**Consultative Group on International Agricultural Research (CGIAR)**

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# Annual General Meeting 2002
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## *STAKEHOLDER MEETING*
## October 30 – 31, 2002

## Agenda Item 3.c. Challenge Programs—Regular Process

Session I: Improving Livelihoods and Natural Resources Management in Sub-Saharan Africa

**Background/Process:**

At AGM01, the CGIAR decided to immediately initiate the regular Challenge Program (CP) process by calling for ideas. Of the 41 CP ideas received, 13 were recommended by the interim Science Council (iSC) and endorsed by the CGIAR for pre-proposal development. The attached pre-proposal, "Improving Livelihoods and Natural Resources Management in Sub-Saharan Africa," is being recommended by the iSC to the ExCo for full proposal development. The pre-proposal will be presented in Parallel Session I. The session will provide the proponents an opportunity to receive comments and suggestions from CGIAR stakeholders.

**Document:** Improving Livelihoods and Natural Resources Management in Sub-Saharan Africa

**Comments:**

*Pre-proposal for a CGIAR Challenge Programme*

# IMPROVING LIVELIHOODS
and
# NATURAL RESOURCE MANAGEMENT
in
# SUB-SAHARAN AFRICA

## "Securing the future for Africa's children"


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**IMPROVING LIVELIHOODS AND NATURAL RESOURCE MANAGEMENT IN SUB-SAHARAN AFRICA**

# Securing the future for Africa's children

## SUMMARY


Two hundred million Africans are chronically hungry. And the number is rising despite over US $18 billion spent annually on food imports. In the 'normal' year 2000, Africa received 2.8 million tons of food aid, a quarter of the world's total. This led the New Partnership for Africa's Development (NEPAD) to recognise that agriculture-led development is fundamental to cutting hunger, reducing poverty, generating economic growth, reducing the burden of food imports and opening the way to an expansion of exports. Chapter 5 of the NEPAD Comprehensive Africa Agriculture Development Programme will set out a reform agenda for agricultural research in Africa, designed to engage the whole research community in collectively tackling the key constraints to African agriculture.

This Challenge Programme will be concerned with the way people use natural resources to support livelihoods and will address the most fundamental constraint to African agriculture, poor soil fertility, by applying a new paradigm for integrated natural resource management, and by applying it with all partners committed to jointly identifying and resolving problems with the full participation of the beneficiaries. It will employ a new mode of competitive funding that will enable the formation of new partnerships of national agricultural research and extension systems, the CGIAR centres, advanced research institutes, non-governmental organisations, farmer organisations and private enterprise, in order to address problems by means of targeted and time-bound research projects with clear objectives and deliverables.

The Challenge Programme's approach to integrated natural resource management, with a focus on integrated soil fertility management, will link with and add value to the core work of the participating institutions and to the other challenge programmes active in sub-Saharan Africa. In view of the important role of women in African agriculture and the disproportionate numbers of poor women, particular attention will be given to their problems and to ensuring that the outcomes do not disadvantage them.

The commonality of soil-related problems and the diversity of the required remedies will make this Programme a hub and a catalyst for much wider research, making it a primary vehicle for the achievement of the goals of Secretary General Kofi Annan's initiative for the World Summit on Sustainable Development, which seeks action in the five key thematic areas of the WEHAB initiative: Water, Energy, Health, Agriculture and Biodiversity and ecosystem management.

The programme's governance and funding mechanisms will be organised through the Forum for Agricultural Research in Africa (FARA) and its members, the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA), Conseil Ouest Africain Pour la Recherche et le Développement Agricole/West and Central African Council for Agricultural Research and Development (CORAF/WECARD) and the Southern African Development Community, Food Agriculture and Natural Resources Department (SADC/FANR), with the participating CGIAR centres and other stakeholders.

The active engagement of a wide variety of institutions, scientists and other stakeholders from NARS, CGIAR and other IARCs indicates the importance attached to the Programme's topic. FARA's leadership, and its established links through the research providers to the beneficiaries, will ensure rapid and effective implementation of Programme activities. In addition to received expressions of investor interest, the CGIAR's commitment to such an inclusive African-led programme at this time will provide a fulcrum for leveraging the new commitments to agricultural research and development indicated at Monterrey, G8 Summit and the WSSD[1].


[1] See Annex 5: Acronyms.

# 1. INTRODUCTION

Africa faces two major challenges. The first is to ensure that its natural resources serve as the basis for economic growth that will result in more active and sustainable participation in the global economy. The second is to ameliorate the degradation of natural resources and erosion of biodiversity in order to improve ecosystem resilience. These challenges are heightened by the need, not only to stop degradation, but also to build up the resources to levels never before attained, in order to meet the demands of a population growing at more than 3% a year (21.5 million extra mouths).

## 1.1 THE VISION FOR AFRICAN AGRICULTURAL RESEARCH

FARA, with its member sub-regional organisations (SROs), has developed a **Vision for African Agricultural Research**, which calls for 6% annual growth in agricultural productivity in order to stem and reverse the decline in food production and incomes of the rural poor in sub-Saharan Africa. The African vision is that, by 2020, the region should: (i) have dynamic agricultural markets among nations and between regions; (ii) be a net exporter of agricultural products; (iii) have food available and affordable, with equitable distribution of wealth; (iv) be a strategic player in agricultural science and technology development; and (v) have a culture of sustainable use of natural resources.

This African vision has been adopted by FARA in its strategy for catalysing innovation and change in agricultural research in Africa. In May 2001, FARA, its sub-regional members and the CGIAR centres issued the **Durban Statement**, reconfirming their full support for the African vision, and calling "*on the international research system, including the CGIAR Centers and advanced research institutions, to forge more effective and efficient partnerships with African NARS and achieve greater programmatic integration*" (see Annex 1). Those words will translate into action through this Challenge Programme.

In consultation with the national agricultural research systems (NARS), the CGIAR Centres active in sub-Saharan Africa have developed a **Strategy for the CGIAR in Africa**, which sets out how they, with their partners, propose to respond to the challenge to eradicate poverty and place African countries on paths to sustainable growth and development. They will address FARA's African vision with cutting-edge science and frontier technologies in natural resource management, policy research, capacity building and networking.

Africa's leaders in Abuja in October 2001 called for a **New Partnership for Africa's Development** (NEPAD) that recognises the importance of agriculture as the engine for economic growth, and the importance of research in making this happen. NEPAD is anchored on the determination of Africans to extricate the continent from the malaise of underdevelopment and exclusion in a globalising world. This is a formidable challenge because Africa still has 340 million people, or half its population, living on less than US $1 per day, a mortality rate of children under 5 years of age of 140 per 1000, and life expectancy at birth of only 54 years. Only 58% of the population has access to safe water and only 41% of people over 15 can read. These statistics indicate an intolerable disparity with the increasing prosperity of developed and emerging economies in other regions. It is an untenable situation that is a serious threat to global stability. To get out of this situation, Africa requires accelerated development, especially of the agricultural sector because 70% of the people live in rural areas.

## 1.2 THE IMPACT OF SOIL DEGRADATION

Africa's efforts to achieve a higher agricultural growth rate are constrained by soil degradation, particularly through loss of organic matter and deficiencies of nitrogen and phosphorus. Degraded soils have a direct negative influence on agricultural productivity, and may be the single most important constraint to food security in sub-Saharan Africa. This problem is most severe in densely populated countries such as Ethiopia, Ghana, Kenya, Malawi, Nigeria, Rwanda, Zimbabwe, and the Limpopo Province of South Africa. These soil deficiencies are compounded by lack of water available in fields when crops need them. Average rainfall is low in many parts of sub-Saharan Africa; but more serious is the high intensity, short duration, temporal variability, and unpredictability of rainfall throughout much of sub-Saharan Africa (see Figure 5 in Annex 4).

The degradation of sub-Saharan Africa's soils and other natural resources is driven by farmers' seeking to increase production through extensification rather than through intensification. The effect is manifest most dramatically by a rapid loss of forests, reduced water quality, genetic erosion, and soil degradation, particularly through loss of organic matter under agricultural and pastoral use. These losses have negative influences on many other resources and environmental services that are important to sustainable development. This is leading to serious distortions in the hydrological balance, impaired access to water, continuing loss of plant genetic resources and encouragement of noxious weed populations. In extreme cases, the loss is irreversible, resulting in the extinction of races of precious indigenous food crops and other useful plants.

There is growing acceptance that the soil fertility problem remains intractable because of the failure to deal with the issue in a sufficiently holistic way. Soil fertility decline is not a simple problem of nutrient depletion: It interacts pervasively over time with a wide range of other biological and socio-economic constraints to sustainable agroecosystem management. It is thus also a problem of inappropriate germ plasm and cropping system design, of water management, of interactions with pests and diseases, of the build-up of noxious weeds such as Striga that reach chronic proportions and are difficult to control, of the linkage between poverty and land degradation, of often perverse national and global policies with respect to incentives, and of institutional failures, including the inability of most rural communities to influence their service providers.

Research has shown that low land and capital resources constrain the adoption of ecologically and economically sustainable soil management practices on the majority of farms in the area. There are other interrelated factors that constrain the farmers' options to respond appropriately to market and ecological challenges that need to be addressed, such as the loss of genetic diversity. Figure 3 in Annex 4 illustrates the extent of human-induced soil degradation and the severity of soil fertility constraints in Africa that affect more than 65% of Africa's cropped area and 31% of its pastureland. The urgency of addressing this is indicated by the projected population growth illustrated in Figure 4, Annex 4.

Comparison of Figures 3, 4 and 5 indicate a coincidence between locations of anticipated population growth, hotspots of soil degradation. This stresses the importance of the link between future livelihoods and soil and water management.

### 1.3 RESEARCH NEEDS

Despite a diversity of proposed solutions, and the investment of much time and resources by a wide range of institutions, soil degradation remains an intransigent problem. Massive nutrient replenishment programmes have been proposed, especially for phosphorus, but their economic benefits and long-term sustainability have been disappointing and need case-by-case evaluation.

Tackling soil fertility issues thus requires an holistic approach of the kind embodied in the concepts of integrated natural resource management (INRM). Soils research must embrace all the driving factors and consequences of soil degradation – biological, physical, chemical, social, economic and political, with a strong emphasis on understanding and seeking to manage the processes that contribute to change. The highly interactive impact of soil fertility degradation and its system level effects justifies it as the focus of this Challenge Programme.

Since the degradation of sub-Saharan Africa's natural resources is driven by farmers' seeking to increase production through extensification rather than through intensification, there is a need to provide incentives for intensification, through lowering marketing costs, improving product prices and reducing labour. As labour, especially that provided by women, is one of the principal inputs to agricultural productivity in smallholder farming systems in sub-Saharan Africa, anything that can be done to raise soil productivity and reduce drudgery in managing soils (e.g., less hoeing and weeding, which are often women's work) will facilitate human and social capital acquisition.

To improve soil and related natural resource management, and therefore livelihoods, strategies are needed to (i) increase the value of farm output through improved productivity coupled to better market access; (ii) increase availability and efficient use of inorganic and organic nutrient inputs at low cash and labour costs to the farmer; and (iii) increase off-farm income.

The Challenge Programme will address the need to make the paradigm shift away from single 'silver bullet' and principally commodity-driven technological package approaches to a truly integrated natural resource

management approach. This will ensure that researchers (national, regional and international) work together with smallholders, extension agencies and civil society so that their products have significant impact, which can be upscaled and downscaled. The Programme will reflect the urgency of meeting the challenge to increase agricultural production at rates in excess of population growth.

## 2. A NEW APPROACH TO ADDRESSING THE CHALLENGE OF SOIL INFERTILITY

The strategy of this Challenge Programme is a new approach to research that will add value and increase impact through integrating productivity enhancement, market access, and environmental protection, and building social capital. To ensure that this happens, the research will be supported by competitive grants that will be structured to provide incentives for scientists to make fundamental changes rather than presenting old approaches in new ways.

Recognising that increased incomes are a prerequisite for investment in improved soil management, this Challenge Programme will be characterised by research that links natural resource management, agricultural production, markets and policies, thus building profitable systems and improved rural livelihoods on sound resource management. This will involve multi-scale analysis and the use of a variety of cutting-edge tools in, for example, systems analysis, systems simulation, spatial analysis, information management, and impact assessment. Integration across scales, components, stakeholders, and disciplines will be fundamental to the new approach, as will be the integration of research with extension, and empowerment of smallholders. This will ensure that the Programme focuses on their demands and needs, and that they will adopt and disseminate Programme products. Taking this approach will require changes in research culture and organisation to encourage wider value-adding partnerships and participatory techniques.

The multi-institutional, multi-disciplinary and integrative approach adopted by FARA for this Challenge Programme will ensure that it will provide a hub to which other research activities, including the other challenge programmes active in sub-Saharan Africa, will be linked. This will promote cohesion, avoid duplication and, most importantly, by exploiting complementarities, add value to the total investment in research and capacity building. Linkages are already envisaged with the challenge programmes on water and food (watershed and farm level studies, increased productivity of water), climate change (soil-carbon trade-offs), desertification (combating degradation), biological nitrogen fixation (legumes for soil fertility), agrobiodiversity for farming systems resilience, and securing livestock genetic resources for present and future food security.

At the May 2002 ASARECA Projects, Programmes and Networks Workshop, ASARECA members and CGIAR centre representatives endorsed an approach for integrating and harmonising agricultural research in the region that had been developed through a systematic consultative process in which predictions of megatrends for the region over the next 20 years were analysed. The key research questions for addressing these trends were grouped into the eight themes shown in Figure 1 below for harmonising and integrating CGIAR and NARS research in the region.

Amongst these themes, three, i.e., Approaches to integrated natural resources management, Market chains, and Policies, are central to this proposal. They are also priorities of CORAF/WECARD – reconfirmed at its July 2002 annual meeting – and of SADC/FANR. The other five themes will be drawn in as appropriate to the achievement of the focused goals of the Programme.

Focusing on these themes, this Challenge Programme will link INRM, agricultural markets and policy research by integrating research on different types of capital and assets into stakeholder-driven processes of adaptive management and innovation to improve livelihoods, agroecosystem resilience, agricultural productivity and environmental services at community, ecoregional and global scales of intervention and impact.

The different types of capital and assets that the Programme will address include: Financial Capital – money, bank accounts, etc.; Physical Capital – which is produced by human industry, e.g., houses, roads, seeds of improved crop varieties, improved animal breeds, chemical fertilisers; Human Capital – the level of health, education and ability of individuals in a population; Natural Capital – the stocks of resources generated by biogeochemical processes and solar energy that yield useful flows of goods and services for present and

future generations (water and soil are pertinent examples of natural capital); and Social Capital – the cohesiveness of individuals in a society, their shared values, culture and strengths of institutions.

The new paradigm accepts that INRM research is fundamentally about the need to balance competing individual and societal interests in multiple uses for any natural resource, including both the physical elements (soil, water, etc.) and the genetic element. For this reason, this Programme will be concerned with the way people use natural resources to support livelihoods, and with the institutional and ecological requirements for establishing long-term sustainability. It will combine a flexible set of integrative frameworks, methods and tools to capture synergies among specialised research dealing with soil related issues. In this context, integrated soil fertility management is the core component and the Programme will test the hypothesis *"that conservation and efficiency of use of soil and other natural resources will be optimised under conditions of market- and/or policy- and institution-driven productivity."*

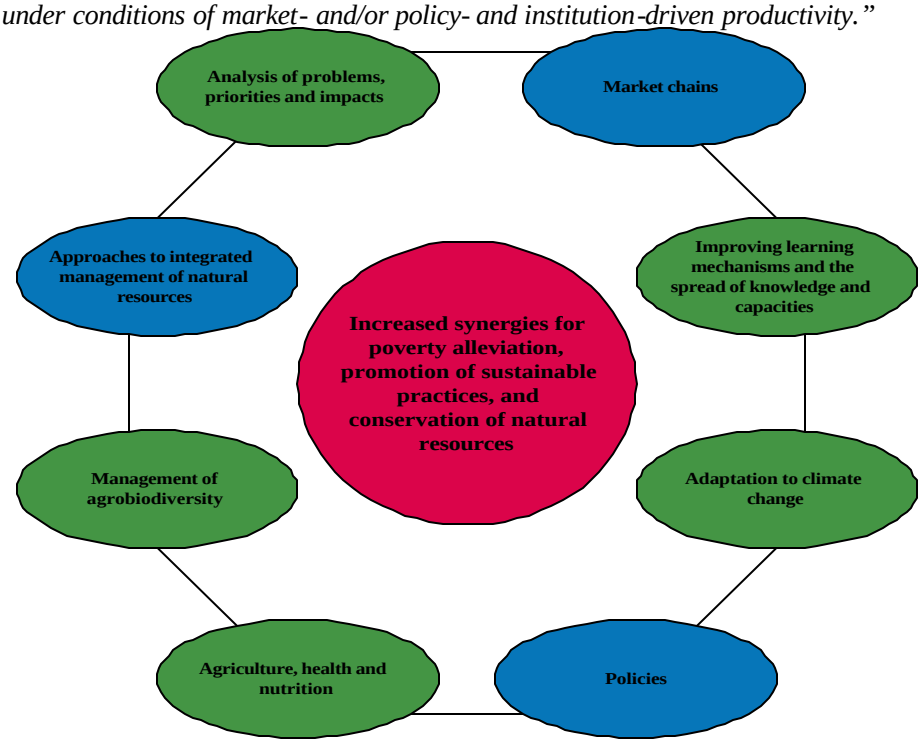


***Figure 1: Themes of the integration and harmonisation process for CGIAR activities, ASARECA May 2002***

The research outputs will include technological options for improving soil fertility and natural resource management in an integrated fashion, management and sustainable use of agrobiodiversity, and policy and institutional options, including implementation mechanisms that facilitate adoption of sustainable practices by farmers and other land users, and enhanced adaptive management capacity of key stakeholders (farmers, scientists, policy-makers). The impacts of the Programme will be assessed by the status of system productivity, ecosystem resilience and enhanced livelihoods, especially of rural women.

## 3. GOALS, PURPOSE, OBJECTIVES AND HYPOTHESES

### 3.1 GOALS

The partners in this Challenge Programme see their role in sub-Saharan Africa by the year 2020 as having contributed to the African agricultural research community's goals of attaining food security and poverty eradication through research, policy support and capacity building, based on environmentally sound management of natural resources.

### 3.2 PURPOSE

To overcome the constraints to sustainable use of sub-Saharan Africa's natural resources, particularly soils, with improved technologies and policies that will enable resource-poor smallholders and livestock producers to achieve sustainable improvements in their livelihoods and secure futures for their children.

### 3.3 OVERALL OBJECTIVES

- To design technologies, policies and institutional options that will stem and reverse the loss of natural resources, and in particular the degradation of soils in sub-Saharan Africa;
- To improve both input and output markets for smallholders, in order to increase their returns and options for generating incomes to improve livelihoods, and to enable investment in natural resource conservation;
- To generate policy options that promote increased incomes, food security, and sustainable land use through the adoption of sustainable farming practices; and
- To build the capacity of researchers in sub-Saharan Africa to exploit new approaches and new science in integrated natural resource management.

### 3.4 ACTIVITY OBJECTIVES

In this pre-proposal, it would be inappropriate to define specific objectives, which is the prerogative of the stakeholders who will contribute to the development of the full proposal. However, the funded activities will address soil and related natural resource management issues identified in participation with the stakeholders. They will have clear, achievable objectives, with deliverables that will be measurable within the life of the project. The competitive grant criteria will favour consortia that demonstrate innovative and high quality science, conducted in multi-disciplinary and multi-institutional modes, with capacity building as an integral component.

### 3.5 POTENTIAL HYPOTHESES

This pre-proposal has received input from over 100 scientists from the whole range of research institutions across and out of Africa. They have proposed hypotheses for research that will contribute to sustainable improvement in soil fertility management in African smallholdings and pastoral systems. These will be added to, refined and pruned for better focus in the process of developing the full proposal, which can only be done when all stakeholders can be fully involved. The prioritised hypotheses will, however, form the bases for calls for proposals for competitive grant funding.

## 4. CONCEPT GENERATION

Initiation of NEPAD in October 2001 coincided with the culmination of long consultations between regional scientists themselves and with the CGIAR Centres on improving the impact of agricultural research. Those consultations had led, in creative steps, to the formation of the sub-regional organisations (SROs) for strengthening agricultural research, ASARECA, CORAF/WECARD and SADC/FANR, which jointly established the regional Forum for Agricultural Research in Africa (FARA). The establishment of FARA completed the chain linking African agricultural scientists to the Global Forum for Agricultural Research (GFAR). This has established a common commitment to the African Vision for African Agricultural Research.

In response to the Vision for African Agricultural Research and the 3rd CGIAR System Review, the CGIAR Centre Directors Committee convened meetings with African partners – *Meeting of Minds I* in Nairobi in May 1999; *Stakeholder Meeting* in Beijing, 22 May 1999; *Meeting of Minds II* in Abidjan in September 1999; and *Meeting of Minds III* Nairobi in March 2001. These meetings brought together senior representatives from African national and regional research organisations and their colleagues in the CGIAR Centres. Since 2001, numerous further meetings have been held, in the context of the regional integration of the activities of the CGIAR and its partners in West and Central Africa and in Eastern and Southern Africa.

Representatives from national agricultural research systems (NARS), farmer organisations, NGOs, SROs and non-CGIAR international institutions contributed to these meetings.

This series of meetings was characterised by a new atmosphere of partnership and optimism that the required impact can be realised through collaboration, which will be facilitated by FARA and the three sub-regional agricultural research organisations. This Challenge Programme represents the current status of these consultations and provides the opportunity to move from discussion to action.

The Programme will be built on programmes and partnerships that have been established through collaborative research between the CGIAR centres, the NARS members of ASARECA, CORAF/WECARD and SADC/FANR and the wide range of collaborations that exist with advanced research institutions globally. A key feature of the Programme is that these collaborations will be advanced on the basis of equity among all partners who have shared commitments to excellence in science and to capacity building for all scientists, especially for the weaker NARS.

## 5. PROGRAMME COMPONENTS

The Programme will be comprised of four sub-themes that will collectively contribute to testing the central hypothesis: *"that conservation and efficiency of use of soil and other natural resources will be optimised under conditions of market- and/or policy- and institution-driven productivity."*

The sub-themes are:

1. integrated natural resource management;
2. development of sustainable market chains;
3. policies for sustainable agriculture; and,
4. scientific capacity building.

### 5.1 INTEGRATED NATURAL RESOURCE MANAGEMENT

The entry point for the management of the natural resource base for agriculture will be at the soils level. Traditional elements of increasing nutrient and water use efficiency and building long-term fertility through increasing soil nutrients and organic matter lie at the heart of this agenda and are integrated with management of hydrological regime, pests and other elements of above- and below-ground biodiversity. A key new element in this research agenda will be bridging spatial and temporal scales, from the plot, farm, landscape and regional (watershed and river basin) perspectives.

The INRM approach will be driven by a few dominant system variables, including soil fertility management and water management. In addition to coping with the short- and long-term consequences of declining soil fertility, the approach will include assisting farmers to cope with limited and unreliable rainfall, aggravated weed pressure, overt losses from insect damage, post-harvest mechanisation and poor labour use efficiency, devalued formal services for knowledge, little or no credit and input support, and an insufficiently developed marketing infrastructure.

In short, the research will commence with participatory problem analysis and will review the status and causes of factors, such as food insecurity, increasing poverty, degrading natural environments, labour use inefficiency, inadequate input/output market, and policy constraints. These will inform the design of research on alternative solutions, which have three major components:

1. Production functions – which incorporate issues such as quantity of food and fibre, quality of products, genetic x environment matching and input/output markets;
2. Human well-being – which accounts for factors such as risk management, participation of resource users in decisions, knowledge base, direct/indirect benefits to the targeted communities; and
3. Ecosystem functions – which incorporate components such as nutrient cycling, carbon sequestration, biodiversity, water balance, weeds and insects.

The emerging alternative options for development will be analysed to assess the tradeoffs and competing interests, to identify ranges of flexible, adaptive options and to resolve market issues. From this analysis will

come a range of outcomes that, to have impact, will require extrapolation, dissemination, policy implementation, and wide-scale adoption. Knowledge and understanding derived from observation of the processes and from change agents and beneficiaries will be fed back to each stage of the process, particularly to participatory problem analysis.

The use of appropriate plants and livestock contributes significantly to soil management and system sustainability. This will be captured by research on adaptive management of appropriate germ plasm, building on plant and livestock research into identifying and improving breeds and varieties that are resistant to diseases and pests, and adapted to the biophysical constraints of different ecoregions of sub-Saharan Africa. These biophysical constraints include low soil fertility, drought and other features subject to the impact of climate change. This germ plasm research will take account of indigenous breeds and varieties with adaptive characteristics, and species domesticated to take advantage of niche markets for African farmers. It will also involve the preservation or enhancement of the natural enemies responsible for keeping insect, micro-organism and plant pests under control. The research will include analysis of the tradeoffs between different enterprises, and between increased productivity and increased adaptation to environmental stresses. The benefits will be assessed in terms of sustainably increased incomes and capital accumulation.

**Objective**

To design technologies, policies and institutional options that will stem and reverse the loss of natural resources, and in particular the degradation of soils, in sub-Saharan Africa.

**Potential Hypotheses**

1. That breaking farm level constraints to use of inorganic and organic fertilisers for maintenance of soil fertility and health will enable farmers to invest in other high-return production strategies;
2. That erosion, rather than nutrient export in agricultural products, is the principal source of soil degradation;
3. That modelling tools, combined with participatory approaches, can help develop new production system configurations, and evaluate their resilience and profitability under different biophysical, social and economic conditions;
4. That properly managed soils will both require, and contribute to, improved interactions between soil, water and biodiversity;
5. That reliable water supply, from either rainfall or irrigation, will encourage farmers to invest more in improving soil fertility;
6. That inclusion of individuals and farmers of both genders, communities and change agents in the research process ensures that interventions are developed to meet the needs of the end-users;
7. That livestock-owning households significantly influence the spatial distribution of nutrients across landscapes, pulling nutrients away from households with no livestock;
8. That increased inter- and intra-specific diversity broadens the genetic base of agricultural production systems, providing resilience and insurance against environmental adversities;
9. That a high level of diversity is crucial for increased food security, nutrition and health;
10. That water access for (informal) irrigation can significantly enhance market production (and access to inputs), and allows farmers to jump over the poverty line;
11. That improved (water saving/collecting) technologies for rainfed agriculture can significantly improve production potential, especially in water-limiting environments;
12. That integrated pest management is essential for full and sustainable production, and that it depends on effective soil management; and

## 5.2 DEVELOPMENT OF SUSTAINABLE MARKET CHAINS

Poorly understood and poorly organised market chains, poor linkage among elements, and missing elements, e.g., for farm inputs, severely limit the capacity of African smallholders to invest in soil improvements. The market constraints that they encounter when attempting to diversify their production have been well documented. The constraints include lack of access to market information, information asymmetry between

producers and sellers, and poorly organised input markets. Many of these problems have worsened since the implementation of market liberalisation policies because, while the public sector has withdrawn from providing many key marketing services, the necessary infrastructure and institutional support (credit, market regulation and information systems, quality standards, legal framework, etc.) are not yet in place to enable the private sector to take over.

**Objective**

To improve both input and output markets for smallholders in order increase their returns and options for generating incomes and income stability.

**Potential Hypotheses**

1. That markets are the most important determinants of adoption of improved soil management;
2. That inadequate input and output markets are important elements of poverty traps;
3. That cash crops are more important than staple crops for raising income levels of farmers;
4. That access to markets and inputs has not improved for many smallholder farmers in SSA, despite market liberalisation, because needed investments in rural infrastructure and in enabling environments for private sector development have not yet been made;
5. That credit remains a major incentive for investments and higher production in rural areas;
6. That producer organisations can play a key role in linking smallholder farmers to markets, especially for higher value products; and
7. Production of staple crops for local consumption can be profitable and will improve household nutritional status.

## 5.3 POLICIES FOR SUSTAINABLE AGRICULTURE

Research in this component will focus on the interface between technological change, institutional change and policy environments. This will contribute to the establishment of a policy framework that will ensure food security and promote agricultural production on a broad genetic base that is ecologically sustainable. The proximate causes of soil fertility depletion and productivity decline include decreased use of fallow and increased commercialisation of agriculture, without sufficient recycling and addition of soil nutrients or protection of soil from erosion, leaching and other mineral loss. There are many factors underlying these proximate causes, such as population pressure, poverty, lack of roads and other infrastructures, poor access to markets, limited farmer awareness of appropriate technologies, land fragmentation and tenure insecurity. Policy research is needed on the cause and effect relationships in different types of situations so that appropriate policy interventions can be identified.

Since there are few possibilities of expanding acreages, especially if water catchments and other vital environmental services are to be preserved, achieving the targets set in the African Vision will require intensification of agriculture. Therefore research is required to develop policies that facilitate the development, adaptation and dissemination of new technologies that, because of the diversity in agroclimatic conditions, and social and economic opportunities, must be adapted to local needs based on participatory approaches to designing interventions. The research must take account of the tradeoffs between private and social costs, and between benefits of soil, water and vegetation management at different scales, i.e., farm, community, national, and river basin scales, and design of institutions at different scales to support sustainable agriculture.

The objective will be to generate policy options that promote increased incomes, food security, fair trade and sustainable land and water use through the adoption of sustainable farming practices. Adoption of enabling policies will require efforts to better inform policy-makers, including involving them in the research.

New international markets involving transfer payments to land users for providing ecosystem services (biodiversity, carbon sequestration, watershed protection functions) are being developed through carbon-offset mechanisms. These potentially provide valuable opportunities to link the private sector with smallholders, but to date there are very few cases of such mechanisms in place in Africa. An example of the potential of transfer payments is provided by the NGO, FACE, which is facilitating an arrangement between farmers in Uganda and the private sector in the Netherlands. The farmers have been rehabilitating very

degraded lands in the vicinity of Mt Elgon National Park, and the private sector in the Netherlands is prepared to invest funds in tons of sequestered carbon in the south, particularly when this is done in a manner that benefits small-scale farmers and enables them to adopt sustainable practices. Before this can be taken up more widely, there are several policy and implementation questions that will have to be answered, especially in regard to validation and valuation of sequestered carbon.

Scientists engaged in this Challenge Programme will benefit from interactions with colleagues engaged in climate change research to ensure that their research will not duplicate but rather add value, especially by improving knowledge of field and pasture level soil carbon sequestration.

**Objective**

To generate policy options that promote increased incomes, food security, and sustainable land use through the adoption of sustainable farming practices.

**Potential Hypotheses**

1. That farmers in Africa will not implement integrated natural resource management without adequate tenure security, and without policies for access to essential inputs, including credit;
2. That INRM practices that provide desired common and private environmental services will not be possible without realistic valuation of, and compensation for, the benefits of the full range of ecosystem services provided by sustainable agriculture to all sectors of society;
3. That the full contribution of biodiversity in economic development and human well-being will not be fully realised without policies, and institutional and legal frameworks for conservation and sustainable use of genetic resources;
4. That public investments in generating sustainable farming options and reversing soil degradation have potentially large social returns, such as increased rural prosperity, reduced poverty, and slower rates of rural-urban migration;
5. That different types and mixes of policy instruments will be needed to respond to land degradation in sub-Saharan Africa, determined by prevailing agroclimatic and socio-economic conditions, national policies and market opportunities; and
6. That new institutional arrangements at community, regional, national and river basin levels are needed to enable users to manage water and land resources effectively.

## 5.4 SCIENTIFIC CAPACITY BUILDING

In recommending a special collaborative focus on Africa, the 3rd CGIAR Review Panel included the suggestion to *"set up an African Capacity Building Initiative for Sustainable Food Security as a major inter-center initiative. It should help train a cadre of African leaders who can assist the political leadership in their countries to remove policy constraints and develop a well-conceived strategy for food security."* In turn, an important goal stated in the African Vision for Agricultural Research is *"to achieve a cadre of qualified, experienced and motivated agricultural research and development specialists, managers, and policy makers to lead the region towards achieving its long-term goals."*

Over the past 30 years, there has been significant progress in building human and material capacity for agricultural research in Africa but it still falls far short of sufficient. Improvements are required, not only in the number and quality of scientists and technical resources, but also in research programme planning, systems management and governance. There is need for revitalising degree-training programmes in order to capitalise on the rich academic resources in African universities. A consultative process to assure that training responds to African needs has been established through the CGIAR-NARS Training Group.

The focus in this Challenge Programme component will be on building the capacity of researchers in Africa to encompass the new approaches involved in integrated natural resource management. The Programme will support the use of improved methodologies, and will encourage a move away from research aimed at generating publications to research that addresses priority problems identified by the intended beneficiaries, and that demonstrates a clear route to impact at farm and community levels. In addition to providing up-to-date, relevant material for undergraduate training, the Programme will provide opportunities for research for postgraduate degrees, for postdoctoral training and for research management at all levels. It will also address

the need to build the capacity of change agents to promote new approaches to integrated natural resource management; for example, through strengthened links between research institutions, community-based organisations and farmer groups. It will ensure that change agents are better informed of research results and of adaptive approaches to dissemination of information.

**Objective**

To build the capacity of researchers in sub-Saharan Africa to exploit new approaches to integrated natural resource management.

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## 6. PROGRAMME OUTPUTS AND IMPACTS

A focused set of key result areas has been identified to enable the Programme to achieve its objectives, by having measurable, beneficial impacts on smallholder livelihoods. These will bring the best and most appropriate science to bear on the development, adaptation and dissemination of new technologies and on improving the policy environments in which farmers operate. These key result areas include building the capacity of African agricultural researchers to lead the development of efficient, demand-driven, participatory and pluralistic agricultural research systems.

### 6.1 INTEGRATED NATURAL RESOURCE MANAGEMENT

By linking good soil management practices to whole-farm requirements for sustainable and profitable production, this research will provide change agents in the public and private sectors, as well as the farmers themselves, with menus of options and means for determining what is most appropriate for their own circumstances. It will also internalise participatory approaches to research for development in African national agricultural research and extension services and the NGO community. It will produce improved gender-sensitive extension materials and methods for individuals, farmer field schools, community-based organisations (CBOs) and farmer groups.

Farming systems will be made more resilient by the use of the most appropriate mixes of traditional and non-traditional, exotic and indigenous species, varieties and breeds, which are best suited to the economic and ecological circumstances of the producers. This is an important, and for livestock possibly the only, means of conserving farm plant and animal biodiversity.

Measurable impacts will include:

1. optimal efficiency of use of inorganic and organic inputs;
2. higher on-farm profitability;
3. better labour use efficiency;
4. improved soil, water and biodiversity management and conservation;
5. adopted sustainable pest management options;
6. improved soil quality and health;
7. higher agricultural production at the regional and national levels;
8. decreased/reversed trends in deforestation, nutrient depletion, soil erosion, genetic diversity erosion, and water pollution;
9. better system resilience to severe shocks such as drought, floods, etc;
10. improved human health through improved nutrition, enhanced water quality and biological pest control; and
11. enhanced capacity of farmers of both genders to manage their systems in a sustainable manner.

### 6.2 DEVELOPMENT OF SUSTAINABLE MARKET CHAINS

This research will produce recommendations for improving smallholder access to input and output markets through better information and organisation, and more effective and efficient delivery systems.

The measurable impacts will include:

1. improved farm gate prices;
2. improved instruments for smallholder credit;
3. more market opportunities for smallholders;
4. better incentives for farmers to invest in improved natural resource management practices, particularly soil management practices; and
5. greater volumes of farm produce marketed by smallholders.

### 6.3 POLICIES FOR SUSTAINABLE AGRICULTURE

This component of the Programme will provide policy-makers with viable options for promoting and enabling the adoption of technologies and marketing strategies for sustainable poverty alleviation. This in turn will result in reduced land degradation, better water management, and enhanced livelihoods for the rural poor.

The development of viable systems of transfer payments will provide opportunities for private sectors in industrial countries, especially multi-nationals, to contribute to improving farming practices in sub-Saharan Africa. This would provide African countries with win-win solutions for matching local returns with national benefits in negotiations over the extraction of raw materials.

The measurable impacts will include:

1. enhanced soil management for long-term production, particularly with respect to biodiversity, water, and land;
2. better-considered policies for enabling enhanced rural livelihoods based on sustainable practices;
3. more sustainable and more profitable agricultural sectors; and
4. enhanced involvement and capacity of policy-makers in natural resource management issues.

### 6.4 SCIENTIFIC CAPACITY BUILDING

Capacity building will be integral to all Programme activities in order to ensure the sustainability of the proven approaches, and continued adaptation by the African research community to new scientific challenges and opportunities. The Programme's contribution to capacity building will be:

1. enhanced capacities of NARS in natural resource management research, which will incorporate appropriate elements of sustainable use of genetic resources, integrated pest management, policy research, biotechnology, information technology, technology dissemination and impact assessment;
2. increased skills in participatory and gender-sensitive methods;
3. better trained African graduates, post-graduates and research managers;
4. NARS more skilled in managing organisational change and partnerships;
5. more cost-effective national research-and-dissemination systems;
6. better integration of agricultural and water management research; for example, by linking up to such water management research capacity building networks as WaterNet and CapNet; and
7. better integration of agricultural research and biodiversity conservation efforts.

## 7. SCALING UP AND ACHIEVING IMPACT

Ameliorating soil degradation and improving water management in sub-Saharan Africa will be associated in two-way cause-and-effect relationships, with improved productivity, enhanced ecosystem resilience, and improved livelihoods. The Programme will have short- medium- and long-term impacts, through actions and policies implemented at different scales, from farm level to community, national and river basin levels.

Scaling up, or spreading adoption of technologies and interventions to larger numbers of farmers will be achieved vertically and horizontally by involving the stakeholders right from the outset, as shown in Figure 2 below.

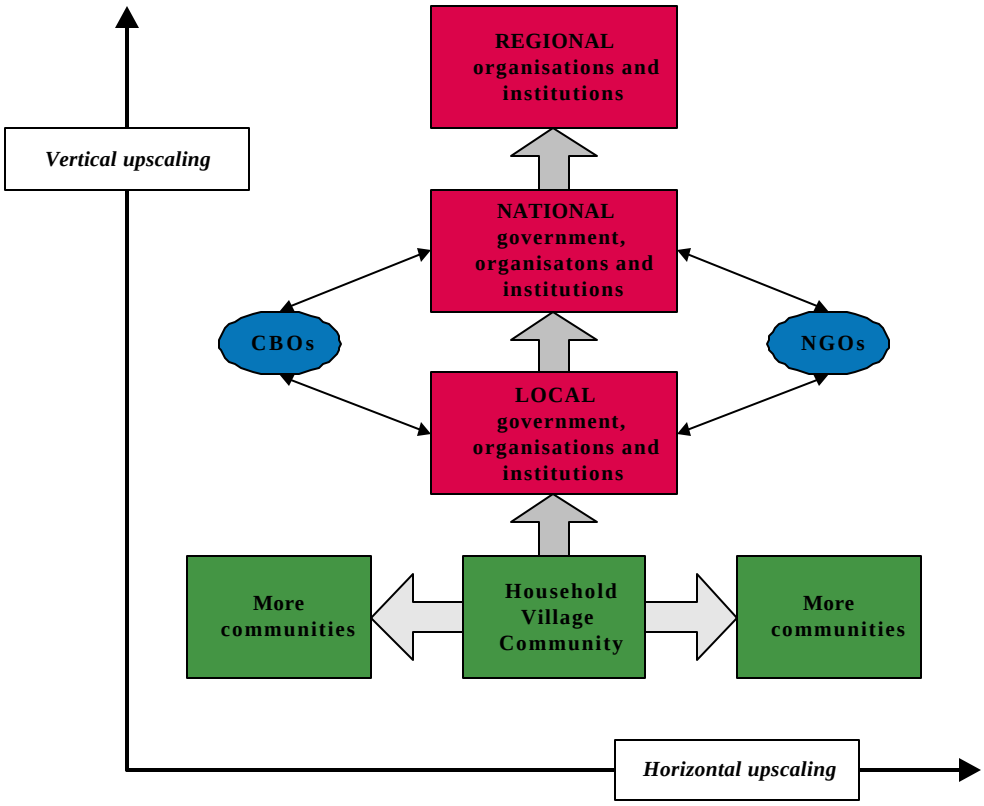


***Figure 2: Scaling up integrated natural resource management.***

The establishment of FARA, and the raised stature of the sub-regional organisations in the eyes of the governments of member countries and amongst the donor community, have created the basis for putting such a programme of partnerships into practice. The participatory approach of the Programme will ensure that the change agents, including the formal extension services, NGOs, private enterprise, CBOs and farmer groups are fully involved and well informed of the research outcomes. The research products will be presented to change agents in ways in which they can be readily understood and delivered to the farmers.

## 8. PROGRAMME INITIATION, CO-ORDINATION AND GOVERNANCE

The Programme will be initiated by stakeholder workshops, organised regionally by the SROs, which will clarify objectives, agree priorities and catalyse working relationships. The workshops will address procedures for:

1. establishing a steering committee,
2. holding further stakeholders meetings,
3. submitting proposals, and
4. initiating and accounting for activities.

The Programme Steering Committee will be chaired by FARA and comprised of the SROs and representatives of key stakeholders, including the CGIAR centres, other international agricultural research centres (IARCs), NARS (including universities), participating institutions from Asia, Europe and North America, NGOs, and private enterprises.

Specific details for governance and management of the Challenge Programme will be developed through further consultations during the development of the full proposal. However, the guiding principles have been developed and agreed in the extensive discussions among national, regional and international partners over the past years. These conform to the principles set out in the Durban Statement, i.e.:

- inclusive partnerships, which reach out to producer, agribusiness, and consumer organisations, as well as to other development-oriented NGOs;
- substantive agendas, based on programmatic priorities;
- operational efficiency, based on competition and decentralisation; as well as
- mutual respect and shared credit.

By adhering to the principal of subsidiarity, the Programme will have a management arrangement that will ensure minimal bureaucracy, but will allow for different approaches that are appropriate for East and Central Africa, West and Central Africa and Southern Africa, to enable them to be consistent with the priorities of ASARECA, CORAF/WECARD and SADC/FANR respectively.

The Programme Steering Committee (PSC) will provide overall oversight and leadership. FARA's involvement will ensure that the PSC has sufficient authority to make binding decisions on the collaborators. There will be sufficient representation of the CGIAR centres to ensure adherence to the CGIAR mission. The PSC will meet in full session once a year to receive reports from the Sub-regional Steering Committees, which will meet a minimum of once a year, and more frequently if necessary.

It is likely that the PSC will establish an independent Programme Advisory Committee (PAC) to provide independent scientific advice. Further discussion is required on whether there should be just one PAC or whether there should be sub-regional PACs. Once that is decided, FARA will lead consultations with stakeholders on the membership.

Participants in the May 2002 ASARECA conference proposed that, in the ASARECA region, programme management will be entrusted to the two committees that are being formed to manage the integration and harmonisation of CGIAR and NARS activities. A committee comprised of the Executive Secretaries of FARA, the SROs and Centre Directors will supervise the overall integration and harmonisation process of which the Challenge Programme is a component. This committee will meet once a year to provide oversight and develop the overall policies.

Day-to-day management and planning of research and capacity building initiatives will be entrusted to sub-regional management committees comprised of collaborating scientists, who will themselves determine their leadership. These will meet four times per year and will be synchronised with the sub-regional arrangements for advancing the integration and harmonisation process.

## 9. FUNDING STRATEGY

In August 2002, the components of this Programme were presented to the WSSD pre-summit meeting on ***Options for a Research Agenda to Achieve the Sustainable Development Objectives of NEPAD*** that was attended by FARA, the SROs and leaders in agricultural research and development. The programme is consistent with the priorities and approaches that will be advocated by Chapter 5 of NEPAD's Comprehensive Africa Agriculture Development Programme, the WSSD Action Plan chapter on Africa, and the five key thematic areas of Water, Energy, Health, Agriculture and Biodiversity and ecosystem management in the United Nations Secretary General's initiative for a coherent international approach to the implementation of sustainable development. In addition to received expressions of investor interest from, amongst others, the Commission of the European Union and the European Consortium for Agricultural Research and Training, the CGIAR's commitment to such an inclusive African-led programme will provide leveraging for the commitments to agricultural research and development indicated at Monterrey, G8 Summit and the WSSD. FARA will work with the partners in this programme in sourcing funding.

### 9.1 FINANCIAL RESOURCE REQUIREMENTS

Funding requirements are anticipated to be around US $25 million per year, over a period of five years, for a programme that will make significant impact in each of the three sub-regions through the involvement of diverse research providers in collaborative activities.

### 9.2 ALLOCATION OF FINANCIAL RESOURCES

It is envisaged that about 20% of the funds committed to the sub-Saharan African Challenge Programme will be devoted to core activities to ensure continuity and commitment of core institutions. About 10% will be directed to Africa-wide activities distributed through a competitive process managed by FARA. This will, for example, support research on continent-wide policy issues. The remaining funds will be subject to competition amongst consortia of institutions formed according to the task from NARS, IARCs, ARIs, NGOs, farmer groups and private enterprises. Preference will be given to proposals that demonstrate strong value-adding partnerships that are best suited to the time-bound task for which they are formed.

In addition to programme funds committed to the sub-Saharan African Challenge Programme, it is envisaged that substantial additional grants will be obtained through funding proposals submitted to investors by different consortia of institutions collaborating in the programme. The PSC will process, endorse and submit proposals that meet its criteria on behalf of the respective consortia.

## 10. ELEMENTS OF SUCCESS

There are four elements essential to the success of any CGIAR Challenge Programme:

1. grassroots buy-in and direction;
2. high level endorsement and support;
3. the capacity to do the job; and
4. congruence with regional and sub-regional research priorities.

This programme demonstrates all of these characteristics:

***Grassroots buy-in*** for the sub-Saharan African Challenge Programme has been assured by the long-standing engagement of all stakeholders in collaborative research projects. This was affirmed in the series of consultations that were involved in establishing the sub-regional organisations, and in developing the African Vision for Agricultural Research. It was endorsed and reinforced in the Meeting of Minds series of workshops.

***High-level endorsement and support*** for the Programme has been dramatically stated in Abuja October 2001 and at the WSSD in 2002. As noted above, Chapter 5 of NEPAD's Comprehensive Africa Agriculture Development Programme specifically recognises the critical need for the INRM research and the important collaborative role of the CGIAR.

***The capacity to do the job*** is assured by the emergence and strengthening of FARA and the SROs, and the commitment to collaboration by all research providers. The NARS, CGIAR centres, ARIs and their extensive networks of colleagues in advanced research institutions throughout the world are capable of focusing all the capabilities of modern science on the solution of sub-Saharan African agricultural and environmental problems.

***Congruence with regional and sub-regional priorities*** is derived from the involvement of FARA, ASARECA, CORAF/WECARD and SADC/FANR, ensuring that the Programme is fully in accord with regional priorities.

The Challenge Program will be designed and managed to take full advantage of existing assets, but it will require new funding, specifically invested to increase the impact of current research investments in stemming and reversing soil degradation in sub-Saharan Africa.

# ANNEXES

## ANNEX 1: THE DURBAN STATEMENT

### THE WAY FORWARD FOR AGRICULTURAL RESEARCH AND DEVELOPMENT IN SUB-SAHARAN AFRICA

1. Agriculture is the engine for improved rural livelihood and economic development in Sub-Saharan Africa (SSA). Recognizing this, the African political leaders have positioned agriculture at the center of their new vision for the future of the continent. In full support of this vision, the SSA agricultural research and development community has called for regional agricultural production to grow at an annual rate of 6% through 2020.
2. The African vision for agricultural research and development envisages that by 2020, the region should:
   - have dynamic agricultural markets among nations and between regions;
   - be a net exporter of agricultural products;
   - have food availability and affordability, equitable distribution of wealth;
   - be a strategic player in agricultural science and technology development, and
   - have a culture of sustainable use of the natural resource base.

   The target level of agricultural growth cannot be achieved without a focused and market-driven technology development and transfer system, an enabling policy environment, and effective institutions.
3. The considerable efforts and financial investments that have been made by national and international institutions over the past 30 years have had limited pay-offs. At the present time, SSA is still dealing with first order challenges of increasing agricultural productivity, lagging behind most of the rest of the world. Additionally, new challenges that threaten the potential of agriculture to contribute to sustainable economic development in SSA have emerged. These include increasing urbanization, globalization and market competitiveness, environmental and natural resource issues (land degradation and desertification, water scarcity and competing demands for water, deforestation, loss of biological diversity, climate change, etc), and the devastating impact of HIV/AIDS.
4. To address these challenges, we, the members of the SSA agricultural research and development community, recognize that effective and broadened partnerships are essential. The national agricultural research systems (NARS) must play a central role in these partnerships. The African countries have made considerable efforts, over the past decades, to develop a solid base-line research infrastructure. In order to harness these resources, the NARS have taken the initiative towards reforming themselves for greater accountability, fiscal stability and impact. They have also strengthened regional collaboration through the formation and development of sub-regional organizations (SROs), and more recently through the creation of the Forum for Agricultural Research in Africa (FARA). The light structures coordinate many decentralized networks, based on subsidiarity principles and increasingly on competition. Other partners, including the CGIAR Centers, have similarly responded to the challenge through more intensive consultation with NARS and greater collaboration among themselves.
5. The way forward is to build on the gains already made. We, the members of the SSA agricultural research and development community hereby agree to commit ourselves to pursue the stated Vision:
   - through the following lines of action:
     - develop and disseminate technologies for increased agricultural productivity and sound natural resource management;
     - utilize the benefits offered by the emerging technologies including information and communication technology, and safe use of biotechnology;
   - guided by the principles of:
     - inclusive partnerships which reach out to producers, agribusiness, and consumers organizations, as well as other development-oriented non-governmental organizations (NGOs);

- substantive agenda based on programmatic priorities;
- operational efficiency based on competition and decentralization;
- mutual respect and shared credit;

- and using the following instruments:
  - high quality human capital,
  - increased and sustained financing, and
  - effective institutions.

6. On the occasion of the CGIAR Mid-term Meeting held in Durban, South Africa, we call upon:

   - the SSA governments to translate their political commitment to agricultural development into concrete actions by providing the necessary resources and creating an enabling policy and institutional environment;
   - the SSA governments to ensure that issues of sustainable agriculture receive their due place on the agenda of the Johannesburg Earth Summit
   - FARA, with the support of the Global Forum on Agricultural Research (GFAR), to play an advocacy role to place agricultural research at the center of the SSA agricultural development agenda;
   - the international investor community to coordinate its efforts, and significantly increase and sustain financial support for African agricultural research;
   - the international agricultural research system, including the CGIAR Centers and advanced research institutions, to forge more effective and efficient partnerships with African NARS and achieve greater programmatic integration; and
   - the CGIAR System to ensure that the proposed changes in program, governance structure, and funding mechanisms are consistent and reinforce our efforts to achieve the African Vision.

- **Forum for Agricultural Research in Africa (FARA)**
- **Special Program for African Agricultural Research (SPAAR)**
- **Association for Agricultural Research in East and Central Africa (ASARECA)**
- **Conférence des Responsables de la Recherche Agronomique en Afrique de l'Ouest et du Centre (CORAF/WECARD)**
- **Southern African Center for Agricultural Research (SACCAR)**
- **CGIAR - Supported Future Harvest Centers**

**Durban, South Africa**
**May 22, 2001**

## ANNEX 2: ELEMENTS OF THE SHARED VISION DEVELOPED AT THE MEETING OF MINDS I

The CGIAR centers support the shared vision through the added value that they bring to collaborative activities. In particular, the CGIAR centers contribute new research approaches in natural resource management and policy, the strengthening of management sciences, the leveraging of funds and fortifying the research development continuum. In addition the CGIAR Centers occupy a strategic place in the NARI to ARI partnership continuum. Based on the discussions among participants, the following elements and key principles emerged to guide the development of the strategy to implement the shared vision

1. In support of the African Vision: CGIAR Centers will, in collaboration with National Agricultural Research Institutes (NARIs) and other African partners, contribute to the generation of international public goods in support of the African vision. The CGIAR centers are committed to enhancing African leadership at all levels of the research development continuum with collaboration based on African priorities.

2. Identification of Strategic Partners: In order to accelerate impact at the farm level, the CGIAR recognizes the need to work with a broader range of partners directly involved in agricultural research and development. Emphasis will be on collaborative activities where impact is achieved at the farmer level through demand-driven participatory research.

3. Capacity Building: Through the NARS, the CGIAR Centers will contribute to strengthening human and institutional capacity. These needs include, but go well beyond, the strengthening of research skills. There is urgent need for strengthening capacity in the management and leadership of collaborative research and resource mobilization. Technological and policy research are both essential in tackling these complex issues and are inexorably inter-linked. The CGIAR intends to strengthen the policy research capacity of NARS, though joint research on methodologies, multi-country comparisons, and responding to requests from policymakers as joint NARS-CGIAR activities.

4. Promotion of Increased Public Investment: Through the demonstration and documentation of large-scale impact from research, the CGIAR will assist NARS to encourage decision makers to increase investments in the public financing of agricultural research. The CGIAR will apply whatever leverage its components have to help attain the goal of increased public investment for all concerned in agricultural research.

5. Fostering Institutional Innovation: The CGIAR will foster innovations in partner organizations through appropriate methods including participatory research, integrated natural resource management approaches, and will contribute through action research to development of alternative institutional arrangements for technology development and delivery systems. The CGIAR Centers will facilitate access to information and enhance communication between NARS and CGIAR Centers and among NARS partners

6. Mutual Ownership: As a guiding principle, mutual ownership of collaborative activities will be enhanced through full commitment of NARS and CGIAR Centers to joint planning and implementation, monitoring and evaluation. The purpose is to achieve interdependence between the NARS and the CGIAR Centers to help attain the goals of all concerned. To ensure complementarity and added value, collaborative activities between NARS and CGIAR Centers will be based on comparative advantages to ensure efficient use of limited human and physical resources.

7. Coordination among CGIAR Centers: CGIAR centers that are actively involved in SSA will coordinate their activities at the national, sub regional and regional level, with the oversight of the Committee on Sub-Saharan Africa of the CDC.

## ANNEX 3: INSIGHT – RESEARCH TO INTEGRATE PRODUCTIVITY ENHANCEMENT, ENVIRONMENTAL PROTECTION, AND HUMAN DEVELOPMENT[1]

***Jeffrey A. Sayer[1] and Bruce Campbell[2]***
*[1]WWF (World Wildlife Fund); [2]CIFOR (Center for International Forestry Research)*



### ABSTRACT

To meet the challenges of poverty and environmental sustainability, a different kind of research will be needed. This research will need to embrace the complexity of these systems by redirecting the objectives of research toward enhancing adaptive capacity, by incorporating more participatory approaches, by embracing key principles such as multi-scale analysis and intervention, and by the use of a variety of tools (e.g., systems analysis, information management tools, and impact assessment tools). Integration will be the key concept in the new approach; integration across scales, components, stakeholders, and disciplines. Integrated approaches, as described in this Special Feature, will require changes in the culture and organization of research.

### Key Words

adaptive capacity, decision making, impact assessment, integration, scale, social learning, systems modeling.

### INTRODUCTION

In the 1960s, a huge gap existed between the technologies used by farmers in developed countries and those available to poor farmers in the tropics and subtropics. International development assistance agencies have made major investments during the past 40 years in attempts to develop advanced agricultural technologies for poor tropical countries. The research centers supported by the Consultative Group for International Agricultural Research (CGIAR) have been major conduits for this aid. The CGIAR supports 16 international

[1] Not including Figures.

research centers with a combined budget of US $350 million per annum. These efforts are widely credited with having averted large-scale famines that had been anticipated in Asia in the 1970s and 1980s. The impacts of such research have been more modest in addressing the needs of Africa. Much of this research adapted technologies from developed countries to conditions in developing countries; it targeted innovations that could yield quick benefits to respond to urgent needs. Major investments went into genetic improvement of a few commodity crops to enhance productivity and improve resistance to pests and diseases. The gains were largely confined to areas of high agricultural potential, and they often benefited the more prosperous farmers, missing the poorest of the poor. In many cases, this research yielded short-term gains at the expense of long-term degradation of soils, water, biodiversity, and non-cultivated land. The initial spectacular gains of the green revolution are unlikely to be maintained (Conway 1997).

There is now widespread recognition that the sustained improvement of the well-being of poor farmers in developing countries will require a different kind of research. Cutting-edge agricultural technology is still needed, but it has to be set in local contexts and be applied in ways that recognize the special conditions of poor farmers. It will have to give more emphasis to management of risks, reduction of dependence on agricultural inputs, avoidance of long-term depletion of productive potential, and more careful control of environmental externalities (Conway 1997). The advent of economic globalization and the increasing domination of agriculture by a few large companies pose special risks for the poor (Korten 1995). Equity in the distribution of benefits is emerging as a major issue.

Green revolution science underestimated the complexity of the systems in which small-scale producers operate. Crop production, for example, is usually only a small part of a broad livelihood portfolio that may encompass a wide variety of off-farm activities, the gathering of forest products, the raising of livestock, etc. Productivity enhancement will remain important, but risk reduction, improved food security, and the maintenance of social capital will assume greater importance. The farming systems of poor people in the tropics are subject to a multitude of exogenous influences. For instance, they are subject to highly variable rainfall, especially in semiarid areas, a constantly changing economic climate with resulting swings in input costs and market prices, dynamic land use changes, and various other episodic events (e.g., the massive rise in AIDS in Africa; widespread fires associated with El Nino events in southeast Asia, etc.).

Research on complex systems is not simple, because of multiple scales of interaction and response; a high frequency of nonlinearity, uncertainty, and time lags; and multiple stakeholders with often contrasting objectives and activities. Furthermore, many earlier attempts to conduct research at the level of large, complex systems are widely seen to have generated needs for excessive amounts of data, to have been very costly to conduct, and to have yielded few results of immediate practical value. This problem has become particularly important in the context of funding allocation strategies based upon ex-post analysis of the impact of research on production. It has been very difficult to attribute any direct impact to much of the research that has been conducted on complex farming systems. This has led many to conclude that natural resource management or agro-ecosystem research is an expensive luxury.

In August 2000, the CGIAR convened a meeting in Penang, Malaysia to address these dilemmas faced by natural resource researchers and to examine ways in which research might be redirected to meet the challenges.

This volume brings together a selection of the papers that formed the subject of the Penang meeting. Papers and discussion at the meeting yielded significant new insights into the ways in which the CGIAR and similar research institutions might modify their way of doing business. The focus was on the use of techniques and approaches drawn from a number of fields of science to yield results with short-term benefits for the poor and their environment. The key components of this new vision of integrated natural resource management (INRM) will be discussed. They involve an interlinked package including: (1) the reorientation of the objectives of research, (2) adding weight to participatory approaches to implementing the research, (3) a series of principles that underlie the research (e.g., broadening temporal and spatial scales of analysis), and (4) the use of a variety of analytical tools (e.g., systems analysis, information management tools).

## THE OBJECTIVE OF INRM: TOWARD ADAPTIVE CAPACITY

In mainstream productivity enhancement research, the prime objective is to improve yields of the dominant crops using plot-specific technologies. In a multi-stakeholder situation with small-scale producers, there will be multiple objectives, and it is unlikely that any single production objective will suit all stakeholders. Standardized technologies that work in many contexts will be only part of the solution. Given the

complexity and dynamism of systems, one of the prime objectives will be to improve the adaptive capacity of the system, i.e., its ability to sustain a flow of the diverse products and services that poor people depend upon, and to do so under constantly changing conditions. Research will need to strengthen the farmer's ability to manage a broad range of production factors, thus increasing her flexibility and her ability to respond to exogenous influences (Hagmann et al, 2002). Considerable focus will be on the managers themselves, helping them to achieve the skills and acquire the technologies that will enhance their control over their own destinies (Lynam et al, 2002, Lal et al, 2001). High-technology research on the components of agricultural systems is still vital, but it has to be placed in the context of specific biophysical and socioeconomic conditions.

## THE APPROACH: LEARNING TOGETHER FOR CHANGE

Three key elements form part of the approach to implementing INRM: (1) management needs to be adaptive; (2) INRM must move further along the research -management continuum; and (3) the approach must provide for, and be based upon, negotiation among all stakeholders. INRM research draws heavily upon, and reflects the advances in, our understanding of social learning (Daniels and Walker 1999, Hagmann 1999, Maarleveld and Dangbégnon 1999). Thus INRM must be based upon continuous dialogue and deliberation among stakeholders; this incorporates adaptive management as well as political processes related to conflict among stakeholders. Ultimately, in the ideal scenario, all management is experimental and all research involves managers; there is little distinction between management and research (Roussel et al, 1991). Natural resource management is like jazz; it requires constant improvisation. This implies that researchers can no longer remain exclusively external actors, but need to engage themselves in action research to develop appropriate solutions together with resource users (Hagmann et al, 2002). Good process facilitation is an essential component of its implementation. This process facilitation is a formal scientific equivalent of the rituals and traditions that socialize complex resource management processes in all human societies.

Natural resource managers are constantly confronted with surprises. Stakeholders change their aspirations, and exogenous factors have unpredicted influences on the system. Managers have to deal with uncertainty and changing targets. One of the key lessons in dealing with complex systems, therefore, is that management must be organized in a way that promotes active and conscious individual and social learning. The inverse relationship between the complexity of systems and our ability to make precise, and yet significant, statements about their behavior suggests that sustainable management of natural resources must be adaptive (Zadeh 1973, Holling and Meffe 1996). The steps within our adaptive management cycle are (1) subsystem definition; (2) reflection and negotiation; (3) action; and (4) evaluation, readjustment, and adaptation. As a result of the evaluation, we move back into the reflective phase and update our conceptualization of the system. This adaptive management cycle is discussed in several papers in this volume (Hagmann et al, 2002, Harrington et al, 2001, van Noordwijk et al, 2001, Lai et al, 2001, Lynam et al, 2002, Douthwaite et al, 2001)

In the adaptive learning cycle, researchers are one, among many, stakeholder groups. The research is conducted as part of an experimental management process involving the full range of stakeholders. Thus, participatory approaches are fundamental and collective action is the norm (Douthwaite et al, 2001, Hagmann et al, 2002). Because numerous stakeholders are involved, negotiation processes are key to the action cycle; thus, actions are an outcome of various negotiation processes. Negotiation occurs throughout the adaptive management cycle, in particular in establishing a common vision during the reflective stage, and in selecting options for implementation in the action phase. Given the emphasis on multiple stakeholders, it is not surprising that many of the successful cases of INRM have as a key objective the development of social capital (Garrity et al, In press; Lovell et al, 2002).

## UNDERLYING PRINCIPLES: GOING TO SCALE BUT REMAINING PRACTICAL

### Multiple Scales of Analysis

A key feature of INRM is its attempt to integrate across spatial and temporal scales. INRM research should never involve just a single snapshot in space or time. In the real world, different processes are taking place over different time frames; some processes will be studied using short time frames, whereas others may have to be studied over decades, usually only possible through simulation (Lovell et al, 2002). As a result, INRM research usually does not involve a simple learning cycle. It will normally depend upon a number of

interlinked and superimposed learning cycles, as some phenomena will have been through many learning cycles, whereas others may not even complete a single cycle within the project timeframe. It is particularly important for INRM research to take slow variables into account. These slow-changing variables affect the dynamics of more rapidly cycling processes and may exceed thresholds or trigger breakpoints, thus causing sudden and surprising shifts in systems. Accumulations of toxic chemicals in soils, water, and organisms, gradual erosion of soil fertility, and depletion of groundwater are all slow variables that need to be tracked in studies of complex resource systems.

Generally, INRM research will never be conducted at a single spatial scale; work often will be required at three scales (Allan and Starr 1982, Holland 1995). Thus, work at the farm/household level may require component studies at lower levels, such as the plot level or the intra-household level, to understand the important processes that lead to the emerging characteristics at the farm/household level. Work at the farm/household level will also generally require work at higher levels, e.g., at the institutional framework established by local government. Two components of spatial scale can be recognized, a biophysical component (from plots to global scales) and an institutional component (from household norms of behavior to global policy instruments). These are not usually congruent, thus adding further complexity (Lovell et al, 2002).

**Decision-making Processes**

Many conceptual models of INRM focus on decision-making processes. Lal et al, (2001) go so far as to term the learning cycle in INRM the "Adaptive Decision-Making Process". Decisions by individuals or households to adopt or not adopt new technology or land use practices depend on a multitude of factors and external influences that will vary from situation to situation, and will be dependent on incentive structures, information flows, etc. (van Noordwijk et al, 2001). Central to the decision-making process is the analysis of trade-offs and competing interests (Garrity et al, In press; van Noordwijk et al, 2001). In much INRM research, the farm household is selected as the main decision-making unit (Lal et al, 2001). Although this may be appropriate in many circumstances, there are situations, most notably involving common property systems, in which other stakeholders at other spatial scales may be key.

**Plausible Promises**

INRM should lead to tangible benefits on the ground; it must be a problem-solving approach (Hagmann et al, 2002, Harrington et al, 2001, van Noordwijk et al, 2001). The motivation to jointly engage in experimentation and research is that there is some "plausible promise" of a beneficial change (Douthwaite et al, 2001). Plausible promises are often made with reference to "best-bet" interventions involving technological and/or institutional innovations. The successful INRM cases are invariably built around very specific intervention possibilities that achieve adaptation and uptake (Garrity et al, In press; Hagmann et al, 2002).

**Scaling Up: Going Beyond the Specific**

INRM research, because it considers numerous variables, many of which are locality specific, has been criticized for yielding only local solutions. However, if natural resource systems are characterized adequately and variables are measured across the full range of variation of the system, then INRM models will yield results that have application across broad ecoregional domains.

The dissemination of conventional agricultural technology research products, e.g., high-yielding crop varieties, follows a simple linear route from researcher to extension worker to farmer (the 'transfer of technology' model). INRM research does not yield technological packages amenable to this sort of dissemination (Douthwaite et al, 2001). In INRM, the farmers, extension officers, and researchers are all stakeholders, participating from the initiation of the research. (Lovell et al, 2002) conclude that scaling up to benefit many people is largely a function of planning and investment at the outset to create the enabling environment that will meet various pre-conditions for scaling up. One of the conditions for scaling up is the adequacy of social capital (Lovell et al, 2002, Hagmann et al, 2002). Scaling up is most likely to happen in the INRM approach if top-down and bottom-up approaches to development are properly reconciled. Both are likely to be needed for an effective delivery of benefits from INRM research (Lovell et al, 2002). The adaptive management cycle is key to scaling up: repeated learning cycles ensure an improvement in the

"plausible promise' through its adaptation to existing systems by ever larger number of producers (Douthwaite et al, 2001).

Any INRM research endeavor should usually have impacts at a number of spatial and temporal scales (Harrington et al, 2001; Lovell et al, 2002; Jones and Thornton, 2002). The work of Hagmann et al (2001) provides an example of impacts at multiple scales. These authors undertook research that spanned from the plot to the policy scale; their work resulted in successful interventions at the plot level and important reorientation of thinking within the national extension service.

## THE TOOLS FOR INRM: CONFRONTING COMPLEXITY

### Systems Modeling

The problems of nonlinearities, unpredictability, and time lags in natural resource systems suggest that systems modeling is a fundamental tool for INRM research. Systems modeling is appropriate at many points in the adaptive management cycle. It can be used to conceptualize the system, to build a common understanding among stakeholders, to identify leverage points for interventions, to analyze different scenarios, to form the basis of decision support systems, to assist in stakeholder negotiations, to identify systems performance indicators and to assist in evaluation of impacts (Campbell et al, 2001; Lal et al, 2001; Lynam et al, 2002; van Noordwijk et al, 2001).

Negative attitudes toward modeling abound, often based on the heavy data requirements of large and complex simulation models. Although such complex models undoubtedly have their place, we are attracted by the concept of "throw-away" models, working computer-implemented models that are built in a few days to solve a particular problem and then are discarded. Much recent INRM research has used participatory modeling, in which stakeholders assist in the development of models and model results are fed back to communities using participatory techniques such as role plays (Lynam et al, 2002).

Across-scale modeling is in its infancy in NRM. Jones and Thornton (2002) demonstrate a method whereby plot-level models can be run for large extrapolation domains and the results can be aggregated to provide useful information at the regional level. Jones and Thornton (2002) also demonstrate the use of a series of interconnected models, ranging from global to plot models.

### Decision and Negotiation Support Tools

Given the complexity of INRM systems, it is likely that some kinds of decision or negotiation support tools will be necessary. The term "decision support system" suggests that a single management authority will make decisions that will then be imposed on the various actors and stakeholders. Thus, van Noordwijk et a1 (2001) prefer the term "negotiation support system". To function adequately, a negotiation support tool, itself, must be the subject of negotiation and shared development efforts between stakeholders (van Noordwijk et a1, 2001; Garrity et al, In press; Lal et al, 2001) conclude that using a decision support tool that is built in a participatory manner will increase the chance of achieving a shared vision.

### Multiscale Databases

Increasingly, decision support systems or systems models are being linked to a variety of databases. Even when not linked in this manner, INRM will invariably require that data from different sources be managed in some kind of database. Data can be of a spatial or nonspatial nature, and both qualitative and quantitative data can be included. Geographical Information Systems are usually involved in the data management system. Jones and Thornton (2002) demonstrate the use of databases at various scales that are linked to modes at various scales. GIS and modeling are also crucial for scaling up. As Harrington et al, (2001) note, such tools should not be abused to support top-down mechanical extrapolation of technologies; rather, stakeholder decisions should be informed by spatial analysis.

### Impact Assessment

Impact assessment is a key feature of INRM, being a tool for adaptation, learning and performance enhancement; providing data for further negotiation among stakeholders; and for resource allocation decisions. Hagmann (2001) pleads for more focus on developing plausible strategies on how research contributes effectively to impact, and then for regular monitoring of the implementation of these strategies, rather than carrying out impact assessment studies that are not linked to the learning cycle. Indicators for

evaluation must be selected at an early stage of the work. To select indicators from the vast array of possibilities, Campbell et al (2001) and Gottret and White (2001) suggest that the capital assets concept may be an appropriate organizing principle, whereas Bossel, (2001) suggests that systems concepts should guide indicator selection. A number of papers in this volume focus on the use of indicators (Bossel, 2001; Campbell et al, 2001; Gottret and White, 2001). The approach advocated here is unlike that used in conventional impact assessment of agricultural research, which generally focuses on ex-post measures of crop yields. Classic ex-post impact assessment tools can be compared to end-of-year school exams, whereas INRM impact assessment tools should be seen as equivalent to continuous assessment.

## THE WAY FORWARD

The successful examples of INRM research are those that have drawn upon and have integrated tools and concepts from different disciplines and scientific fields. This is what distinguishes modern approaches to INRM from some earlier discipline-based studies of natural resource problems. If the real needs of poor farmers in developing countries are to be met, then integrated approaches are essential. The farmers themselves are practicing integrated management of their resources, basing their management on knowledge acquired over generations (Berkes et al, 2000). Effective INRM research should link seamlessly with the knowledge of the client farmers. If scientists continue to operate in a simple, reductionist, technological world, they will fail to achieve the potential pay-offs that could be obtained by linking modern science to the traditional knowledge base. More importantly, however, changes occurring in the world defy the understanding of the small farmer. Macro-economic changes, increased climate variability, etc., will be major determinants of human well-being in poor countries, and science must contribute understanding of these phenomena to research on the system. Similarly, the development trajectories followed by the poor will have major implications for the global environment.

The world is becoming more integrated, and integration emerges as the most important concept in the INRM approach: there is a need to integrate across disciplines, across scales, across stakeholders, and across components (Lal et al, 2001). However, the marginal costs of adding each additional component into the system have to be considered and have to be less than the marginal benefits of such additions. A clear articulation of the problem, plausible solutions, and tangible potential benefits must still underlie all research investments.

A common criticism of the ecological approach to NRM is that it attempts to describe a multicomponent system in which everything is connected to everything else, and that such complexity defeats useful analysis. Recent theory and supporting observation suggest, however, that this complexity is not boundless, but has its own natural subdivisions and boundaries, and that 3-5 key variables often drive any particular system (Holling et al, 2000). Thus, defining a set of key processes and components can yield progress toward a goal of sustainable production.

Integrated approaches to natural resource management, as described in this volume, will require major changes in the culture and organization of research (Ashby, 2001; Hagmann et al, 2002). It is a new way of doing business. The management environment is faced with a long-term future that is unknowable; it has to deal with non-equilibrium conditions, multiple aspirations, and ambiguity. Although we see INRM being built on a social learning process, we also see the organizations involved in INRM becoming learning organizations, in which top management promotes institutional flexibility, conditions favorable to complex learning, integration of scientists with other stakeholders, etc.

Many of the arguments used in this paper are similar to those that predominate in the modern management science that is taught in business schools. Many of the problems of managing complex natural resource systems are similar to those of running a commercial company in a rapidly changing world. However, agricultural, forestry, and other NRM institutions have mostly evolved to deal with much simpler and more predictable conditions. They now have to change. Reconciling the need for increased supplies of food and fibers with the need to maintain the environment and to do this in a way that can bring a billion people out of absolute poverty is not a problem that can be solved by laboratory science alone. We need a predictive science that can enable us to produce more, to do so sustainably, and to do so on the basis of a limited resource base. This is the modern science of INRM that we describe in this volume.

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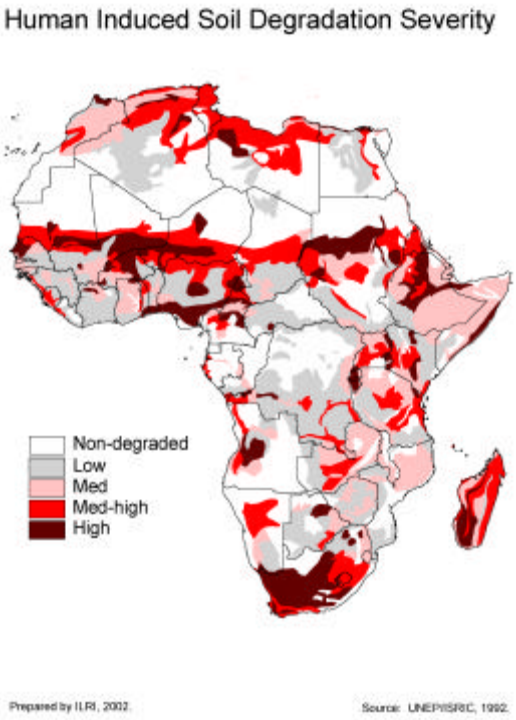
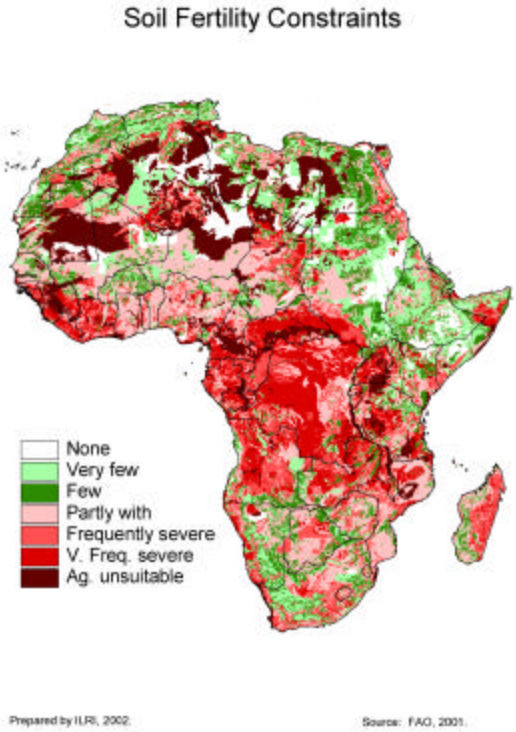
## ANNEX 4: MAPS

***Figure 3: Human induced soil degradation severity and soil fertility constraints***



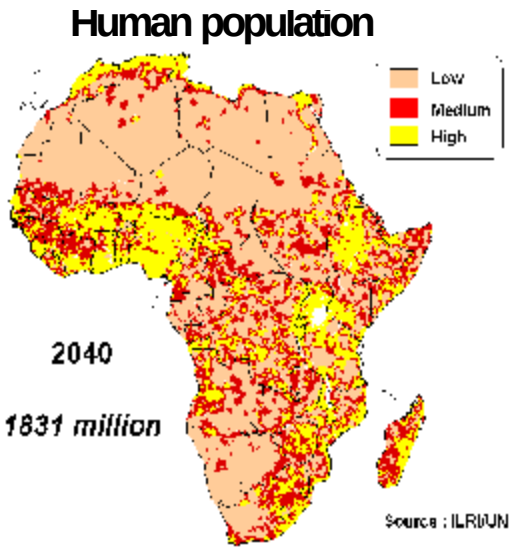



*Figure 4: Projected human population changes between 2000 and 2040*

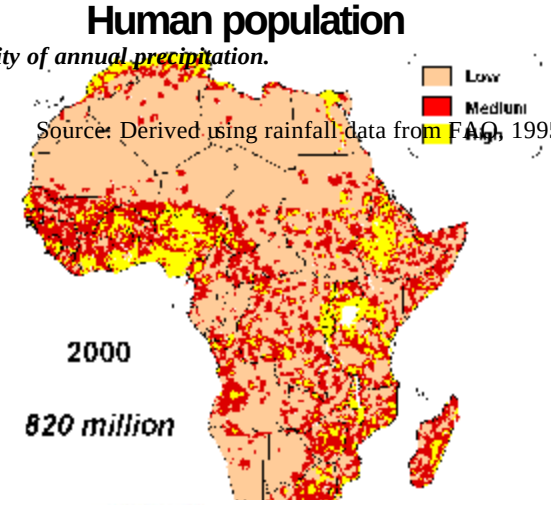
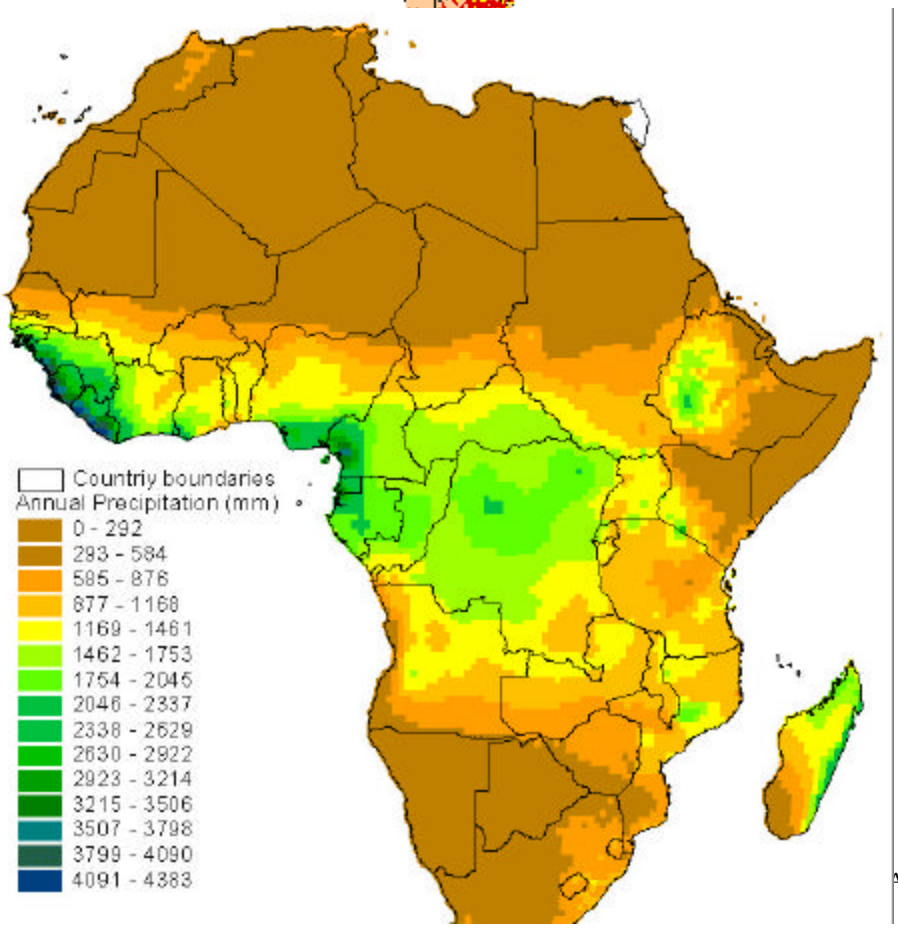



*Figure 5: Spatial variability of annual precipitation.*

Source: Derived using rainfall data from FAO, 1995.



## ANNEX 5: ACRONYMS

| | | |
|---|---|---|
| ARI | – | advanced research institute |
| ASARECA | – | Association for Strengthening Agricultural Research in East and Central Africa |
| CAADP | – | Comprehensive Africa Agriculture Development Programme |
| CBO | – | community-based organisation |
| CORAF/WECARD | – | Conseil Ouest Africain Pour la Recherche et le Developpement Agricole/West and Central African Council for Agricultural Research and Development |
| ECART | – | European Consortium for Agricultural Research and Training |
| FAO | – | Food and Agriculture Organization of the United Nations |
| FARA | – | Forum for Agricultural Research in Africa |
| IARC | – | international agricultural research centre |
| INRM | – | integrated natural resource management |
| IPM | – | integrated pest management |
| ISFM | – | integrated soil fertility management |
| N | – | nitrogen |
| NARES | – | national agricultural research and extensions systems |
| NARS | – | national agricultural research systems |
| NEPAD | – | New Partnership for Africa's Development |
| NGO | – | non-governmental organisation |
| P | – | phosphorus |
| PAC | – | Programme Advisory Committee |
| PSC | – | Programme Steering Committee |
| SADC/FANR | – | Southern African Development Community (SADC), Food Agriculture and Natural Resources Department (FANR) |
| SRO | – | sub-regional organisation, e.g., ASARECA |
| WEHAB | – | Water, Energy, Health, Agriculture and Biodiversity and ecosystem management |
| WSSD | – | World Summit on Sustainable Development |

**CHALLENGE PROGRAM**
**IMPROVING LIVELIHOODS AND NATURAL RESOURCE MANAGEMENT**
**IN SUB-SAHARAN AFRICA: Securing the future for Africa's children**

**PLAN FOR FULL PROPOSAL DEVELOPMENT**

FARA requests US $200,000 to meet the cost of developing the full proposal and business plan. The development process will involve:

| | **Activity** | **Year 2002** |
|---|---|---|
| 1. | Consultant engaged to oversee the proposal development process | December |
| | | **Year 2003** |
| 2. | The consultant would be responsible for:<br>- Organizing and facilitating electronic and physical regional consultations with stakeholders in West and Central Africa and Eastern and Southern Africa;<br>- Developing the workshops' recommendations into a cohesive draft proposal | February - March |
| 3. | Circulate the draft proposal to all stakeholders | April |
| 4. | The Consultant will coordinate work to:<br>• Obtain feedback from the stakeholders, and with them<br>• Refine the draft proposal | April |
| | • Task force meetings Develop a business plan for the each research theme and the proposal as a whole<br>• Develop recommendations for collaborative arrangements, governance and management. | May |
| 5. | Finalize the proposal | June |
| 8. | Stakeholders Meeting to approve the proposal | June |
| 9. | Submit the proposal | June |

Notes:

1. The consultant will report to an interim Program Steering Committee, which may be comprised of the Chairs of FARA, ASARECA, CORAF, SACCAR the Center Directors sub-committee for sub-Saharan Africa and a representative of non-CGIAR advanced centres. Amongst the questions that will have to be answered during the development of the full proposal are who should be on the Program Steering Committee, how they will be chosen and when and how it will be established.

2. It is expected that there will be a single challenge program for sub-Saharan Africa with three sub-components, one each for ASARECA, CORAF/WECARD and SACCAR regions. These regions are expected to have different emphasis within the common themes

3. The business plan will provide a detailed operational and fund raising strategy. In addition to received expressions of support there are good prospects for new funding components of this program from bilateral and regional funds such as the European Development Fund because sub-Saharan Africa is high on donors priorities

**Budget**

| | **Activity** | **Budget US $** |
|---|---|---|
| | | |
| 1. | Consultant engaged to oversee the proposal development process | 40,000 |
| | | |
| 2. | - electronic and physical regional consultations with stakeholders in West and Central Africa and Eastern and Southern Africa;<br>- Developing draft proposal | 10,000 |
| 3. | Circulate the draft proposal to all stakeholders | 5,000 |
| 4. | • Obtaining feedback from the stakeholders, and with them<br>• Refining the draft proposal | 10,000 |
| | • Task force meetings to develop a business plan for the each research theme and the proposal as a whole<br>• Develop recommendations for collaborative arrangements, governance and management. | 40,000 |
| 5.<br>8. | Finalize the proposal<br>Stakeholders Meeting to approve the final proposal | 50,000 |
| 9. | Submit the proposal | |
| | Administration and secretarial services | 10,000 |
| | Travel | 10,000 |
| | Communications | 5,000 |
| | Contingencies | 20,000 |
| Total | | 200,000 |