

Biosciences eastern and central Africa (BecA)

Business Plan 2005 - 2009

April 2005

*Biosciences eastern and central Africa is part of a network of centres of excellence,
mobilizing biosciences for Africa's development, and sponsored by the
New Partnership for Africa's Development (NEPAD)*

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Contents

Preface	vi
List of Participants in the Design Phase	vii
Abstract	viii
Executive Summary	ix
PART ONE: BACKGROUND	1
1. Introduction	2
1.1 Overview	
1.2 Context of Poverty, Food Security, Malnutrition and Health in Africa	
1.3 Evolving Role of Women in Food and Agriculture and in Science and Technology in Africa	
1.4 Importance of Food and Agriculture in Africa	
1.5 Investments in Agricultural Research in Africa	
2. New Partnership for Africa's Development (NEPAD)	11
2.1 Origins and Objectives	
2.2 G8 Support for Africa through NEPAD	
2.3 NEPAD's Science and Technology Platform	
2.4 NEPAD's Agriculture Platform	
2.5 NEPAD's Concept of Centers of Excellence in Science and Technology	
3. Role of Science and Technology in Africa's Development	15
3.1 Global Context	
3.2 Role of Science and Technology in Sustainable Development	
3.3 Scientific Context	
3.4 Social Context	
3.5 Biosciences in Africa: Opportunities and Constraints	

PART TWO: Biosciences eastern and central Africa (BecA)	23
ESTABLISHMENT AND ACTIVITIES	
4. BecA Vision, Mission, Nature, Objectives, Outputs	24
4.1 Vision	
4.2 Mission	
4.3 Nature	
4.4 Objectives	
4.5 Outputs	
5. Program Overview	26
5.1 Program Scope	
5.2 Program Goals	
5.3 Operating Procedures	
5.4 Project Initiation and Implementation	
5.5 Project Selection Criteria	
5.6 Project Biosafety, Biocontainment and Regulatory Requirements	
5.7 Project-specific Contractual Agreements	
6. Capacity Building and Training	32
6.1 Capacity Building and Training Opportunities	
6.2 Capacity Building and Training Services	
7. Scientific and Technical Core Competencies	35
7.1 Scientific and Technical Core Competencies	
7.2 Research-related Services	
8. International Linkages	40
8.1 Essential International Linkages	
8.2 Discovery to Delivery Partners	

9. Communications and Marketing	43
9.1 Stakeholders	
9.2 Understanding and Meeting Expectations	
9.3 Marketing and Public Awareness	
9.4 Communications and Public Awareness Program	
10 Governance and Management	47
10.1 New Institutional Arrangements	
10.2 Context	
10.3 Stakeholders	
10.4 Participation	
10.5 Steering Committee	
10.6 Scientific Advisory Committee	
10.7 Network Coordinator and Secretariat	
10.8 Financial Management	
10.9 Relationship of <i>BecA</i> to the <i>Hub</i> and Secretariat Host Institution (ILRI)	
10.10 Relationship of <i>BecA</i> with NEPAD	
10.11 Contractual Arrangements for the Establishment and Operation of <i>BecA</i>	
10.12 Risk Assessments and Risk Management	
10.13 Monitoring and Evaluation	
11. Financial Strategy	54
11.1 Overview	
11.2 Design Phase - 2004/05	
11.3 Implementation Phase - 2005/07	
11.4 Development Phase - 2007/09	
11.5 Financial Principles for Projects	
11.5 Mobilizing Financial Resources	
11.6 <i>BecA</i> Challenge Fund	
PART THREE: ANNEXES	61
A. Glossary of Terms, Acronyms and Abbreviations	
B. Bibliography	
C. FAO crop production statistics for eastern and central Africa	

Preface

Biosciences eastern and central Africa (BecA) has become a reality because people and institutions in Africa are willing to share knowledge and facilities to the benefit of all Africans. By creating this center of excellence in Africa, for Africans, to resolve African problems, the stage has been set for outstanding people to do outstanding research, using cutting edge techniques and modern facilities.

Creative people coming from the scientific community, national institutions and regional organizations in eastern and central Africa have led this bold initiative, with its unique organizational framework, style of governance and management, and wide geographic focus. The early endorsement of the initiative by the New Partnership for Africa's Development (NEPAD) Steering Committee is warmly acknowledged.

Another early supporter was the Board of Trustees of the International Livestock Research Institute (ILRI), who at its meeting in November 2002, agreed to wider sharing of ILRI's laboratories and facilities with its African partners. The Biosciences Africa interim Steering Committee was established and met for the first time in December 2002.

The design phase of the initiative is being undertaken primarily with the financial support of the Government of Canada, provided through the Canadian International Development Agency (CIDA) and its Canada Fund for Africa (CFA). This support is gratefully acknowledged.

Additional support for *BecA* in its early stages has been provided through the CGIAR Generation Challenge Program, the Gatsby Charitable Foundation, the Syngenta Foundation for Sustainable Agriculture, the Rockefeller Foundation and the Doyle Foundation. Their support for this initiative is much appreciated.

Special thanks go to members of the *BecA* interim Steering Committee, the Implementation Group, its core team and the nine task teams, each led by a member of the Implementation Group, and to the staff of the *BecA* secretariat, who have worked tirelessly over the past year to make *BecA* a reality. The deliberations of these various groups as well as extensive consultations with other stakeholders have been integral to the development of this Business Plan. The members of these groups are listed overleaf. Their many contributions are gratefully acknowledged.

Romano Kiome
Chair *BecA* interim
Steering Committee

John Mugabe
NEPAD Secretariat
South Africa

Carlos Sere
Director General ILRI
Nairobi, Kenya

Nairobi, Kenya
April 2005

List of Participants in the Design Phase

BecA interim Steering Committee

An interim Steering Committee (ISC) was convened to design *Biosciences eastern and central Africa (BecA)*. The current members are:

Dr Tsedeke Abate, Ethiopian Agricultural Research Organization

Professor Emmanuel Bajyana, National University of Rwanda

Dr Romano Kiome, Kenya Agricultural Research Institute (Chair of the ISC)

Dr Seyfu Ketema, ASARECA secretariat, Entebbe, Uganda

Dr Rose Kingamkono, Tanzania Council of Science & Technology

Dr John Mugabe, NEPAD Secretariat, South Africa

Professor Z Nyira, Uganda National Council of Science and Technology

Professor Norah Olembo, University of Nairobi

Professor Onesmo Ole-MoiYoi, International Centre of Insect Physiology and Ecology (ICIPE) (Chair of the *BecA* Scientific Advisory Committee)

Dr Gabrielle Persley, The Doyle Foundation

Dr Carlos Sere, ILRI

The Terms of Reference of the interim Steering Committee are to:

- Provide oversight for the design phase
- Develop and approve a work plan and seek funding for the design phase
- Develop and approve a business plan covering future strategy, governance, financial planning and marketing
- Supervise an interim secretariat and the design phase coordinator
- Provide general information and publicity to stakeholders

BecA Implementation Group, Task Teams & Core Team

In March 2004 a Core Team, Implementation Group, and nine Task Teams were established to contribute to the design of *BecA* and formulation of the Business Plan. The Implementation Group reported to the interim Steering Committee. The Task Teams were practical working teams required to examine specific areas and develop proposals that would inform the business plan. The task teams were organised and headed by a Team Leader who was also able to recruit outside experts. Each Task team was led by one of the members of the implementation team. The Core Team was the umbrella for all Task Teams, responsible for coordination, organization and strategy. The contributions of the implementation group and task team leaders and the many others who added value to the work of the task teams are much appreciated.

BecA Implementation Group:

Professor James Ochanda (*BecA* interim Coordinator)

Professor Aggrey Ambali

Mr Chris Banks

Professor Andres Binder

Dr Rose Kingamkono

Dr John McDermott

Professor Norah Olembo

Dr Gabrielle Persley

Dr Ed Rege

Dr Bruce Scott

BecA Core Team:

Professor James Ochanda

Professor Andres Binder

Dr Gabrielle Persley

Dr Ed Rege

BecA Secretariat

Professor James Ochanda

Mr Chris Banks

Ms Mildred Okoth

Ms Mary Kiowi

Biosciences eastern and central Africa (*BecA*)

Abstract

Science can contribute to Africa's development. *Biosciences eastern and central Africa (BecA)* is an initiative to make this happen in eastern and central Africa. *Biosciences eastern and central Africa* will consist of a *Hub* and *Secretariat* based on the campus of the International Livestock Research Institute (ILRI) in Nairobi, Kenya and *regional nodes* and *other laboratories* distributed throughout eastern and central Africa for the conduct of research on priority issues affecting Africa's development.

The *BecA* Business Plan 2005-2009 describes the vision, mission, intended outputs and required inputs to achieve *BecA's* strategic objectives, including identifying the necessary human, physical, and financial resources. It outlines the scientific and technical competencies and services that will be available to the African scientific community. *BecA* has a strategy for capacity building and training, complemented by an initial portfolio of research activities, to support the development of science and technology capacity in Africa. *BecA's* scope covers agriculture and food security, including animal health and nutrition; and the intersections of agriculture with poverty, human health and nutrition, and the sustainable use of Africa's natural resources. Particular attention and support is given towards realizing the potential of women and young people in agriculture and in science and technology in Africa. The crops and livestock important to the well being of women will receive particular attention. Support includes targeted awards and other activities addressing gender, youth, and diversity issues. Targeted awards are also available to people coming from post-conflict countries in Africa to encourage their participation in the program.

A range of *partnerships* is being sought with research, education, and training institutions both within Africa, and through linkages with the international scientific community and the private sector. A communications strategy will strengthen dialogue with rural and urban communities, women's groups and consumers in Africa, the scientific community, prospective investors, and the media.

BecA will comply with national and international standards in the handling of intellectual property, biosafety, and regulatory procedures. An environmental impact assessment (EIA) of the *Hub* facilities and a strategic environmental assessment (SEA) of the program are being undertaken as part of the design phase and a risk management plan developed to mitigate any identified risks.

Innovative governance and management arrangements will enable scientists from a variety of countries and institutions to share first-class facilities and equipment to develop solutions to problems affecting the livelihoods of millions of people across Africa.

The first phase in 2005 is being undertaken mainly with the financial support of the Government of Canada, provided through the Canadian International Development Agency (CIDA) and its Canada Fund for Africa (CFA). This support is gratefully acknowledged. Further information is available at www.biosciencesafrica.org

Biosciences eastern and central Africa (*BecA*) Executive Summary

Overview

Biosciences eastern and central Africa (BecA) is an initiative endorsed by the Steering Committee of the New Partnership for Africa's Development (NEPAD) to support eastern and central African countries develop and apply bioscience research and expertise to produce technologies that help poor farmers secure their assets, improve their productivity and income and increase their market opportunities. It provides a focal point for the African scientific community to support the activities of national, regional, and international agencies as they address agriculturally related problems of the highest priority for alleviating poverty and promoting development.

Biosciences eastern and central Africa (BecA) consists of a *Hub* located on the campus of the International Livestock Research Institute (ILRI) in Nairobi, Kenya, that will provide a common biosciences research platform, research-related services and capacity building and training opportunities; and a *network of regional nodes and other laboratories* distributed throughout eastern and central Africa for the conduct of research on priority issues affecting Africa's development. *BecA* is being established amongst a group of cooperating institutions that agree to make their facilities available for regional use.

The business plan describes the vision, mission, outputs and resources required to achieve *BecA*'s strategic objectives, including identifying the necessary human, physical, and financial resources. It outlines the scientific and technical competencies and services that will be available to the African scientific community through the venture. *BecA* has a strategy for capacity building and training, complemented by an initial portfolio of research activities, to support the development of science and technology capacity in Africa. The scope covers agriculture and food security, including animal health and nutrition; and the intersections of agriculture with poverty, human health and nutrition, and the sustainable use of Africa's natural resources. Special attention is being paid to the needs of women and young people and to people from post conflict countries, to encourage their participation in all aspects of the scientific program. The critical role of women in African agriculture is also being addressed. *BecA* aims to contribute to the achievement of the Millennium Development Goals in Africa, especially those concerned with the reduction of poverty, improved nutrition and the control of diseases.

Challenge for Africa

The challenge is to use new developments in the biosciences in work to reduce poverty and create wealth in Africa in sustainable and equitable ways. Many of the problems constraining Africa's development require solutions specifically tailored to the unique local, national and/or regional circumstances. Some solutions may be developed from existing knowledge and adaptation of available technologies. Many, however, require new knowledge, new discoveries and endogenous innovation—by Africans, for Africa. The initiative described here addresses this challenge.

Poverty, Food Security, Malnutrition and Health Nexus in Africa

Agriculture is the mainstay of most people's livelihoods throughout sub-Saharan Africa. The agricultural sector provides food for people living in rural and urban areas. It is the main source of employment. Foreign exchange earnings for most countries come from the export of agricultural commodities. A thriving agricultural sector provides the engine of growth for broader social and economic development.

Main farming systems in Africa

A 2004 study by the Inter-Academy Council on the future of food and agriculture in Africa (IAC 2004a) recommended improving the productivity and sustainability of four main farming systems, where there are opportunities for immediate gains: These systems are:

- *Maize based-mixed system*, based primarily on maize, cotton, cattle, goats, and poultry;
- *Cereal / root crop mixed system*, based on maize, sorghum, millet, cassava, yams, legumes, and cattle;
- *Tree crop-based system*, based on cocoa, coffee, oil palm, and/or rubber;
- *Irrigated system based on rice*, cotton, vegetables, rain-fed crops, cattle and poultry.

Regionally and nationally important crops

Fifteen crops are important across eastern and central Africa. These are:

- *Cereals*: Maize, millet, rice, sorghum, wheat

- *Legumes*: Beans, cowpea, groundnut
- *Vegetative crops*: Banana/plantain, cassava, sweet potato
- *Cash crops*: Coffee, cotton, oil palm, and sesame.

The overall production statistics conceal some important country-specific variations. For example, Ethiopia has unique cereal, legume and oil crops grown on a large scale. Sudan cultivates large areas of sorghum, millet and groundnuts, which dominate regional statistics for these crops. There are also regionally important abiotic stresses, such as drought, and biological constraints, such as the parasitic weed *Striga*, which affect several crops and most countries. These regionally and/or nationally important crops and traits provide a framework for choices as to priorities for investments in research and development activities.

Livestock production and health

A global review on animal health analysed the needs and opportunities for research to develop new technologies for the better control of the most important diseases of livestock. Perry et al. (2002) identify the possible approaches for discovery and delivery of new technology, likely time frame, level of investment, and probability of success. Amongst the top 20 diseases of livestock in eastern, central and southern Africa, there are several for which current research opportunities are likely to result in improved disease control measures and deliver benefits to poor people. These diseases are:

- Contagious bovine pleuro-pneumonia;
- East Coast Fever;
- Gastrointestinal parasitism;
- Heartwater;
- Liver fluke;
- Newcastle disease of chickens;
- Trypanosomiasis, the cause of sleeping sickness in cattle and a similar disease in humans.

Biosciences and sustainable development

Problems that seem intractable through conventional biological research can be tackled by applications of new approaches, using modern biosciences. Advances in the biosciences promise powerful new ways of improving crop and livestock productivity

and minimizing threats to human health and to the environment. This has led to development of a new generation of safer and more affordable vaccines for important human diseases such as meningitis, and for animal diseases such as rabies. In food and agriculture, applications of biosciences have resulted in the development of new crop varieties with improved tolerance to pests and diseases, better storage quality and higher nutritional value; and new diagnostics and vaccines for the more effective control of livestock diseases.

Current constraints to the optimal use of biosciences in Africa

- The lack of sufficient, suitably trained scientists, who are able to have a career path as scientists in Africa;
- The limited involvement of women and girls in science and technology at all levels;
- The lack of adequate laboratory facilities and equipment and the human and financial resources essential to operate, maintain and sustain them;
- Lack of clear problem definition, based on dialogue amongst farmers, consumers, researchers and the public and private sectors;
- The shortage of operating funds for projects;
- Limited local private sector involvement in science and technology applications in Africa, in order to develop and deliver products to market;
- Lack of networking within the African scientific community and with the international scientific community to access knowledge, state of the art techniques and deliver potentially useful technologies.

Biosciences eastern and central Africa (BeCA)

Vision

Biosciences eastern and central Africa (BeCA) enables African scientists and institutions to become significant technological innovators as well as technology users. This will be accomplished by undertaking biosciences research and innovation targeted at issues affecting Africa's development, while accessing and using the best of science worldwide.

Mission

To improve the livelihoods of resource-poor people in Africa, through the development and use of new technologies and strategies for sustaining agricultural production, improving human health, and conserving the environment.

Nature

Biosciences eastern and central Africa (BecA) consists of a *Hub* located on the campus of the International Livestock Research Institute (ILRI) in Nairobi, Kenya, that will provide a common biosciences research platform, research-related services and capacity building and training opportunities; and a *network of regional nodes and other laboratories* distributed throughout eastern and central Africa for the conduct of research on priority issues affecting Africa's development. *BecA* is being established amongst a group of cooperating institutions that agree to make their facilities available for regional use.

Objectives

The objectives of *BecA* are to:

1. Provide *focal points* for the African scientific community to support the activities of national, regional and international entities addressing agriculture-related problems for reducing poverty, creating wealth and promoting Africa's development. The main objective is to bring improved and marketable agricultural products to African farmers.
2. Create and strengthen *human resources* in biosciences and related disciplines in Africa.
3. Promote scientific excellence by bringing together a *critical mass* of scientists drawn from national, regional and international institutions in modern facilities where they can undertake cutting edge research. The goal is to help solve some of the most important development constraints affecting the health and well being of people in Africa.
4. Increase *access to affordable, world-class research facilities* within Africa.
5. Produce, manage and disseminate bioscience *information and knowledge* relevant to Africa's development.
6. Facilitate access to advice and training on *intellectual property, biosafety and other regulatory issues*.
7. Attract *additional investments* for biosciences in and for Africa from governments, the private sector, and regional and international bodies.
8. Serve as a platform to forge *partnerships* with other *biosciences laboratories* and with those entities responsible for *product development and delivery, within Africa and globally*.
9. To strengthen the *role of women* in African agriculture, and to facilitate the greater participation of women and girls in biosciences and related research in Africa; and
10. To use new developments in biosciences to *protect the environment and conserve biodiversity* in Africa.

Linkages within Africa and Globally

An essential component in establishing centers of excellence in science and technology is to establish linkages with other such centers in Africa and globally. Biosciences is a rapidly evolving field and establishing linkages with individuals and institutions working at the cutting edge is critical in establishing and maintaining the reputation of *Biosciences eastern and central Africa* as a center of excellence for biosciences in Africa. In this context, partnerships are being sought with a variety of research, education and training institutions in Africa who are currently using biosciences, and with the international scientific community. Early partnerships are also being sought with those responsible for: defining needs in rural communities, understanding the role of women in African societies, identifying consumer preferences and trends, and/or for developing and delivering new innovations and technologies.

Program Overview

Scope

Biosciences eastern and central Africa facilitates, hosts and conducts research in areas where new developments in biosciences offer promise to address previously intractable problems constraining Africa's development; where these are areas appropriate to *BecA's* scientific and technical core competences; and where it can complement and add value to other national, regional and international activities. Capacity building is a major goal of all program activities.

The focus is on improving the productivity and sustainability of agriculture in Africa, through improved products, with high impact on the market in the near future. The research activities include attention also to the influence of agriculture on the environment and to the interactions amongst poverty, food security, malnutrition and human health.

Operating procedures

The operating procedure are flexible, in order to encourage an expansion of the use of modern biosciences to address major challenges constraining Africa's development. Ways in which scientists are able to engage with *BecA* include participating in research projects hosted by the *BecA Hub* and/or regional nodes. In some instances, one country or institution identifies the topic. In others, related projects address regionally important problems, in a concerted way, and include participants from several countries in Africa, and linkages with the international research community and the private sector. Students affiliated with universities are able to undertake theses research in association with particular projects. They may also apply for *BecA* fellowships at www.biosciencesafrica.org

Capacity building and training

In view of the dearth of sufficient expertise in science and technology in Africa, *Biosciences eastern and central Africa* sees implementing a strong program in capacity building and training as central to achieving its mission. It provides opportunities to increase the capacity of institutions and individuals to conduct biosciences related research in Africa and to develop and deliver new technologies. It provides opportunities for training of scientific and technical staff and students from research institutions and universities through post-graduate study, short-term training, workshops and seminars; and access to ongoing learning. Realizing the potential of women scientists and young scientists in Africa is being given particular attention and support in all aspects of capacity building and training, through targeted awards and other special activities addressing gender and diversity issues. Study awards and fellowships are also being targeted at people coming from post conflict countries in Africa.

BecA Challenge Fund

In the establishment of *Biosciences east and central Africa*, there is a need to facilitate access by African scientists to the new regional biosciences laboratories and facilities. Establishing a *Challenge Fund*, where financial support is available on a competitive basis to scientists working in Africa, assists this access. Support is provided through short and long-term fellowships and competitive grants available to stimulate research, project preparation and/or participation in training activities. Targeted awards are available for women scientists, young scientists and scientists from post-conflict countries in Africa.

Scientific and Technical Core Competencies

Core competencies

The areas of scientific and technical core competencies and the associated infrastructure that are available through *Biosciences eastern and central Africa* are summarized in *Box 1*. These technologies are available to support capacity building and training and specific research activities in Africa. Core competency in these technologies means that *Biosciences eastern and central Africa* has the necessary laboratory and containment facilities, equipment, operating funds and the technical skills to establish and keep these technologies operating optimally; as well as access to the complementary scientific skills to guide research programs using the specific technologies.

Research-related services

Research-related services available to the African scientific community include access to advice and expertise in the following areas: Bioinformatics; biometrics; laboratory management and equipment maintenance; biosafety policies and practices; communications and knowledge management; information technology; intellectual property management; other regulatory management; science writing and preparation of proposals; partnerships for technology delivery; and targeted technology support in all areas of scientific and technical core competencies.

Box 1. Biosciences eastern and central Africa - Areas of scientific and technical core competencies

Bioinformatics: The assembly of data from genomic analysis into accessible forms.

Diagnostics: More accurate and quicker identification of pathogens using new diagnostics based on molecular characterization of the pathogens.

Genomics: Use of the available molecular information about all the genes in selected species.

Functional genomics: Use of the knowledge that converts the molecular information into an understanding of gene functions and effects: how and why genes behave in certain species and under specific conditions. Functional genomics also entails research on the protein function (*proteomics*) or the whole metabolism (*metabolomics*) of an organism.

Gene sequencing: The identification of the structure of the genes in an organism.

Molecular breeding: identification, evaluation and expression of useful traits using marker-assisted selection (MAS).

Transformation: introduction of one or more genes into a species in order to confer potentially useful traits.

Tissue culture: The cultivation of whole plants from single cells or meristems in the laboratory; (for example, the technique is used in gene technology to regenerate transformed cells into living modified organisms (LMOs).

Vaccine technology: Use of modern *immunology* to develop recombinant DNA vaccines for improved control of animal and fish diseases.

Vectors: Cultivation of ticks and tsetse flies, as aids for the study of vector-borne diseases that severely affect people and livestock in Africa.

- Reducing brain-drain through provision of powerful incentives for African scientists abroad to return home, and for those currently working in Africa to remain professionally active in the region.
- Reducing gaps in biosciences knowledge, skills, and technologies between Africa and the industrial countries.

New **products** include:

- More relevant and effective *new products*, intellectual property, and/or international public goods developed through bioscience applications specifically targeted at solving Africa's agricultural, health and environmental problems.
- These products may include crops that are resistant to stress and pests, nutritionally enhanced foodstuffs, and vaccines and diagnostics for regionally important livestock diseases.

The initiative also provides **access to modern facilities and equipment**, including:

- State-of-the-art *research laboratories* for the biosciences, in areas such as genomics, molecular breeding, transformation technology, and immunology
- New laboratory and greenhouse *containment facilities* for safe genetic manipulation of plants, animals, microbes and parasites.

The **research-related services** include:

- More effective management of intellectual property, biosafety, and other regulatory issues in Africa.
- Improved access to *information technology services and bioinformatics databases*.

Governance and Management

New institutional arrangements

Developing new ways of organizing and managing science is an important feature of *Biosciences eastern and central Africa*. A key institutional challenge is to find ways that permit effective sharing of facilities, equipment, and other resources among countries, institutions, and other partners in the region. Innovative governance and management arrangements will enable scientists from many

Outputs

The **outputs** will include:

- African scientists undertaking doctoral and postdoctoral studies, in association with African and other universities, and with special emphasis on young scientists, women scientists and those from post conflict countries in Africa.
- Continuing professional development of mid-career scientists in African national agricultural research institutions and universities.

countries and institutions to share first class facilities and equipment, and use these to develop solutions to problems affecting the livelihoods of millions of people across Africa.

The conceptualization of the governance and management of *BecA* revolves around three themes, namely:

- How will the *BecA Hub* be organised, including the infrastructure and facilities, strategic planning, and the relationship with ILRI as host and with NEPAD?
- How will the *BecA Hub* and other participating laboratories in the *BecA* network work together; and how will *BecA* work with other NEPAD biosciences initiatives elsewhere in Africa; and with other stakeholders?
- How will discovery and delivery activities be identified and managed?

Contractual Arrangements: *BecA* is being formally established as an unincorporated joint venture amongst a number of cooperating institutions. A suite of contractual agreements sets out the relationships, roles and responsibilities amongst the various parties to the joint venture. ILRI is both a member of the joint venture, along with other national and regional bodies, and the host of the *BecA Hub* facilities and the Secretariat.

Accountability: In the proposed contractual and governance arrangements, there are also built in accountability mechanisms to the co-sponsors of the venture, including NEPAD, and to other investors, through provisions for participation in the governing body (the steering committee), audit procedures and external evaluation.

The innovative governance and management arrangements, developed as a result of extensive consultations, will enable scientists from a variety of countries and institutions to share first-class facilities and equipment to develop solutions to problems affecting the livelihoods of millions of people across Africa.

Participation in *BecA*

Participation in *BecA* is open to national, regional, and international institutions, and public and private organizations that agree to contribute toward achieving

the mission of *BecA* through their participation and/or support of its program and activities. Participation may be through activities and services conducted at the *BecA Hub*, and/or other participating laboratories in the network. The *BecA* Steering Committee will determine the terms and conditions of participation.

***BecA* Steering Committee**

Biosciences eastern and central Africa has independent governance with a steering committee of up to 12 members. The members include representatives from NEPAD, the African Union, East African Community (EAC), the Forum for Agricultural Research in Africa (FARA), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), ILRI, and members coming from Kenya as the Hub and Secretariat host country, other countries of eastern and central Africa and from civil society, the scientific community and the investors.

Scientific advisory committee

The Steering Committee has access to independent scientific advice on program matters through a Scientific Advisory Committee, which includes leading scientists from Africa and the international scientific community. The Chair is also a member of the Steering Committee.

Network coordinator and secretariat

The day-to-day management is the responsibility of a small secretariat located at the *BecA Hub*, and led by a *Network Coordinator*. The network coordinator and other secretariat staff members reflect the diversity of the African scientific community. The Network Coordinator is selected and appointed by the Steering Committee.

Financial strategy

A financial plan covering the first five years of operation is being prepared as part of the design phase, in planning for the long-term financial sustainability of the initiative.

Risk Assessments and Risk Management

BecA will comply with national and international standards in the handling of intellectual property, biosafety as well as other regulatory procedures. An environmental impact assessment (EIA) and a

strategic impact assessment are being conducted as part of the design phase. Other risks and liabilities will be assessed and a risk mitigation and management plan prepared.

Impact on African Agriculture and Sustainable Development

A monitoring and evaluation system will be put in place to monitor the achievements and outcomes of *BecA*. This includes monitoring the responsible use of inputs, the delivery of intended outputs, and, most importantly, the use of these outputs in ways to achieve outcomes that lead to increased food security and improved livelihoods of resource-poor people in Africa.

Communications

The communications strategy will strengthen dialogue with farmers and consumers, rural and urban communities, civil society, the scientific community, prospective investors, and the media. Forming opinions, managing the expectations of different groups of stakeholders, and addressing perceptions about *BecA* are important tasks. Further information about *BecA* is available at www.biosciencesafrica.org

Acknowledgements

The design phase is being undertaken mainly with the financial support of the Government of Canada, provided through the Canadian International Development Agency (CIDA) and its Canada Fund for Africa (CFA). This support is gratefully acknowledged. Additional support for the design phase has been gratefully received from the Gatsby Charitable Foundation, the Rockefeller Foundation, and the Syngenta Foundation for Sustainable Agriculture. The concept development was supported by the Doyle Foundation.

Additional Web Resources

www.biosciencesafrica.org

www.acdi-cida.gc.ca

www.nepadst.org

www.ilri.org

www.doylefoundation.org

PART ONE: BACKGROUND

1. Introduction

1.1 Overview

Science can contribute to Africa's development. *Biosciences eastern and central Africa (BecA)* is an initiative to make this happen in eastern and central Africa. *Biosciences eastern and central Africa* will consist of a *Hub and Secretariat* located on the campus of the International Livestock Research Institute (ILRI) in Nairobi, Kenya and *regional nodes* and *other laboratories* distributed throughout eastern and central Africa for the conduct of research on priority issues affecting Africa's development. It is being established amongst a group of institutions that agree to make their facilities available for regional use. The vision, mission, intended outputs, and required inputs to achieve the strategic objectives are described here, including identifying the critical human, financial, physical, and scientific resources necessary for success.

1.2 Context of Poverty, Food Security, Malnutrition and Health in Africa

Progress toward the Millennium Development Goals

The Millennium Development Goals (MDGs) were adopted by 189 member states of the United Nations in the Millennium Declaration of September 2000 as targets over the next 15 years to produce substantial improvements in the lives of people worldwide (MDG website www.developmentgoals.org).

The MDGs are a set of eight goals for which 18 numerical targets have been set and over 40 quantifiable indicators have been identified. The goals are:

- Eradicate extreme poverty and hunger.
- Achieve universal primary education.
- Promote gender equality and empower women.
- Reduce child mortality.
- Improve maternal health.
- Combat HIV/AIDS, malaria, and other diseases.
- Ensure environmental sustainability.
- Develop a global partnership for development.

The first Millennium Development Goal calls for

reducing the proportion of people living on less than US\$1 a day to half the 1990 level by 2015 - from 28% of all people in low and middle income economies to 14%, and halving the proportion of people who suffer from hunger between 1990 and 2015.

The *World Development Indicators* review progress toward the major development goals. The latest indicators show that global poverty rates continue to fall, largely due to substantial progress in reducing poverty in East Asia, mainly China. The global trends mask substantial regional differences, including less progress towards achieving the MDGs in many African countries. (*Table 1.1, Box 1.1*).

Sub-Saharan Africa

Slow economic growth across much of Africa means that more than 314 million people in the countries of sub-Saharan Africa live on less than US\$1 a day. It is forecast that on present trends *poverty in Sub-Saharan Africa will fall very slowly in the next 11 years, unless there is a major change in prospects*. Based on future projections, the numbers of poor people in sub-Saharan Africa is expected to increase to 366 million by 2015 (see *Table 1.1* and *Box 1.1*)

Sub-Saharan Africa is a region with diverse countries and some countries, such as Cameroon, Tanzania, and Uganda, have sustained remarkable growth and achieved progress towards poverty reduction and other MDGs. Their success demonstrates that substantial progress is possible in Africa, given suitable policy environment, adequate public and private investments, and absence of civil strife. (*Box 1.1*)

Food security and malnutrition

Prevalence rates of underweight children have been falling in most regions, but too slowly to achieve the 2015 MDG target (*Fig. 1.1*). Since 1990-92 the total number of undernourished people in developing countries has fallen by 20 million, and the prevalence of undernourishment by 3 percentage points. Regional trends show the greatest progress in East Asia and Pacific. The rates of malnutrition remain high in South Asia, and they are rising in Sub-Saharan Africa (*Fig. 1.1 & 1.2*).

Table 1.1**People living on less than \$1 a day**

	millions		%	
	1990	2001	1990	2001
East Asia and Pacific	472	284	29.6	15.6
China	377	212	33.0	16.6
Europe and central Asia	2	18	0.5	3.7
Latin America and Caribbean	49	50	11.3	9.5
Middle East and North Africa	6	7	1.6	2.4
South Asia	462	428	40.1	31.1
Sub-Saharan Africa	277	314	44.6	46.5
Total	1,219	1,101	27.9	21.3

People living on less than \$2 a day

	millions		%	
	1990	2001	1990	2001
East Asia and Pacific	1,116	868	69.9	47.6
China	830	596	72.6	46.7
Europe and central Asia	58	94	12.3	19.7
Latin America and Caribbean	125	128	28.4	24.5
Middle East and North Africa	51	70	21.4	23.2
South Asia	958	1,059	85.5	76.9
Sub-Saharan Africa	382	514	75.0	76.3
Total	2,689	2,733	61.6	52.8

Source: World Bank data

Box 1.1 Sub-Saharan Africa: Progress toward Millennium Development Goals (MDGs)

Slow growth in Sub-Saharan Africa has meant increases in both the share and number of resource poor people in the 1990s, leaving it as the region with the largest share of people living below US\$1 a day. The forecast anticipates per capita growth averaging 1.6% over the 2006-15 period – a reversal of the region's long-term historical decline. This is far short of the growth needed to reduce poverty to half the 1990 level. In fact the number of poor people in Africa is expected to rise from 314 million in 2001 to 366 million people by 2015 in Sub-Saharan Africa. Africa also remains highly dependent on commodity exports. Some countries are also experiencing political and economic instability.

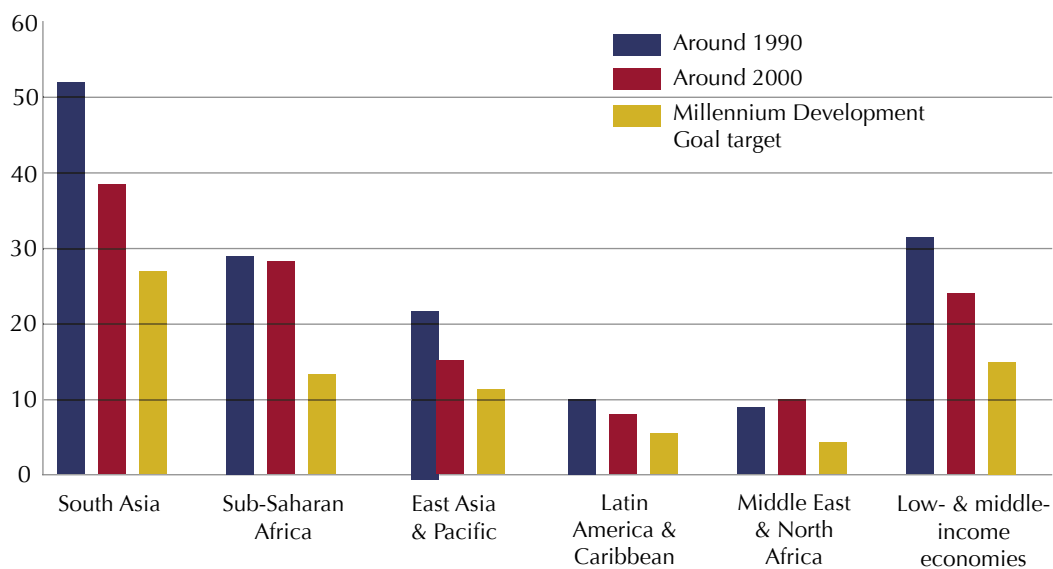
Human health effects: HIV/AIDS stands as the leading cause of death in Sub-Saharan Africa. Malaria and tuberculosis are also serious problems. These epidemics present a major public health, economic, and social challenge. In Sub-Saharan Africa life expectancy has declined from 50 to 46 years since 1990. Five countries still have life expectancies less than 40 years of age.

Other factors: Africa is the region with the lowest average primary school completion rates. Infrastructure in Sub-Saharan Africa is not well developed: only 13 % of the roads are paved, and less than 3% of the population has access to a telephone line or mobile phone.

Source: Millennium Development Goals http://www.developmentgoals.org/Sub-Saharan_Africa.htm

Figure 1.1

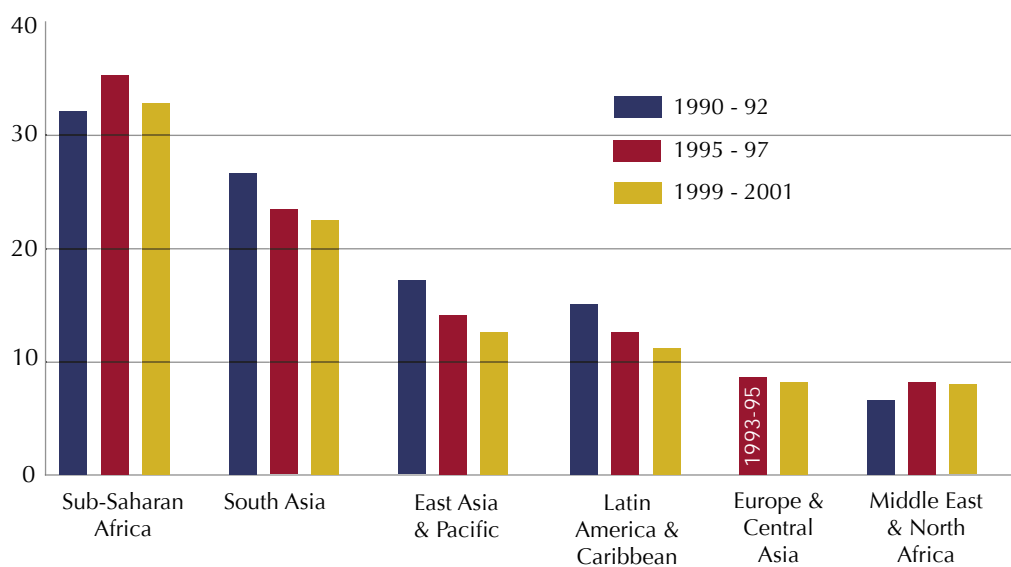
**Prevalence of underweight children (%)
(weight for age)**



Source: WHO and World Bank staff estimates.

Figure 1.2

Prevalence of undernourishment (%)



Source: FAO 2003. *The State of Food Insecurity in the World*

1.3 Evolving Role of Women in Food and Agriculture and in Science and Technology in Africa

Women in Africa play a critical role within the community, and in productive and reproductive life, engaging in agriculture and establishing business enterprises, as well as providing health care and education. An Inter Academy Council Report on *Inventing a Better Future: A Strategy for Building Worldwide Capacities in Science and Technology* (IAC 2004b) highlights that many societies worldwide continue to discriminate against women. Women constitute half of the world's population but in many countries receive only one-tenth of the income and own less than 1% of the property. Women also constitute about three-fifths of the world's illiterate and in many regions receive less food, education, and health care than do men. Over the past 20 years, the number of rural women living in poverty has almost doubled.

An IFPRI 2020 Brief entitled *Increasing the Effective Participation of Women in Food and Nutritional Security in Africa* (Quisumbing *et al.*, 2004) highlights that despite growing evidence of gains in agricultural productivity and nutritional status when more resources are placed in women's hands, gender gaps still remain. It also highlights that while education gaps are closing more quickly than asset ownership, both gaps are closing more slowly in Sub-Saharan Africa than they are in the rest of the world. Asset gaps are potentially more important for food and nutrition security in Africa than elsewhere because of women's key role in food production.

A two-pronged approach to close these gender gaps in Africa is feasible – firstly eradicating discrimination against women – and secondly, promoting catch-up by implementing more active measures in key areas such as control over land, water, and other assets and investment in education, health, childcare and other services for women. There are some examples of positive approaches to the role of women in agriculture that have worked well in Sub-Saharan Africa. For example:

Pro-women approaches to livestock management

Livestock are important assets to women and can help them accumulate wealth more easily than by

acquiring land, provided women control the decision-making and management of the livestock. This allows women to bring wealth to the household, which in turn increases their status within the household. In Kenya, some livestock schemes have given legal ownership of livestock to women, to ensure that they remain in charge of decisions about their management. Livestock are removed from households where women are mistreated or prevented from making independent decisions about the livestock.

Pro-women approaches to technology development and selection

Technology can help women farmers by reducing their workload. Involving women farmers in decisions about which technologies to develop is important as women tend to grow different crops and value different crop traits than men. One example is the development of a new rice variety in West Africa that has high yield, drought resistance and broad leaves and substantially reduces weeding required by women and children. Another example is the new cassava processing methods developed in Nigeria that have reduced women's workloads in food preparation and provided opportunities for commercialization of cassava products (Quisumbing *et al.* 2004).

Muntemba and Blackden (2000) also stress the importance of involving women farmers in the development and selection of technologies where women are predominantly the end-users. There are numerous examples of new technologies that have been developed without the input of the women end-users, and were not adopted because the technology did not fit the physical and socio-cultural conditions of end-users, or when end-users face specific socioeconomic constraints in applying the technology.

In the area of food security, women should be free to grow the kinds of crops on their plots of land that they think are important for the food security and nutritional status of their family. This may involve revising formal rules of access and including more women in the design and implementation of outreach programs, as well as in actually delivering the public services.

Role of women in science and technology in Africa

Sub-Saharan Africa has the world's lowest literacy rate, which is directly linked to poverty. Even among those women taking formal education, the numbers who study science subjects are much lower than men. Figures from the Association for the Development of Education in Africa (ADEA) and the Forum for African Women Educationalists (FAWE), show that of 22% of girls attending secondary school, only 10% study science-related topics. Women form only 15% of the scientific field in Africa and only 1% of them are in leadership positions.

It is sometimes believed that girls struggle to achieve at school, and that they are poor at science, mathematics, and technology. But it is lack of opportunity rather than ability that is the limiting factor. With limited resources to spend on education, poorer families may send their boys to schools, keeping girls at home to provide support. Opportunities to study at home are limited, and early marriage and pregnancy add further potential blocks to education.

Integrating gender and diversity into BecA's program and activities

BecA commissioned a report by Rathgeber (2005) on integrating gender into BecA's activities, as a component of the design phase. The report analyses the present situation and offers a series of practical suggestions as to how BecA can integrate gender considerations into its program and contribute towards resolving gender imbalances in food and agriculture and in science and technology in Africa. The full report is available as a resource document at www.biosciencesafrica.org.

In response to the suggestions and recommendations of the Rathgeber report, BecA has taken the following actions:

1. Added a specific objective to the BecA objectives, namely: *To strengthen the role of women in African agriculture, and to facilitate the greater participation of women scientists in biosciences and related research in Africa (Objective 9);*
2. BecA's Scientific Advisory Committee is including amongst its project selection criteria the potential positive and negative impact of BecA proposed activities on women in Africa.

3. Encouraging research groups at African institutions with interests linking gender and diversity with biosciences issues to develop research proposals for consideration and endorsement by BecA for funding;
4. Allocating one third of BecA PhD fellowships to women scientists.
5. Setting a target in governance and management arrangements that at least one third of the members of the BecA Steering Committee and the Scientific Advisory Committee should be women. This target is being met in the current composition of both committees during the design phase.
6. Including provision for new hostel accommodation and new child care facilities on the ILRI campus in anticipation of an increasing number of women scientists being hosted at the *BecA Hub* and Secretariat;
7. Developing modalities for BecA members and participants to increase communicating with and mentoring girls and young women scientists in order to encourage more women and girls to participate in science and technology in Africa;
8. Accessing on-going advice for the BecA Secretariat on how to address gender and diversity issues in food and agriculture and science and technology by identifying current expertise at African universities, in programs sponsored by NEPAD and others, and the CGIAR Gender and Diversity Program;
9. Integrating gender considerations into all components of the BecA program, and monitoring positive and negative impacts of BecA activities on women by means of the BecA project log frame and its indicators.

1.4 Importance of Food and Agriculture in Africa

Agriculture is the mainstay of people's livelihoods throughout Sub-Saharan Africa. The agricultural sector provides food for people living in rural and urban areas. It is also the main source of employment. Foreign exchange earnings for most countries come from the export of agricultural commodities. A thriving agricultural sector

provides the engine of growth for broader economic development.

Several recent studies by national, regional, and international agencies suggest that future strategies for food and agriculture in Africa will focus on:

- Increasing the *quantity* of food and feed available in rural and urban areas.
- Improving the *quality* and *nutritional content* of food and feed.
- Enabling better *access* and *affordability* of food.
- Improving the *efficiency of rural production* systems, thus enabling workers to move to other productive enterprises besides farming.
- Ensuring *environmental sustainability*, including the conservation of biodiversity.
- Increase farm *income* by enabling farmers to add value to food crops and/or produce cash commodities with high returns.

A recent analysis by the Inter Academy Panel (IAC 2004a) suggested that significant productivity gains could be made in at least four crop/livestock mixed systems in Africa (Box 1.2). The regionally and nationally important crops in eastern and central Africa are shown in Box 1.3.

Box 1.2. Farming systems in Africa with opportunities for immediate productivity gains

The four main crop/livestock systems in Africa where there are opportunities for immediate productivity gains are:

- *Maize-based mixed system*, based primarily on maize, cotton, cattle, goats, and poultry.
- *Cereal / root crop mixed system*, based on maize, sorghum, millet, cassava, yams, legumes, and cattle.
- *Tree crop-based system*, based on cocoa, coffee, oil palm, and/or rubber.
- *Irrigated system* based on rice, cotton, vegetables, rain-fed crops, cattle and poultry.

Source: Inter Academy Panel on the Future of Agriculture in Africa (IAC 2004a)

Box 1.3 Regionally and nationally important food crops in eastern and central Africa

Fifteen food crops are important across eastern and central Africa. These are:

- *Cereals*: Maize, millet, rice, sorghum, wheat.
- *Legumes*: Beans, cowpea, groundnut.
- *Vegetative crops*: Banana/plantain, cassava, sweet potato.
- *Cash crops*: Coffee, cotton, oil palm, and sesame.

The overall statistics conceal some important country-specific variations. For example, Ethiopia has unique cereal, legume, and oil crops grown on a large scale. Sudan cultivates large areas of sorghum, millet, and groundnuts, which dominate regional statistics for these crops. Feed and fodder crops for livestock are also important. There are also some regionally important abiotic and biotic stresses such as drought and parasitic weeds (*Striga*), which affect several crops in most countries. FAO production statistics for individual crops by country, by region, and total cultivation in Africa are given in Annex C.

Source: FAO statistics

Livestock production and health

The important role that livestock play in leading families both into, and out of, poverty is illustrated by a recent study in western Kenya (Kristjanson *et al.* 2004). The study looked at stages of progress into and out of poverty, as defined by the communities themselves (see Box 1.4). It found that families that progress beyond the stage of owning a sheep or a goat do not consider themselves poor, and indeed consider themselves relatively well off if they progress to owning dairy cattle. Conversely, if family circumstances, or livestock diseases, lead to the loss of cattle, this can result in families slipping back below the poverty line.

Livestock health priorities and research opportunities

Perry *et al.* (2002) conducted a global review of constraints to livestock health. Their report identifies

the top twenty diseases of importance in Africa ranked according to their impact on the poor (Box 1.5). The authors then analyzed the needs and opportunities for research to develop new technologies for improved control of each of these top 20 diseases. Their report identifies the possible approaches for discovery and delivery of technology, the likely time frame, level of investment, and probability of success. This analysis indicates there are several livestock diseases important in eastern and central Africa for which there are current research opportunities likely to result in improved control measures that would deliver benefits to poor people.

The researchable diseases of livestock important across eastern and central Africa are (in alphabetical order):

- Contagious bovine pleuro-pneumonia (CBPP).
- East Coast Fever (ECF) (cattle).
- Gastrointestinal (GI) parasitism (small ruminants).
- Heartwater.
- Liver fluke.
- Newcastle disease (ND) (chickens).
- Trypanosomiasis (cattle and also humans).

Box 1.4 Stages of progress out of poverty in western Kenya

1. Food
2. Clothing
3. House repairs
4. Primary education for children
5. A chicken
6. A sheep or goat

7. Local cattle
8. Improving housing, furniture
9. Secondary education for children
10. Buying or leasing land

11. Dairy cattle
12. Buying land/plots
13. Permanent houses
14. Investing in a business

First poverty line:
Beyond this line, households no longer consider themselves poor

Second poverty line:
Beyond this line, householders consider themselves relatively well off

Source: Kristjanson et al. (2004)

Box 1.5 Top twenty African livestock diseases/pathogens ranked according to their impact on the poor

	West Africa Region	Eastern, Central and Southern Africa Region
TOP 10		
Listed alphabetically	Anthrax Black-leg Contagious bovine pleuro-pneumonia (CBPP) Dermatophilosis Ectoparasites Gastrointestinal (GI) parasitism Heartwater Liver fluke (fascioliasis) Respiratory complexes Trypanosomiasis	East Coast Fever (ECF) Ectoparasites Gastrointestinal (GI) parasitism Haemonchosis Infectious coryza Newcastle disease (ND) Neonatal mortality Nutritional/micronutrient deficiencies Respiratory complexes Rift Valley Fever (RVF)
NEXT 10		
Listed alphabetically	Anaplasmosis Brucellosis Contagious caprine Pleuro-pneumonia (CCPP) Foot-and-mouth disease (FMD) Foot problems Haemorrhagic septicemia (HS) Newcastle disease (ND) Peste des petits ruminants (PPR) Rift Valley fever (RVF) Sheep and goat pox	Babesiosis Contagious bovine pleuro-pneumonia (CBPP) Coccidiosis Foot problems Fowl pox Heartwater Liver fluke Reproductive disorders Tick infestation Trypanosomiasis

Source: Perry *et al.* (2002)

1.5 Investments in Agricultural Research in Africa

The United Nations commissioned a report by an Inter Academy Council on food and agriculture in Africa (IAC 2004a) that urges African governments and international development agencies to implement a wide range of measures to enhance the potential contribution of science and technology to Africa's food needs. Recommended measures include building a network of centers of research excellence across Africa, taking stronger steps to prevent the brain drain of newly qualified scientists out of the continent, providing an enabling environment in which agricultural research can flourish, and investing more national GDP in agricultural research in Africa.

Another Inter Academy Panel reported on: *Inventing a better future: A strategy for building worldwide capacities in science and technology* (IAC 2004b). It stresses that investments in science and technology are increasingly important for economic growth, as a growing level of investment in research and development is generally correlated with improved GDP growth outcomes. This IAC Report states that the high-income industrialized nations spend between 1.5 and 3.8% of their GDP on research and development, while most developing nations invest less than 0.5 %. The Report recommends that national governments in developing nations should

increase their spending considerably to at least 1% of GDP, but preferably closer to 1.5%.

A recent IFPRI Brief (Beintema and Stads, 2004) examines trends in investments in agricultural research in Sub-Saharan Africa. As a region, Sub-Saharan Africa relies heavily on agriculture. The agricultural sector accounts, on average, for close to 20% of total GDP and about 60% of the total labor force, though many Sub-Saharan African countries depend on agriculture to a much greater extent than these regional averages indicate. Despite the mass of evidence pointing to agricultural development as a priority, growth in agricultural research investments in Sub-Saharan Africa has stagnated over the past two decades.

Agricultural research capacity is an important factor in building food security and economic stability in Africa. New and better-targeted technologies are essential to this process, and a well-developed and well-supported agricultural research system is a prerequisite not only for the design of these technologies but also for their dissemination and adoption. In 2000, R&D spending in Sub-Saharan Africa totaled nearly \$1.5 billion (in 1993 international dollars), but funding has become increasingly scarce, irregular, and donor-dependent. Institutional reforms and sound S&T policies are needed to improve the efficiency and effectiveness of agricultural research in Africa (Beintema and Stads, 2004).

2. New Partnership for Africa's Development (NEPAD)

2.1 Origins and Objectives

The New Partnership for Africa's Development (NEPAD) is a vision and strategic framework for Africa's renewal. It is a long-term vision of an African-owned and African-led development program. It is based on a common vision and a conviction shared by African leaders, that they have a pressing duty to eradicate poverty and to place their countries, both individually and collectively, on a path of sustainable growth and development. At the same time, they must participate actively in the world economy and body politic, and thus halt the marginalization of Africa in the globalization process.

NEPAD is the development program of the African Union (AU). The overall objective of NEPAD is to give impetus to Africa's development by bridging existing gaps in priority sectors in order to enable the continent's renewal. NEPAD's priority sectors include infrastructure, information and communication, human resource development, agriculture, the environment, culture, and science and technology.

NEPAD originated from a dialogue amongst African Heads of State. The NEPAD strategic framework document arose from a mandate given to the five initiating Heads of State (Algeria, Egypt, Nigeria, Senegal, South Africa) by the Organization of African Unity (now the African Union) to develop an integrated socioeconomic development framework for Africa. The 37th Summit of the OAU in July 2001 formally adopted the strategic framework document (www.nepad.org).

2.2 G8 Support for Africa through NEPAD

Africa Action Plan

At the G8 Summit in Genoa, Italy, in July 2001, a group of progressive African leaders presented the New Partnership for Africa's Development (NEPAD), a made-in-Africa plan to end poverty and marginalization in the world's poorest region. This initiative has won the endorsement of almost every country in Africa, and its leaders have made a commitment to hold themselves accountable before their people—and before the world—for its achievement. They state that Africans are responsible for their own future, and they invite the world to join them as equal partners in the realization of their plan.

The world has responded to the invitation. With Canada taking the lead, the G8 group of countries—Canada, France, Germany, Italy, Japan, Russia, the U.K., the U.S. and the European Union—developed its Africa Action Plan, which includes more than a hundred commitments in support of NEPAD. The G8 Africa Action Plan was approved at the G8 Summit in Kananaskis, Alberta, Canada, in June 2002. The Canada Fund for Africa was established in the context of this G8 Action Plan. (*Box 2.1*)

Box 2.1 Canada Fund for Africa (CFA)

Canada has been one of the main supporters of NEPAD, both politically and financially, through the Canada Fund for Africa (CFA), allocating CAD\$500 million to support the objectives of NEPAD and the G8 Africa Action Plan. The Canada Fund for Africa became operational following the 2002 Kananaskis G8 Summit in Canada, under the guidance of the Minister for International Cooperation.

The CFA fosters innovation and economic growth, strengthens African institutions, and improves the well being of future African generations. The CFA complements Canada's ongoing assistance program in Africa, which is administered by the Canadian International Development Agency (CIDA), where the CFA Secretariat is located. The Fund focuses on the key challenges identified in NEPAD. It works closely with African institutions, governments, and organizations to deal with some of the most critical issues of our times: HIV/AIDS, peace and security, and good governance. It will help bridge the digital divide and will also support local efforts to increase food production and manage critical natural resources.

The Fund responds directly to Africans' call for more investment to spur economic growth, reduce poverty, and support social programs throughout the continent. It will assist African civil society to engage in further development and implementation of NEPAD.

The Fund was designed to support bold new initiatives and large-scale programs that have a major impact on sustainable development in Africa. The CAD\$500 million Fund has now been fully allocated to initiatives and programs that support the made-in-Africa vision and objectives of NEPAD.

Canada Fund for Africa Support for the Design Phase of BecA

The Canada Fund for Africa made an initial contribution of C\$4.5 million to ILRI in 2004 to support the planning and design phase of *BecA*, as well as initial capacity building, training and communications activities, and the establishment of an interim secretariat. The design phase is focusing on the governance and management framework, an environmental impact assessment, a technical construction plan for the implementation phase, the research agenda, and policies to guide *BecA*'s bioscience technology research and use. Upon satisfactory review of *BecA*'s design recommendations, proposed management structure, results of the environmental assessment and proposed risk mitigation strategies, which are all underway, the Canada Fund for Africa will seek Treasury Board approval for the implementation phase of the project. This phase will focus on constructing the *BecA Hub Facility*; building and strengthening institutional and human capacity for research, including innovative research service platforms; bioscience training and leadership opportunities for African scientists and technicians, particularly youth and women; and a specific fund to enhance the role of women in bioscience research.

2.3 NEPAD's Science and Technology Platform

The African Forum on Science and Technology for Development (AFSTD) was established by the NEPAD to promote the application of science and technology for economic growth and poverty reduction.

The NEPAD science and technology platform has the following objectives:

- To promote cross-border cooperation and connectivity by utilizing the knowledge currently available in existing centers of excellence in Africa.
- To develop and adapt information collection and analysis capacity to support productive as well as export activities.

- To generate a critical mass of technological expertise in targeted areas that offer high growth potential, especially in biotechnology and natural sciences.
- To assimilate and adapt existing technologies to diversify manufacturing production.

Current information on the activities of NEPAD's S&T program is available at: www.nepadst.org

2.4 NEPAD's Agriculture Platform

The NEPAD agriculture platform has the following objectives:

- To strengthen national and regional food security using scientific methods and tools that are environmentally sound, to increase the food supply, and reduce hunger.
- To promote agriculture research that develops technologies that enhance agriculture enterprises.
- To develop home-grown school feeding schemes to meet the nutritional needs of children.
- To stimulate the livestock sector to address poverty and hunger, using research, science, and policy interventions to control pests and diseases and that meet international safety standards.

Current information on the activities of NEPAD's Agriculture program is available at: www.nepad.org

2.5 NEPAD's Concept of Centers of Excellence in Science and Technology*

The conceptual framework and general policy guidance for translating into action the concept of building networks of centers of excellence across Africa was described by Mugabe (2003). NEPAD recognizes that Africa's economic renewal and sustainable development will not be achieved without effective and efficient research and development (R&D) institutions. Through NEPAD, African countries wish to establish networks of centers of excellence, for cross-border staff exchange, training programs, and collaborative research.

*Section 2.5 is based on a paper by Mugabe, J. (2003) *Centres of Excellence in Science and Technology for Africa's Sustainable Development: Towards new forms of regional and sub-regional networks*, prepared for the African Ministerial Conference on Science and Technology for Development, November 2003.

In developing the science and technology and agriculture frameworks, NEPAD has emphasized the need to strengthen and, where necessary, to create centers and/or networks of excellence. These would support the broad objective of science and technology and agricultural institution building and human resource development critical to the achievement of Africa's interests in the global context.

NEPAD's vision is to have a continent-wide network of state-of-the-art facilities engaging in cutting edge science for Africa's development. Building such networks is one of the most significant ways of pulling together Africa's scientific and technical resources to address shared priorities and common regional R&D challenges.

Current status of R&D institutions in Africa

Many African R&D institutions are facing major challenges arising from globalization and liberalization of economies, rapid technological change, and increasing private sector investment in R&D. To meet these challenges, they will need to acquire new forms of capabilities, including the capacity to understand changing policy contexts, and to align their research programs with sustainable development agenda. Such capabilities are multidisciplinary, an orientation lacking in R&D institutions in many countries.

There are now renewed efforts to rethink approaches to organizing and building R&D institutions in Africa. These are stimulated by a growing realization that many of these agencies are not configured in such ways to focus on and contribute to the attainment of sustainable development.

Most of the efforts to build R&D institutions in many African countries have failed to generate centers of excellence. This has resulted in the low and declining levels of scientific and technological development, relocation of high-level scientists to other regions of the world, limited and declining scientific publications output, low and declining patent intensity, weak links between industrial production and research, and erosion of public confidence in R&D institutions.

Toward a NEPAD program on centers of excellence

NEPAD defines a center of excellence as an institution that is making an impact, by effectively and efficiently

solving or contributing to the solution of specific problems. To qualify as a center of excellence, an institution should have achieved demonstrable high levels of scientific productivity and innovation on the basis of agreed upon standards.

The institution should have developed structures and activities oriented to build capacity. "This may be understood as the ability to (i) improve the quality of human resources through training and the work involved in producing excellent scientific outputs, (ii) enlarge the access to knowledge through networking with the international scientific community and other means, and (iii) relate to funding sources that may support expansion and upgrading. The possession of a satisfactory competence in capability building is a necessary characteristic if the institute is to keep up its level of excellence and improve on it"(Araoz, 2003).

In new areas of science and technology, African countries can achieve significant levels of development and innovation for sustainable development if and when they mobilize and direct their capabilities to specific R&D challenges. Success will be achieved if countries build their individual scientific and technological capabilities through agencies and programs that consolidate and sharply focus resources on common, well-defined problems or agenda.

NEPAD and the Plan of Implementation for Agenda 21 adopted at the World Summit for Sustainable Development (WSSD) in Johannesburg in 2002 recognize the establishment of networks of centers of excellence as one of the best ways to strengthen Africa's scientific and technological development. Such networks would serve as sites to mobilize regional resources to confront and solve common sustainable development problems. Countries can maximize technological learning through such networks.

The networks of centers of excellence need clear objectives in line with regional sustainable development goals and needs. They can attract stable, adequate and predictable funding from a variety of sources, and sell their services to the public and private sectors. In addition, they should be endowed with up-to-date equipment, information facilities, management systems, and strong and dynamic links to international science bodies and private sector clientele.

NEPAD's program on networks of centers of excellence provides intellectual guidance and political support to sub-regional and regional efforts to establish networks of centers of excellence. It will be a source of policy guidance to NEPAD and other regional initiatives on centers of excellence.

Through research and consultative processes, the NEPAD secretariat will also:

- Develop features or characteristics of centers of excellence and then assess the extent to which existing selected networks and centers in Africa fit the descriptions.

- Draw lessons from experiences in other regions, such as Canada and the European Union, in developing knowledge networks and/or centers of excellence.
- Design and implement measures to effectively engage existing centers of excellence in the implementation of NEPAD's programs.

These concepts underpinned NEPAD, ILRI and other parties coming together in 2002 to foster the development of *Biosciences eastern and central Africa* as a regional initiative for eastern and central Africa. Key documents are on the *BecA* website at www.biosciencesafrica.org

3. Role of Science and Technology in Africa's Development

3.1 Global Context

World population trends

World population projections predict that about 73 million people will be added to the world's population every year from 2002 to 2020. Most will be living in the developing countries. Meeting the food needs of this growing and increasingly urbanized population will require increases in agricultural productivity, and matching these increases to rising incomes and consequent dietary changes, especially the increasing demand for livestock and fish. World food and feed grain production will need to increase by 40% and roots and tubers by 58% in order to meet projected world food demand in 2020 (Pinstrup-Andersen *et al.* 1999). Livestock production will need to double by 2020 in order to meet the expected demand for milk and meat (Delgado *et al.* 1999). Improving the livelihoods and incomes of people in rural and urban areas is also critical to food security, since people's access to food depends on income. These production increases will have to be achieved through sustainable increases in agricultural production per unit of land and water, in order to conserve natural resources, and reverse some of the damaging environmental effects of past agricultural practices.

Environmental trends

- The intensification of agriculture in favourable areas has come at the cost of damage to the environment, with increasing salinity problems in irrigated areas, and damage to human health, ecology, and wildlife due to misuse of pesticides.
- Other agricultural-associated practices, including deforestation, overgrazing, overfishing and water pollution also threaten the sustainable use of natural resources.
- Decreasing water availability for agriculture is one of the most important trends. There is a need for more efficient use of water in agriculture, including the development of drought-tolerant crop varieties.
- Pressure on agricultural land for urbanization and industrialization increases. There are limited prospects for expanding the land available for agriculture, except by moving into forests, or marginal areas with poor soils and little water.

- Deforestation and loss of biodiversity by the clearing of land for agriculture is occurring in areas of mega-terrestrial biodiversity. The use of modern plant varieties also threatens the loss of land races of crops.
- Natural disasters pose a continuing threat to agriculture, and the long-term effects of climate change are unknown.

Future food security strategies

Strategies to achieve the needed increases in the quantity and quality of global food supplies and ensuring that there is sufficient food available at affordable prices in the developing world include:

- Achieving sustainable productivity increases in food, feed, and fibre crops in both irrigated and rainfed areas.
- Improving nutrient content of diets, especially for women and children.
- Reducing chemical inputs of fertilizers and pesticides and replacing these with biologically based products.
- Integrating soil, water, and nutrient management.
- Conserving, characterizing and using agriculturally related biodiversity.
- Improving the nutrition and productivity of livestock and controlling livestock diseases.
- Achieving environmentally sustainable increases in marine fisheries and aquaculture production.
- Increasing trade and competitiveness in global markets, especially for products from developing countries.

3.2 Role of Science and Technology in Sustainable Development

Science and technology have underpinned social and economic gains from agriculture. From 1960 to 2000, increases in global food production more than kept pace with population growth: World cereal production doubled, per capita food production increased 37%, calories supplied increased by 35%, and food prices fell by almost 50% (Pinstrup-Andersen *et al.* 1999).

Most of the agricultural productivity gains during the “Green Revolution” were due to yield increases, particularly those resulting from the discovery of dwarfing and other genes that conveyed useful traits into new, high-yielding wheat and rice varieties. These and other scientific discoveries, when combined with a mix of supportive public policies, appropriate institutions, political commitment, public and private investments in rural areas (particularly for irrigation, credit and inputs), led to halving the numbers of people living in poverty, and largely achieving food self sufficiency, especially in Asia.

The overall achievements mask significant variations in agricultural performance across regions. For example, the productivity gains across much of Asia have not been matched by similar productivity increases in Africa, in either crops or livestock.

Despite the increasing global availability of food, some 850 million people lack access to sufficient nutritious food at affordable prices. Approximately 60% of these people live in South and East Asia, and 25% live in Sub-Saharan Africa (Pinstrup-Andersen and Cohen 2000).

Future developments in science and technology, including the continuing discoveries in modern biology, can contribute to strategies for achieving food security and creating wealth for resource poor people, if they are:

- Directed at clearly defined targets that affect poverty reduction, food security, environmental conservation and/or trade competitiveness.
- Accompanied by political will, supportive public policies, and public and private investments in both science and technology and product development and delivery.
- Implemented under the auspices of regulatory frameworks that generate public trust and confidence in the safety and ethical use of new biological products and processes for human health, food and agriculture and the environment.

3.3 Scientific Context

Modern science encompasses new developments in the biological, physical and social sciences. In the biological sciences, recent discoveries allow much greater understanding of the structure and function of human, animal, and plant genes and the proteins and other biochemical products they produce. Discoveries

in the physical sciences underpin the revolution in information and communications technologies. These branches of science come together in the field of bioinformatics, whereby large amounts of biological data can be assembled and analysed (Box 3.1).

Box 3.1 New understanding of plant and animal genes

Genomics refers to the processes used in identifying the location and function of all the genes contained in an organism. This new knowledge is changing the future of breeding for improved strains of crops, livestock, fish, and tree species. Although much of the discussion about biotechnology today is focused on the opportunities and risks associated with interspecific gene transfer, the same scientific discoveries bring new tools to assist breeders to identify and transfer genes through conventional breeding within a particular species. In many environments, future gains in productivity will depend upon manipulation of complex traits, such as drought or heat tolerance or tolerance to parasites. These traits are often difficult to identify and utilize in conventional breeding programs without the additional help of modern science.

Contributions of modern biology to food and agriculture

The contributions of modern biology to today's agriculture are substantial. They include:

- Better understanding of how plants function, and how they respond to the environment.
- More targeted selection objectives in breeding programs to improve the performance and productivity of crops, livestock, and fish and post harvest quality of food.
- Molecular (DNA) markers for smarter breeding, by enabling early generation selection for key traits, thus reducing the need for extensive field selection.
- Powerful molecular diagnostics, to assist in the improved diagnosis and management of parasites, pests, and pathogens.
- Development of vaccines for the control of livestock and fish diseases.

The applications are in their infancy. The rapid progress being made in plant sciences is expected to enhance plant breeding as the functions of more genes and how they control particular traits are identified. These developments may enable more successful breeding for complex traits such as drought tolerance; a benefit to those farming in marginal and rain-fed lands worldwide. Breeding for such difficult traits has had limited success with conventional breeding of the major staple food crops. Further scientific advances will result in crops with a wider range of traits of interest to consumers and to farmers, including food with improved nutritional quality.

Strategic research is required in order to understand the genetic basis of the agriculturally important

crops, livestock, and fish, to identify potentially useful genes to address important constraints, and to understand how the gene products (proteins and other metabolites) function in the cells of the living organism. Scientific developments in emerging areas offer promise of new ways to deal with previously intractable problems in crop and livestock production, forestry, and fisheries and contribute to sustainable development. To achieve this promise, they will need to be combined with other skills in areas such as nutrition, biochemistry, immunology, ecology, and risk management, as well as understanding and addressing community concerns about new technologies (*Box 3.2*).

Box 3.2 Understanding risks and benefits of new technologies

The rapid increase in the use of new techniques for understanding and modifying the genetics of living organisms has led to greatly increased interest and investments in biosciences. These developments have been accompanied by increasing public concerns as to the power of the new technologies and the safety and ethics of their use for improving human health, food and agricultural production, and the environment.

Public concerns lie in four major areas:

- Ethical issues.
- Socio-economic effects.
- Food safety and human health.
- Impact on biodiversity and the environment.

The ethical issues relate to moral and social concerns about the nature of gene technology itself and the consequences of its use in specific situations. There are also concerns about the appropriateness of the use of intellectual property rights in relation to living organisms, and means to ensure the equitable sharing of benefits by holders of genetic resources, owners of indigenous knowledge, and inventors.

Socioeconomic effects are concerned with the economic risks and benefits in the use of new biological applications, the implications of intellectual property management on agriculture in different countries, and in identifying who gains and who loses from the use of new technologies in various circumstances.

In relation to food safety and human health, there are concerns about assessing the risks of new foods to human health, in the short and long term; identifying specific nutritional benefits of new foods developed for this purpose; and searching for any unintended effects.

In relation to impact on biodiversity and other possible environmental effects, the concerns relate to assessing the risks and benefits of releasing living modified organisms into the environment, and the effects such releases may have on the environment. These effects may be through direct effects on the environment, including potential impact on biodiversity, and/or indirect effects through changing agricultural practices that affect the environment.

Consideration of these issues, on a case-by-case basis, provides a basis for choices on the merits and safety of the applications of new biotechnologies to address particular problems, relative to existing agricultural technologies and other technology options.

Sources: ICSU, 2002 & 2003

3.4 Social Context

There are new developments in the social sciences that underpin community participation in technology development and evaluation. Participatory methods can help understand the problems and identify the researchable issues, particularly of small farmers operating in marginal environments. These participatory approaches may also help to clarify the concerns of people in rural and urban communities in regard to the deployment of new technologies, including the products of biotechnology. They may also assist in the integration of modern science and traditional knowledge, in order to develop knowledge-intensive solutions to specific problems that are technically feasible and socially and ethically acceptable, in various rural and urban communities (Serageldin and Persley, 2000. Available online at <http://www.worldbank.org/html/cgiar/publications/prometh/pscont.html>).

3.5 Biosciences in Africa: Opportunities and Constraints

Why Biosciences in Africa?

Advances in the biosciences promise powerful new ways of improving crop and livestock productivity, and minimizing threats to human health and to the environment. Problems that seem intractable through conventional agricultural, veterinary, environmental, and medical research can be tackled by applications of these new approaches. This has led to development of a new generation of safer and more affordable vaccines for important human diseases such as meningitis, and for animal diseases such as rabies. Applications in food and agriculture have resulted in the development of new crop varieties with improved tolerance to pests and diseases, better storage quality, and higher nutritional value. 'Marker-aided' breeding of important food crops and farm animals, which employs genetic markers to select desirable traits such as tolerance to drought and disease, allow new cultivars and breeds to be developed by smarter breeding. This can be achieved far more rapidly than has been possible through conventional breeding and selection programs.

Constraints to the optimal use of biosciences in Africa include:

- Lack of clear problem definition, based on dialogue amongst farmers, consumers, researchers, and the public and private sectors.
- Lack of sufficient, suitably trained scientists, who are able to have a career as scientists in Africa.
- Lack of adequate laboratory facilities and equipment and the human and financial resources essential to operate, maintain, and sustain them.
- Shortage of operating funds for projects.
- Limited private sector involvement in science and technology applications in Africa, to develop products and deliver them to market.
- Lack of networking with the international scientific community to access knowledge, state of the art techniques and potentially useful technologies.

The challenge is to mobilize new scientific advances for Africa's development, to reduce poverty and create wealth in sustainable and equitable ways. Many problems constraining Africa's development require solutions specifically tailored to unique local, national, and regional circumstances. Some solutions may be developed from existing knowledge and adaptation of available technologies. Many, however, require new knowledge, new discoveries and endogenous innovation — by Africans, for Africa.

Current Biotechnology Priorities and Program in Eastern and Central Africa

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), in developing a regional biotechnology strategy amongst its 10 member countries, has identified specific priorities for biotechnology applications for commodities important in eastern and central Africa. These are based on an analysis of current constraints, possible availability of new technologies, and/or potential for new R&D approaches to address previously intractable problems.

The priority commodities, constraints, and thematic areas identified by ASARECA, and in which it supports programmatic activities in biotechnology are summarized in *Box 3.3*.

ASARECA's biotechnology strategy and priorities provide guidance for the development of the activities of *Biosciences eastern and central Africa*. Examples of other national, regional and

international programs relevant to the activities of *Biosciences eastern and central Africa* are summarised in Box 3.4

Box 3.3 ASARECA - identified priorities for biotechnology in eastern and central Africa

Priority commodities:

Crops: Maize, wheat, beans, cassava, sorghum, potato, banana, coffee, groundnut, and citrus

Livestock: beef and dairy cattle, sheep and goats

Natural resources: soil and water, biodiversity and forestry

Priority constraints to the applications of biotechnology

Technical constraints

1. Inadequate protocols for regeneration and rapid multiplication of disease-free planting materials including diagnostic systems.
2. Lack of protocols to produce larger numbers of quality livestock breeds in a short time frame.
3. Lack of access to isolated genes, novel germplasm, and biotechnologies.
4. Lack of new genes/markers and transformation protocols to address production constraints and/or to improve food quality and other characteristics in the region.
5. Inadequate characterization, evaluation, and conservation of existing crop, animal, and soil-organism germplasm.

Other constraints

6. Inadequate capacity to utilize biotechnology (human, infrastructure, ICT, bioinformatics).
7. Inadequate policies and legal frameworks to enable the utilization of biotechnology (biosafety, IPR, strategies).
8. Inadequate biotechnology product delivery opportunities.
9. Inadequate awareness and appreciation of the role of biotechnology in R&D.

Priority thematic areas for project development to address constraints

1. Developing protocols to generate quality planting materials.
2. Discovering new genes, markers, and related protocols to address constraints and opportunities.
3. Improving accessibility to genes, novel germplasm, and biotechnologies.
4. Developing and commercializing protocols to generate productive, quality livestock.
5. Strengthening human resources and infrastructure to achieve regional goals in agricultural biotechnology.
6. Creating awareness and advocacy of a role for biotechnology in R&D.
7. Characterization, evaluation and conservation crop, animal and soil organism genetic variation in the region.
8. Developing and institutionalizing IPR and biosafety policy frameworks.
9. Developing pathways for delivering of biotechnology.

Source: ASARECA (2003) priority setting report for the ASARECA Biotechnology Initiative September 2003 Association for Strengthening Agricultural Research in Eastern and Central Africa, Entebbe, Uganda.

Box 3.4. Illustrative list of biosciences and biotechnology programs in eastern and central Africa

National Programs on Biosciences and Biotechnology

High level political support, national policies and strategies, in support of specific research programs and projects are in operation in several countries, for example in Ethiopia, Kenya, Rwanda, Tanzania and Uganda. These programs are supported by national resources as well as receiving external support from bilateral donors and multilateral agencies including UN agencies and the World Bank.

Regional Programs

African Agricultural Technology Foundation (AATF)

AATF is a not-for-profit foundation facilitating and promoting partnerships with public and private sector entities designed to remove many of the barriers that have prevented smallholder farmers in sub-Saharan Africa from gaining access to existing agricultural technologies that could help improve food security and reduce poverty. <http://www.aftechfound.org>

African Biotechnology Stakeholders Forum (ABSF)

ABSF aims to create an enabling environment in which Africa can participate and benefit from biotechnology in a responsible and sustainable manner. The association, through the dissemination of information, aims to enhance the understanding and awareness of all aspects of biotechnology including Bio-safety and Intellectual Property Rights. <http://www.absfafrica.org>

Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)

ASARECA is a non-political organization of the National Agricultural Research Institutes (NARIs) of ten countries: Burundi, D. R. Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda. ASARECA's Biotechnology and Biosafety Programme (BIOTECH) contributes directly to ASARECA's objectives of improving food security and alleviating poverty. <http://www.asareca.org/>

BIO-EARN

The mission of the BIO-EARN Programme is to build capacity in biotechnology in Ethiopia, Kenya, Tanzania and Uganda and promote appropriate research and related policies. It promotes sharing of experts and facilities amongst institutions and training of scientists. In its first two phases, BIOEARN trained approximately 20 African graduate students to PhD level, in cooperation with Swedish universities. In its next phase, it aims to develop and support regional research projects in agricultural biotechnology and environmental biotechnology. <http://www.bio-earn.org>

Biotechnology Trust Africa (BTA)

Biotechnology Trust Africa (BTA) is a non-profit making charitable body registered in Kenya to promote the development and application of biotechnology in Africa with emphasis on agriculture, health, environment, industry and policy. <http://www.biotechafrica.or.ke>

NEPAD's Pan-African network

NEPAD is developing a Pan-African biotechnology network linking several networks and centres of excellence in biotechnology and biosciences across Africa. Through AFSTD, NEPAD is also establishing a high level task force on biotechnology to facilitate open and informed regional multi-stakeholder dialogues on issues related to modern biotechnology. <http://www.nepadst.org>

International Programs

Future Harvest research institutes including the following:

The International Center for Tropical Agriculture (CIAT)

CIAT conducts international research on beans, cassava, and forages. <http://www.ciat.cgiar.org>

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

ICRISAT's research focuses on sorghum, millet, groundnut, chickpea and pigeonpea, and breeds them for higher productivity, resistance to pests, diseases, and other stresses. <http://www.icrisat.org>

Box 3.4. (cont'd) Illustrative list of biosciences and biotechnology programs in eastern and central Africa

The International Institute of Tropical Agriculture (IITA)

IITA's research focuses on smallholder cropping and post-harvest systems and on the following food crops: cassava, cowpea, maize, plantain and banana, soybean, and yam. <http://www.iita.org>

The International Livestock Research Institute (ILRI)

ILRI's research focuses on livestock diseases in developing regions of Africa, Asia and Latin America and the Caribbean. <http://www.ilri.org/>

The International Potato Center (CIP), Peru

The International Potato Center research focuses on potato, sweet potato, other root and tuber crops. <http://www.cipotato.org>

Insect resistant maize for Africa (IRMA) Project

The IRMA project was launched in 1999 by the International Maize and Wheat Improvement Center (CIMMYT) and the Kenya Agricultural Research Institute (KARI), with financial support from the Syngenta Foundation for Sustainable Agriculture. The project is aimed at producing maize that is adapted to various Kenyan agroecological zones and is also resistant to key insect pests, primarily stem borers. Both conventional and biotechnology-based sources of resistance will be examined for their effectiveness against the borers. <http://www.cimmyt.org/ABC/InvestIn-InsectResist/htm/InvestIn-InsectResist.htm>

International Service for the Acquisition of Agri-biotech Applications (ISAAA)

ISAAA is a not-for-profit organization that delivers the benefits of new agricultural biotechnologies to the poor in developing countries. It aims to share these powerful technologies to those who stand to benefit from them and at the same time establish an enabling environment for their safe use. <http://www.isaaa.org/>

Program for Biosafety Systems (PBS)

PBS is a partnership program for biosafety capacity development. PBS supports partner countries as they develop the policy and legal framework, administrative procedures, technically qualified personnel and outreach mechanisms integral to their national biosafety systems. PBS work emphasizes sound science-based decision making and research, while also addressing socioeconomic considerations. <http://www.ifpri.org/themes/pbs/pbs.htm>

Rockefeller Foundation

The goal of the Rockefeller Foundation's *Food Security Program* is to improve the food security of the rural poor through the generation of agricultural technologies, institutions and policies that sustain livelihoods in areas of sub-Saharan Africa and Asia bypassed by the Green Revolution. The four key areas within this program are: new crop varieties for Africa; enhancing soil productivity in Africa; markets to increase the incomes of poor farmers; and public goods for poor farmers. The Foundation supports a number of plant breeding programs in Africa. <http://www.rockfound.org>

UNEP/GEF Biosafety Projects

The objectives of the GEF Initial Strategy on Biosafety are: To assist with national biosafety frameworks; to promote information sharing and collaboration, especially at the regional and sub-regional level; and to promote collaboration with other organizations to assist capacity-building for the CBD Biosafety Protocol. <http://www.unep.ch/biosafety/about.htm>

PART TWO: BIOSCIENCES EASTERN AND CENTRAL AFRICA (BecA)

ESTABLISHMENT AND ACTIVITIES

4. BecA Vision, Mission, Nature, Objectives, Outputs

4.1 Vision

Biosciences eastern and central Africa (BecA) enables African scientists and institutions to become significant technological innovators as well as technology users. This will be accomplished by undertaking biosciences research targeted at issues affecting Africa's development, while accessing and using the best of science worldwide.

4.2 Mission

The Mission of *BecA* is to improve the livelihoods of resource-poor people in Africa, through the development and use of new technologies and strategies for sustaining agricultural production, improving human health, and conserving the environment.

4.3 Nature

Biosciences eastern and central Africa (BecA) consists of a *Hub* and Secretariat located on the campus of the International Livestock Research Institute (ILRI) in Nairobi, Kenya, that will provide a common biosciences research platform, research-related services and capacity building and training opportunities; and a network of regional nodes and other laboratories distributed throughout eastern and central Africa for the conduct of research on priority issues affecting Africa's development. *BecA* is being established amongst a group of cooperating institutions that agree to make their facilities available for regional use.

4.4 Objectives

The objectives of *BecA* are to:

1. Provide *focal points* for the African scientific community to support the activities of national, regional and international entities addressing priority agriculture-related problems for reducing poverty, creating wealth and promoting Africa's development. The main objective is to bring improved and marketable agricultural products to African farmers.
2. Create and strengthen *human resources* in biosciences and related disciplines in Africa.
3. Promote scientific excellence by bringing together a *critical mass* of scientists drawn from national,

regional and international institutions in modern facilities where they can undertake cutting edge research. The goal is to help solve some of the most important development constraints affecting the health and well being of people in Africa.

4. Increase *access to affordable, world-class research facilities* within Africa;
5. Produce, manage and disseminate *bioscience information and knowledge* relevant to Africa's development.
6. Facilitate access to advice and training on *intellectual property, biosafety and other regulatory issues*.
7. Attract *additional investments* for biosciences in and for Africa from governments, the private sector, and regional and international bodies.
8. Serve as a platform to forge *partnerships* with other *biosciences laboratories and networks* and with those entities responsible for *product development and delivery, within Africa and globally*.
9. To strengthen the *role of women* in African agriculture, and to facilitate the greater participation of women scientists in biosciences and related research in Africa;
10. To use new developments in biosciences to *protect the environment and conserve biodiversity* in Africa.

4.5 Outputs

The **outputs** include:

- African scientists undertaking doctoral and postdoctoral studies, in association with African and other universities, and with special emphasis on young scientists, women scientists and those from post-conflict countries in Africa.
- Continuing professional development of mid-career scientists in African national agricultural research institutions and universities.
- Reducing brain-drain through provision of powerful incentives for African scientists abroad to return home, and for those currently working in Africa to remain professionally active in the region.
- Reducing gaps in biosciences knowledge, skills, and technologies between Africa and the industrial countries.

New **products** include

- More relevant and effective *new products*, intellectual property, and/or international public goods developed through bioscience applications specifically targeted at solving Africa's agricultural, health, and environmental problems.
- These products may include crops that are resistant to stress and pests, nutritionally enhanced foodstuffs, and vaccines and diagnostics for regionally important livestock diseases.

The initiative also provides **access to modern facilities and equipment**, including:

- State-of-the-art *research laboratories* for the biosciences, in areas such as genomics, molecular breeding, transformation technology, and immunology.
- New laboratory and greenhouse *containment facilities* for safe genetic manipulation of plants, animals, microbes, and parasites.

The **research-related** services include enabling access to:

- More effective management of *intellectual property, biosafety, and other regulatory issues in Africa*.
- Improved access to *information technology services, bioinformatics databases and biometrics and statistical services*.

Box 4.1 Concept of Biosciences eastern and central Africa

Biosciences eastern and central Africa is an initiative endorsed by NEPAD's Steering Committee to support eastern and central African countries develop and apply bioscience research expertise to produce technologies that help poor farmers secure their assets, improve their productivity and income and increase their market opportunities. It provides a central point for the African scientific community to support the activities of national, regional, and international agencies as they address agriculturally related problems of the highest priority for alleviating poverty and promoting development.

Research will focus on problems that can be addressed by biological research, that are especially important to the poor in the region, and that are not being investigated by research institutions or the private sector in industrial countries. Examples of regional priorities include production of crops that are stress tolerant, disease resistant, or nutritionally enhanced. These crops would be mainstays of poor farmers, but of little or no importance to large-scale farmers or multinational agribusinesses. Many diseases killing the crops and livestock of the poor are neglected by the R&D community. Controlling livestock diseases requires development of vaccines and diagnostic tests and better use of indigenous breeds possessing genetic resistance to disease. No vaccines or diagnostic tests currently exist for some of the most economically devastating diseases of livestock in the region. Other diseases are being inadequately controlled by crude technologies.

State-of-the-art research laboratories will be available for the biosciences, as well as containment facilities for safe genetic manipulation of livestock, plants, and microorganisms. A key

institutional challenge is finding ways to effectively share facilities among countries and partners. Sharing expensive facilities makes great sense for the poorest continent on earth, but there are few existing models to signpost how to achieve this. This sharing will foster institutional innovations generating greater collaboration among Africa's research systems, advanced biosciences institutions worldwide, and the private sector.

Biosciences eastern and central Africa is hosted by existing research institutions, with refurbished laboratories of the International Livestock Research Institute in Nairobi, Kenya, at the center of the Hub. This greatly reduces the need to invest in new buildings and infrastructure.

Biosciences eastern and central Africa is open to all qualified institutions and individuals. Initial focus will be on a handful of projects to resolve high-priority problems identified by national and regional organizations. Projects may originate from individual scientists within universities or national research organizations, and regional organizations. International consortia and the private sector are encouraged to use the facilities and work with African scientists and their institutions to address the agreed research priority issues.

Sources: 1. Mugabe, J. (2003) *Centres of Excellence in Science and Technology for Africa's Sustainable Development: Towards new forms of regional and sub-regional networks*. Paper prepared for the African Ministerial Conference on Science and Technology in Development; and 2. *BecA* brochure and website at www.bioscienceafrica.org

5. Program Overview

5.1 Program Scope

Biosciences eastern and central Africa (BecA) facilitates, hosts, and conducts research in areas where new developments in biosciences offer promise to address previously intractable problems constraining Africa's development; where these are areas appropriate to *BecA*'s scientific and technical core competences; and where it can complement and add value to other national, regional and international activities. Capacity building and training is a major goal of all program activities.

The focus is on improving the productivity and sustainability of agriculture in Africa, through improved products with high impact on the market in the near future. The research activities include attention to the influence of agriculture on the environment, and to the interactions amongst poverty, food security and malnutrition and human health.

The objectives and intended outputs of the program are shown in *Box 5.1*.

Box 5.1 Biosciences eastern and central Africa projects: objectives and outputs

Objectives

- Provide focal points for the African scientific community to support the activities of national, regional, and international entities addressing priority agriculture-related problems for reducing poverty, creating wealth and promoting Africa's development; with the objective of bringing improved agricultural products to African farmers (Objective 1);
- Create and strengthen human capital in biosciences and related disciplines in Africa (Objective 2);
- Bring together a critical mass of scientists drawn from national, regional, and international institutions in state-of-the-art facilities where they can undertake cutting-edge research to help solve some of the most important development constraints affecting the health and well-being of people in Africa (Objective 3);
- Increase access to affordable, world-class research facilities in Africa (Objective 4);
- To strengthen the role of women in African agriculture, and to facilitate the greater participation of women scientists in biosciences and related research in Africa (Objective 9); and
- To use new developments in biosciences to protect the environment and conserve biodiversity in Africa (Objective 10).

Outputs

- Continued professional development of mid-career scientists in African national agricultural research institutions and universities;
- More women and young people participating in the science and technology sector in Africa;
- Reduced brain-drain through provision of powerful incentives for African scientists abroad to return home, and for those currently working in Africa to remain professionally active in the region rather than having to leave for institutions in industrial countries to pursue a career;
- State-of-the-art research laboratories for the biosciences;
- Containment facilities for safe genetic manipulation of plants, animals, and microbial agents;
- More relevant and effective new products, intellectual property, and international public goods developed through bioscience applications specifically targeted at solving Africa's agricultural, health, and environmental problems.

5.2 Program Goals

The goals of the program are:

- **Capacity building**
Increase know-how and technology transfer through training and teaching.
- **Research facilitation**
Support research projects in areas of scientific and technical core competencies, at the *Hub*, regional nodes and other participating laboratories
- **Innovative solutions**
Develop novel contributions to bring improved products to the market.

5.3 Operating Procedures

The operating procedures are flexible, in order to encourage greater use of modern biosciences to address major challenges constraining Africa's development. Ways

in which scientists are able to engage with *Biosciences eastern and central Africa* include participating in research projects hosted by *BecA*, at either the *Hub*, one of the regional nodes or other participating laboratories. In some instances, one country or institution identifies the topic. In others, related projects address regionally important problems, in a concerted way, and include participants from several countries in Africa, as well as linkages with the international research community and the private sector. Students affiliated with universities are able to undertake these research in association with particular projects. Special attention is being paid to the needs of women and young people in agriculture and in science and technology in Africa, and to people from post-conflict countries. Targeted activities encourage their respective participation in all aspects of the program. For example, one third of post graduate research fellowships will be targeted for women scientists.

The initial processes and partnerships are summarized in *Box 5.2* and illustrated in *Figure 5.1*.

Box 5.2: Biosciences eastern and central Africa Research and capacity building processes and partners

Prerequisites for BecA

> needs regular re-evaluation and adjustment

1. Research + capacity building strategy
2. List of *BecA* S&T core competencies
3. Appropriate infrastructure
4. Balanced portfolio of hosted projects of partners (guided by Scientific Advisory Committee)

Project Portfolio

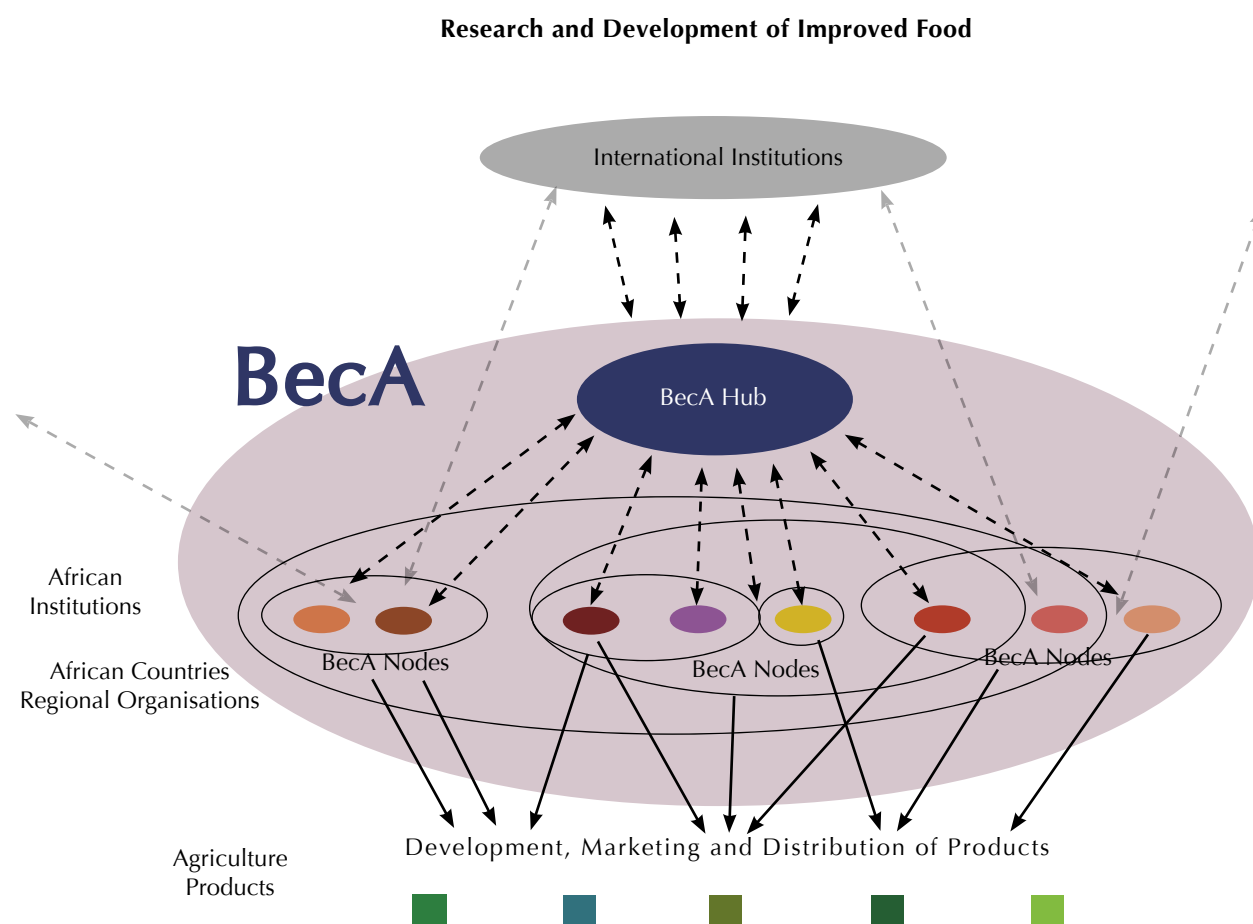
> a rolling process with partners

1. Visit countries + institutions to understand partners' needs in dialogue
2. Define projects + champions - match with *BecA* competencies
3. If appropriate: facilitate new projects and/or participate in existing projects/networks
4. Evaluate appropriate site for project initiation (hub/regional node/other laboratory)
5. Secure funding for the project

Partners

- | | |
|---|--|
| 1. African countries/institutions/regions | > Owners, champions, drivers, stakeholders |
| 2. African scientists | > Project leaders and investigators |
| 3. Bioscience staff | > Capacity building, coaching, technology transfer |
| 4. ILRI | > Partner: research, infrastructure, Hub host |
| 5. Other international centers | > Champions, drivers, innovators |
| 6. International partners | > Innovation, know-how/technology transfer |
| 7. Funding partners | > Support of infrastructure, projects, capacity building and training activities |

Figure 5.1 Biosciences eastern and central Africa (BecA): Networking research and product development within Africa and globally



5.4 Project Initiation and Implementation

Networking Processes

The following consultative processes were initiated during 2004/5:

- A *Stakeholder Consultative Workshop* (January 2004) was attended by 60 people from 6 countries and representatives of several African organizations, including the African Union and NEPAD. The full report is available at www.biosciencesafrica.org/documents.htm
- Presenting and discussing the concept of *BecA* and inviting participation in its activities at several regional meetings, including those sponsored by ASARECA, FARA, BIOEARN and NEPAD;
- Initiating a series of series of consultative workshops in several countries of eastern and central Africa to identify problems requiring further research, and capacity building and training opportunities. The relevant national bodies in each country and *BecA* cosponsored the workshops in Ethiopia, Kenya, Tanzania and Uganda during 2004 and Rwanda in 2005;
- Developing guidelines for the identification of *strong regional scientific nodes* in institutions that are willing to make their facilities available for regional use. These nodes will be distributed throughout eastern and central Africa and serve as an interface between the *Hub* and other participating laboratories; for example for accessing the bioinformatics platform.

- Establishing a *Bioinformatics Platform* - including a dedicated website with data bases and analytical tools that are now available to the entire African research community at www.becabioinfo.org. (Box 5.3)

Box 5.3. Some examples of research projects emerging from BecA-sponsored planning workshops

BecA, together with IITA and other partners are facilitating the development of an *African Biotechnology Cassava Consortium (ABCC)*, and supporting website, to address priority constraints limiting cassava production and processing. It involves about 30 participants from 7 countries, other regional bodies and cassava research and development programs, including the NEPAD PanAfrican Cassava Initiative. Further information is available on the website: <http://www.biosciencesafrica.org/cassava/index.html>

BecA and other national partners, ICRISAT, the Syngenta Foundation for Sustainable Agriculture and other funding organisations are fostering the development of an African Sorghum/Millet Annotation and Improvement Consortium (ASMAIC) for sorghum and pearl millet, and development of supporting website. Participants include plant breeders from 15 African countries. The purpose is to access information from the successful mapping of the genomes of other cereals and use the data to develop more drought tolerant and disease resistant lines of sorghum and pearl millet in Africa, through more efficient and targeted breeding with new molecular tools and technologies.

Website: <http://www.biosciencesafrica.org/asmaic/index.html>

Project Initiation

The topics are likely to be within the broad priorities framework for food and agriculture in eastern and central Africa, as set out by the African Union, NEPAD, and ASARECA. The topics identified will be the result of a match between priority problems, scientific opportunities, and scientific and technical core competencies available through *Biosciences eastern and central Africa*.

For example, the workshop in Ethiopia identified strong interest in proposing projects on tef (the staple food) and coffee (the major export commodity), to be led by scientists from Ethiopia. Tanzanian workshop participants indicated priority for additional work on trypanosomiasis, a disease affecting humans and livestock in Africa. Other possible topics emerging from regional consultations include improved control measures for other orphan diseases of livestock in Africa, such as Newcastle disease in chickens; improvement of cereals and root crops, through the use of marker assisted selection. Other examples where research projects are emerging as the result of workshops, co-sponsored by *BecA* and various other parties are given in Box 5.3.

Project topics are likely to be mainly in agricultural research, but could extend to environmental and medical applications of biosciences in Africa, where *Biosciences eastern and central Africa* has the necessary scientific and technical core competencies. For example, environmental applications could include the use of *BecA*'s genotyping facilities for characterizing biodiversity in species of African wildlife.

Project Characteristics

Projects hosted by *Biosciences eastern and central Africa* will have certain common characteristics, including country initiation, advocates in Africa, available scientific leadership, willingness to contribute to the broader objectives of *Biosciences eastern and central Africa*, and adequate financial support.

The specific characteristics include:

- Project leader has a PhD or equivalent experience in conducting independent research.
- Project is initiated through national institution/ university in the region.
- Project leader(s)/principal investigators come primarily from African research institutions and/or universities, and have linkages with the African and international scientific community.
- Project has institutional linkages to contribute toward developing biosciences networks in Africa (championship).
- Project has adequate financial support to cover the salary of the researchers, technical staff, and other operating costs.

- Project is within the scientific and technical core competences (that is, laboratory facilities, equipment, and technical staff are available at either the *BecA Hub*, regional nodes or other participating laboratories in the network to enable the conduct of the research).

Project Leadership

The project leaders / principal investigators will be experienced scientists, and will commit time to act as mentors/supervisors to students, thus contributing to the formation of the *Biosciences eastern and central Africa* research community and assisting in capacity building. Additional masters and doctoral students may be available to projects through fellowships offered on a competitive basis. The initial fellowships are advertised at: www.biosciencesafrica.org/fellowships.htm

Financial Support

- Projects are hosted by *Biosciences eastern and central Africa*, on a cost-recovery basis. Some (but not necessarily all) research is conducted at *BecA Hub* laboratories and/or *regional nodes or other participating laboratories in the network*, on a cost-recovery basis.
- Project proponents and principal investigators are primarily responsible for arranging their own financial support.
- *Biosciences eastern and central Africa* may assist partners in related projects mobilizing the necessary financial resources, to help bring a critical mass of scientists and resources together to address a specific high priority problem.

5.5 Project Selection Criteria

The *BecA* Scientific Advisory Committee advises the *BecA* Steering Committee and management on the suitability of hosting specific projects. Project selection criteria include:

- Topic is a priority for one or more countries in eastern and central Africa
- Near to market demand for proposed outputs

- Products likely to be acceptable to consumers
- Potential for impact is high
- Potential for positive impact on women and low likelihood of negative impact
- Likelihood of success high
- Quality of science high
- Potential for use of *BecA's* core competencies.
- Link to capacity building and training activities
- Contribute to pursuit of *BecA's* Vision and Mission
- Enhancement of *BecA's* reputation.

5.6 Project Biosafety, Biocontainment and Regulatory Requirements

The required standards for occupational health and safety and biosafety at the *BecA Hub* are guided by the findings of the Environmental Impact Assessment of the *BecA Hub facilities* conducted in 2004/5.

ILRI, as the host institution for the *BecA Hub* laboratories and secretariat, is responsible for providing suitable equipment and containment facilities for plants, animals, microbes, and parasites/pathogens, as well as procedures that meet national and international biosafety standards. The project leaders, principal investigators and other scientists working at the *Hub* are responsible for ensuring that their research is conducted in accordance with national and international biosafety standards, as set out in the *BecA* Project Agreement. They are also responsible for meeting regulatory requirements for the field-testing and release of any potential products. These requirements will be included in contractual arrangements agreed for specific projects hosted at the *BecA Hub*. ILRI, as the responsible host institution, will monitor biosafety and bio-containment procedures at the *Hub* laboratories, to ensure that all research on site is in accordance with national regulations and international best practices and agreed standards.

Similarly, where *BecA-sponsored research* is conducted at *regional nodes or other participating laboratories in the network*, their respective host institutions will be responsible for the provision of international best practices. Each host institution will be responsible for monitoring compliance with these safety standards in *BecA* projects conducted on their sites. These responsibilities will be set out in specific agreements between *BecA* and the respective host institutions for the *regional nodes and other participating laboratories in the BecA network*. (See Box 10.3)

5.7 Project-specific Contractual Agreements

A project-specific contractual agreement will set out the roles and responsibilities of the contracting parties for each project, while using common contractual arrangements for all projects, to the greatest extent possible. These agreements will also address policies and guidelines for intellectual property management in projects. Contractual arrangements are discussed further in Chapter 10 on Governance and Management. A template for Project Agreements is available separately from the *BecA* secretariat.

6. Capacity Building and Training

6.1 Capacity Building and Training Opportunities

Biosciences eastern and central Africa (BecA) sees implementing a strong program in capacity building and training as central to achieving its mission (see Box 6.1, 6.2.)

Box 6.1 Biosciences eastern and central Africa capacity building and training: objectives and outcomes

Objectives

- Create and strengthen *human resources* in biosciences and related disciplines in Africa (*Objective 2*).
- Increase access to *affordable, world-class research facilities* within Africa (*Objective 4*).
- To strengthen the *role of women* in African agriculture, and to facilitate the greater participation of women scientists in biosciences and related research in Africa (*Objective 9*).

Outputs

- Trained young African scientists to masters and doctoral levels, in association with regional universities;
- Increased opportunities for women scientists, and for scientists from post-conflict countries.
- Continued professional development of mid-career scientists in African national agricultural research institutions and universities.
- Reduced brain-drain through provision of powerful incentives for African scientists abroad to return home and for those currently working in Africa to remain professionally active in the region rather than having to leave for institutions in the industrial countries to pursue their careers.
- Reduced gaps in biosciences knowledge, skills, and technologies between Africa and the industrial countries.

BecA provides opportunities to increase the capacity of institutions and individuals in Africa to conduct biosciences-related research, and to develop and deliver new technologies. It does this through providing opportunities for young scientists to work with more experienced mentors for research experience, short- and long-term training, workshops and seminars, and access to ongoing learning through distance education.

Realizing the potential of women scientists in Africa will be given particular attention and support in all aspects of capacity building and training. Also, a new generation of young scientists needs to be encouraged and helped to take up research careers in Africa. One third of post graduate fellowships will be targeted towards women scientists, in keeping with the recommendations of a report by Rathgeber (2005) on gender issues in agriculture, science and technology in Africa (see also Section 1.3 of this document).

The need to address the dearth of sufficient capacity in science and technology throughout much of the developing world is well articulated in an Inter Academy Panel report (IAC 2004b) report and in recent studies commissioned by NEPAD, such as the report by Clark and Mugabe (2005), which is available online at: http://www.nepadst.org/publications/docs/doc25_022005.pdf.

Capacity building and training partnerships

In the area of capacity building and training, there is a need to establish partnerships with African universities, and with internationally renowned research groups to develop systematic capacity building and training programs. Formal relationships with academic bodies such as academies of science will assist this endeavor.

Several national, regional, and international programs are also supporting capacity building in biosciences in Africa. These include programs supported by ARPIS and ICIPE; ASARECA, BIOEARN, CABI, the CGIAR Future Harvest institutes, International Foundation for Science (IFS), Rockefeller Foundation, United Nations agencies, the Wellcome Trust, the World Bank as well as several bilateral donors, including USAID, who have a large programs of research and capacity building activities.

Opportunities are being sought by *BecA* to identify synergies with current programs, and to complement them. This includes enabling access to the facilities and services available at the *BecA Hub*, *regional nodes* and/or *other participating laboratories*, by other biosciences programs in Africa, where these facilities and services would be helpful for the conduct of their research and capacity building and training activities.

Several cosponsored activities between *BecA* and other programs have been conducted during 2004/5 and others are being explored. An early result of this approach was the conduct of a training course on *marker-assisted selection in plant breeding*, jointly sponsored by the CGIAR Generation Challenge Program and *BecA*, in December 2004 in Nairobi. The course was the first of its kind conducted in eastern and central Africa, and was attended by approximately 40 participants from 15 African countries.

BecA co-hosted with ICIPE and ILRI the 3rd Annual ***Africa Genome Initiative*** (AGI) Conference, held in Nairobi in March 2005. www.africagenome.co.za

6.2 Capacity Building and Training Services

BecA offers the following capacity building and training services:

- Fellowships for African scientists, with special emphasis on women scientists, young scientists and those from post-conflict countries in Africa.
- Co-supervision of thesis related research, in association with specific projects.
- Conduct of short courses and workshops.
- Seminar series, including traveling seminars to various countries in the region.
- Provision of suitable accommodation and child care facilities at the *Hub*, especially for visiting women scientists and postgraduate students.

These services are summarised in *Box 6.2*.

Launch of Fellowships for Doctoral Studies in January 2005, in specific areas related to *BecA*'s research competencies and projects. The direct link to the fellowships program is: www.biosciencesafrica.org/fellowships.htm

Box 6.2 BecA Capacity Building and Training Services

1. Targeted training of scientific and technical personnel from African research institutions and universities, through their participation in specific projects

- The participation of scientific and technical staff from African research institutes in specific projects, which they have identified as priorities, will enhance the research capabilities of both the individuals and the institutions.

2. Thesis-related research by students, in partnership with African universities

- Students with thesis research requiring use of laboratory facilities and the scientific and technical core competencies of *BecA*; Thesis research will normally be undertaken in association with a *BecA* hosted project;
- *BecA* is not a degree-granting body, but welcomes partnerships with African (and overseas) universities as the degree-granting bodies.
- Students/postdoctoral fellows may be supported either through their own institutions, by external granting agencies, or by applying for fellowships offered on a competitive basis by *BecA* through a *Challenge Fund*. These fellowships will be awarded on the advice of an independent Scientific Advisory Committee. First call is at: www.biosciencesafrica.org/fellowships.htm

3. Postdoctoral fellows

- Postdoctoral fellowships include some start-up grants for postdoctoral fellows beginning their research careers in Africa.

4. Visiting Scientists

- Visiting scientists are encouraged, from African institutions and from research institutions on other continents.

5. Short-term use of research facilities

- Short-term use of research facilities will be available to students, other visiting scientists and companies on a cost-recovery basis.

6. Specific short-term training courses

- *BecA* offers training courses in the use of specific techniques and applications of biosciences. Short courses are held either at the *Hub*, *regional nodes*, or other laboratories participating in the network.

7. Travelling seminar series

- *Research seminars*: Seminars by project leaders/principal investigators to report progress in projects; these seminars will be held at the *Hub laboratories*, *regional nodes*, and other participating laboratories and partner institutions.
- *Visiting scientists* are invited to present seminars at the *Hub laboratories*, *regional nodes* and at other locations in the network.

8. Annual scientific meetings

- *Scientific meetings*: An annual scientific meeting is planned for participants in the *BecA* network. These regular meetings will be held at different locations and link with other centers and networks of excellence in biosciences across Africa, wherever possible.

7. Scientific and Technical Core Competencies

7.1. Scientific and Technical Core Competencies

The areas of scientific and technical core competencies and the associated infrastructure that will be available at the *BecA Hub* are summarized in *Box 7.1*. These core competencies will be available to support specific research activities in Africa, including capacity building and training, at either the *BecA Hub*, *regional nodes and/or other participating laboratories in the network*.

Core competency in the specified technologies means that *Biosciences eastern and central Africa* will have the necessary laboratory, containment facilities, equipment, operating funds and the technical skills to keep these technologies operating optimally; as well as access to the scientific skills to guide research activities using the technologies. The activities of *BecA* will be conducted under national guidelines and regulations for biosafety and biocontainment and in accordance with international standards and best practices. These standards will be informed by the occupational health and safety and the biosafety studies conducted under the auspices of the Environmental Impact Assessment (EIA) of *BecA*.

The core competencies available through *BecA* cover the use of selected cutting edge technologies in genomics, molecular biology, biochemistry and bioinformatics, as well as bioanalytical tools for crops and livestock, such as gene sequencing, array technologies, proteomics, marker technologies, transformation, immunology, and diagnostics. (*Box 7.1*)

In addition to the core competencies that are available at the *BecA Hub*, further competencies will be accessible through *BecA*, either at regional nodes or other laboratories in Africa. Some required competencies will be accessed through international cooperation with other laboratories worldwide. The core competencies available to African scientists through *BecA* are a dynamic list, which will be reassessed at regular intervals. They will be adapted to the evolving needs of the countries in Africa. They will also be responsive to new scientific developments worldwide, so as to access new technologies through international cooperation. (Some examples of outsourcing technologies are given in *Box 7.2*)

7.2 Research-related Services

There are a number of areas where *Biosciences eastern and central Africa* will provide access to advice and services, either through its own capabilities, or through linkages with partners in Africa and/or internationally. The objectives and outputs relevant to the provision of research-related services are shown in *Box 7.3*. The range of research-related services includes:

Technical services available through *BecA*

- Bioinformatics.
- Biometrics and statistics.
- Laboratory and equipment management.
- Technical support in all areas of core competencies.
- Partnerships for technology delivery in areas such as seed production, diagnostics and vaccine production systems.

Advisory services able to be accessed through *BecA*

- Intellectual property management, including guidance on freedom to operate and to commercialize IP (in association with African Agricultural Technology Foundation (AATF) and other partners).
- Biosafety policies and practices.
- Regulatory management including advice on the preparation of biosafety dossiers on potential products, for consideration by regulatory authorities;

Communication and knowledge management services

- Improving access to knowledge through better access to library resources and more widely available Internet access.
- Improving the distribution of knowledge through research publications and internet-based publishing by scientists in Africa.
- Public communications about biosciences, including presentations at national, regional and international forums.
- Advice on writing research proposals and grant applications to science funding bodies and development agencies in Africa and internationally.
- Advice on preparing scientific papers for publication.

Box 7.1: Biosciences eastern and central Africa:

Areas of scientific and technical core competencies planned at the BecA hub (April 2005)

1. Bioinformatics - *The assembly of data from genomic analysis into accessible forms.*

Competencies

- a) Data integration, -management and -interpretation
- b) Data base generation, -maintenance and -curation
- c) Analysis and use of publicly generated genome maps and expression data
- d) Annotation and curation of trait genes of interest for regionally important crops, livestock, insects, parasites and environmentally important microbes
- e) Discovery and analysis of markers for regionally important crops and livestock (MAB, etc.)
- f) Ability to analyze lines for "Association Mapping," "Near Isogenic Line Mapping" or "Recombinant Inbred Mapping"
- g) Ability to handle haplotypes and all forms of marker assisted breeding (MAB)
- h) Use of publicly available proteomics and metabolomics datasets
- i) Integrated bioinformatics for Systems Biology approach

Infrastructure

- a) Powerful, high speed Bioinformatics server: 52-CPU Paracell Opteron Cyclon Linux cluster with Paracel Blast and GeneMatcher2 25 nodes, 3 TB storage
- b) Highway gate with 500 MB/sec
- c) Air conditioned and dust proof LAN room
- d) Computer room with 25 workstations for computational work, training, etc.

Capacity Building

- a) Bioinformatics service, data interpretation and training for users in Africa

2. Discovery and confirmation of markers and genes via DNA sequencing

- a) Appropriate DNA sequencing instrumentation: ABI 3730s
- b) Appropriate PCR machines to amplify and sequence DNA: ABI 9700s

- c) Multichannel pipettes and liquid-handling robotics to set up amplification and DNA sequencing reactions
- d) Appropriate automation for picking and gridding of libraries

3. Amplification of markers and genes via PCR

- a) PCR machines, including real-time-PCR (Q-PCR)
- b) Appropriate level of lab automation to allow most efficient use of available personnel and equipment

4. Sources and handling of genetic material and libraries

Competencies

- a) Appropriate germplasm storage and handling of regionally important crops and livestock
- b) Genetically diverse lines with segregating phenotypes
- c) Appropriate Near Isogenic and Recombinant Inbred lines
- d) BAC libraries
- e) Genomic and cDNA libraries

Infrastructure

- a) Greenhouses, growth chambers, seed storage room, plant tissue culture facility, etc.

5. Purchasing / preparation of reagents for DNA and marker technologies

- a) DNA polymerase for PCR amplification
- b) Labeled nucleotide mixes for DNA sequencing
- c) Labeled nucleotides for SNP detection
- d) DNA extraction and quantification methods and infrastructure

6. Gel electrophoresis for SSR markers

- a) Appropriate scale and source of agar gel electrophoresis for desired throughput
- b) Labor to convert gel positions to haplotypes
- c) PAGE with silver staining

Box 7.1: (continued)

7. Technologies for SNP markers

- a) Single base extension technology with oligo primers
- b) Appropriate ABI sequencing instrumentation: ABI 3730s
- c) Perlegen Sciences technology as alternative (to be evaluated)

8. Analysis and comparison of gene expression (arrays)

- a) Hybridization and data analysis with publicly available expression microarray chips
- b) Build up of Affimetrix Gene Chip platform for Africa, comparison to Agilent etc. (to be evaluated)
- c) Spotting of subsets of important genes for expression analysis with micro-/macroarrays
- d) Data analysis and interpretation

9. Transformation capacity for crops of importance in Africa

Competencies

- a) Tissue culture initiation capability
- b) Biolistic DNA delivery technology
- c) *Agrobacterium* delivery technology
- d) Other DNA transfer approaches as needed
- e) Regeneration capability

Infrastructure

- a) Transformation lab with necessary biosafety level(s) for plants and microbes

10. Genotyping

- a) SNP and SSR markers for genotyping: for new markers, use of SNPs (higher throughput at lower cost per datapoint).

11. Phenotyping

Competencies

- a) Expertise to analyze medium throughput critical phenotypes from crops and livestock of regional importance with physiological-biochemical and diagnostics methods
- b) Virus, fungus, pest and parasite infection capabilities and disease analysis
- c) Capability to use molecular marker technology and genomics to improve regionally important crops and livestock.

Infrastructure

- a) Greenhouse, growth chambers and incubation space for crops, livestock, vectors and pathogens important in Africa
- b) Analytical methods (NIRS)

12. Immunology and Molecular Biology for livestock diseases, vectors and diagnostics

Competencies

- a) Antigen screening for vaccines and diagnostics (ELISA etc.)
- b) Monoclonal antibody production
- c) PCR based diagnostics for animals and plants
- d) Recombinant DNA technology
- e) Transfection technology, cell biology, tissue and cell cultures (parasites, insects)
- f) Vector genomics and baculovirus expression
- g) Gene cloning, expression technologies, protein methods, genotyping, vaccinology

Infrastructure

- a) Insect facilities for ticks, tsetse flies, and other vectors

13. Protein Technologies and Proteomics

- a) PAGE and Western Blot systems
- b) FPLC and other standard purification methods
- c) 2D gel proteomics with appropriate analytical technologies

14. Analytical Technologies

- a) VIS/UV Spectrophotometry recording systems
- b) Near Infrared Reflection Spectroscopy (NIRS)

15. Imaging technology

- a) Microscopes and other equipment for the characterization of insect vectors, viruses and other parasites and pathogens

16. Laboratory Information Management systems (LIM)

Box 7.2: Areas where BecA will seek access to competencies in other laboratories through international linkages and outsourcing, to complement BecA's core competencies

1. Bioinformatics

Buildup of big databases
Development of programs where useful ones already exist
Buildup of mega bioinformatics hub

2. DNA sequencing

High throughput sequencing
Routine sequencing where cheaper services exist

3. Amplification of markers and genes via PCR

Excessive automation and expensive equipment

4. Sources and handling of genetic material and libraries

Buildup of whole crop libraries

5. Purchasing / preparation of reagents for DNA and marker technologies

Purchasing when useful inhouse preparation procedures do not exist

6. Technologies for SNP markers

Development of new SNPs, where existing ones can be used
Discovery of new SNPs technologies

7. Analysis and comparison of gene expression (arrays)

Development of new arrays
Use of extensive, expensive and sophisticated arrays

8. Transformation capacity for crops of importance in Africa

Discovery and development of new transformation technologies for crops

9. Genotyping

Discovery of new genotyping technologies

10. Phenotyping

Phenotyping with sophisticated, specialized methods where expertise exists elsewhere (LC MS etc.)
High throughput phenotyping

12. Immunology and Molecular Biology for livestock diseases, vectors and diagnostics

Development of antibodies and methods, where useful ones exist

13. Protein Technologies and Proteomics

LC GC MS MS technologies

14. Analytical Technologies

Sophisticated analytical tools where not enough expertise

15. Imaging technology

Sophisticated equipment where not routinely used and without expertise

16. Laboratory Information Management systems (LIM)

Development of new programs

Box 7.3 Biosciences eastern and central Africa research-related services: objectives and outputs

Objectives

- Increase access to affordable, world-class research facilities within Africa; (*Objective 4*).
- Produce, manage and disseminate bioscience knowledge relevant to Africa's development (*Objective 5*).
- Facilitate access to advice and training on intellectual property, biosafety and regulatory issues (*Objective 6*).

Outputs

Facilities

- State-of-the-art research laboratories for the biosciences, including genomics, gene technology, immunology, etc.
- Containment facilities for safe genetic manipulation of plants, animals, and microbial agents.

Research-related services

- More effective management of intellectual property, biosafety and regulatory issues in Africa.
- Technical support in all areas of core competencies.

8. International Linkages

8.1 Essential International Linkages

Biosciences will have an increasing impact on agriculture, health and economic growth. Within industrial countries, the gains in knowledge and innovation through biotechnology, genomics, proteomics, bioinformatics, and other bio-disciplines are accelerating. This is the result of the knowledge and infrastructure available to industrial countries, and also because of partnerships and teamwork. Collaboration in research and development that brings together people and infrastructure is a cornerstone of many of the most successful programs that transform discovery into value.

An essential component in establishing centers of excellence in science and technology is to establish linkages with other such centers in Africa and globally. Biosciences is a rapidly evolving field and establishing linkages with individuals and institutions working at the cutting edge is critical in establishing and maintaining the reputation of *Biosciences eastern and central Africa* (*BecA*) as a center of excellence in Africa.

The benefits to be realized from increased biosciences capacity in Africa will be accelerated significantly through international linkages. There are many steps in creating value from research, and discoveries have to be compatible with the innovation framework in a country. *BecA* is an extraordinary opportunity to align the very best research with African needs and African capacity for innovation. It places in Africa a research capacity of international caliber. The successes the initiative can generate will come much more quickly if the international research community is encouraged to collaborate. The biosciences themselves have no borders, but their applications do because of social and geographic distinctiveness of different countries.

Multiple partners at multiple locations

The nature of *Biosciences eastern and central Africa* means that the programs and activities take place in locations throughout eastern and central Africa. They are focused on solving eastern and central African priority problems, and provide many opportunities for partnership links nationally and internationally. Potential partners include universities, national, regional, and international research institutions, the private sector, and the international scientific and

development communities. There is a high degree of interest from international partners working on priority African problems, who would benefit from conducting further research in the African environment.

BecA encourages partnerships with academic and research institutions within and beyond Africa. Those partnerships serve to enhance the research capacity of African scientists through improved access to training opportunities, through encouragement of larger teams of scientists focused on relevant problems, and through improved access to facilities and funding that will be needed to propel the research. Through such international partnerships, infrastructure at research organizations outside of Africa can be employed to accelerate discovery.

Partnerships are being sought between *BecA* and a variety of research, education and training institutions in Africa, and with the international scientific community and the private sector. *BecA* is willing to work with other research and learning programs in Africa and internationally, including those endorsed by NEPAD, and other agencies. A range of possible international linkages and partners with *BecA* is illustrated in *Box 8.1*

Steps to ensure *BecA* has a vibrant, successful, long-term program of international linkages include:

- *BecA* providing the opportunity for visiting scientists, postdoctoral fellows, and graduate students to spend time in Africa engaged in research with African collaborators. African scientists will also be able to travel outside of Africa to work in laboratories and research facilities of collaborators, on a short-term but regular basis so as to establish viable cooperative research programs.
- African scientists being encouraged where possible to accept joint adjunct faculty appointments in universities outside of Africa, while remaining based in Africa. This would facilitate joint applications to science funding bodies internationally;
- *BecA* developing a strong external communications plan that describes its programs and research priorities, so that potential partnering scientists and organizations know what is being done and what the opportunities for collaboration are. This also includes providing

guidance on potential funding sources for research projects.

- International partnerships being encouraged with scientists at the *Hub* in Nairobi, and also with scientists located at regional nodes and

other participating laboratories in the network in Africa; this will accelerate strengthening capacity throughout the network by linkages with the international scientific community.

Box 8.1 *Biosciences eastern and central Africa*: examples of international linkages

Research partners	<ul style="list-style-type: none">• Specific projects• S&T trends• Outsourcing for competencies
Capacity building and training resources	<ul style="list-style-type: none">• Formal training• Mentors/supervisors• Fellowships
Sources of information, knowledge & know-how	<ul style="list-style-type: none">• Access to ongoing sources of information (data-bases, publications, know-how)
Research-related services	<ul style="list-style-type: none">• Intellectual property• Biosafety• Regulation• Equipment repair and maintenance
Product development and delivery	<ul style="list-style-type: none">• Project management• Product appraisal• Market appraisal• Product delivery

Source: Wildeman, A.G (2004) University of Guelph, Canada

8.2 Discovery to Delivery Partners

Product development and delivery

Other important partners are those entities that are able to move scientific discoveries toward deliverable products. These include local companies, and larger biosciences companies, with experience in bringing biosciences-based products to market (e.g. medicines/ pharmaceuticals, livestock vaccines and diagnostics, and new crop varieties). Early involvement of private sector partners will assist in the design of effective programs of discovery and delivery.

It will be critical to *BecA*'s success to have an understanding of how scientific discoveries can lead to deliverable products, and to facilitate the necessary linkages in relation to specific projects. One early approach is to identify available technologies that are potentially useful in Africa and facilitate their adoption, approval, and use, as examples of biologically based products able to solve specific problems in Africa.

The multiple partners needed to move along the innovation chain from discovery to delivery to ensure successful outcomes are illustrated in *Figure 8.1*.

Figure 8.1 Multiple partners required to turn discovery into delivery

Biotechnology in Agriculture



Source: Peacock, J. 2005. In: *Discovery to Delivery*. BioVision Alexandria April 2004. Bibliotheca Alexandrina, Alexandria, Egypt.

9. Communications and Marketing

9.1 Stakeholders

Biosciences eastern and central Africa (BecA) serves two main groups, the beneficiaries and the investors. To be successful, both groups will need to be satisfied. The immediate beneficiaries are members of the scientific community in eastern and central Africa. The ultimate beneficiaries will be African farmers, rural and urban communities and civil society.

The characteristics of the target groups are:

- *Immediate beneficiaries* are the scientists from national and regional research institutions, African universities, and the broader scientific community. The scientists assess the initiative on the basis of the means it provides to assist them in furthering their research goals. This includes accessibility and availability of facilities, technology, support structures, mentoring, and an enabling environment focused on overcoming obstacles and finding solutions to priority problems.
- *Ultimate beneficiaries*, who are the farmers, neighbouring communities, and other rural and urban communities and civil societies in Africa. They will assess *Biosciences eastern and central Africa* on the basis of results - how effective it can be in helping to solve their problems.
- *Potential investors* are the African governments, the bilateral and multilateral development agencies, private foundations, science foundations and corporate firms. Potential investors assess *Biosciences eastern and central Africa* on the basis of its worthiness, credibility, and effectiveness. The reputation and credibility of management is key, together with the confidence that funds are prudently managed. The development agencies consider how activities fit with their current policy and programming areas. Science foundations are concerned with the quality of science. Private firms assess *Biosciences eastern and central Africa* on how it fits with their strategic marketing plans.

Key stakeholders

The key stakeholders with whom *BecA* needs to communicate are:

- *Political supporters* – (e.g. African Union (AU), NEPAD, African governments);
- *Investors*: Current investors such as Canada Fund for Africa (CFA); Gatsby Charitable Foundation; Rockefeller Foundation; Syngenta Foundation for Sustainable Agriculture; as well as other targeted, potential investors in the development community and selected science-funding agencies.
- *Scientific community*: Research networks, research partners and scientists accessing the *BecA* facilities in Africa, including NARS in countries of eastern and central Africa; regional bodies; International agricultural research centers; advanced research institutes; universities; and the global scientific community.
- *Users of research outputs* (e.g. farmers, rural and urban communities, NGOs, private companies).
- *Local communities and consumers* who are affected by *BecA*'s activities.
- *Environmental and health advocates*.
- *The media*, as opinion formers and ways and means to reach different stakeholders.

BecA's communications activities need to be targeted toward these different groups of stakeholders and meeting their varying needs and expectations.

9.2 Understanding and Meeting Expectations

Beneficiaries' expectations and perceptions

Beneficiaries' expectations are based on several factors – their needs, word of mouth, past experience with the service provider; other experience with associated providers, and external communications. Understanding and meeting the varying expectations of the immediate and ultimate beneficiaries requires frequent and frank dialogue between the different groups and those responsible for initiating and managing *Biosciences eastern and central Africa*. *Biosciences eastern and central Africa*'s view of

* Chapter 9 is based on the reports of the Biosciences Africa Stakeholders meeting (January 2004) and *BecA* Task Team 4 on Communications; the commissioned papers by Dr Mufi Koch (2004) on communications and Ms Elizabeth Dodswell of CABI on knowledge management (CABI 2004). These documents are available as resource documents. Additional insights come from the reports of the Strategic Environmental Assessment in 2004/5.

what beneficiaries expect and their own views of what they expect need to be crossed - checked regularly for compatibility, as differing expectations can lead to a lack of trust. External communications influence expectations and perceptions. Identifying and closing any gaps between "what we say we will do" and "what we do" will be crucial to successful communication by *BecA*.

Community communications have been initiated during the environmental impact assessment (EIA) and Strategic Environmental Assessment (SEA) in 2004/5. Details of the process are given at: http://www.pharmeng.com/new_web/Biosciences.htm It is critical that there is follow up by *BecA* and ILRI on these initial consultations with local communities, in order to increase mutual trust and understanding of differing perspectives. This may be accomplished through activities socially and educationally beneficial to the local community, and in developing risk mitigation strategies to deal with any unintended or unexpected consequences of *BecA*'s activities.

Investors' expectations

Biosciences eastern and central Africa is subject to the scrutiny of its investors. Investors expect to be kept up to date with activities and new developments. They also expect *BecA* to be accountable for the prudent use of their funds. Investors expect public recognition of their contributions and to know that their contributions are assisting in working toward solutions. To secure investors, *BecA* needs to create trust, provide frequent information, offer involvement in activities and have impact through some early successes.

9.3 Marketing and Public Awareness

With an understanding of beneficiary and investor needs and expectations, decisions about meeting those needs and expectations can be taken to ensure a coherent marketing plan that is consistent with the Vision and Mission of *BecA*.

Initial marketing and promotion activities are being undertaken to raise awareness of *Biosciences eastern and central Africa*. These activities are targeted at different groups of stakeholders. Marketing *BecA* to the stakeholders in the farming and scientific communities includes preparing a suite of

communications and public awareness activities, including articles and other publications, workshops, discussion forums, presentations, seminars, laboratory visits, training events, and fellowship awards.

Marketing *BecA* to potential investors needs to be underpinned by in-depth knowledge of the policies and programming priorities of each target investor. For example, in relation to potential investors in the development community, activities include: Presentations to selected development agencies, including identifying possible synergies between current and future investors in the financing of the overall program at the *BecA Hub*, regional nodes and other laboratories participating in the *BecA* network; targeted communications about progress and successes; and an easily accessible information service for investors, provided via the web at (www.biosciencesafrica.org) and other media outlets.

Similarly, in communicating with potential investors and other stakeholders amongst African governments, and regional organizations, including NEPAD and the African Union, communications need to be targeted toward describing how *BecA* contributes to meeting the needs and expectations of particular countries, and the overall development goals of Africa's leaders, nationally, regionally and Africa wide.

In regard to communicating with the *science funding agencies*, in Africa and globally, the communications activities need to be focused on *BecA*'s ability to facilitate and deliver high quality and innovative science in Africa.

Forming opinions, managing the expectations of different groups of stakeholders, and addressing perceptions about *Biosciences eastern and central Africa* will be important tasks, especially in the early days of *BecA*.

9.4 Communications and Public Awareness Program

Communications Goals

Rapid developments in information and communication technologies are creating new opportunities for access to information and knowledge, including support for data-intensive scientific research programs. *BecA*'s communication and information management program aims to achieve the following goals:

- Integration of communications into all aspects of *BecA*'s program of activities;
- Building a communication program to enhance relationships with stakeholders and other partners, thereby building confidence among partners and stakeholders;
- Ensuring development of interactive communication pathways with dissemination and feedback mechanisms.

To achieve these goals, *BecA* will invest in its communications program. *State-of-the-art* research needs *state-of-the-art* communication to achieve impact. The key message is that *Biosciences eastern and central Africa* is about purposeful science for Africa's development. *BecA* is initiating a phased communications program as outlined in *Box 9.1*.

Strategic Alliances for Communications Activities

In developing its communications program, *BecA* will seek to cooperate, and where appropriate to partner with other entities communicating about agricultural research, biotechnology and biosciences, in Africa and globally. Possible communications partners in Africa include national agricultural information centers, and regional or international entities.

Languages and Means of Dissemination

The intention is that the communications products will be available in print, on disc and on the web, and in English and French, initially. Articles targeted at rural communities in eastern and central Africa will also be written in the appropriate African language.

Box 9.1 BecA Communications Program Activities

Phase One (2003-2004 and ongoing)

BecA Brochure

- Describes concept of *Biosciences eastern and central Africa* (also available online)

Web site: www.biosciencesafrica.org includes

- News, reports, presentations, announcements, recruitment and procurement opportunities.
- Maintaining database of key documents in BecA's development.
- Links to related web sites (e.g. NEPAD, CIDA, ILRI, and others).

News articles, press releases

- Articles on various BecA activities, appearing in newspapers and magazines in Africa, and on web sites such as SciDevNet.

Phase Two (2005 onwards)

BecA flyers

- Short description of facilities and services available through BecA.
- Other short topics, such as "20 Questions about Biosciences in Africa."

BecA Newsletter

- Regular newsletter distributed to research partners, investors and other stakeholders, with summary of key developments and feature article (available in print and online, and in English and French).

Briefing Notes targeted at various stakeholders, such as

- *Policy / advocacy briefs* targeted at political supporters (eg. NEPAD, G8).
- *Investor briefs*, targeted at current and future investors.
- *Community briefs* targeted at rural and urban community stakeholders and civil society, explaining concept of mobilizing biosciences for sustainable development and the potential risks and benefits of new technologies.

News articles, press releases, press kits, visitors packs

- Regular articles available for newspapers, magazines and for posting on web sites.
- Visitors packs.
- Press kits, with key contacts list.
- Facilitating access by journalists to stakeholders for interviews on key topics.

Phase Three (2006 onwards)

In addition to continuing with the BecA newsletter, briefing notes, news articles, and press briefings, as above, more attention will be given to communicating the outputs of the research and capacity building and training programs, and to assisting scientists in areas such as literature review, proposal writing and publication of results.

Scientific publications

- Research reports and publications in on line and print journals
- Extension publications about new technologies
- Workshop and seminar proceedings
- BecA Business plan and Annual Report
- Access to data bases, to facilitate research, capacity building and training
- Science writing courses, to assist scientists in the region in the preparation of project proposals, and in the preparation of research results for publication

Other media

- As the BecA program expands, there are likely to be stories emerging that are suitable for dissemination through radio and television, in Africa and globally.

Issues management

- Fact sheets, media responses prepared in relation to specific queries or emerging issues.

Posters

- *Posters* illustrating the contribution of biosciences to Africa's development will be useful to support BecA's participation in workshops, farm days, scientific conferences, etc. They may also be used as wall illustrations in the BecA Hub and Secretariat, regional nodes and other laboratories in eastern and central Africa.

Multimedia, interactive and traveling displays

- *Multimedia and interactive displays* on the role of biosciences in Africa may form part of a public awareness program, on the role of science and technology in Africa. For example, an attractive and educational display on site at the Hub laboratories could be a focus for visits by school children, farmers and other community groups. The displays also could be replicated in other countries in the region.
- *Traveling shows:* For example, a biosciences display could be included on the medical train that moves through eastern Africa, visiting schools and rural communities; other carefully prepared traveling shows on aspects of biosciences, food and agriculture could be developed for schools, women's groups, refugee groups and others with limited access to science and technology in Africa.

10. Governance and Management

10.1 New Institutional Arrangements

Developing new ways of organizing and managing science is an important feature of *Biosciences eastern and central Africa (BecA)*. A key institutional challenge is to find ways that permit effective sharing of facilities, equipment, and other resources among countries, institutions, and other partners in the region.

Innovative governance and management arrangements will enable scientists from many countries and institutions to share first-class facilities and equipment, and use these to develop solutions to problems affecting the livelihoods of millions of people across Africa.

10.2 Context

The conceptualization of the governance and management of *BecA* revolves around three themes:

- How will the *BecA hub* be organized, including the infrastructure and facilities, strategic planning, and the relationship with ILRI as the host and with NEPAD?
- How will the *BecA hub* and other participating laboratories in the *BecA* network work together; and how will *BecA* work with other NEPAD biosciences initiatives elsewhere in Africa and with other stakeholders?
- How will discovery and delivery activities be managed?

Key elements for effective governance, management and functioning of a center of excellence were discussed during the consultative workshop with stakeholders on the design of *BecA* in January 2004, in Nairobi, Kenya.

These elements, as described by Smith (2004) are:

- Clear, inclusive, responsive, and iterative governance system.
- Clear mechanism for distribution of internal (and external) funds.
- Active management of research coordination.
- Focused educational development and systematic student support.

- Focused internal formal and informal interactions.
- Clear lines of communication and interaction amongst centers of excellence.
- Wide range of partners and collaborators.

Governing principles

The following governing principles were taken into consideration in the design of the governance and management of *BecA*:

- Simple, non-complex structure.
- Transparent decision-making.
- Minimal and sustainable running costs.
- Inclusive ownership by stakeholders.
- Easily accessible or open to stakeholders.
- Flexible in decision-making, but with certainty.
- Diverse representation by gender, country, stakeholder groups, and international outlook.
- Co-evolution of procedures, policies, and processes.
- Relevant to the science and applications, and knowledge intensive.

10.3 Stakeholders

Before defining the governance structure, identification of the stakeholders of *BecA*, and how they would participate in the governance and management of *BecA* was seen as important and vital. The Task Team on Governance and Management identified four categories of stakeholders:

- Political and policy support, including:
 - o African Union (AU).
 - o New Partnership for Africa's Development (NEPAD).
 - o National policy- and decision-makers.
- Resource supporters, including:
 - o Investors.
 - o Developmental partners (donor community).
 - o Regional Economic Communities, including:
 - The Intergovernmental Authority in Development (IGAD).

* Chapter 10 is based on the reports of Task Team One on Governance and Management, (chaired by iSc member, Dr Rose Kingamkono), and commissioned papers by Dr Patricia Mbote (2004) and Dr James Smith (2004), all of which are available as resource documents. The proposed governance and management arrangements are contained in an accompanying set of draft contractual agreements.

- The East African Community (EAC).
- Research network partners and users of *BecA*, including:
 - o The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA).
 - o Advance Research Institutions/Institutes.
 - o National Agricultural Research Institutions.
 - o CGIAR/ Future Harvest centers.
 - o Universities.
 - o African scientists.
 - o Innovators.
- Users of S&T, including:
 - o Private sector/industry
 - o Farmers
 - o Consumers
 - o Nongovernmental Organizations (NGOs)

10.4 Participation

Participation in *Biosciences eastern and central Africa (BecA)* is open to national, regional, and international institutions, and public and private organizations that agree to contribute toward achieving the mission of *Biosciences eastern and central Africa* through their participation and/or support of its program and activities. Participation may be through activities and services conducted at the *BecA Hub*, other regional nodes and/or through other laboratories and organizations participating in the *BecA* network. The terms and conditions of participation will be determined by the Steering Committee.

Box 10.1. BECA Steering Committee: Terms of Reference and Scope

Functions of the Steering Committee: Responsible for the governance and oversight of *BECA*. The Steering Committee will:

- Appoint the *Network Coordinator* as chief executive officer.
- Appoint the senior management team.
- Appoint the Scientific Advisory Committee.
- Appoint an Executive Steering sub-Committee and the Executive Finance sub-Committee.
- Oversee the Management team in the management, administration and furthering the mission and objectives of *BecA*.
- Oversee the development of strategic plans in the short, medium and longer term.
- Oversee the resource mobilization and stewardship of the funds.
- Appoint the auditors.
- Oversee periodic reviewing, monitoring and evaluation of the quality and relevance and overall operations of *BecA* to ensure compliance with the set benchmarks and objectives.
- Ensure an appropriate balance and synergy between the core, strategic, and other research programs.
- Ensure compliance with statutory requirements.

Appointment of members of the SC: The Chairperson and members of the SC will be appointed by and report to the Members of the *BecA* Network, as set out in the *BecA* Establishment Agreement

Term of service: The Steering Committee members will serve for a period of three (3) years, renewable once, and a maximum of six (6) years with overlapping or staggered retirement of members for continuity. The Chair of the Committee shall serve for a maximum of three years and shall be rotated between countries.

Operations of the Steering Committee: The Steering Committee will meet bi-annually for major executive and policy decisions, and discussions dealing with strategic and relevant issues. Speedy decision-making shall be devolved to the Executive Steering sub-Committee described below.

The Executive Steering Committee (ESC) is a sub-Committee of the Steering Committee made up of up to seven people and appointed by the Steering Committee from among themselves, to which the SC shall delegate some of its functions. The ESC will be responsible for the functions of the SC between meetings and shall report to the SC at subsequent meetings. The ESC will meet at least quarterly.

The Executive Finance sub Committee (EFC) will oversee financial matters and report to the SC. The EFC will meet at least quarterly.

10.5 Steering Committee

Biosciences eastern and central Africa will have independent governance with a Steering Committee of up to 12 members. The members will include representatives from NEPAD, and the African Union, East African Community (EAC), the Forum for Agricultural Research in Africa (FARA), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), ILRI; members coming from the *Hub* and Secretariat host country (Kenya) and other countries of eastern and central Africa, and from other relevant entities, including civil society, the scientific community and

the investors. The Terms of Reference and scope of the Steering Committee are given in *Box 10.1*.

10.6 Scientific Advisory Committee

The Steering Committee has access to independent scientific advice through a Scientific Advisory Committee, which will include members from Africa and from the international scientific community. The terms of reference and scope of the committee are given in *Box 10.2*.

Box 10.2. *BecA* Scientific Advisory Committee: Terms of Reference and Scope

The *BecA* Steering Committee will be advised by a Scientific Advisory Committee on scientific and technical matters relating to the Activities, including capacity building and training activities and research projects hosted by *BecA*.

Functions: The Committee will be responsible for the oversight of *BecA*'s program through the following activities:

- Setting up regulations/standards for quality scientific proposals.
- Overseeing the peer reviewing and selection process of proposals and approving/ endorsing for funding.
- Undertake monitoring and evaluation of ongoing projects.
- Work with the Steering Committee in formulating the scientific strategies and training.
- Work with the Steering Committee in developing fund-raising strategies.

Membership: The committee will be made up of seven persons appointed by the Steering Committee. Their appointment will be in their individual capacity and based on international standing and reputation, track records and recognition in fields relevant to *BecA* activities, including biosafety. The composition of the Committee will also be cognizant of geographic and gender dimensions.

Term of service: The members will serve for a period of two years renewable once, for a maximum of 4 years, with overlapping or staggered retirement of members for continuity. They will elect one member from among themselves to be Chair. The committee will meet as frequently as necessary to perform its functions, but not less than twice a year.

The Chair of the SAC shall report to the SC at each SC meeting.

10.7 Network Coordinator and Secretariat

The day-to-day management of *BecA* is the responsibility of a small secretariat located at the *BecA Hub*, and led by a *Network Coordinator* as chief executive officer. The Network Coordinator and other secretariat and scientific staff members reflect the diversity of the African scientific community. The Network Coordinator is selected and appointed by and reports to the Steering Committee.

The functions of the Network Coordinator shall include but not be limited to:

- Directing the scientific and administrative activities of *BecA*.
- Managing, administering and furthering the vision, mission and objectives of *BecA*.
- Leading the management team.
- Implementing all decisions of the Steering Committee.
- Serving as the Secretary to the Steering Committee and the Scientific Advisory Committee.

The specific responsibilities of the Network Coordinator are to:

- i. Provide leadership to all components of *BecA* Network;
- ii. Provide day-to-day management of *BecA Hub* and Secretariat.
- iii. Liaise with Members;
- iv. After consultation with the Science Advisory Committee, enter into *BecA* Project Agreements with Participants for the conduct of Activities;
- v. Ensure that *BecA* Resources are used in accordance with the Annual Budget and any directions of the Steering Committee;
- vi. Monitor and keep the Steering Committee and Members informed of Activities;
- vii. Prepare reports required by donors;
- viii. Prepare draft Annual Budgets and Business Plans and submit them to the Steering Committee for approval;
- ix. Advise the Steering Committee on the appointment of the Thematic Program Leaders and other *BecA* secretariat staff;

- x. Identify new research opportunities;
- xi. Authorise public statements about *BecA* in accordance with Steering Committee guidelines;
- xii. Inform NEPAD on progress in activities;
- xiii. Identify opportunities to link with and coordinate activities with other bioscience 'centres of excellence', networks, and programs, including those sponsored by NEPAD in other regions in Africa; and
- xiv. Carry out any other duties delegated by the Steering Committee.

10.8 Financial Management

All *BecA* funds will be deposited in *BecA* designated account(s) at ILRI, and there will be three signatories to any *BecA* financial transaction. The Steering Committee will form an Executive Finance sub Committee (EFC) to oversee financial management issues and audit requirements. All *BecA* accounts, records, and documents will be open for annual auditing by an Auditor appointed by the Steering Committee, in consultation with the EFC and ILRI and conducted preferably in conjunction with ILRI's annual external audit.

10.9 Relationship of *BecA* to the Hub and Secretariat Host Institution (ILRI)

- ILRI will host the *BecA Hub* and Secretariat on its campus in Nairobi, Kenya;
- ILRI will be a founder member of *BecA* by becoming a signatory of the *BecA* Establishment Agreement and will be represented in the Steering Committee as the Host of the *BecA Hub* and Secretariat;
- ILRI will also be represented in the Executive Finance sub Committee (EFC), a committee that will work in closely with the Management team in preparation and management of financial matters, preparing the annual budget, and organizing fund-raising activities;
- ILRI laboratories on the ILRI campus in Nairobi will be upgraded to state-of-the-art research facilities and ILRI will make these Premises accessible to the African research community;

- The terms, conditions, costs, and means of access of *BecA* are set out in specific contractual arrangements between the *BecA* Steering Committee and ILRI.

10.10 Relationship of *BecA* with NEPAD

- The *BecA* network will have independent governance, with regional ownership and leadership provided by means of a *BecA* Steering Committee, which is the autonomous governing body of the *BecA* network, and reports to the Members.
- The *BecA* Network is one of four networks of centers of excellence in biosciences in Africa being established by NEPAD and its partners. NEPAD shall be permanently represented on the Steering Committee.
- NEPAD is carrying out feasibility studies for other centers of excellence in biosciences in other regions of Africa, and identifying priorities and mechanisms to form a Pan-African network in biotechnology and biosciences across Africa.
- NEPAD, as a mediator of nations and stakeholders, shall assist *BecA* in mobilizing political and financial support and awareness creation about *BecA* to policy and decision-makers in African governments and with international partners.
- The Steering Committee of *BecA* shall report to NEPAD about the outputs and outcomes of its activities.

10.11 Contractual Arrangements for the Establishment and Operation of *BecA*

Nature: *Biosciences eastern and central Africa* (*BecA*) consists of a *Hub* located on the campus of the International Livestock Research Institute (ILRI) in Nairobi, Kenya, that will provide a common biosciences research platform, research-related services and capacity building and training opportunities; and a *network of regional nodes and*

other laboratories distributed throughout eastern and central Africa for the conduct of research on priority issues affecting Africa's development. *BecA* is being established amongst a group of cooperating institutions that agree to make their facilities available for regional use and/or who support the sharing of such facilities amongst the African scientific community.

BecA's unique feature is the establishment of a *shared research platform* with first class research facilities, including state of the art laboratories, high end computing and bio-containment facilities, able to be accessed by the African scientific community; as well as research-related services and capacity building and training opportunities. The platform provides a means to assemble at the *hub* a critical mass of human, financial and scientific resources to enable cutting edge research to be undertaken in Africa.

Contractual Arrangements

The founding members and sponsors of *Biosciences eastern and central Africa* encourage greater access to biosciences facilities and equipment available in the region. This principle underpins the formal contractual arrangements, which aim to be simple, with the overall purpose of the initiative in mind.

The contractual arrangements include an establishment agreement amongst a number of parties to establish *BecA* as a network, consisting of a *Hub*, regional nodes and other participating laboratories and institutions. The main agreement sets out the broad modalities of the network, including the role and responsibilities of ILRI as Host of the *BecA Hub* and Secretariat. It is complemented by specific contractual agreements relating to the roles, responsibilities, and accountabilities of the institutions hosting the *regional nodes*. The operation of individual projects is governed by specific Project Agreements. The proposed suite of agreements is given in *Box 10.3*.

The *BecA* draft contractual agreements are available from the *BecA* secretariat for consideration by potential members and participants in the *BecA* Network.

Box 10.3. Biosciences eastern and central Africa: Contractual Agreements

Contract	TORs/ Scope of Agreement
1. <i>BecA</i> Establishment Agreement amongst members	<ul style="list-style-type: none"> • Contractual arrangement amongst parties to establish the <i>BecA</i> network • Sets out legal agreements amongst a number of parties who form the network (as members of a joint venture) • Sets out roles and responsibilities and obligations of various parties • Sets out ILRI's role and responsibilities as host of the Hub and Secretariat • Accountabilities of ILRI to <i>BecA</i> Steering Committee
2. <i>BecA</i> Regional node-hosting Agreements (<i>BecA</i> /Regional Node Host Institution)	<ul style="list-style-type: none"> • Regional node hosting institutions – roles and responsibilities • Accountabilities to <i>BecA</i> Steering Committee
3. Project Agreements (<i>BecA</i> /Participants)	<ul style="list-style-type: none"> • Project Principal investigator(s) /lead institutions • Roles and responsibilities of specific projects and participants • Project scope, activities and budget • Accountabilities
4. Contribution Agreements	<ul style="list-style-type: none"> • Sets out contribution arrangements for support of <i>BecA</i> Activities by various parties

10.12 Risk Assessments and Risk Management

Environmental assessments: An environmental impact assessment (EIA) and strategic environmental assessment (SEA) have been undertaken during the design phase in 2004/05. Details of the process are at: http://www.pharmeng.com/new_web/Biosciences.htm

Biosciences eastern and central Africa will comply with national and international standards in the handling of intellectual property, biosafety and other regulatory procedures. As a result of the environmental risk assessment (EIA) and the strategic environmental assessment (SEA), risks and liabilities are being assessed and a risk management plan prepared during the design phase in 2005.

The EIA and SEA reports are available as separate documents for consideration. The preliminary assessments of the SEA have been taken into account in the preparation of the *BecA* draft contractual agreements in March 2005.

10.13 Monitoring and Evaluation

Biosciences eastern and central Africa takes a focused approach, through a series of hosted projects and competitive fellowship awards. The projects and fellowships focus on innovative ways to apply modern biology to solve current agricultural problem in eastern and central Africa. The focus is on projects that contribute toward resolution of priority problems as identified by national and regional organizations.

Indicators of Success

Investing in scientific research, capacity building and training is long-term, sometimes taking many years to realize measurable economic impact through new technologies. Intermediate evidence could include other quantitative indicators such as:

- Number of scientific publications produced as a result of research activities.
- Number of additional African scientists involved in first-class research projects.

- Number of additional African women involved in scientific research.
- Number of opportunities for young graduates to develop a research career in Africa.
- Number of partnerships formed with first-class laboratories and research groups elsewhere in Africa and globally.
- Attraction of complementary funding.
- Number of intermediate technologies available for immediate use.
- Positive impact on women and young people in Africa.

Impact on African Agriculture and Sustainable Development

A monitoring and evaluation system will be put in place to monitor the achievements of *BecA*. This includes monitoring the responsible use of inputs, the delivery of intended outputs, and, most importantly, the use of these outputs in ways to achieve outcomes that lead to increased food security and improved livelihoods of resource-poor people in Africa. These requirements are further elaborated in the log frame.

11. Financial Strategy

11.1 Overview

Key considerations in developing a strategy for the sustainable financing of *BecA* are:

1. What resources are required to underpin the ongoing operations of *BecA*, beyond the design and early implementation phase in 2005?
2. How can the necessary resources be mobilized?
3. How should the financial resources be managed?

This section summarizes the current financial situation for the *BecA* design (definition) phase (2004/05), the proposed allocation of funds for the implementation phase (2005/07), and the resource requirements for the development phase (2007/09).

11.2 Design Phase - 2004 /05

In October 2003, NEPAD and ILRI signed a formal memorandum of understanding that launched the "Biosciences Facility" as a centre of excellence in Nairobi, and provided the contractual framework through which ILRI will host the *Hub* facility. An initial contribution of CAD\$4.5 million has been received from the Canada Fund for Africa to support the initial definition phase, which will focus on the governance and management framework for *BecA*, completing the environmental assessment, developing a complete technical construction plan for the implementation phase, defining the research agenda, and developing policies to guide bioscience technology research and use. Budget details for Canadian Contribution 2004-05 are given in Table 11.1.

In the evolution of the *BecA* concept, this facility is envisaged as being the *BecA Hub* that is linked with and provides capacity building and training activities and research services for a network of regional nodes and other participating laboratories throughout eastern and central Africa.

During the design phase, other support has been provided through the CGIAR Generation Challenge Program, the Gatsby Charitable Foundation, the Rockefeller Foundation, the Syngenta Foundation for Sustainable Agriculture and the Doyle Foundation. This support includes means for capacity building and training, communications activities, and funds for the identification of potential research projects

to be hosted by *BecA*, including the identification of African scientists able to act as project leaders and champions in Africa.

11.3 Implementation Phase – 2005/07

The Government of Canada has pledged a further CAD\$25.5 million from the Canada Fund for Africa (CfA) to establish this center of excellence in Biosciences for eastern and central Africa (*BecA*), subject to the satisfactory completion of the design phase requirements and the approval of the Treasury Board.

An indicative budget has been prepared for the implementation phase in 2005-07, (*Table 11.2*). This covers the costs of establishing and managing the facilities at the *Hub*, including the purchase of new equipment needed to establish the core competencies (as detailed in Chapter 7), and the operation and maintenance of this equipment; plus a substantial capacity building and training program. High priority is also being given to establishing a bioinformatics network in eastern and central Africa, so that the *Hub*, regional nodes and other participating laboratories in the network are linked and able to exchange data with one another, and are also able to access international databases. Substantial investments are being made in computer hardware and software during the design phase to start this bioinformatics network in eastern and central Africa. (see www.becabioinfo.org).

There is also a component for NEPAD regional activities (as identified during the design phase). Their purpose is to catalyse linkages amongst the laboratories, participating in the *BecA* network, within eastern and central Africa, and with other NEPAD-sponsored centers of excellence in other regions of Africa. This is to facilitate the development of a functioning Pan-African biosciences network, with connectivity and ability to utilize new knowledge to achieve outcomes important to Africa's development.

An early opportunity to establish such linkages and use them to work on specific research projects is in bioinformatics. An African bioinformatics network will consist of a group of interconnected laboratories in several countries of Africa having the human capacity and the necessary hardware and software to be able to analyze, interpret and utilize the large

amounts of data coming from genomic research. The Africa bioinformatics network will also be linked with the leading bioinformatics centers globally, and able to access their databases. These include leading centers in North America (e.g. Cold Spring Harbour in the USA) and Europe.

11.4 Development Phase 2007 /09

Areas of ongoing costs

Once *BecA* is fully operational as a regional center of excellence in biosciences, there is a need to ensure that there are sufficient funds available and able to be mobilized to cover the annual (recurrent) operating costs, invest in additional capital expenditure (equipment) to maintain the laboratories at the cutting edge in the fast moving field of biosciences, and continually invest in people and new opportunities through a capacity building and training program.

Mobilizing the resources to operate first-class biosciences laboratories in Africa on a long-term basis is a challenge that the proponents of *BecA* take seriously. Indeed the design phase is looking not only at the facilities and equipment that are desirable to meet the current needs, but also what is practicable to sustain them in the long term.

The ongoing costs are associated with three main areas:

1. ***BecA facilities and equipment, including containment facilities and biosafety:*** The functioning and maintenance of the facilities and equipment, including upgrading as necessary to maintain the current core competencies and research-related services (as described in Chapter 7); the costs include operating containment facilities and other biosafety-related services. The current budget estimates are based on the assumption of having an additional 50 scientists (or fulltime equivalents) at the *Hub* site each year.
2. ***BecA Secretariat staff and management costs,*** in order for *BecA* to have continuity in scientific leadership, and access to expertise in specialized areas of science, communications, and product development and delivery mechanisms.
3. ***Capacity building and training,*** so that *BecA* continues to contribute to the development of

human capacity in biosciences in Africa. As the participants in current biosciences programs in Africa (such as those supported by NEPAD, ASARECA, BIOEARN, the Rockefeller Foundation, amongst others) and the *BecA* program gain experience, the strength of regional nodes and other participating laboratories in the *BecA* network will grow. These laboratories will also need continuing investments in staff, facilities, and equipment. *BecA* could play a useful role in catalyzing investment from a consortium of donors to support capacity building at the *BecA Hub*, regional nodes and other participating laboratories who are contributing to regional needs.

Estimate of annual costs: 2007/ 09

Based on current estimates, the annual costs of operating the *BecA Hub* are likely to be in the order of US\$3 million pa. An additional US\$1 million per year is required to continue a strong capacity building and training program beyond 2007. This program will continue to give special emphasis to increasing the role of women in agriculture, and in science and technology in Africa. Targeted awards will be available to increase science capacity in post-conflict countries. An estimate of costs and indicative annual budget for *BecA* activities in 2008 is given in *Table 11.3*.

11.5 Financial Principles for Projects

It will be important for *BecA* to establish and adhere to clear financing principles. These should include the requirement that all projects:

- Have a financing plan and be fully funded; no project will be started until it has adequate financial support.
- Have project grant agreements in place
- Have a separate 'project account' and an authorizing officer.
- Be subject to regular review, not only of the science but also of the financing plan.

11.6 Mobilizing Financial Resources

The sources of finance to sustain *BecA* will come mainly from the following sources:

Project overheads

The operational procedures being established for *BecA* propose that each project hosted by *BecA* will contribute toward the overall running costs of the *BecA Hub* by paying an agreed overhead charge and direct costs.

As *BecA* becomes fully operational, and if it is well marketed through an active communications program, the volume of hosted projects is likely to increase. In order to reach this target, *BecA* will need to invest early in assisting scientists in the region in preparing research proposals for funding, not only from development agencies but also from science-funding agencies.

Income from fees for services

Other sources of income may come from fees for services; bench fees from short-term users of the facilities; and income from hosting seminars and workshops for external users.

11.7. *BecA* Challenge Fund

BecA Challenge Fund for capacity building and research

The capacity building component of *BecA* may be attractive to investors, and financed through a proposed *BecA* Challenge Fund. For example, a 10-year capacity building program for biosciences in eastern and central Africa could be financed with US\$10 million, as a draw down fund. These funds could be based on contributions to a Trust Fund, and/or multiyear commitments to an agreed program and achievement of milestones.

There is a need to facilitate early access by African scientists to the new regional biosciences facilities and services. A Challenge Fund, where financial support would be available to scientists on a competitive basis for work in Africa, will assist access and start up of activities. A Challenge Fund is especially important in the early stages, while scientists and institutions in Africa are seeking longer term support through nationally and internationally financed projects, from both the development community and science funding agencies.

The Challenge Fund will:

- Fund African scientists on a competitive basis, for thesis research, postdoctoral fellowships, and/or as principal investigators for specific projects.
- Specifically target awards toward women and young scientists, and to those from post-conflict countries in Africa.
- Ensure scientific leadership is available for *Biosciences eastern and central Africa* through supporting scientists with a mix of competencies and experience. This will ensure that mentors are available to younger scientists undertaking research and postdoctoral studies.
- Support short-term training courses and master classes on specific topics, where there is demonstrated need in the region.
- Provide small grants to assist with proposal preparation.
- Encourage proposals with links to colleagues in national agricultural research institutes and universities in Africa, international research institutes, and/or the international scientific community.

The Terms of Reference for the establishment of the Challenge Fund will be set by the *BecA* Steering Committee. The Scientific Advisory Committee will provide independent advice to the Steering Committee on the allocation of grants from the Fund.

Table 11.1 BeCA Budget for the Definition Phase 2004-05

Estimated Budget in Canadian Dollars – Definition Phase

1. Governance and Management

a. Support to the design phase of Biosciences Initiatives in other regions (NEPAD)	\$500,000
b. Coordination and management	\$200,000
c. Monitoring and evaluation	\$100,000
d. Public awareness, business development and community liaison	\$200,000

2. Facilities

a. Technical design (including architect, engineer, specialists in biosafety and biocontainment)	\$700,000
b. Consultancy services	\$100,000

3. Equipment

\$1,800,000

- a. Information technology and bioinformatics
- b. General laboratory equipment
- c. Sequencing and genotyping
- d. Proteomics and analytical tools
- e. Installation costs, maintenance and service contracts

4. Building and/or Strengthening the Research Capacity

\$400,000

- a. Training fund
- b. Competitive Grants for research
- c. Research Grants for young women scientists

5. Environmental Impact Assessment

\$500,000

TOTAL CAD\$ \$4,500,000

Table 11.2 BecA Implementation Phase – Indicative Budget- Summary 2005-07 (USD k)

Position	2005	2006	Total 2005+2006
1. Scientific support, Management, Governance	1,000	1,000	2,000
2. Hub site, Laboratories refurbishment (labs, biosafety facilities, greenhouse, student facilities)	3,500	3,500	7,000
3. Equipment and Maintenance (related to core competencies)	1,500	1,500	3,000
4. Research Support for BecA Members and Participants (activities, research, technical services, communications, regional nodes)	1,000	1,000	2,000
5. Capacity Building and Training Activities (fellowships, training courses, challenge fund etc)	1,500	1,500	3,000
6. NEPAD Regional Network Activities	1,000	1,000	2,000
7. Management Fee to ILRI (5%)	450	450	900
And Contingency	250	250	500
Grand Total Biosciences (US\$)	10,200	10,200	20,400
(Can @ USD 0.80)	12,750	12,750	25,500

Table 11.3 *BecA* Development Phase – Indicative estimates of annual budget for development phase (USD k)

	2008
1. <i>BecA</i> hub, secretariat, scientific resources	
<i>BecA</i> hub and secretariat costs: scientific and technical support staff to maintain core competencies; management, governance costs;	1,000
2. <i>BecA</i> hub facilities and equipment- operation, maintenance	
(Regionally shared facilities for labs, biocontainment, greenhouse, etc related to core competencies)	1,000
3. Research Support for <i>BecA</i> Members and Participants	
(activities, research, technical services, communications, regional nodes)	1,000
4. Capacity Building and Training Activities	1,000
(fellowships, training courses, challenge fund etc)	
Total <i>BecA</i> annual estimate of costs (USD k)	4,000

PART THREE: ANNEXES

Annex A

Glossary of Terms

Bioinformatics: the assembly of data from genomic analysis into accessible forms.

Diagnostics: fast and accurate identification of pathogens based on molecular characterization of the pathogens.

Genomics: the molecular characterization of all the genes in a species.

Functional genomics is the knowledge that converts the molecular information represented by DNA into an understanding of gene functions and effects. Functional genomics also entails research on the protein function (*proteomics*) or the whole metabolism (*metabolomics*) of an organism.

Insertion mutants are mutants of genes that are obtained by inserting DNA, for instance through mobile DNA sequences, transposons. In plant research, the capacity of the bacterium *Agrobacterium* to introduce DNA into the plant genome is also employed to induce mutants.

Gene sequencing/genotyping

Gene chips (also called **DNA chips**) or **microarrays**. Identified expressed gene sequences of an organism can be placed on a matrix as expressed sequence tags or synthesized oligonucleotides. If a sample containing DNA or RNA is added, those molecules that are complementary in sequence will hybridize.

High throughput (HTP) screening makes use of techniques that allow for a fast and simple test on the presence or absence of a desirable structure, such as chemically specific DNA sequences or expression patterns of genes.

Shotgun genome sequencing is a strategy by which small pieces of DNA are randomly sequenced. The huge amount of sequences obtained have considerable overlaps and by using appropriate computer software it is possible to puzzle together sequences and align them to build larger units of genetic information.

Single nucleotide polymorphisms (SNPs) are the most common type of genetic variation used as specific markers. SNPs are stable mutations consisting of a change at a single base in a DNA molecule.

Gene technology

Modern biotechnology means the application of: a) In vitro nucleic acid techniques, including recombinant DNA and direct injection of nucleic acid into cells or organelles; or b) Fusion of cells beyond the taxonomic family, that overcome natural physiological reproductive or recombination barriers.

Transformation means introduction into an organism of single (or multiple) genes conferring potentially useful traits.

Living modified organism (LMO) means any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology, usually through *transformation* (Synonym of **genetically modified organism-GMO**).

Molecular breeding

Identification and evaluation of useful traits using *marker-assisted selection (MAS)*.

Tissue culture

The cultivation of single cells or meristems in the laboratory. Often whole plants can be regenerated from tissue culture. The technique is used in gene technology to regenerate *transformed* cells into *LMOs*.

Vaccine technology: Use of modern *immunology* to develop recombinant DNA vaccines for improved control of animal and fish diseases.

Vectors of livestock diseases

Cultivation of ticks and tsetse flies, as aids for the study of tick-borne diseases and trypanosomes that are carried by tsetse flies and cause diseases in cattle and humans.

Acronyms and Abbreviations

AATF	African Agricultural Technology Foundation	IAC	Inter-Academy Council
ABSF	African Biotechnology Stakeholders Forum	IARC	International agricultural research center
ADEA	Association for the Development of Education in Africa	ICIPE	International Centre for Insect Physiology and Ecology
AFSTD	African Forum on Science and Technology for Development	ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ARPIS	African Regional Postgraduate Programme in Insect science	IFPRI	International Food Policy Research Institute
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa	IFS	International Foundation for Science
AU	African Union	IGAD	Intergovernmental Authority in Development
BAC	Bacterial artificial chromosome	IITA	International Institute of Tropical Agriculture
BIOEARN	East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development	ILRI	International Livestock Research Institute
CABI	CAB International	ISAAA	International Service for the Acquisition of Agri-biotech Applications
CFA	Canada Fund for Africa	KARI	Kenya Agricultural Research Institute
CGIAR	Consultative Group on International Agricultural Research	LMO	Living modified organism
CIDA	Canadian International Development Agency	MAB	Marker assisted breeding
EAC	East African Community	MDGs	Millennium Development Goals
EIA	Environmental Impact Assessment	NARIs	National Agricultural Research Institutes
ELISA	Enzyme-Linked Immunosorbent Assay	NARS	National agricultural research system
FAO	Food and Agriculture Organization (UN)	NEPAD	New Partnership for Africa's Development
FARA	Forum for Agricultural Research in Africa	NGO	Nongovernmental organization
FAWE	Forum for African Women Educationalists	NIRS	Near Infrared Spectroscopy
FPLC	Fast performance liquid chromatography	PCR	Polymerase chain reaction
G8	Group of Eight (Leaders of Canada, France, Germany, Italy, Japan, Russia, United Kingdom, United States and representatives of the European Union)	R&D	Research and development
GMO	Genetically modified organism	SEA	Strategic Environmental Assessment
		SNPs	Single nucleotide polymorphisms
		SSRs	Simple sequence repeats (microsatellites)
		USAID	United States Agency for International Development
		WSSD	World Summit on Sustainable

Annex B

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Useful Websites for Further Information

African Biotechnology Cassava Consortium (ABCC)
<http://www.biosciencesafrica.org/cassava/index.html>

African Forum on Science and Technology for
Development (AFSTD) <http://www.nepadst.org>

Agenda 21 and Programme for Further
Implementation of Agenda 21
[http://www.un.org/esa/sustdev/documents/agenda21/
index.htm](http://www.un.org/esa/sustdev/documents/agenda21/index.htm)

Association for Strengthening Agricultural Research
in Eastern and Central Africa (ASARECA)
<http://www.asareca.org>

African Sorghum/Millet Annotation and Improvement
Consortium (ASMAIC)
<http://www.biosciencesafrica.org/asmaic/index.html>

Biosciences eastern and central Africa (*BecA*)
<http://www.biosciencesafrica.org>

BecA Bioinformatics Platform <http://www.becabioinfo.org>

Canada Fund for Africa
<http://www.acdi-cida.gc.ca/canadafundforafrica>

Doyle Foundation <http://www.doylefoundation.org>

Future Harvest <http://www.futureharvest.org>

Gatsby Charitable Foundation <http://www.gatsby.org.uk>

G8 Gleneagles 2005 <http://www.G8.gov.uk>

International Livestock Research Institute (ILRI)
<http://www.ilri.org>

New Partnership for Africa's Development (NEPAD)
<http://www.nepad.org>

Rockefeller Foundation <http://www.rockfound.org>

Syngenta Foundation for Sustainable Agriculture
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Annex C: FAO crop production statistics for eastern and central Africa (ECA)

Cereals - Area Harv (Ha)

	Burundi	Congo	Eritrea	Ethiopia	Kenya	Madagascar	Rwanda	Sudan	Tanzania	Uganda	ECA Total	Africa Total
Sorghum	57,000	85,000	200,933	1,170,000	145,000	-	171,808	5,500,000	610,000	260,000	8,199,741	24,328,138
Maize	116,000	1,450,000	13,362	1,600,000	1,500,000	190,000	104,628	80,000	1,580,000	660,000	7,293,990	26,767,859
Millet	9,200	55,000	70,000	300,000	92,000	-	5,000	2,440,000	250,000	390,000	3,611,200	20,614,025
Rice	19,200	413,685	-	8,350	11,000	1,350,000	6,423	4,800	401,070	76,000	2,290,528	8,690,099
Wheat	10,000	9,000	20,000	1,000,000	125,000	4,200	12,046	150,000	60,000	8,000	1,398,246	8,228,297
Barley	-	780	43,965	700,000	22,000	-	-	-	2,000	-	768,745	3,858,952

Legumes - Area Harv (Ha)

	Burundi	Congo	Eritrea	Ethiopia	Kenya	Madagascar	Rwanda	Sudan	Tanzania	Uganda	ECA Total	Africa Total
Beans	270,000	198,508	2,000	209,600	630,000	83,000	358,002	13,000	370,000	765,000	2,899,110	4,254,174
Groundnut	12,000	456,590	1,747	16,035	17,000	48,000	15,900	1,900,000	117,000	211,000	2,795,272	10,508,909
Peas	48,000	100,000	3,500	192,682	-	4,600	31,228	-	63,000	27,000	470,010	541,349
Chickpea	-	-	4,000	195,800	55,000	-	-	12,600	64,000	6,300	337,700	532,588
Cowpea	-	-	-	-	100,000	4,600	-	-	147,000	64,000	315,600	8,877,991
Pigeonpea	2,000	-	-	-	150,000	-	-	-	66,000	78,000	296,000	419,400
Soybean	400	29,208	-	7,500	-	50	31,289	-	5,600	151,000	225,047	1,075,675

Vegetative - Area Harv (Ha)

	Burundi	Congo	Eritrea	Ethiopia	Kenya	Madagascar	Rwanda	Sudan	Tanzania	Uganda	ECA Total	Africa Total
Cassava	82,000	1,839,962	-	-	-	352,500	130,457	6,000	660,900	390,000	3,461,819	11,215,373
Sweet potato	124,000	43,889	-	34,027	58,000	94,500	195,370	650	511,300	570,000	1,642,736	2,490,610
Banana	300,000	83,859	-	5,100	80,000	50,000	-	2,300	77,000	135,000	733,259	*1,074,285
Potato	10,000	19,724	5,000	36,736	120,000	49,700	124,972	2,100	80,000	73,000	521,232	1,139,559

* 4,098,963 plantains

Cash - Area Harv (Ha)

	Burundi	Congo	Eritrea	Ethiopia	Kenya	Madagascar	Rwanda	Sudan	Tanzania	Uganda	ECA Total	Africa Total
Fruit	317,500	418,550	350	51,824	204,345	165,150	368,663	119,810	471,700	1,790,594	3,908,486	
Sesame	-	9,300	4,611	58,780	26,000	-	-	850,000	100,000	211,000	1,259,691	1,840,382
Coffee	18,000	100,000	-	260,000	170,000	193,500	28,000	-	130,000	264,000	1,163,500	2,886,613
Cotton	3,658	70,000	-	44,000	50,000	28,500	-	210,000	420,000	250,000	1,076,158	5,432,251
Vegetables	-	-	-	-	-	-	-	-	-	-	894,745	4,808,855
Coconut	-	1,100	-	-	15,000	33,000	-	-	310,000	-	359,100	665,075
Oil Palm	1,200	250,000	-	-	-	1,800	-	-	4,500	-	257,500	4,195,400

