Findings of the Lake Kivu Pilot Learning Site Validation Team

A Mission Undertaken to Identify Key Entry Points for Agricultural Research and Rural Enterprise Development in East and Central Africa

Forum for Agricultural Research in Africa
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PMB CT 173, Accra, Ghana
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**Members of the Validation team**

Dr. Mateete Bekunda (Chairman, Uganda), Ir. Elysee B. Mudwanga (DR Congo),
Ms Elize Lundall-Magnuson (South Africa), Dr. Kehinde Makinde (Rwanda), Dr.
Peter Okoth (Kenya), Dr. Pascal Sanginga (DR Congo), Dr. Emily Twinamasiko (Uganda) and Dr. Paul L. Woomer (Kenya)

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**Forum for Agricultural Research in Africa (FARA)**
12 Anmeda Street, Roman Ridge,
PMB CT 173, Accra, Ghana

Tel: +233 302 772823 / 302 779421
Fax: +233 302 773676
Email: info@fara-africa.org

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Acronyms and Abbreviations

AFRENA  Agroforestry Research Network for East and Central Africa  
AHI     Africa Highlands Eco-regional Programme.  
ASARECA - Association for Strengthening Agricultural Research in Eastern and Central Africa.  
BDS: Business Development Services  
BNF: Biological Nitrogen Fixation  
CAADP Comprehensive African Agriculture Development Programme (NEPAD)  
CBOs Community-based organisations  
CCD Convention to Combat Desertification  
CGIAR Consultative Group on International Agricultural Research  
CIAT International Centre for Tropical Agriculture.  
CN: Concept Note  
COMESA Common Market for Eastern and Southern Africa  
ECA Economic Commission for Africa (United Nations)  
ECABREN East and Central Africa bean Research Network  
ECAPAPA East and Central Africa Programme on Agricultural Policy Analysis.  
EU: European Union  
F&M: Facilitation and Mentoring Services  
FAO Food and Agricultural Organisation of the United Nations  
FARA Forum on Agricultural Research in Africa  
FARA Forum on Agricultural Research in Africa  
GFAR Global Forum on Agricultural Research  
GIS Geographic information systems  
IAR4D Integrated agricultural research for development  
IARIs International Agricultural Research Institutions  
ICRAF International Centre for Research in Agroforestry.  
IITA International Institute for Tropical Agriculture  
ILRI International Livestock Research Institute  
INERA: Institut National d’Etudes et Recherche Agricole  
INRM Integrated natural resource management  
IPM Integrated pest management  
ISAR Institut des Sciences Agronomiques du Rwanda  
LG: Local Government  
LI: Lead Institution  
MC: Management Committee  
MDGs Millennium development goals  
NAADAS – National Agricultural Advisory and Development Services.  
NARES National agricultural research and extension institutions  
NARIs National agricultural research institutions  
NARO: National Agricultural Research Organisation  
NEMA National Environmental Authority.  
NEPAD New Partnership for African Development  
NGOs Non Governmental organisations  
NRM – Natural Resources Management.  
NRM Natural Resource management  
PC: Programme Coordination  
PLS: Pilot Learning Site  
PRSP: Poverty Reduction Strategy Paper  
PSC: Programme Steering Committee  
R&D – Research and Development. RSSP: Rural Sector Support Project  
SRO: Sub-Regional Organization
SSA CP: Sub-Saharan Africa Challenge Programme
SWC – Soil and Water Conservation.
TF: Task Forces
UCA: Uganda Cooperative Alliance
UNFFE: Uganda National Farmers Federation
UNIR: Université Nationale du Rwanda
UWA: Uganda Wildlife Authority
VT: Validation Team
1. Summary

The Sub-Saharan Africa Challenge Program seeks to overcome food insecurity, reverse natural resource depletion and foster rural enterprise development. It designated three geographic areas in East-Central, Southern and West Africa as Pilot Learning Sites where interdisciplinary teams of agricultural scientists will work closely with development specialists, private sector and farmer organizations to conduct impact-oriented research designed to overcome the persistent constraints to agricultural production and enterprise development. One of these areas is the Lake Kivu Pilot Learning Site where DR Congo, Rwanda and Uganda intersect. This equatorial highland site covers approximately 20,000 km² and consists of volcanic mountains surrounded by hills and valleys. It has a semi-humid to humid climate with mild to cool temperatures and is bounded by Lake Edward to the north and Lake Kivu to the south.

Three important features contributed to the selection of the Lake Kivu Pilot Learning Site as a focus for agricultural and developmental research. The site holds high concentrations of population and poverty with 90% of its 12 million people reliant upon small-scale agriculture. The site hosts unique natural resource endowments that are protected within several national parks but under threat from surrounding populations. The site has a history of civil unrest over the past two decades and its vigorous re-emergence from conflict offers opportunities to better understand how agricultural policies, institutional re-organization and market-led development interact. The site’s deep soils and favourable climate offer strong potential for agricultural growth but its resource base is rapidly degrading, largely due to mismanagement of steep cultivated slopes and wetland valleys. The area is somewhat remote from international markets but supports vigorous cross-border trade and growing internal demand. Services offered to small-scale agriculture through research and extension remains weak and organizations operating within the site require both financial assistance and peer support.

It is one thing to identify a priority area for impact-oriented actions and yet another to establish a successful research and development program that positively impacts upon its diverse stakeholders. First, the Forum for Agricultural Research in Africa, through its Sub-Saharan Africa Challenge Program, sought partnership within the sub-region and a paradigm to guide their actions. Then ASARECA was appointed to implement activities of the program, with the International Centre for Topical Agriculture (CIAT) serving as the lead institution in partnership with the Africa Highlands Initiative (AHI) and the Institut des Sciences Agronomiques du Rwanda (ISAR).

The emergence of Integrated Agricultural Research for Development (IAR4D) presented an opportunity to address persistent problems in new ways. IAR4D involves an innovative set of principles, an integrated research agenda and a recognized need for greater organizational capacities and flexibility among research partners. Research is not merely intended to develop and escort new technologies to farmers but also empower farmers to better understand and respond to changing circumstances as they emerge. Farm enterprises and commodity production are no longer viewed in isolation of one another but rather seen as interacting with natural resource management, markets and policies. Collaboration is no longer approached in a top-down manner through assigned tasks but rather partnerships are forged that recognize the importance of participation and interaction balanced with individual needs and goals. IAR4D is based upon key entry points for change and engages different disciplines and stakeholders within iterative problem-solving. A Validation Team was established to identify critical entry points for cutting edge research with focus on new opportunities and how this would respond to development challenges; validate, refine and
suggest additional research hypotheses; examine capacities within the Pilot Learning Site and
determine how different stakeholder groups would be involved.

The Validation Team mission was commissioned by ASARECA and CIAT during
October 2005. The team consisted of eight members from DR Congo (2), Kenya (2),
Rwanda (1), South Africa (1) and Uganda (2). Its members were experienced agricultural
scientists, research administrators, entrepreneurs and marketing, information and
development specialists, each with established credentials to work within interdisciplinary
settings. The team relied upon several field survey methods including literature review plus
secondary data collection, key informant interviews, focus group discussions, documenting
and characterising examples into case studies. Analysis of research challenges was based on
five priority areas, producing more food at less cost, diversifying agro-enterprises for wealth
creation, improving markets, sustaining agriculture and natural resources and policy and
institutional development. The team also gave due considerations to ASARECA’s aspirations
for balancing cutting edge science with people-oriented impacts and the addressing the food
security and income generation needs. During 15 days spent in field investigation in DR
Congo, Rwanda and Uganda, the team examined agricultural and marketing activities in 12
locations and conducted four stakeholder workshops, eight focus group discussions with
farmers’ associations, 14 interviews with input retailers and stockists, and over 24 interviews
with key informants representing different institutions and individuals in the resource-to-
consumption and policy chain. Seven case studies that illustrate key interdisciplinary issues
within the Pilot Learning Site are presented in this report.

Production of food in the Lake Kivu PLS is characterized by cultivation of beans, banana,
and maize in various combinations of two or more crops in the humid area and sorghum,
maize and potatoes, bush beans and bananas in drier areas. Cabbage, onions, carrots and
tomatoes are cultivated for market. Smallholder livestock production is limited to a few zero
grazing units or communally grazed indigenous cattle and goats but a few large commercial
dairies are established in valley bottoms. The limited use of purchased farm inputs due to
farmers’ limited capacity to invest in farm improvement has resulted in resource degradation.
Smallholder farming may be thus characterized as cycle of low yields, food deficits, little or
no marketable surpluses, and an inability to check land degradation. Eight entry points are
identified for producing more food, both as crops and livestock, and at reduced costs.

Intensified production should be based upon three approaches: improving yield and
market quality of food crops, introducing new high value crops and integration of crop and
livestock production. Specific research and development entry points were identified to
guide the development of scientific technologies and/or the refinement and transfer of
existing ones to improve disease and pest control, provide new improved varieties and
breeds, enhance nutrient recycling and trigger value addition.

The Pilot Learning Site has strong potential for increased production but entrepreneurship
and enterprise spirit remain weak. This is due in part to limited experience in adding value to
products but may also be attributed to poor market access and infrastructure, small fragmented
and degraded farmlands and weak institutional support. Livelihood opportunities within the
site must become expanded through agro-enterprise development and diversification. This will
reduce risk and increase the framers’ competitiveness on local, national and international
markets and will enhance their capacity to generate incomes. Market development, product
development and diversification into high value products, were seen as important entry points
for developing technologies that will link small-scale farmers in marginal areas to markets.
Markets for most major commodities are imperfect because prices are established through
bargaining in absence of adequate market information. Key market participants are itinerant
village collectors, stationary market brokers, long distance traders and agro-processors. Making
the marketplace more transparent establishing farmers’
collective bargaining are two critical challenges. Seven entry points for rural enterprise development and improved marketing are identified within this report.

Sustainable use of the natural and agricultural resources calls for measures to counter the effects of continuous, long-term hillside cultivation and increased pressure on wetlands and forests. Land management technologies must be identified and promoted to ensure that hillside farming enterprises will offer sufficient economic incentives to encourage better land conservation measures and that the exploitation of the wetlands is based upon sufficient information that allows for profitable utilization without compromising watershed integrity. Greater opportunity must also be sought for perennial crop establishment on steep hillsides and the improvement of contour hedges. This need may accommodate the domestication of useful indigenous plant species as a means of fostering plant biodiversity and the fauna dependant upon them. Such mechanisms are particularly important among farms within the buffer zones surrounding national parks and other conservation areas. Four entry points toward better resource and biodiversity protection were identified by the team.

The SSA-CP is adopting the IAR4D approach which calls for multi-stakeholder participation in the design of technology interventions. Therefore all stakeholder organisations and institutions will gradually transform to encompass this new research paradigm. Organisational change should be seen in people’s skills and attitudes, processes and procedures and the necessary adjustment in structures. Capacity development programmes will be designed to equip managers to understand, coordinate and facilitate the process of organisational change and create platforms for simultaneous “learning together” of teams at different levels. Individual scientists and stakeholder teams will acquire disciplines for impact oriented research and inter-disciplinary skills to be able to work in teams. Information and knowledge management mechanisms and monitoring and evaluation systems will be incorporated in the capacity building programmes to enhance institutional and societal learning. The design of the capacity building programme will give opportunity for stronger institutions to nurture weaker ones, also drawing from the strength and expertise of other regional and international institutions to establish fairly uniform regional standards. The farmer organisations will be given special attention to ensure that they are empowered to enhance their role in decision making and demand articulation. They also need skills to be able to negate and participate in debates that affect them. Four entry point opportunities were identified within the areas of IAR4D and organizational change.

There are already a number of policies that support different aspects of agricultural production but in some cases the mechanism and capacities for implementing these policies are lacking. Policy research will analyse the extent to which these policies are conducive and provide incentives for small holder production and market integration and for allowing scientists and innovators to appreciate the results of their intellectual outputs. The process of policy research will be improved by creation of platforms for facilitating participatory policy debates, to increase the contribution of stakeholders in dialogue and advocacy. Three entry points for policy research are raised within this report.

The identification of the entry points was in response to the six hypotheses proposed by FARAnet as having particular relevance to enterprise development within the Lake Kivu Pilot Learning Site. The Validation Team examined these and, where applicable, refined and expanded them to additionally cover farmer decision making and address differences in land management, market development and natural resource protection as they occur within the site. Fourteen working hypotheses were generated to address basic component questions within the main hypotheses.

It is considered that research and development teams will be constituted following the IAR4D principles, to conduct activities addressing the refined hypothesis. The VT proposes a vertical integration within each experimental site, and horizontal partnerships across
countries. Within each country, the major institutions and individual stakeholders along the resource-to-consumption and policy continuum should be identified and encouraged to participate in research for development teams. These should include national agricultural research institutes, government extension services, non-governmental organizations, civil society organizations, farmers’ organizations, traders, transporters, processors, exporters, private business sector, government departments, and international research centres. Across countries, partnerships between teams and institutions should be established. The Pilot Learning Teams will identify and select specific locations for conducting research, based on biophysical and socioeconomic characteristics. It will be important to start with locations where teams can build on, add value to, and take advantage of existing institutions and capacities (human, material, and social) in order to achieve and demonstrate impacts. The potential for scaling out/up within the pilot learning site and beyond should be one of the important criteria for site selection.

The long-term vision of the Kivu Pilot Learning Site is to contribute to poverty elimination in East and Central Africa. This can be achieved through research for development activities that aim at improving food security, income, livelihoods and environmental sustainability in the Lake Kivu Pilot Learning Site. The VT suggests four outcomes that must be combined together to generate impacts. These are: (i) increased utilization of market driven technologies to improve agricultural productivity and conserve natural resources; (ii) diversified enterprise options and improved market access; (ii) enhanced organizational capacity of stakeholders for impact oriented research enhanced, and (iv) enhanced decision-making capacity of different stakeholders to influence policy formulation and implementation.
2. Introduction

2.1 Background

Sub-Saharan Africa is the only region in the world where livelihoods and food security continue to deteriorate and the number of Africans living in poverty has increased by 50% in the last 14 years (Amoako, 2003). As a result, Africa continues to take a disproportionate amount of food aid. The Lake Kivu Pilot Learning Site (PLS) spans approximately 20000 km² where north-eastern Rwanda, eastern Democratic Republic of the Congo (DR Congo) and south-western Uganda intersect. The equatorial highland site consists of tall volcanic mountains surrounded by hills and valleys. It has a semi-humid (800 mm yr⁻¹) to humid (>2000 mm yr⁻¹) climate and mild temperatures with greater precipitation and cooler temperatures occurring at higher elevations. Geologically, the site falls within the western arm of the Great Rift Valley (the Central Albertine Rift) between two highland lakes, Lake Edward to the north and Lake Kivu to the south.

Population densities range from 400 to 700 persons km⁻² with two thirds of the population lives below the poverty line. Over 90% of the population relies on subsistence agriculture with average farm sizes of 0.5 ha. The area is also endowed with several globally important conservation areas including Bwindi, Mgahinga, Queen Elizabeth, Virunga and Volcanoes National Parks. This is a region of exceptionally high biodiversity and levels of endemism, including the only natural habitat of the endangered mountain gorilla and there is pressing need for viable development strategies to protect this biodiversity while improving the livelihoods of those living around it. The area is described as “emerging from conflict” with DR Congo, Rwanda and Uganda having experienced civil wars 5, 10 and 20 years ago, respectively. As a result, large differences in infrastructural and market development and institutional support exist within the site.

2.2 FARA and the Sub-Saharan Africa Challenge Program

The Forum for Agricultural Research in Africa (FARA) is a regional organization bringing together the major stakeholders in agricultural research in Africa. FARA’s mission is to enhance and add value to the effectiveness and efficiency of agricultural research systems. FARA’s vision for African agricultural research saw agricultural production growing at 6% per annum and providing the base for agriculture-led industrialization. One of the mechanisms for ensuring that FARA’s agenda is geared towards greater impact on African people, was the development of the Sub-Saharan Africa Challenge Programme. A Challenge Program (CP) is a time-bound, independently-governed program of high-impact research, that targets the CGIAR goals in relation to complex issues of overwhelming global and/or regional significance (and global impact), and requires partnerships among a wide range of institutions in order to deliver its products.

The SSA-CP’s mission seeks to add value to and enhance the impact of ongoing agricultural research for development in sub-Saharan Africa. The Programme aims to transform the way that sectors and institutions at all levels approach agricultural research. The goal of the SSA CP is to bring about improved rural livelihoods, increased food security and sustainable natural resource management throughout sub-Saharan Africa as a result of greater impact from agricultural research for development. It will thereby contribute to meeting the poverty and hunger targets of the Millennium Development Goals, and NEPAD
goals as set out in the Comprehensive Africa Agriculture Development Programme (CAADP).

The extensive consultation process that culminated in the development of the SSA CP adopted the “Integrated Agricultural Research for Development” (IAR4D) paradigm that can foster synergies among disciplines and institutions, along with a renewed commitment to change at all levels from farmers to national and international policy makers. The IAR4D takes a systems approach that goes beyond INRM, to encompass as well the domains of policies and markets, and the effects that these have on the productivity, profitability, and sustainability of agriculture.

The general approach to rural transformation involves intensification of subsistence-oriented smallholder farming systems, better managing natural resources while intensifying their use, developing more efficient markets and developing enabling policies. IAR4D requires additional mechanisms to foster integration of these four dimensions, and a new way of doing research and development. Therefore the support pillars of IAR4D include 1) promotion of organizational and institutional change to enable cross-disciplinary research and development and multi-institutional collaboration; 2) capacity building for project teams, farmers, and scientists in African institutions; 3) information and knowledge management and 4) continuous monitoring and evaluation and a systemic approach to impact assessment (Figure 1).

The thematic research areas and support pillars are in line with both the Association for Strengthening Agricultural Research in Africa (ASARECA) strategic objectives and the
Science Council priorities for CGIAR research. The goals of the CGIAR Science Council are to 1) sustain biodiversity for current and future generations, 2) producing more and better food at lower costs, 3) reduce rural poverty through agricultural diversification and emerging opportunities, 4) alleviate poverty while maintaining managing water, land and forest resources; and 5) improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger. The Validation Team directed its efforts toward these goals throughout its mission to the Lake Kivu Pilot Learning Site.

The scientific programme of the SSA CP will target removing significant constraints to sustainable improvement of livelihoods, as diagnosed at specific locations. It will focus on cutting edge science that can contribute to achieving developmental people oriented impacts. For the first phase of the SSA CP, three Pilot Learning Sites (PLSs) have been selected by the African sub-regional organizations for agricultural research. Within the Eastern and Central Africa sub-region, the SSA CP activities are implemented by ASARECA, with the International Centre for Topical Agriculture (CIAT) serving as the lead institution in partnerships with the Africa Highlands Initiative (AHI) and the Institut des Sciences Agronomiques du Rwanda (ISAR).

2.3 Initial hypotheses

The FARA Secretariat (2004) proposed six hypotheses as having particular relevance to rural enterprise development within the Lake Kivu Pilot Learning Site. The Validation Team was asked to examine these hypotheses as entry points for cutting-edge agricultural research within the Lake Kivu PLS and to revise and expand these hypotheses as necessary. As these are intended to guide research projects rather than individual studies, these hypotheses are necessarily global in nature. These hypotheses follow …

\[H_1\] Strong producer organizations have increased bargaining power and ability to collectively market produce and thus increase returns (income) to land and labor.

\[H_2\] Investments to sustain and maintain the natural resource base are more sustainable when they are linked to market-oriented production or when there are financial incentives for conserving natural resources and biodiversity.

\[H_3\] Increased livelihood options linked to markets including joint management for buffer zone inhabitants will decrease pressure on conservation areas and biodiversity and increase returns to land and labor.

\[H_4\] Investment in partnership arrangements that integrate research and development expertise and perspectives will achieve greater impact through scaling out islands of success.

\[H_5\] Innovative information organization and sharing systems will enhance uptake of technologies and improve decision making.

\[H_6\] Strengthened local governance through improved community facilitation improves ability to influence development policy and advocate for support to local marketing and natural resource management initiatives.

At first impression, these hypotheses seem to be useful in aligning individual research activities within larger developmental goals. On closer impression, however, the hypotheses appear skewed toward enterprise development and research administration rather than research approaches, farmer decision making and, indeed, they seem to be broadly applicable to many places in addition to the Lake Kivu area. None of these hypotheses actually addresses differences in land management, market development or natural resource
protection as they occur within the Pilot Learning Site. The process of examining and expanding these hypotheses was one of the major challenges before the Validation Team and the outcomes from that effort appear later within this report.

### 2.4 Validation Team mission.

The terms of reference for the VT specified the purpose, scope, objectives and expected outputs of the VT. They also suggest the methodology for the VT. The Validation Team was expected to:

1. Consult different stakeholders and suggest a list of critical entry points based on field realities, priorities, and opportunities for wealth creation amongst the poor whose livelihoods depend on agriculture and natural resources.
2. Analyze available science and suggest innovative and original ideas for implementing IAR4D to achieve developmental impacts.
3. Validate current hypotheses (see SSA CP and PLS priorities), refine and if necessary suggest additional hypotheses; and assess if current hypotheses can be scaled-up to national and regional levels. Examine and recommend a balance between markets, food security, poverty alleviation and environmental sustainability.
4. Suggest critical entry points for research, with focus on new opportunities (e.g. introduction of new crops, high value crops, products etc) and threats (climate change, genetic erosion, environmental degradation) given the constant increase in population.
5. Examine and suggest what should be the “science” and “cutting edge research” to respond to development targets and challenges in the PLS.
6. Examine the uptake pathways and critical stakeholders in each of the critical entry points and suggest how to involve them in the entire research process.
7. Suggest how SSA CP can integrate and add value to regional (ASARECA), national and local priorities. Harmonize expectations of different partners (Science Council, Donors, ASARECA, countries, stakeholders, Farmers) and integrate entry points and hypotheses into Science Council priorities.
8. Examine capacities in the PLS, and determine what and how to involve different stakeholder groups (private sector, business sector, civil society, farmers organizations, government, policy).
9. Within the delimitation of PLS, suggest intervention sites (experimental sites) for the task forces.
10. Prepare a draft Logical framework that suggests an impact pathway on how integrating the four pillars of the SSA-CP will lead to poverty alleviation, food security, environmental sustainability and wealth creation.

### 2.5. Validation Team composition.

The VT was composed of eight members from different disciplines, institutions and background selected by the Management Committee of the PLS. The team had a mixture of regional experts and experienced scientists doing similar work, and who had complementary skills and expertise.

1. Professor Mateete Bekunda, Soil Scientist and Chair of the VT, Makerere University, Uganda
2. Dr. Pascal Sanginga, Rural Sociologist, CIAT, Uganda
3. Dr. Kehinde Makinde, Agricultural Economist, ISAR-Rwanda
4. Dr. Peter Okoth, Information and Konowledge Management, TSBF-CIAT, Kenya
5. Dr. Paul Woomer, Crop Improvement, SACRED AFRICA, Kenya
6. Dr. Emily Twinamasiko, Institutional analysis and organisational change, IAR4D, NARO, Uganda
7. Mr. Elysee Mudwanga, private business sector, Pharmakina-Bukavu, DR Congo
8. Dr. Elisabeth Lundall-Magnuson, Entomologist and Member of the Facilitation and Mentoring Services, Agricultural Research Council, South Africa

Although each member of the team had individual responsibilities to address one of the areas below, the VT adopted an integrated team approach to achieve synergies amongst team members expertise and skills.

1. INRM (soil conservation, water management, soil fertility, watershed management, wetlands, fisheries, forestry, conservation, wildlife)
2. Crop Improvement (genetic improvement, integrated pest and disease management, agronomy, horticulture)
3. Markets (agribusiness, post-harvest handling and livestock products)
4. Socio-economics (livelihoods, gender, nutrition and policies and Impacts
5. Information and knowledge management including GIS
6. Organizational development and institutional capacities for IAR4D
3. Methods Employed

3.1 General approach

The VT relied upon a combination of analytical and descriptive, inductive and deductive methods, quantitative and qualitative approaches with a holistic system perspective rather than disciplinary components. These methods and approaches were developed in a way to avoid the temptation of developing a shopping list of entry points and research hypotheses. Rather they were meant to focus on more innovative ideas (what is new and how is it different?) and more integrated holistic perspectives leading to a systematic process of entry-points identification and priority setting. The suite of methods employed included literature review and secondary data collection, key informant interviews, focus group discussions, case studies, market chain analysis, institutional capacity assessment and spatial analysis. More detailed description on each of these approaches follows.

**Literature review and secondary data collection.** The exercise to generated a list of documents that provided secondary data and information that the validation team used to analyze available science and suggest innovative and original ideas (business unusual—what will be different, and how it will be done differently to implement IAR4D) for testing hypotheses and for achieving the developmental impacts, and for adding value to regional and national research and development priorities. The team developed a preliminary list of type of information needed to validate the hypotheses and determine priority entry points. The collection and analysis of these documents and secondary data continued throughout the validation exercise.

**Key Informant Interviews.** Based upon the restated research hypotheses, a check-list was developed to assist in the process of verification and validation of research hypotheses and determination of possible entry points based on stakeholders experiences, perceptions and expectations. The stakeholders be consulted are the key actors along the “resources-to-consumption” and policy system. These include farmers and farmers’ organizations, local government and policy actors, development organizations, market chain actors, private business sector, government technical and administrative services, national agricultural research institutes, Agricultural Universities, politicians, etc. See Appendix 1 for the list and contacts of Key Informants.

During field visits, different stakeholders were approached in various manners. Colleagues within national agricultural research systems were provided a full briefing on the SSA-CP and FARA, and the role of the Validation Team in launching the Lake Kivu Pilot Learning Site was explained. Then, the importance of entry points for new research was discussed. Agricultural administrators, such as District Agricultural Officers, Agricultural Extension Supervisors and National Park Superintendents, were advised of the potential for developmental research and rural enterprise development within their areas, and the current constraints to agriculture and potential opportunities for market-led development were discussed. In many cases, SSA-CP and FARA documents were photocopied and provided to scientists and administrators. Local non-governmental organizations, farmers and their associations were approached in a different manner. Often we were introduced to the organization or farmer group by a local agricultural officer. The team described its mission as assisting the agricultural research community to improve the relevance of its research. When asked how they might benefit, it was made clear that no immediate returns were
forthcoming, but a strong possibility existed that they could become research partners or provide research site in the not-too-distant future. Agricultural input suppliers and agro-processors were advised that the team is conducting a rapid survey and we required information from them to be considered within a new agricultural development and research program. In cases where something of interest was noted along the roadside, we simply greeted the farmer or bystanders, introduced ourselves as scientists, asked a few questions and if we may take a photograph and thanked them for their cooperation. The team was able to communicate with different stakeholders in an impressive assortment of languages including English, French, Kiswahili, Kinyarwanda, Runyankore and Rukiga. In general, all informants were interested in our activities and cooperative except for some merchants who were otherwise busy with customers. Only in one case did a park official state that we required a letter from his superiors before he could release information (that was otherwise available over the internet!).

**Focus Group Discussion.** We used the techniques of “appreciative inquiry”, a positive approach to change that focuses on the collective wisdom, knowledge, strategies, attitudes, skills, and capabilities of the organization at its best. It is a strategy for intentional change, a process of collaborative inquiry, based on interviews and affirmative questioning, that collects and analyse success stories of a community or an organisation. At the level of farmers’ groups, we were guided by the “asset-based approach” of the sustainable livelihood analysis (SLA) framework to analyse the main factors that affect people’s livelihoods, and to gain a realistic understanding of what shapes people’s livelihoods and how the various influencing factors can be adjusted so that, taken together, they produce more beneficial livelihood outcomes. This approach was useful to identify the promising opportunities and strategies they can use to build their livelihood assets for achieving better livelihood outcomes in rural communities. In each PLS country, the Validation Team organized a Senior Stakeholder Consultation that combined brainstorming and small working focus group discussions to suggest critical entry points and researchable areas.

**Case studies.** Throughout the mission and after each visit and interview, VT members were tasked to build some case studies documenting and characterizing examples that have shown successful outcomes, impacts and performance of organizations that R&D institutions in the PLS have been associated with. The analysis of these cases helped to identify ‘success factors’ and examine critical entry points for research and science that can help to scale up success, and address researchable constraints that hinder development and livelihood improvements. The case studies were built in a way that examines how the different thematic areas of IAR4D (intensification, NRM, markets and policies) and the support pillars (partnerships and institutions, facilitation, information and knowledge management, and impacts) are integrated (or not) to bring about changes in people’s livelihoods. The case studies were also built around the key hypotheses of the Lake Kivu PLS (markets-led intensification, farmers organizations, buffer zone management, partnerships, information and knowledge sharing, and policies).

**3.2. Approaches toward specific research and development goals**

Team members were required to develop specific approaches to recovering and synthesizing information concerning their disciplinary responsibilities described in Section 2.5 that complimented the goals of the CGIAR Science Council.
Producing more food. This component of the Validation Team mission considered the potential for greater food production through both food cropping and livestock enterprises. Food crops were examined with regard to their potential for genetic improvement, presence of insects and disease, expression of nutrient deficiency symptoms and their relationship to one another within cropping systems. These factors were assessed through field observations, discussions with farmers and consultation with agriculturalists such as district agricultural officers, extension specialists and researchers. Special attention was paid to the availability and price of key farm inputs such as seed and fertilizers by visiting merchants and conducting a short, formal, closed-and-open-ended survey. The trends in the availability and price of these inputs were examined with respect to their distances travelled through supply pipelines.

Expanding rural enterprise. The analysis of community agro-enterprise was guided by the resources-to-consumption (R-to-C) approach that permits a wide analysis of the entire production or value chain and its different players, and the forward and backward linkages between resources management, production, processing, marketing and consumption, and investments in resource base and other livelihood assets. At the community level, a participatory market chain diagnosis was used to rank different enterprise options, identify their bottlenecks and constraints, and investigate different actions to overcome them for achieving a more competitive production chain. Community-level group discussions were triangulated with interviews with key informants, market visits, interviews with traders and processors. These options were characterized following the Ansoff’s matrix of product-market mix, to determine strategies for increasing the marketing opportunities and competitiveness of small hold farmers. This analysis was complemented by a review of a number of sub-sectoral analysis studies of selected crop enterprises (potatoes, banana, beans and sorghum) that helped to further understand the whole value chain from the provision of inputs, production, transportation and commercialization of the commodity.

Improving markets. Stakeholder analysis was used to assess the interests of market actors (individuals, groups and institutions) that are important to the success of the proposed program or are ultimately affected either positively or negatively by the program. Market chain analysis was used, as appropriate, to identify participants in the product demand and supply chain in order to evaluate the perceptions, expectations and recommend appropriate entry points for market-based interventions. Furthermore, quantitative and qualitative data from secondary sources was combined with key informant interviews to explore market opportunities for traditional and value-added products and also identify issues for follow up research.

Sustaining natural and agricultural resources. Smallholder farmers in the densely populated highlands of the Lake Kivu Pilot Learning Site (LK-PLS) face major constrains because of high population densities and stressed natural resources consequent upon increased demand on them. Indicators of some of these stresses and approaches to mitigate them have been documented in print as research outputs, reports from development organisations and institutional planning documents. Collation, evaluation and summary of information from available documents was aimed at identifying background information concerning the resource characteristics in the PLS and the capacity to sustain continued production. The VT gathered data during field visits through field observations and photography particularly relying upon dialogue with land managers.
**Fostering biodiversity.** The validation focused upon the elements of biodiversity within the PLS that form part of conservation efforts, interacting with various stakeholders to determine the status of current and planned conservation efforts. It examined interactions between conservationists and neighbouring communities and the impacts that population and land use pressures exert upon adjacent protected areas. Also considered was the enforcement of current protection policies, the sense of responsibility held by those living around the park and their knowledge of local biodiversity. Particular attention was paid to buffer zones surrounding the parks and the opportunities for income generation within them.

**Strengthening institutions and policies.** A rapid organizational assessment tool was developed to understand the status, capacity and key issues affecting key stakeholder organisations and institutions (Organisations, Governance, Legal and policy frameworks) in the PLS to determine relationships/linkages/interactions, concerns, expectations (or interests) and capacities in connection with the SSA-CP. Participation analysis matrix was developed to describe the characteristics, interests, capacities, concerns and expected contribution (e.g. technologies, facilitators). Then using a task analysis check list, we were able to indicate in what activities in the IAR4D innovation process the different stakeholders are likely to be involved in technology development, policy formulation and review, farmer empowerment and product development.

### 3.3 Itinerary and work plan

The schedule of the VT was arranged in such a way to combine literature review and secondary data gathering, then stakeholders’ consultations, key informants interviews, field visits to farmers organizations and market and enterprise visits within the PLS were conducted. When larger towns such as district or provincial headquarters were visited, the process of collecting secondary information was resumed. Senior Stakeholder Consultations were held in Kabale (11 October), Goma (16 October) and Butare (22 October). Present at the meetings were representatives from NARS, the ministry of agriculture, agricultural extension, local universities, development organizations and NGOs. These meetings were attended by 15 to 25 persons and lasted from three to five hours. After introductions and general discussion, these informants were split into 2 or 3 working groups to identify farming constraints and opportunities and their findings reported in plenary at the meetings conclusion. Every few days, several hours were devoted to a Validation Team meeting and writing up various team member responsibilities. The final six days of the mission were spent synthesizing information, preparing publication quality materials and finalizing the report. The itinerary of the validation team and its major tasks at each site is presented in Table 1 and Figure 2.
Table 1. Itinerary and tasks of the Lake Kivu Pilot Learning Site Verification Team.

<table>
<thead>
<tr>
<th>date</th>
<th>location</th>
<th>country</th>
<th>tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 5-9</td>
<td>Kampala</td>
<td>Uganda</td>
<td>Conduct Verification Team briefing with ASARECA, the Management Committee, and the CIAT the lead institution. Develop team work plan and itinerary. Collect background information and conduct key informants interviews with ASARECA, NARO, National Agricultural Advisory Services, Uganda National Farmers Association, Uganda Wildlife Authority, Uganda Cooperative Alliance, CIAT and Makerere University. Conduct market visits (Uchumi and Nandos. Appointment with Mukwano and Shoprite cancelled). Survey agricultural stockists (5)</td>
</tr>
<tr>
<td>October 10-12</td>
<td>Kabale</td>
<td>Uganda</td>
<td>Field visits and discussion with farmers associations and farmer success stories (3). Conduct Senior Stakeholder Consultation. Visit District Local Government Chairman, District Agricultural Officer, District Surveyor and National Forest Authority offices, NARO ARDC Scientists. Survey agricultural stockists (2).</td>
</tr>
<tr>
<td>October 13-14</td>
<td>Kisoro</td>
<td>Uganda</td>
<td>Field tour of eroded hillside farms and Mgahinga and Bwindi National Park buffer zones. Visit District Agricultural, Extension and Fiseheries Officers, Kisoro District Farmers and Beekeepers Associations and Sitwe Mound (under community bye-law management). Visit Birunga Dairy. Interviews with Africare staff. Survey agricultural stockists (2)</td>
</tr>
<tr>
<td>October 18-20</td>
<td>Ruhengeri</td>
<td>Rwanda</td>
<td>Field tour of Bishwati farmers’ association and watershed. Visit ISAR Station and conduct stakeholder meeting, Volcano National Park headquarters and Sina Gerard agro-processing. Survey agricultural stockists (3)</td>
</tr>
<tr>
<td>October 23</td>
<td>Butare</td>
<td>Rwanda</td>
<td>Visit ISAR Headquarters and Rwanda National University GIS centre. Conduct Senior Stakeholder Consultation</td>
</tr>
<tr>
<td>October 25-30</td>
<td>Kampala</td>
<td>Uganda</td>
<td>Collect final secondary information and data bases, conduct spatial analysis, synthesize findings and prepare final report.</td>
</tr>
</tbody>
</table>

3.4 Evaluating and refining the research hypotheses.

The Validation Team was asked to examine six hypotheses as entry points for cutting-edge agricultural research (Section 2.3) and revise and expand these hypotheses as necessary. The outcomes from that effort appear later within this report (Section 8). The process through which these hypotheses were evaluated and the questions used to test their relevance follows:
Figure 2. Site visits within the Lake Kivu PLS by the Validation Team. Members of the team visited 17 locations over 14 days but were unable to reach Rutshuru, DR Congo because of security concerns. The team also spent 12 days in Kampala, Uganda preparing for and synthesizing the validation mission.

1. **Restatement.** Is the *global hypothesis* too general, jargonistic or tautological to direct research activities and if so how may it best be restated and better labelled?
2. **Distillation.** Can the hypotheses be distilled into a series of simple questions that assist in its acceptance or rejection through surveys and field experiments?
3. **Specification.** What are some useful *working hypotheses* based upon conditions within the Kivu PLS that can guide impact-oriented research activities?
4. **Simplification.** Can the global and working hypotheses be captured within simple *research questions* and which are the most important questions to be raised?

The process of re-examining the Lake Kivu PLS hypotheses started at the very onset of Validation Team activities and continued throughout its duration. After several rounds of examination, the initial hypotheses were restated and related working hypotheses and research questions, appearing later in this report, were developed.

The process of distillation sought to break the hypothesis into basic component questions. To a large extent, this exercise was intended to assure that all team members had a similar interpretation of each of the six initial hypotheses. The questions distilled were also useful during the informal interviews conducted during the team’s field visits. The distillation of all six hypotheses is not included within this report but we offer the following example for the first hypothesis that states “*Stronger farmer associations have increased bargaining power*
and the ability to collectively purchase key farm inputs and market produce and thus increase members’ returns to investment, land and labour.”

1. Do you belong to or work with a farmer association?
2. If yes, what is its name, origin, membership & services?
3. Has participation in the farmer association …
   … increased its members’ bargaining power?
   … resulted in collective marketing?
   … improved the economic wellbeing of its members?

If the answer to all of the questions was yes, then one could accept the hypothesis in principle and undertake its refinement. Indeed, this was the case because from the onset of the field visit we discovered farmer groups that were collectively purchasing inputs at bulk discounts, marketing products through forward contracts at a premium price and were committed to seeing their association expand its membership and the services offered to them. We conclude that this is a useful hypothesis.

The next hypothesis that was considered states “Investments to sustain and maintain the natural resource base are more sustainable when they are linked to market-oriented production or when there are financial incentives for conserving natural resources and biodiversity.” From its onset this hypothesis appears tautological (sustain … sustainable) but moreover the linkage between market orientation and conservation is not clear. Nor is it clear if the investments refer to those in research or business. If we assume the former, then an approach to better understanding this hypothesis may be developed through a series of questions …

1. Are agricultural and natural resources being better conserved through research?
2. Has resource conservation led to new of greater market opportunities?
3. Can financial incentives improve resource conservation?

Most key informants generally found it difficult to understand this hypothesis and to answer these questions. Eventually this hypothesis was split into two, one that addresses benefits from market oriented production through research in enterprise development and another that examines financial incentives to protect natural resources and foster biodiversity, that are presented later in this report. Without going into further detail, this process was conducted for each of the remaining four initial hypotheses.
4. The Setting

4.1 Location, population and infrastructure

The Lake Ki vu Pilot Learning Site (PLS) is located in the central part of Africa to the west of the Albertian Rift Valley and strides across three countries, Democratic Republic of Congo (DRC), Rwanda and Uganda. The area lies between longitudes 29° 15’ and 30° 53’ E latitudes 0° 20’ and 2° 08’ S. The area is bounded by Lake Edward to the north and Lake Kivu to the south-west. The area covers Bushenyi, Kabale, Kanungu, Kisoro, and parts of Nyungamo and Rukungiri Districts in Uganda, and all or parts of the Rwandan Provinces of Byumba, Gisenyi, Gitarama, Kibuye, Kigali and Ruhengeri but not the area surrounding Kigali City. In the Democratic Republic of Congo, the site falls within south-eastern North Kivu Province including Goma and Rutshuru but not Masisi or the western shore of Lake Kivu. Figure 3 presents the roads and towns within the Pilot Learning Site (left) and its administrative boundaries (right).

Population estimates within the Pilot Learning Site are not up to date but likely to range between 10 and 12 million. Uganda and Rwanda provide the most recent population information of 2,315,244 and over 4 million, respectively, based upon censuses conducted in 2001. The data from North Kivu are based upon considerably older estimates from 1994. The population in North Kivu falling within the Pilot Learning Site was 3,290,035. If a population growth rate of 2.5% per year is assumed, then a current estimated population within the Pilot Learning Site is about 11,856,000 but this approach does not account for losses and migration during the recent turbulent past. Rwanda’s population density is greatest with about 500 persons km\(^{-2}\). In the DR Congo and Uganda, the population density is between 250 and 300 persons km\(^{-2}\). Throughout the area, greater than two-thirds of the population lives below the poverty line and over 90% live on smallholder agriculture and livestock with under 0.6 ha of land per family.

The road network in the three bordering countries is varied and is largely dictated by their

Figure 3. The Lake Kivu Pilot Learning Site showing road networks and major towns (left) and its administrative boundaries (right).
mountainous terrain. Most of the Pilot Learning Site in Uganda is covered by gravelled roads to allow easy movement of vehicles. This contrasts with the situation in Rwanda where despite the hilly and mountainous terrain, most of the roads are tarmac. The Democratic Republic of Congo has damaged tarmac roads covering only a few kilometres in Goma Town. The rest of the area is covered by few earth roads that were destroyed in places by the recent volcanic eruption of Mount Nyiragongo. The other forms of transport in the region are by air through the airports in Kigali and Goma or by sea through Lake Kivu that connects DRC and Rwanda. The reliability and amounts of electric power within in the region differs with Uganda and Rwanda having better power supply than the DR Congo.

4.2 Climate, geology and soils

The Pilot Learning Site has bimodal rainfall providing opportunity for two cropping seasons during the year. The “long rains” occur from mid-February through early June while the “short rains” occur from mid-September to mid-December. The average annual rainfall in the entire region varies between 800 mm to 2000 mm. Figure 4 presents the average monthly precipitation and temperatures throughout the year in Kabale, Uganda, one of the relatively drier areas within the Pilot Learning Site (see Figure 5). The relative humidity ranges between 90 – 100% in the mornings and decreases to between 42 and 75% in the afternoons. The Great Lakes Region in which the Pilot Learning Site is located comprises the mountainous ‘interlacustrine’ areas that include Rwanda, Burundi, the Kivu region of Congo, and south-western Uganda. The terrain is dominated by hills and valleys with most slopes ranging between 12 to 50% but some as great as 80%. The intersection of the three countries is located on the famous Virunga chain of volcanic mountains consisting of eight major volcanoes. Most of them are dormant except the two southernmost ones, Mount Nyiragongo
(3462 m) and Mount Nyamuragira (3063 m). These volcanoes have erupted on several occasions during the 1970s through the 1990s and most recently in 2002 and 2003. The Virunga Mountains are home of the critically endangered Mountain Gorilla, listed on the IUCN list of Endangered Species due to habitat loss, poaching, human disease, and war. The Karisoke Research Centre, founded by Diane Fossey to observe gorillas in their native habitat, is located between Mount Karisimbi and Mount Visoke.

Most soils occurring in the pilot learning site are volcanic Andosols except in some parts in Uganda north of Kisoro and south and east of Ruhengeri where deeply weathered, lateritic Ferralsols occur. Andosols have little or no structure and are very susceptible to erosion. Other than their potential high phosphorous sorption capacities, these Andosols are relatively fertile and support intensified farming in absence of fertiliser inputs. The Ferralsols are considerably lower in potassium (Table 2) and other cation bases. Both of these soils require different and specialized management both in terms of their physical properties and mineral nutrient and there is widespread evidence of soil degradation throughout the area, especially on the steepest cultivated slopes.

Table 2. Status of phosphorus and potassium deficiencies in soils of south-western Uganda (Siriri, unpublished data).

<table>
<thead>
<tr>
<th>Description</th>
<th>Level (mg kg(^{-1}))</th>
<th>% of Ferralsol sites</th>
<th>% of Andosol sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deficient</td>
<td>0-3</td>
<td>25</td>
<td>41</td>
</tr>
<tr>
<td>Moderate</td>
<td>4-10</td>
<td>46</td>
<td>39</td>
</tr>
<tr>
<td>High</td>
<td>&gt;10</td>
<td>29</td>
<td>20</td>
</tr>
<tr>
<td>Potassium status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deficient</td>
<td>0-0.18</td>
<td>61</td>
<td>30</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.19-0.4</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>High</td>
<td>&gt;0.4</td>
<td>15</td>
<td>60</td>
</tr>
</tbody>
</table>

4.3 Vegetation and Land Use

The original natural vegetation of the Pilot Learning Site was largely montane forest with the closed canopies at lower elevations thinning on higher slopes. To the west of the site is Congolean Humid Forest, and to the east is Sudanese Savannah. Almost all of the non-protected natural vegetation within the site was cleared for agriculture. The only clear illustration of part of the native vegetation is found in Echuya Forest Reserve and Bwindi National Park. Relics of forest/savanna and a mosaic of patches of savannah and scrub at various stages of the succession back to forest can be found at altitudes between 2200 and 3200 MASL where the influence of fire and cultivation has been reduced.

Current land use within the PLS can be placed into three broad categories namely: agricultural land, national parks and forest reserves. The agricultural land in is characterized by the cultivation of banana, potato, beans, maize and several other lesser grown food crops. Coffee and tea are occasionally grown within the site, particularly in Rwanda and Uganda. Emerging lucrative markets for vegetables such as cabbage, aubergines, leeks, onions, and carrots are resulting in further farm diversification, especially in the valley bottoms. Valley bottoms are used for dairy farming but many continue to support natural wetlands, which are now protected in Uganda but routinely drained in Rwanda. Orchards are few but some apples, avocados, mangoes and passion fruits are being cultivated. One feature throughout
the site is the spread of eucalyptus and, to a lesser extent, wattle (*Acacia mearnsii*). These trees have escaped from former tree plantations and form the majority of woody biomass observed in the non-protected areas.

Land tenure throughout the site is customary, meaning that families inherit untitled (non-deeded) land that may be bought or sold. Many of the cultivated hillsides are covered by simple earth terraces constructed about 50 years ago to reduce soil erosion and run-off; the assumption was that hillsides with an inclination exceeding 15° would not be cultivated and that land would be fallowed (Martins, 1945). However, due to increasing population pressure, many slopes exceeding 30° are now cultivated, using inappropriate tillage methods, and little or no fallowing is practiced. Thus farming is increasingly being constrained by continuous land degradation resulting from soil erosion and nutrient depletion, and many fields are being abandoned (field interviews). Land fragmentation further complicates implementation of soil conservation and water management practices. Relatively little land is committed to tree plantations. For example, *Cypressus lusitanica*, *Pinus patula*, and Eucalyptus are cultivated on only 3982 ha in Kabale District, Uganda. One exception is the expanding quinine industry in Eastern Congo where *Cinchona* spp. is grown for five to seven years on c. 5000 ha for its bark that is processed into anti-malarial medicines and poles used for building material.

**4.4 Policy and Institutional Setting.**

Decentralization in Uganda is one of the most ambitious reforms of local governance in Africa. The decentralization process was initiated in 1986 and culminated in the 1995 Constitution and the 1997 Local Government Act which provides the legal framework for the participation of local communities in policy-making. Uganda’s decentralisation policy has vested most of the administrative, service provision and policy management to the districts. Districts are divided into counties, then sub-counties, parishes and villages/cells. The Plan for Modernisation of Agriculture (PMA) provides the overall policy framework for guiding agricultural and rural development in Uganda. It also specifies government structures, institutions and mechanisms for its implementation. These include the National Agricultural Advisory Services (NAADS), the new National Agricultural Research Systems (NARS), the National Environmental Management Authority, the National Forestry Authority, the Uganda Wildlife Authority and many other decentralized structures for implementing area-based plan for modernization of agriculture. The National Agricultural Research Organization (NARO) has also undergone institutional changes, including decentralization of agricultural research through outreach agricultural research and development centres to cover different agroecological zones in the country. NARO is now evolving to form a national agricultural research system that should include both public and private research institutes, agricultural universities, civil society, farmers organizations and the private sector.

Rwanda has made remarkable progress on the economic, policy and social fronts since the genocide of 1994. Following the Uganda example, Rwanda’s National Decentralization Policy emphasizes the empowerment of local populations to fight poverty by participating in planning and management of their development process. Rwanda’s Poverty Reduction Strategy Paper (PRSP) prioritizes agriculture as a critical area for growth. The Agricultural Policy Outline developed by the Ministry of Agriculture, Animal Resources and Forestry (MINAGRI) calls for a radical change of approach to transform and modernize Rwanda through the development of a modern agriculture that is better adapted to markets, promotes high enterprise profitability, and reinforces agricultural research and advisory services. The government has developed an agricultural strategy with the objectives of increasing rural
incomes, enhancing food security, and converting agriculture into a viable sector by moving it away from a subsistence- to a market-based activity.

The main elements of the strategy are to (i) promote market-based agriculture by developing markets for both inputs and products; (ii) improve soil conservation and management; (iii) extend available land by developing swamplands in an environmentally sustainable framework; (iv) promote the livestock and fisheries subsectors; (v) improve farming methods through research, extension and information services, and intensification of the use of inputs; (vi) promote rural credit and other financial mechanisms for rural-based activities; (vii) promote the formation of farmers' groups and professional associations; and (viii) improve storage and farm-to-market roads. Recent government policies such as Trade Integration Programme and Vision 2020 provide policy frameworks that will support IAR4D initiatives. To respond to these challenges, the Rwanda national agricultural research institute has also embarked in an ambitious plan for decentralization and strengthening of technology to enable researchers to be in close contact with rural communities and other partners of rural development.

Of the three countries, the DRC has experienced a long period of major political and economic instability. As a consequence, policies and institutions are in a permanent state of crisis and no institutional reforms of any significance have taken place for the past 20 years. DRC is still facing enormous “emerging from conflicts syndrome” and challenges for recovery and reconstruction. The continuing civil war and external forces have resulted in a bifurcation of the system, particularly in the area covered by the PLS. However, with the progress in the peace and reunification process, there are prospects for recovery. Despite this picture, there are a number of institutions and structures that are actively working on agricultural research and development in eastern DRC. These include the national agricultural research institute (INERA) which has been collaborating with ASARECA Networks, CGIAR centres and advanced research institutes over the last decade. There are also agricultural universities, UN agencies international organizations, civil society organizations and farmers’ organizations, which are still working in an emergency and relief frameworks, with some of them moving towards sustainable development.
5. Research and Development Challenges

5.1 Producing more food at reduced cost.

Food crops. The small-scale farmers within the Lake Kivu PLS cultivate various combinations of potatoes, beans, banana and maize as their main food crops. Potatoes are usually grown as a monocrop but sometimes intercropped with maize. Both climbing and bush beans are cultivated with the former usually grown as a monocrop and the latter intercropped with banana or maize. One feature of food production within the area is complex polyculture where several food crops such as potatoes, beans, maize and sorghum are grown together, often on over-planted raised beds or in relay (sequential planting). Clearly, this arrangement is designed to reduce risks as failure of one or more crops will be compensated by the others and is essential a form of risk-adverse crop diversification. This strategy is weak in that it makes poor use of available seeds, results in excess intercrop competition and exacerbates nutrient limitations, particularly N (Photograph 1).

Other important food crops that are less often grown include sweet potatoes, peas, coco yams and pumpkins, usually as intercrops. One exception to this is the extensive valley bottom cultivation of sweet potatoes on well drained raised beds in Rwanda. Several vegetable crops are also cultivated for market, usually as monocrops in smaller fields near homesteads including cabbage, onions, carrots and tomatoes. The most important crop in Kabale and Kisoro, Uganda is potato, climbing beans appear predominant in Rwanda and Congo’s farmers are the most diversified. Cassava is said to be important in the northern, lower elevation part of the pilot learning site but the team was unable to visit this area.

Much of the differences in cropping combinations that occur within the pilot learning site are accounted for by the availability of moisture (Figure 5). The annual precipitation varies between 800 and 2000 mm yr⁻¹. The drier areas occur to the east of the PLS and in the Western Rift Valley located to the south of Lake Edward. These drier areas are nearly semiarid and the natural vegetation is savannahs and dry woodlands. The farms in Byumba, Rwanda and Kabale, Uganda, and lands to their east suffer periodic drought. A similar, but less dry area also occurs around Katanda, DR Congo, but much of this land falls within the Volcano National Park. These areas produce sorghum, maize and potatoes, but bush rather than climbing beans are generally cultivated and bananas are grown in the valley bottoms rather than hillsides. The humid areas, with well distributed rainfall of nearly 2000 mm per year, occur around the Virunga Mountains and in northwestern Rwanda. Farmers in this area are able to grow banana on hillsides, prefer climbing beans to bush varieties and

Photograph 1. Relay intercropping of maize, sorghum, potatoes and beans on raised beds near Ruhengeri, Rwanda. Note the chlorotic maize and sorghum.
must either grow moisture loving crops, such as cocoyam, or take special precautions to drain the valley bottoms for the production of sweet potatoes, climbing beans and vegetables. Ironically, households in the humid zone occasionally suffer from water shortages when deep, young soils of volcanic moisture rapidly absorb rainfall and year-round water bodies are rare.

Several crop disorders were noted during field visits. Banana wilt has reached near epidemic proportions. Late blight of potatoes is common. Nitrogen and phosphorus deficiencies are frequent but not widespread in southwestern Uganda or near Goma because of the high inherent fertility of these volcanic soils (Andosols). Nutrient deficiency symptoms were sometimes expressed on maize and beans growing near healthy potatoes.

Large differences in the sophistication of seed systems were noted between countries with Kabale, Uganda having the strongest and Goma, Congo the weakest. In Uganda, bags of improved potato seed (small tubers of cv. Victoria Red) were widely available to farmers while in Congo farmers rely upon self propagation of cv. Cruiser for its disease resistance. Victoria is by far the preferred variety by most consumers. Seed of hybrid maize and improved bean are available through retailers in Uganda but not Congo and Rwanda although it is likely that most farmers in all three countries continue to rely upon local land races. The availability and prices of fertilizers and seeds of field crops within the Pilot Learning Site are described in greater detail within the Farm Input Supply case study (Section 6.2).

The constraints to food crop production are described in Figure 6. The limited reliance upon purchased farm inputs results in part from a paucity of farm input retailers (1) but more so from the weak demand for those products by small-scale farmers due to their limited capacity to invest in farm improvement. Cultivation in absence of inputs results in low and declining crop yields due to soil fertility depletion (2), uncontrolled pests and diseases and reduced yield potential (3). Low yields result in household food deficits (4), little or no crop surpluses (5), alienation from the marketplace (6) and an inability (or unwillingness) to check land degradation (7). The resulting low household incomes further reduce the farmer’s capacity for investment and perpetuate the cycle of poverty (8). Because of the complex causes of poor crop yields among these small-scale farmers, and their far-reaching effects, no simple intervention is likely to overcome yield limitations and uplift households from poverty, rather an integrated approach involving farm inputs, land conservation technologies and improved access to markets is required.

Figure 5. Annual precipitation within the Lake Kivu PLS ranges from 839 to 1937 mm per year.
**Intensifying livestock production.** Livestock development offers various opportunities for improving food security and especially to increase the availability of high quality protein in the Lake Kivu region because of the multiple marketable products. This can best be achieved through the integration of livestock in the crop production systems. There are profitable trade opportunities in livestock products in the region.

Several community initiatives and technological interventions have been introduced in Kabale district but have not adequately addressed the problem of soil conservation. Stakeholders suggested that that a market-driven approach may be more successful than any of the previously used methods. The logic was that use of high value perennial crops or rearing of livestock that required establishment of pastures on the hillsides would reduce tillage and hence allow soils to recover. Livestock manure could be efficiently utilised in soil fertility management. Birunga Dairy Industries established in Kisoro town during 2004 has the capacity for packing 5000 litres of pasteurized milk and 4000lts of yoghurt per day. The owner is in the process of installing a UHT production unit that will have flow capacity of 4000 litres per hour. Already, the processor buys milk at 350 shillings per litre from Kisoro but but also from Kabale, Ntungamo and Rubaare. He sells the pasteurized milk in Kisoro, Kabale, Rwanda and DR Congo.
In Eastern DR Congo the community bordering the forest reserve in Kibumba, North Kivu consists of traditional livestock keepers. During the recent civil war, refugees and fighting soldiers depopulated the area of all livestock. The communities have not taken up new livelihood activities apart from the growing of annual crops on a small scale. Nature conservation organisations are giving them goats mostly to reduce encroachment on the neighbouring forest game reserve. It is important to ensure availability of the right species and breeds for the restocking exercise and to incorporate appropriate forages for improved feeding regimes. For example the growing of fodder crops such as *Calliandra* spp, improved *Pennisetum* spp, and *Setaria* along terrace bunds would help control soil erosion and at the same time feed livestock. Livestock keeping in Rwanda is performed mostly by pastoralists operating outside of the Pilot Learning Site although zero grazing is becoming more popular. In Ruhengeri zero-grazing, under a Heifer Project International initiative, is integrated with crop production.

There are real opportunities for profitable livestock production in the Pilot Learning Site but the challenge remains *how to ensure profitable production on the limited natural resource base*. This raises many questions. How can animal scientists best develop appropriate breeds for high productivity? How can land managers effectively utilize small holdings for developing quality feed? How can improved post-harvest handling of livestock products allow better market access? These issues require multi-stakeholder research to develop strategies for increasing yields and profits from raising livestock. Answers to these questions are useful in verifying the *Partnership Synergy Hypothesis* described in Section 8.5 of this report.

### 5.2 Diversifying Agro-enterprise for wealth creation among the poor

Rural agro-enterprise development has been identified as the critical entry point of the Lake Kivu Pilot Learning Site yet throughout this area entrepreneurship and enterprise spirit appear very weak. The site is characterized by large numbers of highly vulnerable rural poor for whom agriculture represents the major opportunity to enhance their livelihoods. The majority of farmers live in marginal areas with poor market access, poor infrastructure, remoteness to major cities and markets, small fragmented and degraded farmlands, deficient institutions, organizations and policies, and often with limited support form research and development organizations. Their small landholdings limit their capacity to produce large volumes of staple crops which have large domestic markets such as maize, and cassava. Many households still do not produce enough for food security and income generation. This situation is exacerbated by limited entrepreneurial skills for adding value to staple commodities, and especially production and marketing of high value products.
Table 3: Strategies for diversifying agro-enterprises in Kivu Pilot Learning Site.

<table>
<thead>
<tr>
<th>Existing Products</th>
<th>Existing Markets</th>
<th>New Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Market Penetration</em></td>
<td><em>Product development</em></td>
</tr>
<tr>
<td></td>
<td>Examples: potatoes, beans, banana, vegetables, maize, and sorghum</td>
<td>Examples: honey, passion fruit, wheat, dairy products, soybean grain, passion fruits, chilli, apple banana</td>
</tr>
<tr>
<td>New Products</td>
<td><em>Market development &amp; expansion</em></td>
<td><em>Diversification into higher value crops</em></td>
</tr>
<tr>
<td></td>
<td>Examples: zero grazing, fish farming, soybean products, dairy products</td>
<td>Examples: temperate Fruits, garlic, French beans, chilli, ginger, cosmetics, medicinals and handicrafts</td>
</tr>
</tbody>
</table>

New livelihood opportunities need to be created for the rural poor in the PLS by introducing technologies and new market linkages that increase their competitiveness and capacity to generate income, as well as their food security needs. Developing a diversity of agro-enterprises can offer small farmers greater risk aversion and more market opportunities at local, national and regional levels. Some development organizations are specializing in this area of linking farmers to markets and agro-enterprise development. In some limited number of cases, they are achieving some impacts locally with significant numbers of the poor. But they are usually poorly connected to or supported by the formal research sector, private sector and government policies. The challenge for R4D organizations is how to link small-scale farmers in marginal areas to growth markets, and how to develop methods and approaches that effectively integrate research, market access and development of community agro-enterprise.

The Lake Kivu Pilot Learning Site has strong potential for a number of products. However, this requires intensifying the production of traditional staples and diversifying into newer, high value products that have growing domestic, urban and international specialized niche markets. This type of markets is growing rapidly, but to be able to seize such opportunities, producers need access to knowledge and technologies that can handle the production, processing and marketing requirements. The analysis of suggested enterprise opportunities in the PLS points to some possible entry points for enterprise development within the PLS. We used the Ansoff’s product-market matrix to characterize the different enterprise opportunities (Table 3).

The rural households in the Lake Kivu PLS are undergoing the difficult transition from subsistence farming to mixed-enterprise agriculture because their needs and aspirations have extended beyond what may be produced on their farms alone. This change is impeded by the area’s remote location, its lack of agro-processing opportunities and the poor selection of crops intended for upper-end, demand-driven markets. Identifying these new crops, integrating them into mixed cropping systems and escorting them to markets are key entry points for research. Such new crops should be high value and rapidly processed or non-perishable. Their propagules must be easily multiplied and inexpensive. They must not complete excessively or displace other important farm enterprises. Additional advantages include the generation of multiple products, compatibility with land conservation measures and livestock enterprises and, in buffer zones, non-palatability to wildlife. These crops must not be susceptible to pests and disease and most farmers lack the ability to control them with pesticides. There must be competitive advantage for these crops within the highlands or else less remote midland areas will produce these crops as well. Several such crops were
mentioned but none conclusively identified including macadamia nut, apples, artemisia, cinchona, tea, peas and mustard but by no means should this list be considered exclusive. The traits of these crops are summarized in Table 4.

Table 4. Some possible cash crops for the Lake Kivu Pilot Learning Site and their likely advantages and disadvantages.

<table>
<thead>
<tr>
<th>Crop</th>
<th>High value</th>
<th>Non-perishable</th>
<th>Rapidly propagated</th>
<th>Multiple products</th>
<th>Pest resistant</th>
<th>Deter wildlife</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potatoes</td>
<td>±</td>
<td>±</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Beans</td>
<td>±</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Peas</td>
<td>±</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Tea</td>
<td>9</td>
<td>±</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Macadamia</td>
<td>9</td>
<td>9</td>
<td>±</td>
<td>8</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Apple</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>±</td>
</tr>
<tr>
<td>Artemisia</td>
<td>?</td>
<td>9</td>
<td>?</td>
<td>8</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Cinchona</td>
<td>±</td>
<td>9</td>
<td>?</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Mustard</td>
<td>?</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

Key: 8 crop fails to meet criteria, ± crop partially satisfies criteria and requires improvement or investigation, 9 crop satisfies criteria, ? crop characteristics not sufficiently understood.

5.3. Improving markets

**Domestic markets.** The existing markets for the major commodities of the Lake Kivu PLS are fraught with many imperfections (Ferris et al, 2002a; Jagwe et al, 2003). As in traditional African marketing systems, most of the traders purchased their products directly from the producers. Purchase prices are often based on current market prices or determined through haggling or bargaining in the absence of adequate market information. Key market participants are itinerant village collectors, stationary market brokers, long distance traders and agro-processors. The marketing structure for grains (beans; maize; sorghum) and banana is described in Figure 7. Long distance traders (generally brokers) pay in cash and often have storage facilities and other quality enhancing equipment. Itinerant traders and retailers appear to benefit most. For example, based on gross margin analysis (the difference between purchase and selling price) travelling traders and urban retailers add about 39% and 27% respectively to the price of cassava flour in Uganda (Collinson et al, 2003).

The goods are often sold to brokers at very low prices because of the strong collusive practices of the brokers. Local traders operate during the market days and will negotiate with long distance traders on behalf of the farmers. According to DIOBAS – a development NGO in Goma (DRC), grains bought from DRC by traders from Rwanda and Uganda are eventually resold in DRC markets often at high prices. This is a simplified illustration of a
more developed system with many participants. However, the figure suffices to show that the potential advantages of organized marketing for commodities for smallholders can be expected to be gained in the linkage between the farmer and the long distance traders, agro-processors and regional markets, i.e. by by-passing the itinerant village collectors. The challenge is to make the marketplace more transparent and organize farmers into marketing cooperatives with requisite skills in collective bargaining.

Export markets. Table 5 describes the economic performance of the three host countries based on a set of economic and trade indicators. It shows that while growth was achieved in the Central Africa in 2003 relative to the previous four years, the performance in East Africa remained at the same level. Export performance in terms of real growth was uneven between the three countries: Uganda recorded a negative growth rate while DRC and Rwanda registered moderate improvements. As shown by the per capita export data, the three economies registered poor performance when compared with the regional averages in East and Central Africa. There is thus some scope for improving on the countries’ performance.

Table 5: Gross Domestic Product and Export Performance, 1999 - 2003

<table>
<thead>
<tr>
<th>Country</th>
<th>Real GDP Growth Rate (%)</th>
<th>GDP Per Capita (US$)</th>
<th>Real Exports Growth (%)</th>
<th>Exports Per Capita (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2003a</td>
<td>2003a</td>
<td>2003a</td>
<td>2003a</td>
</tr>
<tr>
<td>Uganda</td>
<td>6.3</td>
<td>5.4</td>
<td>244</td>
<td>228</td>
</tr>
<tr>
<td>DR Congo</td>
<td>-2.4</td>
<td>5.0</td>
<td>102</td>
<td>115</td>
</tr>
<tr>
<td>Rwanda</td>
<td>7.2</td>
<td>3.2</td>
<td>224</td>
<td>209</td>
</tr>
<tr>
<td>C. Africa</td>
<td>2.1</td>
<td>4.4</td>
<td>287</td>
<td>355</td>
</tr>
<tr>
<td>E. Africa</td>
<td>4.0</td>
<td>2.6</td>
<td>242</td>
<td>263</td>
</tr>
</tbody>
</table>

The Lake Kivu PLS host countries have historically been exporters of primary products (such as coffee and tea) and a few studies confirm their comparative advantage in the production of these crops (Oyejide, 1993; Amjadi et al., 1996; ADB, 2004). Potentials exist for industrial utilization and exports of non-traditional agricultural enterprises such as fruits and vegetables within the region, but domestic producers and processors also face competition from imports produced in Kenya, South Africa, and outside the continent (Ferris et al., 2002b; Mbwika, 2003). Indications for possible improvements were obtained during the field visits. For instance, the Ugandan Cooperative Alliance (UCA) has been successful in forming farmer groups and improving their access to technical assistance, credit, improved inputs, and market-price information. The Alliance has introduced new value-added products including solar dried fruits, fruit juice, banana flour, banana wine, aloe vera syrup, processed maize and milk products including fruit-flavoured yoghurt. It has also forged strong partnerships with agricultural research institutions to transfer technologies to improve productivity and income. However, the need for enhancing quality standards (including packaging, labelling) of processed products was still apparent. **The major bottleneck in promoting exports through value-adding activities is the lack of appropriate processing equipment to produce high quality, competitive products. Improving quality standards will reduce risk in the agro-food trade.**

Sina Gerard, a passion fruit exporter in Nyirangarama, Rwanda, reported that his weekly exports of passion fruit to Belgium had declined from 3 tons to 0.5 ton due to insufficient supplies occasioned by viral infection of passion fruit. The fruit processing plant established in 1998 cannot satisfy his growing export contracts for the same reason. The potential benefits he sees in the crop is reflected in promotional activities involving the distribution of free seeds to 3000 farmers in Gisenyi, Gikongoro and Byumba Districts which are yet to be affected by the virus. The company also employed agronomists to conduct trials and provide advisory services to the farmers. **The major challenge for agroprocessors is the assurance of adequate and consistent supplies of high quality raw materials.**

**5.4 Sustaining agricultural and natural resources**

**Soils.** Farmers in the PLS grow annual food crops on hillsides using traditional practices. Annual crops offer little protection to the erodible soils which become more exposed to the elements that cause erosion during the frequent tillage operations. Up to 1 t ha\(^{-1}\) soil loss in erosion has been measured on a runoff plot in a single rain storm on a hill slope in Kabale (Bagora, 1990). Nutrient removal in crop harvests, with limited replenishment from external inputs, also contributes to nutrient depletion. Annual nutrient output rates in harvests from cropping systems in Rubaya, Kabale, were found to be as high as 72.3, 7.7 and 49.4 kg ha\(^{-1}\) for nitrogen, phosphorus and potassium, respectively (Bekunda and Manzi, 2003). Almost all stakeholders the VT interacted with identified soil degradation as the most prevalent constraint to productivity. For their continued survival, they must reduce soil degradation.

Soil fertility management research and outreach programs have been conducted in the ASARECA countries by several institutions; that of the African Highlands Initiative being more relevant to the Lake Kivu PLS. Similarly, agroforestry programs have had some impact in introducing technologies for erosion control, nitrogen replenishment, biofuels and even stakes for climbing beans. It is considered, however, that these programs promoted more of technological innovations which are only a component of INRM. During discussions with stakeholders, it was clear that the socio-economic environment (e.g. enhanced marketing pathways), land tenure systems (e.g. land fragmentation) and community specific
characteristics (e.g. ability to conform to bylaws) play roles in farmer decisions to adopt soil management innovations. **The challenge is to develop hillside farming enterprises that offer both food security and economic incentives to the farmers and consequently lead to the appreciation and adoption of conservation measures as a means of protecting the enterprises.**

**Wetlands.** Wetlands are transitional zones between upland ecologies, including farmlands, and deepwater systems such as rivers and lakes. They receive and transform biological and chemical inputs from the general landscape ecology and because of their transitional position; they can be among the most productive systems. Human activities can alter the roles of the wetlands. Because of the high population densities, most wetlands, river banks and lake shores in the PLS were cleared of their natural vegetation and converted to crop and pasture land. They no longer serve as erosion deposits and as a consequence, rivers carry muddy waters, silting is evident and water levels in rivers are low indicating excessive drainage. In some cases, patches of cleared swamp have been acidified and are devoid of vegetation. Clearly, wetland biodiversity has been disrupted.

Policies of the countries hosting the PLS recognize the importance of conserving the ecological integrity of the wetlands but in the face of serious demographic pressure. In Uganda, the policy seeks to reverse the historic wetland losses in the face of continuing drainage and encroachment by agricultural enterprises. In Rwanda, management of marshlands has taken the approach of community participation at all levels of decision making. Rice growing is being integrated with fish farming as a means of diversifying resource outputs, following impact studies on water resources, environment and human health. Farmers construct fish ponds which are also used as sources of water for rice irrigation. Aquaculture compost is being used to partly replace mineral fertiliser requirements for the rice crop. Fish farming in the PLS may be feasible only in the wetland areas as construction of ponds in highly porous andosols on steep slopes with no water sources is not a feasible option. **The challenge is to allow exploitation of the wetland and water system resources based on sufficient information and management technologies that will allow their rehabilitation and rational utilization.**

**Forests and trees.** Most forests in the Lake Kivu PLS are natural and are found in the protected areas. Deforestation decreased forested areas by as much as 70% during the period between 1950s and late 1990s. Recent deforestation created areas for refugee re-settlements and agricultural utilization. For the most part, countries of the Lake Kivu PLS are enforcing the Convention on the Protection of the World Cultural and Natural Heritage, thereby limiting utilization of forests in protected areas. The area planted to managed forests is equally limited. In the Kabale and Kanungu districts of Uganda, plantation forestry made of the eucalypt and cypress trees covers approximately 4000 ha of National Forestry Authority (NFA) land. The plantations belong to both the NFA as well as private entrepreneurs to whom NFA leased part of its land. In isolated cases, such as Gisenyi, Mutura District of Rwanda, local authorities have introduced corrective action and have been planting native tree species at the top of cultivated mountains.

Most farmers grow trees on-farm. In Rwanda, the eucalypt is the tree most commonly grown; it grows fast and has comparatively better qualities for on-farm use, including timber for structural construction, firewood, fence poles, stakes for climbing beans and the tree produces nectar and pollen that is collected by bees and which benefit beekeepers. As much as possible, the eucalypt is grown on land that is not suitable for crop production, and occasionally on prime agricultural land as individual trees or in cluster. However, its allelopathy does not allow maximum utilization of land through intercropping, and it is
considered to have the ability to lower the water table. The eucalypt and the black wattle are
grown under similar circumstances in Uganda. The black wattle is preferred for its high
quality charcoal and strength of fibre made out of its bark. Its potential as a source of gum
has not been exploited. The challenge is to identify on-farm niches for the growing of trees
with preferred characteristics while freeing land for those trees with more multiple uses in
crop and livestock production.

**Fostering biodiversity.** It is estimated that the 34 regions in the world, identified as hotspots
by Conservation International only cover 2.3 percent of the Earth's land surface but they
harbor well over 50 percent of all terrestrial plant and animal diversity. Habitat loss due to the
clearing of tropical forests for agriculture, logging, and the collection of fuel wood continues
to be the major factor in the declining number of primates (Science in Africa, 2005).

The protected areas of the Pilot Learning Site (PLS) have been identified as world
biodiversity hotspots and include the Bwindi National Park (Uganda), Ruwenzori Mountains
National Park (DR Congo), the Kibale National Park (Uganda), the Queen Elizabeth Park
(Uganda), the Nyungwe National Park (Rwanda), Kahuzi Biega National Park (DR Congo)
and the Virunga Volcanoes Park that is shared by the DRC, Rwanda and Uganda. The last
species of the mountain gorilla (*Gorilla gorilla beringei*) are found in the 434 km² Virunga
Conservation Area and in the Bwindi National Park while the Eastern lowland gorilla
(*Gorilla gorilla graueri*) is found in the eastern forests of DRC. The wetland area of Queen
Elizabeth is a designated Ramsar site (wetlands of global significance and value) and 550
bird species of which two are globally threatened can be found in the park.

The World Wide Fund (WWF) reports that illegal clearing of the forest for agriculture in
DR Congo and Rwanda in 2004 has decreased the habitat of the mountain gorillas. This
encroachment reduced their breeding area and limited their main food sources. “Recent
meetings between administrative and military authorities from DR Congo and Rwanda have
been very positive and have apparently led to the removal of illegal settlers and a cessation
in forest clearance,” says Dr Peter J. Stephenson, Coordinator of WWF’s African Great Apes
Programme. Limited access to the park has been given to traditional healers to collect
traditional medicine in Uganda and Rwanda, women in the DRC are allowed to collect dead
branches, vegetables and mushrooms and beekeepers from Rwanda and Uganda are allowed
to keep their beehives in the buffer zones.

Communities around the park have been using various beneficial plant, tree, and fungi
species inside the park for decades but the number of people needing these species have
increased dramatically. People in DR Congo have been collecting mushrooms from the forest
and sell it in the local market in Goma. However, if they could increase their production they
would be able to deliver to the … Sun on the border between Rwanda and DR Congo who
has already indicated that they need a steady flow of mushrooms. Beekeeping projects have
been established in the buffer zones of the parks in Rwanda and Uganda. The existing
beekeeping projects in DR Congo falls out of the PLS but there is scope to increase the
number of beekeeping projects in the buffer zones and outside protected areas. **There is an
opportunity to study the domestication of beneficial plant, fungal and insect species that
are useful to people outside the park in order to transform them into commercial
enterprises.**

The tourism industry and ecotourism have been contributing to the financial management
of the biodiversity hotspots. Ecotourism is becoming more popular in benign environments.
However, if it must be managed responsibly so that it is not destructive to biodiversity. One
of the biggest tourist attractions to the PLS is the visiting of the gorilla parks, generating
about US$ 20 million annually. It is perceived by people living around the park that they
have not benefited from the income from the park but the park authorities in Volcanoes and
Mgahinga National Parks indicated that 5% and 20% of park revenues, respectively, are returned to the community through community development (water supply, schools, health clinics) or as targeted employment. *The challenge is to maximize revenue from the tourism industry for park and buffer zone management without compromising the parks’ integrity.*

**Watershed management.** A watershed can be defined as a geographical unit of land draining from surrounding ridge tops to a common point such as a lake or stream confluence with a neighboring watershed. It also consists of communities that are interlinked, and with common socio-economic characteristics. The watershed as a unit of operation in NRM is convenient for various reasons. Plot or farm level interventions to NRM overlook the fact that landscapes are interconnected (flows and causal interactions between neighbouring farms and villages) and involves social interaction (common property resources, institutions governing natural resources – property rights, by-laws, groups, norms).

Integrated watershed management offer opportunity to use broader units of analysis and intervention for sustainable natural resource management rooted in the local capital and making effective use of available research capacity through multi-disciplinary team work. The landscapes on which small farmers in the PLS operate are interconnected and actions in one plot often affects neighbouring farmers. Examples include soil and water conservation practices, use of pesticides, irrigation, livestock grazing, use of fires during land preparation etc. Patchy conservation of soil involving construction of conservation structures in scattered plots will be affected by non conserved plots where runoff can destroy established structures. Some structures like cut-off drains concentrate water that might end up causing more erosion in a neighbouring plot. The use of pesticides by few farmers might not address the whole problem of pests as they will move to untreated plots where they will cause serious damage and resurface later in the treated plot. Adoption of some technologies like the laborious soil conservation measure requires either collective action by the community or strong incentives to individuals. *It is considered that IAR4D operating at watershed level represents an important opportunity for addressing issues in innovative ways by expanding the range of social and environmental benefits from isolated interventions.* Table 6 is a summary of threats to natural and agricultural resources, their impacts and potential research and development activities to minimise degradation of these resources.

**Table 6. Threats to biodiversity and sustainable natural resources in the Pilot Learning Site.**

<table>
<thead>
<tr>
<th>Type of threat</th>
<th>Source of threat</th>
<th>Effect in conservation target</th>
<th>Conservation and research activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced biodiversity</td>
<td>Conversion of lands to agriculture</td>
<td>Habitat loss for protected wildlife</td>
<td>Biodiversity protection policy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loss of species of insects, small animals and plants</td>
<td>generating projects in buffer zone</td>
</tr>
<tr>
<td>Soil degradation</td>
<td>Hillside agriculture</td>
<td>Nutrient loss resulting in reduced crop yield</td>
<td>Domestication of useful species</td>
</tr>
<tr>
<td>Potential chemical pollution associated with intensification</td>
<td>Susceptibility of higher value crops to pests and disease requires increased use of pesticides</td>
<td>Water sources polluted with chemicals, fish and water plant material decrease</td>
<td>Biological control of diseases and organic production practices</td>
</tr>
<tr>
<td>Wetland degradation</td>
<td>Agriculture and</td>
<td>Loss of biodiversity &amp;</td>
<td>Policies on wetland</td>
</tr>
</tbody>
</table>

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5.5. **Institutional capacity development and organizational change**

The SSA-CP is piloting a shift from a research paradigm where technologies are viewed as an end to one where they are an intermediate in an integrated process for achieving a “people oriented impact”. The new paradigm, Integrated Agricultural Research for Development (IAR4D) is characterised by the inherent complexity of the issues addressed, cutting across sectors and scales; the active involvement of a broad range of different stakeholders in collective innovation systems; the use of systems thinking to integrate different disciplinary perspectives; the identification of development strategies that integrate technological, institutional and policy options; and the evaluation of (potential) outcomes of the innovation and research process by the different stakeholders based on a range of criteria, (Hawkins 2005).

The SSA-CP programme proposal emphasizes the importance of institutional development to successful implementation of IAR4D and highlights four elements that influence institutional change are organisational and institutional change, capacity development, information and knowledge management and monitoring and evaluation. IAR4D dictates establishment of inter-institutional partnerships based on mutual trust and ownership of the process and clearly defined roles. Organisations will therefore be compelled to change outlook and approach in the way they have been doing business in order to allow a shift from technology focus to a people focus and to permit ‘looped’ action research mode that results in societal and institutional learning. Organisational change requires policy support to stimulate new direction and the SSA-CP programme (FARA, 2004) recommends policy change as an entry point. For example in Uganda the government has already approved a new policy that calls increased market orientation and more-stakeholder involvement among other things MAAIF, 2003). The Uganda National organisation has re-aligned her research programme to comply with the new policy and offers an example of a “research and development continuum” strategy (NARO, 2004).

There is need for multi-pronged capacity and competence development that will impart new knowledge, skills and attitudes to individuals to stimulate the formation of multi-disciplinary research teams. The teams should have the competence to able to integrate the analysis of national and regional development as well as biophysical and social (hard and soft systems) issues, and ensure that the solutions obtained are scaled out to improve livelihoods in a wider area. This will foster continuous institutional transformation. The change should start with the formation of inter-institutional task forces that will ‘learn together by action and reflection’ approach undergoing continuous mentoring until the desired transformation is achieved.

**Capacity building.** The whole range of stakeholders who are involved in the implementation of IAR4D must therefore be part of an interactive capacity development process. Key stakeholders are, farmers, and their various organisations and fora, National and international research organisations, public advisory services, private sector (business community and processors), Non-governmental and community based organisations and universities. The envisaged roles and capacities of each of the stakeholders have been reviewed and challenges for capacity development identified. In addition to equipping scientists with skills for biophysical analysis, teams will be furnished with social soft skills to be able to facilitate and
participate in multi-stakeholder processes. It will also ensure that all stakeholders are empowered enough to negotiate and to participate on equal partnership basis and/or initiate and lead their own processes. Teams need continuous coaching to ensure the change in mind-sets that will result in institutionalization of the IAR4D process agricultural research.

**Information and knowledge management.** IAR4D is a learning process, and requires a system of information and knowledge management to enhance reflection and feedback for societal learning and improved decision making. Ongoing monitoring and evaluation, and a systemic approach to impact assessment, to track progress towards overall goals, signal the need for mid-course adjustments, and document the returns on investment in IAR4D. IAR4D is a multi-stakeholder action learning process that integrates multiple simultaneous activities. Therefore the evaluation process will not only focus on progress, benefits and impacts of the research but will pay attention to lessons learnt and the effectiveness of the learning process in bringing about empowerment and social and institutional change. Biophysical and social baseline data will be an important starting point for establishing milestones for monitoring, evaluation, impact assessment and institutional learning. Teams will be equipped with self assessment skills to be able to gauge the effectiveness of their learning.

**Organisational change.** Implementation of the SSA-CP programme under the Integrated Agricultural Research for Development (IAR4D) paradigm calls for increased stakeholder involvement to ensure responsiveness to client demands and market opportunities. Consequently, the stakeholders who are not traditional researchers must be empowered to participate and to be able to articulate their demands and priorities. Traditional researchers will also need new skills and attitudes to be able to operate in a multi-stakeholder ‘innovation system research’ process and continue to provide cutting edge science to solve the technological problems that constrain the development process. This calls for formation of multi-dimensional inter-institutional and inter-disciplinary partnerships to enhance institutional capacities to respond to inherent complex needs that characterise IAR4D. It is crucial that the partnerships go beyond market integration and take into consideration the sectoral and sub-sectoral interdependency. Capacity development for implementing and institutionalizing IAR4D entails a gradual nurturing process consisting of tailor made learning events interspersed with action and reflection to allow participants to link tools and processes. The process encompasses need for organizational and institutional change, capacity building for impact-oriented science and for inter-disciplinary skills, a system for knowledge management and information sharing for up/out scaling and a monitoring & evaluation and impact assessment to ensure reflection and learning.

ASARECA’s strategic plan indicates that many of the NARS scientists already have adequate training and experience in agricultural research (ASARECA 2005). The Validation Team visited research facilities in the PLS, Kachwekano (NARO), Ruhengeri (ISAR) and also held discussions with programme leaders in Butare and with scientists from Bukavu (INERA), DRC. These NARS indicated the need to acquire disciplinary training to strengthen capacity for impact oriented research, as well as special skills to re-orient them from business as usual to become team players in business unusual. Universities are responsible for imparting knowledge and skills to future researchers. They should therefore incorporate IAR4D skills in their training programmes to roll out graduates who are prepared to participate in the research agenda. Private sector, especially agro-processors and traders of agricultural inputs and produce will get more involved in natural research management and marketing of in smallholder systems. The private sector players have to be sensitised to form processors’ and traders’ associations, and to strengthen linkages with farmer groups and research. Private sector actors require negotiation skills. Advisory services are involved in
farmer group formation and training. These too will benefit from team learning to be able to empower farmers with the knowledge required to participate in demand-led research systems.

**Strengthening farmers’ organizations.** One of the most promising features of the Kivu PLS is the emergence of different forms of farmers’ organizations with different functions and roles, from seed multiplication, soil erosion control, bee keeping, marketing, savings and credit, watershed management, byelaw formulation, restocking, etc. We found several examples and success cases where the increased level of farmers’ organization has accelerated dissemination of knowledge and technologies, accessing market opportunities, organizing collective marketing, and formulating local policies for natural resources management, and influencing the research and development agenda. Recent research has also shown the importance of social capital foundations for sustainable management of natural resources, successful policy interventions, rural agroenterprise development and community development (Pretty, 2003). In their account of successes in African agriculture Gabre-Madhin and Haggblade (2003) stressed that farmers’ organizations have become a powerful force for providing an array of collective services including technology development and testing, collective action in natural resources management, and information dissemination and sharing.

Empowering farmers’ organizations is an essential feature of any programme that addresses poverty, marketing and NRM issues. One key hypothesis guiding IAR4D is that *investments in strengthening social capital will lead to pro-poor sustainable market institutional (institutional, technology, human, social, policy, amongst others) and improvement in rural livelihoods for the majority of small scale farmers*. IAR4D therefore requires better understanding of mechanisms and processes for strengthening farmers’ organizations and other rural innovation systems to contribute to sustainable agricultural development and enhanced technological and institutional change. While farmers’ organizations are increasingly becoming an important stakeholder group in agricultural research and development, there is limited systematic research into their dynamics, composition, performance and effectiveness. Yet, such analysis is critical to building more effective ways of organizing and working with farmers’ groups, building their capacity to innovate, experiment and scale up participatory research.

**5.6. Refocusing Policies**

Implementing IAR4D requires that governments and organizations within the Pilot Learning Site devise a range of policy instruments that can influence stakeholders behavior for the adoption of new technologies and enterprises. At the same time, institutions that have focused primarily upon resource management must now also consider enterprise development to poverty alleviation. Supporting policies covering the whole spectrum of market interventions, input availability, produce processing, improving infrastructure, and evoking organizational change are all necessary to foster profitable production and linkages to growing markets but too often they cater to the aspirations of endowed land managers rather than the reality faced by poorer farmers daily.

The problem is not the lack of appropriate policies but rather the mechanism and capacities for implementing them. For example, there are policy frameworks within the Pilot Learning Site including the Poverty Eradication Action Plan and the Plan for Modernisation of Agriculture in Uganda and the Poverty Eradication Strategy Paper and Trade Integration Programme in Rwanda. These policies are often accompanied with structures and institutions for their implementation. In their recent review of policy research on African agriculture, Idachaba (2001) and Omamo (2003) observed that agricultural researchers and policy
analysts have failed to put Africa’s agricultural problems on the policy agenda in more than abstract fashions. Idachaba (2001) contends that policy analysis is the easier part, “the much more difficult and rather murkier part is to get the policy implemented and adopted by users; that is to get the results of policy analysis and policy recommendations into political decisions by governments”.
6. Illustrative Case Studies

6.1 Producing more food: Agricultural input supply

Technologies are ultimately expressed on farms through the availability, purchase and use of products purchased from retailers (or obtained through farmer organizations). The stockists of these products tend to specialize in agricultural and veterinary supplies although some key inputs, such as fertilizers and seeds, are also sold by other merchants just before planting seasons. Most farm inputs, especially fertilizers and pesticides, are imported to East Africa through the Port of Mombasa in Kenya and then travel along a pipeline through Nairobi and Kampala before reaching southwest Uganda, Rwanda and eastern Congo, a distance up to 1800 km. As goods travel along that pipeline, their retail sales prices increase due in part to the cost of transportation but other factors may also result in price distortion that cause too many products to be unaffordable to small-scale farmers.

Because of the importance of farm input supply to the improvement of farm enterprises, special effort was made to visit agro-veterinary merchants throughout the Lake Kivu PLS during the verification mission. Upon arrival to a market center, a team of two or three members would ask local informants where farm products are offered for sale, visit the shop, briefly explain our purpose and ask a series of questions concerning the variety and price of key farm inputs. When possible, a short open-ended discussion would follow and then the team would proceed to another input supplier until several, or in some cases all, of the merchants were interviewed.

Km 1167. Numerous shops specializing in farm inputs and veterinary products are located along Nakivubo Place and its side streets near the main (new) bus station in Kampala. These farm input shops specialize in horticultural supplies, particularly vegetable seeds and pesticides but most shops also sell fertilizers and improved food crop seeds (Photograph 3a). Some of these shops were also selling grafted fruit tree seedlings ($1.62 each) and day old layer and broiler chicks ($1.00 and $0.46, respectively). Only one shop, New SK Farm Supply, offered seeds of traditional Ugandan vegetables.

Km 1605 and 1701. Two shops were located in Kabale Uganda, Kigoro Farm Supply and Kabale Agro Input Supplies, next to each other in the main market near the bus station. The latter shop carried many more improved seed of food crops and fertilizers claiming to sell about 150 fifty-kg bags of fertilizer each month just before each growing season. Two shops were also located in Kisoro, Uganda, Farmers House and Munanza Shop, one block apart from one another along the town’s main street. The first shop specializes in fewer farm inputs, particularly vegetable seeds and pesticides but also offers some fertilizers (Photograph 3b). The second shop is a hardware store that also sells some farm products. This shop claims to sell about 100 fifty-kg bags before each growing season and a similar amount of fertilizers repackaged into smaller quantities. The owner of Munanza Shop is involved in the transport of many different trade goods into Kisoro and takes special orders for agricultural inputs delivered from Kampala.

Km 1738. Farmers’ demand for farm inputs, especially fertilizers, is much greater in Ruhengari, Rwanda than in neighboring southeastern Uganda and Goma, Congo. This town has three large fertilizer distributors across the street from its town market and numerous other smaller agro-veterinary shops. The fertilizer distributors only sell fertilizers and also deal in other bulk products such as salt. A crude estimate is that these fertilizer distributors
market 1600 fifty-kg bags of fertilizer per month at the onset of each growing season. The smaller shops repackage these fertilizers and also sell vegetable seeds, pesticides and other farm inputs. At least two of these smaller shops are operated by agricultural cooperatives and were extremely busy at the time of our visit (it was difficult to conduct a full interview). Curiously, none of these shops market improved food crop seeds, such as maize or pulses, although two merchants indicated that these seeds are often available through the nearby NAR station (ISAR). Stockists reported that their goods were obtained from both Kampala, Uganda and Kigali and truckloads of fertilizer, which enter Rwanda duty-free, were observed at the border crossing near Kisoro, Uganda.

Km 1744. Kigali is slightly outside of the Lake Kivu PLS but it serves as a source of farm inputs to much of Rwanda. Several farm supply shops were observed on the outskirts of the city along the Butare Road and in the main business district on and near Rue Eymgne. Surprisingly, these shops were not open on Saturday morning or mid-afternoon, 22 October when the team sought to obtain information from them. At first, we were informed that the fourth Saturday of every month was devoted to community cleanup, but this apparently did not deter the countless beauty shops, internet cafes and others that were open for business. Furthermore, only one of these shops, Agro-Tech was listed in the Rwandan telephone directory. Indeed, one must question how serious these business persons really are or how weak the demand for farm inputs might be!

Km 1807. Our search of a merchant specializing in farm inputs in Goma, DR Congo was only partially successful. A well known shop was evidently destroyed by the 2004 lava flow and its new location could not be discovered despite repeated inquiries. Two hardware stores that also offer a limited selection of farm supplies were eventually located on a side street in downtown Goma. Neither shop markets fertilizers nor seeds of field crops such as improved maize or pulses. The Quincacillerie Kivu store imports a wide selection of East Africa Seed Co. vegetable seed from Kampala and repackages them into 50 g as to a service to development organizations but sells very little directly to farmers (Photograph 3c). The lack of a merchant specializing in farm inputs in so large a city (>500,000 inhabitants) and servicing so large a rural area suggests that most farmers in North Kivu do not rely upon purchased inputs.

The farm input pipeline. Diammonium Phosphate (DAP) is the most widely distributed fertilizer within the Pilot Learning Center but it is not available in DR Congo (Table 7). This fertilizer contains 18% nitrogen and 20% phosphorus, the two nutrients that field observation suggests are limiting in most of the soils. The next two most available fertilizers are urea and Triple 17. Urea is a concentrated form of nitrogen (46%) compared to other nitrogen-bearing fertilizers that partially offsets the high cost of transportation. It is, however, difficult to manage because of its highly reduced form and potential volatility. The widespread availability of Triple 17 NPK fertilizers suggests that it is used on vegetable crops and potatoes that have higher potassium requirements and less extensive root systems. CAN fertilizer, that is very well suited as a top dressing of field crops with high nitrogen demands, is not offered for sale within the pilot learning site suggesting that the fertilizer management is not particularly sophisticated.

Clearly as fertilizers move down the supply pipeline, their price increases (Table 7). Note that the three fertilizers reported in both Nairobi and Ruhengeri, DAP, urea and Triple 17, increase in price by $0.13, $0.11 and $0.12 per kg respectively, or an average of $0.12. Considering the distance travelled (1254 km), this is equivalent to $0.10 per km ton. Based upon past experience, this increase in price is slightly greater than the cost charged by transporters in Nairobi ($0.06 to $0.08 per km ton) but may also reflect the recent increase in fuel prices. The prices charged in Kabale are anomalous and likely reflect weak demand and weak competition by other merchants. **Considering the paucity of agro-minerals in East
Africa, mineral fertilizers are unlikely to become produced more locally in the near future. The key to producing more food at less costs involves improving fertilizer use efficiency, and supplementing mineral fertilizers with locally-processed organic inputs.

Table 7. Availability and price of fertilizer as it moves through the supply pipeline to and within the Kivu PLS.

<table>
<thead>
<tr>
<th>location</th>
<th>distance (km)</th>
<th>fertilizers (no. sold)</th>
<th>DAP</th>
<th>CAN</th>
<th>Urea $US kg⁻¹</th>
<th>Triple 17</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi</td>
<td>484</td>
<td>5</td>
<td>0.45</td>
<td>0.37</td>
<td>0.42</td>
<td>0.45</td>
<td>SSP @ 0.36</td>
</tr>
<tr>
<td>Kampala</td>
<td>1167</td>
<td>6</td>
<td>0.52</td>
<td>0.45</td>
<td>0.52</td>
<td>0.51</td>
<td>SSP @ 0.51</td>
</tr>
<tr>
<td>Kabale</td>
<td>1605</td>
<td>3</td>
<td>0.59</td>
<td>n.a.</td>
<td>0.59</td>
<td>0.59</td>
<td>n.a.</td>
</tr>
<tr>
<td>Kisoro</td>
<td>1701</td>
<td>2</td>
<td>0.54</td>
<td>n.a.</td>
<td>n.a.</td>
<td>0.54</td>
<td>25-5-5 @ 0.54</td>
</tr>
<tr>
<td>Ruhengeri</td>
<td>1738</td>
<td>3</td>
<td>0.58</td>
<td>n.a.</td>
<td>0.53</td>
<td>0.57</td>
<td>n.a.</td>
</tr>
<tr>
<td>Goma</td>
<td>1807</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

The supply pipeline for improved seed of field crops does not extend as far as fertilizers and are less influenced by distance from suppliers. It is difficult to attribute this effect with the limited evidence collected by the Validation Team but several factors may come into play. Perhaps the seeds produced elsewhere do not perform well in the PLS. Perhaps farmers are unable or unwilling to invest in improved field crops seed. Because seeds expire, and fertilizers do not, merchants are less willing to carry them. More detailed investigation is certainly in order to better understand the price structure and diminished availability of field crop seeds because the use of hybrids and improved varieties, particularly in the more fertile soils is a means to greatly improve food production.

Considering the selection of vegetable seed, pesticides and spraying equipment throughout the retailers visited in the PLS, it appears that farm input supply is more responsive to marketable, higher value crops (Photograph 3). If this is indeed the case, then producing and fairly marketing farm surpluses of field crops, particularly potatoes, maize and beans, may serve as a stimulus for a greater variety of farm input products. The challenge remains how to break the present cycle of no investment leading to poor yield leading to low incomes and the inability to invest. How can agricultural research assist poor farmers on small farms to break this cycle?

Photograph 3. Farm inputs along the “supply pipeline”: a) well stocked agricultural input shop in Kampala, b) a hardware merchant stocked with imported vegetable seeds and some fertilizers in Kisoro and c) a paucity of farm inputs sold alongside hand tools and paints in Goma.
6.2 Improving markets: Nandos and the Nyambumba United Farmers Group

Nandos’ business activities and challenges represent those of a typical food processing outlet in the region. Being a conglomerate of multinational fast food restaurants with holdings in South Africa, Kenya, Tanzania and Zimbabwe, the firm has access to expertise and best practices in fast food business and the capacity to provide a secure source of effective demand for chicken and potato out-growers. The main problem that Nandos faces is the availability and consistent supply of good quality potato throughout the year for the restaurant in Kampala. Ideal potato for chips should have no ‘eyes’, be oval in shape and should not be less than 380 g in size. Nandos requires 15 tons of potato per month.

In response to this situation, the Nyabyumba United Farmers Group was formed in Kabale to supply potatoes to Nandos. The group has 125 members and markets 7.5 tons of potatoes in 125-kg bags to Nandos every two weeks through forward contracts for the past 27 months. Potatoes are sorted and bulked at a collection point (Photograph 4). The group appears well-organized. Farmers kept records of production and marketing activities to keep track of profitability of their investments. The groups’ market intelligence and record keeping skills enabled them to construct a benefit:cost analysis presented in Table 8. The estimated benefit to cost ratio is 1.7 implying that farmers are operating on a 70% returns on investments. If only cash costs are considered, the benefit to cost ratio increases to 2.3. The economic analysis does not consider the purchase and depreciation of knapsack sprayers and the need by some members to rent land, but it clearly indicates that room exists to improve the profitability. The farmers purchase and plant disease-free seeds (tubers) of Victoria red potato on steep slopes, applying fertilizer (about 50 kg per hectare) and dimethoate fungicide. Farmers also obtained discounts through collective purchase of these inputs with improved quality of inputs. Helping producers acquire the knowledge and means for delivering high-quality products to the market appears to be a real opportunity. This would entail promoting farmer associations, assisting them to develop their own warehouses and buy relatively inexpensive cleaning equipment, and then linking them to markets.

Photograph 4. The biweekly shipment of potatoes from the Nyabyumba United Farmers Group (7.5 t) is loaded onto a lorry for transport to Nandos restaurants in Kampala.
The group regards soil degradation and occasional drought their greatest production challenges. It seeks to develop irrigation facilities so that potato production is improved during the drier months when presently they suffer difficulties from meeting their monthly contract with Nandos. The development of irrigation within the hillside farms poses a large research and engineering challenge given the terrain and the farmers’ limited financial resources. There is however wetland in the valley bottoms and a small pump could certainly provide water to the lower slopes. Transportation costs are the highest single costs with transporters charging $0.08 per kilometre ton. The group hopes to purchase their own lorry to transport their potatoes.

Members claim that they produce beans twice a year but market their surpluses individually. Developing a system for post harvest handling, grading and marketing of beans and other pulses by small scale farmers associations poses a research challenge. The group also expressed interest in initiating and managing a revolving fund so that they would not be required to secure a bank loan before each cropping season and stated their intention to enter into value addition of potatoes by developing potato crisps. Micro-finance and value addition thus offer opportunity for developmental research which should be undertaken in a manner suited for different types of farming and socio-economic settings. Nandos also developed a working arrangement with UgChick Poultry Limited in Gayaza which supplies the 900 chickens weekly at the average price of USh 4000 per bird. Nandos requires that the chicken not exceed 1.3 kg. Efforts by Nandos to locally source cheese, ice cream and mayonnaise and sauces have not succeeded. According to Isaac Kerube, Nandos’ Production Manager, this is an area for research. Research is needed to better understand how groups of smallholder farmers can secure forward contracts from top-end buyers and then meet their quality requirements and delivery schedules.

Table 8. The costs and returns of potato production by the Nyambumba United Farmers Group near Kabale, Uganda.

<table>
<thead>
<tr>
<th>costs per bag</th>
<th>USh</th>
<th>US$</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>5000</td>
<td>2.70</td>
<td>50000 per bag</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>1800</td>
<td>0.97</td>
<td>1.5 kg @ UGSh1200 per kg</td>
</tr>
<tr>
<td>Pesticide</td>
<td>1000</td>
<td>0.54</td>
<td>Dimethoate insecticide</td>
</tr>
<tr>
<td>farm labor</td>
<td>5000</td>
<td>2.70</td>
<td>2 days @ UGSh 2500 ea</td>
</tr>
<tr>
<td><strong>Marketing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bag</td>
<td>105</td>
<td>0.06</td>
<td>UgSh 700 ea w/15% attrition</td>
</tr>
<tr>
<td>local transport</td>
<td>2000</td>
<td>1.08</td>
<td>hand carry to collection point</td>
</tr>
<tr>
<td>loading &amp; weighing</td>
<td>1100</td>
<td>0.59</td>
<td>includes unloading in Kampala</td>
</tr>
<tr>
<td>group fee</td>
<td>200</td>
<td>0.11</td>
<td>includes grading</td>
</tr>
<tr>
<td>Transport</td>
<td>8000</td>
<td>4.32</td>
<td>8 t lorry to Kampala</td>
</tr>
<tr>
<td>total cost per bag</td>
<td>24205</td>
<td>13.08</td>
<td></td>
</tr>
<tr>
<td><strong>gross return</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sales to Nandoos</td>
<td>40250</td>
<td>21.76</td>
<td>125 kg bag @ UGSh 322/kg</td>
</tr>
<tr>
<td><strong>net return</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16045</td>
<td>8.67</td>
<td></td>
</tr>
<tr>
<td><strong>benefit:cost ratio</strong></td>
<td>1.66</td>
<td>1.66</td>
<td></td>
</tr>
</tbody>
</table>
6.3 Diversifying enterprises 1: Money from honey

Beekeeping is well-known as a traditional activity within the Pilot Learning Site but less appreciated as an income generating pursuit. The market for honey exists but there is need to be a mindset change among beekeepers in the PLS. They need to see the business opportunity and need to realize that the natural resources exist to maintain at least 50000 modern beehives in the PLS. This could lead to the production of 2500 tonnes of honey and 25 tonnes of beeswax per year.

Beekeepers in Uganda and Rwanda maintain hives in the buffer zone around the national parks. Beekeeping is ideally suited as a non-intrusive agricultural activity in the buffer zone and since the bees fly up to 5 km to collect nectar, water, gum and pollen they do not need to be placed deep into the forest. The increased number of bee colonies in the forest ensures the pollination of fruit species in the forest that are eaten by other animals. The Zambian Beekeepers Association has been very successful in exporting their organic honey to Europe and they have already indicated to the Rwandan beekeeping projects in the buffer zone that they require 100 tonnes of honey per month. The beekeepers benefit tremendously from Eucalyptus that has colonized the area. The beekeepers association of Uganda are marketing Eucalyptus honey in their store in Kisoro. The beekeepers in Rwanda cannot produce enough honey for their local market.

The most common uses of hive products are the selling of liquid honey, beeswax candles and propolis mixes. However there is no knowledge of hive products for the cosmetic and leather industry, beehives use for pollination services, pollen use as protein supplement etc. Traditional beehives in Eucalyptus trees can be seen next to the roads in Rwanda. There is also an apiary site on the way to Ruhengeri where the beekeeper is using a combination of traditional as well as Langstroth hives. One of the top fruit processors in Rwanda also keeps bees and markets the honey in Kigali. His facility for the food processing could easily be used for bottling of extracted honey using modern extracting machines.
One of the successful associations is the Kisoro Beekeepers Association from Kisoro, Uganda. The Association was established in 1997 with 400 members. These numbers have grown to 565 in 2005. The initial start-up funding was around US $18000. The association is self-sustaining and employs 4 permanent staff members who have to market, manage and process the hive products that association members deliver to the processing plant. The comb pieces are processed manually into liquid honey and the beeswax cast into candles. The honey is marketed as Mghahinga Honey and sold in 500 g jars. Honey production by the group ranges between 8 to 9 tons per year which does not meet the need of their local buyers. The group sells processed honey for $1.12 per kg which is resold in supermarkets in Kampala for $2.72. The association introduced a profit sharing system when beekeepers deliver 100 kg of honey or more, however, the average income for the producers was only $7 last year. Their outlet in Kisoro also sells beeswax candles, propolis and honey vinegar. The smallest amount of honey is only 15 ml intended for sale to the poor for medicinal purposes.

Beekeepers in Uganda have lost bee colonies due to crop spraying and had to get special permission to keep their hives in the forest. However, this means that they are very far from their hives and cannot manage or inspect them easily. The extraction of honey from broken combs is difficult; the honey that is delivered is mixed with pollen and brood and sometimes not ripe which make it difficult for the processing plant to package top quality honey. The Kisoro Beekeepers Association has market linkages in place but there is opportunity to expand to the rest of the PLS and then export to Zambia, South Africa and Europe. Expansion may require mechanized facilities, use of modern hives and new management practices and development of portable hives used for pollination services.

Several important challenges exist in the facilitation of beekeeping. An effective mechanism to introduce modern hives and accompanying management practices is not well understood. Despite limited use of insecticides, beekeepers report the loss of bee swarms due to crop spraying. The processing facilities are not sufficiently hygienic and the quality of beeswax does not meet the standards required for the top-end cosmetic industry. The products require marketing research that promotes its environmentally-friendly role. Clearly, a variety of research investments are required before beekeeping can achieve its full potential within the Pilot Learning Site.
6.4 Diversifying enterprises 2: Emerging from conflict (again)

Kibumba is a small market center about 25 km north of Goma in DR Congo that is facing difficulties emerging from civil strife that has plagued the area for more than a decade. In the past, the inhabitants raised cattle and practiced small-scale agriculture on the lower foot slopes of the Virunga Mountains, specifically Mount Nyamulagira and Mikeno, on the margins of the Virunga national park. Suddenly a massive influx of refugees arrived from Rwanda in 1994 destabilizing the community by placing excessive demands upon its limited resources and services. Two years later, civil war caused most residents to flee the area leaving behind their livestock. Upon their return, they discovered the area was then occupied by foreign troops who did not protect their land rights against migrating pastoralists (from the same country). As they attempted to restock their herds and establish market farming for nearby Goma, civil war erupted again in 1998 to 2000 and since then the area may be described as insecure. The Congo has re-established control of this area by placing police and infantry along every road and patrolling the park’s forests and the community may be described as emerging from conflict once again.

The farmers are now cultivating potatoes, beans, maize and coco yams for food and market. Producing onions, carrots and other vegetable for markets in Goma is being adopted by many households (Photograph 5). The communities’ cattle herds were so depleted they are yet to recover. Two NGOs are presently assisting the community to establish market agriculture, control land degradation and restock their herds. PADA (Programme d’Appui au Développement Agricole), founded in 2001, has organized collection points for produce and provides advice to farmers. It charges each household a one-time membership fee of US $5 and annual dues of $1 for its services and claims to have almost 2000 members. It produces several different tree seedlings, eucalyptus, calliandra, casuarinas and croton for its members, claiming to have distributed over 8000 in 2005. The NGO has also organized farmers to collectively plant the seedlings through “food for work” with assistance from the World Food Programme, WWF and other international NGOs. Many other organizations have intervened in Kibumba and neighbouring communities under their emergency and humanitarian programmes for the last 5 years. Research is needed on mechanisms and processes for making a transition from emergency humanitarian operations to

Photograph 5. Onions and maize in Kibumba, DR Congo. Note the inexpert weed management (foreground) and diseased maize (right).

Photograph 6. A homemade bicycle loaded with potatoes transport 25 km to Goma.
more sustainable development interventions that empower farmers to plan and manage their own initiatives. The group’s major concerns are low prices offered by opportunistic middlemen, high cost of transport to Goma, armed robbery, and lack of improved varieties of potato. Because transporting one 100 kg bag of produce by truck costs $6, goods are often ferried on homemade bicycles (Photograph 6) directly to Goma or to Kibumba market where traders from Goma collect the goods. PADA is now helping farmers to organize collective marketing of their produce through two warehouses in Goma.

APRONA (Association pour la Protection de la Nature) is another NGO that is assisting the community to restock its goats. The activity started in 2002 with 420 goats obtained through UNDP by giving two nanny goats to each of 200 households and retaining a small nucleus herd. Each household then passed on the first two offspring to other households when they are four months old. The NGO, through its small office in Kibumba market, provides veterinary assistance, recruits new members and monitors the distribution process. This approach appears to work! The communities herd is now over 1300 strong and goats have been provided to over 600 households. One founding member household has increased its herd to 15 animals over the past three years. The members are not entirely satisfied with their accomplishments however because they prefer to raise cattle. They claim that the prices offered for goats is too low (about $20 per head) and that there is little preference or market for goat milk. One positive effect is that the goat milk is fed almost exclusively to children with members referring to it as medicine.

Numerous opportunities for research and rural enterprise development exist in Kibumba and its neighbouring communities but at some peril. The nearest government agricultural station has been abandoned due to the instability of the area. The NGOs that perform so admirably lack access to current information and lack capacity to produce extension material. Workers with PADA were not fully aware of the multiple uses of the tree species they distribute, particularly calliandra and croton as a feed for ruminants and poultry, respectively. The seedlings of both calliandra and casuarina lacked root nodules, indicating that their symbiotic capacities to fix atmospheric nitrogen are unnecessary reduced. Nitrogen deficiency is widespread, even on beans another symbiotic legume. Much of the land is rocky and their proper management difficult. Water is unavailable to the community during the dry season because its delivery system was destroyed by war and water harvesting techniques are not well understood. Several diseases were noted on maize as most farmers cultivate an unimproved land race. Poor access to improved potato seed perpetuates disease and reduces its production and market price. The production constrains in Kibumba and its neighboring communities require the attention of several agricultural disciplines and there appears to be a ready market for new ideas and technologies among the existing rural development interests.

That the residents of Kibumba and its neighboring communities are recovering is a tribute to human perseverance. They have been forced repeatedly to flee their homes and farms and returned to find them looted and destroyed. They have seen their road and water delivery infrastructure degraded by senseless warfare. They have lived under military occupation and constant threat from well armed bandits. Once civil conflict was more-or-less brought under control, nature showed its wrath in the form of volcanic activity and lava flows that covered thousands of hectares and further destroyed roads. Kibumba and many other communities in DR Congo offer opportunities for research into understanding the mechanisms for recovery and resilience of agricultural systems and livelihood strategies in armed conflict situations.
6.5 Sustaining agricultural resources: Hillside conservation

Most highlands in Eastern and Central Africa are characterized by high population densities. It is considered that early settlement of these areas was a result of the agricultural suitability of the highland environments, particularly the volcanic derived soils, and security from deadly tropical diseases, notably malaria. Forest and natural vegetation were cleared and converted to agricultural land. The earlier settlers realized the need to conserve the soil from physical degradation processes, mainly erosional, by allowing terraces to gradually develop behind grass strips, trash lines and stone barriers. This ensured continued food security. These practices were further emphasized during the colonial period during when maintenance of these structures also started demanding convincing economic arguments. As these were not forthcoming, less effort was put into the maintenance of terrace structures. Both remaining terrace benches and the new fields with depleted conservation structures developed systematic variation in crop production, giving low or no yields on their upper sections, and progressive yield increases down slope. The uneven productivity is hypothesized to be a result of (i) ergonomic tillage along the slope, but which scours the topsoil on the upper parts of the terrace with consequent deposition on the lower parts and, (ii) intensive pulverization of soils for growing of two or more crops during the year which creates suitable conditions for erosion, and (iii) lack of incentives for farmers to invest in soil fertility input and physical conservation technologies. Having been cleared of their natural vegetation, the lowlands have only limited capacity to retain deposited soils. The Validation Team observed three approaches to hillside conservation approaches: utilizing existing structures and resources into beneficial conservation structures (hedgerows and stone lines), community-based enforcement of bylaws (hill domes in Kisoro) and economic enterprise-led reduced tillage (perennial high-value crop, livestock pastures and feeds).

Hedgerows are found along the slope contour and around homes throughout Rwanda and southwest Uganda but these appear to be intended more to mark land boundaries than to contain soil erosion (Photograph 7). This conclusion is reached because 1) the contour hedgerows are spaced far apart on even the steepest slopes, 2) the contour hedges are intersected by vertical ones, 3) little or no terracing occurs between the widely spaced hedges and 4) no special conservation measures appear to be in place where severe soil erosion has resulted in rocky outcrops. Nonetheless, farmers obviously devote time and resources toward the hedges. Near homes, the hedges are mixtures of Dracaena africana and Euphorbia spp.

that are started from stem cuttings and reinforced with sticks and wire to reduce access. Nearby fields are frequently marked by hedges of Erythrina sp., a nitrogen fixing legume that may be started from cuttings or seed. Outfields are marked with mixtures of Erythrina sp., Lantana camara and other shrubs. Trimmings from the hedgerows appear to not be used as inputs to soil. This is the case even for the symbiotic legume erythrina which has stout, sharp thorns along its stems. Clearly, the development of more productive multiple use hedges is an important area for research. Furthermore, the paucity of fodder species, such as Pennisetum atropurpureum (napier grass) or Calliandra calothyrsus (a fodder legume)
within these hedges may be limiting the development of confined livestock enterprise.

Farmers who cultivate extremely steep slopes are faced with a dilemma because their options for land conservation are limited and they must always conduct their field operations from the bottom to the top, unlike moderate slopes where it is more feasible to work along the soil contour. The options for conservation are limited because structures intended to protect the soil, such as contour bunds or bench terraces are difficult to construct and risk being undermined from below. One consequence of these limitations in rocky soils is the development of vertical stone lines (Photograph 8). Basically, as farmers digging upslope encounter rocks, they place them either to the left or right. As more rocks are encountered, they are placed next to or on top of the others causing lines, and in the rockiest locations, walls to form that run vertically from the top to the bottom of the field. These vertical stone lines defy the basic convention of soil conservation, to place physical obstructions along the slope contour to check the momentum of runoff and the soils it carries. Proponents of this traditional practice argue that the rock lines nonetheless cover and protect a large proportion of soil and the risks of rocks becoming loose and dangerously rolling downhill are less. Nonetheless, massive amounts of soil are eroding and the traditional practice of vertical rock lines is doing very little to reduce loss. The practice of vertical stone line formation requires more detailed study as does the opportunity to convert them into contour walls for bench terracing. The development of these walls will require arduous labor but if properly constructed will become a permanent feature of the landscape and better protect soils for future generations. Furthermore, water harvesting and irrigation will become feasible on the terraces.

One traditional conservation measure, natural fallows, is now seldom practiced due to scarcity of land. Land is continually tilled and planted to the traditional annual crops, sometimes supporting up to three crops a year where climate is favourable. Such tillage practices often leave soils exposed, pulverised and vulnerable to erosion during periods before crop canopy is developed enough to provide cover. When the land is exhausted, it is abandoned, sometimes also referred to as falling. Jonathan Bakama of Hamurwa in Kabale District acquired such exhausted land. In order to control large volumes of runoff water that was passing through his land, he constructed vertical water channels to lead the water away, reinforced with elephant grass to minimise widening of the channel. That was until he learnt from an extension agent, that contour-based water trap benches can better control runoff, store more moisture and, when reinforced with livestock fodder crops, enable him diversify into the livestock farming. Mr. Bakama is now operating semi-confined goat and diary units. The livestock manure is used to rehabilitate the grass cover and in the establishment of fruit crops. This is one successful example of the integrating livestock, crop and natural resource system concept. The practice of integrated production systems requires more research, information and policy support to attract consolidation of land management activities at community level to achieve a watershed effect.
6.6 Fostering biodiversity: Hard Edge versus Buffer Zones

The wildlife and conservation authorities in Congo, Rwanda and Uganda do not generally believe in Buffer Zones surrounding national parks and other nature reserves, rather they support what is called a Hard Edge. Buffer Zones assume that inhabitants adjacent to nature reserves be granted limited rights to the periphery of natural resources in return for honouring a set of principles that are designed to protect those reserves and its biodiversity. A Hard Edge simply prohibits those inhabitants from accessing the park as a means to reduce human interference within it.

Several arguments were presented to support the Hard Edge over Buffer Zones but are Hard Edges also hard on neighbouring communities? Hard Edges permit the construction of fences designed to prevent large mammals from damaging crops and injuring people. Hard Edges prevent the spread of disease from wildlife to domestic animals and from humans to apes, especially habituated gorillas. Wildlife is less able to recognize Buffer Zones with its subtle gradients and will simply expand their feeding areas accordingly resulting in greater damage to farmers fields. Buffer Zones are very difficult to police and enforce. Buffer Zones require complex arrangements of indirect compensation while rewarding neighbours and communities honouring the Hard Edges is more straightforward.

Charles Izaara, Principal Surveyor in the Kabale District Local Government, provided an example of a successful Hard Edge established at the Mgahinga National Park. This park occupies 34 km\(^2\) of step slopes and is part of the larger Virunga Conservation Area in Uganda, Congo and Rwanda (Bygott and Hanby, 1998). Hunting is banned within the conservation area and crop damage by wildlife created tension between the park authorities and neighbouring inhabitants. In response, a fence one meter tall and nine km long was built of stone along the park boundary that was designated a “buffalo fence” because it was considered strong and tall enough to contain buffalos and forest elephants. To compensate neighbouring households for their denial of forest resources, 20% of park revenues are provided to them either as services to the community (schools, running water, medical clinics) or through their preferred hiring as labourers in projects within the park.

Neighbouring inhabitants are also permitted entry into the park to collect honey, traditional medicines and planting material, such as bamboo rhizomes. This arrangement appears to be working well although smaller wildlife, especially baboons, cross the fence and continue to damage croplands and there is little evidence of emerging small-scale eco-tourism enterprise adjacent to the park. One park ranger (Photograph 9) commented that the buffalo wall has accumulated sediments in places and its height has decreased but we were unable to document these areas.

One group that has not been treated particularly well in the process of protecting the park is the Batwa, pygmies that are believed to be the first inhabitants of the area. For millennia, they lived as hunters and gatherers in the forest leaving little mark upon it (Bygott and Hanby, 1998). Bantu tribes arrived about 2000 years ago and cleared most of the land for cultivation but the Batwa remained in the diminishing forest until they were eventually evicted from the park during the 1990s. The Batwa were provided small parcels of land outside the park but they have little experience in agriculture and mostly work as low paid laborers. An opportunity exists to study the process through which evicted forest inhabitants can better adjust to their changing circumstances, become effective land managers and develop more secure livelihood strategies.

A different approach is under development at the nearby Bwindi National Park that contains the “Impenetrable Forest”. The park occupies 331 km\(^2\) of hilly montane forest and has been designated a World Heritage Site by UNESCO because of its tremendous plant and animal biodiversity. Neighbouring inhabitants are offered preferred hiring, revenue sharing
and animal control programs but are generally denied access to forest resources within the park. In response to severe damage to cropland by wildlife, a 350 m “Buffer Zone” was recently gazetted from private land along 12 km of park boundary from neighboring farms, an area of 450 ha (or 1000 acres). This action affected 491 households that were paid Uganda Shillings 750 million (about $417,000) to relocate. The intention was to reduce the damage to cropland by establishing an area of preferred grazing of secondary vegetation but this was unsuccessful as wildlife appeared to immediately enter newly adjacent farms as well. A new approach is being considered within the buffer strip, planting a band 150 m wide (or 180 ha) in tea so that wildlife can clearly distinguish this “Buffer Zone” but this initiative is proving difficult to sell to conservation agencies for funding. Also being considered were artemesia and Aloe vera.

The Virunga National Park in DR Congo also practices a mixture of hard edge and buffer zone strategies. Under law, no one is to enter the park without a permit issued by its authorities, however, during the wars in Rwanda and Congo land invasions occurred. The park is now evicting these farmers and providing them with new land to the west of Lake Edward. To reinforce park boundaries among local communities, the park built a 20 km “buffalo fence” to contain larger wildlife (FZS, 2004). This effort involves 28 neighboring land manager associations and employed 1278 members. In addition, several buffer zones were established from lands where invaders were evicted. These range in width from 500 to 4000 m and neighbouring inhabitants are permitted to gather dead fall fuel wood and other non-timber products. The opportunity to develop market-oriented farm enterprises that deter wildlife is a unique area for research and, given the size of the park, a key entry point for development. The possibility of establishing epiphytic gardens featuring plant biodiversity otherwise inaccessible to even the most adventurous park visitors as community-based tourist attractions was also raised.

This response by the Governments of Uganda and Congo suggests that our Buffer Zone hypotheses and research questions may be naive. New strategies for livelihood depend upon sufficient numbers of tourists visiting the area to support neighbouring residents through employment and small business opportunities related to environmental protection and awareness. Even when this occurs, the returns from agriculture are not greatly affected unless a substantially greater demand for higher value and specialty crops also results. Clearly, the Government of Uganda has not yet ascribed to the concept of Buffer Zones in their fullest sense but that, given soft footprints, authorities are willing to permit residents to collect non-timber forest products and to compensate them for their cooperation. The processes of softening the Hard Edge policies imposed by conservation authorities upon neighboring inhabitants and modifying cropping systems so that they are less attractive to wildlife deserve greater study so that site specific factors are better taken into account and corrective adjustments made when either the park’s natural resources or its neighbors’ livelihoods become threatened.
6.7 Strengthening institutions: Private sector dynamics in Eastern Congo

The Democratic Republic of Congo has experienced several armed conflicts, civil unrest and wars in the recent decades which have resulted in the collapse of public sector, particularly in agriculture. The private business sector, which was one of the key pillars of agricultural development and export marketing, has equally been dramatically affected. Many plantations were abandoned, several factories and processing industries have closed (Table 9, top) and several businesses were destroyed. From 1992 to 1998, livestock were greatly reduced (Table 9, bottom) to forced migration of farm households and looting by several armies that operated within the area.

The challenge is how to rebuild these factories which were providing outlets and markets for small scale farmers and how to restock the herds of households reliant upon animal enterprises.

Policy incentives for developing small scale and low cost cottage industries and agro-processing factories will add value to farm produce and animal products, and improve their marketing. Research results and lessons in other countries, particularly Uganda and Rwanda, will be necessary to guide policies, strategies and investment decisions for facilitating rapid recovery and resilience of agricultural systems during armed conflicts.

Despite the gloomy statistics, some private businesses are thriving. In the Lake Kivu Pilot Learning Site, the private sector is investing in both food crops such as oil crops, tuber crops, cereals, pulses, and industrial crops namely tea, Cinchona sp., Prunus Africana, sugar cane, papaya and coffee. For example, Domaine de Katale based in Rutshuru has its own aeroplanes for transporting agricultural goods to Kinshasa and other major cities in DR Congo. The majority of livestock in North Kivu is owned by the private sector. With prospects of reunification and peace in the eastern part of DRC, there are now several airlines and air freight companies that transport food products (beans, potatoes, vegetables and livestock products, and fish) daily for marketing to Kinshasa and other major cities in DRC.

One such company is Pharmacina. Its main activities are based on management of Cinchona plantations and processing for the production of quinine, and supply of the raw material needed for anti-malarial medication. Pharmacina plantations and suppliers is located in the Kivu Pilot Learning Site where about 80% of the world cinchona trees grow. In addition to owning and exploiting its own plantations (3090 ha), Pharmacina also organizes an out-grower scheme of farmers associations and cooperatives, and individual producers of cinchona (Figure 8) which operate over 3000 ha. Dried bark is purchased for

Table 9. The decline in agro-processing (top) and farm animals (below) resulting from civil unrest in Eastern Congo.

<table>
<thead>
<tr>
<th></th>
<th>before 1996</th>
<th>after 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rice</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>oil palm</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>cotton</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>sugarcane</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>quinine</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>coffee</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>tea</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farm animal</th>
<th>1992</th>
<th>1998</th>
<th>change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>295150</td>
<td>39821</td>
<td>-87%</td>
</tr>
<tr>
<td>goats</td>
<td>37200</td>
<td>27440</td>
<td>-26%</td>
</tr>
<tr>
<td>sheep</td>
<td>108006</td>
<td>45451</td>
<td>-58%</td>
</tr>
<tr>
<td>pork</td>
<td>121500</td>
<td>34167</td>
<td>-72%</td>
</tr>
<tr>
<td>poultry</td>
<td>2567000</td>
<td>1208173</td>
<td>-53%</td>
</tr>
</tbody>
</table>

Sources. Provincial Division of Agriculture, South Kivu (top) and Service National des Statistiques Agricoles, Goma, North Kivu (below).

55
US $1.00 to $1.20 per kg and about 1700 t of cinchona bark is purchased and processed by Pharmakina each year.

There are significant challenges for small scale farmers to organize themselves into more powerful cooperatives to collective access services provided by Pharmakina, and produce barks with high standards, and therefore obtain better price for the producer. Organizing farmers into effective cooperatives and increase their technical and business skills remain a challenge that Research and Development organizations can address. Often individual farmers are not able to access credits and expand their production.

The banking system in DRC has collapsed and there are no mechanisms for accessing credits to invest in agriculture. At the same time, there are now a number of emerging savings and credit associations and cooperatives that finance non farm business. Developing financial institutions that support agricultural development is a key challenge to help individual producers to expand their production capacities.

Pharmakina has diversified its activities and is also moving into food crops. This is still preliminary, and working through associations and groups of former plantation workers. However, they lack improved materials and farming technologies to produce high quality products that can be sold in urban markets. Pharmakina is now collaborating with INERA (Institut National d’Etudes et Recherches Agronomiques) to produce, multiply and disseminate certified seeds of key commodities such as rice, maize, cassava and grain legumes. INERA is also using Pharmakina Laboratory facilities for quality assurance, and laboratory analysis of various research protocols. INERA has also helped Pharmakina on soil and plant analysis. Laboratory facilities at Pharmakina are cutting edge technologies and can help public research institutions and universities to do their analysis. **There are opportunities for the private sector to take on some roles and provide research services to the public sector. The challenge is to develop effective mechanisms based on business principles for close partnerships between public research institutions and private business sector.**

![Suppliers and areas of Cinchona bark in Nort Kavu, DR Congo.](image)
7. Entry Points for Research and Enterprise Development

Entry points for research are essential things that must be learned for science to fully contribute to interventions intended to improve the lives of rural stakeholders within the pilot learning site. They are specific and relate to research hypotheses and questions. They should be understandable in terms of what investigations are required. Although they are presented separately, they need to be integrated to achieve desired outcomes.

7.1 Technological innovations for producing more food

The low yields of food crops and livestock within the pilot learning site are largely the result of the reduced yield potential of unimproved landraces confounded by diminishing soil fertility and uncontrolled pests and diseases. The Farm Input Supply case study (Section 6.2) concluded that few farmers plant improved, disease-resistant crop varieties or apply fertilizers and pesticides except for farmers who are required to meet industry standards and are well connected to markets (see Section 6.5). Similar accounts were given regarding supplementary feeding and disease control in livestock. Clearly, increased use of purchased key farm inputs is an important step to increasing food crop yield. In many settings, both the availability of those inputs and the capacity for farmers’ investment must be expanded. It is, however, the several crop and livestock disorders resulting from pests and diseases, that the stakeholders considered most limiting in production, for which research was considered very important. Farmers, agricultural officers and processors in the PLS expressed concern over uncontrolled banana wilt, late blight of potatoes, bean root rot and stem maggot, passion fruit woodiness and rust on wheat. Livestock production is plagued by such diseases as East Coast Fever, mastitis, and contagious pleuro-pneumonia. The VT proposes “iterative problem-solving through adaptive on-farm research” on better management of existing crops which involves adjusting plant populations, planting arrangements, legume rotations, relay intercrops, IPM, crop-livestock interactions and other well-established agricultural principles that are lacking among the farms within the Pilot Learning Site. It is these sort of studies that will lead to the initial benefits the project brings to farmers. Furthermore, adaptive on-farm research is also cutting edge. The process of empowering small-scale farmers to better understand and respond to emerging constraints is not well understood and is an essential part of the new paradigm described within the FARA proposal (Section 1.3).

On the long-term perspective, competitive productivity can best be achieved through genetic breeding for control of pest and disease disorders as well as better agronomic traits like early maturity. The Validation Team recommends that biotechnology aided research is an appropriate entry point for producing more food if it is employed to supplement other research and management approaches in producing clean planting materials, engineering disease resistant materials, shortening breeding cycles and in the biological control of livestock diseases, among its other applications.

7.2 Hillside and wetland husbandry

Soil erosion is widely perceived to be a major problem in the Lake Kivu Pilot Learning Site and nearly all the stakeholders visited highlighted erosion as the major cause of land degradation and a major development challenge. There is some evidence of successful implementation of soil and water conservation measures in the area, but that of failure in a wide range of settings is quite prominent. The first question would be to ask why this is so. Evidence of land husbandry success from Machakos in Kenya, also with a high population.
density and land scarcity, suggests that improved access to the growing market of Nairobi and to information through informal networks and formal extension service encouraged farmers to invest in agricultural transformation and consequently try out a range of land conservation measures (Tiffen et al, 1994). Two approaches to hillside conservation in the PLS are proposed. The first is to present opportunities to farmers for transiting from annual crops to perennial high value crop enterprises that could allow construction of short terraces on the steep and sometimes stony hillsides, minimize tillage and offer greater protection through canopy cover. Some crops like macadamia and apples (already introduced in some areas) are proposed in Table 4 with potential areas of research support needed for their introduction. The second approach is to transform the numerous hedges used as boundary delineations or as bund support into low-cost but multi-purpose vegetation barriers that add value to the soil e.g. through biological nitrogen fixation, and have potential to be livestock fodder in crop/livestock integration systems. We recognize that research is needed to establish the local environmental conditions and economic factors so that these are not construed as being prescriptions. This entry point is based on the concept that it is only high value enterprises on fragile lands that may lead to construction of expensive conservation structures.

The functions of wetlands are varied and include water storage, nutrient cycling, particulate removal, maintenance of plant and animal communities, water filtration and groundwater recharge. They reduce damage from flooding, improve water quality and enhance habitat for fish and wildlife. Policies of the countries hosting the PLS recognize the importance of conserving the ecological integrity of the wetlands but in the face of serious demographic pressure. Maintaining these functions and values presents a challenge for science to derive strategies for incorporating wetlands management in farming, grazing and fishing that must also serve to conserve the ecosystem, biodiversity and sustainable productivity. We propose this entry point based on the principal that in areas where demographic pressure is such that wetlands have to be utilized, it is essential that research generates sufficient information and management technologies for their utilization only up to their ecological resilience levels. It is considered that IAR4D operating at watershed level represents an important opportunity for addressing issues in innovative ways by expanding the range of social and environmental benefits from isolated interventions.

7.3 Viable buffer zones

Buffer zone and park management is one area where the three countries hosting the pilot learning site appear to be working very closely. The intention is to reduce the damage to cropland by wildlife and also allow inhabitants adjacent to nature reserves limited rights to the periphery of natural resources in return for honouring principles that are designed to protect those reserves and biodiversity therein. A mixture of “hard edge” , “buffer strip” and “buffer zone” approaches are presently in play around the different nature reserves in the area. The number of tourists visiting the area to support neighbouring residents through employment and small business opportunities related to environmental protection and awareness is not yet sufficient. A unique area for research around park edges is to develop market-oriented farm enterprises that deter wildlife while securing improved livelihoods for the communities around the parks. An example is the domestication and commercialisation of beneficial insect, plant and fungal species to decrease the effect misuse on biodiversity and increase the income of people living around protected areas. The process of domestication is largely a research issue that involves several scientific disciplines. A further area of policy
and social research is to develop mechanisms for adaptive management and alternative conflict management systems

7.4 Diversifying Agro-enterprises and expanding markets for wealth creation

The small landholdings in the PLS limit farm level capacity to produce large volumes of staple crops such as maize, banana and cassava which have domestic and regional markets. At the same time, the highland agro-ecology places farmers in the PLS at an advantage in intensifying production and diversifying into newer, high value products that have growing domestic, urban and international markets (Table 3). The VT recommends action research to identify market opportunities and demand for different products and to determine what strategies will benefit different categories of farmers.

Market and value chain analyses are required to clearly delineate markets and demand for existing and new products, and to develop strategies for promoting efficient market institutional innovations that are needed to support the transition from semi-subsistence production to product development and diversification into higher value agricultural products and markets. These include evaluating different models of producers' and entrepreneur organization, microfinance, market information systems, business development services, input marketing, extension advice, rural infrastructure and policy options that will support the development of sustainable and integrated agroenterprises. This entry point will integrate a number of research hypotheses, namely the Market Access, Friendly Farm, and the Buffer Advantage Hypotheses.

7.5. Building Knowledge Societies

Action research on mechanisms and processes for institutionalizing IAR4D, facilitating organizational innovation and mobilizing multi-stakeholder learning teams will be an important component of the SSA CP. While farmers' organizations are increasingly becoming an important stakeholder group in agricultural research and development, there is limited systematic research into their dynamics, composition, performance and effectiveness. Yet, such analysis is critical to building more effective ways of organizing and working with farmers' groups, building their capacity to innovate, experiment and scale up successful agroenterprises. Empowering farmers' organizations is an essential feature of any programme that addresses poverty, marketing and NRM issues. One key hypothesis guiding IAR4D is that investments in strengthening social capital and farmers' organizations will lead to pro-poor sustainable market institutional innovations and improvement in natural resources. This entry point provides numerous opportunities for testing four related hypotheses: the Farmer Association, Community Leverage, Market Access, and Partnership Synergy Hypothesis. This entry point is based on the premise that the success of research and agroenterprise development efforts will be highly dependent on the development and strengthening of quality partnerships with research, development organizations, farmers' associations, market chain actors, private business sector, and government agencies.

Strengthening partnerships requires increased capacity for information and knowledge sharing amongst different stakeholder groups. It is recommended that compilation and synthesis of available information would form the background for identifying gaps in the characterisation of the Pilot Learning Site required for determining the development domains for technologies and products. It is expected that research teams other knowledge disseminators will clearly outline their communication strategy that allow to translate
complex research findings into simple tools and products that can improve stakeholders' decision-making, and scaling within and outside the PLS.

7.6 Tailoring Policies

Idachaba (2001) observed that policy analysis is the easier part, “the much more difficult and rather murkier part is to get the policy implemented and adopted by users” Indeed, there are several policy frameworks, institutions and structures that have been developed and are implemented with varying degrees of success in the PLS. The most contentious is that of consolidation of land and farm operations into more productive units. The VT recommends action research into policy recommendations with support mechanisms, capacities, and tools for their implementation. This entry point addresses the Community Leverage hypothesis and requires policy action research to analyse policy constraints and incentives for uptake and scaling up of different policies and community byelaws within and outside the PLS.
8. Refined Hypotheses and Research Questions

8.1 The Farmer Association Hypothesis.

The original hypothesis states that ‘Strong producer organizations have increased bargaining power and ability to collectively market produce and thus increase returns (income) to land and labor’. This hypothesis was revised slightly into:

**H1: Farmer Association Hypothesis.** Stronger farmer associations have increased bargaining power and the ability to influence markets and thus increase members’ returns to investment, land and labor.

**Related working hypotheses**

H1.1 **Groups in transition hypothesis.** Local self-help groups that form to better access information and new farming technologies are too small to conduct marketing operations and must amalgamate with other similar organizations to achieve sufficient economy of scale.

H1.2 **Risk of capture hypothesis.** The greatest threat to the growth of farmer associations in the process of expanding their services to members is “capture by member elites” but clear understanding of members’ rights, transparent business operations and regular change in elected officers can overcome this threat.

H1.3 **Inner strength hypothesis.** Farmer associations that are formed by outside influences are less resilient than those resulting from spontaneous common needs.

H1.4 **Association focus hypothesis.** The limited resources of agricultural extension are best focused upon farmer associations rather than the general farming population because the farming associations can offer coordination services and greater peer support.

**Related research questions**

1. Are smallholder farm organizations well positioned to serve not only as distributors of information to members, but also as the focus for the intersection of new technologies and expanded market opportunities?
2. What is the size required for an association of smallholder farmers to operate in a self-sufficient manner while providing a full range of agricultural services, which services should be offered and what, and how, should those members be charged for those services?
3. How may empowering farmer associations best be incorporated into the adaptive research process?
4. What is the role of smallholder farmer associations in expanding input use by their members, which types of inputs are best traded through these organizations and how much savings may be passed to members who purchase these materials?
5. What conditions and facilitation processes are required to enhance community based enterprises?
8.2 and 8.3 The Market Access and Friendly Farm Hypotheses

The original hypothesis states that “Investments to sustain and maintain the natural resource base are more sustainable when they are linked to market-oriented production or when there are financial incentives for conserving natural resources and biodiversity.”

This hypothesis was separated into two hypotheses relating to market access and resource conservation because the original hypothesis was considered too vague. The following two hypotheses are sufficiently specific to serve as working hypotheses as well.

**H2: Market access hypothesis.** Improved access to markets by smallholder farmers accelerates incentives for adoption of improved technologies and investments in natural resource management.

**Related research questions**

1. Which new farm enterprises and markets permit farmers to improve their livelihood without depleting natural resources?
2. Which combination of farm enterprises and value-added activities allow food insecure households to escape poverty and enter new markets and how much land is required for them to do so?
3. Under what conditions does market orientation lead to increased investment in NRM?

**H3: Farm investment hypothesis.** Greater reliance upon purchased inputs and new farm enterprises by smallholder farmers reduce the rate of resource depletion resulting from their farming operations which in turn protects the natural environment and fosters biodiversity.

Related working hypothesis:

**H3.1. The Best Field Fix Hypothesis.** Productivity and profitability of crop and livestock enterprises can be rapidly improved through a combination of adaptive, iterative problem solving research and biotechnology applied to new problems.
Related research question

1. Do more diverse farm enterprises enhance farm biodiversity and ease pressure upon nature flora and fauna and if so which enterprises foster biodiversity most?

8.4 The Buffer Advantage Hypothesis

The original hypothesis states that “Increased livelihood options linked to markets including joint management for buffer zone inhabitants will decrease pressure on conservation areas and biodiversity and increase returns to land and labor.” This hypothesis does not take into account that granting greater access into national parks or surrounding buffer zones may compromise the natural environment, an opinion was voiced by numerous park authorities and conservationists, that serves as the basis of the Hard Edge policies presently in effect. The hypothesis was revised to state:

H4: The buffer advantage hypothesis. Access to buffer zones separating natural and agricultural landscapes by neighboring inhabitants permits participation in specialized enterprises that compliment farming without compromising the adjacent natural reserve.

Related working hypotheses

H4.1 Soft footprint hypothesis. Removing deadfall and non-timber forest products has no significant effect upon the forest biomass and biodiversity but removing live branches changes forest composition by providing greater opportunities to secondary and exotic species.

H4.2 Fencing hypothesis. Fencing boundaries between farms and adjacent natural reserves is feasible only when large mammals, such as elephants, buffalos and hippos, regularly destroy crops but is much more expensive and less effective than precautionary culling of rogue animals.

H4.3 Transitional livelihood hypothesis. The transition from liability to protector of adjacent natural reserves requires that buffer zone inhabitants receive specialized training, short-term financial incentives and longer-term market and policy support and, if any of these components are lacking then the household resumes practices that compromise the adjacent conservation areas.

H4.4 Hard edge hypothesis. Permitting access and limited use of forest resources within conservation areas to neighboring inhabitants compromises the integrity of the natural ecosystem and its biodiversity, is too difficult to supervise and results in overly distorted indirect compensation.

Related research questions

1. What is the potential of eco-tourism within the Kivu PLS to support alternative livelihood activities within buffer zones, what are those livelihood options and how many eco-tourists are required to support one household engaged in those activities?
2. What set of principles are required among buffer zone inhabitants to protect the adjacent natural ecosystem, how shall they be rewarded for upholding those principles and to how wide an area surrounding the nature reserve should those principles apply?
3. What penalties should be imposed upon those who violate buffer zone principles and how shall they be enforced?

8.5 The Partnership Synergy Hypothesis.

The original hypothesis states that “Investment in partnership arrangements that integrate research and development expertise and perspectives will achieve greater impact through scaling out islands of success”. Concerns were raised over this hypothesis because the form of investment is vague and it is somewhat tautological (e.g. stronger partners achieving greater impacts). Also, the phrase “scaling out islands of success” was challenged because it does not recognize niche advantage. Nonetheless, the importance of the hypothesis in institutional building and its relationship to expanding relevant expertise was recognized and a radically improved restatement was not developed. The hypothesis was therefore slightly modified to state that:

**H5: Partnership Synergy Hypothesis.** Investment in partnership arrangements that integrate research and development expertise and perspectives assists partners to better understand, initiate and replicate local “success stories”.

**Related research questions**

1. What partnerships are required to support transitions to market oriented agriculture and research?
2. To what extent do “islands of success” represent specialized niches offering agro-ecological, socio-economic advantages and how do these conditions and information about them influence the ability to expand or replicate their success?
3. What is the cost and benefit of different partnership arrangements?
4. What approaches are more effective in forging public-private partnerships?

8.6 The Armed with Knowledge Hypothesis

The original hypothesis states that “Innovative information organization and sharing systems will enhance uptake of technologies and improve decision making”. While this hypothesis appears concise in targeting uptake and decision making, the phrase “innovative information organization and sharing systems” appears awkward (at least for those not well versed in information systems). Furthermore, it seems to embrace innovation for its own sake rather than the content of the information and its understanding by various stakeholders. The hypothesis was therefore restated as:

**H6: Armed with knowledge hypothesis.** More responsive and interactive information sharing is required to facilitate awareness and adoption of useful agricultural and NRM technologies but this information often requires processing before it is useful for decision making.

**Related working hypotheses**
H6.1 **Tools not talk hypothesis.** Technical information alone is unable to effect change in farming practices and agribusiness opportunities but must be accompanied by the necessary tools and products that capture and operationalize that information.

H6.2 **Problem-solving hypothesis.** Agricultural technologies designed along strict ideological principles achieve less impact, despite their informational advantages, than those resulting from iterative, pragmatic problem-solving but documenting and replicating that success is more difficult.

H6.3 **Keep it simple hypothesis.** Greater impacts are achieved at the grassroots level from translating simplified information into local languages than providing complex information in less understood languages.

H6.4 **The information pathway hypothesis.** More complex technical information is best distributed through electronic format, simplified information is best published in newspaper or aired through broadcast media and simple extension messages are best distributed as written materials.

**Related research questions**

1. What forms of information that accompany pioneering agricultural technologies and new products are required and how are they best distributed?
2. How can farmer information become transformed to make it more understandable to agricultural specialists engaged in problem solving and, just as importantly, *vice versa*?
3. How can environmentally and socially responsible actions, such as reforestation, soil conservation and watershed quality protection, be better explained to local communities and reconciled with their routine land management operations and household activities?

**8.7. The Community Leverage Hypothesis**

The original hypothesis states that “*Strengthened local governance through improved community facilitation improves ability to influence development policy and advocate for support to local marketing and natural resource management initiatives*”. This appears to be a “feel good” hypothesis stating that if outside influences form or reinforce community groups, then local government will become more responsive to farmers’ and conservations’ needs. Everyone asked agrees that this is a valid hypothesis and indeed hopes that this is the case, but some questioned whether it is too passive from the community mobilization perspective as credit for change appears to be awarded to the facilitators rather than the community itself. The hypothesis could be restated in a manner that calls attention to community collective action as:

**H7: Community Leverage Hypothesis. Stakeholder empowerment and its resulting collective action encourage local government to develop more responsive policies toward agribusiness, land tenure and natural resource management.**

The original and restated hypotheses, and their related working hypotheses and research questions prompted lively debate among team members, some of whom asserted that a topic alluding to perennial poor governance is outside of the Validation Team’s mandate. Others responded that our focus upon “business unusual” and the ongoing spirit of community reconciliation permit such speculation. Keeping in mind that the team lacks politicians, we offer the following working hypotheses and related research questions.
Related working hypotheses

H7.1 **Business unusual hypothesis.** Community groups forming with set agendas are less able to positively influence local government than are those arising from and operating within flexible economic and social goals.

Related research question

1. What mechanisms of stakeholder empowerment best lead to collective actions that result in more responsive and transparent local governance?

2. How do land tenure and other agricultural policies impact smaller and weaker communities, to what extent does these lead to conflicts and what alternative collective actions permit these communities to receive fairer treatment?

9. Assembling Research Teams

The VT proposes a vertical integration within each experimental site, and horizontal partnerships across countries. Within each country, the major institutions and individual stakeholders along the resource-to-consumption and policy continuum should be identified and encouraged to participate in research for development teams. These should include national agricultural research institutes, government extension services, non-governmental organizations, civil society organizations, farmers organizations, traders, transporters, processors, exporters, private business sector, government departments, and international research centres. Across countries, partnerships between teams and institutions should be established. For example, agricultural universities in Uganda could form interdisciplinary teams with other Universities in DR Congo or Rwanda to address common problems or different complementary aspects of the same problem in order to increase synergies following the principles of IAR4D. Involving young scientists and professionals and building their capacity should be an important consideration in forming teams. The SSA CP and lead institution should provide support for forming horizontal teams, team building and planning research agenda with the full participation of key stakeholders.

The Pilot Learning Teams should identify and select research themes and specific locations for conducting research in an integrated holistic system approach, based on biophysical and socioeconomic characteristics. It will be important to start with locations where teams can build on, add value to, and take advantage of existing institutions and capacities (human, material, and social) in order to achieve and demonstrate impacts. The potential for scaling out/up within the pilot learning site and beyond should be one of the important criteria for site selection. This should not however exclude “niche” advantage for some site specific opportunities.
10. The Result Framework for Research Impacts

The long-term vision of the Kivu Pilot Learning Site is to contribute to poverty elimination in Sub-Saharan Africa. This vision corresponds to the Millennium Development Goals of reducing poverty and hunger, to which both FARA, ASARECA, the SSA CP, the CGIAR Centres and the three countries are fully committed. The long term impact of the Lake Kivu Pilot Learning Site is to improve food security, income, livelihoods and environmental sustainability in the Lake Kivu Pilot Learning Site. The VT suggests four outcomes that must be combined together to generate impacts. These are:

1. Increased utilization of demand driven technologies to improve agricultural productivity and conserve natural resources;
2. Diversified enterprise options and improved market access;
3. Enhanced organizational capacity of stakeholders for impact oriented research, and
4. Enhanced decision-making capacity of different stakeholders to influence policy formulation and implementation.

Although these outcomes are shown separately for easy of presentation, it is important to understand that these outcomes must be integrated and combined together to generate impacts. Research proposals and pilot learning teams must clearly show how they can produce research outputs and conduct innovative research and development activities to generate these development outcomes.
Table 9 below proposes some outputs that must be combined together to generate the four outcomes. The set of activities needed to deliver these outputs are shown in Table 10.

Table 9: The Result Framework for achieving Research Impacts

<table>
<thead>
<tr>
<th>Outputs that must be combined together to produce outcomes (2-3 years)</th>
<th>Outcomes that must be combined together to generate impacts (3-5 years)</th>
<th>Impacts that must be achieved to reach the long-term impact (5-10 years)</th>
<th>Long term Impact (15 years)</th>
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<tr>
<td>1.1. Technological innovations for increasing productivity and competitiveness of crop and livestock systems developed, tested and adopted by farmers.</td>
<td>1. Increased utilization of demand driven technologies to improve agricultural productivity and conserve natural resources.</td>
<td>Improve food security, income, environmental sustainability and livelihoods of small holder farmers in the LK PLS.</td>
<td>Contributing to poverty elimination in Sub-Saharan Africa.</td>
</tr>
<tr>
<td>1.2. Integrated natural resource management strategies and innovations developed and implemented.</td>
<td>2. Diversified enterprise options and improved market access.</td>
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<tr>
<td>1.3. Technologies for intensifying integrated crop-livestock systems tested and adapted by farmers.</td>
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<td>2.1. Increased capacities of farmers’ organizations and entrepreneurs to access better market opportunities.</td>
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<tr>
<td>2.2. Technologies for value addition and diversification of agricultural products developed and promoted.</td>
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<tr>
<td>2.3. Strategies and approaches for market access for staples and high value products.</td>
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<tr>
<td>3.1. Methodologies and approaches for institutionalizing market responsive And client oriented research promoted.</td>
<td>3. Organizational capacity of stakeholders for impact oriented research enhanced.</td>
<td></td>
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<tr>
<td>3.2. Methodologies and materials for building capacity of Pilot Learning Teams in impact oriented research developed and utilized by stakeholder groups.</td>
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<tr>
<td>3.4. Tools and products for management and sharing of knowledge and information to improve decision making enhanced.</td>
<td>4. Decision-making capacity for agricultural policy analysis, formulation and implementation enhanced.</td>
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<tr>
<td>4.1. Increased capacity for analysis formulation and implementation of enabling agricultural and trade policies.</td>
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<td></td>
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<tr>
<td>4.2. Platforms and mechanisms for policy advocacy and dialogue established.</td>
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11. Way forward

The Validation Team presents some observations that were made by the stakeholders during consultations with the Validation Team, which we recommend should be considered by management of the Lake Kivu Pilot Learning Site. First, we support the proposal from the Stakeholder Consultation in the DR Congo that the site be extended by 80 km to the south to include Masisi and northern Lake Kivu. The reasons for this proposal are given in Appendix 3. Second is the expressed need for a feedback of our validation exercise from all the
stakeholders we consulted with. We recommend that the Lead Institution devises a mechanism to ensure that stakeholders who participated in the validation exercise get feedback on the outcome. The addresses of the various stakeholders contained within this report form an entry point for initiating contacts in preparation for team formation. Lastly, we recommend that the LI should facilitate a participatory process for consolidating the proposed logical framework.
12. Acknowledgements

The Validation Team received invaluable contributions from many stakeholders at short notice. Sometimes the visits were impromptu, meeting field officers without notice and discussing with many farmers as they worked their fields. The stakeholders are listed in Appendix 2, but we may have missed listing some for which we apologise. We are most grateful for the openness with which the information we sought was given. We thank our different institutions (NARO, ISAR, TSBF, Makerere University, FORMAT and CIAT) for allowing us to conduct this mission.

We acknowledge the constructive debate with the European Union Review Mission members, and the participating organizations consequent upon our presentation of the preliminary report. It helped us better target our report towards the needs of the Challenge Programme. We express our thanks to CIAT, and especially Dr Robin Buruchara and Ms Sifah Murhonda for the excellent facilitation we were afforded in terms of transport, arranging accommodation and providing the necessary facilities as needed. This ensured no disruption as we executed our task.
13. Bibliography


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13. Appendices

Appendix 1. Validation Team composition and contact details

Dr. Mateete Bekunda (Chairman)
Professor of Soil Science and Dean, Faculty of Agriculture, Makerere University, P.O. Box 7062, Kampala, Uganda.
Tel. +256-41-542277; mob. +256-77-430752
Email: mateete@agric.mak.ac.ug

Elysee Mudwanga Bishako
Tel: +243 998623960 Email: mudwanga_elisee@yahoo.fr

Ms Elize Lundall-Magnuson
Facilitation and Mentoring Services Consortium - FARA Programme Manager – Beekeeping for Poverty Relief Agricultural Research Council, Private Bag X134, Queenswood, Pretoria, South Africa. Tel +27 12 356 9800,
Fax +27 12 329 3278, Cel: +27 82 379 1093 Email:
lundallme@arc.agric.za or magnuson@global.co.za

Dr. Kehinde Makinde
Senior Economist, Institut des Sciences Agronomique du Rwanda (ISAR), Rubona, BP 138, Butare, Rwanda. Tel :250-08563362 ; Email : komakinde@yahoo.com

Dr. Peter Okoth
Project Information Manager, Tropical Soil Biology and Fertility (TSBF) Institute of the International Centre for Tropical Agriculture, P.O. Box 30677-00100, Nairobi, Kenya. Telephone 254-20-7224775. Email: p.okoth@cgiar.org

Dr. Pascal Sanginga
Senior Research Fellow, Rural Innovation Institute of CIAT P.O. Box 6247, Kampala, Uganda. Tel: +256 (41) 567670
Tel: +256 (41) 567670 . E-mail: P.Sanginga@cgiar.org

Dr. Emily Twinamasiko
Senior Research Officer, Adaptive Research, IAR4D Co-ordinator, NARO, Box, 295, Entebbe, Tel. 256-41-320178, 256-77-488385, E-mail; etwinamasiko@naro.go.ug, Uganda

Dr. Paul L. Woomer
Technical Advisor, FORUM for Organic Resource Management and Agricultural Resources (FORMAT), P.O. Box 79, The Village Market, Nairobi, Kenya. Telephone: 254-20-7122337. Email: plwoomer@africaonline.co.ke
**Appendix 1 LIST OF KEY INFORMANTS AND CONTACTS IN THE PLS**

**DR CONGO**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Institute</th>
<th>Email</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mbakulihare Etienne</td>
<td>Coordinateur FOPAC, Federation des Organisations des Producteurs Agricoles du Congo</td>
<td><a href="mailto:fopacrdcongo@yahoo.fr">fopacrdcongo@yahoo.fr</a></td>
<td>243 998 623440</td>
</tr>
<tr>
<td>Dr. Vet. Katunga Musale</td>
<td>Coordinateur CIALCA, Consortium for Improvement of Agriculture and Livelihoods in Central Africa</td>
<td><a href="mailto:katungamusale@yahoo.fr">katungamusale@yahoo.fr</a></td>
<td>243 998 669793</td>
</tr>
<tr>
<td>Kambale Muhasa</td>
<td>Coordinateur, CEDRU, Centre pour le Developpement Rural de Rutshuru</td>
<td><a href="mailto:paulmuhasa@yahoo.fr">paulmuhasa@yahoo.fr</a></td>
<td>243 810 394282</td>
</tr>
<tr>
<td>Ir. Lunze Lubanga</td>
<td>Directeur, INERA, Institut National D'Etudes et Recherche Agronomique</td>
<td><a href="mailto:lunze@yahoo.fr">lunze@yahoo.fr</a></td>
<td>243 810 605996</td>
</tr>
<tr>
<td>Ir. Mapatano Sylvain</td>
<td>Coordonnateur DIOBASS Plateforme DIOBASS</td>
<td><a href="mailto:mapatano_s@yahoo.fr">mapatano_s@yahoo.fr</a></td>
<td>243 815 217572</td>
</tr>
<tr>
<td>Bwabwa Hakiza Maheshe</td>
<td>DIOBASS Plateforme DIOBASS, Goma</td>
<td><a href="mailto:bmbwabwa@yahoo.fr">bmbwabwa@yahoo.fr</a></td>
<td>243 997 731964</td>
</tr>
<tr>
<td>Prof. Walangululu, Masamba</td>
<td>Dean, Facultes des Sceinces Agronomiques, Universite Catholique de Bukavu</td>
<td><a href="mailto:walangululu@yahoo.fr">walangululu@yahoo.fr</a></td>
<td>243 813 176 063</td>
</tr>
<tr>
<td>Jean</td>
<td>Directeur General, Institut Superieur de Developpement Rural</td>
<td><a href="mailto:mabitijula@yahoo.fr">mabitijula@yahoo.fr</a></td>
<td>243 998 624 129</td>
</tr>
<tr>
<td>Prof. Katanga Kababi Joseph</td>
<td>Professor, Universite des Grands Lacs</td>
<td><a href="mailto:jos_kat@yahoo.fr">jos_kat@yahoo.fr</a></td>
<td>243 998 610 859</td>
</tr>
<tr>
<td>Prof. Gakuru Semalumu</td>
<td>Recteur, Universite des Grands Lacs</td>
<td><a href="mailto:gakusema@yahoo.fr">gakusema@yahoo.fr</a></td>
<td>243 998 610 122</td>
</tr>
<tr>
<td>Flori Mbolela</td>
<td>FAO</td>
<td><a href="mailto:florimbolela@yahoo.fr">florimbolela@yahoo.fr</a></td>
<td>243 819 601 122</td>
</tr>
<tr>
<td>Mbula Deo</td>
<td>Conservateur Principal, Institut Congolais pour la Conservation de la Nature, ICCN</td>
<td><a href="mailto:deombula@yahoo.fr">deombula@yahoo.fr</a></td>
<td>243 808 557191</td>
</tr>
<tr>
<td>Kajuga Binyeri</td>
<td>Directeur Provincial, Institut Congolais pour la Conservation de la Nature, ICCN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alex Dzifanu Nyarko-Badoho</td>
<td>FAO, Coordonnateur Adjoint des Operations Agricoles</td>
<td><a href="mailto:KwamiDzifanu.Nyarko@fao.org">KwamiDzifanu.Nyarko@fao.org</a></td>
<td>243 818998490</td>
</tr>
<tr>
<td>Uwingeri Prosper</td>
<td>Conservateur Adjoint, Parc National des Volcans, Office Rwandais du Tourisme et des Parcs Nationaux</td>
<td><a href="mailto:uprolic@yahoo.fr">uprolic@yahoo.fr</a></td>
<td>250 08535949</td>
</tr>
<tr>
<td>Kwizera Janvier</td>
<td>Community Conservation Warden</td>
<td><a href="mailto:jankinzl@yahoo.fr">jankinzl@yahoo.fr</a></td>
<td>250 088 37389</td>
</tr>
<tr>
<td>Dr. Agnes Matilda Kalibata</td>
<td>Coordinator, Rural Sector Support Project, MINAGI-World Bank</td>
<td><a href="mailto:kalibatts@yahoo.co.uk">kalibatts@yahoo.co.uk</a></td>
<td>250 08302180</td>
</tr>
<tr>
<td>Bizima Anania Joseph</td>
<td>Senior Agronomist, Rural Sector Support Project, MINAGI-World Bank</td>
<td><a href="mailto:jbanania@hotmail.com">jbanania@hotmail.com</a></td>
<td>250 08491833</td>
</tr>
</tbody>
</table>

**UGANDA**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position/Institute</th>
<th>Email</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kakuru Adison</td>
<td>Chairman, Kabale District Local Government</td>
<td></td>
<td>077 459445</td>
</tr>
<tr>
<td>Sebaduka Hannington</td>
<td>CARE, Kabale</td>
<td></td>
<td>077 468207</td>
</tr>
<tr>
<td>Mutabazi, Sunday</td>
<td>District Production Officer, Kabale District</td>
<td></td>
<td>077 829442</td>
</tr>
<tr>
<td>Kyasimire Clare</td>
<td>Africa Highlands Initiative</td>
<td><a href="mailto:casimire@yahoo.co.uk">casimire@yahoo.co.uk</a></td>
<td>077 448080</td>
</tr>
<tr>
<td>Turyamureeba Gard</td>
<td>National Agricultural Research Organization</td>
<td></td>
<td>077 4592617</td>
</tr>
<tr>
<td>Tindyebawa Justice</td>
<td>District Information Officer, Kabale District</td>
<td></td>
<td>077 4592617</td>
</tr>
<tr>
<td>Kazimbazi James</td>
<td>District Agricultural Officer, Kabale Local Government</td>
<td></td>
<td>077 492617</td>
</tr>
<tr>
<td>Kabakiraho Bahuunde</td>
<td>District Veterinary officer</td>
<td></td>
<td>77524143</td>
</tr>
<tr>
<td>Name</td>
<td>Discipline</td>
<td>Email</td>
<td>Telephone</td>
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<tr>
<td>-------------------------------</td>
<td>--------------------------------------</td>
<td>------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Dr. Mark Cyubahiro Bagabe</td>
<td>Director General</td>
<td><a href="mailto:markbagabe@yahoo.co.uk">markbagabe@yahoo.co.uk</a></td>
<td>+250-530145</td>
</tr>
<tr>
<td>Dr. JonasNugabe Nutsabwa</td>
<td>Director of Research</td>
<td><a href="mailto:J_nugabe@yahoo.fr">J_nugabe@yahoo.fr</a></td>
<td>+250-530558</td>
</tr>
<tr>
<td>Elie Rene Gasore</td>
<td>Rice/Sorghum Research</td>
<td><a href="mailto:ergasore@yahoo.com">ergasore@yahoo.com</a></td>
<td>+250-08875075</td>
</tr>
<tr>
<td>Prof. Jasper K. Imungi</td>
<td>ATDT/ISAR</td>
<td><a href="mailto:imungik@yahoo.com">imungik@yahoo.com</a></td>
<td>+250-08308386</td>
</tr>
<tr>
<td>Dr. Emile Ndejuru</td>
<td>Head, Tech Transfer Unit</td>
<td><a href="mailto:Endejuru2003@yahoo.com">Endejuru2003@yahoo.com</a></td>
<td>+250-08750136</td>
</tr>
<tr>
<td>Nyagahungu I.</td>
<td>Postharvest Unit</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Uwizerwa Mathilde</td>
<td>Scientist</td>
<td><a href="mailto:Uwiz99@yahoo.com">Uwiz99@yahoo.com</a></td>
<td>+250-08591608</td>
</tr>
<tr>
<td>Umunezerro Olive</td>
<td>Animal Production</td>
<td><a href="mailto:umunezerol@yahoo.fr">umunezerol@yahoo.fr</a></td>
<td>+250-08459543</td>
</tr>
<tr>
<td>Uwimana Gaspard</td>
<td>Animal Production</td>
<td><a href="mailto:uwigas@yahoo.fr">uwigas@yahoo.fr</a></td>
<td>+250-08473440</td>
</tr>
<tr>
<td>Prof. Martin N. Shem</td>
<td>Animal Production</td>
<td><a href="mailto:martinshem@yahoo.com">martinshem@yahoo.com</a></td>
<td>+250-08556558</td>
</tr>
<tr>
<td>Prof. Noel Kanuya</td>
<td>Animal Reproduction</td>
<td><a href="mailto:nkanuya@yahoo.com">nkanuya@yahoo.com</a></td>
<td>+250-08556568</td>
</tr>
<tr>
<td>Prof. Fredrick Owino</td>
<td>Forestry/Agroforestry</td>
<td><a href="mailto:forin@kenyaweb.com">forin@kenyaweb.com</a></td>
<td>+250-08543559</td>
</tr>
<tr>
<td>Rushemuka Pascal</td>
<td>Agroforestry</td>
<td><a href="mailto:prushemuka@yahoo.fr">prushemuka@yahoo.fr</a></td>
<td>+250-08779808</td>
</tr>
<tr>
<td>Gashaka Gervan</td>
<td>Cassava Research</td>
<td><a href="mailto:gashaka@yahoo.fr">gashaka@yahoo.fr</a></td>
<td>+250-08419149</td>
</tr>
<tr>
<td>Hakizimana Patnee</td>
<td>Rice Program</td>
<td><a href="mailto:phakiza@yahoo.co.uk">phakiza@yahoo.co.uk</a></td>
<td>+250-08592191</td>
</tr>
<tr>
<td>Badege Peter</td>
<td>TTU/Socio-economics</td>
<td><a href="mailto:badegep@yahoo.com">badegep@yahoo.com</a></td>
<td>+250-08570741</td>
</tr>
<tr>
<td>Rukundo Placide</td>
<td>Biotechnology Unit</td>
<td><a href="mailto:rukundoplacide@yahoo.fr">rukundoplacide@yahoo.fr</a></td>
<td>+250-08745904</td>
</tr>
<tr>
<td>Dr. Jeremias G. Mowo</td>
<td>Soil and water management</td>
<td><a href="mailto:jgmowo@yahoo.com">jgmowo@yahoo.com</a></td>
<td>+250-08552575</td>
</tr>
<tr>
<td>Jean Damascene Ndayambaje</td>
<td>Agroforestry</td>
<td><a href="mailto:ndjeadamas@yahoo.fr">ndjeadamas@yahoo.fr</a></td>
<td>+250-08487721</td>
</tr>
<tr>
<td>Eugene G. Nsama</td>
<td>Potato</td>
<td><a href="mailto:egashabukans@yahoo.fr">egashabukans@yahoo.fr</a></td>
<td>+250-08406807</td>
</tr>
<tr>
<td>Leon Nabahungu</td>
<td>Soil Scientist</td>
<td><a href="mailto:nabahungu@yahoo.fr">nabahungu@yahoo.fr</a></td>
<td>+250-08406807</td>
</tr>
<tr>
<td>Dr. Michele Schilling</td>
<td>Director, GIS Center, NUR. Butare</td>
<td><a href="mailto:cgismur@yahoo.fr">cgismur@yahoo.fr</a></td>
<td>+250-08562510</td>
</tr>
<tr>
<td>Wagoire William</td>
<td>National Agricultural Research...</td>
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<td>Kanzikwera Rogers</td>
<td>National Agricultural Research...</td>
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</table>

Appendix 2. Key informants and interviews

Table X: List of Participants at Senior Stakeholders’ Meeting
Appendix 3. Senior Stakeholder Consultation in DR Congo

The stakeholder consultative meeting was held in Goma on 17 October and attended by 19 participants (Table x). Further consultations were held with the FAO Representative in charge of agricultural operations in Eastern DR Congo; the National Services of Agricultural Statistics (NSA), The Congo Institute of Nature Conservation (ICCN), the Compagnie Africaine d’Aviation (CAA), and three local NGOs (DIOBASS, PADA and APRONA). The main objectives of the senior stakeholder consultative meeting were to brainstorm on a list of critical entry points and opportunities for research and development. The meeting started with a brief background on the SSA CP and the mission of the validation team. It is important to note that some of the participants attended the Lake Kivu PLS launching meeting in Kigali in April 2005, and therefore had advance knowledge of the SSA CP. The first recommendation was to extend the PLS by 50 km to the south to include Masisi and northern Lake Kivu. The same issue was raised at the earlier meeting in Kigali. The key reasons offered for expanding the area were:

1. The current area covered by the PLS is dominated by the Virunga National Park which occupies over 70% of the land area. There are also some industrial plantations within the site, leaving only about 10-20% to small scale farmers. Expanding the site southward will include areas that are agriculturally important than the Virunga Parkland.

2. This area has also considerable challenges and limiting factors that are also found in many parts of DRC. Therefore results can found wider application for scaling out to wider geographic, within DRC and in the PLS.

3. Although the site is named after Lake Kivu, the lake is not part of the site in DRC. Expanding southward will include the lake, and therefore legitimize the title of "Lake Kivu" PLS, and will run parallel to Rwanda side of the PLS.

4. Finally, this area is more accessible to scientists from both Bukavu and Goma, and may be more secure than part of the current PLS.

The problems constraining agricultural development in the DR Congo are complex and have been exacerbated by several years of political instability, poor governance, wars and armed conflicts, as well as natural disasters. Some of these factors are structural such as poor infrastructure (roads, transportation, electricity), fragmented and diminishing land sizes (National park occupies over 50% of the PLS, and industrial plantations occupy about 25%).
bad governance and lack of coherent agricultural policies. Some of these constraints are technical and are rather recent. These include outbreak of crop diseases that are threatening key food crops such as banana, cassava, potatoes and beans. Most varieties of food crops have degenerated, and there has not been any formal diffusion of improved varieties in the last two decades or more. Although there are now several NGOs and farmers organizations, many of these institutions are weak, and lack technical, human and financial capacity to provide relevant services to farmers. Following both plenary and working group discussions, it was agreed that research and development opportunities include:

1. **Improving productivity of food crops.** Banana and cassava are seriously threatened by bacterial wilt, mosaic and viruses. These need scientific interventions and technologies, or transfer of technologies from Uganda where these diseases have been well managed. Another approach is to intensify the production of key staple food crops that have good market demand (banana, cassava, beans, potatoes and vegetable crops). Other key interventions will be to introduce more resistant varieties and improved technologies for increasing productivity of key crops.

2. **Examining crop-livestock interactions.** This research will have significant impacts in livestock production regions, but also could provide incentives for soil and water conservation. Particularly, in livestock, many organizations are introducing new breeds, but there is no research support to guide restocking, no laboratory for control of animal health.

3. **Improving marketing and commercialization of agricultural products.** The current prices that farmers are offered in the markets are very low and do not provide good opportunity for increasing production. Farmers are not competitive and do not have market intelligence. Most produce are sold immediately after harvest when prices are very low in the markets. The fact that farmers are not organized into producers and marketing associations, limit their bargaining power and ability to influence prices.

4. **Agroprocessing and value addition.** Processing of maize, sorghum and banana into flour presents an opportunity for increasing profitability of food crops. Soybean is gradually replacing beans in some areas. The crop could be further promoted if there were processing opportunities. There are some success stories of farmers associations who are able to process maize grain and banana into flour and therefore capture higher prices in the market.

Strengthening research and development capacity: There are good scientists both at INERA, Universities and some NGOs that have experience in the region, but need to be supported (financially and with technologies) to better serve the PLS. There are also existing technologies developed in DRC and through ASARECA networks and CG centres. FAO and other international NGOs are currently using technologies and materials produced by INERA.

Strengthening farmers associations. The lack of coordination and synergy amongst different farmers organizations and NGOs operating in the same area leads to duplication and confusion, and limited impacts. Facilitating platforms for information sharing and coordination amongst different players will achieve economies of scale and accelerate impacts. Most NGOs do not have the required technical skills, knowledge and tools to support farmers’ organizations, and facilitate their transition into market economies.

Linking R&D partners within the PLS. The DRC stakeholders requested the VT to assist in identifying and linking potential partners, and the Lead Institution to facilitate processes that can help to develop joint proposals. The VT should also provide feedback and share copies of their report.
Appendix 4. Senior Stakeholder Consultation in Rwanda

Two senior stakeholders meetings were held in Rwanda. The first consultation was held in the ISAR Ruhengeri station on Tuesday October 18, 2005 involving ISAR researchers, and the representatives of NGOs, Farmer organization and District Council. The second meeting, attended by research managers and scientists from ISAR headquarters, was held on Friday 21 October 2005 at the Pirlot Hall of ISAR, Rubona (Table x). The objective of both consultations was to obtain stakeholders inputs into the validation exercise. Opening the Rubona meeting, the Director General of ISAR, Dr. Mark Bagabe, welcomed the Validation Team to ISAR and provided a brief background to the ISAR scientists on the SSA-CP and its activities to date. He emphasized that technologies can not survive if they are not owned by farmers. Therefore, while research should drive the Lake Kivu PLS agenda, the research itself must be both participatory and market-led to be relevant. Thereafter, Emily Twinmackso introduced the mission of the validation team and the expectations from the consultation. The discussions were conducted in an open ended manner. The following section contains the highlights from stakeholders’ views on the major themes for the two consultations.

1. Adaptive research approaches are needed. The Rwanda part of the Lake Kivu PLS was reported to be the most densely populated area in SSA. The land is considered fairly fertile, however, there is a need to build capacity on conservation of natural resources. Adaptive research is necessary to identify appropriate technologies for NRM. Major crops are potato, beans, banana, and maize.

2. Eucalyptus replacement. Concerns about land shortages led to a controversial discussion on the value of Eucalyptus. While the tree is favoured by farmers because of its short growth cycle, coppicing ability, honey and fuel wood, it is also reputed to be a nutrient miner. ISAR scientist indicated that the Rwandan Government has a plan to replace Eucalyptus growing in fertile soils with high value traditional forest species such as Mahogany through Biotechnology. More than 10 varieties are currently being screened.

3. Strengthening farmer groups. The Farmer group representative indicated that farmers are not consulted in technology generation. Partnership with the groups is currently at the level of meetings. Farmer organization requires attention because of the high impact nature of their activities.

4. Linking farmers to markets. The greatest challenge lies in the volatile markets. Prices collapse at harvest to increase sharply two months later. There are opportunities for exploiting niche markets given adequate information and a simplified credit arrangement. The example of mushrooms for neighboring hotels was cited. Farmers require information support to enable them compete effectively in the domestic and global markets alongside business orientation.

5. Adding value. Lake Kivu PLS should build commodity chains, particularly for the purpose of value addition. Farmers get more from processing but are hindered by lack of appropriate processing equipments. Farmers’ Association established a processing plant for passion fruit which is now moribund.

6. Expanding opportunities within Buffer Zones. The Lake Kivu PLS is expected to transform the national parks into economic opportunities. For example, beekeeping is a very important resource. Rwanda has a deficit of honey which can be met in the buffer zone. It is important to consider high value crops for which there are good prospects in the international markets. Furthermore, the direct and indirect benefits of eco-tourism should be exploited for improved well-being.
7. **Intensifying livestock research.** It is essential to be focused on farmer objectives and understand the entry points. Due to acute shortage of land in Rwanda, some farmers may prefer zero grazing, while others opt for manure. There could still be others who will prefer milk. Overgrazing was reported to be a serious issue in the highlands as livestock feed is a big constraint.

8. **Building research capacity.** The need to strengthen ISAR’s research capacity was emphasized. There are pathological issues to be resolved particularly on potato (bacterial wilt) and passion fruits (viruses) and ISAR has had no pathologist for many years. Most of the orchards have been devastated.

9. **Advance GIS capacities.** The GIS Remote Sensing and Research Center in Butare expressed interest in collaborating with Lake Kivu Pilot Learning Site research to develop site and regional databases and participate in data exchange programs.
Appendix 5. Senior Stakeholder Consultation in Kabale, Uganda

The meeting was held at White horse in Kabale and was attended by heads of units in the district, representatives of non governmental organisations and coordinators of farmer organisations. The objective of the meeting was to get views of key stakeholders on development challenges and possible entry points for research and development. The chairman introduced the concept of the SSA-CP and challenged the stakeholders to discuss why science was not making much difference in eradicating poverty, what were the key development challenges and suggestions for possible interventions. The discussions were done in groups. Following is a summary of the issue that came up in the group discussions.

Marketing. Stakeholders emphasised the need to link production to market. This could be done through value addition, improved infrastructure, provision of market information and formation and formation of cooperatives and marketing associations. A major challenge to marketing was that all farmers in the area planted and harvested at the same time, flooding the market. This made it difficult to bargain for good prices.

Farmer groups. There are number of farmer groups linked together by proximity or common products. Some are too small and need to merge into bigger associations. Concern was that most farmer groups were not empowered enough to demand services. Two examples of strong farmer groups were cited, the Bukinda and the Karambo farms groups. The Bukinda group has been able to tap a zero grazing project and are now benefiting from manure and milk. They have a system of re-investing into group and farm activities. They are also trying biogas, natural resource management and malaria control. The Karambo group is involved in natural resource conservation and producing potato seed. The group has a bank account and tried to save money. The following suggestions came up in group discussions.

- Need to empowered to know what they need and to be able to demand for it
- Baseline data on Farmer groups to understand why the groups were formed and what their legal statuses are. This may help in the formation of better groups
- How do formal and informal farmer groups compare, e.g., those formed by external agents versus the ones that form spontaneously.

Partnerships. There is lack of linkages and synergies between programmes. Some organisations are working together through some lose collaborative arrangements.

Natural resource management. Natural resource depletion especially soil erosion on hill slopes was cited as one of the major problems. Two possible strategies for controlling natural resource depletion were suggested. One was to control erosion on the hill slopes by using what already exists; an example is using hedge rows on terraces using local shrubs or fodder trees. The other is to apply market driven improvement strategy. This means an environment friendly production system that at the same time produces marketable goods. An example is growing of high value crops that require minimum tillage, like horticulture or other perennial crops or the there keeping of livestock so that land is under pasture most of the time.

Information. Farmers do not get sufficient information. There is little information sharing and lack of trans-institutional trust. Some organisations take others’ information and present
it as their own, without acknowledging or giving credit to the source. This discourages synergy. There is need to improve information management to facilitate lesson sharing. Institutionalisation of information sharing mechanisms and tools should ensure that local systems are part of the system. There is also need to encourage farmer libraries.

**Horticulture.** Farmers in Kabale are taking on growing of temperate fruits, especially apples. Although the fruit has potential on the local market, sales are not yet smooth. The fruits are failing to compete with the apples imported from South Africa due to size. This poses a challenge for improving size to out-compete imported apples. There is also a possibility of advocating for a policy to reduce imports. There is still a lot of research to be done before apple growing becomes cost-effective.

Another issue that came up was the possibility of using old science to solve new problems.

**Contribution of the district Chairman.** The chairman emphasized the problem of land fragmentation and natural resource depletion. He supported the strategy of minimum tillage production.

Stakeholders requested for feedback when the validation exercise is finished. They said that many researchers went to the district to get information but never return to share outcomes or send copies of reports.
### Appendix 7. SUMMARY ISSUES ARISING FROM STAKEHOLDER ORGANISATIONS

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Concerns</th>
<th>Opportunities</th>
<th>Linkages</th>
<th>Capacity gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>NARO Kachwekano ARDC</td>
<td>Poor linkages with NAADS. Poor funding. Farmers rarely come and look for information. Very difficult to know if farmers’ concerns are actual concerns – farmer fatigue. No market considerations taken into account when introducing technologies. Misinformation – fertilizer kill soils</td>
<td>Positioned within PLS; Strength in potato research, linkages with other NARO, Some experience and expertise for IAR4D Technology packages on some products, nothing about temperate fruits Peas, sorghum and small ruminants</td>
<td>Several NGO and CBO, PREPARE,</td>
<td>Livestock research, Inadequate personnel and facilities.</td>
</tr>
<tr>
<td>ISAR Headquarters (Rubona) and Ruhengeri Station</td>
<td>Lack of financial resources to implement technologies; Sensitisation of farmers on Nature Reserves; Lack of cohesive farmer groups for collective action; How to exploit cultural groups for technology development process; Lack of information sharing mechanisms</td>
<td>ISAR LI; Ruhengeri within PLS; Strong policy support</td>
<td>Butare University, CIAT,</td>
<td>Critical Mass, NO IAR4D experience, lack inter-disciplinary skills</td>
</tr>
<tr>
<td>INERA Congo</td>
<td>Lack of base line data, Distance from PLS, Choice and size of site takes non productive area, Young inexperienced scientists. Destruction of research facilities for livestock, limited funding</td>
<td>International NGO’s getting research results from INERA.</td>
<td>University of Bukavu, CIAT/IITA CYMMIT, CIP and ASARECA, FAO and various NGO’s</td>
<td>Critical mass, young untrained, inexperienced scientists, Lack livestock scientists, Only 2 between research institute and University, No experience in IAR4D</td>
</tr>
<tr>
<td>Farmer Federation: UNFFE</td>
<td>Lack of genuine partnerships, Information channels, farmer training</td>
<td>District farmers associations</td>
<td>Skills to empower farmers and organize them for collective action</td>
<td></td>
</tr>
<tr>
<td>District farmers Organisation: Kisoro farmers’ association</td>
<td>Lack of funding for planned activities, limited market opportunities, lack of good seed, no clear link with farmers</td>
<td>Farmer link extension system can be used to mobilize and train farmers. Can be coordinators for inputs supply and credit facilities, enterprise development</td>
<td>District production department, grass root farmers associations</td>
<td>Few technical officers, Facilities for information collection, packaging and dissemination</td>
</tr>
<tr>
<td>Kisoro Beekeepers Association</td>
<td>Extracting equipment not adequate, bees killed by pesticide spraying, cannot supply enough for market,</td>
<td>Product diversification; quality control; disease control; Varroa mite monitoring</td>
<td>Shoprite, Royal Supermarket</td>
<td></td>
</tr>
<tr>
<td>Farmer groups: Karambo farmer group, Kibumba farmers’ group</td>
<td>Inability to enforce by-laws due to limited local government support. Lack of linkage to district NRM</td>
<td>Target audience for empowerment programmes, partners for innovation</td>
<td>CIAT, AFRICARE, NAADS, District production</td>
<td>Negotiation skills, savings and credit management, collective marketing,</td>
</tr>
<tr>
<td>Stakeholder</td>
<td>Concerns</td>
<td>Opportunities</td>
<td>Linkages</td>
<td>Capacity gaps</td>
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<tr>
<td>Private Sector: Processors (diary processing, fruit products)</td>
<td>Lack of raw materials, poor infrastructure, failure of farmers to organize themselves to supply raw materials, pests and disease reducing fruit availability, quality of raw materials, especially milk; seasonal fluctuation</td>
<td>Ready market, little competition, chance to participate in production chain may influence quality of products,</td>
<td>Farmers, milk traders</td>
<td>Quality standards, Partnership development (team building)</td>
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<tr>
<td>Private sector: Produce buyers</td>
<td>Infrastructure</td>
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<tr>
<td>Advisory/Extension services: NAADS</td>
<td>Insufficient budget, Lack of financing for farmers to take up new technologies, lean human resource at district level</td>
<td>Involvement with farmer empowerment, enterprise development, adaptive research</td>
<td>Research, farmer groups</td>
<td>Few staff, quality of service providers</td>
</tr>
<tr>
<td>Advisory/Extension services: NGO Congo</td>
<td>Inefficient markets for the farmers; some land tenure systems – do not favour agricultural development; Lack of capacity from service providers; lack of research support like new varieties, quantity and quality of seed and technologies; information inaccuracy; inadequate processing facilities</td>
<td>Transition from relief to sustainable development; platform for NGO information sharing;</td>
<td>FAO, farmer groups, World Food Programme; 151 NGO’s linked; INERA; farmers associations; CIAT; IITA; ASARECA networks</td>
<td>Interdisciplinary skills; business skills; communication and information management skills;</td>
</tr>
<tr>
<td>Advisory/Extension services: NGO Uganda example Africare</td>
<td>Too thin on the ground; research results not translated in usable messages; groups are not empowered to seek solutions and demand services; lack of business and marketing skills; lack of information sharing mechanisms; difficult to get farmers to the same level of understanding as developers Micro finance missing in their system</td>
<td>Wide coverage of the PLS. They follow an integrated approach</td>
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<tr>
<td>ASARECA</td>
<td>Desire to balance science and people impact</td>
<td>NA</td>
<td>Umbrella for regional NARS and commodity networks, link to CGIAR and ARIs</td>
<td>NA</td>
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Appendix 7: Development and Research Entry Points

The low yields of food crops within the pilot learning site are largely the result of the reduced yield potential of unimproved landraces confounded by diminishing soil fertility and uncontrolled pests and diseases. The Farm Input Supply case study (Section 6.2) concluded that few farmers plant improved, disease-resistant crop varieties or apply fertilizers and pesticides except for farmers who are required to meet industry standards and are well connected to markets (see Section 6.5). Clearly, increased use of purchased key farm inputs is an important first step to increasing food crop yield (Figure 8). In many settings, both the availability of those inputs and the capacity for farmers’ investment must be expanded. Fertilizers in particular should be applied at rates that optimize returns per unit input rather than larger amounts intended to maximize returns per unit land determined through diminishing returns. Several accompanying technologies compliment the use of fertilizers and improved crop varieties. Soil erosion must be contained and crop rotations and intercrops undertaken that reduce pest and disease and improve nutrient recycling. Combining organic and mineral inputs often increases the benefits from the applying smaller amounts of fertilizer. Increasing yields beyond household food needs is not sufficient to uplift households from poverty unless farmers’ market intelligence and opportunities are correspondingly improved. Farmers must improve post-harvest handling operations and storage facilities in order to meet quality standards of top end buyers and remain competitive within the marketplace. Clearly, a suite of interventions is required to raise household incomes yet field operations and enterprises that diverge too drastically from farmer’s tested practice are unlikely to receive widespread adoption. Furthermore, interventions must not overestimate the capacity for poor rural households to invest in farm inputs or to repay loans even when incentives such as low interest or revolving loans are in place.

Field visits and interviews with different stakeholders suggest that there are a few success stories of farmers groups and entrepreneurs who have accessed profitable market opportunities and attempted to develop profitable and sustainable enterprises. The lessons learned in these “success cases” have the potential to be scaled out and up to other areas and institutions. Research efforts must focus on understanding, distilling and promoting the critical success factors and driving forces of these success, and developing effective strategies, tools and products that can help in scaling up these models within and outside the PLS. Understanding the distributional effects of these different models of linking farmers to markets is still a research challenge that needs to be addressed. Undertaking IARD in ways that are more empowering of the poor, in particular by helping them acquire the capacity to identify more profitable agroenterprises, and to participate in high value agricultural markets is a research challenge.
Organisational change in this programme connotes the institutionalization of IAR4D in the region and necessitates the involvement of a wider range of stakeholder in research and the ability to facilitate and co-ordinate multi-stakeholder research and learning processes. Organisational change should be seen in people’s skills and attitudes, processes and procedures and the necessary adjustment in structures. The managers of organisations and institutions need skills to drive and manage the change process. Organisational change also requires policy changes too to allow latitude for re-organisation to fit into the desired management framework for IAR4D. Capacity development for organisational change targets the individual to enhance their participation and specific contribution; teams, to enhance working together in multi-stakeholder processes, organisations, to create platforms for learning together; and inter-institutional to facilitate the formation of multi-dimensional research and development teams. Capacity building institutions have observed that the challenge in developing IAR4D competences is how to ensure simultaneous capacity development for all stakeholder groups at different levels of the innovation system” (Daane, 2003). A major challenge is to understand the constraints to policy implementation and provide adequate information and technical support to policy makers. The major thrusts of policy research in the Lake Kivu PLS should therefore be not only to guide policy formulation but also to enlighten policymakers on the appropriate implementation strategy through closer dialogue and interaction. The entry points for agricultural research focused upon poverty alleviation, natural resource protection and rural enterprise development follow.
1. **Characterization of banana germplasm, disease management, yield improvement and processing.** The Pilot Learning Site falls within a secondary Center of Diversity of banana. It is an important food and cash crop and its production is being compromised by banana wilt disease and poor nutrient management. Interdisciplinary research on banana targeting its selection, management and commercial applications offers the potential to generate findings useful to the research systems within the Pilot Learning Site, and millions of small-scale banana producers elsewhere in Africa.

2. **Overcoming bean production constraints.** Beans are the most important source of protein within the Pilot Learning Center but its productivity is compromised by several constraints. Farmers and agricultural officers expressed concern over uncontrolled root rot and bean fly. Climbing beans have a modest potential for symbiotic nitrogen fixation (BNF) but managements designed to maximize BNF and better recycle crop residues are not well understood. Furthermore, the staking required for climbing beans poses huge resource and labor requirements to farmers but offers potential to positively interact with soil conservation interventions and other farm enterprises. Great potential exists for beans to become more widely marketed but top-end buyers insist upon uniformity, and diversity of bean size and color grown by farmers pose a challenge to its collective marketing.

3. **Improved potato cultivation and marketing.** Potato is an extremely important crop within the Pilot Learning Site, particularly within the higher elevations where other crops become limited by low temperature. Farmers expressed concerns over the availability and quality of seed tubers, difficult to control pests and diseases (particularly late blight), susceptibility to drought and unfair markets. Potato cultivation requires two major disturbances of soil, one to plant and the other to harvest, and this interacts with soil conservation concerns. Research focused upon finding practical solutions to potato production and marketing constraints will find immediate application among a large number of small-scale farmers.

4. **Better livestock breeds.** Increasing livestock production within the site will be enhanced by development and introduction of suitable livestock breeds and species. In areas the Validation Team visited, the farmers expressed preference for dairy production under zero grazing due to limited land for grazing, however, few are actually raising improved breeds under confinement. Some of the range lands can also accommodate goats and beef cattle. In all cases, acquisition of stocking material is a problem. In some areas, animals for zero grazing are provided by the Heifer Project International. Eastern DRC lost most of their animals during civil war and is just being restocked with goats which will later be sold to purchase cattle. It is therefore important that sufficient stocking breeds are available.

5. **Integrated livestock feeding systems.** The Lake Kivu Pilot Learning Site is intensively cropped and area for pasture development is limited. There is also limited tree and shrub cover leaving limited browsing for goats. Napier grass (*Pennisetum purpureum*) offers largely unexploited potential as a hedgerow crop for both feed and soil conservation. It is problematic finding sufficient feed for livestock and can be worse during the dry season. Intensification of livestock within smallholds will be faced with the challenge of inadequate feed resources and research is required to design integrated, low cost feeding systems.
6. **Managing livestock and diseases.** Livestock production within the site is plagued by livestock pests and diseases, reducing productivity and herd growth. Examples are East Coast Fever and other tick-borne disease, mastitis and reproductive diseases. The site is also in the stretch that has been involved in outbreaks of major infectious diseases such as contagious bovine pleuro-pneumonia. Most areas have stockists offering veterinary supplies but veterinarians are few and farmers are not well acquainted with diagnostic procedures. Research is required to develop appropriate, low cost, livestock disease programs and to explain them to farmers. Competitive livestock productivity will not be achieved even with good breeds unless there are technologies for effective management and control of diseases.

7. **Value addition.** Dairy and other livestock are marketed raw and this reduces the prices at farm level. The lack of agro-processing also reduces sales as not all products are consumed raw. This in turn may reduce production. For some products, only primary processing is possible, e.g. the cooling of milk. Secondary processing is also possible on farm and off-farm for products like ghee, cheese and yoghurt. Processing into more diverse products will require specialised equipment and skills. Issues that are inherent in value addition are the post harvest losses. The main challenge is how to attract and encourage investment in value addition for livestock products. The second is the development of easy to use on-farm post harvest handling methods that will help to increase the storage and transportation period of livestock products.

8. **Horizontal transfer of maize-based and zero grazing farm enterprises from the Kenyan Highlands and elsewhere.** Farming opportunities are more advanced in the not-too-distant Kenyan highlands and many of these can find immediate application within the Pilot Learning Site. Foremost among these are maize-based and confined livestock enterprises and their interactions. Several improved open pollinated maize varieties and hybrids are commercially available in Kenya that should be evaluated in the Lake Kivu PLS. The use of insecticidal and fungicidal seed dressing greatly improves crop emergence, economizing on seed. Substituting hybrid maize or disease –resistant legume seed for traditional landraces may increase yields by 60% to 120%. Combining these technologies with modest pre-plant and top-dressed mineral fertilizers (34 kg N and 5 kg P ha⁻¹) increases yields by another 25% to 50%. Yields increase another 7% when 2 t of farmer’s compost is substituted for pre-plant fertilizers and 10% when maize rows are staggered into a 2x2 arrangement. Relay intercropping of climbing beans with maize may offer an alternative to staking. Smallholder dairy operations offer a steady income flow that is required among smallholders. This entry point is somewhat downstream along the research and development continuum but this permits opportunity for immediate involvement of development organizations and grassroots groups within adaptive on-farm research. Improved technologies, such as maize-legume intercropping or livestock feeding systems, can be “packaged” for testing and evaluation by farmers. This approach would offer a first-wave impact within the Pilot Learning Site because little background research and development is required prior to the initiation of field activities.

9. **Explore smallholders’ market intelligence and information.** The Lake Kivu Pilot Learning Site can expand economic opportunities in the agriculture sector by increasing sales and jobs for agriculture-related businesses, however, it must have a business oriented-image to do this. The entry point into the market chain is at the farm level and the objective here is to develop supporting supply chain in response to demand. From there, entrepreneurs who can fulfil the role of market linkages can work with various
segments of the market chain to produce the greatest impact and generate maximum revenue for clients and producers in select commodities by stimulating functioning supply chains in response to a specific market demand. Where should market information kiosks be located and what services are required? How can they become self-supporting unless they also serve as collection points? What is the role of telecommunications in information delivery to small-scale farmers? Several areas of research are necessary to better understand and deliver improved market intelligence.

10. **Improve produce quality.** Increased access to top-end markets requires that industry standards be maintained. Many perceive smallholders as producing inferior produce in large part because they are unaware of quality criteria and lack the simplest post-harvest processing tools. Furthermore, quality testing is often offered for a fee that poorer farmers cannot afford. How can quality control standards be introduced to and maintained by farmers? What new tools are required and for which crops? How can quality be assured while crops are being bulked by several different farmers? What penalties should be imposed among members of collective marketing groups who are unable to meet minimum grades? Research on quality control is required before many most top-end markets can become approached.

11. **Targeting new markets with existing products.** Market expansion for existing products is one means to encourage farmers to produce and market larger crop surpluses. This approach requires market, institutional, policy, and social innovations to empower farmers to increase their bargaining power and become more competitive through association with market chain actors. Research is needed to identify and forge linkages with the different actors involved in the supply chain and to clearly delineate the market requirements, in terms of volumes, frequency of sales, quality parameters and potential prices.

12. **Add value to available produce.** Adding value to produce improves access to both existing and new markets. Mechanisms for value addition include better grading, strategic storage, better packaging and processing “produce into products”. These strategies can be applied to numerous commodities including potatoes, passion fruits, soybeans, tomatoes, honey, and dairy products. It is intended to increasing the competitiveness of small-scale farmers and better linking them to the private sector. Research into market institutional innovations that support the transition from production to agro-processing and value addition is required to improve product quality and competitiveness of small entrepreneurs.

13. **Diversification into high value products with high returns to land and labour.** This approach includes temperate and tropical fruits, organic vegetable production, spices, cosmetic and medicinal plants, and a variety of horticultural crops. Higher value crops and products will inevitably mean a shift to work with higher order private sector players, causing a shift away from traditional partners. High value agricultural products are however often perishable and targeting specialized niche markets with high quality standards that resource poor farmers may not able to meet. The challenge for R4D is to develop mechanisms and strategies for facilitating the participation of resource poor farmers in high value agricultural markets, and assess the distributional effects of high value crops and agricultural products. This may require investments in advocacy to support new policy options in marketing for specific groups, locations and market chains, and for land use mapping and consolidation.
14. **Strengthen farmer associations.** Research should focus on strengthening farmer organizations capacities and abilities to diversify into higher value products, increase their bargaining power and influence pricing in agricultural markets. Research should assess the different forms of organization and collective action to support different agro-enterprises for overcoming transaction costs, distribution of benefits and risks between smallholders and market agents; and for reducing the negative social, environmental and economic effects stemming from transition to market oriented production. This type of research will need to identify the ways and mechanisms in which farmers’ organizations function and how impacts can be enhanced to stimulate new income opportunities for the rural poor, especially for women and creating marketing platforms for smallholder producers.

15. **Explore market innovations.** The establishment of more efficient business and enterprise development services BDS will require research to assess the demand for new services, to detect the strengths and weaknesses of the services and institutions at different points in the value chains. This assessment should provide an overall quantitative and qualitative analysis to identify important gaps in service provision, and design new enterprise and business development support services as well as innovative market institutions for promoting efficient marketing systems such as microfinance, market information systems, business development services, pricing policies, input marketing, extension advice, and rural infrastructure.

16. **Better hillside management.** There are several management alternatives that could be employed to reduce soil erosion and consequent land degradation. Terracing has been used in the PLS over time, but we observed extensive destruction of terrace bunds on cultivated hillsides, either because they are not strengthened/stabilised and are too weak to hold or in search of the more fertile soil deposited from the top of the terrace. In most cases, the bunds also form boundary delineations between plots of different farmers. In some cases, land is abandoned when it no longer support annual crops. Opportunities exist for rehabilitation of the unstable bunds, over worked terrace soils and abandoned lands. We identified development and utilisation of productive multiple hedge plant species in bund stabilisation and as sources of organic inputs or fodder for livestock as an important area for research. Transition from annual crops to perennial high value crop enterprises minimize tillage and offer greater protection through canopy cover, but there is minimum research data to support the enterprises. Because of limited land holdings, these enterprises are better developed at community level.

17. **Better wetland utilization.** The functions of wetlands are varied and include water storage, nutrient cycling, particulate removal, maintenance of plant and animal communities, water filtration and groundwater recharge. They reduce damage from flooding, improve water quality and enhance habitat for fish and wildlife. Maintaining these functions and values presents a challenge for science to derive strategies for incorporating wetlands management in farming, grazing and fishing that must also serve to conserve the ecosystem, biodiversity and sustainable productivity (incompatibilities between resource activities and the objectives of protection and conservation).

18. **Domesticating threatened biodiversity.** The domestication of non-timber forest products outside protected areas and converting them into income generating projects like beekeeping, mushroom production, planting of bamboo and agro-forestry projects would
decrease the pressure for deforestation for agriculture and for energy. The domestication and commercialisation of beneficial insect, plant and fungal species to decrease the effect misuse on biodiversity and increase the income of people living around protected areas. The process of domestication is largely a research issue that involves several scientific disciplines.

19. **Replacing eucalyptus.** Large differences exist concerning the comparative benefits of eucalyptus, and to a lesser extent wattle trees. Some see them as biological invaders and a post-colonial artifact. Others consider them welcome woody biomass within an otherwise deforested landscape. It is certain that eucalyptus grows where many multi-purpose, indigenous tree species once stood. The merits of eucalyptus and its replacement with other trees, and the field operations achieving that end deserve research attention.

20. **Expand organisational capacities.** Capacity development will target both the supply and demand sides of the innovation systems. On the supply side, focus will be on national agricultural research systems, concentrating on empowering research managers to enable them understand IAR4D process and have the skills and attitudes for facilitating the change process. Key areas include, but are not limited to, research planning and management within innovation systems approach, monitoring and evaluation of research, including impact assessment, building and managing partnerships, lobbying and negotiation skills, organizational development, change management and leadership skills. The farmer organisations will be the main focus on the demand side. The main objective will be to empower them with competences that will enhance their role in decision making and demand articulation.

21. **Facilitate organizational innovation.** Developing sustainable community agroenterprise for smallholder farmers is a relatively long and intensive process that requires effective facilitation by a number of partners, with shared visions and commitments. The success of agroenterprise development efforts will be highly dependent on the development and strengthening of effective quality partnerships with farmers’ organizations (producer and marketing associations) and market chain actors, specifically with private business sector, business development services, research and development and government agencies.

22. **Mobilize multi-stakeholder learning teams.** Learning together by action and reflection will strengthen the institutionalization of IAR4D. Learning events that hinge around the seeking of solution to interlinked complex issues will enhance the institutionalization of multi-stakeholder innovation research. Formation of inter-institutional, multi-disciplinary teams will be encouraged and the teams will participate in learning events to increase their capacity for identifying and solving development issues. The teams must have, among other things, harmonious understanding of innovation systems concept, stakeholder analysis, working in teams, negotiation and conflict resolution, participatory market analysis, action research, scenarios & strategies, social organization / decision making and screening for environmental and social impacts. They also need soft skills that are vital for working together. Skills for facilitating multi-stakeholder processes, knowledge and information management will also be important.

23. **Better information and knowledge management.** This addresses the challenges inherent in management and utilization of formal and informal knowledge and information. The development of mechanisms for effective collection, analysis and dissemination of information is necessary for building knowledge data bases, lesson
sharing and effective monitoring and evaluation for institutional learning. Key research questions derived from the “Armed with Knowledge Hypothesis” will be entry points for testing this hypothesis and will offer opportunity for developing methods and approaches for integrating relevant knowledge systems into agricultural management models. Key questions include: What forms of information that accompany pioneering agricultural technologies and new products are required and how are they best distributed? How can farmer information become transformed to make it more understandable to agricultural specialists engaged in problem solving and, just as importantly, vice versa? How can environmentally and socially responsible actions, such as reforestation, soil conservation and watershed quality protection be better explained to local communities and reconciled with their routine land management operations and household activities?

24. Conduct policy analysis. Research must examine the extent to which policies provide incentives to small-scale farmers to improve their livelihoods and the extent to which these policies support agro-enterprise development and natural resource management strategies within their reach. Assessing their effectiveness and impacts on small scale farmers is an area for policy research. For instance, research is needed to understand the impact of trade and the factors responsible for the type of impact on different categories of market actors. Understanding constraints in the implementation of different policies could be another area for research.

25. Refine policy formulation and implementation. Omamo (2003) recommends a different approach to policy research focusing on piloting action research in case studies of innovative approaches for identifying convincing how to answers. However, with few exceptions, efforts have not focused on increasing local participation in policy review and formulation (Scoones and Thompson 2003). At the community level, there have been successful examples of local policy formulation and implementation e.g. byelaws for watershed management in Karambo and Kisoro. The challenge is to translate and link local level policy processes to high level policy mechanisms. The whole area of environmental and NRM governance in buffer zones, of common pool resources, and watershed management could be an entry point. This could also include developing conflict management mechanisms, and building skills in conflict management.

26. Advance policy dialogue and advocacy. Despite the recognition that policy processes are important for sustainable livelihood outcomes and natural resources management, there is concern that NRM research and technology development have not been reflected in policy change, nor have they affected decision-making processes of wider communities. Through action research and collective learning processes, researchers can develop policy scenarios using tools such as policy analysis matrix and devise more effective strategies for connecting research and policy makers, and using research results to influence policy decision-making. Based on research findings, stakeholders could engage in policy advocacy and dialogue e.g. through workshops, seminars and policy briefs.
### Appendix 8. Tentative Logical Framework for the Lake Kivu Pilot Learning Site

**Super goal:** Contributing to poverty elimination in Sub-Saharan Africa

**Goal:** Improve food security, income, environmental sustainability and livelihoods of small holder farmers in the LK PLS

<table>
<thead>
<tr>
<th>Outcome 1</th>
<th>Outcome 2</th>
<th>Outcome 3</th>
<th>Outcome 4</th>
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<tbody>
<tr>
<td>Increased utilization of demand driven technologies to improve agricultural productivity and conserve natural resources</td>
<td>Diversified enterprise options and improved market access</td>
<td>Organizational capacity of stakeholders for impact oriented research enhanced</td>
<td>Decision-making capacity for agricultural policy analysis, formulation and implementation enhanced</td>
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</table>

#### Output 1.1
Technological innovations for increasing productivity and competitiveness of crop and livestock systems developed, tested and adopted by farmers

**Activities**

1.1.1 **Develop profitable and resilient agricultural technologies for pest and diseases management of major crops (banana, cassava, potatoes, beans, fruits) using biotechnology and other approaches**

1.1.2 **Expand availability, accessibility and use of necessary farm inputs**

1.1.3 **Conduct strategic and on farm adaptive research for the introduction and adaptation of new high value crop varieties that have market demand.**

1.1.4 **Strengthen**

#### Output 2.1
Increased capacities of farmers’ organizations and entrepreneurs to access better market opportunities

**Activities**

2.1.1 **Conduct market chain research to identify and promote opportunities for enterprise diversification and value addition of agro enterprises**

2.1.2 **Develop approaches, tools and materials for strengthening capacities of farmers organizations, entrepreneurs and their service providers to undertake market chain analysis**

2.1.3 **Develop integrated agro enterprise options for high value crops that have market demands**

#### Output 3.1
Institutional change mechanisms for market responsive and client oriented research promoted

**Activities**

3.1.1 **Promote institutional change towards inter-disciplinary and multi-stakeholder collaboration**

3.1.2 **Develop capacity that support the Integrated Research for Development paradigm**

3.1.3 **Develop participatory monitoring, evaluation and impact assessment tools for IAR4D**

3.1.4 **Enhance capacity for diagnosis and management of pests and diseases, including molecular and conventional tools for breeding for pest and insect resistance**

#### Output 4.1
Increased capacity for analysis formulation and implementation of enabling agricultural and trade policies

**Activities**

4.1.1 **Identify policy incentives, constraints and opportunities for land consolidation, natural resource management, biodiversity conservation and marketing**

4.1.2 **Provide research information, tools and skills to guide policy formulation and implementation**

4.1.3 **Develop tools and products that influence uptake of research results to guide policy design, formulation and implementation.**

4.1.4 **Strengthen farmers organizations and rural communities to forge collective action processes in NRM, and agroenterprise development policies.**
<p>| seed systems and dissemination mechanisms of improved varieties |   |   |</p>
<table>
<thead>
<tr>
<th>Output 1.2</th>
<th>Integrated natural resource management strategies developed and implemented</th>
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<tbody>
<tr>
<td><strong>Activities</strong></td>
<td></td>
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<tr>
<td>1.2.1</td>
<td>Promote more effective integrated soil, water and nutrient management for hillside conservation</td>
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<tr>
<td>1.2.2</td>
<td>Develop and promote strategies for rational utilization and rehabilitation of wetlands and marshlands for provision of environmental services, food and income</td>
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<tr>
<td>1.2.3</td>
<td>Identify on-farm niches for multi-purpose trees</td>
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<td>1.2.4</td>
<td>Identify and promote alternative enterprises in buffer zones to protect of biodiversity hotspots and domestication of beneficial non-timber forest products</td>
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<tr>
<td>1.2.5</td>
<td>Forge collective action processes for hillside conservation, conflict management, and environmental conservation</td>
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<tr>
<td>1.2.6</td>
<td>Conduct an inventory of INRM technologies and translate existing knowledge into tools and products for</td>
</tr>
</tbody>
</table>

| Output 2.2 | Value addition and diversification of agricultural products enhanced |
| **Activities** | |
| 2.2.1 | Conduct market chain analysis of high value crops to identify critical points and develop strategies for increasing their competitiveness in the value chain |
| 2.2.2 | Identify and promote market institutional innovations that benefits poor farmers, especially women (micro-finance, credit, collective marketing, taxes) |
| 2.2.3 | Develop strategies and mechanisms for scaling out/up successful agroenterprises |

| Output 3.2 | Capacity of Pilot Learning Teams in impact oriented research strengthened |
| **Activities** | |
| 3.2.1 | Facilitate and improve farmer organization capacity to experiment and adapt technologies and innovations in support of their enterprises |
| 3.2.2 | Increase skills of small holder producers and their service providers to initiate and manage associations for collective action in NRM and marketing |
| 3.2.3 | Develop strategies for scaling out the islands of success |
| 3.2.4 | Develop skills in community based monitoring and evaluation and information sharing systems |

<p>| Output 4.2 | Platforms and mechanisms for policy advocacy and dialogue established |
| <strong>Activities</strong> | |
| 4.2.1 | Conduct impact assessment and policy analysis studies on uptake processes and develop policy options and recommendation for upscaling research results |
| 4.2.2 | Facilitate platforms for policy action research, dialogue and advocacy |
| 4.2.3 | Build skills in alternative conflict management in buffer zones |
| 4.2.4 | Conduct comparative studies on the performance and effectiveness of different policies in Agriculture, NRM, trade and market |
| 4.2.5 | Facilitate mechanisms for harmonization of national policies and development of regional policy frameworks on plant genetic resources, animal health, biosafety, seed and inputs, trade, and research cooperation |
| 4.2.6 | Disseminate lessons and guidelines for strengthening policy analysis, formulation, |
| different user groups. |  | implementation and impact assessment. |</p>
<table>
<thead>
<tr>
<th><strong>Output 1.3</strong></th>
<th><strong>Output 2.3</strong></th>
<th><strong>Output 3.3</strong></th>
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<tr>
<td><strong>Activities</strong></td>
<td><strong>Activities</strong></td>
<td><strong>Activities</strong></td>
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<tr>
<td>1.3.1 Evaluate options for improving the integration of crop-livestock production systems</td>
<td>2.3.1 Strengthen farmer organizations skills and marketing institutional innovations to facilitate market access, collective action and business development services.</td>
<td>3.3.1 Establish base-line data and databases on agricultural production and production systems, marketing, institutions, biodiversity, NRM and best practices in the LK PLS</td>
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<tr>
<td>1.3.2 Build capacity for diagnosis and management of livestock health and feeding systems</td>
<td>2.3.2 Identify and reduce bottlenecks in promoting exports and improve quality standards</td>
<td>3.3.2 Translate available information into user friendly products and tools</td>
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<tr>
<td>1.3.3 Promote value addition of livestock products along the resource-consumption chain</td>
<td>2.3.3 Forge strong alliances amongst market chain actors</td>
<td>3.3.3 Develop communication strategy and information dissemination mechanisms</td>
</tr>
<tr>
<td>1.3.4 Genetic improvement options</td>
<td>2.3.4 Establish business promotion services for selected commodities</td>
<td>3.3.4 Establish market information systems within the PLS</td>
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