to ITAACC. The workshop report is available on the ITAACC website www.icipe.org/itaacc

This report summarizes the findings of intervention area "B" that has been implemented by the GFA Consulting Group GmbH[3] from September 2013 until June 2014. The goal was the:

Development and application of a method to assess the demand-supply match for agricultural innovations in Africa

- The "demand" is defined as the specific challenges farmers face within their farm or within the value chain they operate in, whereas
- "supply" refers to the innovations developed for them by the CGIAR, AVRDC and *icipe* (referred to as International Agricultural Research Centers (IARC)).
- Agricultural innovation is defined as the process of creating and putting into use agricultural practices, new in a particular environment (Gildemacher and Wongtschowski, 2013).

The method should be easy-to-use, compatible and cost-efficient so that it can be used by a range of partners who would like to assess the need-supply match further. In addition, the assessment should include BMZ funded research (Kasten, 2013) and selected development projects of GIZ. Finally, special attention should be given to innovations that contribute to climate change adaptation and gender equity in Africa.

The objective of the assessment is to create a better understanding on how the gap between research and farmers practice can be bridged by helping farmers articulate their needs, and by consulting all actors in the innovation system. In addition, the findings will help guide investments for promotion and piloting selected innovations through GIZ development programs, ITAACC and the Advisory Service on Agricultural Research for Development (BEAF).

Given the rapid nature of the assessment, the results reported are not representative of the African agricultural sector, however, they provide some interesting insights into existing problems and allow a constructive discussion of possible solutions. The objective has been to "flag" issues, rather than making sweeping recommendations.

1.3 Study resources

The study was conducted over a nine month period by a team of six people. The team leader, Dr. Lorenz Bachmann, and deputy team leader, Lennart Woltering, had intermittent contracts for 75% of the time. The regional experts for East Africa (Tom Apina), Southern Africa (Brigid Letty), West Africa (Dr. Jean Nyemba) and North Africa (Prof. Benasser Alaoui) were mobilized for 63% of the study period. The budget of this study was around 0,5 Million Euros.

[3] www.gfa-group.de

2 METHODOLOGY

2.1 Project implementation strategy

Defining the needs for agricultural innovations of almost a billion farmers in Africa, all with their specific resource base and climate, is impossible. Similarly, the 17 IARC have produced an overwhelming amount of research findings during the last decades. It is therefore of critical importance to define the scope and limitations of this project carefully. The innovations developed by the IARC are evaluated regularly by a range of donors and institutes, whereas farmer needs are hardly documented. It was decided to prioritize efforts on assessing the need of farmers, thereby focusing on the kind of needs that the CGIAR, AVRDC and *icipe* can supply. Hence, a focus is on a limited number of commodities that are cultivated by smallholder farmers- mostly staple crops. Rather than reaching out to individual farmer households, it was decided to approach stakeholders that give an aggregated demand of smallholder farmer needs. These are farmer organizations (FOs) and intermediaries, such as development organizations (GIZ, NGOs, etc.), actors along the value chain (input suppliers, seed companies, processors) and government agencies. These actors are much easier to link up with for any follow-up activities. Individual farmer needs have been collected by the eRAILS project[4] in 2013. The eRAILS data was analyzed in such a way that it could be integrated into this study. On the supply side, the regional representatives of the IARCs were asked to select up to five top innovations of their center that are ready for dissemination and that have a large positive impact on the livelihoods of smallholder farmers in their region. It was assumed that these top innovations covered the bulk of the farmer needs. Specific interviews on those innovations were done with the scientists heading that research, thereby reducing the number of IARC interviews considerably.

Based on a literature study[5] and stakeholder meetings it was found that beyond the needs for innovations, other themes like adoption of innovations, information exchange, and extension were important to understand uptake of suitable innovations concerning climate change adaptation. Twelve hypotheses were formulated around these research themes (Table 1).

Table 1: The hypotheses that form the framework for analysis

Main research theme	Hypothesis
Needs for innovations	H01. IARCs are addressing key needs of farmers
Adoption of innovations	H02. Innovations are affordable for farmers
	H03. Farmers and scientists share similar views on key criteria for design/adoption of innovations
	H04. Gender equity is an important criteria for actors in the innovation system
	H05. Farmers are the major stakeholder in the design and implementation of IARCs' research
Information exchange	H06. The ways information on innovations is shared matches the requirements of farmers
Extension	H07. Farmers rate advisory services they receive as adequate
	H08. Effective linkages exist between different actors in the innovation system
	H09. IARCS innovations have been up-scaled adequately
Climate change	H10. Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes
Other	H11. Research results financed by BMZ in the past are found readily among current top five innovations of IARCs
	H12. Research at the IARC is aligned with overall international development goals

Questionnaires for Farmer Organizations (FOs), intermediaries and IARCs were developed to be able to answer to the twelve hypotheses. The questionnaires were designed in a way that the questions asked on the demand side relate to the questions asked on the supply side. For example, FOs and intermediaries were asked about the kind of challenges associated with a commodity, whereas the IARCs were asked what key problems their top innovation addresses. Or, the perception on the

[4] The eRails project sent technicians to 1061 households in 8 African countries in Africa to ask farmers with what problem they need help. The project is funded by FARA and data was collected in 2013. http://www.erails.net/FARA/erails2/erails2/Home

[5] The literature review of other methods was documented in the inception report (September 2013). It also includes a list of most important criteria for innovations used by various donors. These formed the basis for the development of the hypothesis

strengths and weaknesses of collaboration with each other was evaluated to support or reject the hypotheses on extension. The questionnaires were developed, implemented and analyzed using GrafStat Edition 2012[6]. This software is very user friendly and allows for simple analysis of data. The number of questions per questionnaire ranged from 34 for the IARCs' center regional representatives to 75 for the farmer organizations. The questionnaires took between 30 and 90 minutes to complete. The questionnaires can be found in the Annex of the inception report on the ITAACC website.

Two GFA team workshops were organized to develop (October 2013), and analyze the results of (April 2014), the questionnaires. The team was trained in the use of GrafStat and detailed work plans were developed. The data collection progress was managed through regular Skype (conference) meetings, joint field visits and sharing of country trip reports.

2.2 Data collection

Data collection took place between November 2013 and April 2014, and it was done on the basis of three steps:

1. Country selection by ranking all countries in East, Southern, West and North Africa based on number of IARC centers and BMZ funded research and development projects present. Table 2 shows the selected countries, whereby the first country listed per region is the country of residence of the regional experts. Data collection has been more intensive in these countries than in the other countries, where the regional experts spent about 5-15 days to collect data.

Table 2: Seventeen countries were targeted for the assessment

East Africa	Southern Africa	West Africa	North Africa
Kenya	South Africa	Cameroon	Morocco
Ethiopia	Zimbabwe	Mali	Tunisia
Uganda	Zambia	Benin	
Tanzania	Mozambique	Ghana	
Rwanda	Malawi	Burkina Faso	
		Niger	

2. The most important commodities for the country's dominant (>10% land cover) agro-ecological zones (AEZ) [7] were targeted using the FAO database[8]. The major commodities provided an entry point for identification of important stakeholders to consult for data collection in the countries to be visited. The commodities were categorized into crops, livestock and (agro-) forestry in the questionnaires. By categorizing according to AEZ, we increased the relevance of findings across Africa because each zone has a similar combination of constraints and potentials for land use.
3. Identification of stakeholders on the demand and supply side. The primary stakeholders to target were mid-sized farmer organizations that represent smallholder farmers of a target commodity. 152 FO interviews were done, of which about 25% were done with organizations with less than 100 members (Figure 2, left). Intermediaries, such as NGOs, government and private sector actors, were the second important stakeholders to identify, as they not only articulate the needs of farmers but also promote innovations. 141 interviews were done with intermediaries, most of them with NGOs (Figure 2, middle). On the supply side, 24 interviews were done with regional representatives of the IARCs who selected the top innovations for which 94 separate interviews were done with scientists. Figure 2 shows, on the right, that most interviews were done at ICRAF, IITA and ICRISAT. Not all centers could be reached, and not all scientists working on selected top innovations could be interviewed. About 90% of the interviews were done face to face, the remaining via email.

[6] http://www.grafstat.de/

[7] http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/Refer/africa.htmGlobal

[8] http://countrystat.org

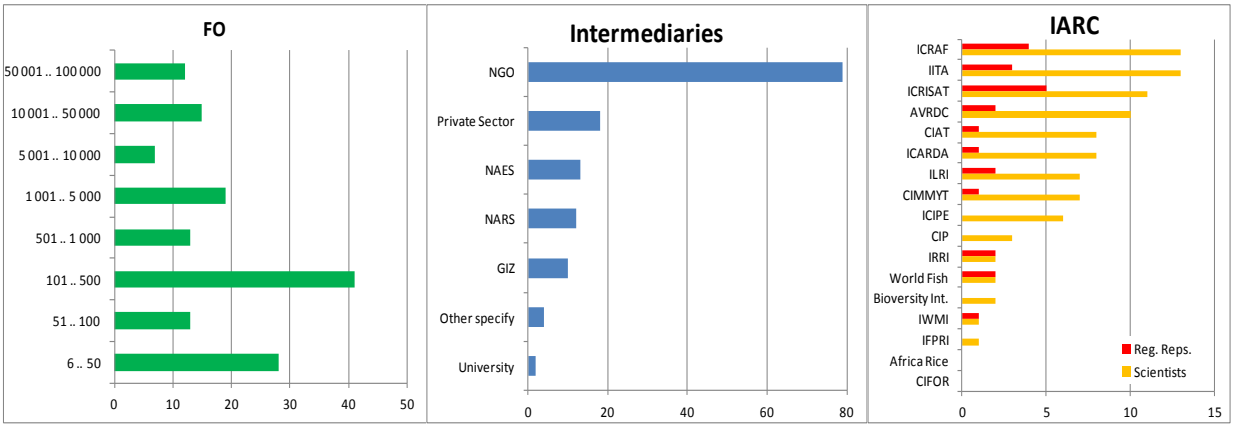

Figure 2: Left: Number of FO interviews per membership size (y-axis), middle: number and type of intermediary organization interviewed, and right: number of interviews per IARC

2.3 Data analysis

The questionnaires contain multiple choice and open questions. The open answers were categorized using a coding tool where the most frequent answers were given a code. In the case that the respondent answers "poor soil fertility and no access to fertilizer", two codes (1. soil fertility and, 2. access to fertilizer) were assigned to that response. Up to three codes were given per response on an open question. The codes were used across the FOs, Intermediary and IARC groups to compare the perception of problems. The data was analyzed per region and major differences with the overall Africa data are highlighted in this report. The Figures and Tables in this report may only show some selected information, but the entire data tables are available in Annex 1, 2 and 3.

The demand-supply match is assessed by comparing the challenges FOs and intermediaries mention per commodity with the problems the innovation of the IARC addresses. In addition, a number of questions that characterize the farmers (FO and intermediary interview) are compared with questions to the IARCs on the targeting of their innovations. A selection of matching cases is highlighted in the regional reports that can be found in Annex 4, 5, 6 and 7.

Three regional workshops in Africa[9] and two international workshops in Germany and Kenya were organized to provide a platform for actors in the innovation system to share, discuss and validate the findings of the assessment. The workshops were set up to enable a fruitful exchange between participants by creating a healthy mix of small group works, presentations, and networking events over two days. The workshop was used to collect and interpret data. The results of the workshop were captured in separate workshop reports and their key findings are integrated in the results section of this report.

[9] Four regional workshops were planned, but due to the political situation in North Africa, the West and North Africa workshops were combined into one, held in Cotonou, Benin, on 19 and 20 March 2014

3 RESULTS

3.1 Demand-supply match for agricultural innovations

Hypothesis 1

IARCs are addressing key needs of farmers

The hypothesis was answered by first screening whether innovations exist for specific commodities, before the relevance of the innovations was evaluated against the needs expressed. Furthermore, questions on the farmer conditions and resources were matched with the questions on the targeting of the innovation. Annex 1 shows the number of interviews done per crop, livestock and agro-forestry commodity with farmer organizations (FOs), intermediaries (NGOs, private sector, government) and IARCs. This section describes only the most relevant findings and gives examples of the demand for innovations for maize and goats. The entire dataset is available in Annex 1, 2 and 3 and it is envisaged that people can do their own data analysis through a web-platform on the ITAACC website.

Major challenges for commodities

Most interviews were done on maize; these were 41 with FOs, 40 with intermediaries and 17 IARCs. This is a reflection that maize is a staple crop in many of the countries included in the study. After that, most crop data was collected on cassava, potato, rice, sorghum, dry beans, groundnuts, vegetables and banana (plantain). FOs were found to be organized around cattle, dairy cattle and goats rather than around other forms of livestock. Much of the IARCs' top innovations related to livestock were dealing with fodder crops to address feed shortages. Only 10% of the interviews were done on the third category, (agro-) forestry and others. This included interviews on fruit trees, nut trees, various agro-forestry species and some species with health properties (*moringa oleifera*) or beauty characteristics such as karité (used for the production of shea butter). Farmers seemed to be organized around mango especially. The agro-forestry species (e.g. *faidherbia albida*, *gliricidia sepium*) were generally only mentioned by ICRAF as target commodities. It became clear that farmer organizations have a strong focus on marketable short duration commodities and growing trees seems secondary to them. In the context of climate change and appropriate adaptation strategies, this is certainly an important shortcoming to be addressed (Section 3.5). Farmers seem to be organized around a limited number of commodities only, whereas IARCs work on a broad array of commodities.

Table 3 shows the coded challenges for maize farmers according to the open questions to FOs and intermediaries. The last column shows what challenges are being addressed by the top innovations of IARCs according to the scientist. The bottom row, nominations, shows the number of coded answers extracted from the responses. The challenge most frequently raised by FOs was access to and quality of seed (16%). This was also mentioned most frequently by intermediaries (14%), but for IARCs this problem ranked only at a medium position (5%). Limited seed multiplication capacity and poor distribution of quality seeds deprive farmers from accessing good quality seeds. Furthermore, many complaints were collected on sales of adulterated seeds. FOs seemed to shy away from hybrid seeds, preferring to (re-)grow Open Pollinated Varieties (OPVs) themselves. The second most important problem for FOs' "marketing" was ranked only medium with intermediaries and IARCs in the interviews. This also had to do with poor policies on import and export regulations for maize as it is a highly traded commodity. FOs raise the issue that food aid and input support programs too often lead to market distortions. The top innovations of the IARCs seem to address the issue of pests and diseases more (14% of responses) than that it is mentioned as an important problem by FOs (5%) and intermediaries (6%). Pests and diseases are a very big problem for farmers in East Africa (especially Maize Lethal Necrosis (MLN)), but since Table 3 gives the overall Africa picture this is evened out. CIMMYT has been quick to react to MLN and set up collaboration with KARI and *icipe*, among others, to come up with resistant varieties and crop management practices. Surprisingly, FOs did not mention striga as a major problem though IARCs offer very elaborate packages on striga control. Lack of access to and availability of drought resistant maize varieties were found problems for farmers, resulting in organizations promoting crop diversification to more drought resistant crops (sorghum, millet, cassava, sweet potato, etc.). A very different perception was recorded on "poor soil fertility" and "low yields" that were raised by only 1% of FOs while this ranked top for researchers (10-14%). Even though poor soil fertility "is" a big limitation to improved production, farmers perceive other problems (e.g. access to inputs and marketing) as much more pressing.

Table 3: Major challenges for farmers according to FOs and intermediaries, and key problems top innovations of IARC address for maize in Africa

Main challenges: Maize	FO (%)	Intermed. (%)	IARC (%)
Access to and quality of seed	16	14	5
Marketing	10	8	5
Access to credit or finance, high production costs	9	5	5
Post harvest processing or storage	8	8	5
Tools, machinery and irrigation equipment	8	3	2
Access to, quality and use of fertilizer and other inputs	7	7	7
Institutional, regulatory and policy issues	6	12	2
Drought, flood, any climate related problem	6	8	5
Pest and diseases (incl. rodents, animals)	5	6	14
Training, knowledge, knowhow, awareness	5	8	7
Cultivation practices, weeding and harvesting	5	3	7
Social issues- theft, adulteration, crime, conflict	4	5	0
Natural resources- land and water availability	4	4	2
Transport and infrastructure	4	1	0
Labor (incl. shortage, price)	3	1	2
Poor soil fertility	1	3	10
Low yields and poor quality	1	3	14
Nominations=	*199*	*119*	*42*

The dataset for other crops, such as cassava, potato, beans and sorghum, show a better balance between the challenge of farmers to access quality seeds and the top innovations that address that (Annex 2). Nevertheless, also for these crops, farmers are more worried about adding value and marketing their crops, than to increase yields.

Table 4 shows the main challenges related to goat rearing using codes specific for livestock. Major challenges raised by FOs were 'diseases and parasites' (especially high kid mortality rates), social problems - especially conflict over grazing land, and feeding (especially shortages during the dry season). From the top innovations documented, IARCs seem to focus a lot of work on fodder, which strongly matches a major FO problem. The top innovations of IARCs address diseases and pests only to a limited extend, probably because much of the health related challenges may already be addressed by available knowledge and medicines without requiring more new research. Innovations to address marketing challenges (especially unstructured markets) seem to be demanded by farmers. There was some reference made by FOs to local breeds not being big or productive enough. However, rather than promoting exotic breeds, a common mechanism to improve productivity, FOs (in particular from North Africa) demand a shift of priorities to improve local breeds which are considered more robust. Similar to the example of maize, IARCs' top innovations seem to address low productivity (milk and meat) whereas this was ranked rather low by FOs (4%).

Table 4: Major challenges for farmers according to FOs and intermediaries, and key problems top innovations of IARC address for goats and dairy goats in Africa

Main challenges: Goats and dairy goats	FO (%)	Intermed. (%)	IARC (%)
Animal health diseases and parasites	20	14	5
Social problems (theft, fire, conflict, etc.)	15	12	5
Feeding (pasture, concentrates, etc.)	13	14	55
Access to land, natural pasture	11	8	
Marketing (incl. road infrastructure)	7	12	5
Breeds	5	4	
Institutional, regulatory, policy issues	5	4	
Drinking water for animals	4		
Veterinary services and medicines, vaccines	4	6	
Low productivity (milk, meat, etc.)	4	1	14
Training, knowledge, know-how, awareness	4	4	5
Low farm gate selling price for products	2	4	
High input costs, credit	2	2	5
Drought, flood, climate	2	4	9
Nominations=	*55*	*49*	*22*

The interviews targeted representatives of farmer organizations, and not individual farmers. In order to have a complete picture, the study analyzed the work of the eRAILS projects which compiled data on farmer problems based on individual farmer interviews (1061 households) in eight African countries (Annex 8). The eRAILS data shows that most individual farming households require help with vegetables, livestock and fruit cultivation (Table 5). Fruits and vegetables generate most problems to farmers while most staple crops (cereals, legumes) seem to be less problematic. Many IARCs are focused on staple crops (maize, rice, etc.) while vegetables are only dealt with by AVRDC. Concerning livestock, farmers requested help mainly on poultry keeping. The GFA study did not consider broilers or layers, as they fall outside of the mandate of the IARCs. The sampling methodology did not allow for much documentation of household chickens when interviewing FOs, as farmers were generally not organized around this commodity. Household chickens are captured in some interviews with NGOs, particularly in Southern Africa, where they support vaccination against Newcastle Disease.

Table 5: Information requests to solve a problem per commodity by households in eight countries (eRAILS data)

Vegetables	Fruits	Cash crops	Root & tubers	Cereals	Legumes	Banana	Others	Livestock
23%	20%	8%	7%	6%	4%	4%	7%	22%

The FOs and intermediaries were asked in what agro-ecological zone (AEZ) their farmers operate, and the IARCs were asked what AEZ their innovation targets. Four AEZ were distinguished based on the length of growing period, and the results are shown in Table 6. Results indicate that the top innovations of the IARCs are most suitable for the semi arid and sub-humid areas, and that less attention is given to the arid areas. This does not match with the data from FOs and intermediaries showing a greater spread, especially into arid and humid zones. It is important to note that any innovation should suit the local agro-ecological zone, as well as local traditions and socio economic conditions. However, during the interviews it was felt that IARC found it difficult to assign an innovation to a specific AEZ, raising questions on the design of those innovations to particular conditions (socio-economic, altitude, etc). Dissemination partners will be helped a lot with good information on the suitability of innovations to particular conditions.

Table 6: Agro-ecological zones where farmers operate and where top innovations focus

	FO (%)	Intermed. (%)	IARC (%)
Arid	10	11	1
Semi arid	36	37	61
Sub humid	40	42	31
Humid	14	10	7
Nominations	*313*	*374*	*84*

Supply of innovations

Annex 3 shows the list of selected top innovations. In this section they are categorized into different types of innovations (Figure 3). Most top innovations were focused on improving varieties, to enhance drought and pest resistance (mainly IITA, ICRISAT, ICARDA and others), and nutritional value (about six innovations of AVRDC and CIAT (bio-fortification)). This is not surprising looking at the history, infrastructure and competitive advantage IARCs have to do that kind of work. Technologies not directly related to varieties, such as repellents or bio-pesticides (*icipe*), vaccines (ILRI), processing techniques for cassava (IITA), or metal silos to vacuum-store seeds (CIMMYT) ranked high (17%). Many of the innovations on improved cultivation practices revolved around integrated soil fertility management (CIAT, IITA) and micro-dosing (ICRISAT). Conservation agriculture with or without trees (ICRAF, ICARDA, CIMMYT) and (supplementary) irrigation were also put into this category. Innovation platforms (IITA, ICRISAT) or Public Private Partnerships (AVRDC) and crowd-sourcing systems (Bioversity, see also Table 7) are important innovations to improve access to seed, inputs and markets. However, when realizing that access to markets is the major challenge for farmers, more research should be done to understand markets, or on development of innovations that add value to production.

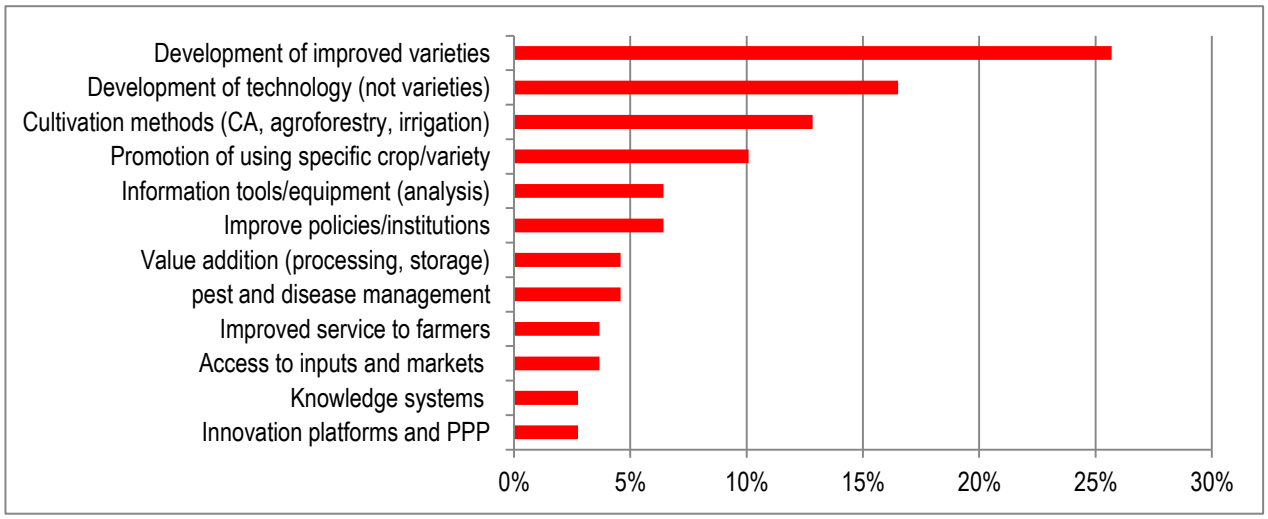

Figure 3: Types of top innovations supplied by IARC

The regional reports (Annex 4, 5, 6 and 7) include a selection of innovations that match well with the farmers' needs. The most important criteria according to farmers (market potential, comparative advantage, affordability, profitability and low risk, see Hypothesis 3) and some additional criteria (climate change, innovativeness and gender sensitivity) were used to select these innovations. Two cases with a high relevance to climate change are presented in Table 7.

Table 7: Examples of matching cases

Case	Key farmer problem addressed	Description of the innovation	Unresolved issues
Evergreen agriculture Conservation agriculture with trees (CAWT) – promoted by ICRAF the World Agroforestry Centre in West, East and Southern Africa 	• Low soil fertility • High cost of inputs • Lack of access to inputs, • Low crop yields • Risk of investing in inputs	The use of *Faidherbia albida*, an acacia native to Africa fixes nitrogen with its roots and drops nitrogen-rich leaves during the rainy season thereby fertilizing the soil. The concepts grounds on current farmer practices. It is highly climate relevant and helps to reduce the temperature in the field. Leaves can serve as mulch or as fodder for animals in the dry season. The tree is ideal for intercropping with any other field crops.	How do we get the know-how and seedlings to farmers? How do you make trees affordable?
Seeds for needs Bioversity International, promoted in East Africa Crops: barley, durum wheat sorghum, cowpea, pigeon pea and common beans. 	• Access to seed • Adapted seed for various farming conditions • Drought resistance • Good yield with low inputs	Crowd sourcing involves thousands of farmers in seed testing. Old varieties of gene banks are taken back to farmers' fields and compared with modern varieties. Farmers test several varieties and retain the best mix of varieties. The testing takes place in farmer fields on hundreds of locations. The concept is based on seed sharing. Thus, farmers do not depend on a formal seed sector to multiply seed.	Research is still ongoing on various issues. Seed exchange across country borders? Further scaling-up after research?

Even though a large number of innovations match with the perceived needs of farmers, it has to be concluded that IARCs are obviously not addressing the needs of farmers completely. This is because the major needs of farmers are related to access to good and affordable inputs and services (seeds, planting materials, advice, etc.), and these are primarily outside the mandate of research centers.

3.2 Adoption of innovations

In order to assess whether innovations can easily be adopted by smallholders farmers, it was necessary to find some mechanisms to characterize the farmers. The study reviewed the following criteria in this context: farmers' resource status, land available on farms, production level, input application level, investment cost for innovations, production cost and services offered to farmers.

Hypothesis 2

Innovations are affordable to farmers

Table 8 shows the use of inputs by farmers according to the farmer organizations. It was found that around 65% of farmers used no or very little chemical pesticides and fertilizer for crop production or medicines and concentrates for livestock. While this low use of inputs needs to be recognized, still between 25 and 30% farmers use moderate levels of chemical inputs according to FOs. The interviews revealed that about half of the farmers applied none or very little organic fertilizer (either animal manure or compost), even though it is often more accessible and affordable than chemical fertilizers. The diversity in use of inputs indicates that agricultural innovations of IARCs should be able to accommodate this.

Table 8: Use of inputs by farmers according to FOs

Use of chemical pesticides	(%)	Use of chemical fertilizer	(%)	Use of organic fertilizer	(%)
None	35	None	32	None	22
Very little	30	Very little	28	Very little (< 1/2 TLU/ha)	28
Moderate	25	Moderate	31	Moderate (1 TLU/ ha)	25
High	10	High (> 100kg/N/ha)	9	High (2 TLU/ha)	20
Nominations=	*202*	*Nominations=*	*194*	*Nominations=*	*184*

Table 9 summarizes some farmer and innovation characteristics, such as yield improvement with top innovations according to the scientists, the farm size of the FO members and the resource status of farmers. IARCs state largely (80%) that their innovations increases yield considerably[10]. Rather few innovations (14%) have a similar or lower yield level compared to existing farmers practice. These may refer to innovations in the sample that address other issues (e.g. marketing platforms, policy platforms etc.). 23% of farmers have farm sizes of less than 0,4 hectares, and only 17% exceed 0,4 hectares. This shows that many farms are precariously small and thus these people actually need various sources of income to earn their livelihood. Considering the high population growth (2 to 3%), and high rates of urban farming in most African countries, the size of farms is likely to shrink further dramatically. The challenge to optimize farming from small (rural and urban) and marginal lands needs to be tackled and agricultural research has an important part to play. Table 9 also shows that most innovations of IARCs target the resource poor farmers (71%) and the majority of FOs (61%) sees their members as resource poor as well. 21% of top innovations are thought by the scientists to be suitable for very resource poor farmers. The resource status of the farmers represented by the farmer organizations interviewed show more spread than that the innovations target.

Table 9: Farmer and innovation characteristics- yield improvement IARC innovations, farm size and resource status

Yield level	(%)	Farm size	(%)	Resource status	IARC (%)	FO (%)
Lower (-15%)	1	<0.4 ha	23	Very resource poor	21	13
Equal (+- 5%)	13	0.4 to 1.6 ha	47	Resource poor	71	61
Higher (+15%)	42	1.6 to 3 ha	14	Relatively well resourced	7	26
Much higher (+30%)	37	> 3 ha	17	Well resourced	2	1
No information	*8*	*N=*	*217*	*Nominations=*	*88*	*255*

What contributions farmers can make and what is affordable to them is difficult to determine. The questionnaires contained a question on the willingness to pay of farmers, but because it was very difficult to answer this question it was left out of the analysis. According to international statistics, 20% of world population lives on less than 1,25 US$ per day. This farmer group can only adopt the cheapest innovations, say up to 50 Euro per hectare. It is assumed that farmers who are better resourced may be

[10] The team also made an attempt to collect current yield levels of farmers. However, the data proofed to be too scattered for a reliable analysis. More productivity data on crops and livestock is available via the eRAILS website see www.erails.net/

able to afford innovations of up to 100 Euro per hectare. Interestingly, one-third of the scientists could not provide any information on the benefit-cost ratio of the innovation, and the large majority admitted they were guessing. Similarly, information on the investment costs, when available, was not from independent sources. Nevertheless, Table 10 shows the investment range for each innovation, bearing in mind that these are rough estimates. According to this assessment, only about 30-40 % of the current top innovations are affordable for the (very) resource poor. Costs per head can be reduced considerably for some of the innovation when farmers share technology. However, most of the innovations will require some financial support from intermediaries or Governments for farmers to experiment with it themselves.

Table 10: Investment required for top innovations

Investment range Euro	Crops # per ha	Livestock # per head	Trees, other # per ha
<10	8	5	4
10-50	17	4	2
51-100	6	5	3
101-400	12	5	4
401-1600	2	2	3
>1601	7	1	1
No information or n.a.	9	3	1

It can be concluded that only a limited number of innovations of IARC seem directly affordable for farmers. Figure 4 illustrates that the need for innovations is high for the very resource poor, but the number of suitable IARC innovations for the very resource poor is rather limited. The analysis of farm sizes and resource status indicate considerable differences among farmers. Surprisingly, relatively low use of manure and compost suggest that more needs to be done to promote crop-livestock-systems. Many more tailor-made solutions for poorer and advanced farmers are needed. Furthermore, to improve access to innovations, more social organization solutions, such as, sharing arrangements, cooperatives, better management of common resources (e.g. pastures, forests, etc.) micro credits, improved credit services, Government programs, donor assistance etc. are needed to reduce costs and make innovations affordable. Without such additional financial or social offers, many of the current top innovations are very likely to remain distant dreams for farmers.

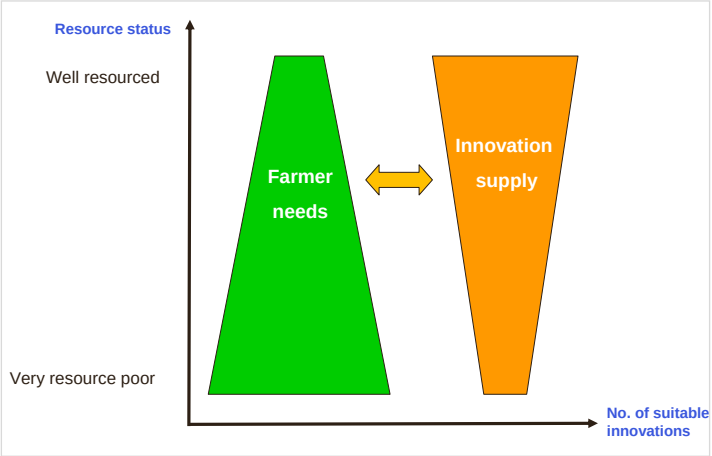

Figure 4: Illustration of supply and demand for innovations

Hypothesis 3

Farmers and scientists share similar views on key criteria for design/adoption of innovations

All stakeholders were asked to select up to four criteria that are important for an innovation to be adopted. Figure 5 shows that all stakeholders rated the importance of the criteria very similar. The highest ranking criteria were big comparative advantage, followed by medium profitability at low risk and then affordability. Surprisingly, compatibility with local traditions ranks rather low for all actors. Last in the preference ranking comes "complexity and broadened farming systems" suggesting that all actors prefer simple, easy solutions. However, considering that climate change will increase production risks in the future, it would seem an advantage to create more complex, more resilient systems. Regarding the top ranking criteria on yield advantage, this finding seems as a contradiction with the earlier discussed open questions analysis on commodities where farmers ranked yield generally very low. It may be that FO representatives distinguished between the general case of any innovation discussed here under this question and the very specific cases of individual commodities. Farmer organizations rate labor saving

and simplicity much higher than intermediaries and IARCs. The selection of these two criteria may have been endorsed by organizations with many female members, as this is an important element of gender sensitive innovations which will be discussed in the next hypothesis.

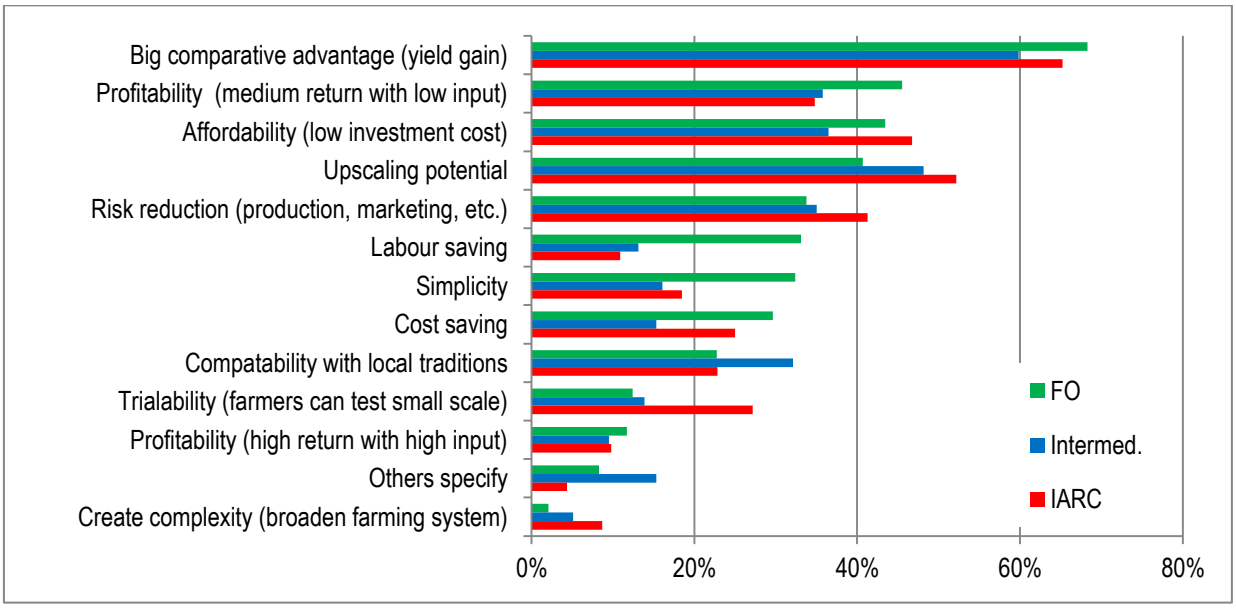

Figure 5: Catalogue of criteria: the most important criteria agricultural innovations should fulfill for successful adoption by smallholder farmers

The results indicate that the hypothesis "actors share similar views on key criteria for design of innovations" can be confirmed. However, there are a number of contradictions with the other study findings. Participants of the final workshop, especially farmer organizations, contested this conclusion. They criticized that scientists interacted too little with farmers and thus did not know farmers' realities sufficiently well. However, it should be realized that it is very difficult for scientists to steer, for example, a breeding program in the context of conflicting criteria (e.g. taste vs. yield). It is recommended to offer a range of options to farmers and have them select themselves what they prefer.

Hypothesis 4

Gender equity is an important criterion for actors in the innovation system

The role of women in agricultural value chains was explored for several commodities. The findings indicate that in general women play a dominant role (not necessarily to the exclusion of men) in field preparation, weeding and harvesting. Sales was also mentioned fairly frequently, but mainly related to food crops (not livestock or cash crops). With some crops, such as cassava, on-farm processing was another important task. Livestock related tasks mainly involve caring for livestock (feeding, identifying sick animals, milking, fetching animals, etc.), but decision-making regarding selling of large livestock is generally male-dominated, though some of the interviewed FOs had active female livestock farmers as members. On the whole, stakeholders seem to be aware that women dominate agricultural activities and that innovations need to take this into account. Both IARCs and intermediaries indicate that they give a high to very high attention to gender (60-75%) (Annex 2). Between15% and 30% stated that the attention on gender equity was only medium. In general, IARCs and intermediaries claim that they take steps to ensure women are represented in beneficiary groups and trainings. It is important to note that gender also involves other vulnerable groups such as youth and elderly.

Besides the specific questions in the surveys, gender played a major role in the group discussions in all workshops. The following was discussed and shared:

- Women are different from men because they have much more difficulties to access credit from formal institutions, have limited access to land and traditionally they are excluded from decision making.
- Technologies in production, processing and marketing need to be re-engineered to account for women's capacity to handle certain tools and equipment.
- It is particularly important not to increase workloads of women as they are generally doing any agricultural activity on top of their household chores. This can be the case when labor intensive crops are promoted.
- It was also highlighted that gender equity should not be seen as a confrontation between men and women, but it is rather the search for complementarities in the accomplishment of different

tasks on or outside (non-agricultural tasks) the farm. This could be addressed through training and education for women and men to compensate for historical gender roles and stereotyping.

It can be concluded that gender equity is an important criteria for actors in the innovation system. IARCs and intermediaries recognize that their innovations should, where relevant, promote gender equity, though a number of them are not gender specific. The importance of women in agricultural value chains was also confirmed.

Hypothesis 5

Farmers are the major stakeholder in the design and implementation of IARCs' research

The role of farmers in the design and implementation of research programs was assessed by looking at the (potential) involvement of farmers in the innovation. The origin of most of the top innovations was a transfer from another region or institute (44%) (Annex 1). Breeding work improvement comes second with 36% and adaptation from farmer-based innovation comes third with 27%. This shows that already today good ideas of farmers provide a major input in innovation development. Only about a quarter of innovations are actually genuine new ideas (26%), and adaptations from the private sector (e.g. fertilizer micro dosing) also play a minor role (7%). On average it takes almost nine years for an innovation to get developed. However, a good proportion (39%) even takes 8-15 years (Annex 2). Most of the work is taking place both on station (54%) and on farm (73%) at the same time. Some of the innovations (5%), however, are developed outside the farming sphere (office, laboratory, other). The level of farmer control in the innovation development process is still limited. In only 11% of innovations, farmers had full control. However, some level of farmer control is already very widespread (62%). Nevertheless, 24% of trials are fully researcher controlled and in 3% of the cases no farmer is involved at all.

Figure 6 shows what stakeholder has the most influence on the research agenda according to the IARC. Researchers are seen as the primary stakeholder, followed by farmers, and donors come third. The private sector apparently has very little influence on the kind of research the IARCs are doing.

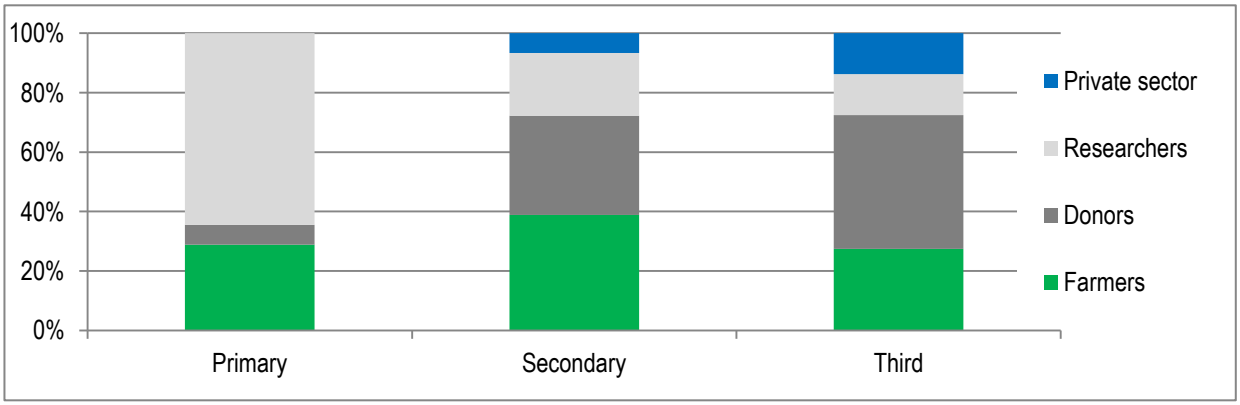

Figure 6: Priority of stakeholders that influence the research agenda

It can be concluded that the hypothesis is partially confirmed. Farmers are involved in the development and testing of innovations, but they are not the major stakeholders. The extent to which farmers can play a role as partners in the development of innovations rather than being recipients of the end product should be explored. This finding suggests that there is still room to increase the influence of farmers on research. A greater level of farmer involvement is certainly likely to influence the level of adoption positively. However, IARCs need to be open to consider the views of farmers as their perceptions on the major challenges can differ considerably (Section 3.1).

3.3 Information exchange

Hypothesis 6

The ways information on innovations is shared matches the requirements of farmers

Farmer organizations and intermediaries were asked how innovations should be promoted to best reach farmers, whereas IARCs were asked how they disseminate their innovations. Table 11 shows that all actors agree that face-to-face interactions with farmers are the best way to promote innovations. Farmers rely on other farmers as a vital source of knowledge and often local leaders play a crucial role in building trust, in particular with outsiders. This can also be confirmed from the eRAILS household data where farmers said they first turn to their neighbor for advice (Annex 8). Farmer to farmer exchange visit is quite popular among the farmers given the fact that it is a lot easier for a farmer to learn from another farmer than from a researcher. Face-to face interactions are crucial and ways should be found to increase this

type of extension, even if it may be quite costly. Access to media is variable but radio remains the most dominant medium for reaching out to farmers especially in rural areas. Most farmers have mobile phones but they mainly use them for voice communication and money transfer and not as a source of agricultural information. This is a new and potential future avenue for disseminating agricultural innovations if well utilized. Only 7% of scientists use mobile phone applications to disseminate their innovation, whereas FOs and intermediaries seem to be much more confident that mobile phone applications would be useful for dissemination. High illiteracy levels especially in rural areas imply that penetration by publications in local languages is useful but should be accompanied by strong extension messages in order realize intended impact.

Table 11: Responses (multiple choice) on best ways of disseminating innovations to farmers (n.a.= not applicable)

	Means of dissemination	FO (%)	Intermed. (%)	IARC (%)
Face-to-face	Farmer training	86	83	74
	Demonstrations	78	80	76
	Farmers days / field days	73	77	66
	Farmer to farmer exchanges	61	66	52
	Farmer leaders	56	n.a.	n.a.
	Farmer to farmer	25	n.a.	n.a.
Media	Radio	47	52	41
	TV	35	23	31
	Internet	30	18	45
	Mobile phone applications	21	14	7
	DVD	8	19	15
Written material	Farmer leaflets / handouts	46	55	48
	Publications in local language	33	28	45
	Magazines / newspapers	31	23	34
	Research Journals	n.a.	12	59
	Manuals	n.a.	42	52
	n=	*1000*	*824*	*632*

The eRAILS data (Annex 8, Table 4) shows that for 54% of the problems mentioned by farmers, the solution already existed for more than 20 years. This shows that a lot of knowledge on farmer problems already exists but that it often does not reach the intended beneficiary.

This hypothesis was largely confirmed as all actors agreed on the importance of several means of dissemination to promote innovations to farmers. Face-to-face interaction is considered the best way of disseminating results.

3.4 Extension

Hypothesis 7

Farmers rate advisory services they receive as adequate

Farmer organizations and intermediaries were asked to rate and explain about the quality of (extension) services by NAES, NARS, NGOs and the private sector[11]. Table 12 shows that farmer organizations are generally positive about the services NGOs provide to the farmers they represent. Especially the capacity building opportunities offered by NGOs are being appreciated. They regret the limited scope in time and location many of NGOs have for their interventions, though. Some FOs worry about the capacity of NGOs to balance their interventions well between providing support and creating dependency with project beneficiaries. FOs also mention poor coordination of interventions (duplications) among NGOs as weakness. A majority of intermediaries claim that the NARS are doing good work which responds to the farmer needs. Others claim that the NARS are inaccessible and lack resources (especially logistically) to provide services to the farmers. Intermediaries call for an urgent need to strengthen the soft skills of NARS to improve collaboration with agencies working on dissemination of innovations.

[11] The CapacityWORKS (management tool of GIZ) Instrument 11 under Factor 2 Cooperation was used to analyze the relations between key actors

Table 12: Quality of services to farmers according to FO and intermediaries

	NGO	NAES	NARS	Private sector
Opinion of FO on...	Good	Neutral	n.a	Very poor
Opinion of intermed. on...	n.a.	Neutral	Neutral	Good

FOs and intermediaries rated the services of the NAES as medium, however, the analysis of coded answers suggest otherwise (Figure 7). The respondents largely share the opinion that the NAES provide low quality services and that they lack competent and motivated staff. Many interviewees assign this to a lack of resources of NAES to reach the farmers and to stay motivated. Others suggest the NAES staff needs to build capacity in dealing with more crops than just staple crops. This involves more attention for cash crops and for new approaches and tools to bring innovations into routine use. Around 10% of the FOs state that they appreciate the support of the NAES despite the fact that in many cases they need to visit the NAES office themselves, or have to pay for NAES staff to come to the field. Another frequently mentioned explanation by NGOs is that farmers do not hold NAES accountable and that there is a need to sensitize farmers about what they should expect from NAES (see Box).

Specific comments from East Africa:

"The Kenyan government adopted a demand driven extension service, but a large part of farmers are not yet made aware that they should demand services from the responsible officers."

The majority of respondents from Uganda were very critical about their NAES. The Ugandan government is currently reviewing the National Agriculture Advisory and Development Services (NAADS) which was conceived as a demand-driven approach and largely publicly funded with services provided by the private sector, after it failed to realized the desired impact[12]

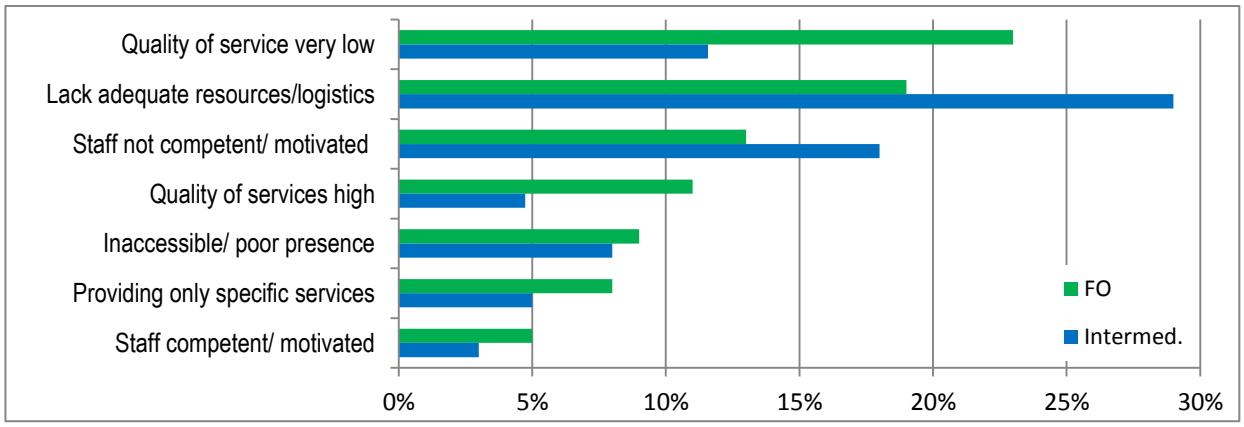

Figure 7: Responses of FO (n=179) and intermediaries (n=190) when asked about the quality of services of NAES

Even though the intermediaries rated the services of the private sector to farmers as good, the open answers give a different picture (Figure 8). More than 20% of FOs and intermediaries mention cases where the private sector is exploiting farmers: e.g. the sales of fake inputs, market monopolies and extortion. This is resulting in mistrust towards the private sector. Services are concentrated around urban areas and are mostly reserved to the better-off farmers. But numerous positive examples of good after-sale services are also given, thereby praising the private sector's sensible approach to extension and good training capacities. However, the private sector still tends to focus on one product only, thereby jeopardizing the optimization of resources for the entire farming system. There is also recognition that government interventions, such as subsidized inputs and fixed sales of produce are making it very risky for the private sector to operate.

[12] http://www.ifpri.org/publication/impact-uganda-s-national-agricultural-advisory-services-program

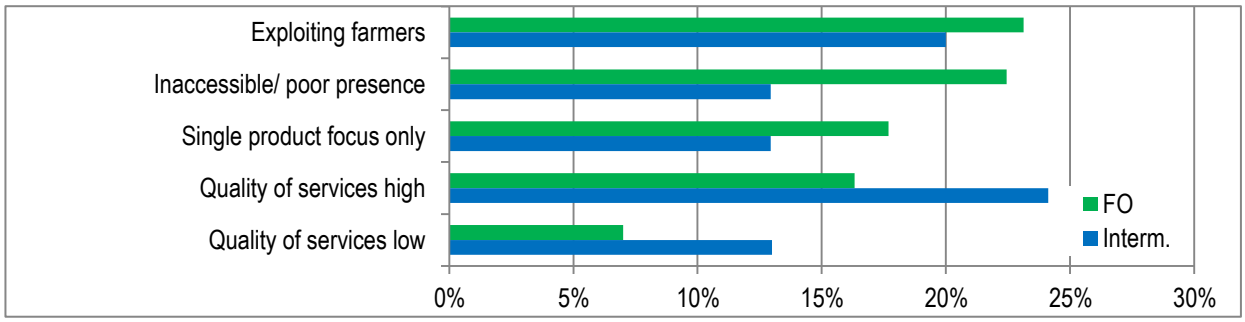

Figure 8: Responses of FO (n=147) and intermediaries (n=170) when asked about the quality of services of the private sector

According to the views of farmer organizations and intermediaries, it can be concluded that farmers are not getting the services they need to improve their farming systems. They are clearly unhappy with the services of the NAES, claiming that they are poorly resourced, not present in the field and staff is not skilled enough to add value to their farming enterprise. NGOs and private sector are said to provide good services, especially when it comes to training and exposure to innovations, but access to those services is difficult. The results indicate that farmers appreciate the knowledge of the private sector on cash crops, whereas the NAES typically know a lot about traditional staple crops. This suggests that good collaboration between the NGOs, NARS, NAES and private sector would be very useful to the farmers.

It is important to note that during the presentation of the results at the final workshop there were mixed reactions on the results; many participants were happy that criticism or praise were finally shared, but on the other side, participants found it very confronting, raising the question if the results can be presented without doing in-depth research on the origins of such comments.

Hypothesis 8

Effective linkages exist between different actors in the innovation system

Farmer organizations and intermediaries were asked with which IARC they have collaborated so far, and what were the strengths and weaknesses of this collaboration. In return, the IARC were asked about the strengths and weaknesses of working with the NAES, NARS, NGOs and the private sector as a partner.

Figure 9 shows with what IARCs the FOs and intermediaries have collaborated. It should be noted that out of the 152 FO interviews, 102 FOs (67%) stated that they never worked with IARCs. This is not surprising since IARCs usually approach farmers through intermediary organizations, which reduces their visibility. However, 62 out of 141 intermediaries claim never to have undertaken activities with IARCs, suggesting that there is still scope for building a bigger partnership base.

Figure 9 shows that ICRISAT, IITA, CIAT and *icipe* are best known by FOs and Intermediaries. This is despite the fact that most activities of *icipe* are concentrated in East Africa only. Many more intermediaries than FOs worked with ICRAF because few FOs are organized around agro-forestry practices.

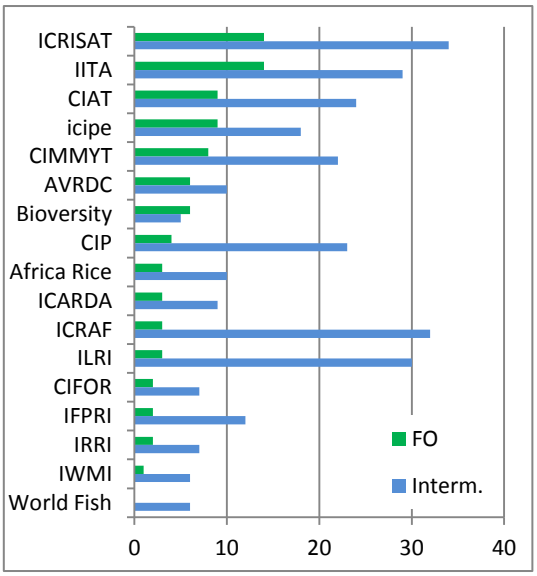

Figure 9: Number of cases FO and intermediaries claim to have collaborated with a specific IARC

Table 13 shows that the majority of FOs and intermediaries think that the approach of the IARCs does not meet the farmer needs, even though the inverse is often mentioned among the top strengths of the IARCs. It was mentioned that IARCs focus too much on the research methodology than on the impact, or focus rather on the need of the donor than that of the farmer. FOs appreciate the training opportunities and high quality standards of IARCs, and the intermediaries appreciate also the openness to share and test germplasm, and the opportunities provided for networking and fund acquisition through IARCs. FOs like to be seen as equal partners and share in the funding for activities, and they claim IARCs can do much more to connect them to interesting partners or knowledge from abroad. Intermediaries would like the IARCs to be more accessible and, for example, have more than one open day per year. They also feel that they have little influence on project designs and budget sharing, and that there are ownership issues (who plants the flag?) when working with some IARCs. Data from 10 GIZ projects indicate that

IARCs hold very relevant information, but that collaboration is difficult due to poor accessibility and high fee rates of scientists (data not shown).

Table 13: Top strengths and weaknesses of IARC according to FO and intermediaries

	Strengths	Weaknesses
FO	25% Approach meets farmers needs 19% Offer good training opportunities 13% High professional standards	32% Approach does **not** meets farmer needs 14% Poor/no funding to FOs 14% Poor facilitator of partnerships
Intermediaries	17% Provide good technologies 13% High professional standards 10% Approach meets farmers needs 10% Good sharing of germplasm 9% Opportunities for networking/acquisition	24% Poorly accessible 19% Approach does not meet farmer needs 16% Poor partner (no mutual respect- and poor feedback on collected data)

The regional representatives of IARCs rate their collaboration with the intermediaries as medium (NGOs, NAES, private sector) to very good (with NARS only). NARS are generally seen as a good partner with whom germplasm is exchanged and field days are organized. NARS also have an important mandate to test and multiply, for example, seeds from IARCs before they are officially released. Still 15% of responses hint they are a poor partner, highlighting that NARS rely too much on funds of IARC to collaborate (Figure 10). Collaboration between IARCs and NARS seems to be stronger in West Africa than in East Africa. Lack of adequate resources for field visits or experimentation is most frequently mentioned as the reason hampering collaboration with NARS and NAES. Many of the IARCs regional representatives characterize the NAES adhering to poor quality standards and working with outdated approaches to extension. IARCs call for a revision of the way NAES operate, starting at the universities where, for example in Kenya, the “poor” students go to the “extension” department, and the “better performing” students can do research. Developing methods for extension is part of social science research and NAES should do that much more in collaboration with NARS. One of the regional IARC directors claims that mutual respect is the basis for good collaboration and IARC staff should invest much more in person to person contact with the government staff.

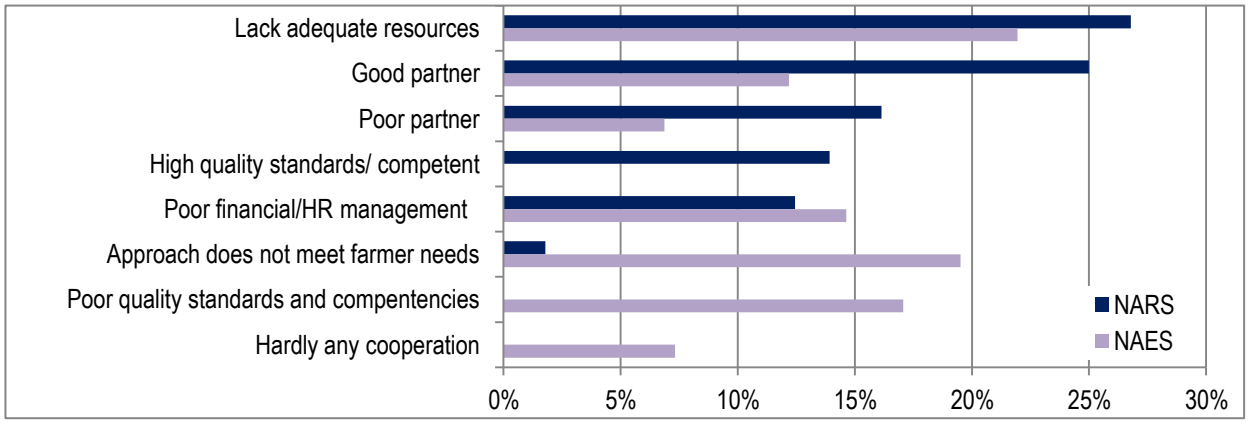

Figure 10: Responses of regional representatives of IARC on their collaboration with NARS (n=56) and NAES (n=41)

Figure 11 shows the responses of IARCs on collaboration with NGOs and the private sector. Both the NGOs and private sector are generally regarded as good partners. IARCs mention that individual NGOs often lack resources, or flexible enough funds to accompany an entire research-development cycle. Some bad experiences with local NGOs were mentioned. Scientists claim that some NGOs lack in-depth knowledge about the innovations and the way to upscale them adequately; taking the research results out of context and thereby failing to provide feedback to the researchers on the dissemination process. There are few NGOs working on livestock. The IARCs regard the private sector as an important player to upscale innovations, but complain that they leave out remote rural areas and they are not interested in seed of Open Pollinated Varieties (OPV). Then again, the private sector is more interested in tradable commodities, whereas the CGIAR works mostly on staple crops for food security.

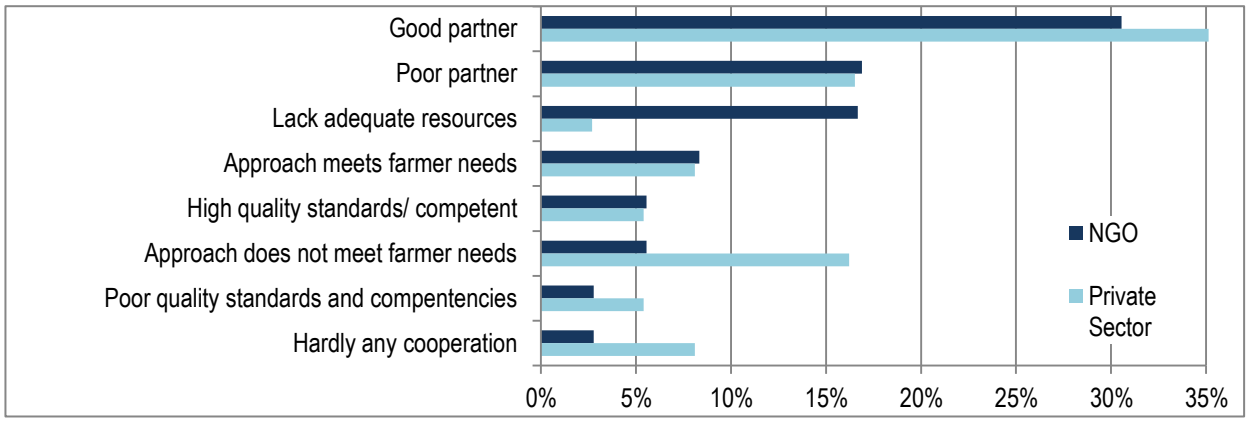

Figure 11: Responses of regional representatives of IARC on their collaboration with NGOs (n=36) and private sector (n= 37)

Looking at the perception of the actors about the collaboration with each other, it can be concluded that there is considerable room to improve trust, understanding and true partnerships to support the smallholder farmers in Africa. Intermediaries see the approach of IARC towards working with farmers more often as weakness than as strength. IARCs are rather negative about the collaboration with NAES, generally positive about NARS (despite lack of resources) and they seem to get used to working with the private sector. Therefore, hypothesis 8 has to be rejected.

Hypothesis 9

IARCS innovations have been up-scaled adequately

This hypothesis was answered by looking at the diffusion potential of innovations, the actors involved and bottlenecks for adoption. When the IARCs were asked about who contributed most to up-scaling of their innovations, they replied that the NARS (36%) and NGOs (34%) had been most instrumental. Only 19% selected NAES, 9% the private sector and only 3% ticked GIZ. This confirms the findings under Hypothesis 8 that IARC do not rely much on the NAES and the private sector for up-scaling of their innovations. Almost two-thirds of the top innovations were considered at a stage of up-scaling. According to the scientists, half of the top innovations had a big, or very big diffusion potential, being suitable for potentially all farmers in the country. 16% of the innovations were thought to have a small or very small potential to reach many farmers. However, it becomes clear that the interpretation of “big diffusion” potential is relative when one looks at the number of households that adopted a specific top innovation (Table 14). It can be seen that 58% of respondents state that less than 5,000 household have adopted their innovation, and only 28% of the innovations reached out to more than 20,000 households. It is important to note that for most IARCs it was difficult to give an exact number, hence 30 surveys were without an answer on adoption. Then again, time is an important factor when looking at adoption. It can easily take ten years between the designing of an innovation until it is ready for large scale uptake. In addition, some innovations have the potential to be taken up more swiftly than others because they are more affordable, or governments have created favorable conditions for uptake, for example.

Table 14: Responses on the number of households that adopted a specific innovation

Number of households that adopted the innovation	Responses (%)
0 - 100	11
101 – 1 000	27
1 001 – 5 000	20
5 001 – 20 000	14
20 001 – 300 000	28
Total number of answers	64
Number of surveys without an answer	30

Figure 12 shows the coded responses of the IARCs' regional representatives on the major bottlenecks for adoption of innovations. Interestingly, the approach of IARCs to up-scaling and collaboration with farmers and partners, as well as poor design of innovations, rank respectively first and fifth. A lack of understanding of the public sector delivery system, and a lack of support for farmer innovations were mentioned by the regional representatives as a weakness of IARC. This may be explained by the fact that the scientists' performance is largely evaluated based on the number of peer reviewed articles that are published (91%), and hardly at the engagement with other actors, in particular with farmers (13%) (Table 15). The second most important bottleneck is the poor enabling policy environment in which innovations are disseminated, especially when it comes to crops that are important for food security.

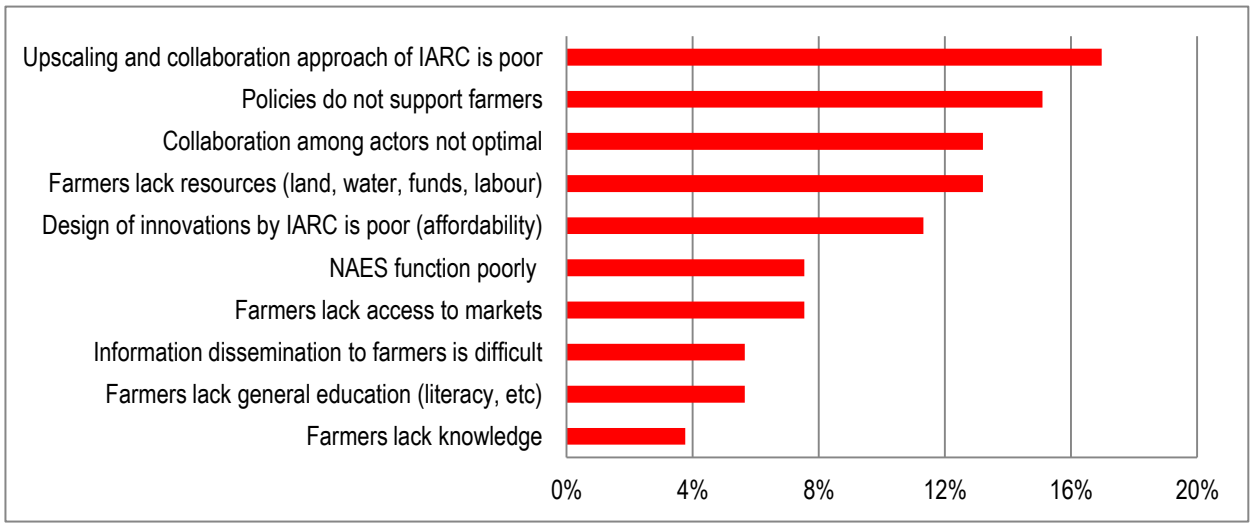

Figure 12: Bottlenecks preventing uptake of innovations according to IARC regional representatives (n=53)

Table 15: Criteria for annual scientist evaluation (n=89) and responses of regional representatives whether the center should increase its mandate to include dissemination and extension as well

Evaluation criteria	Responses (%)		Increase mandate?	Responses (%)
Peer reviewed publications	91		Yes	9
Acquisition of funds	70		Yes to some extend	39
Quality of the scientific work delivered	65		No	35
Perceived impact of the research	57		Already have the mandate	17
Novelty of the research	44			
Engagement with other actors of the value chain	30		Nr of answers	23
Engagement with farmers	13			

Table 15 also shows that 35% of the regional representatives think that their center should not increase their mandate of research. They claim not to have any competitive advantage to do extension, and it requires a lot of resources and different skills. Others consider the existing dissemination mechanism as poorly functioning and advocate for more adaptive research, thereby suggesting that one needs to understand dissemination to come up with good innovations. Some respondents claim that they are involved in very successful research for development projects where the border between research and development is not very clear.

Based on the responses collected from the IARCs, it can be concluded that the innovations of IARCs are not yet up-scaled adequately (hypothesis 9 partly confirmed). Most of the top innovations have not reached more than 5000 households each and the diffusion potential of a considerable number is rather limited according to the scientists. The respondents assign this largely to poor partnerships for up-scaling, thereby also reflecting on their own approach to collaboration and up-scaling. A constraint to successful up-scaling of technologies from IARC can also be found in the fact that scientists are largely evaluated based on the number of articles they publish rather than on their engagement with farmers or extension agents.

3.5 Climate change

Hypothesis 10

Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes

The IPCC (2014) has released its fifth global report on climate change in 2014 and it states very clearly: "*Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased*." The report highlights that global temperature has risen already 0.6°C in the last forty years, and for Africa a rise of a further 2°C by 2050 is predicted according to the current most likely emission scenario (RCP 8.5). This means that warming is likely to triple in speed in the next 40 years compared to the last 40 years. This will entail very serious challenges for the world's agriculture. Successful global negotiations to curb emission are urgently needed, as farm adaptation measures cannot prepare farmers adequately to the magnitude of changes predicted.

The large majority of stakeholders consulted during this study confirm that climate change entails serious problems for farmers. Others state that climate variability has always been there (often mentioned in the Sahel), or that climate change is not among the most pressing problems farmers are facing. Increased drought, erratic rainfall, increased temperature and vulnerability are seen as major challenges in Africa (Table 16). Farmers and intermediaries confirm that the changing climate is leading, in particular, to a loss in productivity (yield or animals). Shorter growing period and increased pests and diseases (43-49%) are mentioned as second and third most common consequence of climate change.

Table 16: Frequency of climate change challenges and climate change consequences ticked by stakeholders

CC problems	FO (%)	Interm.(%)	IARC (%)
Increased drought	69	66	62
Erratic rainfall	69	78	63
Increased temperature	55	43	32
Increased vulnerability	34	57	48
Increased flood risk	32	46	15
Increased rainfall	16	15	11
Nominations	*658*	*654*	*286*

CC consequences	FO (%)	Interm.(%)
Yield, animal, productivity losses	84	98
Shorter growing period	44	61
Increased pests and diseases	43	49
Reduced flowering	30	40
Increased erosion due to floods	14	19
Damages to infrastructure	12	10
Nominations	*590*	*680*

After the FOs and intermediaries expressed the challenges climate change poses for farmers, they were asked about the coping strategies they promote among the farmers they represent. The strategies are coded and presented in Figure 13. Farmer organizations are mostly promoting ways of using water more efficiently at a watershed (water harvesting) and farm scale (e.g. drip irrigation). Intermediaries, on the other hand, rather promote the use of varieties which are better adapted to the consequences of climate change. This even ranks higher than the promotion of different crops that might be more suitable to the changing conditions. Especially in East Africa, farmer organizations claim to shift from cows to camels and from maize to sorghum. Almost 10% of the farmer organizations admitted that they were not promoting any climate change coping strategy among their members, largely because they did not know what a suitable strategy would be. It is remarkable that only 7% of the responses indicated that agro-forestry and planting trees could be a strategy to promote. The latter was analyzed in group works at the final workshop and it was concluded that there was still a need for extension and awareness raising activities, in particular of traditional practices that include the integration of trees. In addition, improved access to suitable tree species for beneficial tree crop interactions, in particular fertilizer trees, and the promotion of the multiple benefits (fuel, fodder, fuel wood, fertilizer, fruits and timber) from agro-forestry systems would improve integration of trees in farming systems. During the workshop it was also highlighted that off-farm income generation was another important coping strategy, but this was not considered in the analysis.

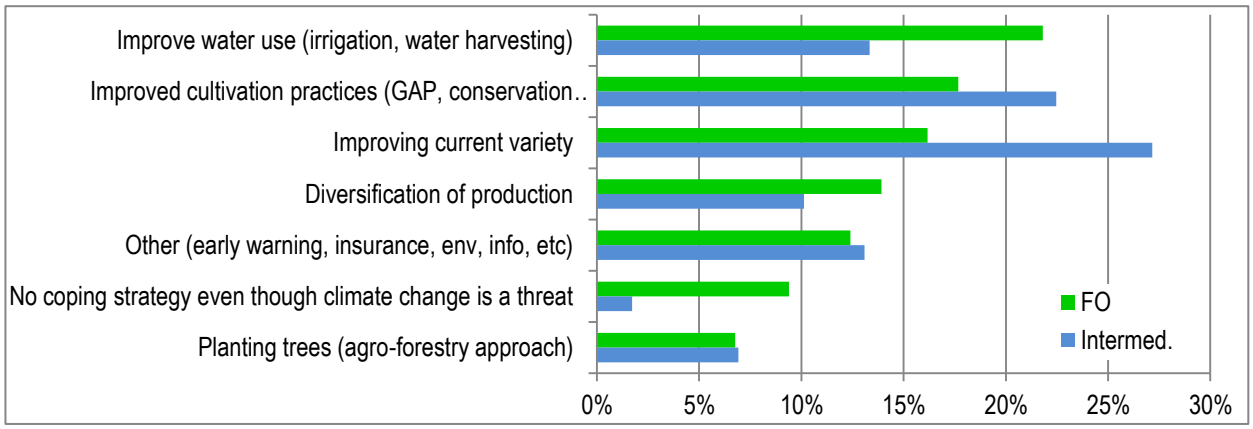

Figure 13: Climate change coping strategies promoted by FOs (n=266) and Intermediaries (n=400)

It can be concluded that hypothesis 10 is confirmed. Climate change is having a clear impact on smallholder farming systems and the actors are promoting a range of coping strategies to deal with the impacts of climate change.

3.6 Other

Hypothesis 11

Research results financed by BMZ in the past are found readily among current top five innovations of IARCs

A total of 94 research outputs were presented by IARCs as top innovations. Among these research outputs, nine were identified to have been directly funded by BMZ through GIZ-BEAF. Furthermore, 17 research outputs (18%) refer to broader programs and it appears very likely that BEAF also contributed to the development of these innovations by funding some aspect or sub-research work included in the process of innovation development. For 68 out of the 94 innovations, no trace to previous BEAF funding could be made in the document of BEAF (Kasten, 2013). Considering that the German contribution to the budget of CGIAR only constitutes 2% of the total, the BEAF score among top innovations is certainly a good achievement. Hypothesis 11 is thus confirmed.

Hypothesis 12

Research at the IARC is aligned with overall international development goals

Hypothesis 12 can be confirmed, as it seems that IARCs align their innovations with the key international development goals shared by the international donor community. On strategic level the regional representatives of IARCs rated poverty reduction impact, food security and scaling potential as the top three criteria that guide their research work (data in Annex 1). Scientists of IARCs come to a very similar ranking of development goals for their innovations (Figure 14).

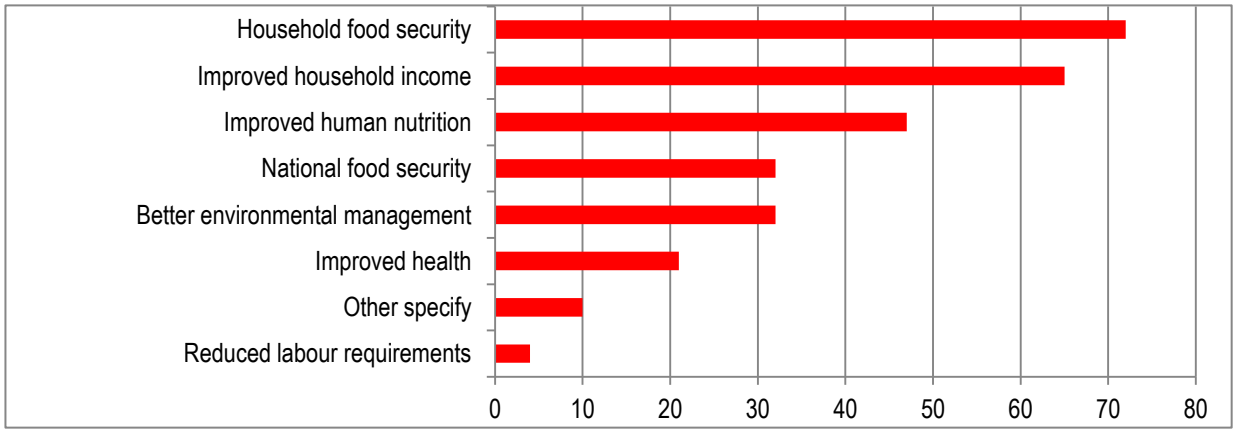

Figure 14: Scientists' goals in the innovation development process (%)

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The findings of the study helped to create a better understanding of the reasons underlying the apparent gap between available agricultural research results within the IARCs and practical farmers' needs in Africa. This was done by collecting quantitative and qualitative information from a wide range of stakeholders active in the innovation system. The method developed to assess the demand-supply match for agricultural innovations helped farmers articulate their needs and gave the IARCs the opportunity to promote innovations that contribute to improve the livelihoods of the rural poor. Moreover, the method also investigated the links between the actors on the demand and supply side, because having an innovation that matches the need will not help anyone if there is no link between the actors. Data collection was done using structured interviews where respondents were able to share their opinion on a range of themes. Even though more than 400 interviews were done over 17 countries, the results reported should not be considered representative of the African agricultural sector. Yet, they provide a broad overview of existing problems and allow a constructive discussion of possible solutions. The objective has been to "flag" issues, rather than making sweeping recommendations.

The data from the interviews were analyzed according to twelve hypotheses, and the findings are summarized in Table 17. Even though a large number of research outputs match with the farmer needs, the hypothesis can only be confirmed partially. This is due to the fact that the major needs of farmers are related to access to good and affordable inputs (seeds, planting materials, advice, etc.), and these are primarily outside the mandate of centers. Most innovations focus on improving traits of crop varieties and only a few innovations aim at improving the marketability of commodities. The IARCs offer a wide array of innovations, but several innovations are likely not to be affordable for the majority of smallholder farmers. Farmers and scientists seem to share a similar view on criteria for innovation development, and all actors seem to be aware of the need to consider gender in the design of innovations or dissemination programs. There is a general consensus that face-to-face interaction (training, demonstration, farmer exchanges) is the best way to share information to farmers. Yet, still the messages are not always reaching the intended recipients. There is considerable room to improve trust, understanding and true partnerships among key actors in the innovation system. Farmers do not rate the advisory services as adequate and also the linkages between all stakeholders are not rated as adequately developed. This results in relatively low uptake of the IARCs' innovations. It could be confirmed that climate change is having an impact on farmers, and despite the fact that a range of coping mechanisms are promoted, research is necessary to keep up with the speed of change.

Table 17: Validation of hypotheses

Hypothesis	Validation
1. IARCs are addressing key needs of farmers	Partly confirmed
2. Innovations are affordable for farmers	Rejected
3. Farmers and scientists share similar views on key criteria for design/adoption of innovations	Partly confirmed
4. Gender equity is an important criteria for actors in the innovation system	Confirmed
5. Farmers are the major stakeholder in the design and implementation of IARCs' research	Partly confirmed
6. The ways information on innovations is shared matches the requirements of key stakeholders	Confirmed
7. Farmers rate advisory services they receive as adequate	Rejected
8. Effective linkages exist between different actors in the innovation system	Rejected
9. IARCS innovations have been up-scaled adequately	Partly confirmed
10. Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes	Confirmed
11. Research results financed by BMZ in the past are found readily among current top five innovations of IARCs	Confirmed
12. Research at the IARC is aligned with overall international development goals	Confirmed

In brief, the main bottleneck for adoption of innovations by farmers is not that the innovations do not match with their needs, but it is rather that farmers do not have access to the innovation. Farmers are poorly informed about existing innovations and they receive little support to experiment with innovations on their farms. Poor infrastructure to access input and output markets, lack of financial and advisory services and inadequate law enforcement (e.g. seed quality) are challenging the average farmer in Africa on a daily basis. Nevertheless, if the IARCs want to reach the intended development impact (CGIAR,

2011), they need to recognize that they are not the single most important driver or initiator of agricultural innovations. This has been considered in the recent CGIAR reforms where the role of scientists has been redefined using the BBC acronym- "Bridge" of best research to development, as "Broker" of partnerships, and as a "Catalyst" for change[13]. In addition, the CGIAR commits to build capacity to innovate. Yet, the study results show that these principles are only lived by a limited number of CGIAR staff, and it is to be seen if the required skills can be acquired in a reasonable timeframe.

4.2 Discussion on the methodology

The method used for this study is probably one of the broadest attempts to gauge agricultural demand and supply in Africa. It proved very useful to combine data collection through interviews, with discussions and validation of the preliminary results in a workshop setting. This enabled sharing and learning of a broad spectrum of stakeholders and a large number of issues, thereby contributing to bridge the gap between research and farmer practice. However, it must be stated that it is very difficult to obtain a representative picture of the demand for innovations by farmers. First of all, there is huge farm heterogeneity (crop diversity, natural resource base and rainfall) among smallholders in Africa. Secondly, it requires good interviewing skills and a lot of patience to obtain information on the major challenges faced by smallholder farmers, let alone information on the kind of innovations they need. Or, as Henry Ford put it; "If I'd asked my customers what they wanted, they'd have said 'a faster horse". Thirdly, it was decided to use representatives of farmer organizations as key respondents, rather than individual farmers. Finally, even though farmers in Africa generally manage many crops and livestock at the same time, the method simplified this reality and only investigated the needs of the two most important commodities. Some of the key strengths and weaknesses of the method are summarized in Table 18.

Table 18: Strengths and weaknesses of the methodology

Strengths	Weaknesses
• Broad overview on demand and supply • Wide coverage of countries • Comprehensive view into research and dissemination • Outstanding learning opportunity for all stakeholders • Good combination of research (+ 400 questionnaires) and dissemination and validation of findings (5 workshops)	• Considering the wide range of agro ecological zones and socio economic factors in Africa, the scope of the study remains limited. • Difficulty to gain a representative picture of farmers problems • Limited coverage of NARS and other research actors • Lower than expected participation of private sector and GIZ agricultural programs

The methodology is useful as a learning tool for a broad range of stakeholders. There are a number of studies on the performance of the IARCs, but these are mostly internal to the centers. This study is valuable because it gives an independent assessment of matches and links according to the perceptions of the key actors in the innovation system. Even though the perception may not always reflect the reality, it is an important element to consider in design of innovations. Perception is based on the social construct of a particular location, and can therefore not be simply discarded as "wrong". The results can influence public spending on IARC, and it immediately helps guide investments for promotion and piloting selected innovations through GIZ development programs, ITAACC and the Advisory Service on Agricultural Research for Development (BEAF). The results show that needs assessment is valuable to engage into discussion and highlight current issues. However, it does not replace any needs assessment for specific research projects. The methodology is simply not detailed enough to capture the "devils hidden in the details". It can, however, motivate actors to do farmer needs assessments to give them more voice in the design of research or development projects.

[13] Patrick Dugan, DDG World Fish, in his presentation at the ITAACC Feldafing workshop (19-22 November 2013)

4.3 Recommendations to IARC

The era of looking at agricultural innovation only in a linear way (research > extension > farmer) is over. Whereas it worked well in countries where access to information, advice and other services (credit, market, inputs, etc.) is good, it never really worked in Africa. Or, as one DG of a CGIAR center put it; "it is unfair towards extension services to expect that our innovations will be disseminated by them automatically". The ITAACC project and IARCs, and many before them (Nagel, 1980; Röling, 1992; Bachmann, 2000), are advocating for a move towards innovation system thinking which focuses on the interaction between diverse actors as key to changing agricultural practices. It follows the principle that taking a new "practice" from one place to the next requires by default the re-creation of the innovation process, to assure local fit and the re-ordering of actor relations required for its success (Gildemacher and Wongtschowski, 2013). After all, changing an agricultural practice is more than only an agronomic issue, it has social, gender, economic and environmental repercussions that are important and must be re-determined locally. It is therefore important for IARCs to involve target beneficiaries early on in the innovation development process. Innovation platforms have the potential to effectively solve problems, because all concerned stakeholders are working together. However, experience from Southern Africa shows that having a good platform coordinator and communicator is critical for success. This was already recognized by Leeuwis (1993) and Engel (1995) some twenty years ago, when they highlighted the importance of the social dimensions of actors. The centers should move beyond farmer participation towards more farmer control and leadership of innovation processes. This will require a different way of managing research projects, with, for example, more funds for partners (FOs, intermediaries) than is currently the norm. This should then also be accompanied by efforts of the government or NGOs to strengthen the management capacity of farmer organizations.

It may also be interesting to approach agricultural research from a "design-thinking" (Brown and Wyatt, 2010) angle. An important element of design thinking is going beyond addressing the needs of the people who consume a product or service to include the infrastructure that enables it. This means that the design of an innovation also includes a concept on how to reach thousands, or millions, of people. In addition, it considers positive deviance of behavior through intensive observation and learning as a source for innovation, rather than relying on information from publications only. This may help to ensure that research is done on true farmer needs. The set up of CGIAR Research Programs (CRP) will help to align research more with the farmer reality, even though the focus may still be too much on commodities than on farming systems[14]. The CGIAR reforms should also provoke centers to revise the evaluation criteria by which scientists are measured rewarding bridging, brokering, and catalyzing besides scientific relevance. However, AIRC should also make changes at an institutional level, whereby positions for communication, partnerships and technology brokers and catalysts are working side-by-side with researchers. If the scientific community appreciated adaptive research, then publications in high-impact "research for development" journals would be a win-win situation. Information on the economics and suitability to AEZ (or other conditions) of innovations is still limited, whereas it is an important decision criteria for development partners to support the dissemination of a particular innovation.

Then again, the question remains of how far the IARCs should go into making sure their innovations reach the farmers. They clearly have a competitive advantage in analyzing farmer practices and setting-up objective experiments. The study results also show that FOs and intermediaries appreciate the capacity of IARCs to train partners and farmers. On the other hand, their approach to farmers and skills in managing partnerships were ranking high as weakness of the IARCs. Considering that extension services in Africa are generally weak, the IARCs are in a difficult position. On the one hand, it will likely overstretch the IARCs in the short term when they do extension themselves. On the other hand IARCs do not seem to rely on government extension to disseminate their innovations. Innovation platforms seem to be a promising approach to validate the competitive advantage of various actors and exploit those. However, facilitation of innovation platforms is very demanding and many shy away from taking up the facilitation role. It is recommended to value adaptive research more, or become partners in innovation processes where there is no distinction between research and extension. It is recommended to analyze the competencies of critical partners and use this to define specific roles and responsibilities for partners for every country, and even for specific commodities.

[14] Studies in Uganda and the Philippines have shown that there are many synergy effects if farmers invest into agro-forestry and crop diversity. Better crop livestock integration leads to many impacts (production, food security, health, etc.) and raised income substantially from 40-60% per country in particular after more than five years of adoption of the systems approach (see Bachmann et. al 2005. Bachmann et al 2009).

4.4 Recommendations to development partners

The "Feldafing Principles[15] for Enhancing Agricultural Innovation Systems" were formulated by IARCs, NGOs and ITAACC in November 2013 to support integration of research and development for impact at scale. The findings of this study endorse the seven principles that were developed:

1. Recognize that innovation is an interactive process with multiple, complementary dimensions.
2. Plan for scaling from the outset of an intervention process.
3. Facilitate multi-stakeholder engagement, tailored to the specific objectives and research topics, building on existing networks rather than creating new ones.
4. Focus on a demand-driven approach to research issues that considers the needs of different groups and gives particular attention to resource-poor and illiterate farmers and women.
5. Create open communication and learning spaces as a facilitated two-way dialogue that gives equal value to contributions of different actors, allowing free access to knowledge and encouraging the sharing of information.
6. Take a long-term perspective that allows innovation processes to evolve and mature.
7. Provide incentives including strategic capacity enhancement for different actors involved in the innovation processes.

Development partners need to play a more effective role in supporting farmers to innovate their farming practices. Much can be gained by aligning research and development projects. This already starts at the project design, for example by having long-term projects that can be phased to balance the influence of research and development. Room for failure and flexibility in budgets are a prerequisite for successful projects. It might also be challenging to bring budget lines of donors together as research and development are often in separated Ministries[16]. Yet, even though IARCs have received funding through GIZ for many years, a large potential remains for improving collaboration between IARCs and GIZ in Africa.

4.5 Recommendations to GIZ-ITAACC

The methodology is probably most valuable as an instrument to validate the functioning of the innovation system every five to ten years. Nevertheless a number of organizations have expressed interest in using the methodology further, and they should be supported. The methodology can also be used at the end of the ITAACC program in 2018 to compare the results with the 2014 results (baseline). The results of the assessment should be fed back to the people that were interviewed and those who attended the five workshops. The findings will be submitted for publication in a journal to reach as many IARCs as possible. The farmer organizations should be reached differently. For example, by means of a dissemination team that provides feedback through local platforms. This will allow for sharing of the study results, but also for linking the supply with the expressed demand. A number of initiatives have been started to do just that, for example through the Virtual Information Platform (VIP) within the African Agricultural Technology Platform (AATP), or through a small-grant project of BEAF headed by *icipe*. It is envisaged that the results will be made available on a web-platform so that people can do their own matching per commodity based on the needs and supply we identified. The BMZ will support the set-up of ten innovation centers in Africa and the findings of this study should be incorporated in their design. In addition, the study provided an entry point of identified needs that can be investigated further by, for example, GIZ and an IARC, to develop a project that aims at bridging the gap between the particular need and supply.

[15] Available at icipe.org/itaacc

[16] Personal communication with Mr Anthofer-European Initiative for Agricultural Research for Development (EIARD) executive secretary in Brussels, 01 April 2014

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Annex 1: Africa and regional data supporting the hypotheses

Annex 2: Coded answers of challenges for crops and livestock

Annex 3: Overview of IARC top innovations

Annex 4: East Africa report

Annex 5: Southern Africa report

Annex 6: West Africa report

Annex 7: North Africa report

Annex 8: eRAILS Data

Annex 1: Africa and regional data supporting the hypotheses

Annex 1: Africa and regional data supporting the Hypotheses

Definition of terminologies used in the Tables below:

FO	Refers to Farmer Organizations interviewed for the study
Interm:	Refers to intermediaries which include NGOs, Private Sector, government and GIZ projects
S1:	Refers to strategic questionnaire administered for the heads or regional representatives of the International Agricultural Research Centres
S2:	Refers to the questionnaire administered for scientists for the top innovations.
IARCs:	Refers to International Agricultural Research Centres
NARS:	Refers to National Agricultural Research Services
NAES:	Refers to National Agricultural Extension Services
#	Number of
na	not applicable

Table 1: Total number of interviews conducted per category per region

	Africa	East	Southern	West	North
	#	#	#	#	#
FO	**152**	41	40	51	20
Intermediaries	**138**	70	30	19	19
GIZ	10	6	3	1	0
NGO	79	47	13	11	8
Private Sector	18	12	3	1	2
Government (NARS and NAES)	27	4	9	5	9
Others	4	1	2	1	0
IARCs					
Regional representatives (S1)	24	7	11	5	1
Scientist (S2)	94	34	30	22	8
Total	**408**	**152**	**111**	**97**	**48**

Hypothesis 1:
IARCs are addressing key needs of farmers

Table2: S1 Does your center have clear steps to ensure that your research agenda responds to farmer needs?

	Africa %	East %	South%	West %	North %
Yes	70	29	80	100	100
Partially	30	71	20	0	0
No, it is not our mandate	0	0	0	0	0
No, we rely on other partners to do problem identification	0	0	0	0	0
No, we have no time for this step	0	0	0	0	0
No, other reasons specify	0	0	0	0	0
N	**23**	**7**	**11**	**5**	**1**

Table 3: Number of interviews per crop commodity per region (note: up to two commodities were covered per interview)

Crops	Africa			East			Southern			West			North		
	FO #	Interm. #	S2 #	FO #	Interm. #	S2 #	FO#	NGO#	S2#	FO #	Interm. #	S2 #	FO#	Interm#	S2#
Banana/plantain	8	7	4	2	1	1	1	0	0	3	1	3	0	0	0
Barley	0	3	5	0	1	1	0	1	0	0	0	0	5	1	1
Beans dry	8	6	7	2	3	2	2	0	0	0	0	0	4	0	0
Cabbages	5	11	3	1	5	1	2	0	0	0	2	2	0	1	0
Cassava	10	19	6	4	11	0	0	0	0	0	2	3	0	0	0
Chickpea	1	1	4	0	0	0	0	0	0	0	0	0	5	0	0
Cowpea	6	3	9	0	0	3	0	0	2	0	1	2	2	0	0
Green beans	6	2	2	1	0	0	1	0	2	1	1	0	2	0	0
Groundnuts	8	5	7	0	6	0	3	1	4	0	1	3	0	0	0
Lentil	1	1	4	0	0	0	0	0	0	0	0	0	5	0	0
Maize	41	40	17	14	19	5	8	11	8	7	5	4	0	0	1
Millet	4	5	6	0	2	0	0	1	0	4	2	6	0	0	0
Onions	7	9	3	1	1	1	0	0	0	5	4	2	0	1	0
Other specify	25	24	15	3	8	5	2	1	2	6	2	5	3	4	5
Potato	10	12	3	4	7	1	4	4	3	0	1	2	0	1	0
Pumpkin, squash	4	3	1	0	0	1	1	0	0	0	0	0	0	1	0
Rice	9	10	3	2	5	2	2	0	0	0	2	1	0	0	0
Sorghum	8	13	8	4	8	1	0	1	2	1	3	5	0	0	0
Soybean	5	7	9	3	1	2	1	1	6	1	1	1	0	0	0
Spinach	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Sweet potato	2	8	3	0	5	2	0	0	1	0	1	0	0	0	0
Taro - arrow root	0	0	1	0	0	0	0	1	0	3	0	1	0	0	0
Teff	1	2	0	2	2	0	0	0	0	0	0	0	0	0	0
Tomatoes	6	11	5	1	4	2	1	0	0	2	1	3	0	2	1
Wheat	6	9	9	2	4	2	0	0	0	2	0	0	8	5	3
Yams	1	2	2	0	0	0	0	0	0	0	1	2	0	0	0
N	**183**	**213**	**137**	**46**	**93**	**33**	**28**	**22**	**30**	**35**	**31**	**45**	**34**	**16**	**11**

Table 4: Number of interviews per livestock commodity per region (note: up to two commodities were covered per interview)

Livestock	Africa			East			Southern			West			North		
	FO #	Interm #	S2 #	FO #	Interm. #	S2 #	FO #	Interm. #	S2 #	FO #	Interm. #	S2 #	FO#	Inter#	S2#
Aquaculture	0	0	2	0	0	0	6	2	1	0	0	1	0	0	0
Camel	0	4	1	0	4	1	2	4	0	0	0	0	0	0	0
Cattle	16	17	11	1	5	6	0	0	4	2	2	3	2	1	0
Dairy cattle	13	15	4	0	_	_	2	3	3	2	0	1	0	0	0
Dairy goats	2	4	0	6	6	2	0	0	3	0	0	0	3	1	0
Fish in natural waters	0	1	2	1	3	0	3	0	2	0	0	0	0	0	0
Goats	8	12	6	0	_	__	0	1	5	0	1	1	0	0	0
Other specify	8	3	7	0	0	0	0	0	0	0	1	3	3	0	1
Pigs	2	1	2	0	3	2	0	0	0	1	0	2	0	0	0
Poultry	6	16	2	1	2	4	0	0	0	1	1	2	0	0	0
Rabbits	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0
Sheep	7	10	3	2	10	0	1	0	3	0	0	0	1	1	0
N	**63**	**84**	**40**	**12**	**38**	**17**	**14**	**10**	**21**	**6**	**5**	**13**	**10**	**3**	**1**

Table 5: Number of interviews per agro-forestry and other commodity per region (note: up to two commodities were covered per interview)

	Africa			East			Southern			West			North		
Trees & others	**FO %**	**Interm. %**	**S2 %**	**FO %**	**Interm. %**	**S2 %**	**FO %**	**Interm. %**	**S2 %**	**FO %**	**Interm. %**	**S2 %**	FO%	Interm %	S2%
Avocado	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0
Cashew nut	2	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Citrus	1	1	1	0	0	1	0	0	0	1	0	0	0	1	0
Faidherbia albida			4	_	0	2	0	0	1	na	0	1	0	0	0
Fodder crops	3		0	1			0	0	0	0	0	0	0	0	0
Gliricidia sepium	0	0	4	0	0	2	0	0	0	0	0	2	0	0	0
Grevellia	0	1	1	0	1	1	0	0	0	na	1	0	0	0	0
Jathropha		0	0		0	0	0	0	0	na	0	0	0	0	0
Karité		1	1	_	0	0	1	0	0	0	1	1	0	0	0
Leucaena	1	0	2	0	0	2	0	0	0	0	0	0	0	0	0
Mango	8	3	3	2	2	1	0	0	0	5	0	2	0	0	0
Moringa	3	4	2	0	1	0	0	0	0	1	2	2	0	0	0
Neem	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0
Olive	2	6	1	0	0	0	0	0	0	0	0	0	2	3	2
Other specify	18	17	13	1	4	3		0	5	4	1	4	3	6	3
Pawpaw	1	1	0	0	1	0		0	1	1	0	0	0	0	0
Pigeon pea	0	2	1	0	1	0			1	0			0	0	0
N	**41**	**39**	**35**	**4**	**12**	**12**	**2**	**0**	**7**	**13**	**5**	**14**	**5**	**10**	**5**

Table 6: S2: Which AEZ does your innovation target?

FO: In what AEZ are your members operating?

Interm: What is the target AEZ for commodity?

	Africa			East			Southern			West			North		
	FO %	Interm%	S2 %	FO %	Interm %	S2 %	FO %	Interm %	S2 %	FO %	Interm %	S2 %	FO %	Interm %	S2 %
Arid	10	11	1	3	5	4	8	0	0	7	6	0	53	47	0
Semi arid	36	37	61	26	30	39	27	90	77	63	71	57	42	63	100
Sub humid	40	42	31	51	52	54	74	67	20	10	18	24	53	37	0
Humid	14	10	7	20	14	4	2	14	3	27	12	19	5	21	0
N	313	374	84	91	93	28	66	36	30	88	34	21	29	32	5

Table 7: S2: Yield in relation to major existing technology in the country

	Africa	East	Southern	West	North
Denomination	**S2 %**	**S2 %**	**S2 %**	**S%**	**S2 %**
Significantly lower (-30%	0	0	0	0	0
Lower (-15%	1	0	0	5	0
Equal (+- 5%	13	7	25	10	0
Higher (+15%	42	41	38	45	50
Much higher (+30%	37	41	38	30	33
No information	8	10	0	10	17
N	**79**	**29**	**24**	**20**	**6**

Table 8: FO: How many farmers are represented by your organization for this commodity?

Membership Classes	**Africa**	**East**	**Southern**	**West**	**North**
	%	%	%	%	%
6 - 50	19	8	13	23	27
51 - 100	9	15	5	4	20
101 - 500	28	20	56	19	13
501 - 1 000	9	8	5	13	13
1 001 - 5 000	13	18	3	15	7
5 001 - 10 000	5	5	13	9	0
10 001 - 50 000	10	15	3	15	7
50 001 - 100 000	8	13	3	2	13
N	**148**	**40**	**39**	**47**	**15**

Hypothesis 2:
Innovations are affordable for farmers

Table 9: S2: How would you characterize your target farmers? FO: How would you characterize the producers of commodity?

	Africa		East		Southern		West		North	
	FO%	S2%	FO%	S2%	FO%	S2%	FO%	S2%	FO%	S2%
Very resource poor	13	20	5	12	8	23	23	33	10	0
Resource poor	61	70	85	70	76	73	48	62	35	100
Relatively well resourced	25	7	10	15	15	3	30	0	50	0
Well resourced	1	2	0	3	0	0	0	5	5	0
N	**255**	**88**	**20**	**33**	**72**	**30**	**88**	**21**	**36**	**4**

Table 10: Interm: How affordable is the innovation for farmers?

	Africa	East	Southern	West	North
	%	%	%	%	%
Highly affordable, almost no cost	16	18	76	13	32
Some cost, affordable for majority	51	53	0	52	26
Moderate cost, savings or credit needed	16	18	5	16	21
Higher cost, only better resourced farmers with credit	5	5	0	6	11
Cost high, but group sharing arrangements can lower cost	11	6	19	13	11
N	**245**	**131**	**21**	**31**	**19**

Table 11: FO: What is the average farm size of your farmer members in ha (acres)?

	Africa	East	Southern	West	North
Classes of farm size	%	%	%	%	%
<0.4 ha (<1 acre	23	38	20	19	8
0.4 to 0.8 ha (12 acres	22	9	16	22	0
0.8 to 1.6 ha (24 acres	24	9	27	38	8
1.6 to 3 ha (48 acres	14	9	14	16	23
> 3 ha (>8 acres	17	0	0	4	62
N	**217**	**55**	**64**	**73**	**13**

Table 12: FO: What is the average level of application of chemical fertilizer for the target commodity by smallholder farmers?

	Africa	East	Southern	West	North
	%	%	%	%	%
None	32	39	31	27	31
Very little	28	35	22	22	31
Moderate	31	16	36	41	31
High (> 100kg/N/ha)	9	10	11	10	6
N	**194**	**31**	**36**	**41**	**16**

Table 13: FO: What is the average level of application of chemical pesticides for the target commodity by smallholder farmers?

	Africa	East	Southern	West	North
	%	%	%	%	%
None	37	34	34	31	44
Very little	31	41	29	33	31
Moderate	26	16	29	24	25
High	10	9	8	12	0
N	**202**	**32**	**38**	**42**	**16**

Table 14: What is the average level of application of external inputs for the target commodity by smallholder farmers?

	Africa	East	Southern	West	North
	%	%	%	%	%
None	34	37	32	29	44
Very little	29	38	26	28	31
Moderate	28	16	32	33	28
High	10	10	9	11	3
N	**396**	**63**	**74**	**83**	**32**

Table 15: FO: What is the average level application of organic manure? (1 TLU = 1 cow)

	Africa	East	Southern	West	North
	%	%	%	%	%
None (no organic inputs at all)	22	10	23	24	14
Very little (< 1/2 TLU/ha	28	57	23	15	7
Moderate (1 TLU/ ha)	25	20	35	34	43
High (2 TLU/ha)	20	13	19	27	36
N	**184**	**30**	**31**	**41**	**14**

Table 16: S2: Amount of investment needed for adoption of innovation by beneficiaries (converted to Euro)

Investment range	Africa	East	Southern	West	North
	%	%	%	%	%
<10	18	23	3	21	0
10-50	18	26	40	5	0
51-100	16	16	7	21	0
101-200	11	3	17	5	20
201- 400	10	10	17	0	0
401-800	7	0	7	5	0
801-1600	2	0	0	11	0
1601-3000	2	0	0	0	60
3001-6000	1	0	3	0	0
> 6001	5	3	3	5	0
No information or n.a.	11	19	3	26	20
N	**104**	**31**	**30**	**19**	**5**

Table 17: S2: Production costs in relation to major existing technology in the country

	Africa	East	Southern	West	North
	%	%	%	%	%
Significantly lower (-30%)	20	7	33	15	29
Lower (-15%)	23	25	15	35	14
Equal costs (+- 5%)	22	14	26	15	57
Higher costs (+15%)	22	29	22	20	0
Much higher costs (+30%)	6	11	4	5	0
No information	7	14	0	10	0
N	**82**	**28**	**27**	**20**	**7**

Table 18: FO: What are the main services you provide for members?

	Africa	East	Southern	West	North
	%	%	%	%	%
Market access (information, transport, etc.)	68	80	51	75	60
Extension	47	39	43	48	70
Input acquisition	49	34	54	67	30
Output collection and marketing	46	46	35	54	45
Price negotiation	46	56	35	42	55
Capacity building / training	66	68	43	88	50
Policy, lobbying and advocacy	42	54	46	29	45
other	35	22	54	33	30
N	**584**	**164**	**134**	**209**	**77**

Hypothesis 3:
Farmers and scientists share similar views on key criteria for design/adoption of innovations

Table 19: S1: On the basis of what criteria did you come up with the selection of these top innovations? Tick top 4 reasons

	Africa	East	Southern	West	North
Criteria	**%**	%	%	**%**	%
Poverty reduction impact	70	71	100	80	0
Food security	70	57	40	40	0
Scaling potential	65	43	80	80	0
Affordability of technology	39	29	40	60	100
Improving health and nutrition	39	29	30	60	100
Bettering natural resource management and environment	35	14	20	20	0
Good gender impact	22	14	40	0	100
Climate change relevance	22	0	50	80	100
N	**83**	**18**	**40**	**21**	**4**

Table 20: FO: What are the most important criteria agricultural innovations should fulfill for successful adoption by smallholder farmers? Interm: What criteria did you use to select the two commodity innovations analyzed above? S1: What are criteria for adoption of technologies by farmers:

	Africa				East				Southern				West				North			
	FO %	Interm %	S1%	S2%	FO %	Interm %	S1 %	S2 %	FO %	Interm%	S1 %	S2%	FO %	Interm %	S1 %	S2 %	FO %	Interm%	S1%	S2 %
Affordability (low investment cost)	44	37	78	47	22	24	86	27	55	55	80	63	44	42	1	48	37	22	100	63
Big comparative advantage (yield gain)	68	60	78	65	56	52	86	45	60	61	80	73	90	63	1	81	58	44	100	75
Compatibility with local traditions	23	32	26	23	6	33	43	21	28	30	30	23	36	32	0	29	47	56	0	13
Cost saving	30	15	9	25	8	6	29	18	3	3	0	30	0	5	0	5	ç!	11	0	38
Create complexity (broaden farming system)	2	5	0	9	3	4	0	12	55	21	0	3	16	11	0	24	32	28	0	25
Labour saving	33	13	22	11	8	9	0	6	65	21	50	17	30	5	0	14	53	44	0	0
Market potential	80	69	na	na	97	81			78	55			82	68		-	53	83	na	na
Others specify	8	15	22	4	0	7	29	3	8	18	0	3	10	16	60	10	21	39	0	0
Profitability (medium to high return with low input -	46	36	70	35	17	24	57	27	50	39	40	33	40	37	60	33	32	33	100	38
Profitability (high return with high input -high risk)	12	10	4	10	8	7	0	3	10	9	0	3	6	5	20	24	21	44	0	25
Risk reduction (production, marketing, etc.)	34	35	30	4	8	33	0	55	58	42	80	40	66	58	60	38	21	22	0	38
Simplicity	32	16	13	19	8	9	0	3	8	27	0	47	48	21	20	48	5	11	100	63
Trialability (farmers can test small scale)	12	14	22	27	6	9	0	30	30	18	0	20	44	37	40	24	11	33	0	0
Up-scaling potential	40	48	26	52	81	67	57	70	23	21	30	40	2	11	40	14	16	44	100	13
N	**673**	**555**	**92**	**338**	**118**	**245**	**27**	**106**	**211**	**139**	**39**	**119**	**257**	**78**	**21**	**82**	**87**	**93**	**5**	**31**

Hypothesis 4:
Gender equity is an important criteria for actors in the innovation system

Table 21: S1: How does gender feature in your research? S2: Does the innovation promote gender equity? Interm: Does the innovation promote gender equity?

	Africa			East			Southern			West			North		
	Interm. %	S1 %	S2 %	Interm %	S1 %	S2 %	Interm %	S1 %	S2 %	Interm %	S1 %	S2 %	Interm %	S1 %	S2 %
Very little	6	9	9	2	14	3	6	10	7	0	0	5	24	0	50
Little	3	0	3	2	0	0	9	0	7	0	0	5	0	0	0
Me-dium	17	30	31	10	29	40	18	30	23	14	40	35	41	0	13
High	29	43	38	31	57	37	27	40	43	36	40	45	24	0	0
Very high	45	17	19	56	0	20	39	20	20	50	20	10	12	100	38
N	**123**	**23**	**88**	**59**	**7**	**30**	**33**	**10**	**30**	**14**	**5**	**20**	**17**	**1**	**7**

Table 22: FO: Where in the value chain do women play an important role?

Tasks/Activities	Africa %	East %	Southern %	West %	North %
Harvest	72	83	71	64	11
Weeding	62	83	77	50	21
Field preparation	58	78	54	64	16
Sales	51	72	80	93	37
Marketing	45	61	40	14	0
Cultural practices	42	28	51	50	11
Processing on-farm	40	11	40	79	32
Other comment	27	6	10	0	26
Watering	21	6	37	43	11
Processing industrial	9	0	26	0	84
N	**1035**	**77**	**341**	**64**	**47**

Table 23: S2 and Intermediaries: Does the innovation promote gender equity? (CODED ANSWERS for AFRICA)

	IARC %	Intermediaries %
Women participate in meetings and platforms and FOs	3	9
Commodity managed by women (often a cultural matter)	9	11
Innovation does not target women specifically, benefits whole household, both men and women involved	24	13
Innovation increases labour for women	4	1
Innovation decreases labour for women	7	3
Women have own trait preferences / innovations are adopted if attractive to women	3	2
Gives women access to household resources / reduces their reliance on men and money controlled by men / improves women's status	8	2

	IARC	Intermediaries
	%	%
Innovation targets women	12	4
Storage and post-harvest processing and food security involve women	4	4
Use of equipment favours men, use of manual methods favours women	1	0
Involves youth and other vulnerable groups	6	4
Reduces conflict between men and women	5	0
Women are prioritised by programme/organisation	13	40
Men take over when a tangible benefit emerges / men still make decisions	0	5
Cash crops generally involve men while food crops involve women, so look at diversification to involve everyone	0	1
Women and minorities are not sufficiently involved	0	2
nominations=	**115**	**174**

Hypothesis 5:
Farmers are the major stakeholder in the design and implementation of IARCs' research

Table 24: S2: What is the origin of the innovation?

	Africa	East	Southern	West	North
	%	%	%	%	%
Genuine new idea	26	17	13	5	50
Breeding improvement work	36	27	43	38	75
Adaptation of farmer based innovation	27	18	37	29	38
Transfer from another region, institute	44	28	50	33	38
Adaptation from private sector	7	3	3	14	0
Other specify	12	8	7	14	13
N	**135**	**102**	**46**	**28**	**17**

Table 25: S2: For how many years do you work on this innovation now?

	Africa	East	Southern	West	North
Range of years	%	%	%	%	%
0 - 1	0	0	0	0	0
2 - 3	12	17	7	10	13
4 - 5	15	24	10	10	13
6 - 7	21	21	21	29	0
8 - 15	38	31	45	33	50
16 - 30 Years	15	7	17	19	25
N	**87**	**29**	**29**	**21**	**8**

Table 26: S2: Location of research trials

	Africa	East	Southern	West	North
	%	%	%	%	%
On station	50	36	53	77	63
On farm	68	55	83	82	86
Extension demonstration site	53	61	63	55	25
na	5	6	7	5	0
N	**176**	**52**	**62**	**48**	**14**

Table 27: S2: Farmer participation during research

	Africa	East	Southern	West	North
	%	%	%	%	%
No participation	3	6	0	5	0
Researcher controlled	24	22	7	32	75
Some level of farmer control	62	69	83	41	13
Full level of farmer control	11	3	10	23	13
N	**92**	**32**	**30**	**22**	**8**

Table 28: S2: Who was the major stakeholder influencing the research agenda (primary, secondary and tertiary most important) in percentages

	Africa			East			Southern			West			North		
	Pri	Sec	Third	Pri	Sec	Third	Pri	Sec	Third	Pri	Sec	Third	Pri	Sec	Third
Farmers	29	39	28	19	38	32	43	32	24	23	55	20	38	25	43
Donors	7	33	45	3	31	39	11	36	36	9	23	70	0	63	29
Researchers	64	21	14	78	19	4	46	25	28	68	23	5	63	13	29
Private sector	0	7	14	0	13	25	0	7	12	0	0	5	0	0	0
N	**90**	**90**	**80**	**32**	**32**	**28**	**28**	**28**	**25**	**22**	**22**	**20**	**8**	**8**	**7**

Hypothesis 6:
The ways information on innovations is shared matches the requirements of farmers

Table 29: S2: How did you disseminate this innovation?

	Africa			East			Southern			West			North		
	FO%	Interm%	S2%	FO%	Interm%	S2%	FO%	Interm%	S2%	FO%	Interm%	S2%	FO%	Interm%	S2%
Demonstrations	78	80	76	76	84	68	83	76	83	78	13	64	74	11	63
DVD	8	19	15	2	15	12	13	24	7	10	13	36	5	28	0
Farmer leaders	56	na	na	41			63	85	67	70	80	64	37	56	63
Farmer leaflets / handouts	46	55	48	59	56	38				44	47	45	26	28	25
Farmer to farmer exchanges	61	66	52	41	72	38	45	73	67	74	80	77	47	72	75
Farmer training	86	83	74	85	84	68	73	61	93	86	93	68	79	78	50
Farmers days / field days	73	77	66	71	78	53	90	79	83	70	67	59	58	56	38
Internet	30	18	45	12	22	53	88	21	47	36	13	5	21	0	0
Local credible institutions	33	na	na	15						42	27	36	11	39	25
Magazines / newspapers	31	23	34	7	21	3	10	33	57	44	20	41	16	17	63
Manuals	na	42	52		37	47	50	64	67						
Mobile phone applications	21	14	7	15	9	15	45	33	3	42	13	27	0	0	50
Mouth to mouth via other farmers	25	na	na	17						4	0	5	32	0	0
Of far not any dissemination done	x	1	3	0	1	6	45	3	0						
Others specify	5	22	24	2	13	18	55	36	27	0	7	32	5	39	25
Publications in local language	33	28	45	15	21	47	13	36	53	50	40	55	16	22	13
Radio	47	52	41	34	41	32	38	70	57	72	87	50	21	33	0
Research Journals	na	12	59		7	56	43	21	57						
TV	35	23	31	15	9	21	30	33	53	60	40	23	21	44	13
N	**1000**	**824**	**632**	**208**	**387**	**195**	**312**	**247**	**246**	**391**	**96**	**151**	**89**	**94**	**40**

Table 30: S2: Who has been contributing most to increase the up-scaling of this innovation?

	Africa	East	Southern	West	North
	%	%	%	%	%
NARS	36	52	25	17	71
NAES	19	22	25	6	14
GIZ	3	0	0	11	0
NGOs	34	11	39	67	14
Private sector	9	15	11	0	0
N	**80**	**27**	**28**	**18**	**7**

Hypothesis 7:
Farmers rate advisory services they receive as adequate

Table 31: Intermediaries: What is the quality of extension service provided to the farmers you work with in your region(s) by NARS ?

	Africa	East	Southern	West	North
	%	%	%	%	%
Very poor - -	16	10	14	11	39
Poor -	27	24	43	11	28
Medium	36	40	36	39	22
Good +	18	22	7	28	11
Very good + +	3	3	0	11	0
N	**122**	**58**	**28**	**18**	**18**

Table 32: FO : What is the quality of extension service provided to your farmers by the following actor: Government (NAES)
Intermediaries: What is the quality of extension service provided to the farmers you work with in your region(s) by NAES ?

	Africa		East		Southern		West		North	
	FO %	Interm.%	FO %	Interm.%	FO %	Interm.%	FO %	Interm.%	FO %	Interm.%
Very good + +	18	6	3	3	8	16	44	36	0	65
Good +	11	14	13	22	5	28	18	14	0	24
Medium	31	36	34	40	43	47	12	14	53	6
Poor	17	29	32	29	18	6	10	21	5	6
Very poor	23	15	18	6	28	3	16	14	42	0
N	**147**	**126**	**38**	**63**	**40**	**32**	**50**	**14**	**19**	**17**

Table 33: FO: What is the quality of extension service provided to your farmers by the following actor NGO

	Africa	East	Southern	West	North
	%	%	%	%	%
Very good + +	22	5	23	39	11
Good +	31	50	28	26	11
Medium	20	34	21	9	21
Poor -	11	11	8	20	0
Very poor - -	16	0	21	7	58
N	**143**	**38**	**39**	**46**	**19**

Table 34: FO: What is the quality of extension service provided to your farmers by the following actor: Private sector; Intermediaries: What is the quality of extension service provided to the farmers you work with in your region(s) by the private sector?

	Africa		East		Southern		West		North	
	FO %	Interm.%	FO %	Interm.%	FO %	Interm.%	FO %	Interm.%	FO %	Interm.%
Very good + +	18	7	10	5	13	9	33	6	10	65
Good +	22	36	36	17	10	22	27	13	10	24
Medium	15	24	26	31	18	19	7	31	10	6
Poor	16	19	26	45	10	38	13	31	15	6
Very poor	28	15	3	2	50	13	20	19	55	0
N	**144**	**123**	**39**	**58**	**40**	**32**	**45**	**16**	**20**	**17**

Table 35: FO and Intermediary view on quality of services provided by various actors to the farmers they represent (CODED ANSWERS for AFRICA)

	Interm vs NARs %	Interm vs NAES%	FO vs NAES %	FO vs NGO%	FO vs PS%	Interm vs PS%
Quality of service low	1	12	26	1	4	9
Lack adequate resources/logistics	11	28	15	6	0	1
Staff not competent/motivated	6	15	15	5	3	4
Quality of service high	16	5	8	16	16	25
Inaccessible/poor presence	17	8	7	20	22	13
Providing only specific services	9	3	6	14	18	13
Service is limited to capacity building	5	3	4	16	1	2
Provide services indirectly through partnerships and collaborations	4	3	2	4	3	2
Staff competent/motivated	2	3	1	6	1	1
Not within their mandate	20	0	0	0	0	1
Exploiting farmers	0	0	0	0	23	20
Other comments	2	21	17	7	9	11
nominations=	**179**	**190**	**179**	159	147	170

Hypothesis 8:
Effective linkages exist between different actors in the innovation system

Table 36: FO : Collaboration with any of the IAR Centers so far? Interm: Have you in the past collaborated with any of the international centers below?

	Africa		East		Southern		West		North	
IARC	**FO %**	**Interm. %**	**FO %**	**Interm %**	**FO %**	**Interm %**	**FO %**	**Interm. %**	**FO%**	**Interm%**
Africa Rice	6	13	0	6	0	14	12	40	0	0
AVRDC	12	13	17	15	0	10	15	20	0	0
Bioversity International	12	6	0	3	13	7	19	0	0	33
CIAT	18	30	17	26	13	45	19	20	25	0
CIFOR	4	9	0	0	0	21	8	10	0	0
CIMMYT	16	28	17	26	13	41	19	0	0	17
CIP	8	29	25	32	13	34	0	10	0	17
ICARDA	6	11	0	0	0	17	0	0	75	67
ICIPE	18	23	33	41	0	10	19	10	0	0
ICRAF	6	41	8	35	25	59	0	30	0	0
ICRISAT	28	43	8	21	75	69	27	60	0	17
IFPRI	4	15	8	6	13	31	0	0	0	17
IITA	28	37	17	21	25	52	38	70	0	0
ILRI	6	38	17	44	0	41	0	10	25	33
IRRI	4	9	8	6	0	17	0	0	25	0
IWMI	2	8	0	0	0	17	4	0	0	17
World Fish	0	8	0	0	0	21	0	0	0	0
N	**89**	**284**	**21**	**96**	**15**	**147**	**47**	**28**	**6**	**13**

Table 37: S1: How do you rate your collaboration with NARS?, How do you rate your collaboration with NAES? How do you rate your collaboration with NGOs? How do you rate your collaboration with the private sector? In percentage of total

	Africa				East			Southern				West				North			
	NARS	NAES	NGO	PS	NARS	NAES	NGO	NARS	NAES	NGO	PS	NARS	NAES	NGO	PS	NARS	NAES	NGO	PS
Very poor	0	13	5	4	29	0	0	0	0	11	10	0	20	0	20	0	0	0	55
Poor	9	17	5	13	14	0	14	0	0	0	10	0	40	0	13	0	0	100	15
Medium	30	26	41	43	29	43	86	20	20	22	40	60	20	20	7	0	0	0	10
Good +	26	26	36	30	29	29	0	30	50	33	20	20	0	80	27	100	100	0	10
Very good + +	35	17	14	9	0	29	0	50	30	33	20	20	20	0	33	0	0	0	10
N	**23**	**23**	**22**	**23**	**7**	**7**	**7**	**10**	**10**	**9**	**10**	**5**	**5**	**5**	**45**	**1**	**1**	**1**	**20**

Table 38: S2: Strength and weaknesses of collaboration with.... (CODED ANSWERS for AFRICA)

	NARS	NAES	NGO	Private Sector
	%	%	%	%
Approach does not meet farmer needs	2	20	6	16
Approach meets farmer needs	2	0	8	8
Good partner	25	12	31	35
Good information on products	2	0	3	3
Hardly any cooperation	0	7	3	8
High quality standards/ competent	14	0	6	5
Lack adequate resources	27	22	17	3
Poor financial/HR management	12	15	3	0
Poor information on products	0	0	6	0
Poor partner	16	7	17	17
Poor quality standards and competencies	0	17	3	5
Total	**56**	**41**	**36**	**37**

Hypothesis 9:
IARCS innovations have been up-scaled adequately

Table 39: S2: How do you rate the diffusion potential of the innovation?

	Africa	East	Southern	West	North
	%	%	%	%	%
Very small (niche production)	6	7	3	10	0
Small	10	7	7	19	13
Medium	28	17	20	33	88
Big	34	43	43	19	0
Very big (potentially most farmers in the country)	22	27	27	19	0
N	**89**	**30**	**30**	**21**	**8**

Table 40: S2: Status of innovation development

	Africa	East	Southern	West	North
	%	%	%	%	%
On-going research	17	15	10	17	38
Field testing	20	21	20	20	25
Up-scaling extension	63	64	70	63	38
Total	**92**	**33**	**30**	**92**	**8**

Table 41: S2: Who has been contributing most to increase the up-scaling of this innovation?

	Africa	East	Southern	West	North
	%	%	%	%	%
NARS	36	52	25	17	71
NAES	19	22	25	6	14
GIZ	3	0	0	11	0
NGOs	34	11	39	67	14
Private sector	9	15	11	0	0
N	**80**	**27**	**28**	**18**	**7**

Table 42: S2: How many households have adoption the innovation up to now?

	Africa	East	Southern	West	North
Categories of households	%	%	%	%	%
0 - 100	11	12	9	7	50
101 - 1000	27	16	30	36	50
1001 - 5000	20	20	26	14	0
5001 - 20000	14	16	17	7	0
20001 - 3000000 house	28	36	17	36	0
Total	**64**	**25**	**23**	**14**	**2**

Table 43: S1: How are scientists evaluated?

	Africa	East	Southern	West	North
	%	%	%	%	%
Peer reviewed articles / publications	24	25	24	21	25
Engagement with farmers	3	0	6	4	0
Novelty of the research	11	18	6	8	25
Quality of the scientific work delivered	17	7	21	21	25
Engagement with other actors of the value chain	8	11	9	4	0
Acquisition of funds	18	25	9	21	25
Perceived impact of the research	15	14	18	13	0
Other	4	0	6	8	0
N	**89**	**28**	**33**	**24**	**4**

Table 44: S1: Bottlenecks for adoption of innovations (CODED ANSWERS for AFRICA)

	Nr	%
Up-scaling and collaboration approach of IARC is poor	9	17
Policies do not support farmers	8	15
Collaboration among actors not optimal	7	13
Farmers lack resources (land, water, funds, labour)	7	13
Design of innovations by IARC is poor (affordability)	6	11
NAES function poorly	4	8
Farmers lack access to markets	4	8
Information dissemination to farmers is difficult	3	6
Farmers lack general education (literacy, etc)	3	6
Farmers lack knowledge	2	4
Total	53	100%

Hypothesis 10:
Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes

Table 45: S1: What aspects of climate change are being addressed by your center in this region? S2: What climate change risks are addressed by the innovation? FO: How does climate change affect your farmer in general? Interm: How does climate change affect your farmers in general?

	Africa				East				Southern				West				North			
	FO%	Int%	S1%	S2%	FO%	Int%	S1%	S2%	FO%	Int%	S1%	S2%	FO%	Int%	S1%	S2%	FO%	Int%	S1%	S2%
Changes in season	70	74	na	na	80	50	na	na	67	77	60		84	50			20	56	na	na
Decreased rainfall	63	63	48	37	78	33	40	21	59	92	90	37	52	33	20	46	70	72	100	75
Erratic rainfall	69	78	71	61	80	67	60	57	69	77		73	78	67	40	31	20	61	100	75
Hailstorms	6	15	na	na	5	11	na	na	15	0			0	11			5	6	na	na
Increased drought	69	66	76	58	73	28	80	57	67	85	80	57	64	28	60	46	80	67	100	88
Increased flood risk	32	46	19	14	22	50	20	18	31	62	30	7	44	50	0	15	25	6	0	25
Increased rainfall	16	15	24	8	2	22	40	7	13	0	30	0	26	22	0	8	25	17	0	38
Increased temperature	55	43	29	33	37	33	20	36	54	23	20	27	76	33	40	23	40	56	100	63
Increased wind damage	13	10	na	na	7	17	na	na	21	0			14	17			25	61	100	75
Increased vulnerability	34	57	67	43	12	17	40	11	18	69	60	27	2	17	80	8	5	6	na	na
Other specify	12	15	29	13	68	17	80	46	13	0	0	13	22	17	60	54	35	28	0	25
N	**658**	**654**	**76**	**210**	**191**	**62**	**19**	**71**	**166**	**63**	**37**	**72**	**231**	**62**	**15**	**30**	**70**	**654**	**76**	**37**

Table 46: FO: What are climate change consequences for commodity? Interm: What are climate change consequences for commodity 1?

	Africa		East		Southern		West		North	
	FO %	Interm %	FO %	Interm %	FO %	Interm %	FO %	Interm %	FO %	Interm %
Animal losses, reduced productivity	-	23.2		24		42	-	16	-	-
Damages to infrastructure (terraces, irrigation, etc.)	12	10.3	11	9	42	42	14	20	0	6
Increased erosion due to floods	14	18.5	14	21	14	21	-	28	5	6
Increased pests and diseases	43	49.4	49	62	12	0	42	32	30	35
Need for re-sowing	-	22.7		25		79	17	28		
Other specify	16	14.6	0	9	70	32	7	12	15	35
Reduced flowering	30	39.5	72	61	38	68	15	16	15	6
Shorter growing period	44	38.6	44	35	21	47	45	52	25	29
Yield losses	84	75.1	91	82	33	0	80	68	75	82
N	**590**	**680**	**160**	**361**	**152**	**63**	**228**	**68**	**33**	**34**

Table 47: S1: Do you think the speed of output of innovations of your center keeps up pace with the current rate of climate change experienced in your region?

	Africa	East	Southern	West	North
	%	%	%	%	%
Yes our output speed is adequate	41	50	40	25	100
No, somewhat lagging behind	59	50	60	75	0
No, heavily lagging behind	0	0	0	0	0
N	**17**	**2**	**10**	**4**	**1**

Table 48: Climate change coping strategies that are being promoted to farmers by FOs and Intermediaries (CODED ANSWERS for AFRICA)

	FO		Intermediaries	
	Nr.	%	Nr.	%
Improved variety-early maturing	19	7	46	11
Improved variety- drought tolerant/resistant	10	4	23	6
Improved variety- disease/pest resistant	5	2	16	4
Improved variety- generally better adapted (AEZ, yield, local conditions)	8	3	14	4
Local/traditional seed varieties	1	0	11	3
Improved cultivation practices (GAP, conservation agriculture, storage, etc)	47	18	91	23
Water availability using pumps and irrigation (infrastructure)	42	16	35	9
Watershed/land management approach (e.g. water harvesting at local and regional scale, erosion control)	16	6	19	5
Planting trees (agro-forestry approach)	18	7	28	7
Diversification of production system- change crop	29	11	31	8
Early warning systems (rains or flooding)	6	2	8	2
Insurance schemes	3	1	1	0

	FO		Intermediaries	
	Nr.	%	Nr.	%
Post harvest, value addition, marketing	7	3	3	1
Energy saving stoves, biogas, environment (direction of mitigation!)	3	1	3	1
Information, sensitisation, linking	9	3	20	5
Greenhouse/ tunnel/ in-house production or animal shelter. Storage	8	3	10	3
Feed only limited number of animals, sell the rest	5	2	18	4
Move production area to high/low land, or seasonal movements	5	2	0	0
No coping strategy even though climate change is a threat	25	9	7	2
Other	0	0	16	4
Total n=	**266**		**400**	

Hypothesis 12:
Research at the IARC is aligned with overall international development goals

Table 49: S1: On the basis of what criteria did you come up with the selection of these top innovations?

	Africa	East	Southern	West	North
	%	%	%	%	%
Poverty reduction impact	70	29	100	80	0
Food security	70	43	40	40	0
Scaling potential	65	57	80	80	0
Affordability of technology	39	14	40	60	100
Improving health and nutrition	39	14	30	60	100
Bettering natural resource management and environment	35	29	20	20	0
Good gender impact	22	0	40	0	100
Climate change relevance	22	71	50	80	100
N	**83**	**18**	**40**	**21**	**4**

Table 50: S2: What were you hoping to achieve with your innovation?

	Africa	East	Southern	West	North
	%	%	%	%	%
Household food security	77	70	97	59	88
Improved household income	70	39	20	23	100
Improved human nutrition	51	36	67	45	63
National food security	34	42	3	23	13
Better environmental management	34	67	70	82	50
Improved health	23	45	17	41	38
Other specify	11	0	3	9	13
Reduced labour requirements	4	15	10	5	13
N	**283**	**104**	**86**	**63**	**30**

Annex 2: Coded answers of challenges for crops and livestock

Annex 2: Coded answers of challenges for crops and livestock

The Tables below show the results of the coding of the open questions.
FO and Intermediaries were asked about the major challenges farmers face for a particular crop
IARC were asked what farmer problem their top innovation addresses

FO= Farmer Organization
Interm.= Intermediary (NGO, GIZ, private sector, government, value chain actor)
IARC= Int. Agric. Research Center (CGIAR, icipe or AVRDC)
nominations= number of answers coded

MAIZE main challenges	FO %	Interm. %	IARC %
Access to and quality of seed	16%	14%	5%
Marketing	10%	8%	5%
Access to credit or finance/ high production costs	9%	5%	5%
Post harvest processing or storage	8%	8%	5%
Tools, machinery and irrigation equipment	8%	3%	2%
Drought, flood, any climate related problem	6%	8%	5%
Institutional/regulatory/policy issues	6%	12%	2%
Pest and diseases (incl. rodents, animals)	5%	6%	14%
Training, knowledge, knowhow, awareness	5%	8%	7%
Access to, quality and use of fertilizer	4%	3%	5%
Social issues- theft, adulteration, crime, conflict	4%	5%	
Transport and infrastructure	4%	1%	
Natural resources- land and water availability	4%	4%	2%
Access to, quality of pesticides and other inputs	3%	3%	2%
Labor, (shortage, price, etc.)	3%	1%	2%
Weeds, weeding	3%		
Any challenge with cultivation practices and harvesting	2%	3%	7%
Poor soil fertility	1%	3%	10%
Low yields and poor quality	1%	3%	14%
Any other problems		2%	7%
nominations=	**199**	**119**	**42**

Cassava main challenges	FO %	Interm. %	IARC %
Pest and diseases (incl. rodents, animals)	21%	25%	9%
Post harvest processing or storage	12%	13%	9%
Tools, machinery and irrigation equipment	10%		
Transport and infrastructure	10%	2%	
Access to and quality of seed	7%	25%	27%
Marketing	7%	11%	
Social issues- theft, adulteration, crime, conflict	5%	2%	
Drought, flood, any climate related problem	5%	4%	
Access to, quality and use of fertilizer	2%		
Access to, quality of pesticides and other inputs	2%		
Natural resources- land and water availability	2%	4%	

Poor soil fertility	2%	2%	9%
Weeds, weeding	2%		
Labour, (shortage, price, etc.)	2%		
Access to credit or finance/ high production costs	2%		9%
Training, knowledge, knowhow, awareness	2%	4%	9%
Institutional/regulatory/policy issues	2%		
Any other problems	2%	4%	18%
Any challenge with cultivation practices and harvesting		4%	9%
Low yields and poor quality		2%	
nominations=	**42**	**55**	**11**

Potato main challenges	**FO %**	**Interm. %**	**IARC %**
Access to and quality of seed	16%	24%	30%
Institutional/regulatory/policy issues	13%	9%	
Pest and diseases (incl. rodents, animals)	12%	3%	
Marketing	10%	12%	30%
Natural resources- land and water availability	7%	3%	
Post harvest processing or storage	7%	3%	10%
Low yields and poor quality	4%	3%	20%
Tools, machinery and irrigation equipment	4%	3%	
Access to credit or finance/ high production costs	4%	9%	
Training, knowledge, knowhow, awareness	4%	3%	
Transport and infrastructure	4%	3%	
Access to, quality and use of fertilizer	1%		
Access to, quality of pesticides and other inputs	1%		
Any challenge with cultivation practices and harvesting	1%	9%	10%
Poor soil fertility	1%	3%	
Social issues- theft, adulteration, crime, conflict	1%	12%	
Labor, (shortage, price, etc.)	1%		
Drought, flood, any climate related problem	1%		
Any other problems	1%		
Weeds, weeding			
nominations=	**68**	**33**	**10**

Rice main challenges	**FO %**	**Interm. %**	**IARC %**
Access to and quality of seed	15%	15%	13%
Marketing	15%	11%	13%
Tools, machinery and irrigation equipment	11%	15%	6%
Access to credit or finance/ high production and input costs	9%	7%	
Institutional/regulatory/policy issues	9%	15%	
Access to, quality and use of fertilizer	7%	4%	
Transport and infrastructure	7%		
Pest and diseases (incl rodents, animals)	4%		13%
Labor, (shortage, price, etc.)	4%	4%	-
Training, knowledge, knowhow, awareness	4%	4%	13%
Post harvest processing or storage	4%	4%	13%

Any challenge with cultivation practices and harvesting	2%	7%	6%
Natural resources- land and water availability	2%		
Poor soil fertility	2%		
Low yields and poor quality	2%	4%	19%
Weeds, weeding	2%		
Drought, flood, any climate related problem	2%	4%	6%
Access to, quality of pesticides and other inputs		4%	
Social issues- theft, adulteration, crime, conflict		4%	
Any other problems			
nominations=	**54**	**27**	**16**

Dry Beans main challenges	**FO %**	**Interm. %**	**IARC %**
Pest and diseases (incl. rodents, animals)	19%	10%	
Institutional/regulatory/policy issues	13%	10%	
Access to and quality of seed	10%	30%	33%
Tools, machinery and irrigation equipment	10%	10%	
Training, knowledge, knowhow, awareness	10%		
Marketing	10%	10%	33%
Natural resources- land and water availability	6%	5%	
Any other problems	6%	5%	
Access to, quality of pesticides and other inputs	3%	5%	
Labor, (shortage, price, etc.)	3%		
Access to credit or finance/ high production costs	3%		
Drought, flood, any climate related problem	3%	5%	
Post harvest processing or storage	3%	5%	
Access to, quality and use of fertilizer			
Any challenge with cultivation practices and harvesting			
Poor soil fertility		5%	
Social issues- theft, adulteration, crime, conflict			
Low yields and poor quality			33%
Weeds, weeding			
Transport and infrastructure			
nominations=	**31**	**20**	**3**

Soybean main challenges	**FO %**	**Interm. %**	**IARC %**
Access to credit or finance/ high production costs	17%	5%	5%
Access to and quality of seed	13%	11%	15%
Training, knowledge, knowhow, awareness	13%	11%	
Institutional/regulatory/policy issues	13%	16%	
Drought, flood, any climate related problem	13%		10%
Post harvest processing or storage	8%	11%	
Any challenge with cultivation practices and harvesting	4%		
Poor soil fertility	4%	5%	20%
Low yields and poor quality	4%	5%	20%
Labor, (shortage, price, etc.)	4%	5%	
Transport and infrastructure	4%		

Marketing	4%	16%	5%
Access to, quality and use of fertilizer			5%
Access to, quality of pesticides and other inputs		5%	5%
Natural resources- land and water availability			10%
Pest and diseases (incl. rodents, animals)		5%	5%
Social issues- theft, adulteration, crime, conflict			
Weeds, weeding			
Tools, machinery and irrigation equipment		5%	
Any other problems			
nominations=	**24**	**19**	**20**

Tomato main challenges	**FO %**	**Interm. %**	**IARC %**
Access to and quality of seed	16%	6%	13%
Tools, machinery and irrigation equipment	13%	6%	6%
Institutional/regulatory/policy issues	13%	6%	
Pest and diseases (incl. rodents, animals)	10%	9%	13%
Access to credit or finance/ high production costs	10%	6%	6%
Marketing	10%	19%	13%
Any challenge with cultivation practices and harvesting	6%	9%	13%
Low yields and poor quality	6%		25%
Access to, quality of pesticides and other inputs	3%		
Labor, (shortage, price, etc.)	3%	3%	
Training, knowledge, knowhow, awareness	3%	9%	
Transport and infrastructure	3%	6%	6%
Drought, flood, any climate related problem	3%		
Access to, quality and use of fertilizer			
Natural resources- land and water availability		6%	6%
Poor soil fertility			
Social issues- theft, adulteration, crime, conflict		3%	
Weeds, weeding			
Post harvest processing or storage		9%	
Any other problems			
nominations=	**31**	**32**	**16**

Wheat main challenges	**FO %**	**Interm. %**	**IARC %**
Any challenge with cultivation practices and harvesting	17%	16%	5%
Tools, machinery and irrigation equipment	17%	8%	5%
Weeds, weeding	12%		
Access to credit or finance/ high production costs	10%	12%	
Access to and quality of seed	7%	12%	14%
Any other problems	7%		
Access to, quality and use of fertilizer	5%		
Pest and diseases (incl. rodents, animals)	5%		23%
Training, knowledge, knowhow, awareness	5%	16%	
Institutional/regulatory/policy issues	5%	12%	
Access to, quality of pesticides and other inputs	2%	4%	

Natural resources- land and water availability	2%		23%
Low yields and poor quality	2%	12%	9%
Marketing	2%		
Post harvest processing or storage	2%		
Poor soil fertility			
Social issues- theft, adulteration, crime, conflict			
Labor, (shortage, price, etc.)			
Transport and infrastructure		4%	
Drought, flood, any climate related problem		4%	23%
nominations=	**42**	**25**	**22**

Sorghum main challenges	**FO %**	**Interm. %**	**IARC %**
Access to and quality of seed	20%	17%	19%
Drought, flood, any climate related problem	10%	8%	13%
Training, knowledge, knowhow, awareness	10%	5%	6%
Pest and diseases (incl. rodents, animals)	10%	11%	3%
Marketing	10%	12%	3%
Access to, quality and use of fertilizer	7%	2%	10%
Any other problems	5%	2%	10%
Access to credit or finance/ high production and input costs	5%	3%	6%
Tools, machinery and irrigation equipment	5%	8%	
Transport and infrastructure	5%		
Post harvest processing or storage	5%	9%	
Access to, quality of pesticides and other inputs	2%	2%	6%
Low yields and poor quality	2%	3%	3%
Institutional/regulatory/policy issues	2%	3%	3%
Social issues- theft, adulteration, crime, conflict	2%	3%	
Poor soil fertility		5%	10%
Any challenge with cultivation practices and harvesting		8%	3%
Weeds, weeding			3%
Natural resources- land and water availability		2%	
Labor, (shortage, price, etc.)		2%	
Total			
nominations=	**41**	**66**	**31**

Banana/plantain main challenges	**FO %**	**Interm. %**	**IARC %**
Marketing	21%	8%	
Natural resources- land and water availability	9%	4%	
Pest and diseases (incl. rodents, animals)	9%	8%	25%
Low yields and poor quality	9%	4%	13%
Transport and infrastructure	9%		
Access to, quality and use of fertilizer	6%	4%	
Institutional/regulatory/policy issues	6%	8%	13%
Drought, flood, any climate related problem	6%	8%	
Access to and quality of seed	3%	28%	25%
Access to, quality of pesticides and other inputs	3%	4%	

Any challenge with cultivation practices and harvesting	3%		13%
Labor, (shortage, price, etc.)	3%		
Tools, machinery and irrigation equipment	3%		
Access to credit or finance/ high production costs	3%	4%	
Training, knowledge, knowhow, awareness	3%		
Post harvest processing or storage	3%	8%	
Poor soil fertility		4%	
Social issues- theft, adulteration, crime, conflict		4%	13%
Weeds, weeding			
Any other problems		4%	
nominations=	**33**	**25**	**8**

LIVESTOCK

Main challenges: Cattle	**FO %**	**Interm. %**	**IARC %**
Breeds		8%	3%
Social problems (theft, fire, conflict)	17%	5%	
Access to land / natural pasture	14%	5%	3%
Feeding	13%	18%	38%
Animal health diseases and parasites	10%	3%	10%
Marketing (incl..road infr.)	10%	15%	3%
Training, knowledge, knowhow, awareness	8%	8%	3%
Water	4%	3%	
Veterinary services and medicines, vaccines	4%	7%	
High input costs, credit	4%	7%	3%
Institutional, regulatory, policy issues	4%	7%	3%
Animal reproduction, insemination, offspring	3%		3%
Tools, machinery and equipment	3%		
Low farm gate selling price for products	2%	3%	
Drought, flood, climate	1%	3%	10%
Processing / value adding	1%	2%	
Other problems	1%		
Low productivity (milk, meat, etc.)		7%	17%
Labor, (shortage, price, etc.)			
Shelter			
nominations=	**93**	**61**	**29**

Main challenges: Goats and dairy goats	**FO %**	**Interm. %**	**IARC %**
Animal health diseases and parasites	20%	14%	5%
Social problems (theft, fire, conflict,	15%	12%	5%
Feeding	13%	14%	55%
Access to land / natural pasture	11%	8%	
Marketing (incl. road infr)	7%	12%	5%
Breeds	5%	4%	
Institutional, regulatory, policy issues	5%	4%	
Water	4%		
Veterinary services and medicines, vaccines	4%	6%	

Low productivity (milk, meat, etc.)	4%	10%	14%
Training, knowledge, knowhow, awareness	4%	4%	5%
Other problems	4%		
Low farm gate selling price for products	2%	4%	
High input costs, credit	2%	2%	5%
Drought, flood, climate	2%	4%	9%
Animal reproduction, insemination, offspring			
Labor, (shortage, price, etc.)			
Shelter			
Tools, machinery and equipment			
Processing / value adding			
nominations=	**55**	**49**	**22**

Main challenges: Dairy cattle	**FO %**	**Interm. %**	**IARC %**
Feeding	17%	16%	69%
Marketing (incl road infr)	12%	16%	
Training, knowledge, knowhow, awareness	11%	19%	
Low productivity (milk, meat, etc.)	9%		6%
Breeds	7%	5%	6%
High input costs, credit	7%	8%	
Access to land / natural pasture	5%	5%	
Animal reproduction, insemination, offspring	5%		
Low farm gate selling price for products	5%		
Institutional, regulatory, policy issues	5%	3%	6%
Processing / value adding	5%	8%	
Tools, machinery and equipment	4%		
Social problems (theft, fire, conflict)	2%		
Animal health diseases and parasites	2%	3%	6%
Veterinary services and medicines, vaccines	2%	8%	
Water	1%	5%	
Labor, (shortage, price, etc.)			
Shelter			
Drought, flood, climate			6%
Other problems		3%	
nominations=	**82**	**37**	**16**

Annex 3: Overview of IARC top innovations

Annex 3 Overview of IARC top innovations

TOP INNOVATIONS DOCUMENTED	CONTACT DETAILS	REGION
AVRDC - VEGETABLES - Postharvest Training Center for vegetable crops.	Ngoni Nenguwo - Postharvest Specialist E: ngoni.nenguwo@worldveg.org T: +255753727820	East
AVRDC - CHILLI - 3 varieties. Nafama: 150 days, 8-15t/ha, medium level hotness, Nisondia: 10-22t/ha, several harvests per year, Semi arid zone, 150 days first harvest, medium level hotness, Bafarima: 145 days, 8-10t/ha, tolerance to humid heat, resistant to bacterial wilt, good conservation in hot temperatures.	Dr. Albert Rouamba albert.rouamba@worldveg.org mob +223 62 95 02 37 bureau 20 70 92 00 ext 215	West
AVRDC - OCCRA - (Gombo) 3 varieties, Variety Sasilon, improved local variety, 52 days 6t/ha, well adapted to cold season, also heat tolerant, semi arid zone| Batoumabè: 52 days, 3t/ha, good adaptation to cold and warm season, semi-arid zone.	Dr. Albert Rouamba albert.rouamba@worldveg.org mob +223 62 95 02 37 bureau 20 70 92 00 ext 215	West
AVRDC - ONIONS - 2 varieties, Founou founou 30t/ha red color, 130 days| semi arid zone| Lafia yellow 25t/ha good for fresh sale, good storage 150days cycle.	Dr. Albert Rouamba albert.rouamba@worldveg.org mob +223 62 95 02 37 bureau 20 70 92 00 ext 215	West
AVRDC - ROSELLE - Hibiscus subdariffa l. 2 varieties: L28: 1-2kg par plant, grown for leaf petals, leaves or grain, adapted for rainy and dry season in semi arid areas. Samandah: 2-3 kg/plant, adapted to rainy and dry season cultivation, red flower capsul, semi arid zone.	Dr. Albert Rouamba albert.rouamba@worldveg.org mob +223 62 95 02 37 bureau 20 70 92 00 ext 215	West
AVRDC - SQUASHES / COWPEAS - Nutrition and traditional vegetables recipes.	Hassan Mndiga - Training and outreach coordinator Email: hassan.mndiga@worldveg.org Tel: +255754626567	East
AVRDC - TOMATOES (4 varieties), 1 variety rich in Vitamin A Bèbi yereyé (12*higher), 23-36t ha, Keneya 20-30t/ha, heat tolerant, Semi arid zones et arid with irrigatoin|Nayeli 10-20t, very transport resistant, high tolerant but not humidity tolerant| Konica 10-20t, less heat tolerant, very transport resistant, arid and semiarid zones, 80-100 days duration.	Dr. Albert Rouamba albert.rouamba@worldveg.org mob +223 62 95 02 37 bureau 20 70 92 00 ext 215	West
AVRDC - TRADITIONAL CROPS - Distribution of local vegetable seed kits.	Dr Tsvetelina Stoilova - Genetic Resource Scientist, Email: tsvetelina.stoilova@worldveg.org, Tel: +255767982729	East
AVRDC - VEGETABLES - Peri-urban best practice hubs for increasing nutrition for consumers and employment for youth (moving youth to do farming as a business).	Dr Thomas Dubois, Regional director AVRDC, thomas.dubois@worldveg.org, +255 (27) 2553903	East
AVRDC - VEGETABLES - Public private partnership in vegetable seed multiplication and dissemination with a specific focus on tomato (Tanya and Tengeru 97 varieties).	Fekadu Dinssa, vegetable breeder, fekadu.dinssa@worldveg.org, +255 (27) 255 3093	East
BIOVERSITY INTERNATIONAL - GENDER - Gender integration - Norm and agency (CGIAR Gender Network).	Anne Rietveld - Associate Expert, Email: A.Rietveld@cgiar.org	East
BIOVERSITY INTERNATIONAL - GRAIN AND LEGUMES - seeds for needs.	Carlo Fadda PhD Genetic Diversity, c.fadda@cgiar.org , +254 20 7224000 switchboard, +254 20 7224505	East
CIAT - BIOFORTIFIED BEANS - High iron and zinc bean varieties suited to semi-arid areas that can improve human nutrition.	Eliab Simpungwe (CIAT-HarvestPlus) e.simpungwa@cgiar.org; +260 97 421 4152	Southern
CIAT - BIOFORTIFIED CASSAVA - High vitamin A cassava varieties suited to semi-arid areas that can improve human nutrition.	Eliab Simpungwe (CIAT-HarvestPlus) e.simpungwa@cgiar.org; +260 97 421 4152	Southern
CIAT - BIOFORTIFIED MAIZE - High Vitamin A maize varieties (already released GV665A, GV664A and GV 662A) suited to semi-arid areas that can improve human nutrition.	Eliab Simpungwe (CIAT-HarvestPlus) e.simpungwa@cgiar.org; +260 97 421 4152	Southern
CIAT - BIOFORTIFIED SWEET POTATO - High Vitamin A sweet potato varieties that are suited to semi-arid areas and improve	Eliab Simpungwe (CIAT-HarvestPlus) e.simpungwa@cgiar.org; +260 97 421	Southern

TOP INNOVATIONS DOCUMENTED	CONTACT DETAILS	REGION
human nutrition.	4152	
CIAT - FODDER - Improved fodder variety Bracaria mulatu-2 (hybrid) well adapted to drought and poor soil fertility to bring more variability in fodder varieties (80% is napier grass).	Birthe Paul, b.paul@cgiar.org, +254 712179755	East
CIAT - MAIZE - Rapid assessment of soil fertility using simple and fast analysis tools.	Rolf Sommer, r.sommer@cgiar.org, +254 20 8632811	East
CIAT - MAIZE AND LEGUMES - Soil fertility management using conservation agriculture and biological nitrogen fixation.	Nelson Mango, social scientist, n.mango@cgiar.org	Southern
CIAT - MAIZE AND SOYBEAN - Integrated soil fertility management. organic manure plus chem. fertilizer, group approach to sharing resources, community service provision for various services as manure transport, contour construction, labor sharing, contour management, soil and water conservation, drought tolerant maize DTA.	Fred Kuzito PhD, f.kizito@cgiar.org +254 02 863 2810	East
CIMMYT - CONSERVATION AGRICULTURE -Conservation agriculture implements: a range of implements for manual, animal traction and tractor-driven land preparation.	Isaiah Nyagumbo i.nyagumbo@cgiar.org; +263 772 238 284	Southern
CIMMYT - CONSERVATION AGRICULTURE: a suite of agronomic practices best suited to the sub-humid areas that are focused on maize production, but which also involve the integration of associated crops - including cotton and sunflower.	Christian Thierfelder; +263 772 815230; c.thierfelder@cgiar.org	Southern
CIMMYT - MAIZE - Drought tolerant maize varieties suited to semi-arid areas and adapted to handle the effects of climate change.	Peter Setimela; psetimela@cgiar.org +263 772 963 436	Southern
CIMMYT - MAIZE - Hand-held NDVI sensor for detection of nitrogen deficiencies in crops.	Frédéric Baudron (PhD), Cropping System Agronomist, Email: F.Baudron@cgiar.org	East
CIMMYT - MAIZE - Insect resistant maize varieties that reduce losses during production and storage.	Peter Setimela; psetimela@cgiar.org +263 772 963 436	Southern
CIMMYT - MAIZE - Metal silos for the storage of grain at household level and which make use of oxygen deprivation technology.	Addis Teshome, a.t.kebede@cgiar.org; 0771 929200 (Maize entomologist)	Southern
CIMMYT - WHEAT - Danda'a Wheat Variety for highland regions.	Dr Bekele Abeyo - Senior Scientist, Wheat Breeder; Email: b.abeyo@cgiar.org	East
CIP - POTATOES - Irish potato: 3 varieties (so far 25 registered in country) 1 variety resistant to phytophtora (holds for 6-8 years), Gudene (mid tolerant, Beleete (highly tolerant), 25-25t/ha, can be cultivated in small and big rainy season, Main rains, altitude 1500-3000m, winter 1000-300m, short vegetation period 3-4 month, traditional take 5 months, storage is similar, improved storage technique for seed.	Steffen Schulz CIP Etiopia s.schulz@cgiar.org +251 920 054 561	East
CIP - SWEET POTATO - Dual Purpose Sweet Potato for Food and Feed for tropical and sub tropical climate	Steffen Schulz CIP Etiopia s.schulz@cgiar.org +251 920 054 561	East
CIP - SWEET POTATO: orange flesh sweet potato rich in Vit A (4 varieties) drought resistance, lazy farmer crop, human and animal nutrition, 400m-2000m, 3-400 are sufficient but should be well distributed, flood tolerant, few diseases.	Steffen Schulz CIP Etiopia s.schulz@cgiar.org +251 920 054 561	East
ICARDA - AGRONOMIC CROPS - Promoting on-farm/in situ conservation of dry land agro biodiversity.	Dr. Ahmed Amri, Phone: +212 5 37 71 49 75. Email: a.amri@cgiar.org	North
ICARDA - CROPS - Genetic Resources Climate Change Trait Capture.	Dr. Abdallah Bari, a.bari@cgiar.org	North
ICARDA - FIGS - Focused Identification of GERMPLASM Strategy (Figs) to search for climate adaptive traits en gene banks.	Dr. Abdallah Bari; a.bari@cgiar.org	North
ICARDA - INSTITUTIONAL INNOVATION - Genetic Resources and Climate Change Platform.	Dr. Abdallah Bari, a.bari@cgiar.org	North
ICARDA - INTEGRATED SYSTEM - Natural resources management using participatory approach.	Dr. Ali Nefzaoui; a.nefzaoui@cgiar.org, Phone: (+ 216) 71 752 134 / 71 752 099; Fax: (+ 216) 71 753 170	North

TOP INNOVATIONS DOCUMENTED	CONTACT DETAILS	REGION
ICARDA - WHEAT - Deficit supplemental irrigation on wheat.	Dr. Mohamed Karrou, m.karrou@cgiar.org	North
ICARDA - WHEAT - Durum production and stress tolerant durum wheat.	Dr. Miloudi Nachit, Durum wheat breeder, m.nachit@cgiar.org	North
ICARDA - WHEAT - Wheat varieties tolerant to diseases or insects	Dr. Mustapha El Bouhsini, Phone: Email: m.bohssini@cgiar.org;	North
ICIPE - BEES - Bee health and pollination services. Pollination has many positive environmental effects. Herbal pesticide to control varroa. All across Africa. Combined with artificial insemination to breed for honey yield and varroa resistance.	Prof Suresh Kumar Raina sraina@icipe.org +254 722488844	East
ICIPE - BEES - Innovations to assess the floral cycle of trees and plants important for honey production.	Tobias Landmann- tlandmann@icipe.org, +254 20 8632716	East
ICIPE - CATTLE - Tse tse repellent collars for cattle. For all areas where Tse Tse is present. Sub humid areas. Semi arid mainly free of tsetse. Cost is 4,5 US $ per month (not mass produced), Drug cost are 2.4 $/months.	Rajinder Kumar Saini PhD, s.raina@icipe.org +254 20 86 320010	East
ICIPE - CATTLE/SHEEP/GOATS - Rift valley fever control. Livestock and human are endangered. Develop attractants for control of pests of mosquitoes and sand flies. (Malaria and, Dengue,) wide spread in east Africa, Kenya the hub of the disease.	Prof. Baldwyn Torto +254 20 863 2000 btorto@icipe.org	East
ICIPE - HORTICULTURAL CROPS - Innovations in biopesticide (1. campaign" (icipe 69) against millibug in roses and citrus, and controls thrips and fruit fly) registered in SA, Ghana, Kenya, Ethiopia and Mozambique) 2. "Achieve" Icipe 79 for control of red spider mite registered in SA, Kenya and Ethiopia) for pest management.	Maniania, Nguya Kalemba [nmaniania@icipe.org], insect pathologist, +254-20-8632072	East
ICIPE - MAIZE - Biological control of alien invasive pests by characterizing virus and developing management tools for Maize Lethal Necrosis (MLN) in maize.	Subramanian, Sevgan [ssubramania@icipe.org], scientist THRIPS IPM programme, +254 20 8632010	East
ICRAF - AGROFORESTRY - Conservation agriculture with trees (CAWT) / evergreen agriculture is the practice of integrating trees (to improve soil fertility) and conservation agriculture and is suited to the semi-arid areas.	Livai Matarirano (Country Representative) L.Matarirano@cgiar.org	Southern
ICRAF - AGROFORESTRY - Conservation Agriculture With Trees (CAWT).	Jonathan Muriuki: E; j.muriuki@cgiar.org; Tel: 0722866773	East
ICRAF - AGROFORESTRY - Development of reference scenarios for REDD+: Reducing emissions from deforestation and forest degradation (REDD) is a mechanism with the twin objectives of mitigating climate change through enhanced forest management in developing countries: vegetative propagation of indigenous trees, soil fertility improvement with agro forestry practices, etc.	Mireille Feudjio and Dieudonné Alemaji/E-mail: d.alemaji@cgiar.org; feutsami@yahoo.fr	West
ICRAF - AGROFORESTRY - Extension of agro forestry practices through Rural Resource Centers (RRC).	Ann Degrande/E-mail: a.degrande@cgiar.org; Tel: +237-79529773	West
ICRAF - AGROFORESTRY - Fruit trees - especially the domestication of indigenous fruit-bearing trees to improve human nutrition.	Livai Matarirano (Country Representative) L.Matarirano@cgiar.org	Southern
ICRAF - AGROFORESTRY - Group sales and Community market information system (MIS) for agro forestry tree products.	Charlie Mbosso and Godwill Nimino/E-mail: c.mbosso@cgiar.org; g.nimino@cgiar.org	West
ICRAF - AGROFORESTRY - Improvement of soil fertility with agro forestry practices.	Takoutsing Bertin/E-mail: b.takoutsing@cgiar.org; Tel: +237-75615301	West
ICRAF - AGROFORESTRY - The identification of suitable species and practices for the establishment of live fences.	Livai Matarirano (Country Representative) L.Matarirano@cgiar.org	Southern
ICRAF - AGROFORESTRY - The identification of suitable tree	Livai Matarirano (Country	Southern

TOP INNOVATIONS DOCUMENTED	CONTACT DETAILS	REGION
species and technologies for the production of bio pesticides.	Representative) L.Matarirano@cgiar.org	
ICRAF - AGROFORESTRY - Tree fodder banks, comprising species adapted to semi-arid areas that provide a source of feed for livestock.	Livai Matarirano (Country Representative) L.Matarirano@cgiar.org	Southern
ICRAF - AGROFORESTRY - Vegetative propagation of indigenous fruit trees.	Tsobeng Alain/E-mail: atsobeng@cgiar.org	West
ICRAF - INSTIITUTIONAL INNOVATION - Rural resource center for learning and exchange.	Jonathan Muriuki: E; j.muriuki@cgiar.org; Tel: 0722866773	East
ICRAF - INSTITUTIONAL INNOVATIONS - Tools to strengthen rural institutions.	Joseph Tanui, (ICRAF) [J.Tanui@cgiar.org]	East
ICRISAT - FODDER - Bana grass: This is a perennial fodder grass that is suited to semi-arid areas and can improve livestock production.	Andre van Rooyen (Country Representative) a.vanrooyen@cgiar.org	Southern
ICRISAT - GENERAL CROPS - Fertilizer micro dosing: The technology was designed to promote fertilizer application by resource poor farmers of the Sahel major crops such as millet and sorghum. 20-60 Kg/ha of fertilizer is applied in or near plant hills compared to 150 Kg/ha or more recommended, without yield decrease. The technology is supported by input stores establishment nearby to improve access to fertilizer and other inputs such as seed| and supported also by the establishment of warrantage stores to conserve grain for better prices and allow access to credit and markets.		West
ICRISAT - GOATS - Innovation platforms: These have been used specifically for goat value chain development. Marketing facilities have been constructed and are being used to create a pull factor for increased investment in goat production and management. The marketing activities are accompanied by support throughout the value chain.	Andre van Rooyen (Country Representative) a.vanrooyen@cgiar.org	Southern
ICRISAT - GROUNDNUT / PIGEONPEA - Groundnut-pigeon pea double-cropping system.	Oswin MM Madzonga omadzonga@gmail.com +265 888 340165	Southern
ICRISAT - MILLET - Improved pearl millet varieties (open pollinated 20, hybrids 6), min 300mm up to 700mm), duration 80 to 120 days, suitable for Sudan Sahelien zones across Africa, altitude max 500m, earlier flowering than traditional varieties.	Tom Hash, c.hash@cgiar.org, +2227 2072 2529 ext 1315	West
ICRISAT - MILLET / GROUNDNUT - Use of the lysimeter to allow the assessment of combined drought, low nutrient, and heat tolerance of millet and groundnut varieties that can be promoted for adaptation to climate change.	Falalou Hamidou, crop physiologist (groundnut and millet), f.hamidou@cgiar.org	West
ICRISAT - MILLET / SORGHUM - Integrated striga management, for all of Africa (sorghum, millet, maize).	Eva Weltzien e.weltzien@cgiar.org, Tel +223 75 44 76 99	West
ICRISAT - MILLET AND SORGHUM - Micro-dosing of inorganic fertilizer (NPK (15-15-15) or ammonium phosphate) in planting pockets of millet and sorghum.	Mahamadou Gandah, m.gandah@cgiar.org, +227 20 73 2529	West
ICRISAT - SORGHUM - Drought tolerant sorghum varieties.	Oswin MM Madzonga omadzonga@gmail.com +265 888 340165	Southern
ICRISAT - SORGHUM - Sorghum varieties (open polinating 25| hybrids 6)| Sudanian zone, 700-1100mm rainfall, most varieties flower in between 5.9 to 10.10| poor soil fertility adaptation, striga resistance, fodder qualities, insect midge resistance, different grain qualities, micro nutrient content.	Eva Weltzien e.weltzien@cgiar.org, Tel +223 75 44 76 99	West
ICRISAT - TOMATOES - African Market Garden- integrated horticultural production package based on low pressure drip irrigation.	Saidou Abdoussalam, s.abdoussalam@cgiar.org	West
IFPRI - POLICY - Comprehensive African Agriculture Development	Dr Detaw Tadesse Email:	East

TOP INNOVATIONS DOCUMENTED	CONTACT DETAILS	REGION
Programme (CAADP).	g.tadesse@cgiar.org	
IITA - BANANA - Entomopathogens for the microbial control of the banana weevil.	Dr. Rachid Hanna/Tel: +237-70190066	West
IITA - CASSAVA - High yielding, pest and disease resistant cassava varieties including yellow root cassava.	Dr. Rachid Hanna/Tel: +237-70190066	West
IITA - CASSAVA - Locally developed cassava processing equipment.	AA Nganga 0999 587 061 a.nganga@cgiar.org	Southern
IITA - CASSAVA - The rapid seed multiplication method for cassava which improves access to high quality planting material and is suited for use in semi-arid areas.	AA Nganga 0999 587 061 a.nganga@cgiar.org	Southern
IITA - COCOA - Designing development projects/PDD for low emission in the forest zone.	Dr. Yemefack Martin/Tel: +237-94144812	West
IITA - FRUIT - Biological control of insect pests of fruits and vegetables with parasitoids: Aphidius colemani| Diaretiella repoe| Fopius arisamus.	Dr. Rachid Hanna/Tel +237-70190066	West
IITA - GENERAL - Integrated soil fertility management.	Dr. Rachid Hanna/Tel: +237-70190066	West
IITA - SOYABEAN - A promiscuous variety of soya suited to semi-arid areas, which fixes nitrogen without requiring inoculants.	Lizzie Kachulu l.kachulu@cgiar.org +265 995 226 331	Southern
IITA - SOYABEAN - A soya seed supply system for the semi-arid areas that is a non-technical innovation that improves the availability of high quality seed.	Office Mulekano o.mulekano@cgiar.org 088 107 3790	Southern
IITA - SOYABEAN - Inoculation of soya seeds to boost yields and promotion of soya varieties that are drought resistant in three different agro-ecological zones targeted at HIV/AIDS victims.	Dr Therese Gondwe, t.gondwe@cgiar.org, IITA Zambia-Lusaka, +260 211 840365	Southern
IITA - SOYABEAN - Nodumax. Biological agent to improve nitrogen fixation of legumes. Soybean. Tested in 13 countries. Sub-humid zone, rain fed regions, probably works on all soils (more research ongoing). Yield increase of 30% for the legume soya.	Cargele Masso c.masso@cgiar.org +254 708 090 089	East
IITA - SOYABEAN - Technology for the production of soya inoculants to improve production.	Rachel - (via Office Mulekano) 088 107 3790 o.mulekano@cgiar.org	Southern
IITA - SOYABEAN - The establishment of a soya innovation platform (through the Miracle Project) which brings different role-players together to strengthen the value chain.	Benedict Kanyika - B.Kanyika@cgiar.org	Southern
ILRI - CATTLE - Hormone assisted mass insemination. Improvement for artificial insemination. Hormones help to mass mobilize many animals in one go to inseminate many cows per village.	Dr. Dirk Hoekstra ILRI Etiopia d.hoekstra@cgiar.org +251 116 17 24 22	East
ILRI - CATTLE / DAIRY CATTLE - East coast fever (ECF) life vaccine. CARI developed it first 30 years ago. Gulf med and Cari invovled. Malawi will now produce the vaccine. 12 countries in east, central and southern AFrica are affected; 1 million cattle die each year. Endemic disease.	Vish Nene, Dir, Vaccine Biosiences Program, n.nene@cgiar.org +254 20 422 3370 ILRI	East
ILRI - FODDER - Alternative Feed seeds (Forage)	Dr Jean Hanson E: j.hanson@cgiar.org	East
ILRI - FODDER - Cultivation and use of leguminous fodder (Lablab purpureus, mucuna pruriens, vigna anguiculata) to promote beef, dairy and goat production in integrated smallholder crop livestock systems, semi arid zone, sub humid zone, wide rainfall tolerance, for arable fodder production, to supplement pastures.	Godfrey Manyawu, g.manyawu@cgiar.org; 263 775 320 400	Southern
ILRI - FODDER - Napier grass, disease tolerant against smut fungus, Kakamega 1 and Kakamega 2, ILRI Kari partnership, for highlands of east Africa above 1500m.	Dr Isabelle Baltenweck, i.baltenweck@cgiar.org phone + 254204223000	East
ILRI - GOATS AND CATTLE - Dry season feeding techniques (including manual grass baling, silage making, forage trees - including leucaena and morura, crop residue use) for feeding cattle and goats in the semi-arid areas.	Saskia Hendrickx, ILRI, Country Representative +258 820896645, Hendrickx, S.Hendrickx@cgiar.org	Southern
ILRI - LIVESTOCK - Index Based Livestock Insurance (IBLI).	Dr Apurba Shee Email: a.shee@cgiar.org Tel: +254700007083	East

TOP INNOVATIONS DOCUMENTED	CONTACT DETAILS	REGION
IRRI - RICE - Komboka and Tai rice varieties.	Dr. Zakaria Lamus Alune Kanyeka, Email: z.kanyeka@irri.org	East
IRRI - RICE - Rice knowledge bank.	Dr. Zakaria Lamus Alune Kanyeka, Email: z.kanyeka@irri.org	East
IWMI - IRRIGATION / ONIONS - Adaptive management for groundwater for household irrigation.	Dr Alemseged Tamiru Haile Email: a.t.haile@cgiar.org Tel: 0923213030	East
WORLDFISH - FISH - Solar drying technology for preserving fish rather than using traditional methods that rely on wood or charcoal.	Simbotwe Mwiya (S.Mwiya@cgiar.org)	Southern
WORLDFISH - GOVERNANCE - Institutional innovation that allows for the co-management of natural resources (especially water resources).	Elias Madzudzo e.madzudzo@cgiar.org; 0974 779 574	Southern

TOP INNOVATIONS MENTIONED BY REGIONAL REPRESENTATIVES BUT NO INTERVIEWS WERE DONE WITH SCIENTIST		
IRRI - RICE - New varieties - Makaassane (for irrigated production); M'ziva (for rain fed lowland areas).	Carlos Zandamela Liaison scientist - carloszandamela@gmail.com - Mobile +258 82 30 62 373; land line: +258 21 462 508	Southern
IRRI - RICE - Clusters for linking producers and millers and strengthening value chains.	Carlos Zandamela Liaison scientist - carloszandamela@gmail.com - Mobile +258 82 30 62 373; land line: +258 21 462 508	Southern
IRRI - RICE - Two-wheel tractor drawn implements for land preparation and leveling.	Carlos Zandamela Liaison scientist - carloszandamela@gmail.com - Mobile +258 82 30 62 373; land line: +258 21 462 508	Southern
IRRI - RICE - Post harvest storage technologies involving oxygen deprivation to kill pests.	Carlos Zandamela Liaison scientist - carloszandamela@gmail.com - Mobile +258 82 30 62 373; land line: +258 21 462 508	Southern
IWMI - INSTITUTIONAL - An approach to unpack gender issues related to water use at a household level.	Barbara van Koppen B.VanKoppen@cgiar.org Skype: barbaravankoppen	Southern
IWMI - INSTITUTIONAL - Multiple-use water services - an approach for public sector water provision.	Barbara van Koppen B.VanKoppen@cgiar.org Skype: barbaravankoppen	Southern
IWMI - INSTITUTIONAL Review of national water legislation to recognize customary water use / traditional water management systems and redress inequities of water distribution to smallholders.	Barbara van Koppen B.VanKoppen@cgiar.org Skype: barbaravankoppen	Southern
WORLDFISH - AQUACULTURE - Integrated aquaculture-agriculture system involving livestock-fish ponds-crops.	Joseph Nagoli (Research fellow) Mobile +265 888403154 J.Nagoli@CGIAR.ORG	Southern
WORLDFISH - INSTITUTIONAL - Catchment water assessment model that maps water availability in a sub-catchment (developed with IWMI).	Joseph Nagoli (Research fellow) Mobile +265 888403154 J.Nagoli@CGIAR.ORG	Southern
WORLDFISH - AQUACULTURE - Technology for solar drying (also documented in Zambia but developed in Malawi).	Joseph Nagoli (Research fellow) Mobile +265 888403154 J.Nagoli@CGIAR.ORG	Southern
WORLDFISH - AQUACULTURE - A smoker for fish smoking that uses much less wood.	Joseph Nagoli (Research fellow) Mobile +265 888403154 J.Nagoli@CGIAR.ORG	Southern
WORLDFISH - AQUACULTURE - A pro-poor fish fingerling production and distribution model that involves an individually owned central hatchery producing Tilapia fry and satellite hatcheries that grow fry into fingerlings and sell them to out growers.	oseph Nagoli (Research fellow) Mobile +265 888403154 J.Nagoli@CGIAR.ORG	Southern

Annex 4: East Africa report

Annex 4: East Africa report

1 DATA COLLECTION

1.1. Countries and commodities

Interviews were conducted for farmer organizations (FOs), Intermediaries (NGOs, GIZ, Private Sector) and International Agricultural Research centres (IARCs) in Kenya, Tanzania, Ethiopia, Uganda and Rwanda. The countries were selected through sets of criteria which also included the FAO AEZ classifications based on the Length of Growing Period (LGP) as shown in table 1 below.

Table 1: Summary of approximate percentages of AEZs making up land areas in selected countries

Country	Arid	Semi-arid	Sub-humid	Humid
	LGP* <75 days	LGP 75-180 days	LGP 180-270	LGP >270
	Area land	*Area land*	*Area land*	*Area land*
Kenya	60	21	5	14
Uganda		10	50	40
Ethiopia	35	30	30	5
Tanzania	5	55	30	10
Rwanda			80	20

A total of 141 interviews were conducted across the five countries and table 2 below provide details per country and per category. Most interviews in East Africa were conducted with Farmer organizations, NGOs and researchers while the government agencies were least interviewed

Table 2: Summary of stakeholder interviewed per country per category

Country	Farmer Org.	Intermediaries				IARC	
		GIZ	NGO	Private sector	Gov't	Strategic S1	S2 Top innovations
Kenya	6	2	19	3	1	5	17
Tanzania	10	0	7	3	2	2	7
Ethiopia	4	2	4	3	0	0	9
Uganda	13	2	13	1	0	0	1
Rwanda	8	0	4	2	1	0	0
Total	**41**	**6**	**37**	**12**	**3**	**7**	**34**

Interviews per commodities

The study covered a range of commodities however majority of response were for maize, potato, sorghum, banana, wheat and cassava while in the livestock sector, cattle and dairy cattle topped the list. There was no significant response gathered from the region on agro forestry and trees. Table 3 and 4 below shows the number of interviews conducted per commodity per category.

Table 3: Summary of stakeholders interviewed on crops

	Maize	Potato	Sorghum	Rice	Banana/Plantain	Wheat	Cassava
FOs	8	4	1	2	2	2	4
Interm.	13	5	6	4	4	2	2
IARC S2	5	1	1	2	1	2	0
Total	**26**	**10**	**8**	**8**	**7**	**6**	**6**

Table 4: Summary of stakeholders interviewed on livestock

Countries	Cattle	Dairy cattle	Sheep	Goats	Poultry
FOs	1	5	0	0	1
Interm.	3	2	2	0	2
IARC S2	10	5	6	6	0
Total interviews	**14**	**12**	**8**	**6**	**3**

1.2. Target Stakeholders

Farmer organizations, intermediaries, International Agricultural Centres (IARCs) and to some extent the National Agricultural Research (NARs) and public extension were the main stakeholders interviewed in the five countries of East Africa. Table 5 below gives a summary of the stakeholder interviewed and some of the issues discussed.

Table 5: Summary of stakeholders interviewed

Countries	IARCs	Intermediaries	Farmer Organizations
Kenya	Kenya is host to a number of IARCs such as ICRAF, ICIPE and ILRI. Other centres are also well represented through their regional offices. This was the main reason majority of scientists interviewed were based in the country. Despite their presence in the country, a number of their top innovations targeted the entire region. A total of 17 top innovations were proposed by the scientists and 5 centre and regional directors were interviewed.	The intermediaries interviewed included those from the NGOs, Private sector, GIZ country bilateral projects, the NARs and the NAES. A total of 19 NGOs spread across the country were interviewed and 3 private sector players. 2 GIZ bilateral programmes were also interviewed and 1 government research agency in Embu. The NGOs interviewed were involved in transfer of innovations through donor funded projects while the private sector was mainly from the input supply side.	A total of 6 farmer organizations were interviewed. Some were commodity specific while others were general and they represented farmers at different levels. For instance, East Africa Farmer Federation (EAFF) and East Africa Grain Council (EAGC) represented farmers at East Africa regional level while national potato council represented potato farmers at national level. Kenya National Farmer Federation (KENAFF) represented all farmers at national level irrespective of the commodity.
Tanzania	A total of 7 top innovations mainly from AVRDC and IRRI were captured and the representatives of both organizations also provided strategic information on behalf of the centres.	In Tanzania, a total of 7 NGOs, 3 private sector players and 2 government agencies were interviewed under this category. A number of NGOs and private sector players interviewed were regional based thus provided representative views on the issues under investigation.	A total of 10 farmer organizations were interviewed. Some FOs represented farmers at national level and were more general such as MVIWATA and ACT while others were commodity specific such as CHAWAMPU (Organization for rice farmers in Morogoro). Tanzania had no single umbrella national farmer organization apart from MVIWATA which is a network of primary farmer organizations and Agricultural Council of Tanzania (ACT) which mainly represented large scale and agribusiness interests.
Ethiopia	A total of 9 top innovations were captured mainly from CIMMYT, IFPRI, IWMI and CIP. No strategic interview was conducted with any of the regional directors.	In Ethiopia, a total of 4 NGOs, 3 private sector and 2 GIZ bilateral programmes were interviewed. The NGOs interviewed were mainly international such as SNV and ACDI Voca and were involved in the promotion of innovations and market related approaches.	Farmer organizations in Ethiopia are structured depending on the geographic coverage and the nature of services offered to farmers. The smallest FO focusing on single commodity with about 10 members are referred to as cooperatives while those involved in multi commodities are referred to us unions. At the national level farmers are represented by federations. 4 farmer organizations at the levels of unions were interviewed across different commodities.
Uganda	Only a single interview on top innovation was conducted with Bioversity.	A total of 13 NGOs were interviewed in Uganda and 1 private sector player. A number of NGOs interviewed was involved in both promotion of innovation and lobbying and advocacy for the interest of smallholder farmers. 2 GIZ bilateral project in the area of climate change were also	Farmer organizations in Uganda are structured from primary specific commodity cooperatives to national farmer federation such as Uganda National farmer Federation (UNFFE) and Uganda Cooperative Alliance both of which were interviewed. Some specific commodity cooperatives interviewed included Uganda Grain Growers who were contracted by Nile brewers to supply sorghum.

Countries	IARCs	Intermediaries	Farmer Organizations
		interviewed	
Rwanda	There was no interview conducted in Rwanda under this category.	4 NGOs and 2 private sector organizations were interviewed. The focus of the NGOs were promotion of innovations while private sector focused on input distribution and market access	Two of the biggest farmer organizations; IMBARAGA and INGABO were among the 8 interviewed FOs in Rwanda which also included other commodity specific. The two national FOs were also providing extension services to farmers which was a unique feature

2 DEMAND AND SUPPLY FOR AGRICULTURAL INNOVATIONS

2.1 Demand for innovations: The challenges faced by farmers

The demand for innovations in Africa was highlighted in the main report. The data for East Africa indicates the main overall trends. However, some more specific regional findings are outlined here:

Access to and quality seeds
Seed adulteration cases were reported as rampant in Kenya, Uganda and Tanzania. This had negative effect on a number of farmers according to the FOs and NGO representatives interviewed. They indicated that majority of farmers especially smallholder had lost faith in the quality of seed available at the retail outlets and as such some were resorting to multiplying their own local seed varieties and selling/sharing amongst themselves. In Rwanda for instance, farmer groups were involved in the multiplication of maize, potato and rice seeds and the government agency (Rwanda Agricultural Board) offered guaranteed market. The agency would afterwards distribute/sell to other farmers. In Ethiopia, the government through the Ethiopian Seed Enterprise (ESE) was responsible for the distribution/sale of the seed and adulteration of seed wasn't a major problem. In countries where the regulator was in total control the main drawback was scarcity/access to seed by majority of the farmers especially at the onset of the season. In Uganda for instance, there was a reported case where a private company purchased maize from the farmers, had it coloured, packed and sold back to the very farmers it came from in pretext that the seed was certified.

As regards other types of seeds such as Cassava, potato, tubers and suckers the main challenge was access to clean planting materials which were not commercially available at the local retail outlets. Some of the critical issues related to seed quality which came up were beyond the scope of researchers however they could assist in development of models and policy briefs to aid policy formulation in support of the sub sector.

The role of farmers in the process of seed evaluation was pointed out by FOs and intermediaries as very critical but more often than not overlooked.

The fear of Genetically Modified Organisms (GMO) seeds by FOs and intermediaries was encountered frequently and that added to some mistrust that FOs have on emerging innovations that come from IARCs. The biggest fear was the total replacement of local seed varieties with hybrid seed. They argued that such a move would subject majority of smallholder farmers to greater poverty since they wouldn't be able to afford the cost of hybrid seeds. One intermediary representative from Uganda put it this way *"To us food is an identity, by a taste of food, one is able to know the origin of the cook. It is this heritage that researchers should respect by promoting and working more on local varieties"*

Marketing
Access to market was identified as a key hindrance to the uptake of innovations and it topped the priority for FOs and intermediaries while researchers focused more on high yielding varieties according the study findings from the Africa wide data.
Market dynamics are determined by factors beyond the control of farmers including both national and regional trade policies. In Tanzania for instance farmers produced with the regional target market in mind. However, due to export controls, farmers were not allowed to export cereal to Kenya yet the prices in Kenya were much better than in Tanzania. IFPRI in one of its discussion paper No 00947 (2010) entitled Agricultural Growth, Poverty and Nutrition in Tanzania advised against imposing restriction on regional export of agricultural communities. In Ethiopia on the other hand millers are forced to shut up their operation once they exhaust the local cereal stock due to stringent importation procedures.

Pests and diseases
Pest and diseases were identified by a number of stakeholders interviewed as a major challenge to farmers. This could be attributed to the minimal use of chemical pesticides as reflected in the study findings which show that about 68 of farmers either use very little or no pesticide in their farms. While most of pest and diseases could be controlled through available medicine, pesticides or IPM, some had no solution so far: e.g. Maize Lethal Necrosis Disease (MLND).

Cassava mosaic disease was also reported widely by farmers. A new short term variety developed by researchers offered better resistance to the disease and the yields were much higher than the local varieties. However farmers were not happy that the variety required them to harvest at once instead of the partial and progressive harvesting method they were accustomed to. The partial harvesting helped against lack of storage facility and guaranteed long term household food security.

Tables 6-9 below show the result of the coded responses from the FOs, intermediaries and scientists on the challenges affecting some specific commodities in East Africa region.

Table 6: Challenges of the farmers for Maize

MAIZE main challenges	FO %	Interm%	IARC%
Access to and quality of seed	23	14	
Access to, quality and use of fertilizer		3	
Access to, quality of pesticides and other inputs	2	2	7
Any challenge with cultivation practices and harvesting	2		7
Natural resources- land and water availability	2	6	
Poor soil fertility		3	20
Pest and diseases (incl rodents, animals)	2	8	20
Social issues- theft, adulteration, crime, conflict	11	8	
Low yields and poor quality		3	13
Tools, machinery and irrigation equipment	4	2	
Access to credit or finance/ high production costs	9	3	
Training, knowledge, knowhow, awareness	7	6	20
Transport and infrastructure	4		
Institutional/regulatory/policy issues	9	17	
Drought, flood, any climate related problem	9	11	
Marketing	9	5	7
Post harvest processing or storage	9	8	
Any other problems		3	7
nominations=	56	65	15

Table 7: Challenges of the farmers for Cassava.

Cassava main challenges	FO%	Interm%
Access to and quality of seed	12	26
Access to, quality and use of fertilizer		
Access to, quality of pesticides and other inputs	4	
Any challenge with cultivation practices and harvesting		3
Natural resources- land and water availability	4	5
Poor soil fertility		
Pest and diseases (incl. rodents, animals)	16	26
Social issues- theft, adulteration, crime, conflict	8	3
Tools, machinery and irrigation equipment	8	
Access to credit or finance/ high production costs	4	
Training, knowledge, knowhow, awareness	4	5
Transport and infrastructure	8	3
Institutional/regulatory/policy issues	4	
Drought, flood, any climate related problem	4	5
Marketing	8	11
Post harvest processing or storage	12	11
Any other problems	4	3

Cassava main challenges	FO%	Interm%
nominations=	25	38

Table 8: Challenges of the farmers for Potato

Potato main challenges	FO %	Interm %.	IARC %
Access to and quality of seed	29	27	
Access to, quality and use of fertilizer			
Access to, quality of pesticides and other inputs	5		
Any challenge with cultivation practices and harvesting		8	50
Natural resources- land and water availability	10		
Poor soil fertility	5	4	
Pest and diseases (incl. rodents, animals)	5	4	
Social issues- theft, adulteration, crime, conflict		15	
Low yields and poor quality		4	50
Access to credit or finance/ high production costs	5	4	
Training, knowledge, knowhow, awareness			
Transport and infrastructure	5	4	
Institutional/regulatory/policy issues	14	12	
Marketing	14	15	
Post harvest processing or storage	5	4	
Any other problems	5		
nominations=	21	26	2

Table 9: Challenges of the farmers for Sorghum

Sorghum main challenges	FO %	Interm %	IARC %
Access to and quality of seed	20	19	
Access to, quality and use of fertilizer	5		
Access to, quality of pesticides and other inputs	5		
Any challenge with cultivation practices and harvesting		10	
Natural resources- land and water availability		2	
Poor soil fertility		2	
Pest and diseases (incl. rodents, animals)	15	12	
Social issues- theft, adulteration, crime, conflict	5		
Low yields and poor quality	5	5	
Weeds, weeding			
Labour, (shortage, price, etc.)		2	
Tools, machinery and irrigation equipment		5	
Access to credit or finance/ high production and input costs		5	
Training, knowledge, knowhow, awareness	10	7	
Transport and infrastructure	5		
Institutional/regulatory/policy issues	5	5	
Drought, flood, any climate related problem	5	7	100
Marketing	15	14	
Post harvest processing or storage	5	5	
nominations=	20	42	1

Tables 10 and 11 below show the result of the coded responses from the FOs, intermediaries and scientists on the challenges affecting some specific livestock commodities in East Africa region.

Table 10: Challenges of the farmers for Cattle

Main challenges: Cattle	FO %	Interm %	IARC%
Breeds		9	4
Access to land / natural pasture	20	14	4
Feeding		9	30
Water		9	
Social problems (theft, fire, conflict,	20	9	
Animal reproduction, insemination, offspring			4
Animal health diseases and parasites	20	5	13
Veterinary services and medicines, vaccines		9	
Low productivity (milk, meat, etc.)		5	22
Low farm gate selling price for products			
Labour, (shortage, price, etc.)			
Shelter			
High input costs, credit			4
Training, knowledge, knowhow, awareness	20	5	
Tools, machinery and equipment			
Institutional, regulatory, policy issues		5	
Drought, flood, climate		5	13
Marketing (incl. road infr)	20	18	4
nominations=	5	22	23

Table 11: Challenges of the farmers for dairy cattle

Main challenges: Dairy cattle	FO %	Interm %	IARC %
Breeds	**10**		9
Access to land / natural pasture	3	11	
Feeding	**16**	**11**	**64**
Water	3	11	
Animal reproduction, insemination, offspring	3		
Animal health diseases and parasites			9
Veterinary services and medicines, vaccines	3		
Low productivity (milk, meat, etc.)	**10**		**9**
Low farm gate selling price for products	**10**		
High input costs, credit	6		
Training, knowledge, knowhow, awareness	**10**	**22**	
Tools, machinery and equipment	3		
Institutional, regulatory, policy issues	3		
Drought, flood, climate			9
Marketing (incl road infr)	**16**	**22**	
Processing / value adding	3	11	
Other problems		11	
nominations=	31	9	11

2.2 The match between supply and demand

There were some matches between innovations from the IARCs and the needs expressed by farmers as summarized in the table below.

Table 12: Summary of matches/gaps in East Africa

Innovations/Research outcomes	Farmer needs
MATCH	
Sorghum (*Sorghum bicolor*) – Gadam variety: • Developed by ICRISAT/KARI 40 years ago • Ready market provided by East Africa breweries in Kenya and Nile breweries in Uganda 	• Lack good quality seed • They need solution for bird menace (Quelea quelea) • They require processing equipment • They want better coordination in order to meet the demand. • They prefer higher yield per unit area • They prefer community seed bank
Index based livestock insurance (IBLI). This innovation has been developed by ILRI and it aimed at designing, developing and implementing market mediated index-based insurance to	• Conflict resulting from the use of communal natural resources (pasture and water). • Lack of sufficient feed especially during drought periods

Innovations/Research outcomes	Farmer needs
protect livestock keepers from drought related asset losses, particularly those in the drought prone Arid and Semi-Arid Lands (ASALs). It represents an exciting innovation that could allow vulnerable rural smallholder farmers and livestock keepers to benefit from insurance and thus reduce climate-related risk.	• Diseases such as Redwater, Foot and Mouth Disease, Brucellosis etc. • Lack of improved local breeds • Weak market structures
GAP	
Maize Lethal Necrosis Disease • The maize lethal necrosis (MLN) disease first appeared in Kenya's Rift Valley in 2011 and quickly spread to other parts of Kenya, as well as to Uganda and Tanzania. Caused by a synergistic interplay of maize chlorotic mottle virus (MCMV) and any of the cereal viruses in the family, Potyviridae, such as Sugarcane mosaic virus (SCMV), Maize dwarf mosaic virus (MDMV), or Wheat streak mosaic virus (WSMV), MLN can cause total crop loss if not controlled effectively. • CIMMYT is leading a team of local and international researchers in the development of maize varieties that are resistant to MLND.	• Total destruction of maize. • Low performance of local varieties of maize • Adulteration of seed especially cereals and legumes • Lack of know-how with regard to fertilizer application • No solution yet

HYPOTHESES 1-5

Table 14 below shows that maize is a key food security commodity in the East Africa region while sorghum and cassava are emerging commodities as a response to climate change due to their high level of resilience. Under the livestock category, dairy cattle emerged top due to increasing demand for dairy products and growing trend of zero/tethered grazing. Poultry also emerged as a key commodity due to its significance at household level as a source of income and protein.

Table 14: Distribution of interviews per commodity

Crops	S2 %	FO%	Interm%	Livestock%	S2%	FO%	Interm%
Maize	8	30	20	Dairy cattle	12	50	16
Sorghum	2	9	9	Poultry	0	17	26
Cassava	0	9	12	Cattle	35	8	13
Potato	2	9	8	Dairy goats	0	8	8
Other specify	8	7	9	Pigs	0	8	3
Soybean	3	7	1	Other specify	24	8	5
Banana plantain	2	4	1	Fish in natural waters	0	0	0
Rice	3	4	5	Camel	6	0	11
Wheat	3	4	4	Goats	12	0	8
Beans dry	3	4	3	Sheep	12	0	11
Teff	0	4	2	Rabbits	0	0	0
Tomatoes	3	2	4	Coastal fish		0	_
Green beans	0	2	0	Aquaculture	0	0	0
Onions	2	2	1	Donkeys		0	_
Cabbages	2	2	5				
Groundnuts	0	0	7				
Cowpea	5	0	0				
Pumpkin/squash	2	0	0				
Millet	0	0	2				
Sweet potato	3	0	5				
Yams	0	0	0				
Chickpea	0	0	0				
Lentil	0	0	0				
Taro arrow root	0	0	0				
Spinach	2	0	0				
Barley	2	0	1				

Table 16 below show that majority of East African farmers are smallholder with between 1-12 acres. This statistic slightly contrast the Africa wide finding as illustrated in the table.

Table 16: Farm size of respondents in Africa and East Africa

Farm size	Africa%	EA%
<0.4 ha (<1 acre)	23	35
0.4 to 0.8 ha (12 acres)	22	38
0.8 to 1.6 ha (24 acres)	24	9
1.6 to 3 ha (48 acres)	14	9
> 3 ha (>8 acres)	17	9

3 LINKS BETWEEN ACTORS IN INNOVATION SYSTEM

HYPOTHESES 6 – 11

Table 17 below shows the comparison between East Africa and the Africa data on the views of farmer organizations and intermediaries on the quality of extension service. A large proportion are in both cases are dissatisfied with the quality of service provided by the NAES. In East Africa Region, more than 70 of both FOs and intermediaries rate the quality of service between medium and very poor. The strong sentiment is also confirmed by the Africa data as illustrated in the table. The results of individual countries also expressed strong sentiments with over 90 of FOs and intermediaries in Uganda expressing dissatisfaction and the government was in the process of reviewing the extension policy. In Kenya, the government policy of demand driven extension did not go well with the stakeholders since farmers were not sensitized enough to demand the services.

Table 17: Comparison summary of the views of FOs and intermediaries on quality of extension service offered by NAES

Quality rating	East Africa		Africa	
	FO%	Interm%	FO%	Interm%
Very good + +	3	3	18	6
Good +	13	22	11	14
Medium	34	40	31	36
Poor -	32	29	17	29
Very poor - -	18	6	23	15

Table 18 below show the comparison between East Africa and the Africa data on the views of farmer organizations and intermediaries on the quality of service offered by the private sector. A large proportion in both cases is satisfied with the service and over 50 rate the service delivery between medium and very good. The issue of seed adulteration however came up strongly with both FOs and intermediaries blaming the private sector. The private sector on the other hand blamed it all on weak structures for enforcement of regulations.

Table 18: Comparison summary of the views of FOs and intermediaries on quality of extension service offered by the private sector

Quality rating	East Africa		Africa	
	FO%	Interm%	FO%	Interm%
Very good + +	10	5	18	7
Good +	36	17	22	36
Medium	26	31	15	24
Poor -	26	45	16	19
Very poor - -	3	2	29	15

4 CONCLUSIONS AND RECOMMENDATIONS

Demand and supply

- The study show that a great percentage of innovations with ability to address the challenges/needs expressed by farmers already exist however weak dissemination and extension services were identified as a key hindrance to diffusion and uptake of such innovations by the target beneficiaries.
- The study further showed that the cost of innovations was beyond reach of majority of the smallholder farmers. For instance the premium expected from the farmers in the Index Based Livestock Insurance (IBLI) innovation was beyond reach for most farmers.
- The farmer organizations and intermediaries blamed researchers for not doing enough to improve local varieties/breeds yet there was a strong market drive for local varieties/products. More research aimed at improving local varieties therefore would resonate well with majority of the population especially those residing in rural areas.
- The study showed that market was an important catalyst behind uptake of innovations especially from IARCs and the renewed interest in white sorghum by farmers 40 years after the innovation was rejected thanks to emergence of market opportunity should serve as a perfect lesson for innovators.
- In East Africa Region, issues that came up as needs of the farmers included;
    - Market access vis a vis the high yielding varieties that researchers put emphasis on. While farmers expressed need to quality high yielding varieties, they also wanted assurance on the market and accompanying value addition and post harvest technologies. They have no or very limited storage capacity and the market glut that sets in at the end of the harvest season negatively affect their profitability.
    - Very few farmers especially smallholder have access to innovation as a result of weak agricultural innovation transfer structures and lack of affordability.
    - Pest and diseases especially MLND was highlighted as major challenges for the region due to the rate of spread of the disease. No solution yet but a team of virologist experts from CIMMYT and KARI were working on finding a solution.
    - Cassava, sorghum and sweet potato were some of the commodities which were making a strong come-back as a consequence of climate change adaptation. Sorghum in particular is preferred by a number of farmers in Kenya and Uganda due to rising demand from the brewers. The production levels were however reported to be low to guarantee better returns to the farmers. Diversification of alternative use of cassava and sweet potato were some of the potential areas for unlocking the potential of these commodities.
    - Regional trade barriers especially on cereals were negatively affecting the morale of farmers to produce. Tanzania occasionally restricted export of cereal thus denying farmers access to niche markets for their produce.

What innovations are impacting lives of farmers in the region most

There is a number of innovations which has been identified in the study as positively impacting on the lives of farmers in the region. The improved varieties that are being bred by IARCs and released through the NARS and multiplied by the private sector are having positive impact on the

farmers. The new varieties are high yielding within a short period and are designed for the market. The following were some of the innovations sampled by the study.

CIMMYT Innovations

Metal Silos

Maize is one of the most important staple food crops in Sub-Saharan Africa (SSA), providing food and income to well over 300 million resource-poor smallholders in eastern and southern Africa (ESA). Lack of appropriate grain storage technologies causes on an average 25 grain losses due to postharvest pests. Due to lack of adequate awareness and access to appropriate technologies, farmers end up selling their maize soon after harvest, only to buy it back at more than twice the price later in the season to meet their subsistence needs, resulting in a continual poverty trap.

CIMMYT through Effective Grain Storage for Better Livelihood of African Farmers Project (EGSP) developed metal silos which has revolutionized the way in which farmers store grains. The innovation is adaptable to any size of farmer thus it has had a good penetration to the target beneficiaries.

MLND research

The maize lethal necrosis (MLN) disease first appeared in Kenya's Rift Valley in 2011 and quickly spread to other parts of Kenya, as well as to Uganda and Tanzania. Caused by a synergistic interplay of maize chlorotic mottle virus (MCMV) and any of the cereal viruses in the family, Potyviridae, such as Sugarcane mosaic virus (SCMV), Maize dwarf mosaic virus (MDMV), or Wheat streak mosaic virus (WSMV), MLN can cause total crop loss if not controlled effectively. CYMMIT is leading a team of local and international virologist in the search for solution.

ILRI

Index Based Livestock Insurance

The innovation aims at designing, developing and implementing market mediated index-based insurance to protect livestock keepers from drought related asset losses, particularly those in the drought prone Arid and Semi-Arid Lands (ASALs). It represents an exciting innovation that could allow vulnerable rural smallholder farmers and livestock keepers to benefit from insurance and thus reduce climate-related risk. ILRI has piloted the project in ASAL regions of Northern Kenya and Southern Ethiopia and while there were a number of unresolved issues, the innovation is very promising for the livestock sector.

ICRISAT

Gadam Sorghum

Sorghum (Sorghum bicolor (L.) Moench) is widely grown as a food crop in Sub-Saharan Africa, but commercialization has proved difficult for several reasons. Sorghum is grown in marginal, semi-arid environments characterized by low and erratic rainfall. The recent competition for Africa's growing beer market has stimulated commercialization of sorghum to produce clear sorghum beer thus creating market opportunity for gadam sorghum produced by the farmers. The development of the value chain for sorghum beer has involved partnerships between national governments, multinational companies, plant breeders, intermediary suppliers, and sorghum growers. The study however found out that the levels of production were very low and could not meet the demand due to the fact that growers prioritize household food security and are therefore reluctant to sell, making it difficult for buyers to ensure a consistent supply. The potential in the value chain is huge however efforts will have to be put on sensitization and production.

Suggestions for collaboration of stakeholders

- Scientist should endeavor to involve farmers, intermediaries and private sector not only in the design of the research project but also in the implementation. This would greatly enhance diffusion and uptake potential for the innovation.
- While the relationship between IARCs and NARs is structured and based on mutual respect for the prevailing mandates, the relationship between research and intermediaries is not structured and only based on convenience. The intermediaries especially NGOs and private sector have a lot of resources that could be used to disseminate innovations on a win-win basis.
- Public extension is weak largely due to lack of resources, yet it remains the single largest extension system through which wide scale dissemination of innovations could be achieved.

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Annex

List of participants and contacts

Name	Organization	Contact
	Kenya	
Gerald Masila: CEO	East Africa Grain Council (EAGC)	gmasila@eagc.org
Mwangi Warui – technical manager	Dairy Goat Association of Kenya (DGAK)	dgak@jambo.co.ke Tel: 0721398906
Wachira Kaguongo	National Potato Council	nkaguongo@npck.org, npck@npck.org Tel. 0722597389/ 0725673745/ +254 20 233823
Booker Owuor: CEO	Kenya Smallscale Cereal Growers Association	Tel: 0724046732 Email: bookerwas@gmail.com
Patrick Kimani CEO	Kenya Livestock Producers Association	Tel: 0722310996/0712800335 Email: info@klpakenya.org
David Mshila - Senior Advisor PPP and Cross Cutting Issues	Promotion of Private Sector Development in Agriculture (PSDA)	
Petra Jacobi	Adaptation to Climate Change and Insurance (ACCI)	M +254 703 501587 E petra.jacobi@giz.de And Joab Osumba E: joab.osumba@giz.de
John Munene	Caritas Embu	Tel: 0728654478
Josephat Mbui Coordinator ICP	Baraka Agricultural College	
Charles Dyer - General Manager	Kisima farm	Email : charlie@kisima.co.ke
Leah Kaguara : Country Director	VSF-Belgium	Tel: +254 707181643/0722 575095 skype: leah.kaguara email: lkaguara@vsfb.or.ke
Everustus Okumu - Caritas Homa Bay Director	Caritas Homa Bay	Email: dids.homabay@yahoo.com
Paul Omollo Owino:	C-MAD	E: paomollo@yahoo.com T: 0720352554
Phillip Kajwang : CEO	CARD	
Shem Owaga: Programmes Officer	AKEFEMA	E: info@akefema.or.ke: T: 0717055465
Peter Mudy	ADS Western	
Oscar Nekesa	ADS Western	
Maurice Juma	KIADI (Kenya Integrated Agricultural Development Initiative)	Email: maurice_juma@yahoo.com
David Simiyu - Coordinator partnership and networking	Inter Chistian Fellowship Evangelical Mission	
Gladys Nabiswa; CEO CREADIS	CREADIS (Community Research in Environment and Development Initiatives)	
Saleem Esmail CEO	Western Seed Company	Tel: +254722514236, Email:

Name	Organization	Contact
		ceo@westernseedcompany.com
Janet Khabeko	ADS North Rift	Tel: +254 722277577, Email: jnabulo@yahoo.com
Dr Seiffuddin Maloo - Kenya/Somalia Coordinator	VSF-Suizze	Tel: +254724257056, Email: smaloo@vsfsuisse.org
Isaiah Oba	Anglican Development Services of Mt Kenya East - Isiolo	Tel: 0725746460 - Field Officer; David Gitari 0724433823 - Field Officer
Malik Adan- Project officer	Red Cross Kenya - Isiolo	Tel: 0721586196
Barako Katelo	PACIDA	Tel 0725764280
Sarah Gubal	ADESO (African Development Solution)	
Tune Ali	Pastoralist Integrated Support Programme PISP	Tel: 0202620990 E: tunealiduba@yahoo.com, tune@pisp.org
Ali Doti	Pastoralist Integrated Support Programme PISP	Tel: 0720878224, 020 2188787, E: aldoti2002@yahoo.com, adoti@pisp.org
Kola Lieta	Kenya Market Trust	Landline:+254 20 2588343/+254 20 2588323/+254 20 4445830 Cellphone: +254 722 201233 /+254 735 337661 Email:klieta@kenyamarkets.org
Fatuma Hassan	Anolei Camel Milk Cooperative	
Uganda		
Sserubula Patrick Accounts Assistant	Mityana-Mubende District Farmers' Association (MMUDFA)	Email: spatrick2008@gmail.com Tel: +256774999801
Kaaya Christine N.T. Resource Mobilization Manager Liaison Staff on Land & Climate Change	Volunteer Efforts For Development Concerns (VEDCO)	Email: kaaya@vedco.or.ug Tel: +256772570095/706732024
Godfrey Mutesasira Senior Program Officer Resource Mobilization	Community Integrated Development Initiatives (CIDI)	Email: gmutesasira@cidiuganda.org Tel: +256782520570/704520570
Dr. Joshua Waiswa Ag. Chief Executive Officer	Uganda Meat Producers Cooperative Union LTD (UMPCU)	Email: nabangijoshua@gmail.com Tel: +256773806597/704883074
Dr. Gerald Nizeyimana Ag. Deputy C.E.O	Uganda Meat Producers Cooperative Union LTD (UMPCU)	Email: sebigerald@gmail.com Tel: +256773806597/704883074
Ina Hommers Deputy Programme Director Energy Programme	GIZ	Email: ina.hommers@giz.de Tel: +256417104120
Mathias Wakulira Technology Link and Innovations Officer- Mbarara	National Agricultural Advisory Services (NAADS)	Email: mwakulira@yahoo.com Tel: +256414345440/066/060
Joshua Aijuka Programme officer Sustainable Farming Systems	PELUM Uganda	Email: joshuaaijuka@pelumuganda.org Tel: +256414533973
Peter Dhamuzungu Project Engineer	Private Sector Foundation Uganda	Email: pdhamuzungu@psfuganda.org.ug Tel: +256312263849/50
Anne Rietveld	Bioversity international	Email: A.Rietveld@cgiar.org

Name	Organization	Contact
Associate Expert Commodities for Livelihoods Bioversity international		Tel: +256414286949
Agnes Kirabo National Coordinator	Food Rights Alliance (FRA)	Email: agneskirabo@yahoo.com Tel: +256772564951
Julius Turyahebwa Project Coordinator Integrated Finance & Agricultural Production Initiative IFAPI III Project	Uganda Cooperative Alliance LTD	Email: jturyahebwa@uca.co.ug Tel: +256414237684
Gloria Namande Technical Officer CDM and Climate Change Mitigation Energy Programme	GIZ	Email: Gloria.namande@giz.de Tel: +256417104118
Kisambira Peter A. Programs Manager	Uganda National Farmers Federation	Email: antonykisambira@yahoo.com Tel: +256414230705/312103345
Dr. Axel Klaphake Country Director Uganda	GIZ	Email: axel.klaphake@giz.de Tel: +256414303901
Jackson Katende Semakula Union Manager	Uganda Horticulture Cooperative Union Ltd	Email: Jackson.semakula@yahoo.com Tel: +256414258898
Musimenta Julius Justice Deputy Executive Director	Agency For Integrated Rural Development (AFIRD)	Email: jjmusimenta@yahoo.com Tel: +256414374851
Joshua Mugezi Awubwa Guina Management Information Systems Office	National Agricultural Research Organization	Email: jmguina@naro.go.ug Tel: +256414320341/2
Arinaye Clayton General Manager	Uganda Crane Creameries Cooperative Union Ltd (UCCCU)	Email: clayton.arinaye@ucccu.or.ug Tel: +256485421643
Alex Barekye Director of Research	Kachwekano Zonal Agricultural Research & Development Institute	Email: alexbarekye@yahoo.com Tel: +256486426495
Rogers Akatwwijuka Zonal Naads Coordinator-Kachwekano	NAADS- National Agricultural Advisory Services	Email: akarogerz@yahoo.co.uk Tel: +256414345060/065/066
Kimbowa Richard Regional Coordinator (RC)-LVEMP II Civil Society Watch Project	Uganda Coalition For Sustainable Development	Email: rkimbowa@ugandacoalition.or.ug Tel: +256414269461/772457465
Mutebi James Assistant Coordinator/ M+E Officer	Sustainable Agriculture Programme-Kampala Archdiocese	Email: mutebijames4@gmail.com Tel: +256414268803
Nassuna Florence Advocacy Project Assistant	Advocacy Coalition For Sustainable Agriculture	Email: acsa.ug@gmail.com Tel: +256779325257/703315757
Ethiopia		
Steffen Schulz (PhD) - CIP Country Representative	CIP	| Phone: +251 11 617 2291 | Cell: +251 920 054561 | Email: s.schulz@cgiar.org| Skype: steffen.schul

Name	Organization	Contact
		z100 International Potato Center (CIP)-Ethiopia | PO Box 5689, Addis Ababa, Ethiopia | www.cipotato.org
Dr Bekele Abeyo Senior Scientist, Wheat Breeder Global Wheat Program, CIMMYT	CIMMYT	Email: b.abeyo@cgiar.org Tel: +251 (11) 6462324/26/27
Frank Sandvoss Advisor-Funding Window for Cross-border Reconstruction and Development Measures	GFA/ African Union Commission	Email: frank.sandvoss@gfa-group.de Tel: +251115517700 ext. 4067
Dr Getaw Tadesse Postdoctoral fellow	IFPRI Eastern & Southern Africa regional Office (ESARO)	Email: g.tadesse@cgiar.org Tel: 0911806370
Prof Abdalla Mohamed Senior Scientist, Cereal Breeder	ICRISAT	Email: A.H. Mohamed@cgiar.org Tel: +251919833025
Dr Ayele Badebo Huluka Research Officer		Email: a.badebo@cgiar.org Tel: +251 911408136
Dr Frederic Baudron Cropping System Agronomist	CIMMYT	Email: f.baudron@cgiar.org Tel: +251 (11) 6462324
Dr Jean Hanson Forage Diversity	ILRI	Email: j.hanson@cgiar.org Tel: +251 (11) 6172351, 6460294
Mr Heinz Loos Project Manager- Ethio-German Agricultural Training Center (ATC)	GIZ	Email: Heinz.loos@giz.de Tel: 0920718505
Dr Georg Deichert Senior Advisor/Agriculture Economics Sustainable Land Management Programme	GIZ	Email: georg.deichert@giz.de Tel: 0920192013
Dr Alemseged Tamiru Haile Researcher, Hydrology/hydrological modelling	IWMI	Email: a.t.haile@cgiar.org Tel: 0923213030
Sebsebe Zewde Senior Advisor Agricultural Dialogue Project		Email: sebsebe.zewde@giz.de Tel: 0911406376
Dr David Kahan Agribusiness Specialist	CIMMYT	Email: d.kahan@cgiar.org Tel: 251 (11) 6462324/26/27
Jan J Von de Haar General Manager Solagrow PLC		Email: solagrow@gmail.com Tel: +251911508620
Daniel Gebremeskel	COMEL PVT, Ltd	Email: comelpvtltdco@yahoo.com

Name	Organization	Contact
Managing Director		Tel: +251914300060
Illu Alemayehu Ossena Extension Subject Matter Expert GFA/GIZ - SLM Programme	GFA	Email: illu.alemayehu@gfa-group.de Tel: +251 911 487229
Hailemelekot Asfaw Partner	Precise Consult International	Email: hailemelekot2003@yahoo.com Tel: +251 911645868
Amanuel Assefa Deputy Chief of Party	Ethiopia Sustainable Agribusiness Incubator Project (ESAI)	Email: kidus_aman@yahoo.com Tel: +251 926797850
Sylvia Von Dem Busche Consultant	GFA Consulting Group	Email: Sylvia.vondembusche@gfa-group.de
Desta Gebremichael Department Head, Environment and Agricultural Development	Relief Society of Tigray (REST)	Email: destagb@yahoo.com, destagbr@gmail.com , rest@ethionet.et Tel: +251 914705704
Iain Wright Director, Director General's Representative in Ethiopia Program Leader: Animal Science for Sustainable Productivity	ILRI	Email: i.wright@cgiar.org Tel: 251 911230109
Sintayehu Alemayehu Deputy Livestock and Livestock Products Marketing Advisor	MercyCorps	Email: salemayehu@et.mercycorps.org, sintayehu1@gmail.com Tel: +251 911045053
Karri Goeldner Byrne PRIME Chief of Party	Mercyorps	Email: kbyrne@et.mercycorps.org Tel: +251 920656911
Paulos Desalegn Senior Value Chain Advisor Team Leader – ASPIRE	SNV	Email: pdesalnge@snvworld.org Tel: +251 911621661
Dadi Gelashe Deputy Livestock Advisor (PRIME)	MercyCorps	Email: dgelashe@et.mercycorps.org Tel: +251 911377156
Dirk Hoekstra Senior Advisor ILRI	ILRI	Email: d.hoekstra@cgiar.org Tel: +251 911645783
Uwe Steen Team leader - SLM	GFA Consulting Group	Email: uwe.steen@gfa-group.de Tel: +251 935336770
Dr Teklu Erkossa Researcher – Land Resource Management	IWMI	Email: t.erkossa@cgiar.org Tel: +251 911310239
Genzeb Akele Sector Lead- Agriculture SNV Netherland Development Organization	SNV	Email: gakele@snvworld.org , genzebak@yahoo.com Tel: +251 911691254
Solomon Abraha Head of Tigray Cooperative Agency	Government Ministry of Cooperatives	Email: solomonabrahahagos@yahoo.com

Name	Organization	Contact
Getachew Hindeya Cooperative and union expert	CREST	Email: getachewhindeya@gmail.com
Abey Meherka Input Specialist	ACDIVOCA	Email: amerka@acdivocaeth.org
Yohannes Agonafir ACDIVOCA		yagonafir@acdivocaeth.org
Tanzania		
Eustace Bwaize Development Officer Step By Step Project	The Diocese of Mt Kilimanjaro – Anglican Church of Tanzania	Email: ebwaize87@yahoo.com Tel: +255784464942/754089887
Ngoni Nenguwo Postharvest Specialist	AVRDC-Arusha	Email: ngoni.nenguwo@worldveg.org Tel: +255753727820
Hassan Mndiga Training and Outreach Coordinator	AVRDC - Arusha	Email: Hassan.mndiga@worldveg.org Tel: +255 784626567, 754656040
Eunice B Ombachi General Manager	Kibo Seed Company -Arusha	Email: kiboseed@habari.co.tz bosibori@kiboseed.co.tz Tel: +255689230567
Dr Tsvetelina Stoilova Genetic Resources Scientist	AVRDC	Email: tsvetelina.stoilova@worldveg.org Tel: +255 767982729
Bradley Georges Project manager – Grant management and compliance interntional and Canadian Programs	World Vision	Email: Bradley_georges@worldvisison.ca
Felix F Temu Technical Operations Director	JRT Agri Service Limited	Email: felixtemu@yahoo.co.uk , fftemu@gmail.com Tel: +255 754574692
Gwantwa Cheyo Huma Resources	GIZ - Dar	Email. Gwantwa.cheyo@giz.de Tel: +255222115901/2115930
Jordan Gama CEO –	Tanzania Organic Agriculture Movement (TOAM)	Email: jordanusgama@gmail.com , toam@kilimohai.org Tel: +255 787 908303
Dr Thomas Dubois Regional Director AVRDC Eastern and Southern Africa	AVRDC	Email: thomas.dubois@worldveg.org Tel: +255758894016
Shine Yudathadei Senior Sales Officer	Seedco Tanzania Ltd	Email: moshi.sct@gmail.com Tel: +255758838364
Hezekiah Keitany	System Analyst – KIBO SEED Co	Email: kiboseed@habari.co.tz Tel: +255754078761
Honest Peter Temba General Manager	Kilimanjaro Native Cooperative Union	Email: kncu@kilinet.co.tz , manhone@yahoo.com , gm@kncutanzania.com Tel: +255754537650
Khalid Ngassa Networking officer	Agricultural Council of Tanzania (ACT)	Email: Khalid@actanzania.or.tz Tel: +255719118793
Mohamed J Mshana Secretary/Manager	Chama Cha wakulima wa Mpunga (Chawampu)	Email: chawampu.amcos@yahoo.com Tel: +255 754367850, 787367850, 714367850

Name	Organization	Contact
Dr Anjello Joseph Tiganna Mwilawa Principal Livestock Research Scientist	TALIRI- Mwanza-Mabuki	Email: ajmwilawal@yahoo.com Tel: +25578754892240/754892240
Dr David Sendalo Fr Director General TALIRI	TALIRI	Email: drsendalo@yahoo.com Tel: +255 0655803018
Mussa Billegeya	ESAFF - Morogoro	Email: mussa@esaff.org Tel: +255 716 881516
Renatus Mbamilo	Agricultural Council of Tanzania (ACT)	Email: mbamilorenatus@yahoo.co.uk Tel: +255787111526
Manase Mrindwa	Tanzania Poultry Breeders Association	Email: mmrindwa@hotmail.com Tel: +255 784 646381/767 646381
Edmund Malik	Tanzania Milk Processors Association	Email: tampa.office2012@gmail.com Tel: +255 713 806440
Burton Nsape - Chairman	Tanzania Association of Mango Growers	Email: info@amagro.org , vesso@amagro.org Tel: +255 754 763440
Deogratius Mlay Tanzania Dairy Board		Email: deomlay@gmail.com Tel: +255713314866
Esther Mally Operations Officer – Coastal Zone	Tanzania Horticultural Association (TAHA)	Email: moro@tanzaniahorticulture.com Tel: +255 712877672
Anania Bansimbile Field Officer – Coastal Zone	Tanzania Horticultural Association (TAHA	Email: moro@tanzaniahorticulture.com Tel: +255 784 588223
Stephen Lauwo	Himo Environmental Trust Fund (HEMTF)	Tel: +255 754465313
Karani Sekiete	Himo Environmental Trust Fund (HEMTF)	Tel: +255 754695191
Rwanda		
Karangwa Innocent Director	Inades-Formation Rwanda	Email: inades_rwanda@yahoo.com Innocent_karangwa@yahoo.fr Tel: 0252 582 612(Bur.)
Musabimana Patrice Chef de Départment Sécurité Alimentaire	Association Rwandaise pour la promotion du Développment Intégré (ARDI)	Email: ardi.muhima@yahoo.fr musabpat@yahoo.fr Tel:+(250) 252 57 39 61/ 45 20
Laurence Mukamana National Coordinator	IFDC	Email: Laurence@ifdc.ord Tel: (+250) 255 10 42 11
Benineza Innocent Executive Secretary	DUHAMIC-ADRI a.s.b.l	Email: benineza@gmail.com Tel: (+250) 788300424
Ugeziwe Janvier Ir. Agronome AO/ Coordinateur des Programmes at Suivi-Evaluation Expert en development rural	DUHAMIC-ADRI a.s.b.l	Email: ugeziwe@hotmail.com Tel: +250 788304817
Sendege Norbert Director General Crop Production	Ministry of Agriculture and Animal Resources, Republic of Rwanda	Email: senorbert@yahoo.fr nsendege@mnagri.gov.rw Tel: +250 788521320

Name	Organization	Contact
Uranus Guest House LTD Rwanda		Email: info@uranusguesthouse.com www.uranusguesthouse.com Tel: +250 782376277 +250 788835030
Musine Juvenal Secretary General	IMBARAGA	Tel: +250788579644 Email:abahinzi2013@yahoo.fr jouve2010@yahoo.fr
Ntakirutimana Joseph Lobbying and Advocacy	IMBARAGA	Tel: +250788221974 Email:gireppe12goal@yahoo.fr ntajoseph@yahoo.fr
Niyonsenga Rogis Private Potato seed multiplier		
Nzamugorora Martin Twizamure Cyuve Farmer Cooperative		Tel: +250788589626
Munyambanza Celestin President Twizamure Cyuve Farmer Cooperative- Musanzi		
Ndayambaje Emile Advisor	IMPABARUTA	Tel: 0788756380
Nyiransengimana Zaugia Group president	IMPABARUTA	

List of participants – East Africa ITAACC Regional Workshop

No.	Name of participant	Male / Female	Organization	Email-Address
1	Mwangi Warui	M	Dairy Goat Association	dgak@jambo.co.ke
2	Norbert TUYISHIME	M	East Africa Farmer Federation	norbert@eaff.org
3	Godson Sadock Chengula	M	PELUM TZ	changulagodson@gmail.com
4	Dr Charles Walaga	M	PELUM Ug/EA	ccwalaga@yahoo.com
5	Mengistu Yared Girma	M	East Shoa Beekeepers association	yaredgiraz@yahoo.com
6	Bonnora Hailemichael Borsamo	M	HADA	yaredgiraz@yahoo.com
7	NZAMUGORORA Martin	M	Syndicat des agri-eleveurs du Rwanda (IMBARAGE) of Rwanda	nzamartin@yahoo.fr
8	Mr NTAHOMVUKIYE JEAN MARIE VIANNEY		Syndicat Rwandais des Agriculteurs et Eleveurs (INGABO) from Rwanda.	j.muntaho@yahoo.fr
9	George Otiep	M	Caritas Homabay	georgeotiep@yahoo.com
10	Karani Sekiete	M	Himo Environmental Trust Fund	sekiete@hotmail.com
11	Lorenz Bachmann	M	GFA/ITAACC	L.Bachmann@gmx.de
12	Lennart Woltering	M	GFA/ITAACC	Lennart.Woltering@gfa-group.de
13	Tom Apina	M	GFA/ITAACC	tom.apina@sustainetea.org
14	Felix Zeiske	M	ITAAC/ICIPE	fzeiske@icipe.org
15	Zadock Adika	M	VSF-Belgium	zadika@vsfbor.ke
16	Kenda Mwenja	M	GIZ-ACCI	andrew.kenda@giz.de
17	Booker Owuor	M	Smallholder Cereal Growers Association	booker@ksscga.org
18	Eng. Dr. Muchiri	M	University of Nairobi	gichukimuchiri@yahoo.com
19	Francis Kiriro	M	KARI	fhkiriro@kari.org
20	Dr Jean Nguya k. Maniania	M	ICIPE	rimaniani@icipe.org
21	Dr Apurba Shee	M	ILRI	a.shee@cgiarr.org

No.	Name of participant	Male / Female	Organization	Email-Address
22	Harriet Nakasi	F	Caritas Uganda	hanakasi@gmail.com
23	Maryleen Micheni	F	PELUM Kenya	maryleen@peluminet
24	Agapeters Kubasu	M	BAC	kubasupeters@gmail.com
25	Oscar Ekesa	M	ADS Western	oekesa@yahoo.co.uk
26	Verrah Otiende	F	ICRAF	votiende@cgiar.org
27	Jonathan Muriuki	M	ICRAF	j.muriuki@cgiar.org
28	Jackson Kinyua Njana	M	CARITAS EMBU	njanajackson@yahoo.com
29	Bryn Davies	F	IL/IBLI	b.davies@cgiar.org
30	Petra Jacobi	F	GIZ-ACCI	p.jacobi@giz.de
31	Katie Downie	F	ILRI	k.downie@cgiar.org
32	Sharon Achieng	F	Sustainet EA	sharon@sustainetea.org
33	Shadrack Gordon Okallo	M	Sustainet EA	shadrack@sustainetea.org

Annex 5: Southern Africa report

Annex 5: Southern Africa report

1 DATA COLLECTION

1.1 Countries and commodities

The Southern African fieldwork covered 5 countries, namely Malawi, Mozambique, Zimbabwe, Zambia and South Africa (see Table 2 for dates of fieldwork). During the data collection period, efforts were made to engage stakeholders within the AEZs that covered more than 5% of the land area of the country (See Table 1). Farmers and intermediaries such as NGOs, NARS, NAES and GIZ were interviewed as they were perceived to have an understanding of the challenges facing smallholders and their needs for new technologies or institutional innovations. A summary of the commodities documented in each of the countries within Southern Africa is provided in Table 2.

Table 1: Summary of approximate percentages of AEZs making up land areas in selected countries

Selected country	Arid	Semi-arid	sub-humid	Humid	Reference
	LGP* <75 days	LGP 75-180 days	LGP 180-270	LGP >270	
	% Area land	*% Area land*	*% Area land*	*% Area land*	
Malawi		45%	50%	5%	CountryStat
Zimbabwe	20%	70%	10%		CountryStat
Zambia		60%	40%		CountryStat
Mozambique	5%	55%	40%		CountryStat
South Africa	50%	25%	20%	5%	CountryStat

*Agro-Ecological Zones Classification based on length of available growing period (LGP).

The Regional workshop took place in Johannesburg, South Africa in February 2014 (See Appendix 2 for list of participants).

Table 2: Summary of commodities covered when speaking to farmer organisations and intermediaries

Selected country[1]	Dates of field work	Organizations interviewed	Crops	Livestock	Tree crops
Malawi	January 2014	5 FOs / 8 INT	Rice, Groundnuts, Potato, Maize, Cassava, green beans, Soybean, Tomatoes, Cabbages, Onions	Dairy cattle, Cattle, Goats	Pigeon pea
Zimbabwe	November 2013	7 FOs / 9 INT	Maize, Tomatoes, Pumpkins, Wheat, Cowpeas, Groundnuts, Onions, Millet, Sorghum, Potato, Drybeans, Soybean	Cattle, Goats, Dairy cattle	
Zambia	November 2013	6 FOs / 7 INT	Drybeans, Soybeans, Groundnuts, Green beans, Sweet potato, Cassava	Dairy cattle, Poultry, Cattle	
Mozambique	March 2014	8 FOs / 6 INT	Maize, Green beans, Groundnuts, Potato, Cabbages, Banana, Rice, Cowpea, Other (Nyemba beans), Cassava,	Goats, Poultry, Cattle, Sheep	Cashew nut
South Africa	April 2014	14 FOs / 3 INT	Maize, Drybeans, Potatoes, Cabbage, Green beans, Onions, Spinach, Pumpkins	Cattle, Goats, Sheep, Donkeys	Moringa, Fodder crops

[1] See Appendix 1 for lists of contacts per country

1.2 Target Stakeholders

A range of stakeholders were engaged during the fieldwork. The stakeholders are summarised below and an additional summary of stakeholders with whom questionnaires were completed is provided in the following table.

Table 3: Summary of stakeholders interviewed during the study in Southern Africa

Country	IARCs	Intermediaries, GIZ and other stakeholders	Farmer Organizations
Malawi	• Meetings were held with ICRISAT and IITA. A representative of CIP also attended the IITA meeting. • ICRISAT's top innovations included pigeon pea, sorghum and groundnut varieties, a dual legume cropping system and some institutional / value chain innovations (community seed banks and collective marketing groups). • IITA is doing substantial work on cassava and soya, and is also investigating the use of innovation platforms. • CIP is doing work on sweet potato and potatoes and some of the top innovations include the introduction of 'diffused light storage to improve post-harvest storage – a technology using local materials, new varieties (and seed multiplication programmes for potatoes) and establishment of market linkages.	• The interviews included The Department of Agricultural Extension Services and the Department of Agricultural Research Services. • Local NGOs included TAPP and Self-help Africa, while international organisations included CARE and Heifer. • CARE described the benefit of supporting indigenous knowledge / local innovation. Their focus on reducing post-harvest losses was also of interest. The need for developing technologies specifically appropriate for women was also highlighted, which make their lives easier and do not create new challenges. • An interview with GIZ revealed that they are initiating a new programme that will not focus on primary production, but will be looking at rural businesses and could support agro-processing. • The FAO have a Climate-Smart Agriculture project. It promotes specific technologies such as agro-forestry, conservation agriculture, etc. • The African Development Bank: has a programme called "Climate Adaptation for Rural Livelihoods & Agriculture. • Flemish International Cooperation Agency: FICA is providing support to the MoA's Extension Department. • Climate Change Information Centres –an initiative of the Ministry of Environment & CC Management. • The UNDP's Sustainable Land Management Programme – this is focused on addressing land degradation.	• A range of FOs was visited including large organisations such as NASFAM, which has some 108 000 individual members as well as smaller producer groups. • An initiative called One Village-One Product (OVOP) established links with some of its producer groups. • A meeting took place with the Farmers Union of Malawi, which is not purely a FO, as its membership includes input suppliers, NGOs as well as the large corporate estates. They happen to be the signatory for Malawi on the CAADP Compact.
Zimbabwe	• CIMMYT, ICRISAT and ICRAF were interviewed. The engagement with IARCs revealed a range of interesting technologies, many of which had been	• Interviews were conducted with NGOs (Heifer, Land o Lakes and World Vision), private sector (Livestock Zone – which is supporting community feedlots) as well as NARS and NAES.	• FOs interviewed included a livestock association that is promoting community feedlots, dairy farmers, vegetable

Country	IARCs	Intermediaries, GIZ and other stakeholders	Farmer Organizations
	developed with smallholders • It was also interesting to note that a number of IARCs had moved into institutional innovation and were not only focused on the development of new technologies. For example ICRISAT was testing innovation platforms – and the establishment of markets – as a mechanism for strengthening value chains.	• Some strong partnerships were identified between NARS and IARCs. For example, in Bulawayo ICRISAT and government researchers from the Matopos Research Station have been working together on various initiatives. • There was an interview with Michael Gluck from the GIZ office. GIZ has been supporting Agritex (NAES) with extension methodology, climate change adaptation and market linkages. Their focus is on strategic support to organisations.	producers (under irrigation) and dryland crop farmers. • Farmers unions that were interviewed included the Zimbabwe Commercial Farmers Union and the Zimbabwe Farmers Union.
Zambia	• Ms Letty attended the launch of the agro-forestry strategy, which was a joint initiative of the Zambian Agriculture Research Institute and ICRAF. • A number of partnerships between IARCs were also identified – for example CIAT HarvestPlus had links with WorldFish. • Worldfish also had institutional innovations such as focusing on strengthening fish value chains while also giving substantial attention to governance issues (co-governance of natural water bodies due to the challenge of over-fishing). • IITA was visited subsequently by another team member. They are also exploring the use of innovation platforms.	• Intermediaries engaged included international NGOs (Land-o-Lakes, Heifer, SNV), local NGOs (FOSUP), officials from national research and extension organisations and farmers' organisations. Some time was spent understanding the structure of the different organisations visited before entering into discussions directly relevant to the questionnaires being completed. • Conducted an interview with Wolfgang Bertenbreiter from the GIZ Office, responsible for the COMPACI project. This is an initiative supporting cotton production but also looking at the integrated production of food crops.	• A range of FOs was visited in both countries – including direct farmer engagement in Zambia. While it was initially foreseen that farmers unions would be categorized as FOs, the nature of the ZNFU, which was far removed from the farmers and made up of associations that had much closer ties with farmers (for example the Dairy Association of Zambia, which was also visited), it was categorized as an intermediary rather than a FO).
Mozambique	• A range of IARCs have offices in Mozambique, being housed within the national research facility. Interviews were conducted with representatives of ILRI and IRRI. At ILRI, work is being done on goat value chains as well as different methods of fodder conservation. • The discussions with IRRI revealed that the centre has been developing a range of technical and institutional innovations including a number of new varieties, implements drawn by 2-wheel tractors for levelling fields and clusters for linking producers with millers.	• A number of local and international NGOs were interviewed. It was interesting to see that CARE has had a strong focus on household poultry, specifically the control of Newcastle Disease with heat stable vaccines. Local NGOs included AENA, UNAC and Kulima, which has extensive coverage. There was much discussion regarding initiatives such as Pro-Savanna which are perceived by some to have negative consequences for subsistence farmers, while others such as AFAB see them offering potential for achieving agricultural development. • Interviews were also conducted with the Ministry of Agriculture. • I met with the Director of GIZ-Mozambique, Dr Lorenz Peterson who suggested that I speak with Dr Rui Brito who is managing	• Interviews were held with various FOs that included irrigation farmers, dry land crop producers, cashew nut producers who were strongly supported by the National Cashew Research Centre, and rice producers. The discussions with rice growers showed that researchers need to recognise the value of local aromatic varieties that receive higher prices but are lower yielding.

Country	IARCs	Intermediaries, GIZ and other stakeholders	Farmer Organizations
		the climate proofing component of a new project that also has a strong agricultural component. • The agricultural development approach targets associations and aims to improve income by 50% by introducing adaptation measures. They will be working with irrigation farmers (vegetables and potatoes), cattle and coastal small-scale fishing. Their focus is on market oriented production.	
South Africa	In South Africa, the only IARC that has a country office is IWMI. They have number of institutional approaches that they promote: • Their gender transformative approach to unpack gender issues related to water use at a household level. Technical interventions must consider that there is negotiation between household members.. IWMI, in collaboration with Worldfish, is applying this approach. • Multiple-use water services (MUWS) is an approach for public sector water provision. It allows for stakeholders to have input regarding their needs in terms of different forms of water use (i.e. safe domestic supplies as well as other needs). • Water law and governance: Review of legislation to recognise customary water use and redress inequities of water distribution to smallholders. GIZ has been promoting the review of water legislation (e.g. permit systems) to address historical situations that discriminated against smallholders.	• In RSA the focus was on engaging FOs directly. Visits to NARS and NAES were limited to interviews with Managers at the KwaZulu-Natal (KZN) Department of Agriculture and Environmental Affairs. • A local NGO (Nkuzi) engaging in land and agricultural development was interviewed in Limpopo. • No other interviews were conducted.	• Interviews were conducted with 14 FOs including farmers from an irrigation scheme in KZN, as well as crop and livestock farmers, pastoralists from the Northern Cape, wool growers from Southern KZN, a number of FOs in Limpopo Province (Moringa producers, land reform beneficiaries) and vegetable farmers in Gauteng (urban agriculture). A range of technical and social problems were encountered during the interviews.

Table 4: Summary of stakeholders interviewed with standard ITAACC questionnaires

Country	Farmer Org.	Intermediaries				IARC	
		GIZ	NGO	Private sector	Gov't	Strategic	Top innovations
Zimbabwe	7	1	3	2	3	3	12
Malawi	6	1	4	1	2	2	8
Zambia	5	1	3	0	2	1	7
Mozambique	8	1	4	0	1	2	2
South Africa	14	0	1	0	2	1	0
TOTAL	**40**	**4**	**15**	**3**	**10**	**9**	**29**

Please find the list of contacts and people met in Appendix 1.

2 DEMAND AND SUPPLY FOR AGRICULTURAL INNOVATIONS

2.1 Demand for innovations: The challenges faced by farmers

As mentioned in the main report, the main problems pertaining to various commodities were investigated through the interviews conducted with FOs and intermediaries and compared against the problems that the IARC top innovations were to address. In some cases, differences were noticed between the Africa-wide data set and the data for the region – this was especially the case for Maize. In the Africa data, access to seeds was the main problem for Maize growers, while in Southern Africa, this featured much lower in the list of problems, while weeds and weeding were seen to be more of a challenge than emerged from the Africa data.

There were also some differences between perceptions of intermediaries and representatives of FOs. For example, if one considers the maize-related problems for Southern Africa, FOs mentioned pests & diseases as well as drought/climate-related issues as main challenges, while intermediaries were more concerned about marketing and access to seed.

Apart from the crop commodities covered in the main report, groundnuts was also investigated for Southern Africa as this crop was encountered in 4 of the 5 countries and is a crop also grown in RSA although it was not documented during interviews.

The main challenges related to groundnuts that were identified by FOs were access to seed, pests & diseases and marketing. Drought and climate-related problems were also quite frequently mentioned. Intermediaries were far more concerned about post-harvest processing and storage, especially the danger of aflatoxins that develop due to poor harvesting and storage methods. These toxins that result from mould growth on the nuts pose a serious danger to people (And animals) that consume the nuts. This is seemingly not recognised by smallholder farmers, which is a concern.

2.2 The match between supply and demand

The extent to which the top innovations identified by the IARCs were broadly addressing farmers' challenges was also given consideration. The tables below (groundnuts, maize and cattle), allow for some discussion of this matching process.

In terms of maize challenges in Southern Africa, there was a good match between supply and demand, given that a fairly substantial percentage of maize-related innovations were found to be addressing pest and disease problems. Many of the innovations were said to be addressing "low yields and poor quality", which was not specifically mentioned by farmers, though they were perhaps more specific in their identification of problems that result in poor yields (e.g. weeds). Another aspect where the match was not strong was in terms of soil fertility, which IARCs seem to recognise more

than FOs as a problem. It is however interesting to notice that the challenges identified in Southern Africa were fairly different from the composite Africa data (See Table 5 and Table 6). In particular access to seed was perceived to be less of a problem in Southern Africa than in the rest of Africa.

With groundnuts there was a strong match in terms of access to and quality of seed – with this being recognised as a problem by FOs and intermediaries and being addressed substantially by IARCs (See Table 7).

With cattle, a slightly different picture emerges (See Table 8). Farmers see social problems and access to land as major challenges – though these are generally not matters that can be addressed by IARCs. Intermediaries (And to a slightly lesser extent FOs) recognised feed shortages as a problem (Especially during the dry season). This was being strongly addressed by work of various IARCs on fodder production and conservation.

Table 5: Main maize challenges for combined Africa data

MAIZE main challenges	FO %	Interm. %	IARC %
Access to and quality of seed	16%	14%	5%
Marketing	10%	8%	5%
Access to credit or finance/ high production costs	9%	5%	5%
Post harvest processing or storage	8%	8%	5%
Tools, machinery and irrigation equipment	8%	3%	2%
Drought, flood, any climate related problem	6%	8%	5%
Institutional/regulatory/policy issues	6%	12%	2%
Pest and diseases (including rodents, animals)	5%	6%	14%
Training, knowledge, knowhow, awareness	5%	8%	7%
Access to, quality and use of fertilizer	4%	3%	5%
Social issues- theft, adulteration, crime, conflict	4%	5%	
Transport and infrastructure	4%	1%	
Natural resources- land and water availability	4%	4%	2%
Access to, quality of pesticides and other inputs	3%	3%	2%
Labour, (shortage, price, etc.)	3%	1%	2%
Weeds, weeding	3%		
Any challenge with cultivation practices and harvesting	2%	3%	7%
Poor soil fertility	1%	3%	10%
Low yields and poor quality	1%	3%	14%
Any other problems		2%	7%
nominations=	**199**	**119**	**42**

Table 6: Main maize challenges for Southern Africa data

MAIZE main challenges	FO %	Interm. %	IARC %
Pest and diseases (including rodents, animals)	13%	5%	14%
Drought, flood, any climate related problem	11%	7%	5%
Access to credit or finance/ high production costs	9%	10%	5%
Marketing	9%	12%	5%
Weeds, weeding	7%		
Tools, machinery and irrigation equipment	7%	2%	2%
Access to, quality of pesticides and other inputs	6%	5%	2%
Institutional/regulatory/policy issues	6%	7%	2%
Access to and quality of seed	4%	12%	5%
Any challenge with cultivation practices and harvesting	4%	10%	7%
Social issues- theft, adulteration, crime, conflict	4%	2%	
Low yields and poor quality	4%	2%	14%
Labour, (shortage, price, etc.)	4%		2%
Transport and infrastructure	4%	2%	
Access to, quality and use of fertilizer	2%	5%	5%
Natural resources- land and water availability	2%	2%	2%
Poor soil fertility	2%	2%	10%
Training, knowledge, knowhow, awareness	2%	7%	7%
Post harvest processing or storage	2%	7%	5%
Any other problems			7%
nominations=	**54**	**42**	**42**

Table 7: Main groundnut challenges for Southern Africa

Groundnuts main challenges	FO %	Interm. %	IARC %
Access to and quality of seed	14%	13%	27%
Pest and diseases (including rodents, animals)	14%		
Marketing	14%	13%	9%
Drought, flood, any climate related problem	11%		18%
Labour, (shortage, price, etc.)	8%	13%	
Transport and infrastructure	8%		
Weeds, weeding	5%		
Tools, machinery and irrigation equipment	5%		
Training, knowledge, knowhow, awareness	5%	13%	
Any challenge with cultivation practices and harvesting	3%		
Poor soil fertility	3%		18%
Social issues- theft, adulteration, crime, conflict	3%	13%	
Low yields and poor quality	3%		18%
Access to credit or finance/ high production costs	3%		
Post harvest processing or storage	3%	25%	
Natural resources- land and water availability		13%	
Institutional/regulatory/policy issues			9%
nominations=	**37**	**8**	**11**

Table 8: Main cattle related challenges for Southern Africa

Main challenges: Cattle	FO %	Interm. %	IARC %
Social problems (theft, fire, conflict,	20%	4%	
Access to land / natural pasture	16%		3%
Animal health diseases and parasites	16%	4%	10%
Feeding	10%	17%	38%
Marketing (incl. road infrastructure)	8%	13%	3%
Water	6%		
Training, knowledge, knowhow, awareness	6%	9%	3%
Low farm gate selling price for products	4%	4%	
Tools, machinery and equipment	4%		
Animal reproduction, insemination, offspring	2%		3%
Veterinary services and medicines, vaccines	2%	9%	
High input costs, credit	2%	9%	3%
Drought, flood, climate	2%	4%	10%
Processing / value adding	2%		
Breeds		4%	3%
Low productivity (milk, meat, etc.)		13%	17%
Labour, (shortage, price, etc.)			
Shelter			
Institutional, regulatory, policy issues		9%	3%
Other problems			
nominations=	**50**	**23**	**29**

2.3 Regional cases of matches

Through the study, a number of cases of strong matches were identified in terms of top innovations that addressed challenges articulated by FOs and intermediaries. These are summarised below. The process of selecting cases considered a number of criteria including whether the innovations were addressing a challenge identified through consultation with FOs, whether the innovation was affordable, and could improve yields, improve market potential and improve profitability (but with a relatively low input requirement). These were criteria identified by FOs as being important for adoption of innovations by smallholders. In addition, cases were identified that had relevance to climate change consequences and did not have any obviously negative gender implications.

Table 9: Examples of strong supply: demand matches from Southern Africa

CASE	Key farmer problem addressed	Description of the innovation	Unresolved issues
Fodder conservation measures	Feed shortages during the dry season	Various fodder conservation measures have been promoted by ILRI in Mozambique. These include hay and silage making, etc. Their imGoats[2] project also used innovation platforms as a mechanism to solve challenges facing smallholder goat keepers.	How do we get knowledge to farmers? How do we encourage an investment in livestock – especially goats, which people see as being low input livestock,
Macia sorghum	Lack of access to good quality seed and effects of drought	An open-pollinated, early-maturing, high-yielding, drought tolerant variety developed by ICRISAT-Bulawayo, Zimbabwe, in 1989 and suited to semi-arid areas *"Can be grown throughout the country, but particularly in areas where maize is a high risk crop[3]"*	How do we address the issue of accessibility? How do we address acceptability of sorghum as a food?
Evergreen agriculture	Low soil fertility, high cost of inputs, lack of access to inputs, low yields, risk of investing in inputs	Conservation agriculture with trees (CAWT) – promoted by World Agroforestry Centre The use of *Faidherbia albida* - an acacia native to Africa that fixes nitrogen with its roots and	How do we get know-how and seedlings to farmers? How do you make trees affordable?

[2] http://clippings.ilri.org/2012/07/10/innovation-platforms-imgoats/
[3] http://www.capstoneseeds.com/capstone-catalogue/crop-seeds/grain-sorghum/macia-sorghum

CASE	Key farmer problem addressed	Description of the innovation	Unresolved issues
		drops nitrogen-rich leaves on to the soil during the rainy season[4].	
Promiscuous soya	Access to quality seed Access to inoculant (an issue throughout Africa) Access to markets (highlighted by intermediaries	IITA-Malawi has worked on: • Promiscuous seed variety • Seed supply system • Innovation platform to facilitate marketing • Inoculant production TGx1740-2F: *"….an IITA-developed promiscuous soybean variety – one that is able to nodulate effectively with diverse indigenous Rhizobia in the soil – is released in Malawi[5]"*	But how do we address high production costs and need for credit? And how do we make seed accessible? Can we address heavy labour requirements?
Bana Grass	Feed shortages, especially in semi-arid areas and especially during the dry season	Bana Grass[6] – a hybrid of Napier and Babala grass (*Pennisetum purpureum* x *P. glaucum)* • A perennial fodder species developed by ICRISAT-Bulawayo • Suited to semi-arid areas	How do we get planting material to farmers?
Rice value chains	Difficulties accessing competitive, stable markets – especially given distance to market centres	IRRI in Mozambique has established clusters for linking producers and millers in order to strengthen value chains. IRRI has also been developing new varieties suited to different conditions, as well as equipment for levelling the rice fields to ensure uniform flooding.	How to address technical issues that ensure quality and consistency of supply?

[4] http://www.worldagroforestry.org/newsroom/highlights/incorporating-trees-agriculture-outstanding-success-re-greening-sahel
[5] http://www.iita.org/soybean-asset/-/asset_publisher/t3fI/content/better-soybean-varieties-offer-african-farmers-new-opportunities?redirect=%2Fsoybean#.U2US3pAaJes
[6] http://www.tropicalforages.info/key/Forages/Media/Html/Pennisetum_purpureum.htm

HYPOTHESES 1-5

1. IARCs are addressing key needs of farmers
2. Innovations are affordable for farmers
3. Farmers and scientists share similar views on key criteria for design/adoption of innovations
4. Gender equity is an important criteria for actors in the innovation system

Regarding hypotheses 1-5, which are summarised above, there were not substantial differences between Southern Africa and the Africa data. Some 80% of IARC representatives interviewed believed that their centres had clear steps to ensure that their research agenda responded to farmers' needs. When asked about production costs in relation to major existing technologies, a third of IARC scientists indicated that their innovations had significantly lower costs, which would seem to respond to need for technologies appropriate for resource-poor farmers. In terms of the criteria that all stakeholders thought important for adoption of innovations by smallholders, big comparative advantage and affordability were mentioned by all stakeholder groups, but the FOs indicated that labour-saving was in fact more important. This was not recognised by intermediaries or IARCs and should be given consideration as it is frequently raised in relation to gender.

Table 10: Stakeholders' perceptions of key criteria for adoption of innovations

KEY CRITERIA FOR ADOPTION	IARC %	FO %	Int %
Market potential	na	78	55
Labour saving	6	65	21
Big comparative advantage (yield gain)	19	60	61
Profitability (medium to high return with low input -	13	58	42
Affordability (low investment cost)	17	55	55
Cost saving	6	55	21
Risk reduction (production, marketing, etc.)	9	50	39
Simplicity	4	30	21
Compatibility with local traditions	6	28	30
Trialability (farmers can test small scale)	9	23	18
Profitability (high return with high input -high risk)	1	10	9
Up scaling potential	9	8	27
Others specify	1	8	18
Create complexity (broaden farming system)	1	3	3
Nominations (multiple choices possible)	**158**	**211**	**139**

How to improve uptake of technologies: Experience from CARE-Malawi

Discussions with CARE in Malawi revealed that the improvement of local technologies is sometimes more effective than the introduction of new technologies. For example, they promoted an improved local mud-smeared grainary and found that it was up-scaled much more rapidly than metal silos, which require special skills as well as resources for their construction. The grainaries, which involved the broader community, also impacted positively on women in households because it gave them more control over decisions to sell grain. Furthermore, threshing is traditionally a woman's job, but with the grainary introduction this became a collective activity involving men and women.

Example of a mud-smeared granary (author: GTZ)[7]

[7] http://www.cd3wd.com/cd3wd_40/INPHO/DB_LOCAL/PHOTOBAN/EN/P301_350.HTM

3 LINKS BETWEEN ACTORS IN INNOVATION SYSTEM

HYPOTHESES 6 – 11

5. Farmers are the major stakeholder in the design and implementation of IARCs' research
6. The ways information on innovations is shared matches the requirements of key stakeholders
7. Farmers rate advisory services they receive as adequate
8. Effective linkages exist between different actors in the innovation system
9. IARCS innovations have been up-scaled adequately
10. Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes

Regarding the extent to which farmers are the major stakeholders in the design and implementation of trials, results for Southern Africa were similar to the Africa data except that there seemed to be more trials where there was some level of farmer control (See Table 11). It was also interesting to see that when IARC scientists were asked about how the primary stakeholder was contributing to the research agenda, 46% said researchers while 43% said farmers.

Regarding methods of disseminating information, there was a much higher appreciation of mobile phones as a potential mechanism for dissemination although it was not yet happening.

Table 11: Level of farmer participation in trials

Level of farmer participation	
No participation	0,0%
Researcher controlled	6,7%
Some level of farmer control	83,3%
Full level of farmer control	10,0%
Total answers	**30**

The linkages between different actors were also explored through the study. The findings in Southern Africa did not differ substantially from the Africa-wide data, except that the assessment of support provided by NARS was less positive (more rated the service as 'poor'). This was often said to be because it was not their mandate to provide extension support.

It was also interesting to see that the IARC representatives that were interviewed generally saw their collaboration with other actors as good, and yet many intermediaries and FOs that were interviewed had not had any contact with IARCs (See Table 12). This highlights the limited reach that the IARCs are able to achieve with their human resource limitations. The methods of evaluating IARC scientists still focus on publication and scientific merit, with far less attention being given to engagement with other actors, which may be contributing to this scenario (See Table 13)

Table 12: IARCs' perceptions of collaboration with other actors

Rating of collaboration	NARS %	NAES %	NGO%	PS %
Very poor - -			11,1	10,0
Poor -				10,0
Medium	20,0	20,0	22,2	40,0
Good +	30,0	50,0	33,3	20,0
Very good + +	50,0	30,0	33,3	20,0
Total answer	**10**	**10**	**9**	**10**

Table 13: Criteria for evaluation of IARC scientists

Evaluation criteria	Responses %
Peer reviewed articles / publications	80
Engagement with farmers	20
Novelty of the research	20
Quality of the scientific work delivered	70
Engagement with other actors of the value chain	30
Acquisition of funds	30
Perceived impact of the research	60
Other	20
Total answers	**10**
Total nominations (multiple choice possible)	**33**

4 CONCLUSIONS AND RECOMMENDATIONS

While the range of innovations being developed by IARCs is in line, not only with the commodities that smallholder farmers are producing, as well as in line with many of their key problems, there are a range of factors that fall outside the research agenda that need to be addressed if agricultural development is to be achieved. The development of innovative approaches to organise farmers and link them with markets as well as sources of knowledge is essential. Furthermore, research activities need to take cognisance of what farmers are doing to address challenges that they experience and build on these efforts where possible.

The institutional innovations that link different stakeholders and strengthen value chains have great potential to improve the livelihoods of smallholder farmers if they provide a framework for the introduction of new technologies that can address other challenges. An ethos of experimentation, learning and sharing must also be stimulated amongst farmers as this ensures less reliance on government extension services, which are poorly resourced and not able to address the needs of all the clients.

Efforts need to be made to strengthen partnerships between IARCs, FOs, private sector, NARS and NAEs to ensure that their innovations, as well as the innovations developed by other stakeholders are actually available to farmers – especially inputs such as improved seed varieties, or equipment for land preparation, planting and so on. It would be most beneficial for all stakeholders to find more structured mechanisms to coordinate their efforts to support smallholders.

The value of smallholder agriculture, as well as the recognition of the challenges they face should inform policy so that resources are made available to strengthen them rather than assuming that more commercialized agriculture is the only solution to national food security.

Appendix 1: Lists of contacts per country

Organization	Category	Contact person and details
ICRISAT – Malawi	IARC	Felix Sichali +265 888 328 783 felixsichali@gmail.com f.sichali@cgiar.org Oswin Madzonga +265 888 40165 omadzonga@gmail.com
Department of Research Ministry of Agriculture	NARS	Dr Makumba (Mrs G Phiri 265 999 11 2992
Department of Agricultural Extension Services Ministry of Agriculture	NAES	Stella Kankwamba +265 88 414 8448 skankwamba@yahoo.co.uk
International Institute of Tropical Agriculture (IITA	IARC	Office Mulekano +265 1 707 022 o.mulekano@cgiar.org AA Nganga a.nganga@cgiar.org +265 999 578 061 Lizzie Kachulu l.kachulu@cgiar.org +265 995 226 331 Benedict Kanyika B.Kanyika@cgiar.org
International Potato Centre (CIP	IARC	Eliya Kapalasa ekapalasa@gmail.com +265 999 788 130
Food and Agriculture Organisation of the United Nations – Malawi Office	Intermediary	George Phiri +265 882 455 004 George.phiri@fao.org FAO-mw@fao.org
National Association of Smallholder farmers (NASFAM	FO	Frank Masankha +265 999 343 289 fmasankha@nasfam.org
Heifer International – Zambia	NGO	Petronella Halwiindi Petronella.halwiindi@heifer.org +265 1 752 525
Farmers Union of Malawi	Intermediary	Jacob Nyirongo jnyirongo@farmersunion.mw Duncan Warren dwarren@farmersunion.mw +265 999 969 229
Linga Association	FO	Rhobyns Kanjedza (NASFAM EO +265 999 614 323 kandedzarhobyns@yahoo.com
Self Help Africa	NGO	Ausward Zidana Ausward.zidana@selfhelpafrica.org +265 1 750 568 / +265 99 365 6320
Trustees of Agricultural Promotion Programme (TAPP	NGO	Winfred Chanza chanzawinfred@gmail.com +265 99 550 2343
CARE - Malawi	NGO	Alex Chimbizi +265 888 327 957 Alex.chimbizi@co.care.org Rose Tshwenko Rose.tchwenko@co.care.org +265 99 220 7700
Mtharansembe Cooperative	FO	Kuliyani Chadooka +265 99 325 9907
BUA Milk Bulking Group	FO	Gershom Kumwende (Heifer International support +265 999 094 705 Chairperson: +265 888 658 271
Biriwiri Farmers and Marketing Cooperative, Ncheu	FO	Christopher Miyoso (Project Manager chrismisoyo@hotmail.com chrismisoyo@gmail.com +265 999 600 990 / +265 888 557 025 Wyson Mtola +265 212 959 149
Mbwanje Rice Cooperative	FO	Edzon Majamanda +265 999 329 935
Meetings with other stakeholders		
African Development Bank		Vinda Kisyombe v.kisyombe@afdb.org +265 882 419 035
UNDP – Sustainable Land Management Programme		Henry Sibanda +265 99 322 0719
FICA (Flemish International Cooperation		Nikolas Bosscher +888 207 910

Organization	Category	Contact person and details
Agency		
GIZ – Malawi		Matthias Rompel +265 881 870 000 matthias.rompel@giz.de
j.ko consult Malawi-German Programme "Promotion of Democratic Decentralisation"		Julian Koschorke +265 998 552 869 Julian@jko-consult.com
Ministry of Agriculture and Climate Change Management (Climate Change Information Centres		Elina Kululanga ekululanga@metmalawi.com
ZIMBABWE		
Livestock Zone	PRIVATE	Muhle Masuku Muhle.masuku@gmail.com +263 773 511 068
World Vision	NGO	Andrew Mugobo Andrew_mugobo@wvi.org +263 712 384 831
Matopos Research Station	NARS	Shadreck Ncube Shadreck_ncube@yahoo.com +263 774 320 489
Mangwe Farmers Association	FO	Adam Dube +260 778 704 887
Zimbabwe Commercial Farmers' Union	FO	Ernest Ndlovu +260 713 462 749
Heifer-International (Zimbabwe	NGO	Busie Mbedzi Busie.mbedzi@heifer.org 263-775-179-420
ICRISAT	IARC	Andre van Rooyen a.vanrooyen@cgiar.org +263 712 616 768
CIMMYT	IARC	Mekuria Mulugetta m.mekuria@cgiar.org +263 712 604 006
Land-o-Lakes	NGO	Catherine Mashayamombe Cathrine.mashayamombe@idd.landolakes.com +263 772 748 309
ICRAF – Zimbabwe	IARC	Livai Matarirano l.matarirano@cgiar.org
Dombashava Horticulture and Poultry Association	FO	Claudius Marimo +263 774 273 336
Zimbabwe Farmers Union	FO	Prince Kuipa pkuipa@zfu.org.zw +263 772 408 345
GIZ – AISPIII	GIZ	Michael Gluck Michael.glueck@giz.de +263 777 282510
Ministry of Agriculture, Mechanisation and Irrigation Development - Agritex	NAES	Nyasha Pamberei pambireinyasha@yahoo.com +263 712 410 070
Directorate of Research and Specialist Services	NARS	Dumisani Kutywayo dumisanikutywayo@yahoo.co.uk +263 712 216 196
ZCFU cereals chairperson	FO	David Marimo davidmarimo@ymail.com +263 772 938 968
Muruwe Agricultural Producers Association	FO	Mutsa Chinyadza +263 779 157 185
International Livestock Research Institute	IARC	Godfrey Manyawu g.manyawu@cgiar.org +263 775 320 400
ZAMBIA		
International Centre for Tropical Agriculture (CIAT	IARC	Eliab Simpungwe e.simpungwa@cgiar.org +260 97 421 4152 Nelson Mango, social scientist, n.mango@cgiar.org
Worldfish	IARC	Simbotwe Mwiya s.mwiya@cgiar.org +260 977 715885
International Institute of Tropical Agriculture (IITA	IARC	Therese Gondwe t.gondwe@cgiar.org +260 211 840365
FOSUP (Farmer Organisation Support	FO	Mike Muleba

Organization	Category	Contact person and details
Programme		mmuleba@yahoo.co.uk +260 966 933 790
GIZ – COMPACI	GIZ	Wolfgang Bertenbreiter Wolfgang.bertenbreiter@giz.de +260 966 511 093
Dairy Association of Zambia	FO	Victor Ngandu Victor.ngandu@yahoo.com +260 977 503117
Heifer-International (Zambia	NGO	James Kasongo James.kasongo@heifer.org +260 977 24597
Zambia National Farmers Union	Intermed.	Godwin Mumba mumba@znfu.org.zm +260 211 252 648
ICRAF – Zambia	IARC	Smart Lungu drsmartlungu@yahoo.com +260 977 836 333
MoA Department of Extension	NAES	Reynolds Shula Shula.reynolds@iconnect.zm +263 977 770 825
Zambian Agriculture Research Institute	NARS	Stalin Sichingi staligan@yahoo.com +263 955 101 012
SNV	NGO	Corjan van der Jagt cvnderjagt@snvworld.org +260 978 469433
Luwimba Organic Cooperative - Chongwe	FO	Saphster Chiposo +263 977 990 345
Chongwe District Farmers Association	FO	Judith Sitwala +260 977 324 083 sitwalajudith@yahoo.com
Chongwe Organic Producers & Processors Association (CHOPPA	FO	Penias Tembo 0977 197 069
Chipembi Wet Farmers Association	FO	Mupenyu Simba +263 964 105 469
Eastern and Southern African Small-scale Farmers Forum	FO	Simon Mwamba esaffzambia@yahoo.co.uk +260 976 900567
MOZAMBIQUE		
CARE	NGO	Nicholas Dexter - 258 829422139 - nicholas@care.org.mz
Kulima	NGO	Domenico Liuzzi - Director General - +248 82312 7160 / +258 21 430665 kulima@tvcabo.co.mz
AFAB (African Fertilizer and Agribusiness Partnership	NGO	Sergio Ussaca - Mozambique Country Manager - +258 21 499576 - sussaca@afab-partnership.org
AENA - National Association of Rural Extension	FO	Jordan Matemulo +258 84 302 4421
Technical Department of Agricultural Extension - Ministry of Agriculture	NAES	Unacio Nhacale - Deputy Director - inhancale@gmail.com +258 82 3913530
Oxfam Novib	NGO	Carmen Munhequete Tel: +258 84 4019428 Carmen.Munhequete@oxfamnovib.nl
GIZ Mozambique	GIZ	Director: Lorenz Petersen T + 258 21 491245 Lorenz.Petersen@giz.de Dr Riu Brito Universidade Eduardo Mondlane ruibrito@zebra.uem.mz +258 82309 334 / +258 1 493 771
International Livestock Research Institute (ILRI	IARC	Saskia Hendrickx, ILRI - Country Representative, S.Hendrickx@cgiar.org, +258 820896645
International Rice Research Institute (IRRI	IARC	Carlos Zandamela Liaison scientist - carloszandamela@gmail.com - Mobile +258 82 30 62 373; land line: +258 21 462 508
UNAC - Mozambique Farmers' Union	NGO	Agostinho Bento - Mafaterre@gmail.com / Inacio Maria Manuel - inacio.unac@gmail.com
Irrigation associatio of Mangese (64	FO	Lino Pita Nassone UNAC representative 828757250 /

Organization	Category	Contact person and details
members		President: Sofia Jorge Matusse
Assoc Kindlimuse (an umbrella org with 111 members from 4 associations	FO	Mr Jorge Chauque - chairperson 258 863291 256
Gimo o cossa union representing 3 cooperatives	FO	President: Elvira Germano +258 8286 731 97. Kulima coordinator:Luis Balate 258 84 4729 447 / 82 43 55 090 / luisbalate@yahoo.com.br
Associacao dos Produtores	FO	Adelaide Machava Congolo - secretary +258 820 89 3370
Associacao Agricole de Albasine	FO	Alfredo Madala Machava - Chief of production +2588453 89 631
Associacao Batlavane	FO	Abel Filipe - community leader +258 82 27 17 500 / Kulima technician - Jocinto Quive +258 824917360 quive112@gmail.com
Assosiciao Tchemulane	FO	Jocinto Quive - Kulima Technician +258 82 49 17360 quive112@gmail.com
SOUTH AFRICA		
KZNDAEA – Extension Directorate	NAES	Theo van Rooyen - Manager: South Region (Agriculture
KZNDAEA – Research Directorate	NARS	Dr JF de Villiers - Senior Manager: Research
Nkuzi Development Association	NGO	Motlanalo Lebete 27 015 297 6972 / 082 770 6820 motlanalo@nkuzi.org.za
International Water Management Institute (IWMI	IARC	Barbara van Koppen B.VanKoppen@cgiar.org Skype: barbaravankoppen
Mooi River Irrigation Scheme Block Committees	FO	Khange Dumakude +27 79 538 7469 / +27 73 6688 502 (Extension assistant with DoA
Maboi Six Community Trust	FO	Albert Tladi +27 72 626 5637
Sivusimpilo Farmers Forum	FO	Thabane Madondo +27 82 253 1274 / +27 84 901 9953
Mtshezi Livestock Farmers Association	FO	Mr Majozi (Past chairperson - contact via Thokozani Xulu (+27 725600963
Ubuhlebezwe Livestock Association	FO	Mr TV Dlamini (Chairperson +27 83 752 0193
Biodiversity and Red-meat Initiative (BRI	FO	Katrina Rooi (+27 72 672 1815
MDASA Moringa Development Association of South Africa	FO	Mr William Ntike (President +27 79 952 3300 wmntike@gmail.com
Limpopo Farmers Development Council	FO	Mr Sekonya (President +27 76 0197 791
Agri Kameelkrans	FO	Maria Adams (+27 76 1030 415
Umzimkhulu Woolgrowers Association	FO	Philani Ngcobo +27 72 713 2823
Amathuli Farmers Association (Oswatini)	FO	Mr Simanga Alpheus Mazeka
Isikhahlamezi project	FO	Mr SA Jafta +27 067 2179
Nquthu Livestock Association	FO	Mr DJ Thwala +27 295 2339
Youth Agricultural Ambassadors (YAA	FO	Lindy Nzwana +27 71 299 1000 lindynzwana@gmail.com

Appendix 2: Southern Africa ITAACC Workshop Participants

Johannesburg, February 2014

No.	Name and Surname	Gender	Organization	Email address	Contact number
1	Jackson Kadioka	M	CAMOSEVHEWA NGWAAGA MULUTO	pholoshong@gmail.com	076 8635 843
2	Macdonald Louw	M	ESAFF-SA	louwmacdonald@gmail.com	071 201 0542
3	David Afful	M	University of Limpopo	David.afful@ul.ac.za	074 418 7321
4	Marisia Geraci	F	Heifer	Marisia@heifer.org.za	079 4444 300
5	Felix Zeiske	M	ICIPE	fzeiske@icipe.org	
6	Sepo Hachigonta	M	FANRPAN	shachigonta@fanrpan.org	071 470 8373
7	Lorato Matthews	F	Gauteng Department of Agriculture and Rural Development (GDARD	Lorato.matthews@gauteng.gov.za	082 400 3985
8	Konanani Liphadzi	F	GDARD	Konanani.liphadzi@gauteng.gov.za	079 932 5066
9	Rendani Nemakanga	F	Limpopo Department of Agriculture	nemakangar@limpopo.gov.za	084 719 8106
10	Nelson Mango	M	CIAT	n.mango@cgiar.org	+263 772 572726
11	Noel Bastian	M	National Emerging Red Meat Producers Organisation (NERPO	agbiz@nerpo.org.za	071 1317 024
12	Gaynor Paradza	F	Institute for Poverty, Land and Agrarian Studies (PLAAS	gparadza@hotmail.com	
13	Michael Muleba	M	FOSUP	mmuleba@yahoo.co.uk	+260 966 933 790
14	Therese Gondwe	F	International Institute of Tropical Agriculture (IITA	t.gondwe@cgiar.org	
15	Everisto Mapedza	M	International Water Management Institute (IWMI	e.mapedza@cgiar.org	+27 12 845 9100
16	Rauri Alcock	M	Mdukatshani Rural Development Programme	khonya@yebo.co.za	082 856 9861
17	Monique Salomon	F	Facilitator	salomon@ukzn.ac.za	083 301 2936
18	Lennart Woltering	M	GFA/GIZ ITAACC	Lennart.woltering@gfa-group.de	
19	Claudius Marimo	M	DOHOPA / Zimbabwe Farmers Union	marimogardens@gmail.com	
20	Nyasha Pamberei	M	AGRITEX	pambereinyasha@yahoo.com	
21	Godfrey Manyawu	M	ILRI – Harare	g.manyawu@cgiar.org	263 775 320 400
22	Wadzanai Katsande	F	FAO	Wadzanai.katsande@fao.org	
23	Evalindi Nzwana	F	Inkululeko Agric Co-operative	lindynzwana@gmail.com	071 299 1000
24	Igshan Samuels	M	Agricultural Research Council (ARC	isamuels@uwc.ac.za	073 257 1067
25	Benny Sithole	M	Department of Agriculture, Forestry and	bennys@daff.gov.za	012 319 7838

No.	Name and Surname	Gender	Organization	Email address	Contact number
			Fisheries (DAFF		
26	Itumeleng Pooe	M	Indalli / MIT Co-op	i.pooe@yahoo.com	073 616 8702
27	Emily Tjale	F	LAMOSA	Emily@lamosa.org.za	082 314 1958
28	Brigid Letty	F	GFA/GIZ ITAACC	bletty@inr.org.za	082 8711 048
29	Armin Kloeckner	M	GIZ	Armin.Kloeckner@giz.de	
30	Lorenz Bachmann	M	GFA/GIZ ITAACC	l.bachmann@gmx.de	+496403 963794

Annex 6: West Africa report

Annex 6 : West Africa report

1. DATA COLLECTION

In the West Africa region like in the other regions covered by the study, the methodology developed by GFA was used. This methodology includes eight steps to assess the demand-supply match for agricultural innovations in Africa: First the countries with their relevant agro-ecological zones (AEZ) and major commodities are selected. After that, the relevant stakeholders on the demand and supply side are identified. The results of discussions and interviews with these stakeholders should then give a representative overview of the demands for innovation and the supply thereof in the region. These are then compared, and matches and gaps are identified.

1.1. Countries and commodities

A criterion used for the country selection was the presence of BMZ funded agricultural programs using a 3-point scale (0=0 no programs funded by BMZ; 1=1-3 programs funded; and 3=over 3 programs funded by BMZ).

Another criterion was the agro-ecological zones (s) covered by the countries. In Table 1 only the AEZ in the target countries that cover more than 10% of the land are included in the assessment. For West Africa, Cameroon, Benin, Burkina Faso, Mali, Ghana and Niger were selected.

Table 1 : Country selection according to agro-ecological zones

	Selected country	Arid	Semi-arid	sub-humid	humid
		LGP* <75 days	LGP 75-180 days	LGP 180-270	LGP >270
		% Area land	*% Area land*	*WA-*	*% Area land*
1	Cameroun	5%	30%	50%	15%
2	Benin	5%	60%	35%	0%
3	Burkina Faso	5%	80%	15%	0%
4	Mali	70%	30%	0%	0%
5	Ghana	0%	25%	50%	25%
6	Niger	60%	35%	0%	0%

In Table 2 below information is provided on the major crops grown in the selected countries per AEZ as defined by the FAO AEZ classification and, production records provided by the FAO country statistics on the basis of quantity produce in MT or US Dollar equivalent.

Table 2 : Major commodities per agro-ecological zone in the selected countries

		Major commodities	
AEZ	Country	Livestock	Crops
Arid	Mali and Niger	Cattle, Goats, Sheep, Camel	Millet, Sorghum, Cowpea
Semi-arid	All	Cattle, Goats, Sheep, Camel, pigs	Sorghum, Maize, Rice paddy , Tomatoes, cowpea, beans, groundnuts
sub-humid	Cameroon, Benin, Burkina Faso and Ghana		Maize, Cassava, Plantain, yams, tomatoes, plantain, taro, groundnuts
Humid	Cameroon and Ghana		Maize, Cassava , plantain, Banana, beans, taro

1. 2. WA-Stakeholders

Table 3 : Total interviews (89) in WA region

Country	Farmer Org.	Intermediaries				IARC	
		GIZ	NGO	Private sector	Gov't	Strategic	Top innovations
Cameroon	14	00	03	00	03	02	10
Mali	11	00	02	00	00	01	01
Burkina Faso	10	00	02	01	01	00	00
Benin	05	01	02	00	00	02	00
Ghana	05	00	01	00	01	00	00
Niger	**05**	**00**	**02**	**01**	**01**	**00**	**03**
Total	50	01	12	01	06	05	14

Table 4 : Summary of stakeholders interviewed during the study in West Africa

Country	IARCs	Intermediaries	Farmer Organizations
Cameroon	Meetings with IITA and ICRAF revealed a number of technologies developed and promoted for use by farmers and farmers' organizations: i) Cassava varieties with high yield and resistance to pests and diseases; ii) Leguminous cover crops for soil fertility enhancement and weed control; iii) Integrated management of banana bunchy top disease through enhancing ecological resistance to disease invasion into newly established fields, etc; (IITA); iv) Vegetative propagation of indigenous trees; v) Groups sales and community MIS for agro-forestry tree products; vi) Extension of agro-forestry practices through rural resource centers; vii) Soil fertility improvement with agro-forestry practices, etc. (ICRAF).	Intermediaries involved in agricultural development programs and interviewed included international NGOs (INADES/Yaoundé) and national NGOs (CAFOR/Yaoundé, CDD/Maroua), NAES (Regional Department of Agriculture in the West Province), NARS (IRAD), integrated agricultural programs (ACEFA/Maroua). .	Many Farmers' organizations were visited in the regions covered so far. They include those identified through CNOP-CAM (The National Forum on Farmers' Organizations in Cameroon), national NGOs, and Development programs. Farmers' organizations are officially recognized and registered entities. Some are very big (above 1000 members; others are very small in size about 20 members).
Mali and Burkina Faso	In Mali, meetings were arranged with the following international research centers and a development institution: ICRAF, AVRDC, ICRISAT in Bamako (Samanko).	IFDC in Mali	In Mali and Burkina Faso, farmers are organized into associations, cooperatives, Unions and Federations. They are highly specialized in different value chains such as mango, sesame, dairy cattle, beef, vegetables, bananas, onions, NTFP, etc.
Benin and Ghana		Representatives of 2 NGOs were interviewed; 2 NGOs in Benin and 1 NAES in Ghana working on: • Vegetables and mangoes in Ghana; • Soybean and Yams in Benin; • Rice and maize in Benin; NGOs are very active in Benin and are already members of an "Innovation Platform". They also work with highly specialized Farmers' organizations on different value chains from production to processing and marketing. The main value chains investigated during data collection are: soybeans, mangoes, pineapple, cashew and shea butter. In Ghana, accent is on pineapple and mangoes in Kpandu	Many representatives of Farmers' organizations were interviewed in Benin and Ghana. They include those identified through REDAD (The Network for Sustainable Agriculture) in Benin and the Kpandu Municipality Department of Agriculture. GIZ has funded programs in the promotion of value chains in this Municipality (vegetables, fruit trees and drip irrigation). Agricultural production is mechanized, and smallholders use big tractors for land preparation for different crops. In terms of farmer organizations, meetings and interviews were held with 10 of them including: Farmers' organizations for pineapple, mango, vegetables, cashew, maize, cassava and soybean. It was not possible to meet

Country	IARCs	Intermediaries	Farmer Organizations
		Municipality (300 Km from Accra) where data collection was conducted.	organizations involved in poultry rearing activities in both Benin and Ghana. Only the humid zone (Benin: > 1400 mm) and sub-humid zone (Ghana: 700-1400 mm) were covered because of time constraints.
Niger	Niger hosts the ICRISAT Sahelian Center in Niamey. It used to be the regional office until 2012 when it shifted to Bamako. ICRISAT hosted a multidisciplinary team of scientists working on crop diversification, far beyond the mandate crops (millet, groundnut, etc), but these activities were dissolved from 2012 as it was too much geared towards development. This stands in total contrast to the trend is seen with donors, and the thought behind the CRPs. Three out of the five top innovations selected by the regional office of ICRISAT in Bamako were being managed by scientists from Niger: i) micro dosing fertilizer for **millet and sorghum**; ii) use of lysimeter to allow the assessment of combined drought, low nutrient, and heat tolerance of **millet and groundnut** varieties that can be promoted for adaptation to climate change identify traits in millet and groundnut, and; iii) African Market Garden (integrated **horticultural** production system based on drip irrigation).	ICRISAT and AVRDC did some research between 2006 and 2011 on crop spacing, varieties and pests of ***moringa oleifera***. Moringa was identified as the major vegetable in Niger, however it remained largely a "forgotten" crop by many organization (exception US Peace Corps). Now moringa popped in all of the discussions with intermediaries. REGIS in a 70 Million US$ USAID project managed by the NGO called CLUSA, is promoting irrigated plantations of moringa PKM-1 variety.	Three out of the five FO interviews were very lively, where problems could be well articulated. A technician of Swisscontact has even brought an ever better performing variety from India, and is promoting that in agricultural training centers. The Chamber of Agriculture, Swisscontact and BBK farm (private sector- multiplication of seeds) cite the attack of a leaf eating worm (identified by ICRISAT, CIRAD and AVRDC as *Noorda sp*. in 2010

2. DEMAND AND SUPPLY FOR AGRICULTURAL INNOVATIONS

2.1. Demand for innovations

H1: IARCs are addressing key needs of farmers

Maize and millet are important crops for all stakeholders, IARCs and Intermediaries have a larger crop spectrum including: sorghum, cassava and vegetables for peri-urban agriculture.

In West Africa the needs of Farmers' organizations are analyzed with two of the most important crops grown in the region (maize and cassava), and for which IARCs have done a great deal of scientific research (IITA).

Table 5 : Key needs of Farmers' organizations for maize

	S2 : Key problems addressed	FO : Key problems	Interm : Key problems
	%	%	%
Access to and quality of seed	13	23	27
Access to, quality and use of fertilizer	6	6	0
Access to, quality of pesticides and other inputs	0	11	12
Any challenge with cultural practices, low crop yields	19	2	0
Access to credit or finance	0	2	15
Poor soil fertility	13	4	3
Diseases	13	4	0
Insects	6	2	0
Birds, rodents, other	0	2	0
Weeds, weeding	0	0	0
Labour, (shortage, price, etc.)	0	6	9
Tools, machinery	0	6	6
High input costs	6	4	0
Training, knowledge, know-how, awareness	6	2	6
Transport	0	0	0
Harvesting, processing	0	2	0
Drought, flood, any climate related problem	6	2	0
Marketing	6	6	18
Post harvest processing or storage	6	13	3
Any other problems	0	0	0

For maize, there is a good match regarding **"access to quality seeds**" between IARCs (25%), FO (23%), and Intermediaries (27%). The issue of quality seeds is consistently addressed by IARCs research programs. Farmers' organizations and intermediaries also indicate that **"access to quality pesticides"** and **"post harvest processing"** are serious issues of concern in maize production. The reason is that maize is highly susceptible to post harvest losses during storage. Farmers' organizations believe that because of marketing delays associated with bad village to market roads, improved post harvest handling and storage should receive adequate attention (access to finance for the construction of improved storage facilities), training and research solutions for the control of post harvest pests and diseases are also needed.

For cassava, IARCs (17%) and Intermediaries (20%) see **"access to quality planting materials"** as a major problem while Farmers' organizations indicate that **"insect pest (13%) and diseases (13%),**

and storage" (13%) are their main concerns in cassava production. There is a complete mismatch between actors with respect to the perception of problems in cassava production. High yielding varieties have been developed by IARCs, but processing, storage and transportation from the farm to the village and from the village to the market are still serious bottlenecks for adoption and upscaling. Further there are no efficient systems for local production and/or distribution of the planting materials proposed by IARCs.

Conclusion: H1, the hypothesis related to FO needs is partially confirmed for maize and not for cassava for West Africa

H2: Innovations are affordable for farmers

In general, affordability and access are keys to dissemination and adoption of innovations.

The level of input use is very limited among smallholder farmers in West Africa. This is not surprising, input costs are very high and suppliers are not expanding input businesses in rural areas because of poor road conditions, high transportation costs, and poorly organized produce markets. Further, their limited resources makes it difficult to invest in the purchase of input when the returns on investment are not guaranteed (94% of farmers fall in the resource poor category with average farm size below 2 ha for about 69% of them).

Innovations and the related input packages are not accessible to the majority of smallholder farmers. So Upscaling innovation dissemination and adoption needs adequate attention and should involve other actors of the supply chain, private sector actors supported by Government regulations to support small input businesses in rural areas.

H3: Farmers and scientists share similar views on key criteria for design/adoption of innovations.

Poverty reduction, scaling potential, climate change relevance (80%), affordability of the technology and improving health and nutrition (60%) ranked very high in West Africa compared to the Africa figures (70%, 65%, and 39%). In fact, this finding summarizes the whole concern about innovation adoption and its relationships to food security indicators (availability, access, utilization, assets creation, gender, sustainability and stability), which are hard to meet in West Africa.

In West Africa the Scientists, Farmers' organizations, and Intermediaries share the view that **"big comparative advantage (yield gain)"** is important criteria for designing and adopting innovations (90%, 63%, 81%) for Farmers' organizations, Interm and S2), higher than the overall Africa figures (68%, 60%, 65%). **"Risk reduction (production, marketing)"** also ranked very high for all actors in West Africa. For farmers, yield gain from the use of improved varieties is important because areas under cultivation and labor cost can be reduced while achieving high production. For the scientists, profitability, low inputs and risk reduction are associated with investment opportunities and efficiency. Both arguments are mutually supportive. **"Upscaling potential"** is important for Farmers' organizations and Intermediaries to ensure profitability and sustainability.

H4: Gender equity is an important criterion for actors in the innovation system

Intermediaries indicate that they give high attention to gender. Researchers also claim that gender is key for accessing funding. Women organizations are very active in West Africa, and their role is predominant in agricultural production, food processing and sales. Some have invested in small and medium industrial processing schemes.

Table 6 : FO : Where in the value chain do women play an important role ?

Tasks/Activities	Africa	West
	%	%
Harvest	72	64
Weeding	62	50
Field preparation	58	64
Sales	51	93
Marketing	45	14
Cultural practices	42	50
Processing on-farm	40	79
Other comment	27	0
Watering	21	43
Processing industrial	9	0
N	**1035**	**64**

For 93% of the commodities that were part of the interviews, women were said to be in involved in sales. Processing on-farm 79%), field preparation (64%) and harvesting (64%) also ranked high.

For maize, women are highly involved in land preparation, weeding, application of cultural practices, harvesting and on-farm processing. IARCs have addressed these activities with gender friendly innovations for many crops apart from maize: maize shellers, millet and rice shellers, maize and/or millet flour making machines (IITA, ICRISAT).

For cassava, land preparation, weeding, application of cultural practices, harvesting, on-farm processing and sales are predominantly carried out by women. IARCs have also proposed innovations suitable for the women in these activities: growing on mounds or simply in lines, cassava graters and driers (IITA).

Conclusion: H4 on the integration of gender in research by IARCs is confirmed for maize and cassava. A number of innovations have been proposed to reduce the work load on the women in this respect: growing cassava on mounds, beds or inline to reduce the incidence of the weeds, to reduce harvesting effort and to increase yield; for maize, cropping maize with climbing beans has improved yield, and diversified production altogether. Processing equipments have also been introduced and are widely adopted in the places where demonstrations have been conducted by IARCs and other development partners.

2.2. Matching cases for West Africa

For West Africa, the best matches are found in the IARCs innovations presented below. Using a 4-point scale (0: no match; 1: very low; 2: average; 3: high), 60% cutoff score was used to select the innovations with the best match. The Table below summarizes the findings.

Table 7 : West Africa best matches

	Key FO problems	Innovations	Unresolved issues
Match-1: **ICRISAT Fertilizer Micro-dosing**	1. High input cost and limited access to quality fertilizers	ICRISAT / Micro-dosing of inorganic fertilizer (NPK (15-15-15) or ammonium phosphate) in planting pockets of millet and sorghum	1. How to ensure access to fertilizers? 2. How do we address market and processing issues?
Match 2: **ICRISAT Improved Millet Varieties**	1. Limited access to improved seed varieties 2. The use of improved seed varieties is associated with high input cost	ICRISAT / Improved pearl millet varieties (open pollinated 20, hybrids 6), min 300mm up to 700mm), duration 80 to 120 days, suitable for Sudano-Sahelian zones across Africa, altitude max 500m, earlier flowering than traditional varieties	1. How to address farmers' need for open pollinated, adapted and locally used varieties together with high yielding and improved varieties?
Match 3: **AVRDC Improved Tomato varieties**	1. Limited access to quality seeds; and lack of locally adapted varieties	AVRDC / Tomato 4 varieties: 1 variety rich in Vitamin A Bèbi yereyé, 23-36t ha; Keneya 20-30t/ha, heat tolerant, Semi arid zones et arid with irrigation; Nayeli 10-20t, very transport resistant, height tolerant but not humidity tolerant; Konica 10-20t, less heat tolerant, very transport resistant, arid and semiarid zones, 80-100 days duration	1. How to upscale local seed production? 2. How to improve access to quality inputs for the control of pests and diseases? 3. How to address storage problems?
Match 4: **IITA Improved Cassava varieties**	1. Unavailability of cassava planting material for the newly released cassava varieties 2. Low yield potential of local germplasm; 3. High pest and disease pressure	IITA High yielding, pest and disease resistant cassava varieties, including yellow root cassava	1. How to scale up dissemination and adoption of post harvest handling and storage technologies? 2. How to address promotion of local varieties used for both leaves and tuber consumption?

3. LINKS BETWEEN ACTORS

H5: Farmers are the major stakeholder in the design and implementation of IARCs' research

For West Africa, many innovations are developed from "breeding improvement work" (38%), "transfer from other regions and institutions" (33%) and quite a few from "adaptation of farmer based innovations" (29%). From the findings, there are efforts to integrate local needs into the research agenda. The general West Africa picture is slightly different to the overall Africa trend. In West Africa 'breeding improvement work comes first.

Research trials are mostly located on-farm (82%) and on-station (77%). This creates a link with local needs and a good learning opportunity for smallholder farmers in face-to-face interactions with the scientists. It should however be mentioned that field demonstrations are costly and have limited coverage because of limited financial resources to scale up.

There is a great level of participation of farmers in the implementation of research program (64%), but clearly limited to selected locations for easy monitoring and follow up.

Researchers are the first major stakeholders influencing the research agenda, followed by farmers as 2nd and donors at the 3rd place. It is possible that the mandates of the IARCs and also the agro-ecological zones defined for their activities are determining factors in this situation. For instance, IITA covers the sub-humid and humid zones with focus on cassava, yams, plantain banana, and cocoyams and; ICRISAT the semi-arid zones with focus on millet, sorghum, and pea.

Conclusion: H5 is confirmed with respect to IARCs effort to integrate local needs into the research agenda and to involve farmers in the implementation of approved research activities. However the efforts are still limited with respect to scope and coverage. Again the West Africa picture is not very different from the overall Africa tendency, it takes 9 years on the average to develop innovations.

H6: The ways information on innovations is shared matches the requirements of farmers

Dissemination of information to farmers uses various channels: extension training and education to create awareness and interest for innovations; demonstrations to show how technologies should be used; radio and TV messages, publications in local languages, etc.

In West Africa, "Farmer training" (86%, 68%, 93%) comes, then "Farmer to farmer exchanges" (74%, 77%, 80%), "farmers' field days" (70%, 63%, 80%) and "Radio" (72%, 50%, 86%) have quite similar importance for all stakeholders. Face-to face interactions even though costly are therefore more appreciated by Farmers' organizations. Radio communications are also highly appreciated. TV and local language publications are valued but less than the top ones above. Mobile phones and internet are not accessible to many in rural areas. They are low in the other choices. The overall Africa picture is again confirmed but with figures lower than West Africa.

Conclusion: H6 on innovations are transfer based on the needs on the farmers is confirmed.

Table 8 : S2 : Who has been contributing most to increase the up-scaling of this innovation ?

	Africa	West
	%	%
NARS	36	17
NAES	19	6
GIZ	3	11
NGOs	34	67
Private sector	9	0
N	**80**	**18**

NGOs are very much contributing in upscaling innovation dissemination and adoption. They have access to funding to carry out local development activities and promotion of value chains. At the same time they provide advisory services and extension support to farmers organizations in terms of training, capacity building, mobilization of local resources and access to inputs.

H7: Farmers rate advisory services they receive as adequate

Generally the innovations adoption rate seems to be very low among farmers. The issue looking at the number of responses is that adoption records do not exist. The scientists interviewed had problems providing this information in West Africa.

Intermediaries generally find it difficult to work with NAES because of their limited capacity to provide these institutions with the resources they need to be functional and effective. However in some places donors through international organizations provide technical and financial support to the NAES. In that case they do not have much problems working with Farmers' organizations in rural communities (Ghana, Benin, Burkina Faso). In West Africa local NGOs are also very active. They also a long history in working with Farmers' organizations and they are officially recognized by Governments. They all have legal frameworks for being involved in local development activities. The West Africa figure (39%) is higher than the overall Africa (22%) figure.

Farmers' organizations in West Africa rate support from the PS as good (60%) compared to the overall Africa figure (40%). The PS is rated lower in both cases by the Intermediaries. The reason is simple: intermediaries are involved in facilitating access to inputs, transportation from the village to the market, post harvest handling and storage, and processing. The intermediaries are not happy because they believe the PS is making too much benefit at the expense of farmers.

H8: Effective linkages exist between different actors in the innovation system

Table 9 : Asked scientists show how they rate their collaboration with NARS, NAES, NGOs and private sector (PS)

	Africa %				West %			
	NARS	NAES	NGO	PS	NARS	NAES	NGO	PS
Very poor	0	13	5	4	0	20	0	0
Poor	9	17	5	13	0	40	0	20
Medium	30	26	41	43	60	20	20	20
Good +	26	26	36	30	20	0	80	60
Very good + +	35	17	14	9	20	20	0	0
N	**23**	**23**	**22**	**23**	**5**	**5**	**5**	5

IARCs collaboration with NARS and NAES ranges medium (60%) to poor (40%), but is good with NGOs (80%) and private sector (60%). In the absence of strong Government extension systems, NGOs have taken over the dissemination of improved technologies proposed by IARCs. NGOs are very active in the West Africa Region, and have organized Farmers' organizations into Cooperatives, Unions and Federations for various value chains (mangoes, bananas, maize, tomatoes, etc). NGOs in the West Africa Region have also provided support in linking Farmers' organizations to agro-input suppliers and local agro-dealers (Mali, Burkina Faso, Ghana and Benin), and produce exporters.

Linkages can be strengthened only if there are systems in place to support innovation dissemination and adoption, ensuring that innovations availability and smallholder farmers' access to innovations are well addressed. These systems should involve IARCs, input suppliers and distributors, local agro-dealers, cooperatives and associations and households, produce collectors/transporters/middlemen, wholesalers and retailers, processors and also, support from local credit and savings schemes to facilitate access to finances.

H9: IARCS innovations have been up-scaled adequately

Responses on the quality of extension provided to the farmers by NAES are divided into 2 categories:	
1. Responses from places where Government institutions are generally weak and poorly supported (Cameroon, Mali)	
i.	Limited information exchange on activities being implemented
ii.	They never come, there is already a system in place in the cotton production zones
iii.	They never go to the farmers, if there are no resources to motivate them they never come
iv.	They only help a few farmers, but their resources are very limited
v.	They work for payment and those who cannot pay do not get any assistance
2. Responses from places where partnerships are encouraged, Farmers' organizations are well organized, NGOs both national and international provide support to NAES and NARS and Innovation platforms are being set up (Ghana, Burkina Faso, Benin)	
i.	Government has provided funds to restart rearing pigs after the swine fever epidemics
ii.	Their work conditions are very much improved
iii.	Production has increased
iv.	They always come to the village in spite of difficulties
v.	Exchange of ideas, joint training sessions, monitoring activities
vi.	The Federation is officially reorganized by the Chamber of Agriculture of Mali
vii.	The Ministry of Agriculture and Livestock is a very important partner for capacity building, sensitization and vaccination campaigns
viii.	Very good collaboration based on the signature of contracts for some activities
ix.	Local AES staff provide supervision of seed production processes for certification
x.	They organize vaccination campaigns and capacity building activities
xi.	We usually appeal to each other whenever support is needed
xii.	We work with Government institutions to ensure that the civil society is involved in decision to address farmers needs for training in the use and adoption of innovations

Table 10 : S2 : How do you rate the diffusion potential of the innovation ?

	Africa	West
	%	%
Very small (niche production)	6	10
Small	10	19
Medium	28	33
Big	34	19
Very big (potentially most farmers in the country)	22	19
N	**89**	**21**

Most innovations developed by IARCs have medium to very big diffusion potential from the point of view of the scientists interviewed in West Africa (71%) quite than the overall Africa figure (81%). The scientists during interviews thought their innovations are good (to extent that they address farmers' needs), but could not tell much about their diffusion and adoption potential.

From the point of view of the scientists in West Africa, NGOs contribute a lot in upscaling innovations diffusion and adoption (67%). Of course they have resources, but limited to the locations where their operations are carried out. They can easily interact and develop partnerships with IARCs for disseminating and facilitating or reporting on the adoption processes. The Africa figures are quite low (34%) for NGOs.

Up-scaling of innovations shows weaknesses with respect to the potential of the innovations for diffusion, very limited involvement of the NAES, technical and institutional bottlenecks (lack of training, lack of resources, and commitment).

Up-scaling by NGOs has been about creating awareness, interest and action to promote adoption among Farmers' organizations within the framework of their collaboration with IARCs. As indicated earlier, this has had very limited impact and sustainability after their programs are phased out. Adoption has short term and long term dimensions (involvement and ownership at the grassroots). The long term dimension of the dissemination and adoption processes are not always well integrated into program design and implementation. Because systems are not in place for sustainability, upscaling therefore becomes challenging.

H10: Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes

In the West Africa region, climatic conditions (droughts and/or floods) have always affected agricultural production. In recent years, climate changes with respect to delays in the beginning of the rainy seasons, the beginning of the dry seasons, have affected planting time, agricultural calendar, and crop yield altogether. Farmers' organizations and Intermediaries agree that **"change in seasons", "erratic rainfall"** and **"increased temperatures"** are serious issues of concern regarding the impact of climate change on smallholder farming systems, but research programs seem to focus on "drought" and "vulnerability".

There is a gap between Farmers' organizations issues and the focus of IARC research programs. Observed issues associated with climate change have still not received adequate attention from IARCs, farmers have no local solutions and do not simply know how to deal with them.

Conclusion: H10, the hypothesis related to climate change is not confirmed for West Africa. Climate issues are not very well addressed in IARC research programs and activities. There is evident lack of understanding, and capacity. This is also true for Africa with slightly higher rates in West Africa.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Demand and supply

IARCs top innovations are only partially addressing key farmers' needs when looking at the major crops grown in the West Africa region (maize and millet). But it is interesting to mention that some aspects of the research content and focus are quite different from farmers' problems. As an example, while there is agreement regarding the need for quality seeds, there are discrepancies in areas such as "soil fertility and crop diseases" for research instead of "processing and storage" the main concerns of farmers for maize. Crops are harvested during the wet season, supply is high, the prices are low, and the incidence of pests and diseases is quite high at that time. Post harvest handling and storage are therefore critical for farmers if they are to take advantage of market prices when supply is low after the harvest time. The causes of gaps between supply and demand for innovations are also influenced by:

- The level of application of chemical fertilizers, pesticides and organic manure is still limited among smallholder farmers. Under these conditions, the results of the application of the recommended cultural practices are unlikely to be achieved.
- Collaboration between IARCs, NARS, NAES, NGOs and PS is very limited, and the capacity to reach out is highly reduced for all actors (limited funding, reduced coverage). This negatively affecting efficient dissemination and adoption of innovations.

4.2. What innovations are impacting lives of farmers in region most

From our findings and discussions "quality and locally adapted seeds" are highly considered by stakeholders as the most promising innovations, likely to positively impact the lives of the farmers in rural areas. But the issues of availability and affordability should receive necessary attention from Government and other development partners to ensure effective adoption and use by farmers. In West and Central Africa, ICRISAT has been promoting local seed multiplication schemes with the collaboration of the NARS and NAES whenever possible, together with the establishment seed banks at the village level to make sure that farmers have access to readily available seeds at the beginning of the cropping season. Local savings and credit schemes have been put in place in this respect to facilitate access to small loans for the purchase of inputs (Mata Masu Dubarai in Niger). To strengthen this process ICRISAT has also been funding capacity building activities for the NARS, NAES and Farmers' organizations through the work of the Millet Research Network.

4.3. Suggestions for collaboration of stakeholders

In West Africa, Collaboration is highly needed between stakeholders. The findings show very limited linkages between IARCs and other development actors. There is need to understand research and there is need to support the innovation transfer system which is way beyond the scope of IARCs. So the discussion should not only be on how to make research more responsive to farmers' needs, but also how to address the critical issue of strengthening the capacity of the innovation transfer system. The NARS are weak, NAES are weak, and the PS is weak under prevailing systems of Government controlled program planning and implementation. Researchers are the primary actors influencing the research agenda. The capacity to address farmers' needs is evident through baselines and Rapid Rural Appraisal strategies. However, it was clear during discussions with stakeholders that, the resources needed for the dissemination of available technologies are not available, therefore limiting adoption by smallholder farmers to the few that are directly involved in "on-farm trials and demonstrations".

LIST OF CONTACT PERSONS AND ORGANIZATIONS

Organization	Category/Name of contact person	Contact person and details
IITA	IARC	Dr. Rachid Hanna
ICRAF	IARC	Dr. Zac Tchoundjeu Email : z.tchoundjeu@cgiar.or
RDA	Gov	Mekountchou Sebastien Tel: +237-75 00 09 54
IRAD	Gov	Onguene Awana Nérée Email: nereeoa678@yahoo.fr
CNPC-C/SODECOTON	Gov	Oumarou Youssoufa Tel: +237-99 78 24 86
INADES		IFC Tel: +237-22 21 15 51
CAFOR		Yakan David Tel: +237-99 50 02 14 Email:
CDD-Maroua		Vandewna Paul Tel: +237-99 59 96 17
FEPRODEX	FO	Mahamad Bahar Tel: +237-99 85 15 91
CROPSEC	FO	Mariam Haman Adama Tel: +237- 99 74 20 13 Email:
ACEFA	FO	Ngoupayou Amadou Tel: +237-77 71 28 39
UCOPACAM	FO	Madjoukouo Claudine Tel: +237-99 19 38 13
COOP-Kabia	FO	Bodo Elise Tel: +237-77 14 73 99
ODEFCOM	FO	Alvine Nnomendoue Tel: +237-77 72 32 98
ENM/Entre-Nous Mesdames	FO	Kabeyene Nanga Tel: +237-74 04 00 25
COOPROVINOUN	FO	Lamandje Dahirou Tel: +237-73 19 65 57
NOWINFOMAFUS	FO	Mufua Esther Tel: +237-95 78 69 07
SOCOOPAMATPA	FO	Minsili Ondobo Tel: +237-77 22 66 78
CAFPEN	FO	NGARLIA DJOHLANA Tel: +237- 97 43 05 96
Mali		
1. CNOP/CAB-DEMESO	Abdou Bomba	Tel: +223-66919989
2. EKT/Etablissement Kadi Traore	Traore Kadi	Tel: +223-76462962
3. ENBEKUN	Mrs. Hawa Konte	Tel: +223-73064615
4. UNPL-Mali	Mamadou	Tel: +223-76363009
5. AOPP	Moussa Traore	Tel: +223-76128966
6. ASIC	Sidiki Dembele	Tel: +223-76022504
7. ULSCPS-Koulikoro	Sekou Koulibally	Tel: +223-73082957
8. ULSCPC-Koulikoro	Isaac Fomba	Tel: +223-76172294
Burkina Faso		
1. FENUGGF-B	Nama Abdoulaye	Tel: +226-70490886
2. UNML-B	Diallo Adama	Tel: +226-70261173
3. FENAFER-B	Mrs. Tapsoba	Tel: +226-66333052
4. FENAOP-B	Abdoulaye	Tel: +226-78278295
5. FNPB-B	Paul Ouedraogo	Tel: +226-75875397
6. UNPM-B	Lamoukri Jean	Tel: +226-70252641
7. FE-B	Boureima Diallo	Tel: +226-70282944
8. FEPA-B	Mrs. Sia Yaro	Tel: +226-70756130
9. UNPS-B	Sawadogo	Tel: +226-70359574
10. UNPL-B	Mrs. Gariko	Tel: +226-71295131
INERA	Kafando	Abdoulaye KAFANDO <layekafando@yahoo.fr>
SPONG	Sylvestre	Sylvestre SPONG <bilsy73@yahoo.fr>
Ghana		
Mawuli FO/Kpandu Municipality Ghana	FO	Steven Ankudey Tel: +233 (0) 201013279

Organization	Category/Name of contact person	Contact person and details
Nuku FO/Kpandu Municipality Ghana	FO	Postia Akorli Tel : +233 (0) 245614578
Norvisi FO/Kpandu Municipality Ghana	FO	James Forson Tel : +233 (0) 502278920
Afadjato FO/Kpandu Municipality Ghana	FO	Johnson Abada Tel : +233 (0) 206468666
Amenuveve FO/Kpandu Municipality Ghana	FO	Mavis Avorgah Tel: +233 (0) 240889268
FO Coordination/Kpandu Municipality	FO	Philip Tamakloe Tel: +233 (0) 246949144
Mawuli FO/Kpandu Municipality Ghana	FO	Steven Ankudey Tel: +233 (0) 201013279
Nuku FO/Kpandu Municipality Ghana	FO	Postia Akorli Tel : +233 (0) 245614578
Norvisi FO/Kpandu Municipality Ghana	FO	James Forson Tel : +233 (0) 502278920
Afadjato FO/Kpandu Municipality Ghana	FO	Johnson Abada Tel : +233 (0) 206468666
MDOA	NAES	Michael Akuamoah Tel: +239 (0) 209978426
Benin		
CERADEB	FO	Late Lucien Tel: +239-64241313
URPS	FO	Aipke Germain Tel: +239 95381140
ADJAKETE	FO	Adamou Aaaron Tel: +239 97496423
FUCCRTK	FO	Gbeou Urbain Tel: +239 96152631
PEA	FO	Laurent Tovisse Tel: +239 90938700
SOJAGNON	NGO	Ayenan Mathieu Tel : +239 96063461
REDAD	NGO	Sewade Patrice
Niger		
ICRISAT - Niger	IARC	Mahamadou Gandah, country rep. Niger. Microdosing.
ICRISAT Niger	IARC	Saidou Abdoussalam, technician (due to absence of
ICRISAT Niger	IARC	Falalou Hamidou, crop physiologist (groundnut)
FCMN Niya (vegetable producer federation	FO	Dr Boukary, boukari.hama@yahoo.fr
Kande Gomni (bring joy)	FO	Salamatou Boureima, 0027 90646678
FUMA GASKIYA- farmer federation Maradi,	FO	Ali Maman Aminou, directeur umagaskiya@gmail.com
FUCOPRI (Federation des Unions des	FO	Illyasou Dandakoye, ingenieur agronome chef de
Mooriben farmers federation	FO	Abdoulaye Amadou, secretaire executif Fed Mooriben,
Swisscontact	NGO	Constantin Tchibozo,
CLUSA	NGO	Dov Pasternak, dov.pasternak@gmail.com
Ferme BBK (seed production)	Private sector	Hassane Amadou, fermebbk18@yahoo.fr
RECA- chamber of agriculture	Government	Patrick Delmas, elmas.reca.cowiram@gmail.com,

List of participants to Regional Workshop North and West Africa on the Transfer of Innovation in Agriculture – Adaptation to Climate Change (GIZ/ITAACC Project), Cotonou, Benin,19-20 March, 2014.

First & last Name	Male/ Female	Institution/Organization	e mail or phone number
Benin			
Dorith von Behaim	F	GIZ	dorith.von-behaim@giz.de
Lara Goldman	F	GIZ ProAgri	lara.goldmann@giz.de
Myra Wopereis		AfricaRice	mwopereispura@gmail.com
Manuele Tamo		IITA Benin	m.tamo@cgiar.org
Richard Pliya	M	eRAILS	pcrd_76@yahoo.fr
Patrice Lagnon Sewade	M	REDAD Network	patsewade@yahoo.fr
Kohico Harrisson	M	Freelance	kouhiko.harrison@gmail.com
Sondjo Elise	F	Coordonnatrice Club Maman, transformatrice	clubsmaman@yahoo.fr
Late Lucien	M	Producteur, transformateur	oceradeb@yahoo.fr
Azonsou Georgine	F	Productrice, transformatrice	+229 96 36 37 51
Ayenan Mathieu	M	Sojagnon-ONG	+229 96 06 34 61
Pieter Wauters	M	GIZ ProAgri	+229 63 10 29 24
Ricarda Schwarz	F	GIZ ProAgri	+229 67 66 13 79
Stefan Kachelriess-Matthess	M	GIZ	-
Sandra Philips	F	SELF/ONG	+229 67 37 14 99
Guinin	M	SELF ONG	+229 97 56 47 37
ITAACC GFA			
Lorenz Bachmann	M	GFA ITAACC	l.bachmann@gmx.de
Lennart Woltering	M	GFA ITAACC	lennart.woltering@gfa-group.de
Jean A Nyemba	M	GFA ITAACC	jnyemba@gmail.com
Si Benasseur Alaoui	M	GFA ITAACC	nasser.alaoui@gmail.com
Marc Bernard	M	GFA ITAACC	marcwbernard@gmail.com
Joerg Lohmann	M	GIZ ITAACC	joerg.lohmann@giz.de
Michel Bernhardt	M	BEAF/GIZ	michel.bernhardt@giz.de
West Africa			
Mali			
Rouamba Albert	M	AVRDC	albert.rouamba@worldveg.org
Okwach E. George	M	ICRISAT	g.okwach@cgiar.org
Bomba Abdou	M	FOPB	cabdemesso@orangemali.net
Niger			
Ali Maman Aminou	M	FO	fumagaskiya@gmail.com
Burkina Faso			
Tandjiékpon Mahoutin Andre	M	ACI	andre.tandjiekpon@giz.de
Sanwidi Maurice	M	CPF	sanwidim@yahoo.fr
Savadogo Inoussa	M	UNPS	inoussa2011@yahoo.fr
Cameroon			
Mvondo Awono Jean-Pierre	M	Dschong University	jpmvondoa@yahoo.fr
Godwe Germain	M	CODAS	germaingn@yahoo.fr
North Africa			
Morocco			
Azennoud Souhad	F	FOó Al Kissane/Farmer	s.azennou@gmail.com
Choukri Rachid	M	ANOC	rachidchoukri@yahoo.fr
Loukili AbdelKrim	M	FO/Bioassil	fermebioassil@gmail.com
Tunisia			
Kaouthar Hamida	F	DGAB, Tunisia	hamida.kaouthar@yahoo.fr

Annex 7: North Africa report

Annex 7: North Africa report

1. DATA COLLECTION

Data collection for Morocco and Tunisia took place between January 2014 and April 2014.

1.1 Countries and commodities

Three Northern African countries were considered at the beginning of the study: Egypt, Morocco and Tunisia, but because of security reasons in Egypt, the study took place in Morocco and Tunisia only.

1.1.1 General Data for Morocco

Morocco has a population of 31.4 millions, a total useful agricultural area (UAA) of 7.941 Million hectares, and 1,500,000 farmers. About 75% of farms have less than 5 ha of cultivated land. Field crops are cultivated on 8 732 200 ha, among which cereals represent 4 770 000 ha, 1 900 000 ha planted to soft wheat, 900 000 ha to durum wheat, and 1 900 000 ha to barley. Acreages planted to cereals lies in a range from 4.5 million hectares in unfavorable years (year 2006-2007 marked by a severe drought) to 5.4 million hectares in years with favorable early rains (years 2003-2004 and 2005-2006) (MAPM, 2010).

Average yields are rather low, with 14.2 q/ha for durum wheat and 15 q/ha for soft wheat. Fallow is practiced annually on 1.5 million ha, while food legumes are cultivated on 400 000 ha, fodder crops on 350,000 ha. Acreages for other crops are: 611 000 ha for oil crops and citrus on 777 000 ha. The irrigated land is about 1 445 000 ha. Livestock is composed of 2,900,000 bovine heads, 18 300 000 heads of sheep, and 5 414 000 heads of goats (MAPM, 2010).

Recent studies have shown that in the past two decades, one out of every two years on average has been marked with drought. This is contrasted with one out of every eleven years at the beginning of last century, and one out of every seven during the 1960s. Seven out of ten farmers have no more than 2.1 ha. of land and struggle with frequent drought, in the absence of any appropriate protection mechanisms.

During the process of selection of FOs, intermediaries such as NGOs, NARS, NAES, we managed to choose stakeholders within the AEZs that covered more than 10% of the land area of the country (See Table 1). Farmers and intermediaries such as NGOs, NARS, Universities and NAES were interviewed as they were perceived to have an understanding of the challenges facing smallholders and their needs for new technologies, institutional or social innovations. A summary of the commodities documented in Morocco and Tunisia each of the countries within North Africa region is given in Table 2.

The semi arid system dominates with 44% of the total arable land, the sub-humid comes second with 26.1% of total arable land, humid with 19% of total arable land. Agriculture in Morocco is therefore dominated by agro-ecosystems with limited or potential, which is semi arid and mountains, which occupy almost two-thirds of the UAA of the country. Areas with a good production potential, and large-scale irrigation, occupy only a third of the national UAA (34.2%).

Table 1: Distribution of farms and Useful Agricultural Area (UAA) for each agro-Ecosystem in Morocco[1].

Agro-ecosystem	UAA in 1000 ha	% Total Morocco	Number of farms in 1000	% Morocco
Mountains (Humid)	1 664	19,0	437,4	30,6
Plains and hills in favourable agro-ecosystem (Sub-humid)	2 282	26,1	287,7	20,1
Plains and plateaus in semi arid/arid agro-ecosystem	3 843 (*including steppes*) (508)	44,0 (*including steppes*) (13%)	520,3 (*including steppes*) (54,3)	38,4 (*including steppes*) (10%)
Large irrigation perimeters	707,4	8,1	100	7 ,0
Saharan and pre-Saharan	236	2,2	85,4	5,9

[1] MAPM (2010) Situation de l'Agriculture Marocaine, N° 10. Situation de l'Agriculture Marocaine. N°10, Décembre 2012.

Agro-ecosystem	UAA in 1000 ha	% Total Morocco	Number of farms in 1000	% Morocco
areas				
All of Morocco	8 732	100	1431,6	100

C.G.D.A. (2009) Atlas de l'agriculture Marocaine. Document de synthèse. Conseil Général du Développement Agricole (C.G.D.A.). Avril 2009. Ministère de l'Agriculture et de la Pêche Maritime, Royaume du Maroc.

1.1.2 General Data for Tunisia

In Tunisia, agricultural land covers about 10.5 million hectares of which 5 million hectares are arable land. They are spread across the North region (37% of the country's most fertile land), the Dorsal and Center (47%), and the south (16%).

Table 2: The four main Agro-Ecological zones of Tunisia[2].

Region	Annual rainfall (mm)	Arable land (%)	Agriculture and soil occupation
North	>500	37	Natural Forest; practice of rain-fed agriculture possible: annual crops and horticulture crops.
Dorsale	400<annual rainfall<500	47	Forest and natural pasture, but fragile; possibility of annual crops and fruit trees, depending on soil and topographic conditions, but with a high climate risk.
Centre	200<annual rainfall<400		Forest and fragile rangelands. Possibility of annual crops and fruit trees but with a high climate risk.
South	annual rainfall<200	16	Very fragile steppes. Easily degraded rangelands. Dry land agriculture can be possible locally with proper management of water runoff.

http://www.agriculture.gov.ma/sites/default/files/ATLASsynthese.pdf

Farmland is spread over about 516,000 small farms; 54% of farms possess less than 5 hectares and represent only 11% of total arable land. These farms are engaged in the cultivation of cereals, vegetables, olive, fruits, and livestock, with 6.9 million heads of sheep and 1.4 million of goat (Iniguez, 2005a).[2]

Cereals in Tunisia are an old and essentially rainfed activity. Its acreage and its yields are highly dependent on climatic conditions, particularly rainfall. Indeed, the area planted annually is around 1.45 Million ha. But this area is experiencing significant inter-annual fluctuations. Over the past two decades, from 1990 to 2010, these plantings ranged from 1.17 million ha in 2002 against 2.03 million ha in 1996.

Tunisia witnessed its worst drought in 50 years from 1999 to 2002, which primarily affected agricultural producers (FAO, 2004)[3]. Yields are therefore experiencing considerable inter-annual variability, ranging from 5 to 20 quintals/ha for durum wheat, 5 to 25 quintals/ha for soft wheat and 4 to 15 quintals/ha for barley.

[2] Iniguez, L. (2005). *Characterization of small ruminant breeds in West Asia and North Africa. Vol.1.* North Africa. International Center for Agricultural Research in the Dry Areas (ICARDA) , Aleppo, Syria, 462 pp. ISBN:92-9127-164-9

[3] Food and Agriculture Organization (FAO) of the United Nations (2004) Progress Achieved in Developing Strategies for Drought Mitigation and Preparedness Planning in the Near East Region, Proceedings of the Third Session of the Agriculture, Land, and Water Use. Commission for the Near East, Doha, Qatar, March 9-11.

Table 3: Summary of commodities covered when speaking to farmer organizations and intermediaries.

Selected country	Dates of field work	Organisations interviewed	Crops	Livestock	Tree crops
Morocco	January 15-February 25, 2014 April, 2014	18 FOs/15 INT	Wheat, Sugarbeets, Tomatoes, Pumpkin, Date palm, Green beans, Saffran, Garlic, Strawberries, Blueberries.	Dairy cattle, Cattle, Goats, Sheep, Beekeeping	Argan, Olive, Apple
Tunisia	February 26-March 10, 2014	02 FOs/6 INT	Wheat, Oat, Alfalfa	Cattle, Goats, Dairy cattle, Sheep, Rabbits, Poultry	Olive

1.2 Target stakeholders

The main mission consisted of completing questionnaires with representatives of Farmer's Organizations (FOs), Directors of IARC (mainly ICARDA), National Research Institutions (NARS: INRA for Morocco and INRAT for Tunisia), National Extension Services (NAES), NGOs, private sector and scientists from IARC and NARS.

INRA, Morocco and INRAT Tunisia are a century old public organizations mandated to undertake research for Agricultural development in both countries. Both institutions have greatly contributed to the modernization of the agricultural sector and agro-systems, and to the improvement of the competitiveness of the two countries agriculture. They are active partners of both international and regional organizations, mainly ICARDA, EC, ICGEG, CIMMYT, AARINENA, FARA, COI, ICRA, and others.

ICARDA is a global agricultural research center working with countries in the world's dry areas. The main objectives of ICARDA are: (i) the sustainable productivity of agricultural production systems; (ii) the improvement of the incomes of smallholder farmers living on dry lands and in fragile ecosystems; (iii) the improvement of nutrition and countries food security strategies. Following Syria's conflict, ICARDA dispatched its scientists between Jordan, Morocco and Tunisia. We therefore, visited ICARDA's offices in Morocco and in Tunisia.

Despite several phone calls and the numerous mails, both GIZ offices in Rabat and Tunisia didn't respond to our requests for appointment. We contacted various GIZ staff in charge of projects dealing with innovation transfer and/or climate change, but none of them found the time to respond to our multiple requests.

Table 4: Summary of stakeholders interviewed with standard ITAACC questionnaires.

Country	Farmer Org.	Intermediaries				IARC	
		GIZ	NGOs	Private sector	NARS/NAES	Strategic	Top innovations
Morocco	18	-	8	1	3	-	4
Tunisia	2	-	-	-	6	1	2

Please find the list of contacts and people met in Annex 1.

Table 5: Summary of stakeholders interviewed during the study in North Africa.

Country	IARCs	Intermediaries	Farmer Organizations
Morocco	Meetings were help with ICARDA scientists in Rabat, Morocco office. ICARDA is a global agricultural research center working with countries in the world's dry areas. The main objectives of ICARDA are: (i) the sustainable productivity of agricultural production systems; (ii) the improvement of the incomes of smallholder farmers living on dry lands and in fragile ecosystems; (iii) the improvement of nutrition and countries food security strategies. Following Syria's conflict, ICARDA dispatched its scientists between Jordan, Morocco and Tunisia. We therefore, visited ICARDA's offices in Morocco and in Tunisia. We tried to have a meeting with the ICARDA coordinator in North Africa, first in Morocco, and in Tunisia, but he was on professional trip in Europe. He therefore accepted to fill the S1 questionnaire. The International Center for Agricultural Research in the Dry Areas (ICARDA) has established strong partnership in dryland research jointly with national agricultural research systems (NARS) of North African countries with a focus to reduce food insecurity and enhance sustainable livelihoods of farming communities in the region.	Interviews included the: - Directorates of Agricultural Extension Services in Rabat and in Khemisset Provinces. - National Institute for Agricultural Research (INRA), Rabat. - Institute of Agronomy and Veterinary Medicine Hassan II, Rabat. - NGOs such as : (1) ALCESDAM, which is a National NGO, whose activities are in favor of farmers of the oasis, it is located in the Province of TATA. Its key objectives are: (i) Improving the efficiency of water resources in the oasis; (ii) Fight against the decline of date palm orchards; (2) Moroccan Association for Organic Agriculture (AMABIO), whose activities focuses on the development of the organic sector through the implementation of actions aimed at strengthening the professional organization; (3) Migration and Development, whose objectives are: implementation of several projects: socio-economic projects, better governance and capacity building, infrastructure and environment protection. (4) Wifak Association of Culture and Social Development, whose objectives are : (i) to valorize and commercialize aromatic and medicinal plants, and (ii) to crush olives for oil extraction for its members, Imilchil, High Atlas. (5) Women Association of Friends of Ait Bouguemez for Development, Environment and Toursim in the Mountains, whose objectives are: (i) Fattening sheep for women and (ii) essential oil extraction from walnuts. (6) Al Bassatin NGO for date palm and olive production, whose objective is to collect water from springs and wells and use it in the oasis to irrigate date palm and olives. (7) National Association for the Development and Enhancement of Prickly Pear (*Ficus indica*); whose objectives are: (i) Development and enhancement of prickly pear (*Ficus indica*) in Morocco.	A range of FOs were visited including large organizations such as: -National Association for Sheeps and Goats (ANOC) counting some 12 452 members across Morocco. -Mohammadi union of dairy cooperatives of Loukkos region, with 5 000 active members. -Moroccan Association of Producers and Exporters of Fruits and Vegetables, the main exporting FO in Morocco. -Moroccan Association of Seeds and Plants (AMSP), with 3 000 active members. -National Association of Cattle Herders (ANEB), with 75 000 active members. -National Association for Read Meat Producers (ANPVR), with 50 000 members. -Moroccan Association of Multipliers of certified Seeds (AMMS) with 1 200 active members. Other medium to small FOs were interviewed: -Agricultural Cooperative Tayyibate, Skoura, Ouerzazate for date palm and olive production (102 members). -Faylal Bio; Taliouine, Ouarzazate for organic garlic and other vegetables, with 2 100 active members. -Agricultural Cooperative Bellouta, Ouezzane for olive oil production. - Agdic women cooperative for argan oil, Amlou (almonds + argan oil + honey) and soap production. -Tiout cooperative for the production and marketing of olive oil, Rural Commune of Maskala, Essaouira. -Cooperative BioAssil for production of organic crops, Benslimane. -Agricultural women cooperative Ariaf Kissane, Rafsai, for organic olive oil, honey and farmers' produced seeds, Taounate Province. -Moroccan Association of producers of small red Fruits.

Country	IARCs	Intermediaries	Farmer Organizations
		(8) National Association Friends of date palm for development and environmental protection, whose objectives are mainly Oasis development to serve the needs of local population, through : (i) Date palm (desertification caused loss of 80% of date palms in Figuig region), and (ii) Sheep production improvement through the use of highly prolific sheep race (9) Maroc Service and Development, localized in Agadir. Its objective is to help farmers how to : (i) defend their commercial interests; (ii) defend quotas at the European union; and (iii) lobbying. (10) AGER Expert for Consulting & Moroccan Company for diverse Activities in agricultural sector, whose objectives are (the development of (i) olive production and (ii) apple orchards in the Middle Atlas.	-Taitmaouin (women in Berber language) cooperative for production, and marketing of argan products. -Agricultural cooperative of beekeeping Sejilmassa, Sidi Slimane. -Assif Malloul Al Filalia Cooperative, Sponsored by the Association Akhiam for apple juice and vinegar production.
Tunisia	We visited ICARDA's offices in Tunisia, and interviewed scientists.	Scientists from INRA Tunisia. Scientists from INAT. There was an interview with General Directorate of Agricultural Production (NAES) with more focus on Cereal production; (2) General Directorate of Agricultural Production (AGPA), Ministry of Agriculture (NAES), with focus on : (i) Oat (*Avena sativa*) for hay and field beans for grains to be used as feed for animals; (3) General Directorate of Organic Agriculture (NAES), whose objectives are : Development of Organic Agriculture in Tunisia (crops & livestock); (4) Agency for Agricultural Extension and Training, whose objectives are: (i) Support for vocational training, and (ii) extension.	FOs interviewed included a livestock association called GIPAG, with 250 members across Tunisia. It is an inter-professional association of poultry products and rabbit enjoying the privilege as an institution of public economic interest. GIVLAIT, counting more than 100 000 active members, is an inter-professional association of red meat and milk producers.

2. DEMAND AND SUPPLY FOR AGRICULTURAL INNOVATIONS

2.1. Demand for innovations: the challenges faced by farmers

As stated in the main report, the major problems relevant to various commodities were explored through interviews carried out with FOs and intermediaries and contrasted against the problems that the IARC and NARS top innovations were to address.

Differences were noticed between the Africa-wide data set and the data for North Africa – this was especially the case for major crops. While Maize was found to be the major commodity for the Africa data, wheat is the most frequently mentioned crop by all actors, barley comes next to some extent. The importance of olives and date palm for tree production could be considered a specificity of North Africa. It is worth mentioning that ICARDA, which is the only IARC in North Africa has been putting emphasis on cereals, mainly wheat and barley.

With regards to crop management constraints, weeds, diseases and insects are the major constraints facing farmers for major crops in North Africa.

There were also some differences between perceptions of intermediaries and FOs. There was no match for food legumes. FOs give more importance to these commodities for the multiple roles they are playing: agronomically as a part of the rotation and as a source of protein for human consumption.

Apart from the crop commodities covered in the main report, argan, which is a natural forest tree, is typical of Morocco. Several women cooperatives were created during the last decade. Some of these cooperatives are supported by funds from the government (building a local for the cooperative activities, trainings, etc.). Other women cooperatives are supported by local or foreign NGOs and through international cooperation.

Box 1: The Argan tree, and its socio-economic and environmental roles

The Argan tree (*Argania spinosa* (L.) Skeels) is indigenous to southern Morocco. It is largely found in the Southeast of Essaouira on the Souss plain.

The Argan forest extends over approximately 800,000 hectares and contains more than 20 million trees. **It acts as a natural barrier against the advance of the neighbouring Sahara Desert**.

The fruit of the tree contains a very hard shell, holding between one and three kernels, from which valuable oil can be extracted.

The Argan forest is extremely important in socioeconomic terms, as it supports more than 3 million people.

We interviewed three cooperatives which are all made of women members (Agdic Cooperative for Argan oil, in Essaouira province; the other in Taliouine and the third in Rural Commune Tiout, in Taroudant Province).

Box 2: Taitmatine cooperative for production, and marketing of Argan products (GFA data), with 56 women members.

Berber women crush the nuts of the argan tree (Titmawin Argan cooperative, Tiout village, Taroudant Province)

©Abdelhak Senna /AFP/Getty Images

The main challenges:

According to Ms. Fadma Hankar, the Titmawin cooperative Director, the main challenges the cooperative is facing are:

(i) Difficulty of selling the products of the cooperative.

(ii) Unfair competition from the private sector (some private companies use vegetable oils other than argan oil, and they don't use real honey in the manufacture of products).

(iil) High ceiling of expenses: enhancement of local products and efforts of workers and members of the cooperative.

Solutions tried by the cooperative to solve problems:

(i) Cooperation with associations that practice Fair Trade principles, and registration of the cooperative as Economic Interest Grouping (EIG). The cooperative sells indeed currently 80% of its production through the Economic Interest Grouping, the remainder being passed in direct selling in the cooperative store or through spot contracts.

(ii) The products of the cooperative from argan oil are certified organic (payment 1 800 €/year and certificate issued by the state showing that the cooperative respect the principles of hygiene and traceability. This allows the cooperative to get fair prices for its products.

(iii) Collaboration with institutions paying its fair value the effort provided by women, and with organizations that practice fair trade principles.

(iv) Collaboration with leading cosmetic companies to sale cosmetic products made by women using argan oil.

2.2 The match between supply and demand

The extent to which the top innovations identified by the IARCs were broadly addressing farmers' challenges was also given consideration. The data for wheat for North Africa looks different from data for the whole of Africa (Table 6 and Table 7). Challenges related to cultivation practices and harvesting were rated higher for North Africa data than for whole Africa (27% against 17%), training, knowledge, know-how, and awareness came second with 27% for North Africa against 5% for whole Africa.

FOs (Table 7) gave importance to multiple challenges farmers are facing with "cultivation practices and harvesting" (27%), and "training, knowledge, know how, awareness" (27), while IARC (ICARDA) gave more importance to "Natural resources (land and water availability)" (26%), to issues related to "Pest and diseases (22%), and to low yields and poor quality (17%). In fact, the prevalence of illiteracy among farmers in North Africa makes it difficult for them to communicate with extension agents and to accommodate new technologies; this is what explains that intermediaries and FOs gave more importance to training, knowledge, know-how, and awareness (27% and 23%, respectively). Low uses of machinery, and more reliance on hand labour, are responsible for low adoption of modern and appropriate practices from soil preparation to harvest.

Table 6: Main wheat challenges for combined Africa data.

Wheat main challenges	FO %	Interm. %	IARC %
Any challenge with cultivation practices and harvesting	17	16	5
Tools, machinery and irrigation equipment	17	8	5
Weeds, weeding	12	-	-
Access to credit or finance/ high production costs	1	12	-
Access to and quality of seed	7	12	14
Any other problems	7	-	-
Access to, quality and use of fertilizer	5	-	-
Pest and diseases (including rodents, animals)	5	-	23
Training, knowledge, know-how, awareness	5	16	-
Institutional/regulatory/policy issues	5	12	-
Access to, quality of pesticides and other inputs	2	4	-
Natural resources- land and water availability	2	-	23

Wheat main challenges	FO %	Interm. %	IARC %
Low yields and poor quality	2	12	9
Marketing	2	-	-
Post harvest processing or storage	2	-	-
Poor soil fertility	-	-	-
Social issues- theft, adultration, crime, conflict	-	-	-
Labour, (shortage, price, etc.)	-	-	-
Transport and infrastructure	-	4	-
Drought, flood, any climate related problem	-	4	23
Nominations=	**42**	**25**	**22**

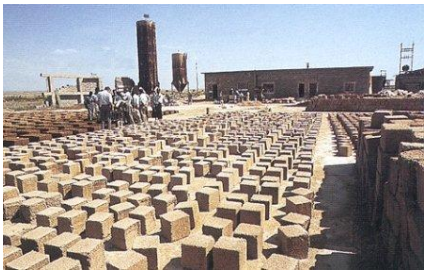
Table 7: Wheat main challenges by FOs, intermediaries and IARC for North Africa.

Wheat main challenges	FO %	Interm. %	IARC %
Any challenge with cultivation practices and harvesting	27	9	4
Training, knowledge, know-how, awareness	27	23	4
Weeds and weeding	11	-	-
Tools, machinery and irrigation equipment	9	11	-
Low yields and poor quality	7	3	17
Access to quality of pesticides and other inputs	4	3	-
Access to and quality of seed	2	11	9
Access to, quality and use of fertilizer	2	3	-
Natural resources- land and water availability	2	-	26
Poor soil fertility	2	-	-
Pest and diseases (including rodents, animals)	2	6	22
Marketing	2	-	-
Post harvest processing or storage	2	-	-
Drought, flood, any climate related problem	-	6	13
Access to credit or finance/ high production and input costs	-	9	-
Social issues- theft, adulteration, crime, conflict	-	6	-
Transport and infrastructure	-	-	-
Labour (shortage, price, etc.)	-	3	-
Institutional/regulatory/policy issues	-	3	-
Any other problems	-	6	4
Nominations=	**45**	**35**	**23**

2.3 Regional cases of good demand and supply matches

A number of cases of strong matches were identified in terms of top innovations that addressed challenges expressed by FOs and intermediaries. According to the methodology followed by GFA team, four cases where there is clear match or gap matches for North Africa were chosen: (i) Feed Blocks: low-cost livestock feeds for North African farmers; (ii) Durum & bread wheat varieties resistant to Hessian fly; (iii) Conservation Agriculture; (iv) Date palm varieties resistant to *Fusarium*.

Table 8: The four cases showing clear match for North Africa.

Case	Key farmer problem addressed	Description of the innovation	Unresolved issues
<u>Feed Blocks</u>: low-cost livestock feeds for North African farmers[1] (Interview with Dr. Mohamed El Mourid, ICARDA Coordinator, North Africa, Tunis, Tunisia).  **Feed blocks making** 	-The principal limiting factors affecting small ruminant productivity in the semi-arid areas of North Africa (NA) is the shortage of forage. -This leads to increasing pressure on rangelands and therefore to a rapid deterioration of plant cover in many areas. -The frequent occurrence of drought in many countries of NA results in widening the gap between the feed supply and nutrient requirements of small ruminants. -The high cost of conventional concentrate feeds (barley grain, bran, etc.) prohibits their wide-scale use, especially by small farmers. Therefore, it is necessary to seek alternative supplements to improve the nutrition and thus the productivity of small ruminants. -A considerable amount of crop residues and agro-industrial by-products (pulp of dates, tomatoes and beet, brewer's grain, wheat and rice bran, olive cake, molasses and poultry waste) is available. -However, these by-products are not efficiently utilized in feeding small ruminants.	- Feed block technology is simple and does not require sophisticated equipment. Blocks are easy to handle, transport and can be made at the farm levels using the family labour. -Feed blocks are a solidified mixture of agro-industrial by-products used for supplementing poor quality roughages and native rangelands. -The value of feed blocks lies in their role as cost-effective supplements and as a means for preserving several high moisture agro-industrial by-products (e.g. tomato pulp, olive cake, etc.). -Different formulae can be manufactured with different levels of urea, binders and a wide range of agro-industrial by-products, which are available locally. -Tomato pulp and olive cake are used in Tunisia, and molasses and cactus in Morocco. -Feed blocks, used as a supplementary feed, results in considerable improvement in ewes' weight gain, conception, lambing and twinning rates.(Nefzaoui et al., 2011) -ICARDA has been developing this technique in collaboration with INRA-Morocco and INRA-Tunisia.	- Indications show that further research could lead to the broadening of the scope of utilization of this technology in order to meet specific nutritional requirements of the animals, including cows, at specific stages, for a better productivity.
<u>Durum & bread wheat resistant to Hessian fly</u>	Durum wheat varieties are Infested with Hessian fly. Hessian fly attack on wheat plants results in thin stand, many dead tillers, and high yield losses.	-Hessian fly resistant durum & bread wheat varieties were developed by multilateral cooperation & germplasm exchange between INRA-Morocco, ICARDA and CIMMYT. -The main durum wheat varieties developed which	The quantity of seeds multiplied using durum wheat varieties resistant to Hessian fly is not sufficient to satisfy the demand.

 Resistant and sensitive durum wheat varieties		are resistant to Hessian fly are: *Saada*, *Massira*, *Arrehane*, and *Aguilal*. -Resistant varieties are multiplied by the National Seed Company in Morocco (SONACOS) and sold only in areas where Hessian fly is a problem.	
<u>Conservation Agriculture</u> **Direct seeding**	- Degradation of soil structure and fertility. -Lack of water because of low rainfall caused by Climate Change. -High production costs & low revenues. **Soil erosion and soil tillage** 	-Using conservation agriculture together with good crop management. -Appropriate machinery developed for tractors with low to medium horsepower with low price (specific seeders manufactured in Syria). -Fodder crops integration in cropping system to avoid grazing of crop residues. -Improvement of soil structure, dry matter content, and biodiversity on the soil surface and within. -Significant reduction of the use of nitrogen and other fertilizers. -Significant reduction of the use of nitrogen and other fertilizers. -Reduction of soil compaction. -Improvement of crop adaptation to changing climatic conditions and stabilization of yields despite unreliable rainfall.	-Special skills needed, Price of machinery is still high, -Acreages devoted to fodder crops are low. Removal from fields of all crop residues until the last straw. -Livestock integration within most farms in North Africa leads to grazing of crop residues.
<u>Date palm varieties resistant to *Fusarium*</u> **Symptoms of the disease at early and late stages**	-Fusarium (known locally as "Bayoud") disease causes considerable damage to date palms. -Bayoud has destroyed in one century more than 10 million palms, most of it in Morocco (15 millions to 4.8 millions currently). -The world's most famous varieties are the most susceptible to the disease: *Medjhool*, *Deglet Nour*, *Boufegouss*. -The disease accelerated the phenomenon of desertification	-INRA developed, during the last 4 years, nine resistant varieties, among which *Najda* ("means Help in Arabic") is the most known. -To guarantee the authenticity of date palm varieties, micro propagation by tissue culture was used. -Multiplication of naturally resistant varieties like *Bousthaoui* was also performed.	-Land scarcity for planting new date palm orchards. Scarcity of irrigation water. -Difficulty for farmers to get subsidies (illiteracy …). -Low capacity in terms of micropropagation of date palm.

	as date palm plays the role of a natural wind break.	**Newly planted date palms**	

[1] Nefzaoui A., Ketata H., and El Mourid M. (2011) Agricultural Technological and Institutional Innovations for Enhanced Adaptation to Environmental Change in North Africa. International Perspectives on Global Environmental Change.

2.4. Results hypothesis 1-4

HYPOTHESES 1-4
1. IARCs are addressing key needs of farmers.
2. Innovations are affordable for farmers.
3. Farmers and scientists share similar views on key criteria for design/adoption of innovations.
4. Gender equity is an important criteria for actors in the innovation system.

Regarding hypothesis 1, though there is only one IARC, which is ICARDA, we can conclude that there were no substantial differences between North Africa and the Africa data. ICARDA's regional Coordinator for North Africa, mentioned that the Centre had always followed clear steps to ensure that research agenda responds to farmer needs.

According to the outcomes of working groups at the Cotonou workshop[4], agricultural innovations should take into account several criteria: (i) the complementarily regarding their respective roles for male, female, and children for the development of innovation and implementation of projects; (ii) the specificity of the social components (males, females, vulnerable groups ... etc.).

Special interest should be given to smallholders, vulnerable groups, women, especially widows. There is no cure all innovations; therefore new technologies should be adapted to different groups with different needs. In the African context where crops and livestock cohabitate within the same farm integrated system innovations should be favored against single interventions.

When asked about production costs (hypothesis 2) the Africa wide data showed that in particular investment cost limit access to innovations. This is certainly also the case in North Africa. Regarding the running costs, the situation seems better, as 44% of the IARC scientists indicated that their innovations had lower to significantly lower costs. The other innovations were on the same cost level as current farmer practice.

In terms of the criteria that all stakeholders thought important for adoption of innovations by smallholders (hypothesis 3), big comparative advantage and affordability were mentioned by all stakeholder groups. While FOs indicated that labour-saving and costs saving in general and market potential were also important, IARC scientists pointed out that simplicity, profitability and up scaling potential are also important for the adoption of innovations by smallholders.

With the scarcity of resources, scientists in Africa can't afford to stay disconnected from realities in the field and at the village level. Researchers should build on existing innovations. They should also analyse and build on farmers' innovations[5].

[4] Assessment of the Demand-supply Match for Agricultural Innovations North & West Africa Workshop Report 19th and 20th March, 2014, Cotonou, Benin.

[5] Assessment of the Demand-supply Match for Agricultural Innovations North & West Africa Workshop Report 19th and 20th March, 2014, Cotonou, Benin.

Table 10: Stakeholders' perceptions of key criteria for adoption of innovations.

Key criteria for adoption	FO %	Interm. %	S1 %	S2 %
Big comparative advantage (yield gain)	57,9	44,4	100,0	75,0
Market potential	52,6	83,3	na	na
Labour saving	52,6	44,4	0,0	0,0
Cost saving	52,6	11,1	0,0	37,5
Compatibility with local traditions	47,4	55,6	0,0	12,5
Affordability (low investment cost)	36,8	22,2	100,0	62,5
Profitability (medium to high return with low input	31,6	33,3	100,0	37,5
Create complexity (broaden farming system)	31,6	27,8	0,0	25,0
Profitability (high return with high input-high risk)	21,1	44,4	0,0	25,0
Nominations	31,0	0,0	5,0	0,0
Risk reduction (production, marketing, etc.)	21,1	22,2	0,0	37,5
Others specify	21,1	38,9	0,0	0,0
Upscaling potential	15,8	44,4	100,0	12,5
Trialability (farmers can test small scale)	10,5	33,3	0,0	0,0
Simplicity	5,3	11,1	100,0	62,5
N	**19**	**18**	**1**	**30**

Gender (hypothesis 4) is thought by ICARDA's regional Coordinator to be the key criteria to access funding. 76% of intermediaries believe that adoption of innovations have medium to very high impact on promoting gender equity.

According to findings of the North/West Africa workshop, there is a necessity to consider women for the development of innovations; address the inequality of leadership in both agriculture and development, as the female work force is important, but the majority of businesses are under male direction; and take into account the concerns of women rather only during field visits[6].

Box 3: Mechanization has the potential to reduce women's' work load.

The development of innovations should involve women as they are the users of them. There are many regions of Morocco and Tunisia where women are performing many tasks. In fact, weeding, field preparation and harvesting for crop production and milking, animal feeding, care for young animals, and produce transformation were most mentioned as women's tasks. Since the use of machinery is seen as men's tasks, any innovations leading to mechanization of sowing, weeding and harvesting could reduce women's work load.

Extraction of Argan Oil, Morocco

Goat milking, Tunisia

Olive harvest, Tunisia

The overall picture in Africa differs from that in North Africa with regards to the level at which gender issues are featured in ICARDA's research agenda. Our survey showed some conflicting results. Indeed, while ICARDA's regional coordinator for North Africa declared that ICARDA had always taken gender issues in consideration in the process of identification of research priorities, ICARDA scientists declared that in one case out of two consideration of gender is very little. Intermediaries adopted a position in

[6] Assessment of the Demand-Supply Match for Agricultural Innovations North & West Africa Workshop Report 19th and 20th March, 2014, Cotonou, Benin.

between, stating that gender feature is medium to high in two cases out of three (64%). Compared to the other 3 African regions, North Africa is therefore behind in terms of gender.

Table 11: How does gender is featured in ICARDA's research agenda?

	Africa			North Africa		
	Interm.%	S1 %	S2 %	Interm. %	S1 %	S2 %
Very little	6	9	9	24	0	50
Little	3	0	3	0	0	0
Medium	17	30	31	41	0	13
High	29	43	38	24	0	0
Very high	45	17	19	12	100	38
N	123	23	88	17	1	7

Results for North Africa differ from those at African level substantially. Farmers are involved in the development and testing of innovation only in one case out of four (25%), while 75% of research are research controlled. This finding shows that North Africa is lacking behind compared to the rest of Africa. Research is much more research station focused and farmers do have less control. This result implies that Hypothesis 5 is only partially confirmed.

Table 12: Farmer participation during research (S2)

Degree of farmers participation	Africa %	North Africa %
No participation	3,3	0,0
Researcher controlled	23,9	75,0
Some level of farmer control	62,0	12,5
Full level of farmer control	10,9	12,5
N	**8**	**92**

2.5 Results hypothesis 5-10

HYPOTHESES 5 – 10

5. Farmers are the major stakeholders in the design and implementation of IARCs' research.
6. The ways information on innovations is shared matches the requirements of key stakeholders.
7. Farmers rate advisory services they receive as adequate.
8. Effective linkages exist between different actors in the innovation system.
9. IARCS innovations have been up scaled adequately.
10. Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes.

Hypothesis 5: The data for Africa showed that Hypothesis 5 is partially confirmed (Table 13). The North Africa picture shows this trend even stronger; the weight of farmers in the process is even weaker. It is obvious that donors and private sector actors play a stronger role compared to Africa in general. Similar to H4 on gender, it may be concluded that North Africa is somewhat lacking behind the general discussion process on methods and approaches to innovation development.

In addressing this issue, participants to the North/West Africa workshop recommended: (i) the necessity to get all stakeholders, including FOs, involved in the identification of constraints and the search for appropriate solutions; and (ii) get FOs involved early in any project.

Table 13: Who was the major stakeholder influencing the research agenda?

	Primary (%)		Secondary (%)		Third (%)	
	Africa (%)	North Africa (%)	Africa (%)	North Africa (%)	Africa (%)	North Africa (%)
Farmers	29	37,5	39,0	25,0	28,0	42,9
Donors	7	0,0	33,0	62,5	45,0	28,6
Researchers	64	62,5	21,0	12,5	14,0	28,6
Private sector	0	0,0	07,0	0,0	14,0	0,0
Total	**90**	**8**	**90**	**8**	**80**	**7**
Without answer	29	0	39	0	28	1

Regarding information sharing (H6) there is little difference between the African and regional picture.

Hypothesis 7: Farmers rate advisory services they receive as adequate. With regards to the quality of extension service provided to the farmers by NAES, 71.4% are judged medium to poor and very poor for whole Africa, while it judged to be medium, poor and very poor by 100% of interviewed FOs.

NAES in North Africa lacks specialized extension specialists, and funds. The situation got worse after World Bank advised Morocco and Tunisia to reduce funds devoted to extension and other services regional administrations were providing for small farmers.

Hypothesis 8: Effective linkages exist between different actors in the innovation system. The linkages between different actors were also explored through the study. The findings in North Africa did differ from the Africa-wide data. Linkages between ICARDA, the only IARC in North Africa, and FAOs, NAES were rated very poor. However, links with NARS were rated are medium. Thus, the ratings are somewhat stronger compared to the Africa wide dat.

According to recommendations of NA/WA workshop, it is necessary to: (i) Finance the process of diffusion of innovations integrating research, NGOs, FOs, and consumers; (ii) Establish and institutionalize an appropriate framework to facilitate collaboration; and (iii) Establish platforms between the different institutions.

Hypothesis 9: IARCS innovations have been up scaled adequately. While IARCS innovations up scaling was thought to be medium to big and very big in 84 % of cases for whole Africa, it is judged to be medium to small in 100% of cases. This may indicate that there IARC innovations are less successful in the North. However, it should be noted that most scientists consulted rarely had precise figures on adoption. Consequently, there could be considerable estimation errors.

Table 14: The level of up scaling of agricultural innovations for whole Africa and North Africa

	Africa		North Africa	
	Number	Share (%)	Number	Share (%)
Very small (niche production)	5	5,6	0	0,0
Small	9	10,1	1	12,5
Medium	25	28,1	7	87,5
Big	30	33,7	0	0,0
Very big (potentially most farmers in the country)	20	22,5	0	0,0
Total	**89**		**8**	

Hypothesis 10. Climate change is having an impact on smallholder farming systems and actors are successfully adapting the production systems to the changes. All stakeholders in North Africa perceive climate change mostly through increased drought, decreased rainfall, and increased temperature. This is similar to overall Africa findings. Other reasons (35%) played a bigger role in NA compared to the continent (12%).

Table 15a. Climate change risks felt by farmers and risks addressed by innovations in North Africa.

	FO %	Interm. %	IARC %
Increased drought	80.0	66. 7	88,9
Decreased rainfall	70.0	72.2	77,8
Increased temperature	40.0	55. 6	66,7
Other specify	35.0	27. 8	22,2
Increased vulnerability	25.0	61.1	77,8
Increased flood risk	25.0	5. 6	22,2
Increased rainfall	25.0	16. 7	33,3
Changes in season	20.0	55. 6	Na
Erratic rainfall	20.0	61.1	77,8
Increased wind damage	05.0	5. 6	Na
Hailstorms	5.0	5.5	Na
Total answers	**20**	**136**	**9**

3. CONCLUSIONS AND RECOMMENDATIONS

The problem perception by the scientists of ICARDA in the case of North Africa, and farmer organizations differ. Researchers working in a scientifically sound way, often face what they call an “unexpected resistance” from farmers that do not perceive improvements on (e.g. yields or other parameters) in the same way as they do.

The ability to have funds to conduct research on various topics, without any directive that the research themes are defined taking into account the real needs of farmers and their point of view before and during implementation, may be an explanation why differences in perception of problems and best solutions are more pronounced and also adoption of innovations seems less good in North Africa.

ICARDA should conduct more experiments on farm, and reduce work in entirely in controlled environments and in the experimental stations. It is through conducting experiments in a real environment that scientists of international research Centers or NARS get to ability to better understand the socio-economic constraints on farm level. It also requires them to worry more about the economics and profitability of the proposed technical solutions. It is also recommended that researchers analyse and build more on farmers’ innovations.

Special attention should be given to smallholders, vulnerable groups and women. The fact that there are no innovations that address all problems; consequently a greater number of different technologies are needed that can cater for different needs or various groups. In the North African context with its mixed farms that produce both crops and livestock, integrated system innovations should be favoured against single interventions.

ICARDA should expand its collaboration with other IARC for more systems related research. Furthermore, the collaboration with NGOs and major donors (WB, GIZ, FAO, IFAD) could be strengthened. Such collaboration would aim to save resources and boost the impact of development programs through synergies.

The data also showed that the private sector is not playing a constructive role for farmers. This field of intervention should be given more emphasis. The problems are aggravated by the fact that credits are difficult to obtain and very expensive.

Climate change is becoming a widely felt reality. It is now becoming a structural characteristic of North African countries, and adaptation measures should be an integral part of any future innovations for both

crops and livestock. Accordingly, priority should be given to the protection of water, soil resources and to forest.

Innovation platforms should be put in place involving different stakeholders. Stronger linkages between the different actors are needed, and they should include farmers' organisations, NARS, NAES, IARCs, government institutions, NGOs, and the private sector.

Taking into account strengths and weaknesses for farmers' Organizations, it is suggested to look for opportunities to improve the government's contribution, decentralize activities and budget by the government; take accompanying measures for young professionals for job creation and professionalization of agriculture; encourage and facilitate the creation of more FOs; put in place good market protection policy; ensure the availability of reliable agricultural inputs; ensure the transformation of the agricultural sector.

For more NGOs role in innovation transfer to farmers, it is suggested to strive for more organization of actors for better transfer of innovations; accept dialogue and cooperation; make transparency ; promote partnership ; have more NGO leaders in the platforms; target long term funding / Diversification of funding sources; mobilization of local resources of producers and/or government.

Taking into account strengths and weaknesses for farmers' Organizations, it is suggested to look for opportunities to improve the government's contribution; decentralize activities and budget by the government; take accompanying measures for young professionals for job creation and professionalization of agriculture; encourage and facilitate the creation of more FOs; put in place good market protection policy; ensure the availability of reliable agricultural inputs; ensure the transformation of the agricultural sector.

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Appendix 1: List of people interviewed with contact details (from trip reports) and list of people attending regional workshop.

Organization	Category	Contact person and details
Morocco		
Sheep & Goat Association (ANOC)	FO	Mr. Choukri Rachid, Director Phone work: +212 5 37 69 8 44 Cellular: +212 6 61 34 8 91 email: rachidchoukri@yahoo.fr
National Association of Cattle Herders (ANEB)	FO	Mr. Noureddine Belkadi, Animal Scientist hone (work): +212 5 37 23 2 44, Cellular : +212 661 5 16 81 email: aneb@menara.ma
National Association of Cattle herders/Meat Production (ANPVR)	FO	Mr. Driss El Bada, Animal Scientist Phone (office): +212 5 37 68 27 51 Cellular: +212 6
Mohammadi Union of Dairy Cooperatives of Loukkos region (North of Morocco)	FO	Mr. Farmer Phone (Office) : +212 5 39 91 85 91
Assif Malloul Al Filalia Cooperative, Sponsored by the Association Akhiam (CAMAF), Imilchil, (South East)	FO	Mr. Hssain Ouzani (President) Phone (Home) : +212 5 35 57 21 14 Cellular : +212 6 7 78 6 81 Website: www.akhiam.org
Moroccan Association of Producers and Exporters of Fruits and Vegetables (APFL), Agadir (South)	FO	Mr. Brahim Ouaddich () Office Phone: +212 28 84 88 8 Cellular: +212 6 61485325
Moroccan Association of Seeds and Plants, Rabat (AMSP)	FO	Ms. Mariam El Bedraoui (Director) Phone (Home): +212 5 37 68 35 95 Cellular: +212 6 61 49 24 23 Email: bedraoui.mariam87@gmail.com
Agricultural Cooperative of Beekeeping Sejilmassa, Sidi Slimane (North west)	FO	Mr. Lhaj Laich (President) Phone: +212 5 37 5 45 32 Cellular: +212 6 61 22 11 85
Moroccan Association of Multipliers of Selected Seeds, Rabat (AMMS)	FO	Mr. Mohamed Bouanani (Director) Phone (Office): +212 5 37 8 9 52 Cellular: +212 6 61 46 68 12
Titmaouin Cooperative for Production, and Marketing of Argan Products (South)	FO	Ms. Fadma Hankar (Director) Office: +212 5 28 85 25 51 Cellular: +212 6 62 13 3 4 email: cooptaitmatine@gmail.com
Moroccan Association of Producers of Red Fruits (AMPFR)	FO	Mr. Aboulghait Zouitina (Manager) Phone (Office): +212 5 37 44 51 Cellular : +212 6 61 22 3676
Agricultural Cooperative Ariaf Kissane, Rafsai, Taounate Province (North-East)	FO	Ms. Souhad Azennoud (President), Farmer & Bee keeper Phone: (Home): +212 5 22 21 3 59 Cellular: +212 6 76 88 9 3 email: s.azennoud@gmail.com
Cooperative BioAssil for Organic Agriculture, Benslimane (Central region)	FO	Mr. Abdallah Madrani (President) Phone (Home) : +212 5 22 5 55 68 Cellular : +212 6 61 95 85 97 email: fermebioassil@gmail.com
Tiout Cooperative for the Production and Marketing of Olive Oil, Rural Commune of Maskala, Essaouira (South West)	FO	Mr. Maati Bousarhane (Director) Phone (Home) : +212 5 24 78 55 94 Cellular: +212 6 67 76 31 1
Agdic Cooperative for argan oil, Amlou (almonds + argan oil + honey) and soap production, Agdic Essaouira (South West)	FO	Mrs. Zahra Tidzi (Director) Phone (Work) : +212 5 24 47 23 58 Cellular : +212 6 67 35 36 46 email: zitearganyahoo.fr
Agricultural Cooperative Bellouta, Ouezzane, Morocco (North)	FO	Mr. El Azzouzi Azhar (Bee keeper) Phone:+212 5 39 7 77 45 Mobile: +212 6 77 58 87 71

Organization	Category	Contact person and details
Agricultural Cooperative Tayyibate, Skoura, Ouerzazate, (South) (created in 211)	FO	Mr. Elqasbaoui Mohamed (Deputy treasurer) Cellular: +212 662 4234
Faylal Bio (organic garlic and saffran production); Taliouine, Ouarzazate (South)	FO	Mr. Khamis Chihane () Cellular: +212 660 777 879 email: potagerbio.ck@gmail.com
Tunisia		
Interprofessional Grouping of Poultry and Rabbit Products (GIPAG)	FO	Ms. Imène Daboussi Phone : +216 71 847 75 Fax : +216 71 845 988 email: gipac@gipac.tn
Interprofessional Group of Red Meat and Milk (GIVLAIT)	FO	Mr. Ahmed Slimane, Phone : +216 98 477 24 email: a_slimane@yahoo.com
IARC (CARDA)		
ICARDA, Tunis, Tunisia	ICARDA (S1)	Dr. Mohamed El Mourid (ICARDA's Regional Coordinator for North Africa) email: m.elmourid@cgiar.org
ICARDA, Tunis, Tunisia	ICARDA (S2)	Dr. Abdallah Bari (Plant breeder) email: a.bari@cgiar.org
ICARDA, Rabat, Morocco	ICARDA (S2)	Dr. Mustapha El Bouhsini (Entomologist) Phone: email: m.bohssini@cgiar.org
ICARDA, Rabat, Morocco	ICARDA (S2)	Dr. Ahmed Amri (Genetic resources specialist) Phone: +212 5 37 71 49 75. email: a.amri@cgiar.org
ICARDA, Rabat, Morocco	ICARDA (S2)	Dr. Mohamed Karrou (Agronomist) email: m.karrou@cgiar.org
ICARDA, Rabat, Morocco	CARDA (S2)	Dr. Miloudi Nachit (Durum wheat breeder) email: m.nachit@cgiar.org
ICARDA, Tunis, Tunisia	ICARDA (S2)	Dr. Ali Nefzaoui (Animal Scientist) email: a.nefzaoui@cgiar.org, Phone: + 216 71 752 134 / 71 752 99 Fax: (+ 216) 71 753
GIZ/NGO/Private sector		
Morocco		
INRA, Rabat, Morocco	INRA	Dr. Rachid Mrabet, Soil scientist, Director of Research Department, INRA, Rabat email: rachidmrabet@yahoo.com
IAV Hassan II, Rabat, Morocco	IAV Hassan II	Prof. Ouafae Benlhabib, Plant breeder Portable: +212 668 194 85 email: o.benlhabib@gmail.com
AMABIO (Moroccan Association of Organic Agriculture, Casablanca, Morocco	NGO (AMABIO)	Mr. Allal Chibane, Head Service of label and AMABIO Director Phone: +212 6 57 831 53 allalchibane@gmail.com
Emigration and Development NGO, Taliouine, Ouarzazate, Morocco	NGO	Mr. Rachid El Hiyani, Phone (Work): 212528534148, Portable: 212 6385533; email: rachid.elhiyani@migdev.org
Maroc Service and Development (SA), Agadir, Morocco	Private sector	Mr. Mohamed El Hanid, Phone: +212 5 28 32 21 8; Portable: +212 6 61 9 89 16; email: elhanid@gmail.com
AGER Expert Consulting & Compagnie Marocaine des Travaux Divers	Private sector	Engineer Aimad CHOUHAB , Portable: +212 661 22 4 39 email: a.chouhab@gmail.com,

Organization	Category	Contact person and details
Wifak Association of Culture and Social Development, Imilchil, Errachidia, Morocco	NGO	Mr. Mohamed Ourehhou, President, Phone: +212 5 35 57 28 19, Portable: +212 6 71 1 21 33
Association of Friends of Ait Bouguemez for Development, Environment and Toursim in the Mountain, Ait Bouguemez, Azilal Province , Morocco	NGO	Ms. Nejma Jellou, President Phone: +21252439563; Portable: +2126618328; email: najmajellou@yahoo.fr
Association for date palm and olive production Ouarzazate Province	NGO	Mr. El Hassani Abderrahmane, Portable: +212 6 23 34 99 51 email: bassatinesskoura@yahoo.fr
National Association for the Development and Enhancement of Prickly Pear (*Ficus indica*), Kelaa Seraghna, Morocco	NGO	Mr. Abderrahmane Ait Hammou, Potable: +212 6 41 73 46 71; email: aithamou@hotmail.com
Association for the Fight against erosion, drought, and desertification in Morocco (ALCESDAM)	NGO	Mr. Lahcen Ahouate, Animal Scientist Portable: +212 671196451; Home: +212 537835355; email: ahouate@hotmail.com>
National Association Friends of date palm for development and environmental protection, Tata, Morocco	NGO	Mr. ELKHALIL Nouhi Phone (office): +212 5 28 8 21 38; Portable: +212 6 7 68 69 38 email: nouhi1@yahoo.fr;
Centre for Agricultural Council, Khemisset, Morocco	Regional NAES	Mr. Mohamed Ramah, Agronomist and Extension Specialist Phone: +212 5 37 55 84 18, Portable: +212 6 65 16 1 45, email: ramahster@gmail.com
	Tunisia	
Institut National de la Recherche Agronomique de Tunisie (INRAT)	INRA, Tunis	Dr. Ramzi Chaabane, Agronomist Cellular: +216 23 55 9 49; email: ramzi23@yahoo.it
INAT, Université de Cartage, Tunis	INAT Tunis	Prof. Nizar Moujahed, Animal Scientist email: nizar.moujahed@yahoo.fr>
Service for Cereals, Ministry of Agriculture, Tunis, Tunisia	NAES Central	Mr. Mohamed Ali Benramdane, Chief, Service of Cereals, Ministry of Agriculture , Phone : +216 71.8.42.2.96; Portable: +216 22.9.29.9.28; email: suivi_dgc@yahoo.fr
General Directorate of Agricultural Production (AGPA), Ministry of Agriculture, Tunis, Tunisia	NAES Central	Mr. Babba Mohamed, Agronomist Portable: +216 238 94 383, email: med1_ingenieur1@yahoo.fr
General Directorate of Organic Agriculture, Ministry of Agriculture, Tunis, Tunisia	NAES Central	Dr. Samah Amara, Portable: +216 71 286 419 email: sameh.amara@hotmail.com
Agency for Agricultural Extension and Training (Agence de Vulgarisation et de la Formation Agricoles), Ministry of Agriculture, Tunis, Tunisia	NAES Central	Mr. Moundher Kharrat, Agronomist Phone: +216 71 78 9 25; Fax: +216 71 79 72 8; Mobile:+216 98 537 966; email: kharrat.mondher@yahoo.fr

Appendix 2: List of people who attended the North and West Africa workshop on the Transfer of Innovation in Agriculture – Adaptation to Climate Change (GIZ/ITAACC Project), Cotonou, Benin,19-20 March, 2014.

First & last Name	Male/ Female	Institution/Organization	e mail or phone number
Benin			
Dorith von Behaim	F	GIZ	dorith.von-behaim@giz.de
Lara Goldman	F	GIZ ProAgri	lara.goldmann@giz.de
Myra Wopereis		AfricaRice	mwopereispura@gmail.com
Manuele Tamo		IITA Benin	m.tamo@cgiar.org
Richard Pliya	M	eRAILS	pcrd_76@yahoo.fr
Patrice Lagnon Sewade	M	REDAD Network	patsewade@yahoo.fr
Kohico Harrisson	M	Freelance	kouhiko.harrison@gmail.com
Sondjo Elise	F	Coordonnatrice Club Maman, transformatrice	clubsmaman@yahoo.fr
Late Lucien	M	Producteur, transformateur	oceradeb@yahoo.fr
Azonsou Georgine	F	Productrice, transformatrice	+229 96 36 37 51
Ayenan Mathieu	M	Sojagnon-ONG	+229 96 06 34 61
Pieter Wauters	M	GIZ ProAgri	+229 63 10 29 24
Ricarda Schwarz	F	GIZ ProAgri	+229 67 66 13 79
Stefan Kachelriess-Matthess	M	GIZ	s.kachelriess@gmx.net
Sandra Philips	F	SELF/ONG	+229 67 37 14 99
Guinin	M	SELF ONG	+229 97 56 47 37
ITAACC GFA			
Lorenz Bachmann	M	GFA ITAACC	l.bachmann@gmx.de
Lennart Woltering	M	GFA ITAACC	lennart.woltering@gfa-group.de
Jean A Nyemba	M	GFA ITAACC	jnyemba@gmail.com
Si Benasseur Alaoui	M	GFA ITAACC	nasser.alaoui@gmail.com
Marc Bernard	M	GFA ITAACC	marcwbernard@gmail.com
Joerg Lohmann	M	GIZ ITAACC	joerg.lohmann@giz.de
Michel Bernhardt	M	BEAF/GIZ	michel.bernhardt@giz.de
West Africa Region			
Mali			
Rouamba Albert	M	AVRDC	albert.rouamba@worldveg.org
Okwach E. George	M	ICRISAT	g.okwach@cgiar.org
Bomba Abdou	M	FOPB	cabdemesso@orangemali.net
Niger			
Ali Maman Aminou	M	FO	fumagaskiya@gmail.com
Burkina Faso			
Tandjiékpon Mahoutin Andre	M	ACI	andre.tandjiekpon@giz.de
Sanwidi Maurice	M	CPF	sanwidim@yahoo.fr
Savadogo Inoussa	M	UNPS	inoussa2011@yahoo.fr
Cameroon			
Mvondo Awono Jean-Pierre	M	Dschong University	jpmvondoa@yahoo.fr
Godwe Germain	M	CODAS	germaingn@yahoo.fr
North Africa region			
Morocco			
Azennoud Souhad	F	FOó Al Kissane/Farmer	s.azennou@gmail.com
Choukri Rachid	M	ANOC	rachidchoukri@yahoo.fr
Loukili AbdelKrim	M	FO/Bioassil	fermebioassil@gmail.com
Tunisia			
Kaouthar Hamida	F	DGAB, Tunisia	hamida.kaouthar@yahoo.fr

Annex 8: eRAILS Data

Annex 8: eRails Data

Farmers demand for information in nineteen communities of eight sub-Saharan countries, by Marc Bernard

The figures presented in this report are the result of an analysis of data that was gathered in the frame of the Information Exchange Service (IES) that was provided in the frame of eRAILS2[1] project. The IES combines a question and answer service with a farm-household survey. Each farmer had the opportunity to ask for advice for a specific problem that he identified on his farm. Within a community repetitive questions were not admitted. The resulting database holds at present data from 1061 farm-household and expert interviews that were carried out in 19 communities in 8 countries of sub-Saharan Africa (Uganda, Kenya, Rwanda, DRC, Benin, Togo, Côte d'Ivoire and Guinea). Farm-household interviews were carried out by field agents of farmers' organizations whereas the interviews with the experts were carried out by knowledge management specialists of the respective national agricultural research institutes. The field agents noted the responses of the farmers to the various questions and did not make measurements. Results must therefore be interpreted with caution.

The questionnaires that were used for data gathering and detailed information about the approach can be found at:

http://www.erails.net/FARA/erails2/erails2/services/information-exchange-service-ies/

Data and further information that characterises the farms and households can be viewed in detail in the spreadsheet that is attached to this report and that can be downloaded at http://www.erails.net/FARA/erails2/erails2/statistics/ .

Table 1 provides a detailed overview of farmers demand for information for a specific commodity in % of the total number of requests. Only commodities for which more than 1% of all request were made are listed. Considering all sites, the ten most important commodities are: Chicken > Maize > Cassava> Banana > Mango > Goat > Eggplant > Orange > Pig and Tomato. There exists a considerable variability between sites. The relative importance of chicken is however remarkable.

Table 1: Information requests per commodity in % of total number of requests

Group	Commodity	All	Female	Male
Animals	Chicken	6,5	8,1	5,5
Cereals	Maize	4,3	4,5	4,2
Root & tubers	Cassava	4,2	4,8	3,9
Banana	Banana	3,9	3	4,5
Fruits	Mango	3,8	5,3	3
Animals	Goat	3,7	4,5	3,1
Vegetables	Eggplant	3,5	5,1	2,5
Fruits	Orange	3,5	1,3	4,8
Animals	Pig	3,2	1,8	4
Vegetables	Tomato	3	3,5	2,7
Fruits	Papaya	2,8	3,8	2,2
Animals	Cattle	2,7	2,5	2,8
Vegetables	Chilli Pepper	2,7	4,3	1,8
Cash crops	Cocoa	2,6	0	4,2
Fruits	Avocado	2,3	3,3	1,8
Legumes	Beans	2,1	2,8	1,6
Animals	Sheep	2,1	2,3	1,9

[1] eRAILS: The electronic platform of the Regional Agricultural Information and Learning System – Project information can be found at http://www.erails.net/FARA/erails2/erails2/

Group	Commodity	All	Female	Male
Vegetables	Okra	2	2,5	1,6
Vegetables	Cabbage	1,9	2,8	1,3
Cash crops	Coffee	1,9	2,3	1,6
Others	Trees and wood	1,6	1	1,9
Vegetables	Spinach	1,4	1,5	1,3
Fruits	Lemon and Lime	1,2	1	1,3
Fruits	Pineapple	1,1	1	1,2
Legumes	Groundnut	1	1,3	0,9
Cash crops	Oil Palm	1	0,3	1,5
Root & tubers	Yam	1	1	1
	Total	71	75,6	68,1
	Other	29	24,4	31,9
	n	*1061*	*395*	*666*

Table 2: Information requests per commodity group in % of total number of requests

Commodity	All	Female	Male
Animals	22,1	22,4	21,2
Banana	3,9	3	4,5
Cash crops	7,7	2,9	10,5
Cereals	6,1	6	6,2
Fruits	19,6	20,4	19,1
Legumes	4,4	5,4	3,6
Others	6,8	5,1	7,6
Root & tubers	6,9	8,4	6,2
Vegetables	22,7	27,1	19,5
n	*1061*	*395*	*666*

Results in the table 3 to 5 suggest that most problems that were highlighted by farmers are:

a) common,
b) of major importance,
c) well known since many years,
d) are observed in most agro-ecological regions and
e) are slightly increasing.

Table 3: Scale of the problem according to farmers

Group Community	n	Very common	Common	Occasionally	Rare	Not applicable
All	*937*	18%	66	14%	2%	1%
Female	*347*	18%	65	14%	3%	1%
Male	*590*	18%	66	14%	1%	1%

Table 4: Frequency of problems - How common is the problem?

Group Community	*n*	*very common*	*common*	*occasionally*	*rare*	*not applicable*
All	*937*	18%	66%	14%	2%	1%
Female	*347*	18%	65%	14%	3%	1%
Male	*590*	18%	66%	14%	1%	1%

Table 5: Since when is the solution to the problem known?

n	*new or unknown*	*less than 1 year*	*1 to 5 years*	*6 to 10 years*	*10 to 20 years*	*more than20 years*	*not applicable*
1007	0%	6%	5%	9%	17%	54%	9%

Table 6: Trend for the problem

Group Community	*n*	soaring	growing	unvarying	decreasing	not applicable
All	*988*	4%	39%	31%	22%	3%
Female	*371*	3%	45%	32%	16%	4%
Male	*617*	4%	36%	31%	26%	3%

Table 7: Production constraints (1= most important)

Group Community	*n*	*access to land*	*labour*	*access to market*	*water*	*transport*	*theft*	*access to inputs*
All	*1022*	*3*	*4*	*5*	*6*	7	1	2
Female	*375*	*3*	*4*	*5*	*7*	6	1	2
Male	*647*	*3*	*4*	*5*	*6*	7	2	1

Table 8: Main sources of monetary income (ranking | 1 = most important)

n	Trade	Farming	Work on other farms	Food processing	Craft	Salary/Employment	Other
1002	2	1	4	6	7	5	3

More detailed eRAIL data is found on the website: www.erails.net/