ASARECA
Transforming Agriculture for Improved Livelihoods

Natural Resource Management and Biodiversity Programme

Vision and Strategy
2009 – 2014




Responding to challenges of enhancing sustainable livelihood systems in Eastern and Central Africa Sub-Region

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Correct citation
[ASARECA] Association for Strengthening Agricultural Research in Eastern and Central Africa. 2009. *Natural Resource Management and Biodiversity Programme Vision and Strategy 2009 – 2014*

ISBN: 978-92-95070-38-7. print
ISBN: 978-92-95070-39-4. pdf

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Natural Resource Management and Biodiversity Programme
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Preface

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) was established in September 1994 and comprises ten member countries: Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda.

ASARECA is a sub-regional not-for-profit organization whose mission is:
To enhance regional collective action in agricultural research for development, extension, training and education to promote economic growth, fight poverty, eradicate hunger and enhance sustainable use of resources in Eastern and Central Africa (ECA).

This mission is a commitment to overcome poverty and hunger in the ECA sub-region. ASARECA sees improved delivery and impact of scientific knowledge, policy options and technologies as a powerful instrument to drive the sub-region towards meeting the Comprehensive African Agricultural Development Program (CAADP) objective which is the agricultural agenda of the New Economic Partnership for African Development (NEPAD) and the Millennium Development Goals (MDGs).

The ten ASARECA member countries have been and are currently investing in agricultural research, extension, education, and training. While ASARECA mobilises operational finances for sub-regionally planned agricultural innovation activities, the partner National Agricultural Research System (NARS) contribute their infrastructure, personnel and some funding towards the sustainable implementation of the programmes. The Heads of State of the ten countries, along with all their counterparts in Africa, have committed themselves as a goal of CAADP, to increase the share of their national budgets for agriculture to ten percent. The support provided to ASARECA by the development partners adds value to ongoing agricultural development efforts in the sub-region to achieve the goals of CAADP.

Over the past two years, ASARECA accomplished major works that reviewed the past performance, current status and future projections of agricultural performance in Eastern and Central Africa sub-region and laid out strategic directions and priorities for ASARECA (2007-2016). It also laid out the Strategic Directions and Priorities for Agricultural Development in the sub-region in the context of CAADP and the MDGs.

ASARECA serves as a forum for promoting sub-regional agricultural research and strengthening relations between NARS in Eastern and Central Africa including the Consultative Group for International Agricultural Research (CGIAR). Aiming to strengthen NARS and link them

regionally, ASARECA has expanded its initiatives and leadership in linking agricultural research to the political dialogue possible in COMESA, FARA and AU/NEPAD. ASARECA monitors political and institutional change in the global research environment and provides to its member countries representation in such fora.

ASARECA adds value to the work of NARS in the sub-region through:

- The identification of shared goals and the promotion of economies of scale and scope through collaboration, specialization and sharing of results.
- The identification of sub-regional public goods that would be under-produced in the absence of shared goals and a regional mechanism.
- Sharing of knowledge and experiences with institutional innovation for more effective agricultural research for development (AR4D), extension and agricultural training and education.

Central to ASARECA vision and mission is the recognition of the value of regional collaboration and the need for regional collective action among member countries and their partners. Also central to ASARECA vision and mission is the notion that agricultural research, convened and facilitated by ASARECA, furthers development aims such as broad-based economic growth, poverty eradication and improved livelihood.

ASARECA has seven new programmes. These are:

1. Staple Crops Programme
2. High Value Non-Staple Crops Programme
3. Livestock and Fisheries Programme
4. Agro-Biodiversity and Biotechnology Programme
5. Natural Resource Management and Biodiversity Programme
6. Policy Analysis and Advocacy Programme
7. Knowledge Management and Up-scaling Programme

This document presents the strategy and priorities developed for ASARECA Natural Resource Management and Biodiversity Programme through collective action of all ASARECA member NARIS and all major ASARECA stakeholders. I would like to thank Dr. Hezron Mogaka, the Manager of the Natural Resource Management and Biodiversity Programme and all our stakeholders for having worked hard and enabled ASARECA define its future direction and priorities in the context of the Sub-regional Natural Resource Management and Biodiversity Programme.

Seyfu Ketema
Executive Director, ASARECA

Table of contents

Abbreviations and acronyms

ASALs	Arid and Semi-Arid Lands
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AU	African Union
CAADP	Comprehensive African Agricultural Development Programme
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CGIAR	Consultative Group on International Agricultural Research
CGS	Competitive Grant System
COMESA	Common Markets for Eastern and Southern Africa
CoP	Conference of Parties
DFID	Department for International Development
EAC	East African Community
ECA	Eastern and Central Africa
FAAP	Framework of African Agricultural Productivity
FANR	Food, Agriculture and Natural Resources
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFAR	Global Forum on Agricultural Research
GHG	Green House Gases
IARCs	International Agricultural Research Centres
IAR4D	Integrated Agricultural Research for Development
IBAR	InterAfrican Bureau for Animal Resources
IGAD	Intergovernmental Authority on Development
INRM	Integrated Natural Resource Management
IPGs	International Public Goods
ISFM	Integrated Soil Fertility Management

IUCN	International Union for Conservation of Nature – The World Conservation Union
IWRM	Integrated Water Resources Management
KIT	Knowledge, Information and Technologies
LVBC	Lake Victoria Basin Commission
M&E	Monitoring and Evaluation
MDGs	Millennium Development Goals
MEA	Millennium Ecosystem Assessment
NARES	National Agricultural Research and Extension Service
NARS	National Agricultural Research Systems
NEPAD	New Partnership for Africa's Development
NGOs	Non-Governmental Organizations
NPs	National Projects
NRM	Natural Resource Management
NRM&B	Natural Resource Management and Biodiversity
PLAR	Participatory Learning and Action Plan
PRSP	Poverty Reduction Strategy Papers
R&D	Research and Development
R4D	Research for Development
SADC	Southern Africa Development Community
SSA	Sub-Saharan Africa
SSA-CP	Sub-Saharan Africa Challenge Programme
TAC	Technical Advisory Committee
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
WECARD/ CORAF	West and Central African Council for Agricultural Research and Development

Executive summary

This strategy sets out the role of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) Natural Resource Management and Biodiversity (NRM&B) Programme in responding to livelihood and environmental management challenges in Eastern and Central Africa (ECA) sub-region. It defines the programme's vision, mission and values, identifies the challenges that confront the vulnerable populations in the sub-region, and provides pathways through which ASARECA will contribute to resolving them. In so doing, the strategy lays out the programme's research agenda for the next five years (2009-2014) and articulates an implementation framework.

The NRM&B Programme vision is stated in the context of its relevance and application in achieving the Millennium Development Goals (MDGs), particularly those relating to eradication of poverty and hunger, and enhancing environmental sustainability and quality for all in ECA sub-region through targeting improved and sustainably managed agro-ecosystems. The programme will also contribute to the implementation of pillars 1 and 4 of the Comprehensive Africa Agricultural Development Programme (CAADP).

The programme mission aims to facilitate increased generation, promotion, sharing and utilization of natural resource management (NRM) knowledge, information, technologies and innovations for the management and conservation of natural resources for the benefit of individuals, society and the environment in ECA sub-region. To fulfil this noble mission, the strategy embraces an integrated NRM approach as a comprehensive framework that blends the multiple aspects of agri-food systems, agriculture and natural resources. It proposes a number of interventions that will facilitate integration, exploring and tapping the benefits of synergy and coordination of the many aspects of NRM. This approach will ultimately lead to improved and sustained livelihood opportunities and management of natural resources. Further, it identifies a number of pathways through which NRM can provide livelihood opportunities and thus unlock the vast potential of natural resource endowment for the benefit of people. Key outcomes expected include:

- Enhanced productivity of natural resources and agro-ecosystems for improved food security and livelihoods;
- Improved incomes and market opportunities, particularly for the vulnerable communities;
- Increased asset base and enhanced productivity through sustainable natural resource management; and
- Enhanced ecosystem services and climate variability and change responses.

The strategy and the research priorities were developed through extensive consultations with key stakeholders. The results of the consultations were further discussed and validated in a stakeholders' workshop which brought together ASARECA partners, scholars, and NRM and development experts, among others.

The NRM&B Programme will generate the following four results (outputs):

i. Generation and uptake of demand-driven natural resource management technologies and innovations facilitated;
ii. Appropriate institutional arrangements for sustainable natural resource management supported;
iii. Capacity to generate effective strategies for promoting sustainable natural resource management enhanced; and
iv. Availability of information on natural resource management enhanced.

It is worth noting that this strategy builds on a previous one developed in 2005, as a direct and necessary response to the review and reorganization of ASARECA that brought forth the institution's Strategic Plan 2007-2016 and Operational Plan 2008-2014. The challenge was to align the institution's NRM agenda with the recommendations of ASARECA Strategy and Operational Plan. The new thematic focus takes into consideration the present and future roles of ASARECA as a sub-regional agricultural research organization with a complementary role on other initiatives at national and sub-regional levels. In this respect, the visions and agenda of such initiatives as the Forum for Agricultural Research in Africa (FARA) and New Partnership for Africa's Development (NEPAD) are put into perspective. While FARA envisions a vibrant and competitive African agriculture (FARA, 2007), NEPAD emphasizes an agriculture-led development that eliminates hunger, reduces poverty and food insecurity. In a similar vein, the strategy's emphasis on improving access to markets, which is core to CAADP Pillars 2 and 4, re-enforces ASARECA-NRM&B Programme's increasing focus on natural resources-based enterprises to enable farmers and pastoralists integrate into the regional market economy (NEPAD, 2004). This is in addition to embracing other CAADP pillars, such as Pillar 1, that aims to extend the area under sustainable land management and reliable water control systems.

Designed within the principles of Integrated Agricultural Research for Development (IAR4D), this strategy is therefore designed to address and define a road map for current and emerging issues and challenges, within the niches that exist in the multitude of institutions working in NRM&B in ECA. It integrates research of different types of natural resources, including biodiversity into stakeholder-driven processes of adaptive management and innovation to improve livelihoods, agro-ecosystem resilience, agricultural productivity and environmental services at community, national, sub-regional and global levels, and defines scales of intervention and impact. This is premised on the fact that natural resources are interdependent and thus, their management is inherently integrative – often referred to as integrated natural resource management (INRM). This would be carried out within the following six thematic areas:

i. Improved water management and productivity in agricultural systems
ii. Enhancing sustainable management of forestry, agroforestry and biodiversity for improved livelihoods and environmental services
iii. Managing productive potential of soils

iv. Policy, institutions and governance for sustainable natural resource management
v. Adaptation to climate variability and mitigation of climate change
vi. Managing fragile and drylands ecosystems for sustainable livelihoods.

Introduction

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is a non-political organization of the National Agricultural Research Systems (NARS) of 10 countries – Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda. The Eastern and Central Africa (ECA) sub-region probably has the highest proportion of people living below the poverty line and food insecurity in the world, coupled with a very high rate of degradation of an under-utilized natural resource base. ASARECA is uniquely positioned in the sub-region to assist the member countries reverse this situation by facilitating generation and uptake of agricultural research innovations and knowledge aimed at increasing economic growth and improving social welfare in the sub-region, while enhancing the quality of the environment. Established in 1994, ASARECA is pursuing its agenda through seven programmes. One of the programmes deals with natural resource management and biodiversity. The natural resource base in this context includes land, water, forests, agroforestry and soils, with communities being the pillar to all research interventions.

In response to emerging challenges and opportunities in ECA sub-region and globally, the NRM&B Programme's new strategy defines its research for development (R4D) niche, strategic focus and implementation arrangements. During the last three years, ASARECA has undergone major institutional changes and programmatic adjustments in response to changing demands in the external environment. In 2006, an evolution in ASARECA strategic direction was triggered by the External Programme and Management Review, which made significant recommendations on ASARECA operational and organizational framework. One of the key recommendations was on the shift from networks to programmes as operational units for fostering agricultural research. This gave birth to seven programmes and three units of which NRM&B is one. To contribute to the achievements of ASARECA as set in its Operational Plan 2008-2014 and Strategic Plan 2007-2016, the NRM&B Programme defined its scope and strategic interventions as outlined in this strategy.

This strategy is written using the ASARECA standard strategic planning framework. As a first step in the planning process, the programme developed an analytical framework to engage the key stakeholders and partners in a series of consultations and dialogue to identify the key issues of national, regional and global importance for NRM. Its development has benefited immensely from the full engagement of a wide range of stakeholders, ASARECA Secretariat, Board of Directors, expert review team, project leaders, and consultations with national and international partners.

The strategy provides a guide to the choices made, and how these choices will be translated into action while responding to global challenges and goals such as those set by the

Millennium Development Goals (MDGs), mitigation of climate change and adaptation to climate variability, globalization of markets and trade, and international agreements for sustainable utilization and conservation of natural resources and the environment. It is also designed in the frameworks of regional priorities such as those identified in the agricultural and environmental programmes of the New Partnership for African Development (NEPAD), and those identified by the Forum for Agricultural Research in Africa (FARA) especially in its sub-Saharan Africa Challenge Programme (SSA-CP) of the Consultative Group on International Agricultural Research (CGIAR). Other regional blocks whose objectives and focus have informed the formulation of this strategy include, the East African Community (EAC), Common Market for Eastern and Southern Africa (COMESA), Inter-Governmental Authority on Development (IGAD) and the Lake Victoria Basin Commission (LVBC). Further, it focuses on the sub-regional natural resources management transformation to create practical options for people to eradicate poverty and conserve the environment.

Chapter 2 describes briefly, the main components of the strategy, giving the vision, mission, and the purpose. It also briefly describes the core values and principles which ASARECA will observe in pursuing the implementation of its NRM&B Programme strategy. Chapter 3 describes the current situation and strategic framework upon which the strategy is based. It identifies the challenges facing ECA countries and provides an outline of the most strategic NRM issues which need to be addressed through regional collaboration. Chapter 4 describes the thematic areas which will be prioritized during the life of this strategy. Chapter 5 explains the implementation arrangements and business plan which will be put in place to realize the results of this strategy.

Programme focus

The Programme focuses on ensuring that natural resources are sustainably managed to positively impact various agro-ecosystems and landscapes for improved livelihoods in ECA. Further, the programme is committing itself to the MDGs and NEPAD-CAADP (Comprehensive African Agricultural Development Programme) as a focus for redefining the ECA sub-regional and international development agenda for NRM. This requires particular output-outcome-impact pathways as depicted in figure 1. The principles of IAR4D (innovations systems) are used as primary basis for analyzing and defining strategic interventions, implementation framework and monitoring and evaluation of outcomes and impacts of the programme. The outputs will be generated as a result of addressing strategic challenges through participatory identified and prioritized strategic interventions. The NRM&B vision, mission and results framework are thus conceptualized around the output-outcome-impact interrelationships.

Vision and mission

ASARECA mandate covers 10 ECA sub-region member states which, despite their abundant and quality natural resources, have a high proportion of food-insecure people living below the poverty line and contributing significantly to environmental degradation. It is estimated that about 150 million people in the sub-region are food insecure and the majority of these live below the poverty line, with their main livelihood options and opportunities firmly anchored on natural resources. There are, however, considerable opportunities and possibilities for economic growth and attainment of the MDGs, particularly those relating to poverty, hunger and environmental sustainability, and CAADP Agenda. Pillars 1 and 4 of CAAPD are especially pertinent and of particular interest to ASARECA.

Thus the programme envisions an ECA sub-region with enhanced livelihoods and a balanced and high quality environment through improved and sustainably-managed natural resources. Its mission is to facilitate, together with stakeholders and partners, increased generation, promotion, sharing and utilization of NRM knowledge, information, technologies and innovations for the management and conservation of natural resources for increased economic growth and improved livelihoods for the benefit of individuals, society and the environment in the sub-region.

Core values

To effectively respond to the current and emerging challenges in the sub-region, the programme will implement the strategy by embracing the following core values:

Integrated and holistic approach

Integration and team work across levels, disciplines, gender, timeframes and space, is critical for effective and efficient management of natural resources because of the complex inter-linkages of the different components of ecosystems and their management.

Empowerment of end-users

Farmers, agro-pastoralists and pastoralists, with their unique traditional norms and socio-culturally-respected values, are the prime custodians and managers of key land and other natural resources. It is their decisions and actions which shape and make the most significant and demand-driven differences. Therefore, their inclusion and active participation in the governance arrangements, technology development and knowledge sharing for the management of natural resources will be a key focus in implementing this strategy.

Impact orientation

Poverty reduction, food security improvement and safeguarding environmental quality, taking account of equity issues, are core to this strategy. These will be pursued through integrated research for development by ensuring that the work ASARECA supports, promotes or undertakes is demand-driven and effectively responds to the circumstances and incentives to drive ASARECA stakeholders—policy makers and planners, agro-entrepreneurs, extension and service providers, as well as households.

Scientific excellence, creativity and flexibility

The stakes in NRM&B are extremely high in terms of the investments necessary for meaningful outcomes and the environmental costs of wrong decisions and actions. For this reason, creativity and recommendations made to stakeholders will emanate from sound evidence based on rigorous scientific methodology and findings of the highest quality.

Regionality

ASARECA has a regional mandate. Likewise, the programme will be implemented regionally to achieve economies of scale and scope, and to ensure optimal availability of regional public goods with respect to knowledge, information and technologies (KIT). This is premised on the fact that optimizing production of regional public goods and services requires effective collective actions and benefit-sharing in cases where members may contribute to the problem or the solution to different degrees and where benefits are not uniform across the member states.

Partnerships for collaborative advantage

Strategic and productive partnerships within and outside the agricultural sector are critical to harnessing the benefits of diverse expertise and perspectives so as to ensure synergies that have direct bearing on finding innovative solutions to major problems and opportunities. Clear roles, responsibilities, governance and supportive mechanisms will ensure application of 'true' partnership norms.

Social differentiation and gender responsiveness

The ECA sub-region is by no means homogeneous. The sub-region is characterised with a wide range of segments of society with a number being quite vulnerable. In addition, ASARECA is committed to promoting gender considerations in pursuing R4D. It is therefore on this foundation that the NRM&B Programme will take into consideration social differentiation and gender issues in the generation and promotion of uptake of NRM innovations.

Results framework

Goal and purpose

Goal. In tandem with the vision, mission and goal of ASARECA, the goal of the NRM&B Programme is to contribute to sustainable productivity, value addition and

competitiveness of the sub- regional agricultural system.

Purpose. To achieve the goal of NRM&B, the purpose of the programme is to enhance utilization of NRM innovations in Eastern and Central Africa's agricultural systems.

Results

Over the next five years, the programme intends to realize the following four results:

Generation and uptake of demand driven natural resource management technologies and innovations facilitated: There is a wide range of technologies, best practices, policies and institutional innovations in NRM yet to be harnessed to support livelihoods and provide quality environmental services. Many of these innovations and technologies remain unutilized or underutilized owing to a number of factors. Validation and adaptation of most of these technologies remain a challenge. The programme therefore intends to invest in the generation and adaptation of new and existing technologies and innovations to unlock the huge potential of natural resources in helping to improve livelihoods in the sub-region as well as enhancing the quality of environment. The result will be derived through targeted research in water productivity enhancement technologies, forestry innovations, sustainable management of biodiversity, promotion of strategies for enhancing sustainable management of fragile and drylands ecosystems, and integrated soil fertility management, among others. The programme will also invest in generating technologies and strategies aimed at climate change mitigation and adaptation to climate variability. Appropriate uptake pathways for the tested and validated technologies will be identified and promoted.

Appropriate institutional arrangements for sustainable natural resource management supported: Weak, duplicitous and inadequate policies and governance regimes remain an intractable problem for NRM in ECA sub-region. This is particularly exacerbated by impacts of climate change and globalization on local, national and regional socio-economic structures. The need to generate and deploy appropriate policy and governance options for NRM and productivity cannot be overstated. The programme will therefore endeavour to support and influence appropriate policy responses to guide sustainable management of natural resources and promote equitable distribution of benefits and costs arising from such conservation initiatives. It is envisaged that through appropriate policy responses, suitable institutional mechanisms will emerge to strengthen homegrown management regimes that take into cognizance and reconcile development objectives and conservation agenda.

Capacity to generate effective strategies for promoting sustainable natural resource management enhanced: This output outlines and directs the programme's strategic direction in strengthening capacities of ASARECA stakeholders and partners to effectively respond to research-development continuum implementation. Researchers, service providers, communities and institutions in the sub-region have limited capacity to undertake appropriate activities so as to optimize agricultural value chain research and development. This output will facilitate empowerment of stakeholders and partners to improve validation, transfer and adoption of knowledge, information, technologies and innovations for NRM in ECA. It will also guide ASARECA in its work with partners within and outside the NRM&B Programme areas.

Availability of information on natural resource management enhanced: A wide range of KIT is available on sustainable INRM. This KIT will be packaged and disseminated from across the six themes and availed in various databases. The database will focus on knowledge generated from NRM research and development as well as knowledge generated by NRM managers through years of practice and informal experimentation. The aim is to ensure that stakeholders easily access the global pool of knowledge and are able to extract what is most relevant.

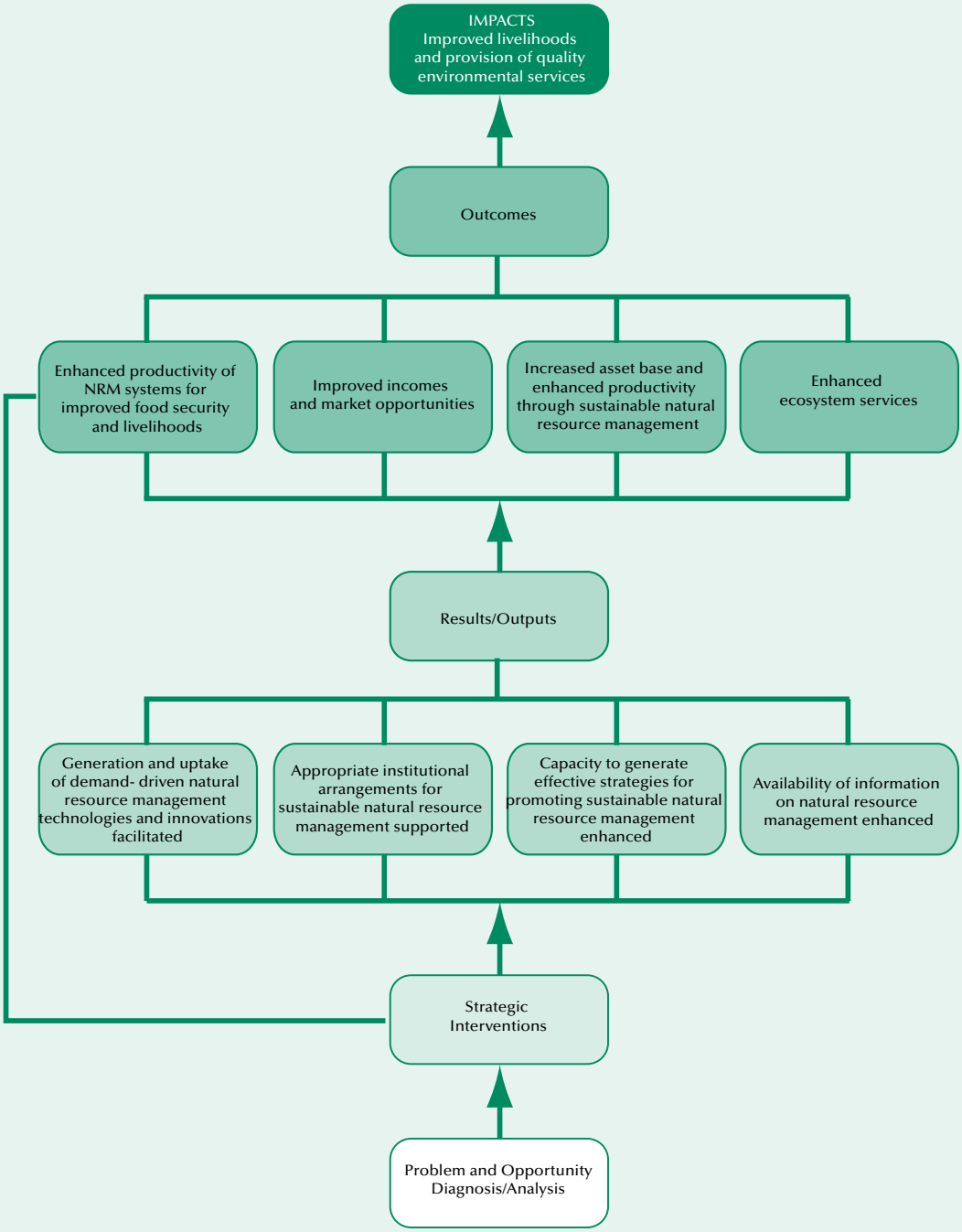

Figure 1: *Output-outcome-impact pathway*

Situational analysis: setting the empirical scene

ECA sub-region has entered the new millennium with a myriad of political, socio-economic and environmental challenges, with profound implications for its agriculture, sustainable growth and development. The sub-region's world-famous abundant species and biodiversity-rich areas as well as its life-supporting water resources and watershed systems are seriously threatened by habitat loss caused by anthropogenic and other factors. The situation is exacerbated by climate variability and change, of which the effects are already being witnessed in the form of variable water supplies, lengths of growing season, extreme weather events (floods, droughts) and changing habitats. How to deal with these trends and challenges to improve agricultural outputs and sustain livelihoods in ECA is key to the success of ASARECA.

The situational analysis thus provides the context and framework within which ASARECA-NRM&B Programme will pursue its mission during the period of this strategic plan. It is envisaged as a constructive mechanism for evaluating and rationalizing the decisions to be made by the programme and is the foundation of its R4D agenda to help move towards the vision of a regional natural resources transformation. Further, the analysis increases understanding of major regional and global trends, including the focus on how these trends are likely to affect the future of ECA sub-region's natural resources. Possible scenarios that will help in decision-making on strategic directions for the programme will also be examined. To this end, the situational analysis drew heavily on the 2005 Millennium Ecosystem Assessment Synthesis Report to identify such trends and plausible scenarios.

Policy and political context

The present and future roles of ASARECA as a sub-regional agricultural organization will continue to be influenced by national, regional and global livelihoods, and state of natural resources agenda. At the global level, the MDGs remain the single most important development framework. . The three Rio Conventions (Convention on Biological Diversity (CBD), United Nations Convention to Combat Desertification (UNCCD) and United Nations Framework Convention on Climate Change (UNFCCC) are particularly important for policies related to biodiversity, desertification and climate change. The United Nations Forum on Forests (UNFF) is also gaining importance for global forest issues. The CBD, through the Global Environment Facility (GEF), offers incentives to promote biodiversity conservation by providing financial resources to meet the incremental cost of conservation. In addition, the UNFCCC, the UNCCD and the Kyoto Protocol provide important frameworks for harnessing financial resources, technology or other conservation-related NRM needs in ECA sub-region.

Within Africa, CAADP and its associated Framework of African Agricultural

Productivity (FAAP) are critical. The African Vision by the African Union and NEPAD of attaining 6% increase in agricultural growth by 2015 is of particular interest, given that one of the avenues identified to achieve this target is stimulation and promotion of a culture across the region of sustainable utilization of the natural resource base. In addition, regional and sub-regional institutions are expected to play a lead role in spearheading science and technology in food systems to address food insecurity and environmental degradation. On this basis, ASARECA is considered as the sub-regional organization for the implementation of CAADP Pillar 4 (see figure 2).

The emerging and evolving agenda of regional integration processes like the Common Markets for Eastern and Southern Africa (COMESA), Inter-Governmental Authority on Development (IGAD) and Southern Africa Development Community (SADC) too are generating important frameworks for leveraging the work of ASARECA. For example, IGAD work on conflicts, early warning, and climate change research and prediction are closely aligned to the goal of ASARECA NRM&B Programme. Other institutional frameworks in the region of relevance to ASARECA and its programmes include EAC, the Nile Basin Initiative (NBI) and LVBC. Environmental management and sustainable development are key pillars for these institutions.

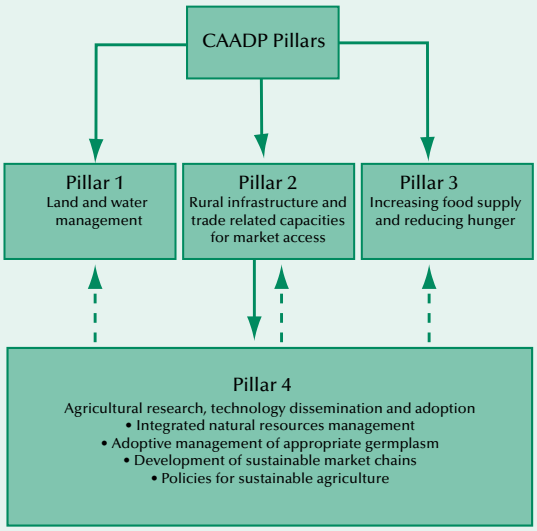

Figure 2: *CAADP Pillar 4, the African response*

Government level decision-making processes are constantly evolving in ECA, giving rise to institutional arrangements with important relevance to ASARECA-NRM&B Programme. For example, decentralization of decision-making and devolution of authority is becoming a major trend in ECA member states. This will influence the way policies are developed and implemented, especially those related to natural resources, property rights, poverty reduction, agricultural development, forestry and land use. As the Millennium Ecosystem Assessment (MEA) report notes, the trend towards democratic institutions has helped empower local communities, especially women and resource-poor households (MEA, 2005). This is particularly important, given that ECA sub-region is one of the poorest and most ecologically-fragile, making it a hotbed for strife rooted in competition for scarce and dwindling natural resources. The governments therefore tend to be preoccupied with conflicts, focussing less on national policies related to poverty reduction, NRM, agriculture, forestry and land use, among others. Obviously, the conflict agenda affect the programme's mandate for generating international public goods (IPGs); hence ASARECA must streamline conflict in its R4D agenda to accommodate the political realities in the sub-region.

Many countries in the sub-region have started to formulate policies to promote natural resource management, though still using

sectoral approaches. Emphasis should be put on creating economic incentives that reward the individual resource manager for their stewardship. In this respect, some of the on-going policy measures and initiatives take three forms: direct investment in support of specified objectives; economic measures that change relative prices and create incentives for desired behaviour; and institutional measures (including regulations that create opportunities for investors in NRM). Strategic public investments to break the vicious cycle of poverty and resource degradation might include infrastructure (roads, dams and so on) and soil recapitalization. A clear challenge in NRM is to design appropriate conservation incentives while avoiding perverse ones. Based on experiences elsewhere, it is imperative that economic incentives and strategic public investments are made in deliberate ways which bridge NRM policies and economic objectives. Some examples include:

- Infrastructural investments strategically designed to facilitate effective chains connecting resources to consumption;
- Improved property rights, for example, ownership rights, user rights, access rights and development rights;
- Market creation, for example, where tradable harvest quotas of wild species (aloe and others) and tradable forest resource shares are set to ensure sustainability of the resource;
- Fiscal instruments that produce revenue for government or community trusts that can be reinvested in NRM such as forest product taxes, royalties and land-use taxes;
- Charge systems, for example, betterment charges, impact fees, road tolls and administrative charges where government or community trusts can receive revenue;
- Financial instruments that might include soft loans or grants (conservation loans or grants), revolving funds, eco-funds and environmental fund; and
- Liability instruments, for example, various types of deposits that ensure enforcement of agreements that impinge on environmental management such as legal liability or enforcement incentives.

Socio-economic characteristics

ASARECA member countries cover a total area of about 8.5 million km^2, populated by some 300 million people, with rural population densities ranging from 13 people per km^2 in Sudan to 1,000 people per km^2 in Kenya. The population growth rate ranges from about 2% (Burundi, Eritrea, Ethiopia, Kenya, Rwanda, Sudan and Tanzania) to 3% (DR Congo, Madagascar and Uganda). About 80% of the population derives their livelihood directly from agriculture, which contributes 38% on average to the gross domestic product (GDP) of most countries. This high population has very low incomes. MDG indicators, such as low life expectancy of just 40 to 50 years and high infant mortality are pointers to the challenges in this sub-region.

ECA sub-region's economic performance over the last 10 years has been disappointing. Most of the countries have an annual GDP growth rate of 3%. Income per capita for nearly all the countries has been on the decline since 1990, while population increase in ECA has averaged 2.5% over the same period. The percentage of people below the poverty line (earning less than US$1 a day) ranges from 20% to 60%. Of the nine "Hunger Hotspots"[1] in Africa, four

[1] Number of children under 5 years of age per square kilometre that are underweight.

are located in ECA.[2] Most of these people depend directly on the natural resource base for livelihood and socio-economic change. Migration trends are likely to continue with movement from the highlands where most people live, to mid altitude and lower elevation, and into urban areas. Encroachment on conservation and protected areas and marginal lands, for example, steep slopes unsuitable for cultivation, will also continue.

Given that absolute poverty is a fundamental obstacle to sustainable conservation of natural resources, environment and development, the poverty-conservation focus that Poverty Reduction Strategy Papers (PRSPs) have brought to national and regional economic planning is very timely.

In addition, major policy and structural weaknesses continue to create macro-level barriers to eradicating poverty at micro-level and promoting sustainable use of the natural resource base. These barriers include: poor infrastructure which severely limit access to markets for both inputs and outputs; inadequate financing of agricultural-based enterprises; limited information on markets, prices and technologies; market imperfections at various levels; and unfavourable trade policies and frameworks. Policies and development support tend to operate in sectors, and NRM&B is usually fractured between agriculture, natural resources, and land and water sectors. It is strongly influenced by land tenure policies (or lack thereof). NRM has a strong interaction with health and education, which is handled by other sectors.

[2] The highland temperate farming systems of Southern Eritrea, and Northern and Central Ethiopia; the highland perennial systems in Rwanda and Burundi; the root crop-based systems in Southern Tanzania; and the cereal-root crop system in Madagascar (Inter-Academy Council, 2004).

Natural resource management

Virtually all major natural resource sectors in ECA are experiencing major oscillations. This is the case of water, land and soil resources, forests and tree crops, biodiversity, and hence the entire spectrum of resources which supply the services and products that sustain human livelihoods. The changes are pervasive and critical particularly in relation to fragile and dryland ecosystems. And they must be considered in the context of the attendant adaptation and mitigation imperatives engendered by climate change and variability.

Water resources

Water scarcity is fast becoming a critical issue for many countries in ECA sub-region and could lead to a severe water crisis if water productivity is not increased. The Comprehensive Assessment of Water Management in Agriculture (CAWMA) report of 2007 highlighted the need for more research and development on both rainfed and irrigated systems to enable countries increase productivity. Similarly, the World Bank's World Development Report indicates that investment in agricultural R&D and in particular the efficient use of water resources has been far more effective than subsidies in helping countries meet food-production goals. The CAWMA report concluded that countries will only produce enough food if they are much smarter about the way they manage their land and water resources. Given that 70–80% of extracted water supplies are used in agriculture, competition for this increasingly scarce resource will be an issue for years to come in many ECA countries. If countries fail to increase water productivity, they will inevitably fail to prevent future food crises. In addition, the impacts of climate change and variability on water

and food production must be taken into account. Learning how to store water better and providing supplementary irrigation to make up for erratic rainfall supplies will be the key to overcoming these challenges.

Indeed, the Millennium Ecosystem Assessment (MEA) report (2005) estimates that more than 1.1 billion people globally lack access to clean drinking water, and that per capita availability of water is declining. Water scarcity is a globally significant and accelerating condition for roughly 1-2 billion people worldwide, leading to problems with food production, human health and economic development (MEA, 2005).

Yet water is crucial for the future of ECA sub-region for the following reasons: (1) more water is needed to fulfil the increasing demand for food, feed and fibre, due to increasing population and changing needs; (2) increasing water conflicts may emerge from poor water governance and cross-boundary demands; and (3) increased trade-off in water use with other ecological services such as wetlands. The concept of integrated watershed management research and development has recently caught the attention of many agencies, governments, donors, and research and development institutions in almost all countries in ECA sub-region. The NRM&B Programme will therefore increasingly raise awareness about the hydrological benefits of forestry and agroforestry systems as 'best bets' for restoring degraded watersheds, given the potential to benefit millions of upland farmers who risk evictions owing to their agricultural practices.

These concerns would also need to capture the wise use of wetland ecosystems for agriculture as they present an important livelihood opportunity for millions of rural poor in ECA. Wetlands are of vital importance for community coping strategies during times of drought; even more so in light of climate change and increased climate variability. However, the use of wetlands for agriculture and its impact on other ecosystem services are poorly understood.

It is evident that all the major sectors of the economy in ECA are considerably influenced by availability of water resources. ECA sub-region countries derive more than 75% of their commercial energy needs from hydro-based sources. The increasing frequency and severity of droughts have borne testimony to the sensitivity of water availability to a series of industrial processes. Many a times, industries have closed down due to lack of water resources. In addition, the prosperity of livestock and fisheries sectors is intricately linked to availability of quality water.

Based on this scenario, it is imperative for ASARECA-NRM&B Programme to develop appropriate technologies and innovations in consultation with its stakeholders, so as to enhance sustainable integrated water resources management that taps into the potential of available surface and underground water resources.

Land and soil resources

Degradation ranges from soil loss through erosion to habitat loss (for example, deforestation) and soil fertility decline, and can be attributed to the interaction between short-term local and long-term global processes. All dimensions of land degradation are of strategic relevance to ASARECA NRM&B Programme. ECA sub-regional trends in land degradation suggest that the structure and functioning of ecosystems is changing rapidly as a result of habitat conversion. According to the MEA report (2005),

cultivated systems now cover one quarter of the earth's terrestrial surface, including ECA sub-region which has in some areas one of the highest population densities in the world. Major areas of cropland expansion in the last two decades include the Great Lakes region of eastern Africa. The major causes of degradation in Africa are growing population and increasing demand for food and cash income, extensification of agriculture rather than intensification, inadequate use of conservation practices, lack of support by local governments and so on.

Forestry and agroforestry resources

The forest ecosystems of ECA sub-region are considered among the world's most fragile ecosystems facing the challenge of deforestation and degradation. For example, deforestation is known to cause decreased rainfall, and the MEA report (2005) noted that deforestation in the tropics (including ECA sub-region) occurred at an average rate exceeding 12 million ha per year over the last two decades. Regional forestry inventory reports indicate that the greatest extent of forest cover in ECA sub-region is found in Central Africa – the Congo Basin, covering 200 million ha. This is considered to be the world's second largest continuous tropical rain forest after the Amazon. Other significant forest ecosystems include the Eastern Arc Mountain Forests of Eastern Africa and in eastern Madagascar. Forests and tree crops provide important ecosystem products and services such as: supply of timber and non-timber forest products including wild foods, medicines, pharmaceuticals and genetic resources; flood and climate regulation; cultural services including spiritual, aesthetic, and recreational values; and supporting services including primary production, nutrient cycling, soil formation and biodiversity conservation, among others. The MEA report indicates that most households in ECA sub-region still depend on biomass in the form of wood or charcoal for their energy needs and many household items, and for income generation.

In responding to these challenges and opportunities, ASARECA-NRM&B Programme's main objective is to promote efficient and effective management of forests ecosystems and trees on-farm (agroforestry) in the sub-region for the improvement of livelihoods of farmers and pastoral communities while safeguarding the integrity of the environment. Domestication of tree species and intensification of tree cultivation systems is a critical tool in improving land productivity, management, profitability, stability and genetic diversity (biodiversity conservation). This involves collection, conservation and utilization of promising species of indigenous fruits, medicinal plants, timber and fodder, among others.

Biodiversity

Sub-Saharan Africa is rich in both variety and abundance of biological diversity and has one of the most important biodiversity endowments in the world. ECA sub-region is host to a wide range of important threatened, rare and endemic species, habitats and ecosystems. Endemism is high in the region as exemplified by Madagascar which is very rich in endemic species. The Eastern Arc Mountain Forests found in part in Tanzania, having evolved in isolation for 10 million years, have as a result about 25% of their plant species being endemic. Within the region, the forests of the Albertine Rift in eastern Congo and the Miombo Woodland of Tanzania are considered as biodiversity 'hotspots'. The sub-region is home to the

world's sole population of 720[3] Mountain Gorillas (*Gorilla beringei*), Chilada baboons, and other critically endangered primates and rare birds. Wildlife is a resource of tremendous economic value for tourism promotion and development of various natural products. Likewise, the region is known to house an immense wealth of microbial genetic resources (*Rhizobium*) that are useful sources of agrobiodiversity and sustainable development.

ECA sub-region is one of the most heterogeneous areas of Africa and is made up of diverse ecologies, lakes, massive forests, unique protected conservation areas, and has extensive river systems, lakes, riverine swamps, valley swamps, seasonal floodplains, ponds and high altitude peat-farming wetlands, all contributing to the high level of aquatic biodiversity. The sub-region has numerous national parks which house wildlife and botanical biodiversity as well as world heritage sites. These areas are surrounded by agricultural lands and other forms of land use that provide livelihoods to local residents. Thus strategies that look into alternative livelihoods or sustainable joint management are critical.

The biodiversity of ECA has economic, social, ecological and cultural values. Environmental service functions of biodiversity include nutrient recycling, soil formation, watershed protection, waste disposal, pollination, climate regulation and carbon sequestration, among others. Value goods are food source, drugs, fibre, resins, dyes, waxes, fuel and timber, while non-consumptive utilization includes ecotourism. In Kenya, about 3 million households rely on forest biodiversity for at least one household need, while in Uganda the economic value of biological resources is estimated at US$741 million annually. Some of the plant species of high pharmaceutical values from the region include *Prunus africana* (Kenya, Uganda, Madagascar, DRC, among others), aloe, *Warbugia ugandensis* (Uganda) and *Fagara macrophylla (*Kenya).

On the other hand, the biodiversity of the sub-region is highly threatened by various forces, man-made and natural factors such as natural habitat degradation, social and political unrest, invasion of alien species, and inadequate recognition of the value of indigenous and traditional knowledge systems. Desertification, particularly in countries to the north, is rapidly changing plant associations, causing rapid loss of biological resources. An extreme scenario is illustrated in countries like Eritrea where the scale of loss of natural vegetation now threatens the country's agricultural productivity base and food security. Deforestation is high in most countries of the sub-region, with serious genetic erosion consequences. For example, in Kenya and Ethiopia, genetic erosion is as high as 5000 and 180,000 hectares per annum, respectively. Overgrazing and frequent wild fires cause large losses of biodiversity in the dry open woodlands throughout the sub-region.

The degradation and subsequent loss of biodiversity remains one of the greatest global challenges facing mankind and is indeed a major concern for environmental sustainability and livelihoods of the rural poor. Biodiversity is being destroyed irreversibly by human activities, and species are being lost at a rate that is more than 1000 times faster than background rates typical over the planet's history (MEA, 2005). This is particularly the case in the biodiversity hotspots

[3] www.panda.org/what_we_do/endangered_species/great_apes/gorillas/mountain_gorilla_population_distribution/

where many species are threatened by habitat loss caused by anthropogenic factors. Between 10% and 30% of mammal, bird and amphibian species are threatened with extinction. Genetic diversity among cultivated species has also declined globally.

The MEA report predicts rapid conversion of grassland and forestland by 10-20% of current areas through to 2050, mainly from expansion of agriculture. Savannas, tropical forests and woodlands are among the biomes projected to lose species at the fastest rate over the next 50 years. Although protected area coverage will likely increase over the next decade, conservation initiatives to mitigate the threat of species extinction will increasingly focus beyond boundaries of protected areas. Efforts will be based on the need for increased habitat connectivity through restoration of degraded lands and enhancement of biodiversity-friendly practices in the vicinity of protected areas. Trade-off analysis in the margins of protected forests will increasingly favour tree-based options.

Biodiversity conservation and management systems in the sub-region are founded on a "top-down" enforcement system and lack the necessary institutional arrangements to undertake effective and sustainable utilization. Policies and legislative frameworks governing conservation, particularly within the protected areas inadequately consider local community needs and priorities. The application of economic instruments is limited, leaving little scope for general public participation in planning.

The genetic base of biodiversity is, however, being seriously eroded and warrants sustainable conservation with an equally important emphasis on genetic enhancement for agricultural development and economic growth. Research methodologies for conservation, characterization and evaluation, and genetic diversity deployment should therefore be developed.

NRM principles and practices are inherently focussed on harnessing the benefits of biodiversity (services and products) for livelihoods and a sustainable productive environment. The NRM&B Programme will spearhead sustainable management of biodiversity and establish strong alliances with major conservation organizations while investing in strategies that exploit the benefits of biodiversity conservation programmes. It is noteworthy that the potential of forestry and agroforestry for contributing to biodiversity conservation can be harnessed through two major pathways, providing habitat for native plant and animal species thereby reducing pressure on natural forests.

Some critical strategic challenges to be addressed through R&D interventions include:

- Identification and characterization of potential values of biodiversity;
- Development of appropriate conservation technologies for ecosystem conservation;
- Facilitation of enhanced bio-prospecting (medicinal, dyes, cosmetics, among others);
- Study economic importance of wild species and biodiversity valuation; and
- Transformation of raw materials into marketable products.

Fragile ecosystems

Fragile and dryland ecosystems in ECA subregion are some of the world's most unstable ecosystems facing the challenge of land degradation. These ecosystems are characterized by: limited and erratic rainfall; overuse as a result of intense population pressure;

sensitivity to climatic shocks; highly erodible soils; increasing population pressure; and populations highly vulnerable to food insecurity. Some of these fragile ecosystems include drylands, wetlands, water catchment areas (water towers) and biodiversity corridors. In ECA sub-region, drylands are home to 20-90% of populations of some of the ECA member countries, and support 50-90% of the national livestock herds and the bulk of world-famous wildlife that support the vibrant tourism sector (World Resources Institute, 2007).

Other products such as wood fuel, medicinal products, honey, gums, resins and woodcarving materials are also obtained from the dryland resources. Land degradation is particularly acute in the drylands which results in structural and functional changes that have major consequences for services rendered from such ecosystems. Mountain systems, home to several people in ECA sub-region, are also vulnerable to land degradation. The MEA (2005) report notes that opportunities for further expansion of cultivation are diminishing in ECA sub-region as most of the land suited for intensive agriculture has been converted to cultivation. The drylands and tropical forests will likely remain increasingly vulnerable to land degradation. According to the MEA (2005) report, the current socio-economic condition of drylands people (40% of who are in ECA sub-region) is worse than in any other area. Furthermore, freshwater availability in drylands is projected to further reduce below the minimum threshold required for human well-being and sustainable development.

Despite the enormous potential of the dryland ecosystems in ECA sub-region, they have the highest poverty incidences in the world partly because of infrastructural and resource underdevelopment; and persistent unfavourable policies, among other reasons. ASARECA-NRM&B Programme is seeking to contribute to improved livelihood options through generating and disseminating technologies to improve sustainable management and conservation (of water, soil, land and biodiversity resources), including the promotion of institutional innovations for participatory governance and improved food security. This will contribute to sustainable management of natural resources with associated poverty alleviation in ECA sub-region.

Climate variability and change

The MEA (2005) report predicts a rapid increase in the impact of climate change as a driver of change in biodiversity across all major biomes. These changes will occur in species distribution, population sizes, timing of reproduction or migration events, as well as increased frequency of pest and disease outbreaks, especially in forested systems (MEA, 2005). ECA sub-region is already bearing the brunt of climate change and suffers most from its negative impacts such as unreliable and poorly distributed rainfall over temporal and spatial scales, loss of biodiversity, and loss of livelihood opportunities. Mitigation efforts will only provide a partial softening of the adverse effects of climate change. Local climatic and terrestrial ecosystems will change, threatening biota and human livelihoods.

No doubt food and fibre production, environmental services and rural livelihoods must improve and not just be maintained despite these changes. ECA sub-region urgently needs development to improve food security, reduce poverty and provide an adequate standard of living for its growing populations. Already farmers are being forced to adapt to a number of changes in the biophysical, social and economic environments, as part of the sweeping changes occurring in the village economies of ECA in the past few years.

In general, mitigation of climate change leads to a stream of public goods through reduced global warming and predictable climatic conditions. There are no direct individual gains and benefits that would give incentives to individuals and communities to effectively participate in activities for mitigation of climate change. This scenario calls for collective national and regional policy and strategic interventions with inherent direct incentives for sustained participation in activities and interventions for mitigating climate change and variability. The recent Copenhagen call that urges political leaders to agree on a global climate treaty at Conference of Parties (COP) 15 provides a window of opportunity to work towards reduction of green house gas (GHG) emissions, which is vital to achieving a common social, economic and environmental future for humanity.

Climate change and variability pose a set of formidable issues which must be considered by decision makers. These include:

- Unreliable rainfall distribution along spatial and temporal scales;
- Physical degradation, loss of biodiversity and engagement in environmentally unsustainable livelihood support opportunities such as rampant charcoal burning in fragile ecosystems like ASALs;
- Very long planning horizon, and long time-lags between GHG emissions and their effects;
- Wide global and regional variation in causes and effects; and
- Global scope of the problem and the need to consider multiple impacts of GHG.

Reliable information about climate change processes and impacts on agriculture and natural resources is key to responding to these challenges. This is necessary in identifying where variability is highest so that action is targeted at commitment of the resources to enhance impact on adaptation and mitigation. It is worth noting that the most vulnerable production systems are also the most amenable to NRM practices.

In addition, global warming trends will increasingly influence the role of trees and crops in adaptation and mitigation initiatives. These trends will need to be carefully analyzed for the various farming systems, including the tree species in use, and soil fertility and conservation management practices. However, all indications are that forest (trees), agroforestry and soil management benefits for climate adaptation and mitigation will *likely* be greatest in the ASALs. Carbon-offset markets and payments for environmental services (PES) under emerging internationally-binding agreements such as the Kyoto Protocol and other recognized incentives for PES offer great opportunities for scaling up forestry, agroforestry, and soil and water management innovations to enhance productivity of the ecosystems among the vulnerable small-holder producers. These options would simultaneously generate environmental benefits through improved carbon sequestration, enhanced soil quality, increased water infiltration and quality, and general aesthetics arising from improved forestry and soil cover, as well as reduced degradation of available natural resources. Tools, procedures and decision-support systems are needed to facilitate sustainable environmental management, including carbon sequestration projects and linkage of streams of environmental services to emerging markets for sustained incentives to resource managers.

Livestock production systems – natural resource interactions

Livestock is produced on 60% of the total landmass in ASARECA member countries, covering three major production systems where poor livestock keepers are located: (i) mixed crop/livestock systems which include the maize-based, highland temperate and perennial systems, and some root crop-based systems; (ii) the agro-pastoral and pastoralist systems; and (iii) landless or urban livestock keepers.

In the mixed farming systems, crop-livestock integration offers a promising opportunity for intensifying agricultural production, diversifying household food sources, improving nutrient cycling and therefore, increasing ecological integrity for a positive impact on livelihoods and NRM. Crop residues are used to feed livestock. Animal manure is used to fertilize the soil on which crop production is based. By adding manure to the fields, not only are nutrients recycled but the improved soil structure helps water to infiltrate and percolate into the soils, thereby reducing soil erosion. Less often recognized is the benefit to micro-biodiversity and more varied land use. Manure application enables farmers to maintain ecosystem function and health, promotes biodiversity and increases the capability of the ecosystem to absorb climatic and anthropogenic shocks (Hollings, 1995). By keeping livestock, crop farmers are able to add value to low-value surplus and waste food, use labour more efficiently, spread risk and add to their valued assets. Despite these advantages, nutrient mining and transfers from pastures to farms persist, particularly for phosphorous.

In ASALs, which cover more than 70% of the sub-region's total land area, pastoralism is the only viable form of food production. Pastoral communities rely on their animals for basic subsistence and sale to meet other needs. Pastoral lands are particularly prone to climate variability and frequent droughts. Producers feel the impact through livestock morbidity, reduced productivity, performance and off-take, depressed market prices and income from the sale of animals, and policies inhibiting them from seeking alternate solutions.

Livestock herders and crop farmers using land within or close to wildlife parks run into problems of predators, livestock diseases, crop destruction and depletion of forage and water. Community-based wildlife management initiatives such as those practised in some areas of Kenya may be viable alternatives in sparsely populated, lower potential areas adjoining protected wildlife sanctuaries (Bourn and Blench, 1999). Only a tiny proportion of pastoral lands are used for tourism; the potential for expansion into adventure tourism and remote hunting is substantial. Cultural tourism is also an option because the region's most unique and traditional peoples live in the pastoral lands. In the urban and peri-urban zones, livestock production systems and processing plants produce large quantities of waste, causing disposal problems that are exacerbated by poor infrastructure and weak regulations, if any. These livestock systems can pollute waterways and have negative impact on poor communities downstream. However, this is a minor issue in this region, but will become important as livestock keeping in urban areas intensifies.

Cross-thematic issues

An analysis of national, sub-regional, regional and global trends outlined above has shed light on specific priorities that will need to be pursued as a cross-thematic framework, and these include an emphasis on knowledge

and information management, generation of technologies and innovations, development of NRM-based methods, approaches and tools. Similarly, this strategy is informed by a SWOT analysis (Ref to NRM&B Thematic Descriptions Report, 2009) on the implementation of the NRM&B Programme agenda and elaborated implication of the situation analysis on strategic focus by the programme. By addressing these in a cross-thematic framework, it is ensured that the full range of options is mobilized to make a real difference for the NRM and biodiversity transformation in ECA sub-region.

Gender issues

Progress in raising gender awareness among the development community and in demonstrating the links between women, development and environment has been encouraging in recent years – at least on paper (MEA, 2005). But this apparent awareness is yet to find full expression in development planning and NRM and biodiversity programmes. Consequently, the perennial disadvantages that women face in NRM and agricultural development in ECA persist. Women continue to bear heavy workloads in farm production, marketing, household chores and casual labouring in much of ECA. Their situation on tenure insecurity and limited access to land, relatively lower financial status, and limited access to services and resources, including health, literacy, capital and food, is barely improving. There is little, if any, improvement in their access to technology and tools as well as the disproportionate burden they carry whenever NRM policies constrain access to and use of resources. Agricultural research and extension support services rarely target women, as they are considered more as gardeners rather than farmers. The NRM&B Programme will ensure that gender issues generally, and women, in particular, are integrated in the design and implementation of all its projects.

Knowledge and innovations generation and management

Substantial research interventions that range from plot-level, through catchments to landscape scale have generated component technologies on various ways of sustainable management of natural resources (land and soils, watershed, forests, agroforestry, fragile and dryland ecosystems, and other managed ecosystems) that provide streams of goods and services to human kind. Technologies exist, that when integrated into policies, strategies and implementation frameworks in ECA sub-region, will improve management of natural resources and thus optimize NRM and associated supply of goods and services.

New ways of generating and adapting NRM and biodiversity innovations, including pathways of knowledge sharing and dissemination are needed to effectively spread the impact of the technologies on sustainable management of natural resources. For instance, concentration on technology components needs to be done in an *innovation systems* context where multiple sources of innovation are nurtured. Natural resources-tailored research and development needs to concentrate more on generating NRM principles and dissemination or implementation strategies that take into account, circumstances where NRM interventions can work best and trade-offs can be considered.

Worldwide and in particular in ECA, considerable work has been done by natural resources and agricultural research, development and conservation professionals and organizations on approaches, methods and tools aimed at improving the effectiveness

and outcomes of improved NRM from the perspectives of the NRM managers, as well as of those providing services and information on NRM. Although these approaches are discussed in literature, their use by practitioners and acceptance by research organizations in ECA sub-region is still limited. Reasons for this are related to capacity gaps, limited dissemination, conventional training curricula that do not appreciate nor introduce these approaches, and a traditional 'science' culture that is oriented towards technology generation at plot level with limited extension to catchments and landscapes. Most R&D activities have not addressed the implementation aspects (the '*how*'), but have concentrated on the '*what*' and '*why*' issues (Omamo, 2003). This implies a need for a paradigm shift and management of organizational change so that scientists and development and extension agents can become more innovative in NRM. Methods related to conflict resolution and negotiation, enhancing collective action for NRM, organizational development and change, facilitation of joint action for improving NRM, and policy dialogue are not well developed and tested.

Implications for ASARECA-NRM&B Programme

The review presented in this chapter has shown that economic, environment and social well-being of ECA sub-region are intrinsically interlinked. This means that the strategic direction must be derived from this principle. Structural constraints such as limited infrastructure and communication; low technical know-how; imperfect markets that do not favour smallholders; poor access to credit, technology and input availability; inadequate or a complete absence of land tenure policies; and limited investment in the NRM and agricultural sector are compromising sustainable management of natural resources and keeping smallholders farmers at subsistence level. People living in agriculturally-high potential areas, representing most of the population in ECA sub-region, down to agro-pastoralists and pastoralists living in marginal ASAL areas, representing a substantial land area with lower population densities, face similar scenarios on the level of investment and sustainable management of natural resources. The outcomes are a declining resource base, increasing conflicts over the use of and access to natural resources, including marginalization of vulnerable groups, and inability to invest in improving land and water productivity so as to improve livelihoods. Thus, a vicious cycle occurs of reinforcement of "poverty and degradation".

No doubt governments in ECA sub-region cannot address the poverty-trap nor make the necessary investments in health, education and the other MDGs without addressing the underlying natural resource challenges. This programme strategy is designed with this in mind. It provides an integrated approach towards tackling the poverty-degradation nexus. It proceeds on the premise that supporting sustainable intensification and diversification means reversing the limitations or driving forces that are causing the poverty-degradation nexus. Policies provide a framework and an enabling environment that can potentially remove many of the structural issues and allow for profitable natural resource transformation into products, goods and services as well as investment in conservation and rejuvenation of the natural resource base in a way that ensures livelihoods and reduces vulnerability for current and future generations. To inform policy adequately, the strategy will be subjected to a comprehensive economic analysis in a separate study.

Thematic focus

Whereas ECA sub-region is reputed for its

abundant natural resources, it has entered the new millennium with a myriad of economic and social problems associated with natural resource management challenges and missed or mismanaged opportunities. Water and forestry resources are diminishing at an alarming rate, land degradation is rampant and farming has been extended to fragile ecosystems without proper management practices. Coupled with all these is severe decline in soil fertility and little or no use of external inputs to enhance soil productivity. In addition, there are inadequate suitable policies and institutional arrangements to foster sustainable use of the natural resources. There is thus the need to critically examine these issues and develop practical, tested and valid solutions that would enhance and sustain agricultural productivity. These challenges will be addressed in six thematic areas. Interrelationships and scope of operation are described diagrammatically in figure 2.

Improved water management and productivity in agricultural systems

Freshwater resources are a critical input for agriculture (crop and livestock production, fisheries, forestry and agroforestry as well as many other economic activities). However, water scarcity is one of the major challenges in sub-Saharan Africa (SSA), threatening livelihoods of people and their environment. Most of the population in SSA live in regions vulnerable to water shortage and where water availability is constrained by low human, institutional and financial capacity. ECA sub-region has significant surface and groundwater resources, with most of these lying in the DR Congo, but they are unevenly distributed and badly managed. Water scarcity is becoming one of the major limiting factors to economic development and improved human welfare in large parts of ECA sub-region. Unfavourable climatic factors such as erratic rainfall, high evaporative demand, and several drought series, among others, contribute to the increasing water scarcity.

With growing demand for water resources from all sectors, it is projected that by 2025, 13 countries in SSA, most of which are in ECA sub-region will experience water stress and another 10 countries will suffer from water scarcity (having less than 1,000 m^3 per capita per year). Furthermore, degradation of water resources including watersheds, wetlands and groundwater is on the increase. Another major uncertainty is the impact of climate change on water availability, and consequently the agricultural systems. There is need to assess the potential impacts of climate variability, climate change on water availability and access, agricultural production systems, and associated livelihoods and ecosystems. It is also important to minimize water depletion in livestock systems through improving quality of forages, and minimizing livestock-related evaporation and runoff. With the water scarcity and climate change crisis, it is necessary to improve water productivity and promote multiple use of water while improving water governance through integrated water resources management (IWRM). It is also critical to focus on the development of models and options for water policies and governance, based on sound scientific and economic evidence in ECA.

The key challenges facing the region on improving water management and productivity in agricultural systems include:

- How to enhance the management of rainwater to improve food production and livelihoods in the face of increasing demands from other sectors and threats from climate change;

- How to increase the productivity of water in agriculture and related sectors – at field to watersheds scales;
- How to enhance the capacity of communities in improving water management and productivity;
- How to foster opportunities for cooperative regional collective action among sub-basin and trans-boundary watershed countries; and
- How to institutionalize equitable and effective water resource governance systems at local, national and regional levels.

Among others, the objectives of this theme include:

- To facilitate efficient management of water resources to enhance crop and livestock productivity and hence multiple uses;
- To enhance equitable access and sustainable use of water resources;
- To promote integrated water resources management for shared transboundary costs and benefits;
- To enhance regional capacity in agricultural water management; and
- To contribute to progressive water policies and governance structures.

The integrated water and water systems management strategic interventions are:

- Enhancing water productivity for multiple use;
- Integrated watershed management in major river basins; and
- Targeting and up-scaling best-fit water harvesting, storage and delivery technologies and practices.

Enhancing sustainable management of forestry, agroforestry and biodiversity for improved livelihoods and environmental services

Forestry and agroforestry management principles are inherently geared towards harnessing the benefits of natural resources and biodiversity (services and products) for livelihoods and a sustainable and productive environment. The focus of ASARECA R4D (science and practice of forestry and agroforestry) is therefore to respond to problems and challenges facing agricultural production largely by smallholder farmers, while also taking into consideration the potential for contributing to biodiversity conservation. ASARECA R4D will be harnessed through three major pathways: (i) reducing pressure on natural forests; (ii) supporting sustainable management of habitats for native plant and animal species; and (iii) serving as a sustainable integrated land use management system for forests, ecosystems and fragmented landscapes.

Despite the abundance and huge potential of the sub-region's natural resources for sustainable development and provision of environmental services, ECA sub-region has not invested adequately in these resources for effective and sustainable management to bring about the required transformation for improved livelihoods. To change this trend, increased investment is required on strategies to facilitate the mainstreaming of forestry and agroforestry management, including biodiversity conservation in the sub-region's development agenda.

About 19% of the land area of SSA is classified as forest (defined as more than 10% tree cover) although estimates range between 18% and 52%, depending on the percentage tree cover (IUCN, 2005). The greatest extent of forest cover in ECA sub-region is found in Central Africa – the Congo Basin which covers about 200 million ha and is the world's second largest continuous tropical rain forest after the Amazon in South America. Other

significant forest areas include the Eastern Arc Mountain Forests of eastern Africa and in Eastern Madagascar. Forest ecosystems play a pivotal role in socio-economic development and ecological stability in the region. These forest ecosystems and woodlands have the highest levels of overall species richness and endemism which are under threat, particularly Madagascar and the Eastern Arc Mountain Forests of eastern Africa. In addition, ECA sub-region has a range of major habitat types or biomes, dominated by tropical and sub-tropical grasslands, savannas and shrub-lands. Other major habitat types include tropical and sub-tropical moist broadleaf forests, and deserts and xeric shrublands.

Forests and agroforestry systems provide the sub-region's timber and non-timber forest-based products. Communities in many parts of the region depend on forests for foods and traditional medicines. At the global level, forests and particularly those within the tropics are rich warehouses of pharmaceutical products and with huge potential for bio-prospecting. Other important ecosystem services associated with forests include: pool of genetic resources; regulating services such as flood and climate regulation; cultural services including spiritual, aesthetic, as well as recreational values; and supporting services including primary production, nutrient cycling, soil formation and biodiversity conservation.

Forests and trees are also critical sources of renewable energy considering that the majority of households in ECA sub-region still depend on biomass in the form of wood or charcoal for their energy needs. In ECA sub-region, trees provide over 80% of the household energy. The inhabitants also depend on trees for construction materials, fruits, medicinal products, fodder for livestock and other alternative livelihoods. Trees are also important in integrated soil and water conservation, among other environmental services such as biodiversity conservation and in mitigating climate change and variability. Similarly, agroforestry offers many entry points to improve the status, income and health of people, and enhances household income through tree enterprise portfolios that address people's nutritional, health and income needs, while providing a buffer against environmental challenges such as drought and degradation.

Plant and animal biodiversity are central to human wellbeing, most notably in food production but also as a source of natural medicines and products. The R4D activities of this theme concerning biodiversity focuses mainly on non-agricultural biodiversity which encompasses wild and domesticated forest species, tree crops, as well as wild food sources, their wild crop relatives, and "associated" biodiversity that supports agricultural production through nutrient recycling, pest control, pollination and sources of genetic material used in breeding programmes for both plants and animals. The biodiversity aspects of this theme and that of ASARECA programme on agrobiodiversity and biotechnology will provide important avenues for synergy and complementarity in the R4D activities of the two programmes.

Despite the enormous values of forests, agroforestry and biodiversity resources in ECA sub-region, unprecedented degradation pressure is being exerted by human activities, and climate change and variability. Principal threats to forests, agroforestry and biodiversity include land use and land cover change, mainly through conversion of natural forest ecosystems to agricultural land and settlement, and loss of fauna and flora occasioned by adverse effects of climate change

and variability. With increasing population pressure, land clearing and deforestation will continue, and hence threats to genetic diversity as a result of species loss are real.

In summary, key challenges facing the sub-region in sustainable management of forests, agroforestry and associated biodiversity include:

- How to enhance availability of appropriate methods and planning tools increasingly available for forest, agroforestry and biodiversity resource managers and practitioners;
- How to facilitate the development and implementation of robust policy and legislative frameworks for sustainable and equitable management of forestry, agroforestry and biodiversity in ECA sub-region;
- How to strengthen the institutional capacity of resource-limited ASARECA member countries in research and development, including governance. For instance, in ECA region, biodiversity is found both in situ and ex situ. There are challenges to sustainable management of biodiversity, which are peculiar to either in situ or ex situ conditions or those which are common to both conditions of biodiversity;
- How to sustainably respond to exogenous human activities such as industrial production and farming activities whose by-products end up as pollutants in the natural ecosystem that destroy the biodiversity;
- How to cope and manage socio-cultural habits that lead to destruction of biodiversity as an in-built attribute, for example, killing of certain wild animals as a form of formal initiation or use of certain tree species for performing ceremonies in some of the communities within ECA sub-region;
- How to regulate introductions of potential invasive species such as *Prosopis* species in East and Horn of Africa rangelands or Nile perch and water hyacinth in Lake Victoria;
- How to develop cultivars or species and varieties for enhanced productivity or adaptation to extreme conditions, such as recurrent droughts, which result in loss of genetic material for plants and animals; and
- How to mobilize adequate resources for investment and enterprise development, including improving access to market opportunities and value addition in forestry, agroforestry and associated biodiversity products.

In responding to the identified challenges above, the programme intends to define clear strategies which are translated into action. The programme's main objective is to promote effective and sustainable management systems and practices for forest ecosystems, agroforestry and biodiversity conservation in the sub-region for improved livelihoods of farmers, other rural dwellers and pastoral communities, while minimizing the environmental footprint. The objectives of this theme include the following:

- Design, develop and disseminate improved technologies and innovations for sustainable and equitable management of forests and agroforestry resources;
- Enhance productivity and conservation of agro-ecosystems for socio-economic benefits and environmental services;
- Facilitate the development of policy options and institutional innovations for enhanced investment in forestry, agroforestry and biodiversity-based enterprises by primary users, governments and other stakeholders;
- Strengthen the capacity and governance framework for effective and sustainable

management of forestry, agroforestry and biodiversity resources; and

- Promote awareness and access to knowledge and information for improved management and application of forestry, agroforestry and biodiversity technologies and innovations, including utilization.

On the basis of the identified challenges and objectives above, the programme will invest in the following strategic interventions:

- Mainstreaming technologies and innovations for sustainable management of forest ecosystems, agroforestry and biodiversity best practices for livelihoods security and environmental services;
- Advancing policies, institutional innovations and enhancing capacity for sustainable and equitable management of forest ecosystems, agroforestry best practices and biodiversity conservation;
- Promotion of economic instruments in forest resource valuation for sustainable management; and
- Domestication and conservation of high value agroforestry species and forest genetic resources and biodiversity.

Managing productive potential of soils

Land degradation is a severe problem in the densely populated highlands of ECA and elsewhere on the African continent. Key factors causing low agricultural productivity, widespread poverty and food insecurity in the region include soil erosion caused by cultivation on steeply sloping terrain, mining of soil fertility through continuous cultivation with limited application of inorganic or organic sources of soil nutrients, and deforestation and overgrazing of rangelands .In addition, insufficient nutrient replacement in agricultural systems on land with poor to moderate potential results in soil degradation. Whereas soil moisture stress inherently constrains land productivity on 85% of soils in Africa, soil fertility degradation now places an additional serious human-induced limitation on productivity. Soil fertility degradation has thus been identified as the single most important constraint to food security in SSA.

Assessments of nutrient stocks and nutrient flow studies in the region have shown large negative balances for major nutrients in many locations and farming systems(Stoorvogel et al., 1993). The commonest deficiency is of nitrogen followed by phosphorus. Use of fertilizer in the region is among the lowest in the world, with average applications of only 9 kg per ha within the region compared to 73 kg per ha in Latin America, 100 kg per ha in South Asia and 135 kg per ha in East and Southeast Asia.

Furthermore, about 25% of soils in Africa are acidic and therefore deficient in calcium and magnesium, and often have toxic levels of aluminium. Extensive areas of salt-affected soils exist in Sudan, Ethiopia, Tanzania and Kenya, especially in irrigation projects. These soils require reclamation to enhance productivity. Large areas of most countries in the region also have Vertisols. These soils are inherently fertile but have poor drainage and workability problems. Minimizing these constraints would enhance soil productivity.

Past research has generated soil fertility technologies with potential for increasing rural incomes and food production. However, uptake and utilization of these technologies has been low and often piecemeal, leading to very low benefits to the farmers. Again, most of these technologies are now out of date and hence need updating and improvement. The approach of integrated soil fertility management (ISFM) is not adequately and

extensively documented and hence calls for more research.

Based on the above analysis, the main challenges in managing soil productivity potential include:

- How to reverse degradation of soil through the development of integrated and sustainable practices for managing soil, soil water and nutrients;
- How to enhance adoption of best-bet integrated soil fertility management technologies; and
- How to build the capacities of researchers, extension officers, farmers and other stakeholders to package and disseminate ISFM knowledge, information and technologies.

To address these challenges, the NRM&B Programme proposes the following objectives under this theme:

- To update soil resource data bases to facilitate specific management decisions at farm, national and sub-regional levels;
- To develop, validate and disseminate improved ISFM packages; and
- To enhance decision-support systems based on improved knowledge and information management practices for different soil types with focus on problematic soils such as acid soils, salt-affected soils and Vertisols.

The above objectives will be realized by undertaking the following strategic interventions:

- Promoting utilization of integrated soil fertility management technologies for major food and high value crops;
- Management of problematic soils for improving agricultural productivity; and
- Management of cropping and conservation tillage systems.

Policy, institutions and governance for sustainable natural resource management

Appropriate governance structures, policies, and institutional mechanisms are critical avenues through which sustainable and equitable management of natural resources can be made compatible with poverty eradication and the other MDGs. They are at the heart of the agrarian systems and environmental sustainability crisis facing ECA sub-region today. Yet the role of policy, institutions and governance in influencing land use systems has for a long time been ignored in the design and execution of agricultural research programmes in Africa. The use-driven sectoral policies and institutions rooted in the continent's colonial history remain largely in place. These policies were not crafted with any coherent environmental sustainability goal in mind. They emphasize command-and-control approaches and punishment, rather than cooperation and innovative incentives to promote mutual and beneficial understanding and compliance.

The effects of weak land use policies, institution and governance structures are evident in various forms. These include distortions in systems of access to and control of natural resources, destruction and plunder of the sub-region's natural resources particularly in the wake of globalization, weak structures for decision-making and managing resource conflicts at all levels of social organizations, failures to appropriately respond to emerging markets and incentives, and the continued use of obsolete technologies. They also explain the gender inequities and unequal power relations within resource-user communities and institutions, which lead to un-

equal access to, and control over benefits from natural resources.

People are more likely to adopt environmentally-sustainable agricultural land use systems when they have clear rights to resources and are confident of future access to and benefits from the resources. In this sense, security of tenure and use right is critical in determining how rural people can secure their livelihoods and alleviate poverty. Likewise, the provision of incentives and empowerment of resource users to access markets, seize new financing opportunities like those in the carbon markets, and harness their collective local knowledge systems of innovation to respond to development challenges is crucial. This calls for a human perspective of these resources – a decentralized approach to land-use, where decisions are made at as local a level as is practical. To support these, ways to nurture and retain political will and capacities are needed to achieve full participation, transparency and accountability in NRM.

The key challenges under this theme therefore include:

- How to integrate indigenous and local knowledge systems and innovations into national and regional natural resource management policy and governance frameworks;
- How to respond to and capture emerging markets and financing opportunities engendered by globalization to improve natural resource management;
- How to institutionalize incentives into policy and governance frameworks to foster mutual and beneficial understanding and compliance; and
- How to stimulate collective action and responsibility for governments to adopt common approaches and instruments to deal with the intractable problems in natural resource management.

The objectives of the theme include:

- To improve the policy, institutional and governance conditions for achieving environmentally-sustainable land use systems in ECA;
- To promote appropriate incentive systems to accelerate adoption of innovations for natural resource management; and
- To establish and respond to the influence of policy, trade liberalization and markets on natural resource management systems.

Based on the aforementioned challenges and objectives, the NRM&B Programme will implement the following strategic interventions:

- Up-scaling and out-scaling of successful innovations and community empowerment;
- Supporting formulation of appropriate incentive systems to accelerate adoption of and sustainable investment in best fit innovations for natural resource management;
- Establishing and responding to the influence of globalization, trade liberalization and markets on natural resource management and innovation systems; and
- Advancing policies, institutional innovations and capacity for sustainable and equitable management of forest ecosystems and agroforestry best practices.

Adaptation to climate variability and mitigation of climate change

Climate change and variability is the single most important atmospheric phenomenon in SSA likely to cause several effects gov-

ernments and other institutions are least prepared to face. Projections of climate change scenarios for ECA sub-region show that temperatures are expected to increase while rainfall will decrease in some parts and increase in others. Temporal and spatial variability of climate, especially rainfall, is a major constraint to productivity, competitiveness and commercialization of crops (including tree crops) and livestock systems in most of ECA sub-region countries. A major drought affecting several countries is recorded in ECA sub-region at least every 5-10 years with amazing irregularity. Beyond the traditionally-held categorization of climate change as an environmental issue, it is clearly also a development issue that is directly linked to poverty reduction, food security, economics, health, human rights, governance and equality within the context of the MDGs. The changes in climate have implications on agricultural productivity (negative or positive) and equally affect natural resources management. Climate change has affected crop yields particularly in the arid, semi-arid and semi-humid zones, leading to food deficits.

In general, climate change presents significant threats to the achievement of the MDGs related to eliminating poverty and hunger, and promoting environmental sustainability. Although ECA sub-region is highly vulnerable to climate change and variability, the sub-region also offers high potential for climate mitigation, adaptation interventions and associated achievement of some of the MDGs.

On the basis of the above analyses, the main climate change and variability challenges include:

- How to enhance the existing inadequate national and regional capacity to assess climate change impacts and design response strategies;
- How to stimulate governments in the sub-region to collectively formulate national and regional policies, regulatory instruments and strategies that would foster desired institutional change for mitigation of, and adaptation to, adverse effects of climate change;
- The need to enhance knowledge and information for mainstreaming climate change as a core issue in sustainable development, including sustainable management of natural resources, energy, agriculture, health and infrastructure;
- How to develop and apply market-based instruments for valuation and documentation of baseline carbon sinks in soils and forestry resources in ECA region and identification of projects with potential for linkage to CDM market incentives; and
- How to establish comprehensive frameworks for addressing national and regional climate change issues for adaptation and coping with climate-induced crises and shocks at national and sub-regional levels with inventory of activities, programmes and associated costs.

In view of the above challenges, the NRM&B Programme's main objective to address adaptation to climate variability and mitigation of climate change is to develop policies, strategies, regulatory frameworks and institutional capacity. This will be supported by appropriate implementation frameworks for enhanced adaptation to adverse effects of climate change and variability, including promotion of activities to mitigate climate change.

To generate the required outputs, this theme will concentrate on the following objectives:

- Implement capacity building programmes for assessment of impacts of

climate change and variability in ECA sub-region;
- Facilitate the development and application of national and sub-regional policies, regulatory instruments, strategies and institutional change for adaptation and coping with climate change and variability-induced shocks and crises in ECA region;
- Facilitate development and application of national and regional policies, regulatory instruments, strategies and institutional change for mitigation of climate change and linkage to markets for carbon sinks and clean development mechanism in ECA sub-region; and
- Promote identification and use of indigenous and locally-adapted plants and animals as well as the selection and multiplication of crop varieties and animal breeds adapted or resistant to adverse effects of climate change and variability.

The above challenges created by climate change and variability will be addressed by undertaking the following strategic interventions:
- Responding to emerging climate change mitigation-related markets (carbon, biofuels and environmental services) to benefit rural communities; and
- Develop, validate and promote technologies, policies and practices for adaptation to climate variability.

Other strategic areas for investment consideration include the following interventions:
- Politically-supported agreement on science-based greenhouse gas stabilization path with 2020 and 2050 reduction emissions targets;
- Capacity and empowerment-supported effective measurements and verifications of "Certified Emissions Reductions – CERs";
- Policy-backed incentives for increased financing of low emissions technologies, complete with mechanisms for deployment of existing and new technologies;
- Policy-supported incentives for making communities more resilient and able to adapt to adverse effects of climate change; and
- Innovative means to protect and balance carbon cycle in terrestrial and sub-terrestrial ecosystems.

Managing fragile and dryland ecosystems for sustainable livelihoods

Fragile ecosystems are important land systems with unique features and resources. They are potentially vulnerable to destruction if not properly managed. Some of these ecosystems are characterized by: limited and erratic rainfall; intense pressure in resource use; sensitivity to climatic shocks; highly erodible soils; increased risk of flooding; and populations that are highly vulnerable to food insecurity. In ECA sub-region, fragile ecosystems include drylands, wetlands, biodiversity 'hotspots/corridors', freshwater wetlands (such as Lake Victoria Basin and associated drainage systems) and the densely populated and degraded highlands, including the major watersheds and water towers of national and regional significance. Other fragile ecosystems include intertidal wetlands, rainforests and coral reefs. An analysis of the main fragile and dryland ecosystems in ECA sub-region is provided under the following classification:

(a) Dryland ecosystems

These ecosystems are characterized by low and erratic rainfall and frequent droughts, often resulting in substantial losses of vegetation such as pastures and browses, livestock, other livelihood support opportunities including biodiversity, and over dependence of the human population on famine relief for extensive peri-

ods of time. In ECA sub-region, drylands are home to 20-90% of the populations of some ECA member countries, support 50-90% of the national livestock herds and the bulk of world-famous wildlife that supports the vibrant tourism sector. Much of these ecosystems occupy large tracts of land mainly in Sudan, Ethiopia, Eritrea, Kenya and Tanzania. Equally diversified and important resources in the drylands are woodlands, which provide the main feed resources for major livestock and wildlife species. Among other important natural resources found in drylands is charcoal, which constitutes over 50% of the urban energy requirements and more than 80% of rural woodfuel (World Resources Institute, 2007). Other products such as honey, gums, resins and woodcarving materials are mostly supplied from the dryland, forest and woodland resources.

Whereas drylands ecosystems offer enormous potential in ECA sub-region, they have the highest poverty incidences in the world partly because of resource underdevelopment and infrastructural constraints; and persistent unfavourable policies, among other reasons. Past land rehabilitation efforts have contributed to the introduction of adaptable species, some of which are invasive, such as *Prosopis juliflora* (Prosopis tree or Mesquite) that has encroached on riparian ecosystems where initial introduction was unintended. Moreover, changing perceptions about productive potential of drylands is an uphill challenge given the little understanding of dynamic life styles of pastoralists and agropastoralists, and the risk of desertification in these ecosystems.

(b) Wetlands ecosystems

These provide many livelihood opportunities as shown by several participatory assessment studies. For instance, many households depend on wetlands for fish, water supply and transport, among other benefits. In ECA sub-region, poorer households are most dependent on wetland resources for food security and income. Based on an assessment of the value of wetlands for fishing and other foods, domestic water provision, transportation, construction materials, firewood, medicinal plants and flood-recession rice, ECA sub-region populations make on average 77% of their income from fisheries, compared to 56% for poorer households (IUCN, 2004). The poorer households are also more vulnerable to losses in fisheries and wetland resources, particularly because they are less able to deal with shocks such as health problems, drought and livestock death.

Similarly, wetland ecosystems perform key hydrological and biological functions that are critical to human health, water filtration, flood control and groundwater recharge. Wetlands improve water quality by removing organic and inorganic nutrients and toxic materials from the water that flows across them. On the other hand, wetlands can be a habitat for disease vectors. Considering that the ECA sub-region has substantial wetlands resources, ASARECA NRM&B Programme needs to provide strategic interventions to improve and sustain the management of these ecosystems for the present and future generations.

(c) Watersheds and mountain ecosystems

These constitute significant landforms in ECA sub-region. About 10% of the world's population depends on mountain resources. Mountains or water catchment areas (commonly referred to as water towers) are important sources of water, energy and biological diversity. Furthermore, they are a source of such key resources as minerals, forest resources and agricultural products, and are important for recreation. These ecosystems are,

however, being rapidly degraded. They are susceptible to accelerated soil erosion, landslides and rapid loss of habitat and genetic diversity. On the human side, mountain inhabitants experience widespread poverty and loss of indigenous knowledge. As a result, most mountain areas in ECA are environmentally degraded. Proper management of mountain resources and socio-economic development of the people in ECA sub- region is urgent. It is important to generate and strengthen knowledge about the ecology and sustainable development of mountain ecosystems as well as promote integrated watershed development and alternative livelihood options.

(d) Biodiversity 'hotspots/corridors'

These ecosystems are under continuous threat mainly by human settlement and activities such as agricultural practices, changes in land use, and climate change and variations. In ECA sub-region, biodiversity 'hotspots' are host to a wide range of threatened, rare and endemic species, habitats and ecosystems. Other major biodiversity habitat types include tropical and sub-tropical moist broadleaf forests, and deserts and xeric shrublands. These ecosystems have the highest levels of overall species richness and endemism, particularly in Madagascar and the Eastern Arc Mountain Forests of eastern Africa. Sustainable management of these ecosystems is guided by the principles agreed by the Parties to the CBD that provides an international framework through which sustainable biodiversity conservation and fair and equitable sharing of benefits arising from its conservation can be fostered. Principal threats to biodiversity in these hotspots include land use and land cover change, mainly through conversion of natural ecosystems, particularly forests and grasslands, to agricultural land and urbanization. With increasing population pressure, land clearing and deforestation will continue and hence the threat to genetic diversity from species loss is real.

In general, fragile and drylands ecosystems face multiple challenges including resource use conflicts, variable and misunderstood governance systems in management, and inequitable sharing of proceeds from use of resources. Other challenges include diminished community empowerment options, limited accountability, subdued voices, non-recognition of local institutional management systems and weak grass roots institutions. Use of communal and individual natural resources such as trees, water and forages is often unsustainable. Sometimes it is caused by pastoral mobility, leading to increased risk of desertification in these ecosystems. Contradictory and sometimes inadequate policies in land use management include land grabbing, reallocation and alienation to other uses. Changing perceptions and attitudes about productive potential of drylands is a challenge, given the little understanding of dynamic lifestyles of pastoralists and agropastoralists and the risk of desertification in these ecosystems.

The key challenges facing these ecosystems comprise the following:

- How to reverse the increasing degradation of natural resources associated with unsustainable utilization of these ecosystems;
- How to enhance stewardship, ownership, collective management and equitable sharing of benefits and costs arising from natural resources to minimize conflicts; and
- How to empower vulnerable communities and institutions in the dryland and fragile ecosystems to sustainably manage the productive potential of their environments.

The main objective of this theme is to de-

velop alternative livelihood options in the fragile and dry-lands environments. Specific objectives are:

- To develop, validate and promote technologies and innovation systems for sustainable and equitable use of fragile and dryland ecosystems-based resources;
- To facilitate development and application of national and sub-regional policies and governance frameworks for sustainable management of fragile and dryland ecosystems;
- To promote development and adaptation of natural resources-related conflicts; and
- To strengthen capacity for resource assessment and management of these ecosystems.

The identified challenges and objectives will be realized by carrying out the following strategic interventions during this strategic plan period:

- Developing and adapting technologies and innovations to combat the risk of desertification; and
- Promoting options for forecasting (predicting) and managing natural resource-related conflicts.

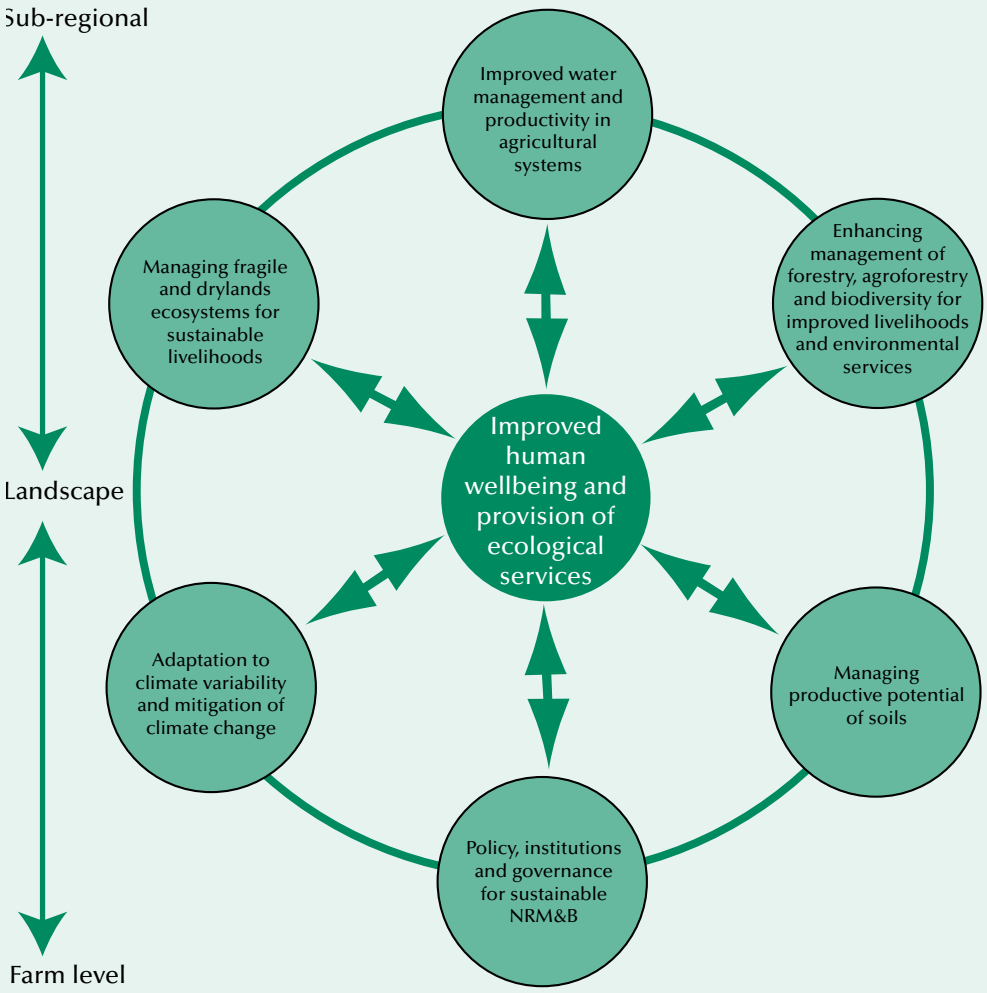

Figure 3: *Thematic inter-linkages and scale of operation*

Implementing the strategy

The operational framework in implementing this strategy is underpinned by an integrated and holistic approach based on a regional framework that is implemented through priority thrusts and associated interventions for addressing food systems, poverty and land resources degradation in ECA sub-region. The strategy will be implemented through six themes that will lead to and facilitate strategic interventions. Implementation of the strategy will contribute directly to ASARECA performance management results.

Implementation approaches and methods

Implementation of the strategy will incorporate social learning and participation so as to ensure that multiple viewpoints, needs and stakes in resolving NRM and biodiversity issues at different levels are negotiated and taken into account. The approach will promote a systems perspective in action; it will recognize the integrated nature of NRM in itself and with livelihood and other objectives and values of the natural resource managers and users. Given the biophysical and socio-economic (including human and policy) interactions inherent in NRM issues, partnerships and multi-disciplinary teamwork plus strong resource mobilization initiatives will be emphasized but with clear roles, responsibilities and contributions.

Strategic partnerships will enable the NRM&B Programme to achieve a critical mass in relevant areas, complete the chain from research needs analysis to technology development, testing, validation, adoption and scaling up to achieve impact. Partnerships will support active participation of local institutions in advancing effective and efficient NRM&B practices, thereby incorporating indigenous knowledge and expertise. Partnerships will support policy and institutional transformations conducive to NRM. Strategic partnerships in NRM&B will provide guidance and strengthen the establishment, management, monitoring and evaluation of partnerships at all levels. With a focus on improving expertise, effectiveness and efficiency, this will promote capacity building and mentoring for ASARECA staff as well as partner scientists and institutions.

The programme intends to implement a substantial proportion of its research agenda through its partners, using mechanisms that reinforce synergy, complementarity and coordination. Partners will participate in setting the research agenda, planning, resource mobilization, implementation, publishing and dissemination of research results. The programme will encourage partnership with the private sector where it helps to fulfil the overall mission of NRM&B that will benefit poor farming communities.

The programme agenda will be implemented through regionally-coordinated projects executed by consortia of NARES, and regional and international institutions at selected pilot learning sites using participatory learning and action research (PLAR) approaches.

Cross-regional synthesis, networking and knowledge-sharing mechanisms will improve the regional value of the findings and enhance spill-over effects. Better links between research and development will necessitate close working relationships between NARS scientists of various disciplines and levels, NGOs, extension services, private sector entrepreneurs such as input supply providers, and most importantly, farmers and policy makers will be promoted under the research for development paradigm.

Other ASARECA cross-cutting programmes such as Policy Analysis and Advocacy, Uptake and Knowledge Management Programme, and Agro-biodiversity and Biotechnology, as well as integrated management programmes such as Livestock and Fisheries, Staple Crops and Non-staple Crops will be closely involved where appropriate in the NRM&B strategy implementation. Partnerships will also be strengthened to include relevant regional and international research institutions including IARCs, advanced research institutes, universities, FAO, IUCN, African Union (AU)/IBAR and private sector research NGOs, among others. These partnerships will build on collaborative advantages and positive synergies, based on comparative advantage under the strategic leadership and direction of the ASARECA-NRM&B Programme Unit. In resource mobilization, a wide spectrum of funding agencies and development partners will be consulted to seek their perspectives, advice, feedback and support. Strong linkages and collaboration will be established with the FARA-led sub-Saharan Africa Challenge Programme (SSA-CP), as well as with similar programmes in the other SSA sub-regional organizations such as CORAF/WECARD and Food, Agriculture and Natural Resources (FANR) of SADC.

Management and governance structure

The management structure of the programme will involve four main levels of governance:

- The General Assembly
- ASARECA {Board of Directors (BoD) and Secretariat}
- Programme Management Unit
- Strategic Intervention Management units which will be responsible for the implementation of supported initiatives.

Through the Secretariat, the Board of Directors will ensure that the NRM&B strategic plan is implemented and accomplished and will provide overall policy direction. The Programmes Committee of the BoD will provide the necessary policy guidance required to implement impact-oriented projects. In addition and based on specific criteria, the Programme Management Unit will from time to time appoint highly qualified persons to advice on the suitability, feasibility and effectiveness of proposed interventions. It will comprise a balanced combination of NRM&B experts sourced from international institutions, NARS and advanced institutes, NRM&B think tanks, universities and the private sector in the region and beyond. Members will be required to have a broad understanding of ASARECA sub-region and will form an indirect mechanism for capacity building and advocacy for the programme. TAC will meet at least once a year and members will serve for a three-year term, renewable once.

Specific terms of refence for such a team will include:

- Advise ASARECA Secretariat through the Programme Management Unit on matters about the NRM&B strategy, programmes and projects supported, promoted or implemented by ASARECA;

- Advise the NRM&B Management Unit on key issues pertaining to natural resource management;
- Provide technical guidance and backstopping to the programme management unit whenever the need arises;
- Guide the design of regional projects necessary to meet the objectives of the NRM&B Programme strategy; and
- Serve as primary resource persons to advise and make recommendations on new initiatives of a strategic or emergency nature set by NARS, the Secretariat and donors.

The Programme Management Unit will oversee the development and implementation of projects and will:

- Provide a mechanism for regional coordination to harmonize projects and activities; and
- Develop and implement fund-raising strategies and activities for implementing the NRM&B strategy.

For programme management, ASARECA rules and procedures such as the competitive grants scheme will guide implementation of regional projects. The coalition of partners—NARS scientists, NGOs, extension service, the private sector, policy makers and civil society organizations—will emphasize generation of public goods for the region, under the leadership of the relevant NARS. ASARECA projects will be designed to run for at least three years to generate desired results. Project leaders will manage the projects on full- or part-time bases. Project leaders will work under the supervision of the programme manager.

Gender considerations

While the programme will be implemented in line with all the core values of ASARECA, particular attention will be paid to the issue of gender. Gender issues will be taken into cognizance at all implementation phases of the strategy. The design and implementation of strategic interventions will be assessed on the extent of their sensitivity to gender matters. Care will be taken to ensure that communication of calls for proposals reach as wide an audience as possible. But particular effort will be made to encourage women to apply, either as individuals or consortia. Only those proposals which demonstrate deliberate effort to capture all the relevant gender perspectives will succeed. Research consortia will be required to demonstrate a balanced mix of gender in their research teams.

Communication of programme results

ASARECA NRM&B Programme will use the most effective pathways to conduct effective research and ensure that research results are communicated in appropriate formats to intended users to achieve positive outcomes and impact. The development of an effective communications strategy will thus help the programme target and reach large numbers of policymakers, opinion leaders, researchers, educators, development workers and investors. The NRM&B Programme will use an array of communication channels for this effort that will include scientific publications, use of the internet, policy briefs, mass media and field visits.

Programme performance management

The NRM&B Programme performance will be judged from several perspectives:

- Impact in contributing to ASARECA focus of facilitating—together with stakeholders and partners—increased generation, promotion, sharing and utilization of knowledge, information, technologies and innovations for the management and conservation of

natural resources to benefit individuals, society and the environment in ECA sub-region;
- Capacity built at individual level and in institutional strengthening;
- Scientific outputs, as measured by the number and quality of research publications and reviews;
- Technologies developed for INRM;
- Products, tools and strategies as elements of these technologies;
- Networks, learning alliances and platforms, and communities of practice facilitated through strategic collaboration with NARES, universities and IARCs; and
- Increased funding from enhanced donor confidence in the NRM&B Programme management, research and development.

M&E will be an integral part of the implementation of the NRM&B strategy. For compatibility purposes, a uniform monitoring system based on the existing ASARECA Performance Management Framework and indicators will be adopted and applied at regional level by the NRM&B Projects Coalition. The evolution and development of an M&E system should be participatory and interactive. To enable the programme to measure the effects and impacts of the interventions, baseline surveys will be carried out and impact pathways mapped out at the onset of projects.

Through capacity building activities, the stakeholders and policy makers will disseminate lessons learnt, important results and other relevant information. The implementers will monitor the projects continuously as part of the social learning process, while external evaluation of the strategy and the results will be carried out twice—during mid and end term intervals. The project leaders, through supervision missions, will be responsible for monitoring and implementing the programme strategy.

Business plan

Human and financial resources are critical for effective implementation of the NRM&B strategy. Funding of the ASARECA-NRM&B Programme will come in five major forms as described below:

- Direct funding managed by the programme to cover the costs of core activities of ASARECA-NRM&B are expected to come from ASARECA core funding but will be supplemented with the other sources such as M&E budgets of the Competitive Grant System (CGS) and NPs-based bilateral funding mechanisms. These funds will be used to maintain the NRM&B Programme and the TAC, support task forces and short-term consultants, provide resources for the consultation of stakeholders and periodic review of priorities and projects, and finance the monitoring, evaluation and impact assessment. The funds will also be used to implement central and cross-cutting projects especially in the synthesis of information, building of knowledge bases as well as sharing and dissemination.
- Research funds will be raised directly from contributions of participating NARES, donors, and ASARECA through its CGS. Regional and international programmes such as SSA-CP, GEF and other global funding facilities for R4D in NRM will be explored.
- Project funding in which multi-country and institutional consortia will—on behalf of ASARECA-NRM&B Programme—develop projects to deliver the sub-regional agenda, and obtain funds for their implementation. These projects will be in research, knowledge sharing and capacity building. Sources of

funds will include development partners, the private sector, the ASARECA CGS and other CGSs such as that of the Challenge Programme—Water and Food. Another way of raising this type of funding will be by entering into twinning agreements between ASARECA-NRM&B Programme and development programmes such as the Nile Basin Initiative, so as to coordinate their research and capacity building activities.

- Institutional contribution (especially in kind) to projects funded through the previous two sources will be another form of funding the ASARECA-NRM&B agenda. In this case, the participating institutions will, for example, provide staff time, land, and research and training facilities to ASARECA-&F projects, at reduced or no cost. Furthermore, ASARECA-NRM&B Programme will strive to build on ongoing activities of NARES which are relevant to the regional agenda.
- Other strategies will include leveraging of funds that have already been allocated—so that they are used to support the ASARECA-NRM&B agenda. A good example of this is the implementation of some aspects of ASARECA-NRM&B priority research projects through graduate students who are already sponsored with research bursaries. They therefore contribute both technical staff time and resources to the ASARECA-NRM&B agenda.

Assumptions and risks

The following are key assumptions underlying the realization of ASARECA-NRM&B's strategic objectives:

- Availability *of adequate financial resources for the implementation of the NRM&B strategy*. In the macro-economic scenario which the governments in the sub-region are facing, it is unlikely that any of them are going to be able to increase significantly, funding for agricultural research and therefore NRM. Effective implementation of the NRM&B strategy will thus need alternative sources of funding and prioritizing of the areas of research in NRM to be undertaken.
- *Availability of the minimum critical capacity (human resources and facilities*). Global, regional and national concerns on environmental degradation caused mainly by inappropriate agricultural practices will increase in the short to medium term. This will exert increasing pressure on agricultural research systems in the region to incorporate many aspects of NRM and environmental research in their programmes, not withstanding their already wide research agenda as well as scarce manpower and other resources.
- *Political will, support and enabling environment in ECA sub-region*. All ASARECA member countries are members of regional economic blocks (COMESA and IGAD) which have increasing regional trade among their objectives. Increased regional trade in agricultural commodities including natural resources products and services will lead to more economic activities as well as economic development, and thus offer incentives for NRM.
- *Willingness* and *collaboration between the technology developers and the consumers*. The liberalized trade scenario, which is emerging in ECA sub-region, will enable farmers, agro-pastoralists and pastoralists to more easily access the products of NRM research being developed in any institution in the sub-region. This may provide a rational basis for planning NRM&B research from a regional perspective in addition to the national focus.
- *Trade liberalization and free movement of people across boundaries will lead to trans-bound-*

ary plant and animal diseases spreading faster in the sub-region. Closer collaboration among the NARS in the sub-region will enable the prompt detection and control of the spread of such diseases and pests. Thus, cross-country collaboration in NRM&B research agenda that cut across national boundaries would require guidance and direction from ASARECA.

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Annexes

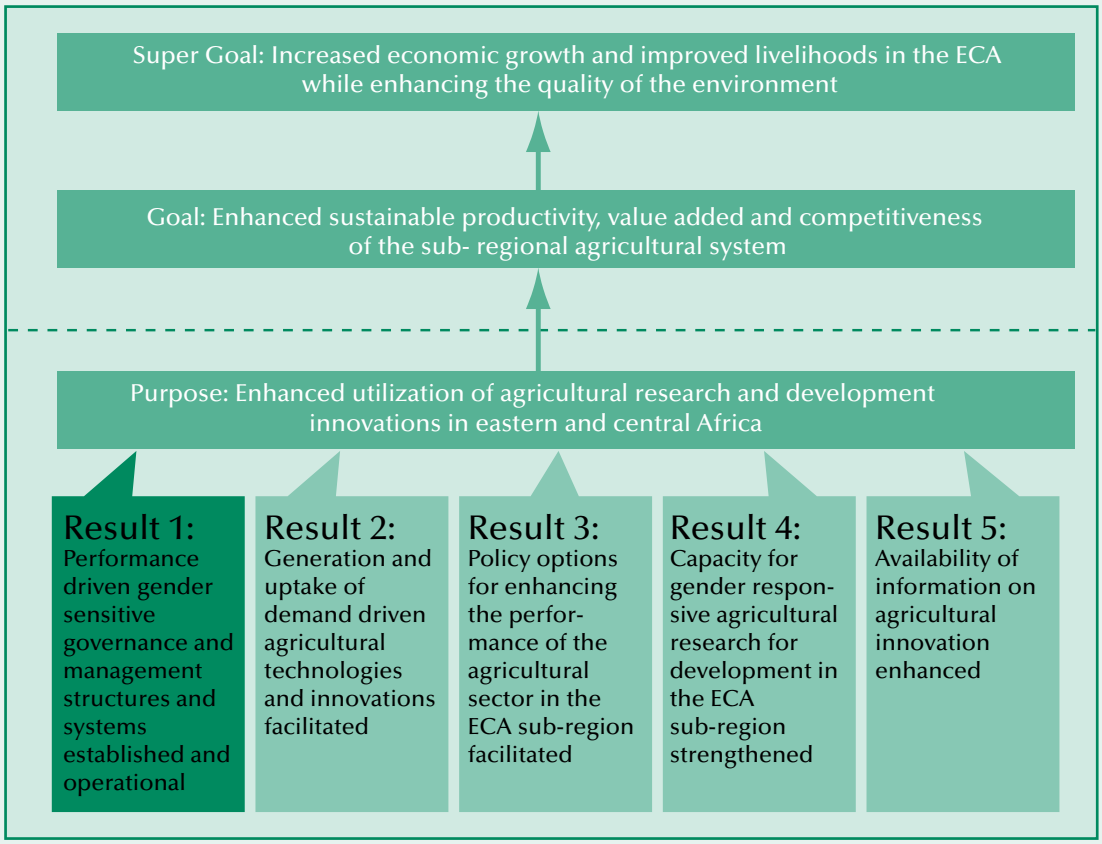
Annex 1: ASARECA Natural Resource Management and Biodiversity Programme Logical Framework 2009-2014

Objective statement	Verifiable Indicators	Sources of Verification	Assumptions
Super Goal: Increased economic growth and improved livelihoods in Eastern and Central Africa while enhancing the quality of the environment	• 6% annual increase in GDP from agricultural sector by 2014. • 50% increase in people living on more than 1$ per day by 2014. • 10% increase in biodiversity and forest cover by 2014	• Government statistics • FAO and World Bank, ADB, Economic Commission for Africa statistics and reports • COMESA and other regional organization reports • UNEP statistics and reports	• Relevant regional and national policies are implemented • Governments continue to support agriculture and poverty reduction as priorities • Equitable distribution of benefits occurs • Agricultural transformation occurs in the ECA region occasioned by technical change
Goal: Enhanced sustainable productivity, value added and competitiveness of the sub- regional agricultural system	• % increase in yield of selected crops • % increase in labour productivity • % decrease in production costs of selected commodities • % increase in volume of processed agricultural products • % increase in value of agricultural output **ASARECA will not track this set of indicators: Instead we shall rely on activities of partner organizations such as COMESA and NEPAD**	• Government statistics • Economic Commission for Africa statistics and reports • FAO statistics • COMESA and other regional organization reports • Selected CGIAR reports and publications: • External evaluation and impact assessment • Appropriate UN organizations	
Purpose: Enhanced utilization of NRM innovations in ECA's agricultural systems	1. % increase in adoption of appropriate soil fertility enhancement technologies 2. % increase in adoption of appropriate water use efficiency (productivity) enhancement technologies 3. % increase in adoption of sustainable forestry management practices 4. % increase of adoption of biodiversity conservation practices	• Programme reports • COMESA reports	• Presence of effective innovation platforms in ECA region • Targeted financial services for NRM exist • Appropriate knowledge and technology delivery mechanisms operational • Functional advisory systems in place

Objective statement	Verifiable Indicators	Sources of Verification	Assumptions
Result/Output 1: Generation and uptake of demand-driven natural resource management technologies and innovations facilitated	1.1 Demand-driven articulation of NRM research portfolio developed and documented by 2009 1.2 Priority research and development issues identified and documented by 2009 1.3 50% of research and development portfolio addressing the needs identified during priority setting process implemented by mid-term and 100% by 2014 1.4 Number of demand-driven innovations generated by 2014 1.5 Number of demand-driven technologies made available to uptake pathways by 2014 1.6 Number of gender responsive innovations generated in NRM by 2014 1.7 50 % of generated demand-driven technologies/innovations made available to uptake pathways by 2012 and 100% by 2014 1.8 Climate variability adaptation and climate change mitigation appropriate strategies identified and recommended to policy makers by 2012	• ASARECA evaluation reports • Programme annual reports • NARS annual reports • NRM&B Programme priority setting document • Manual on techniques • Scientific publications	• ASARECA-donor relations remain cordial • Willingness of participating countries to support the processes to their conclusion • Political, social and economic stability does not deteriorate to critical levels.
Result/Output 2: Appropriate institutional arrangements for sustainable natural resource management supported	2.1 Priority institutional constraints to enhancing sustainable natural resource management identified and documented by 2011 (At least 1) 2.2 Number of appropriate institutional arrangements for promoting sustainable natural resource management recommended to decision makers by 2014 (At least 1) 2.3 Number of institutional arrangements that enhance access to and use of natural resources by women and the youth recommended to policy makers by 2014 2.4 Number of conflict management regimes over access, use, control and ownership of natural resources recommended to policy makers by 2014	• ASARECA evaluation reports • Programme annual reports • NARS annual reports • NRM&B Programme priority setting document • Manual on techniques • Scientific publications • Policy briefs	• Government, non-government, sub-regional and national organizations operate effectively at all levels • Willingness of participating countries to support the processes to their conclusion

Objective statement	Verifiable Indicators	Sources of Verification	Assumptions
Result/Output 3: Capacity to generate effective strategies for promoting sustainable natural resource management enhanced	3.1 Capacity strengthening priority needs assessment on promoting water use efficiency and biodiversity conservation for livelihoods and ecosystem services carried out by 2010 3.2 50 % and 100% of the identified priority capacity strengthening needs addressed by 2012 and 2014 respectively 3.3 50% and 100% of Programme research portfolio implemented by 2012 and 2014 respectively 3.4 Number of referred journal publications by 2014 (at least 1, 2 and 3 by 2010, 2012 and 2014 respectively) 3.5 Number of technologies and innovations made available for uptake by 2014	• Training reports • Training manuals • Training needs assessment reports • Programme reports	• Partnerships with adequate capacity for generation and uptake of technologies and innovations exist. • Adequate human, physical and financial resources are maintained within NARS and other partners. • Government, non-government, regional and national organizations operate effectively at appropriate levels. •
Result/Output 4: Availability of information on natural resource management enhanced	4.1 Priority information packages and target stakeholders identified and documented by 2011 4.2 Number of appropriate information packages on NRM addressing identified stakeholder needs prepared by 2012 4.3 Information management platforms on water use efficiency, sustainable biodiversity conservation for livelihoods and ecosystem services, and management productive potential of soils identified, documented and used by 2010 4.4 % of packaged information/ knowledge products delivered through the identified pathways by 2014	• Needs assessment reports • Field verifications • ASARECA website, newsletters and documentaries • Programme reports	

Annex 2: Summary of ASARECA Performance Management Framework



Annex 3: NRM&B Programme Theme and Strategic Interventions Ranking

No.	Theme	Mean score (%)	Strategic intervention	Mean score (%)	Ranking
1	Improved water productivity and management in agricultural systems	70.9	Enhancing water productivity for multiple use	60.2	2
			Integrated watershed management in major river basins	60.2	3
			Upscaling best-fit water harvesting, storage and delivery technologies and practices	59.4	4
2	Enhancing sustainable management of forestry, agroforestry and biodiversity for improved livelihoods and environmental services	70.0	Mainstreaming technologies and innovations in forestry and agroforestry resource management for sustainable livelihood	56.0	7
			Domestication of high value agroforestry species and conservation of forest genetic resources	54.9	9
			Promotion of economic instruments for sustainable forest resource management	51.8	14
3	Managing the productive potential of soils	67.7	Promote utilization of integrated soil fertility management technologies for major food and high value crops	61.1	1
			Management of problematic soils for improving agricultural productivity	53.7	12
4	Institutions and governance for sustainable natural resource management	66.1	Up-scaling and out-scaling of successful innovations and community empowerment in NRM	57.2	5
			Support formulation of appropriate incentive systems to accelerate adoption of and sustainable investment in best-fit innovations for natural resource management	55.5	8
			Establish and respond to the influence of globalization, trade liberalization and markets on natural resource management and innovation systems	52.2	13
			Advancing policies, institutional innovations and capacity for sustainable and equitable management of forest ecosystems and agroforestry best practices.	51.2	15
5	Managing fragile and drylands ecosystems for sustainable livelihoods	65.7	Developing and adapting technologies and innovations to combat the risk of desertification	56.5	6
			Promoting options for forecasting and managing natural resource-related conflicts	51.0	16
6	Adaptation to climate variability and mitigation of climate change	65.4	Responding to emerging climate change mitigation-related markets (carbon, bio-fuels, environmental services) to benefit rural communities	54.5	10
			Develop and promote technologies, policies and practices for adaptation to climate variability	54.3	11

Annex 4: Strategic Interventions

	Strategic intervention	%
1	Promote utilization of integrated soil fertility management technologies for major food and high value crops	61.1
2	Enhancing water productivity for multiple use	60.2
3	Integrated watershed management in major river basins	60.2
4	Upscaling best-fit water harvesting, storage and delivery technologies and practices	59.4
5	Up-scaling and out-scaling of successful innovations and community empowerment in NRM	57.2
6	Developing and adapting technologies and innovations to combat the risk of desertification	56.5
7	Mainstreaming technologies and innovations in forestry and agroforestry resource management for sustainable livelihoods	56.0
8	Support formulation of appropriate incentive systems to accelerate adoption of and sustainable investment in best-fit innovations for natural resource management	55.5
9	Domestication of high value agroforestry species and conservation of forest genetic resources	54.9
10	Responding to emerging climate change mitigation-related markets (carbon, biofuels, environmental services) to benefit rural communities	54.5
11	Develop and promote technologies, policies and practices for adaptation to climate variability	54.3
12	Management of problematic soils for improving agricultural productivity	53.7
13	Establish and respond to the influence of globalization, trade liberalization and markets on natural resource management and innovation systems	52.2
14	Promotion of economic instruments for sustainable forest resource management	51.8
15	Advancing policies, institutional innovations and capacity for sustainable and equitable management of forest ecosystems and agroforestry best practices	51.2
16	Promoting options for forecasting and managing natural resource-related conflicts	51.0

ISBN 978-92-95070-38-7

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