SOUTHERN AFRICAN NETWORK FOR BIOSCIENCES (Sanbio)

BUSINESS PLAN

2006 - 2011

PREPARED BY

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Acronyms and Abbreviations

AATF	African Agricultural Technology Foundation
ABI	African Biosciences initiative
AFSTD	African Forum on Science and Technology for Development
AIDS	Acquired Immune Deficiency Syndrome
AU	African Union
BECA	Biosciences Eastern and Central Africa
BRICS	Biotechnology Regional Innovation Centres
CIDA	Canadian International Development Agency
CSIR	Council for Scientific and Industrial Research
DST	Department of Science and Technology
EFC	Executive Financial Committee
G8	Group of Eight (Canada, France, Germany, Italy, Japan, Russia, UK, USA plus EU)
GDP	Gross Domestic Product
GM	Genetically Modified
GNP	Gross National Product
HIV	Human Immune virus
HR	Human Resource
HRD	Human Resources Development
ICT	Information and Communication Technology
ILRI	International Livestock Research Institute
IPR	Intellectual Property Rights
IKS	Indigenous Knowledge System
JICA	Japan International Cooperation Agency
LDC	Least Developed Countries
MAS	Marker Assisted Selection
MDG	Millennium Development Goals
NEPAD	New Partnership for Africa's Development
NGO	Non Governmental Organization
PI	Principal Investigator
R&D	Research and Development
SADC	Southern African Development Community
SANBio	Southern Africa Network for Biosciences
SC	Steering Committee
SME	Small and Medium Enterprise
S&T	Science and Technology
TSAG	Technical Scientific Advisory Group
TBD	Tick Borne Diseases
UN	United Nations
USA	United States of America
USAID	United States Agency for International Development
WHO	World Health Organization
WSSD	World Summit on Sustainable Development

1 BACKGROUND

1.1 Science and Technology in Africa

The world is changing at a rapid pace, driven largely by developments in Science and Technology (S&T). The benefits of these developments are, however, not shared equitably across the globe, with developing countries significantly lagging behind industrialized nations, which have at their disposal considerable financial and human resources. With industrialized nations continuing to master the tools of S&T, vastly outspend developing nations in research and development, and even capturing essential natural and human resources from developing nations, it is anticipated that, without intervention, the current disparity is likely to grow wider[(1)].

Africa is one of the world's richest regions in terms of natural resources. The continent is blessed with vast mineral wealth, great agricultural capacity, and rich diversity of plants and animals. The continent has, however, seen little of the profits from the exploitation of these natural resources. Africa's economy is heavily based on agriculture, which accounts for about 35% of the continent's Gross Domestic Product (GDP), 40% of its exports and 70% of its employment[(2)]. African agriculture has, however, failed to keep pace with population growth. This is evident from the average yield of major crops (maize, sorghum, millet, rice) in the region which stands at 1.2 tons/ha, compared to 4.9 tons/ha for China and 6.6 tons/ha for the United States. A number of factors have contributed to this decline. These include poor agricultural inputs (fertilizers, irrigation, improved seeds, insufficient diseases and pest management), natural disasters (drought, floods, land degradation), urbanization, overgrazing, over-fishing, heavy reliance on external funding, poor agricultural policies implemented by some governments, and civil conflicts. In 2005, 36 of the listed 50 least developed countries (LDCs) were found in sub-Saharan Africa[(3)].

To ensure food security, a number of measures need to be implemented. These include affordable agricultural inputs; integrated soil, water and nutrient management; good governance by African governments, improving the nutrition and productivity of livestock; achieving environmentally sustainable increases in freshwater and marine aquaculture production, and increasing trade and competitiveness in local, national and global markets. S&T is integral to many of these measures, and consequently to food security and the well-being of all Africans.

S&T is amongst the main drivers of economic growth and development, to the effect that an explicit correlation exists between a country's scientific and technological status, and its economic growth. The role of science and technology in meeting sustainable goals was recognized during the World Summit on Sustainable Development (WSSD) in 2002. In the Plan of Implementation, it was recommended that science and technology be mobilized to solve problems associated with energy deficiency, food insecurity, environmental degradation, diseases, water insecurity and many other sustainable development challenges. The plan calls for the international community's intervention to assist in promoting technology development, transfer and diffusion to Africa, and further develop technology and knowledge available in African centers of excellence, and support African countries to develop effective science and technology institutions and research activities capable of developing and adapting to world class technologies.

S&T, therefore, has a key role to play in national development agendas. Africa's common objectives and commitment to collective actions to develop and use science and technology for the socio-economic transformation of the continent and its integration into the world economy is articulated in the "Consolidated Science and Technology Plan of Action." This plan is based on three interrelated conceptual pillars: (a) capacity building (b) knowledge production, and (c) technological innovation. Africa is, however, encountering serious difficulties in the development of S&T, including a steady decline in R&D investment, political instability, brain drain, obsolescence and dilapidated infrastructure. These circumstances are exacerbated by insufficient levels of literacy, and too few girls and women with S&T education. R&D investment figures available suggest that overall government support for R&D in Africa is one of the lowest in the world (about 0.2 per cent of GNP) with a few exceptions in the region, such as South Africa where the current national expenditure on R&D is about 0.81% of GDP [(4)].

African governments recognise that they need to increase their investment in S&T in order for them to identify and exploit opportunities that will make a significant change in their economies. In the Lagos Plan of Action for the economic development of Africa, member states were urged to aim at reaching the target of mobilizing, at the domestic level, 1% of their GDP for the development of their S&T capabilities within the coming decade. This realisation has come at an opportune time when most of the economic coordination instruments and structures in the region and the rest of the world recognize the importance of developing S&T capacities of the poor countries. To assist African countries in meeting their targets, the African Forum on Science and Technology for Development (AFSTD) was established by the New Partnership for Africa's Development (NEPAD). The AFSTD is a platform on which African countries share experiences on ways and means of leveraging financial resources for R&D. Through this forum, African countries will explore and establish innovative institutional arrangements to mobilize funds for regional R&D activities, and 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 centres of excellence in Africa.
- To develop and adapt information.
- To collect and analyse the capacity to support productivity 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 the natural sciences.
- To assimilate and adapt existing technologies to diversify manufacturing production.

1.2 Bioscience in Africa: Opportunities and Challenges

Bioscience is the study of biological systems. It includes the application of techniques, whether biological or non-biological, to make or modify products or processes and to apply these in biological systems. Bioscience is multidimensional in nature, involving many types of research and innovation. Pharmaceuticals, biologics, bio-agriculture, environmental biotechnology, medical devices, manufacturing and material design are all disciplines that exist under the definition of bioscience.

Biosciences and modern biotechnology in particular, are seen as one of the major engines of growth in the world in fields such as human health, industrial processes and agriculture. This is especially true in the USA, Europe and Japan but Africa lags woefully behind with some notable exceptions such as Egypt, Kenya and South Africa. The two key problems are a lack of sufficient funding from governments and a shortage of skilled expertise. The problem is exacerbated by the lack of private sector activity in the region to 1) support and initiate research and 2) take up products and processes that are the outcome of projects.

Emerging developments in biosciences offer promise of new means to address a number of constraints that are limiting productivity and sustainable development in Africa. These rapidly evolving developments in biosciences are enabling better understanding of genes, the products they encode for and how these interact in complex pathways within living organisms. In bioscience, this understanding is leading to better means of manipulating and regulating genes, to develop improved strains of crops and livestock, better diagnostics and more targeted therapeutics and vaccines.

Mobilising the emerging developments in biosciences in Africa requires identifying priority problems and the pathways required for successful technology development and delivery. Success will require more human capacity (scientific and technical capability), access to appropriate laboratory facilities and equipment for key strategic and applied research, and an enabling environment to allow for the responsible use of bioscience directed at African issues. The lack of sufficient numbers of trained people, suitable laboratory facilities and specialized equipment and technical expertise are constraining the present use of bioscience to address African problems. The NEPAD African Bioscience Initiative (ABI) is addressing these constraints by making optimal use of presently available human resources and facilities and mobilising public and private responses to address key issues. This involves developing a number of groups (focal points and/or virtual centres) to focus on particular biological issues. These groups will be supported by key laboratories in Africa where scientists can share specialised facilities, equipment and related services such as functional genomics and bioinformatics facilities.

1.3 Investment in Bioscience Research in Africa

Current investment in Bioscience research in Southern African countries is very low compared to developed countries and some Asian countries. Funds for bioscience research in the Southern African countries come mainly from foreign donors such as the European Commission (including the thematic priorities, International Cooperation and the Marie Curie mobility instruments), Rockefeller Foundation, JICA, Wellcome Trust, UN agencies, USAID, the Royal Society, and from government bilateral projects. Funds given by these organizations are project related funds that typically cease at the end of the projects and do not provide long-term support.. Bigger investments from which Africa has started benefiting are from the Canadian government and also from the Bill and Melinda Gates Foundation. Foreign donor contributions to bioscience research in Africa are much appreciated however; African governments need to invest more of their own resources in this area.

Southern African countries have realized the benefits of bioscience and some of these countries, including South Africa, have started to invest appropriately. The South

African government for instance, has created four Biotechnology Regional Innovation Centres (BRICS) that are solely responsible for bioscience activities ranging from plant, animal and mining, to human health. The fruits of their investment will be realized in three to four years time. Swaziland intends to follow the example of South Africa.

2 THE NEW PARTNERSHIP FOR AFRICA'S DEVELOPMENT (NEPAD)

The New Partnership for Africa's Development (NEPAD) is a socio-economic development programme of the African Union (AU). It is a new vision of African leaders in their quest for a socio-economic renewal of the entire continent. This initiative was adopted at the AU Summit in Lusaka, Zambia, 2001. African Heads of State and Governments realized that Africa can only take its proper place in the international community if it gains economic strength, hence the objective of NEPAD is to stimulate Africa's development by bridging existing gaps in priority sectors which include agriculture, health, education, infrastructure, information and communication technology, environment, tourism, science and technology, African Peer Review Mechanism and private sector and civil society (see NEPAD, 2001). The NEPAD Secretariat has been instrumental in raising awareness of the role of science and technology in sustainable development. The NEPAD objective for Science and Technology Platforms are spelt out as follows:

- to promote cross-border cooperation and connectivity by utilizing the knowledge currently available in existing centers of excellence on the continent;
- 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.

In November 2003, African Ministerial Conference on Science and Technology, organized by the NEPAD Secretariat with the support of DST and the United Nations Education, Scientific and Cultural Organization (UNESCO), adopted an 'Outline of a Plan of Action' containing flagship programme areas and specific policy issues. They also established the African Ministerial Council on Science and Technology (AMCOST) and its Steering Committee for Science and Technology as the overall governance structure for setting continental priorities and policies pertaining to the development and application of science and technology for Africa's socio-economic transformation. The conference stressed the urgency of building the continent's capacities to harness, apply and develop science and technology in order to eradicate poverty, fight diseases, stem environmental degradation, and improve economic competitiveness. At this conference the Ministers adopted the following flagship programmes :

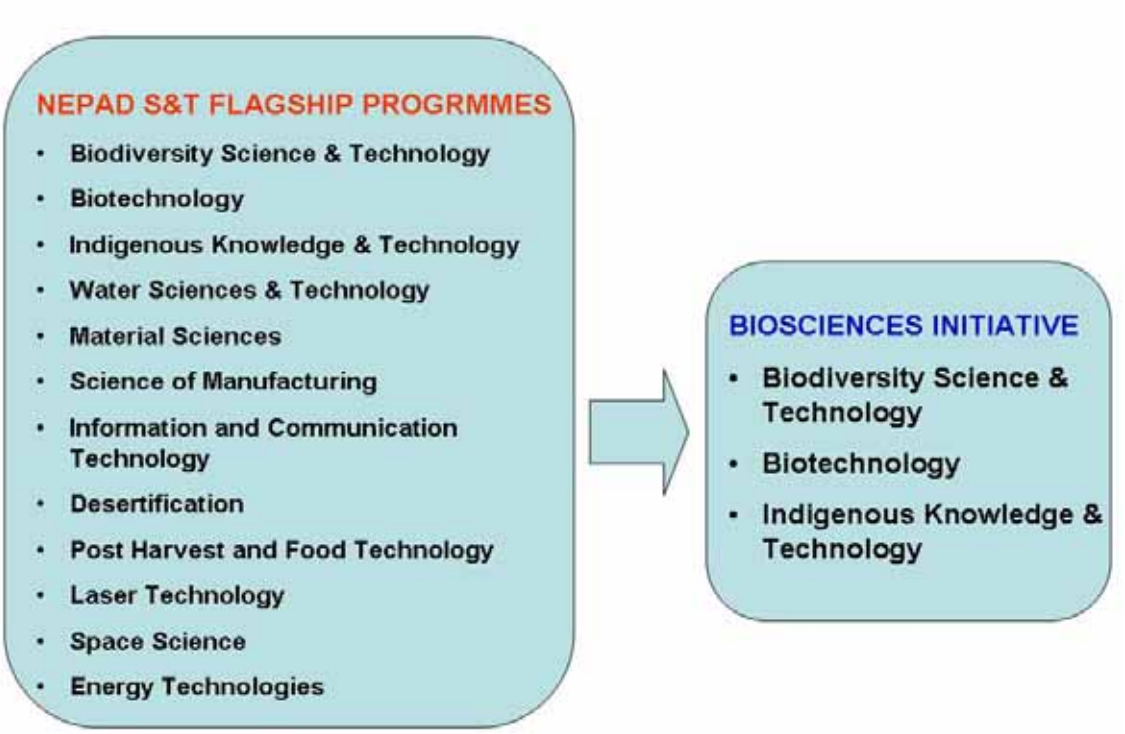

Figure 1. NEPAD Science and Technology flagship programmes and a cluster of programmes in the Biosciences Initiatives

2.1 NEPAD/ABI Regional Biosciences Networks

One of the NEPAD S&T flagship program is the Biosciences initiative. This initiative consists of Biodiversity Science and Technology, Biotechnology and Indigenous Knowledge and Technology. In order to have an impact in Africa, the Bioscience initiative decided to have four regional networks in the continent.

Four regional networks have been established on the continent as follows:

1. Biosciences Eastern and Central Africa Network (BecA Net).
2. Southern Africa Biosciences Network (SANBio).
3. West Africa Biosciences Network (WAB Net).
4. North Africa Biosciences Network (NAB Net).

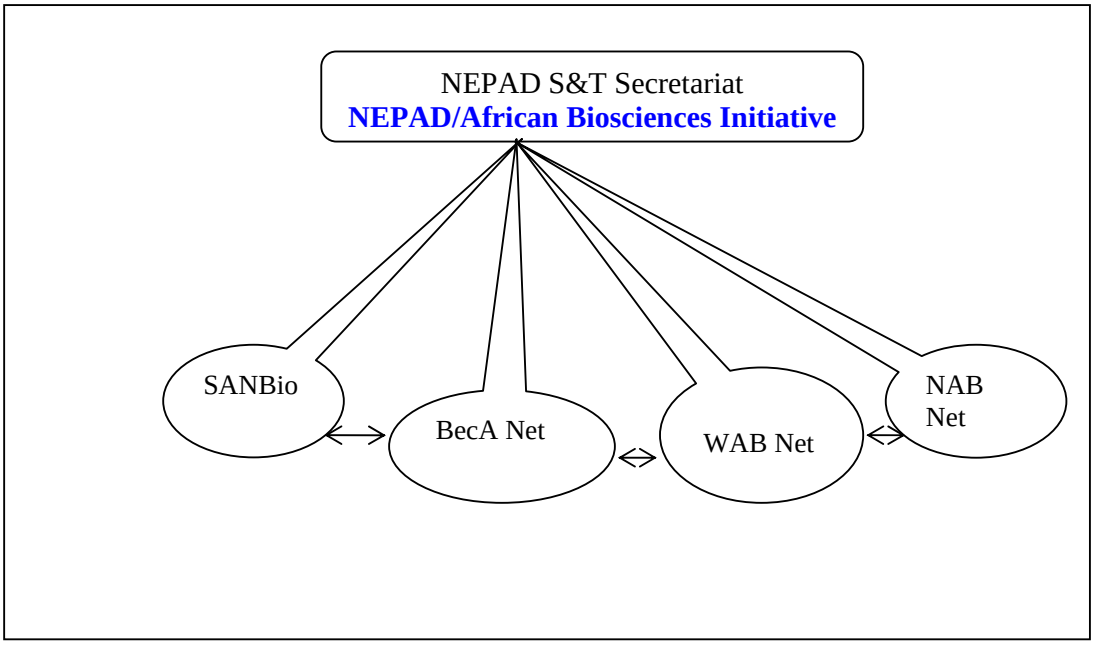

Figure 2. NEPAD/ABI regional network initiatives linked to the NEPAD Secretariat.

2.2 Southern Africa Network for Biosciences (SANBio)

Southern Africa Network for Biosciences (SANBio) is one of the four regional networks. It has been established with the regional hub being hosted by the Council for Scientific and Industrial Research (CSIR) in the Republic of South Africa. The network covers 12 countries in the sub-region which includes: Angola, Botswana, Malawi, Mauritius, Mozambique, Namibia, Lesotho, Swaziland, Seychelles, Republic of South Africa, Zambia and Zimbabwe.

At the regional workshop on NEPAD S&T flagship programme held in Johannesburg in November 2004, nominations were received for members that should serve on the steering committee for the network. The workshop also resolved that the network activities will be involved in human health, animal health/production, industrial and mining bio-processing, environmental remediation and plant/crop biotechnology. The committee had its first meeting in June 2005 to approve the programmes that the network should concentrate its activities. The network was officially launched on 5th August 2005.

2.3 Vision

SANBio's vision is to utilise biosciences for social economic development, particularly contributing to improved health, food security and sustainable livelihoods of the people of Southern Africa.

2.4 Mission

The mission of SANBio is to build and strengthen capacity in biosciences through networking, promotion of scientific excellence and harnessing of the indigenous knowledge for sustainable utilization of natural resources and wealth generation of the people of Southern African.

2.5 Goal

The overall goals of SANBio are:

- to enable Southern Africa to harness and apply science, technology and related innovations to eradicate poverty and achieve sustainable development
- to build capacity in the region to ensure that Southern Africa contributes to the global pool of scientific knowledge and technological innovations
- To bring new innovative bioscience related products in the market by capitalizing on the expertise in the region.

2.6 Objectives

The strategic objectives of SANBio are to:

- Address Southern African problems in agriculture, health, and environment through the application of bioscience technologies
- Use new developments in biosciences to protect the environment and conserve biodiversity in Southern Africa
- Build and strengthen human capacity in biosciences in Southern Africa
- Promote access to affordable, world-class research facilities within Southern Africa
- Harness indigenous knowledge and technology of the Southern African people for sustainable utilization of natural resources and wealth generation

2.7 Strategies

The main reason for creating regional biosciences networks is that in biosciences research, there is a need for critical mass of infrastructure, equipment, services, and support technicians to provide an environment that is conducive for high quality research of international standard. In the short term, there is a lack of such facilities in the sub-region and it may not be feasible to have individual national institutions with such capacities; thus the concept of a strong shared facility is advocated at SANBio. It is recognized that for SANBio to produce research outputs with impact on development, a range of laboratories and institutions with complementary capacities to move the research into concrete products will be required. The network concept is thus seen as composed of a Hub, Nodes and a broader set of membership. The nodes would provide certain services to other members and receive certain critical investments to make them effective in their specific service.

Various options of networks can be articulated. As such it is necessary from the beginning to define a preferred option. For example, one model of networking is to have nodes linking to the hub only. In this scenario the hub works tirelessly to service the nodes. This requires a strong financial and administrative base at the hub in order for it to effectively support the individual nodes. Alternatively, you can have the nodes linking to the hub but also actively communicating and collaborating with each other. Under this scenario the hub only works to coordinate the activities of the nodes. The later model is more conducive for sustainability in the sense that it promotes synergies and a collaborative culture which lead naturally to the development of long term viable partnerships. Such partnerships are more likely to continue beyond donor support.

Both options require strong support at national and regional levels. Once there is strong support at national level, the role of the hub will be to seek what is called the financing gap. Many donors will want to see commitment from national governments before committing their own resources. Hence the success and long term viability of the network calls for strong national and regional support. The other prerequisite for the success and sustainability of a network is to ensure that the right competencies are identified at focal points in order to provide effective operations at the nodes.

Equally important to the success of the network is the need to ensure that all partners in the network cultivate a sense of belonging to the network. This could be achieved by ensuring that each country should be identified by at least one centre of excellence. This way no one will feel left out. Those centres less endowed with resources can be then be supported or nurtured through the network. Given the many limiting factors to R & D in biosciences, there is need to prioritize areas of research depending on identified capabilities and strengths of the various players in the network.

All the members of SANBio are entitled to have access to the Nodes and the Hub. SANBio Hub will coordinate the activities of the network by working together with the Nodes to provide a common research platform, research related services, capacity building and training of young scientists in the region. The Nodes will be distributed among the institutions of excellence in the 12 Southern African countries, making SANBio a leader in Bioscience research for the region.

2.8 Role of the Southern Africa Network for Bioscience

1. Provide a *focal point* for the Southern African scientific community to support the activities of national, regional and international entities addressing priority problems for reducing poverty, creating wealth and promoting Africa's development;
2. Create and strengthen *human capital* in biosciences and related disciplines in Southern Africa;
3. Promote scientific excellence by bringing together a *critical mass* of scientists drawn from national, regional and international institutions in a 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 Southern Africa;
4. Increase *access to affordable, world-class research facilities* within Southern Africa;
5. Produce, manage and disseminate bioscience *knowledge* relevant to Southern Africa's development;
6. Facilitate access to advice and training on *intellectual property*, *biosafety* and *regulatory* issues;
7. Attract *investment* for biosciences in and for Southern Africa from governments, the private sector, and regional and international bodies; and serve as a platform for forging *partnerships* with other biosciences initiatives elsewhere in Africa and worldwide.
8. Define relevant outputs to address regional problems through the application of bioscience technologies and the development of a technology implementation programme.

A regional biosciences network consists of a hub and several nodes distributed throughout the region. The choice of the hub is based on an institution that is involved in cutting-edge scientific research in biosciences while nodes are institutions that are also actively involved in research and have expertise that provide unique skills and research facilities to complement the capacity of the hub. This arrangement allows institutions in the region to address problems that require a pool of human, physical and financial resources

2.9 Role of the Hub

The CSIR Bioscience unit was officially designated as the Hub for SANBio on the 27th of June, 2005 by the steering committee of the African Ministerial Council on Science and Technology (AMCOST). A formal Memorandum of Understanding (MoU) was signed by NEPAD and the CSIR on the 5th of August 2005. The process for selection of CSIR as a hub was made through an open call in the region. There were certain guiding principles in selecting the Hub. These included the following:

1. The Hub will act as a central focal point for the integration of R&D expertise and facilities across the region to achieve synergy and cooperation in biosciences in the development of the regional network.
2. It will be involved in a vigorous programme of capacity development. In a number of countries the expertise is severely limited and this will not only offer an opportunity to correct the deficiency but also ensure a greater potential for all of the countries to participate in projects.
3. It will coordinate the identification of projects, which have already been initiated and could serve as a base to develop regional projects.
4. It will develop a close scientific cooperation with other networks and Hubs.

2.10 Nodes

The Nodes are centres of excellence or institutions with high reputation in certain disciplines that will be distributed among the 12 SANBio countries. A Node may be designated so, because of the following principles:

1. It is regionally important and fulfils national development priorities.
2. It has a particular strength, e.g. capacity/competency in a particular technology.
3. It has established a culture for collaboration, regionally and internationally.
4. There is a clear indication of political (national) support for the institution as indicated by (trends in) levels of activities.
5. It demonstrates that the research work being done in the institution contributes to improved food security, income generation, human health and/or environmental sustainability within the region.
6. It demonstrates a potential for collaboration, networking and the involvement of regional biosciences activities.

2.11 Roles of the Nodes

1. Provide a particular strength, e.g. capacity/competency in a given technology

2. Provide an operational focal point outside the hub to service other members of the network in a specific project related area where the Nodes have the necessary expertise.

2.12 Management of the Nodes

The Nodes initially will be managed by technical coordinators, whose main role will be responsibility for operations in their domain at the regional level, and ensure that members remain committed to the network.

The internal processes of management at the Nodes will be evaluated periodically, preferably with the help of the external peer groups e.g. steering committee, Technical advisory group, collaborators etc).

Nodes should reflect a suitable regional spread and need not be single physical entities but could also include networks that have already demonstrated the ability to cooperate. A formal process to identify the Nodes will be developed by the SANBio secretariat.

2.13 Interaction between the Hub and Nodes

A group within the Hub can also act as a Node in their area of expertise. The Hub will stimulate interaction (staff exchange, training, use of expensive equipments etc.) between the nodes of the network and also between the four different networks. Researchers from the Nodes will have access to equipments and human capital that will be available at the Node. Consortium based research involving more than four countries will be highly encouraged by the Nodes and the Hub.

2.14 Relationship between NEPAD and the Regional Biosciences Networks

NEPAD is providing a platform on which the biosciences networks are being established. The networks shall belong to the countries of the regions while NEPAD shall provide policy guidelines. The overall governance of the networks shall be provided by the regional steering committee which will comprise members from relevant regional bodies and institutions. NEPAD shall assist the regional networks in mobilizing political and financial support and awareness creation to policy and decision makers in African governments and with international partners.

2.15 Relationship between the CSIR and SANBio

CSIR Biosciences unit will host the SANBio Hub and Secretariat on its campus in Pretoria, South Africa. CSIR will be represented in the Steering Committee as the Host of the SANBio Hub and Secretariat; CSIR will also be represented in the Executive Finance sub Committee (EFC), a committee that will work closely with the SC in preparation and management of financial matters, preparing the annual budget, and organizing fund-raising activities. CSIR Bioscience laboratories will be made accessible to the African research community .The terms, conditions, costs, and means of access of SANBio will be set out in a specific contractual arrangements

The Biosciences unit has been fulfilling certain coordinating and administrative functions up to now. SANBIO SC would want the CSIR Biosciences to continue

assisting in the financial and HR administration, as well as other administrative duties of the SANBio initiative.

CSIR Biosciences will assist in maintaining SANBio on the administrative side in the following manner:

Human Resources support

Assist in recruiting and appointing of the Director and secretariat position of SANBio. These positions will initially be administered through CSIR system, until SANBio's legal status has been finalized.

Financial Support

Biosciences and CSIR will fulfill the full financial support and payroll support to the SANBio office. Financial re-imbursements to projects will also be handled by Biosciences. All financial and reporting systems will be set up for SANBio according to requirements of the PFMA Act. This support will be given for the first year of operation free of charge. Thereafter, the two parties have to negotiate.

O*ffice space and infrastructure*

Biosciences will make 48 square meters available as office space to SANBio in building 20, Scientia, Meiring Naude Road, Pretoria free of charge. SANBio would need to install its own telephone and fax lines as well as network connection.

Procurement

The personal assistant and the Director will be registered in the CSIR electronic procurement system. Authorization will be made by the SANBio Director. However, the SANBio steering committee will give the Director signing powers to a certain rand limit R20,000.00. Amounts above this limit will be approved in the system by the Biosciences Director and the Financial Manager.

3. GOVERNANCE AND MANAGEMENT

Issues of governance, and the governance arrangements and management that go with it have become increasingly important in modern societies. A transparent and accountable system of governance is critical to the success of SANBio. The following management model is proposed: The SANBio secretariat will be run by a Coordinator and a personal assistant. The secretariat will be based at the CSIR campus in Pretoria, South Africa. Projects and administrative issues will be coordinated at the secretariat. Participation in SANBio will be open to all the members of the region. Participation will be through activities and projects that will be hosted by the Hubs and Nodes.

3.1 Steering Committee (SC)

The Steering Committee will consist of government delegated representatives from countries of the region, a representative from the CSIR and a representative from the

NEPAD secretariat. The SC will be the ultimate authority for the network. The duties of the SC amongst others will include:

1. Defining an appropriate legal structure for the regional network and any contractual agreements that have to be developed.
2. Allocating resources and identification of additional resources needed.
3. Approving terms of reference for task forces, panels, working groups and any other such groups.
4. Overall monitoring of projects with input from the Scientific Advisory Committee (see below) regarding the technical progress.
5. Defining performance indicators.
6. Developing or sub-contracting a biosafety, ethical, IPR guideline and ensuring that projects undertaken comply with these measures.
7. Developing guidelines on a commercialisation strategy.
8. Identifying with advice from the Technical Scientific Advisory Group (TSAG) the relevant themes.
9. Determining the criteria for Node identification.
10. Determining a process for project approval.
11. Identification of the network personnel and their requirements.
12. Promoting exchange of information at the regional and national level.

3.2 Members of the steering committee

The country representatives for the steering committee have been appointed by their governments. There is representation from each of the 12 countries. A representative from the CSIR and the NEPAD S&T secretariat are members of the steering committee. Principles regarding composition of the steering committee were based on seniority, diversity and level of expertise. The chairperson was appointed by the members. Gender was taken into consideration in selecting this committee. At least 30% of the committee are females.

3.3 Term of service

The steering committee members will serve for a period of two years renewable once and a maximum of four years. The chair shall serve for a maximum of three years and shall be rotated between the countries.

3.3.1 Meetings of the steering committee

(1) The chair shall convene at least two steering committee meetings in a year.
(2) A quorum of the steering committee shall be fifty percent (50%) including the chair.
(3) Meetings other than the annual steering committee meeting shall be held at such times and places as the chair of the steering committee deems necessary.
(4) Each steering committee member has one vote and if a vote is tied the steering committee chair will have a second, tie-breaking vote.
(5) Steering committee members need not be physically present in the same place for a steering committee meeting to be held. The steering committee may meet by the steering committee members communicating with each other by any technological means by which they are able simultaneously to hear each other and to participate in discussion.

(6) A steering committee member may give his/her proxy vote to another current member of the steering committee if unable to participate in person or by technological means in steering committee meetings.

(7) If a steering committee member is unable to participate in two (2) consecutive steering committee meetings, the steering committee may review his/her membership of the steering committee.

(8) The chair shall give notice of the date of each regular meeting of the committee not less than four weeks prior to the date of such meeting. The chair shall give such notice for any special meeting of the committee not less than two weeks prior to the date of such meeting.

(9) The chair may in consultation with the committee invite representatives from government, science councils, policy makers or donor agencies to attend and observe the committee meetings.

(10) If the required majority of all steering committee members eligible to vote on a resolution have signed, a copy of an identical document (including a facsimile) stating that they are in favor of a resolution in terms set out in the document, then:

  (i) a resolution in those terms is deemed to have been passed at a steering committee meeting held on the day on which the last steering committee member constituting a majority has signed the document; and

  (ii) the minutes for the following steering committee meeting will record that the resolution was passed in accordance with this clause.

(11) The SANBio Director shall serve as the secretary of the steering committee

3.4 Network Director and Secretariat

The Director of the secretariat will be responsible for the day-to-day management of the network. This will be a small secretariat led by a Network Coordinator.

The functions of the Network Director are as follows:

1. Manage, administer and further the vision, mission and objectives of the SANBio.
2. Monitor, evaluate and implement the SANBio business plan..
3. Implement strategic plans as well as undertake strategic marketing of SANBio.
4. Ensure that network activities are decentralized to member states in terms of planning and implementation in order to enhance maximum utilization of resources.
5. Fund raise in order to secure adequate and stable sources of financing so that the regional network as an organization becomes self-sustaining financially and able to provide support to the Nodes in the region will be done in conjunction with the NEPAD secretariat.
6. Foster and promote entrepreneurial values and skills as an integral part of all programmes being provided.
7. Prepare and submit to the network Steering Committee quarterly and a yearly comprehensive action plans, and a financial budget, as well as a yearly progress reports of activities.
8. Develop and maintain proper reporting and effective relationship and good communications with partner institutions as well as stakeholders.

9. Oversee the implementation of the Steering Committee resolutions, directives and guidelines.
10. Ensure that the accounts relating to network funds are audited annually and timeously by an authorized and certified Auditor.
11. Implement all decisions of the Steering Committee.
12. Serve as the Secretary to the Steering Committee and the Scientific Advisory Committee.
13. Identify new research opportunities
14. Authorise public statements about SANBio in accordance with steering committee guidelines.
15. Liaise SANBio with the NEPAD secretariat and the other three hubs in the country.
16. Prepare a draft Annual Budget for each upcoming Financial Year; and submit the draft Annual Budget to the Steering Committee and EFC not less than fourteen (14) days before the meeting at which the Steering Committee will consider whether to approve it.

3.5 Term of service

The candidate should have a PhD in biological sciences or related areas of science and will be an experienced and credible senior individual with strong leadership and excellent organizational skills. Additional position requirements include the following:

- In depth knowledge of new and advanced bioscience applications
- Skills and experience in strategic planning and implementation
- Experience in initiating and developing networks/collaborations with a range of stakeholders within a complex multidisciplinary and multicultural setting
- Excellent communication, writing, presentation and networking skills and proven ability to influence and engage a wide range of stakeholders
- Experience in developing proposals, negotiating and securing support from investors
- Fluency in spoken and written English
- Experience in research management in biological sciences
- Work experience in southern Africa.

A two year contract term is advised. Renewal will be based on performance of the Director.

3.6 Technical Scientific Advisory Group (TSAG)

This group will consist of a group of experts in their fields drawn from across the region with international involvement if appropriate. The TSAG is subject to the steering committee's oversight and is responsible for SANBio's strategic planning and program development, as well as for ensuring the quality and relevance of activities. Responsibilities of the TSAG include the matters set out below.
In consultation with the Steering Committee and subject to its oversight

1. Development of project criteria
2. Designing a process to call for proposals

3. Assessing projects with other peers and make recommendations to the steering committee.
4. Designing processes to monitor the scientific progress and output of projects and make recommendations to the steering committee regarding changes.
5. The TSAG may co-opt additional expertise as required to review and/or monitor specific scientific activities if these are beyond the expertise of the group at that time.
6. Identify potential partners for activities in the international scientific community; oversee the quality of the publications and dissemination of the outputs of activities and ensure that the outputs are communicated to potential users of science-based information.
7. Identify and recommend to members opportunities for commercializing research outcomes and potential Intellectual property that will be generated from the project/projects.
8. Ensure the quality and relevance of the research programs, research related services and capacity building and training activities conducted under SANBio auspices

3.7 Membership

The group will be consulted as and when the need arises. Gender and geographic location will be important in the composition of this group.

3.8 Executive Finance Sub-Committee

The Steering Committee shall establish an Executive Financial Committee (EFC) comprising of up to five (5) people who shall be responsible for the financial oversight of SANBio and shall report to the Steering Committee.

The function of the committee will be as follows:

1. Review of SANBio annual budget
2. Monitor and evaluate the implementation of the projects based on agreed upon milestones and deliverables
3. Develop and implement guidelines and procedures for mobilizing and allocating local and foreign funds.
2. Recommendations to the steering committee on good financial management.

3.9 Membership

Membership will include the chair of SANBio, SANBio Director, a member from SANBio steering committee, a representative from CSIR, a representative from the NEPAD secretariat and the Manager of finance in CSIR Biosciences as ex officio.

3.10 Terms of Reference

The members shall serve for three years with an option for renewal.

3.11 Establishment of a legal entity

At any time during the term of this agreement, the steering committee may by unanimous vote adopt a resolution authorizing the director to establish a legal entity in the Republic of South Africa, in order that such legal entity might, for example, make contracts, and acquire and dispose of property in furtherance of activities. Such resolution shall include appropriate recognition of authorities to be exercised by the newly formed legal entity and shall become effective upon adoption in writing by all members.

4. PROGRAMME OVERVIEW

The Steering Committee will oversee the TSAG programmes for a short-, medium- and long-term strategic plans for the Network, and will approve a business plan for each financial year, giving consideration to priority activities and projects in the areas of food and agriculture, environment, animal and human health. The SC will also consider the following cross-cutting themes:

(a) Capacity building and training;
(b) Knowledge management, information technology and communications;
(c) Policy, investments, resources, and partnerships for the implementation of technology delivery.

In identifying potential activities and participants, the TSAG will consider:

(a) Constraints that might limit the outcomes of activities in one or more countries;
(b) The probability of developing bioscience-based solutions;
(c) Potential markets for new technologies;
(d) Available pathways for moving from discovery to technology delivery;
(e) Identifiable, potential partners with interest in participating in Activities;
(f) Available project management skills; and
(g) The benefits to be derived from a successful outcome.

Thematic areas selected were proposed by the delegates representing the 12 member countries of SANBio who attended the November 2004 NEPAD Science and Technology Southern African Regional Workshop. Consultation with key scientists in each country was made by the delegates before presenting their programmes to the steering committee. The current capacity and institutions that can carry out research in specialized fields were identified in the region. Themes were selected based on the needs of the region. For future proposals, a template will be developed by the secretariat and distributed to the region. It is proposed that the following procedure be used for project proposals:

- Calls for project proposals should be made public by the SANBio Director after clearance from the SC. Calls should preferably be open and have a fixes closing date. A two stage proposal is recommended, consisting of a short (10pp) pre-proposal to which a “go/no go” decision will be given. A template will be developed. This will be followed by the submission of a full proposal. Proposals should be submitted to the Coordinator of SANBio who will further

submit the proposals to whatever other peer reviewers they wish to use, to judge their worth. Templates must be provided to the applicants to submit their proposals.

- Project proposals should be based on certain thematic areas outlined by the TSAG and approved by the SC.
- Projects should focus on problems of the region and not just the creation of human capacity.
- Projects should focus on cross-border problems with a minimum number of country (e.g. at least four) partners and be in accord with the countries' own research strategies.
- It is vital that the SANBio achieve some early successes and technically stretching projects should be assessed with caution.

Selected projects will be short listed and announced on a yearly basis. The time for the call and successful project announcement should be fixed by the secretariat.

4.1. Programme Goals

The goals of SANBio are:

- To develop new products as a result of innovative research outcome.
- Improve the productivity and sustainability of agriculture in Africa.
- Strengthen the role of women and younger scientists in biosciences.
- Build capacity that will be project related.
- Create new and powerful research networks.
- Commercialize products.

4.2 Outputs

- Knowledge generation in the form of effective validated skills.
- Well trained researchers in the field of biosciences.
- New products and services that will result from research projects.
- New partnerships that will develop from consortium based research.
- Capacity building in the area of biosciences.
- Intellectual Property and publications that will result from projects.
- Techno parks that will be developed as a result of partnerships with the private sector.
- A reduction in the loss of expertise by providing a conducive environment and good incentives for African and international scientists to work in Africa.

4.3 Capacity Building

Growing human capital is critical to the economic growth of the region and Africa at large. Capacity building will be a critical aspect of SANBio's activities, for as noted above, the lack of suitable expertise in the region is one of the major barriers to the uptake of biotechnology and the development of appropriate solutions by organisations within the region. Capacity building addresses not just the enlarging of the science base but also provides training for those in support areas such as policy, public understanding of biosciences and ethical issues.

Capacity building should address the needs of the region, and it should be relevant to the trainee's country and **be project based not merely** activities created to offer training possibilities. The project areas selected cross across the different needs of the region. Projects will also be at the different stages. It is envisaged that young scientists and women will be trained by participating in this projects. All projects must have a capacity building component. One of the challenges will be to ensure that trained personnel do not return to a "vacuum" and that there is suitable infrastructure and opportunities for growth in the home country or the programme will simply increase the drain of trained staff to those countries in the region or beyond which offer those opportunities. This issue could be addressed by providing good infrastructure and salary incentives in the Hub and Nodes.

Realizing the potential of women scientists in Africa will be given particular attention and support in all aspects of capacity building and training at SANBio. This is a cross cutting issue in all the regional Hubs. In addition, young scientists needs to be encouraged and helped to take up research careers in Africa. One third of post graduate training will be targeted towards women scientists.
Projects

Capacity Building Training Programmes

- A programme for short term internees located at institutions and Nodes across the regions will be instituted in the second year of running.
- The need for a development fund for MSc and PhD candidates taking into account 1) the costs of accommodation, registration and the time spent by supervisors in organisations which are fee earning, 2) identification of suitable universities for degree registration, especially where the university may be distant from the site where the work is conducted, 3) legal issues with the movement of students within the region, 4) identification of suitable supervisors at universities and home institutions where applicable, etc. This will be a condition for funded projects.
- Promotion of SANBio to potential funders of a post-graduate and post doctoral initiatives e.g. Rockefeller, USAID, the Royal Society, Wellcome Trust, John Innes Centre, Rothamsted International, European Commission Marie Curie instruments etc.
- Determine the need for short-term courses in scientific and non-scientific fields such as proposal writing. Assess the extent to which the electronic medium could be used, other providers outside SANBio be found and especially where a link could be made into NEPAD's open source project AVOIR.
- Determine the need for an annual or biennial conference. In spite of the costs, a conference would aid greatly in creating an identity for SANBio and provide opportunities for young researchers to meet and make presentations.
- Determine the need for the development of an electronic forum taking into account the IST infrastructure in the region's partners.
- Determine the current accessibility within the region to scientific literature and how this can be improved if needed.

4.4 Criteria for Accreditation of NEPAD Science and Technology Projects

SanBio is one of the networks under the NEPAD Science and Technology Programme. SANBio will follow the same criteria that is implemented by NEPAD S&T for accreditation (refer Africa S&T consolidated Plan of Action 2005).

4.5 Private Sector Involvement

The private sector will be motivated to contribute significantly to grow SANBio. As much as possible the private sector will be encouraged to participate in projects. Researchers and young scientists will benefit from private sector participation in that they will not only learn about the science of a project, they will also learn the relevant business aspects. Private sector partners will include SMEs, large multinational companies, local companies and trusts, that have experience in bringing bioscience products to the market eg the AATF and South Africa's BRICs. Private sector involvement in projects will shorten the product development and dissemination time. It will also be envisaged that the private sector will take up some of the products and processes that eventually result from the research projects. They should also be involved in initiating and financially supporting some of the projects.

A list of private sector companies for the region will be compiled and letters will be sent to them informing them about the activities of SANBio and also how they can contribute to the success of SANBio. Seminars and workshops will be organized by SANBio to showcase project outcome to the private sector.

4.6 Regional Cooperation

All the accepted projects will have at least four partners from the Southern Africa region. Partner countries should play a significant role in the project and should not be included just to increase the numbers. Funding should be appropriately disbursed between the partner countries. There should be buy in from the different countries into a project. This will be facilitated by the SC. In addition, to the regional projects, there will be cross cutting projects that will involve the other networks in the continent. Such type of projects should be encouraged by the NEPAD S&T secretariat.

Scientific and technological development is a learning process that is largely achieved by countries through cooperative or collaborative efforts of sharing experiences, information, infrastructure and such other resources as human and financial. Today no country can secure higher levels of scientific advances and technological progress without interacting with its peers and neighbors. The ability of countries and firms to innovate, both in technical and managerial ways, is largely determined by strategic alliances they forge both within their industrial landscape and across sectors. Furthermore, for industrial firms to become successful in generating new innovations they often have to create partnership with public R&D institutions. This is clearly manifested in such fields as biotechnology: relatively strong and strategic partnerships between university R&D activities and operations of companies.

Regional cooperation in S&T can take various forms, including joint science projects, sharing of information, conferences, building joint or common laboratories, setting common standards for R&D, and exchange of expertise. A common problem or challenge, such as the development of a HIV/AIDS vaccine, drought resistant plant or genetically improving the nutritional content of our crops can be one of the primary factors stimulating cooperation

It is vital that SANBio is seen as a truly regional cooperative venture and regional input must be provided into the:

- Composition of the SC
- Composition of the TSAG
- Identification of the technical Nodes
- Identification and participation in the projects
- Participation in the Human Resource Development (HRD) programme
- Having cross cutting projects that will involve the other networks

At the same time, it should be accepted that it will be impossible for all twelve countries to participate in all projects because of 1) the relevance of a project to that country and 2) the expertise, experience and infrastructure available. However, projects will always be consortium driven and this will maximise the potential for wider input.

5 INTERNATIONAL LINKAGES

Bioscience has 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 programmes that transform discovery into value. (BECA 2005)

International linkages in SANBio will aim to forge and maintain strategic and intellectual alliances between individuals, institutions and organisations in the science research communities nationally and internationally to support the international competitiveness of the Southern African countries. Bioscience 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 SANBio. The benefits to be realized from increased biosciences capacity in Africa will be accelerated significantly through international linkages. The many steps involved in creating value from research, and discoveries have to be compatible with the innovation framework in a country. SANBio has an extraordinary opportunity to align with the very best research within Africa and outside Africa. 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.

The nature of SANBIO means that the programmes and activities take place in locations throughout Southern Africa. They are focused on solving Southern Africa's 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 an African environment.

SANBio encourages partnerships with academic and research institutions within and beyond Africa. For example, internationally the CSIR has cooperation agreements with major overseas R&D organizations and companies and is currently working with eighteen African countries. Through such international partnerships, infrastructure at research organizations outside of Africa can be employed to accelerate discovery.
Steps to ensure SANBio has a vibrant, successful, long-term programme of international linkages that include the African diaspora:

- SANBio providing the opportunity for visiting scientists, postdoctoral fellows, and graduate students to spend time in Southern Africa engaged in research with African collaborators. SANBio 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 programmes and networks.
- SANBio 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;
- SANBio developing a strong external communications plans that describes its programmes and research priorities, so that potential partnering scientists and organizations know what is being done and what the opportunities for collaboration are.
- SANBio scientist should be able to participate in network projects of the other regions. These programmes should be encouraged by the SC.
- Research projects involving international collaborations should be encouraged in SANBio projects.
- Links to the other regional Hubs and Networks will be encouraged and joint projects will be developed.

6. COMMUNICATION AND MARKETING STRATEGY

The aims of the SANBio must be communicated widely to ensure its long-term impact and success. A strong outreach programme will be required to advertise the importance of the Hubs and Nodes and the activities and projects in which they are involved. The communications plan will address the following groups:

- Political supporters in regional government, the AU and NEPAD
- Current and potential donors
- Research organisations
- Existing and potential international collaborators
- The private sector
- Policy makers
- Opinion forming NGOs
- The general public

Other strategies will include

- Conducting public awareness workshops on biosciences in general and biotechnology and biosafety.
- Conducting interactive radio and television programmes.

- Sensitising the media personnel.
- Developing regional biotechnology and biosafety information systems

A website on SANBio will be established **in July 2006**. Beyond SANBio a website linking the four regional Hubs will be developed. This website will contain information on the projects and the institutions involved. Flyers of the activities of SANBio should also be made. Posters on SANBio should be presented by the PIs in conferences and workshops.

7 RESOURCE MOBILIZATION

7.1 Financing Strategies

Interim management of the funds will be managed by the CSIR. The CSIR is able to manage the finances of multi-disciplinary and multi-organisational R & D projects of this nature.

Initial indications regarding funding for the NEPAD initiative as a whole have been most promising with positive responses from the G8, CFA and CIDA with significant funds going to BECA. A concerted action to secure sufficient funding from local, regional, donor and private sector funding will be put in place. A cost recovery programme to charge for services will also be developed. This must be in conjunction with the NEPAD secretariat, the other Hubs and regional participants to ensure there is no conflict in approaches to funding providers. Member states will have to contribute to the initiative on an annual basis.

Various resources will be required in order for the region to effectively implement the identified research agenda in biosciences. However, given the high levels of poverty and hunger, the resources to fund interventions in biosciences aimed at reducing the human crisis associated with the problem are substantial. Steps are therefore required to ensure that there is a framework that supports an adequate mobilization of resources to fund biosciences from both local and external sources. The bulk of the resources can only be obtained through budgeting by national governments and donor support. It is important that the research agenda is linked to government budgeting processes by developing annual work plans on the basis of the research agenda and linking these to the ministries of finance of each country. Specific strategies for improving the status of R & D in biosciences in Southern Africa will include the following:

- Use available information on funding procedures of various bilateral and multilateral funding agencies to open up communication with them and prepare proposals for funding. It will also be necessary to equip staff in the nodes with skills in negotiations, project proposal preparation, and familiarizing them with funding procedures. Since the information for R & D institutions could only be improved through increased research and development activities, R & D institutions should be proactive in the development of project proposals for donor funding.
- One of the key constraints associated with the general lack of funds for R & D in Biosciences in the region is that this lack of funds is partly as a result of inadequate information concerning the existence of the various bilateral and multilateral sources of funding which can be accessed at both national and

international level. This paucity of information on funding sources can be addressed by computerization of R & D institutions and ensuring access to internet would greatly assist in the continued flow of information on potential funding agencies. The Network Director should ensure continuous flow of information on funding by undertaking periodic internet searches on funding agencies, many of which have their own websites. Furthermore, the RND will maintain direct contact mail communication with various agencies to monitor any changes in their funding policies. Any such changes would then be communicated to nodes in the network.

- Strengthen linkages between industry and public research centers in biosciences to set up joint ventures: There is need for the detection and evaluation of suitable technologies and their further development in pilot schemes for industrial application. One way of strengthening linkages between industry and public research centers is to set up joint ventures.
- Lobby national governments to increase support to biosciences through their R & D institutions for research funds, equipment and staffing. Special incentives, such as tax rebates, to be given to private sector institutions supporting R & D institutions in biosciences. To effect this, governments would require to establish thresholds for contributions beyond which a company would qualify for a rebate.
- Fostering North-South collaboration through such innovations as twinning of research institutions for research cooperation. The Royal Veterinary and Agricultural University in Copenhagen for instance, is at the center of a group of European Universities and research institutions willing to develop collaborative links with counterpart institutions.
- The SANBio through the RND should play a more leading role in mobilizing financial resources in collaboration with the national governments and in conjunction with international institutions, such as the African Development Bank (ADB), UNIDO, PTA, ECA, etc as well as with the various bilateral and multilateral funding agencies.
- The SANBio should encourage governments and international donors to commit 10% of all major grants, loans, debt write-offs and swaps, rehabilitation and adjustment funds, etc especially to biosciences R & D.
- The SANBio should encourage governments and international donors to commit 0.5% to 1% of all major grants, loans, debt, write-offs and swaps, rehabilitation and adjustment funds, etc to biosciences R & D.
- The SANBio, through regional governments should play an active role to impress on multinational corporations to commit 0.5% of their turnover in each country for the promotion of biosciences R & D in the region.
- Retention of incomes by R & D institutions generated through royalties and consultancy Services should be encouraged as much as possible.
- Research levy which should be ingenuously collected and administered as an integral part of a general levy fee. The idea is that the many levies collected by governments could be consolidated as much as possible and collected by a single agency which could then distribute this to other beneficiary organizations.
- There should be a standing programme by SANBio to sensitize policy makers on

biosciences matters. These should include parliamentarians, Chambers of Commerce and Industry, technically – oriented and finance and Planning Ministries, Development Committees, Economic and trade missions, etc.

- Formation of a Resource Mobilization Task Force within the Steering Committee.
  Alternatively, the Task Force could be appointed from outside the SC in consultation with other institutions within the network. The RND could be an *ex officio* member to the Task force. From time to time he can travel with the Task Force to meetings with donors to lobby for project funds. At such meetings, it will be the duty of the RND to articulate the SANBio research agenda and highlight R & D activities planned or taking place in the various nodes within the network.
- Setting up a centralized regional lobby for donor support through regional groupings such as SADC and COMESA.
- Seek to establish a Biosciences Consultative Forum to spearhead dialogue on biosciences and galvanize Private Sector Support for R & in biosciences. The Forum can hold special regional meetings on specific themes. A key note speaker, a Noble Prize Laurent, for example, could be invited, in addition to other speakers. Donors and foundations such as Rockefeller Foundation, Ford Foundation, W.K Kellogg Foundation, Kuwait Fund for Development, etc can be invited to such a gathering. The objective of such a forum would be to expose donors to what the network is doing. If done annually the network can develop a following and one or two donors can pick up an aspect for funding. In Zambia we have examples of Forums that have had positive results such as the Agriculture Consultative Forum (ACF), Tourism Consultative Forum (TCF), and the Environment and Natural Resources Management Consultative Forum (ENRMCF).
- Enhancing IPRs to stimulate innovation in biosciences R & D

7.2 Risk Assessment and Biosafety and IP Management documents

Risk Assessment, Biosafety and IP Management documents would be prepared by professionals for the SANBio secretariat

7.3 Commercial Plan

This will be written once funding sources and projects have been approved. A commercial plan will be written for each specific project.

Table 11.1. SANBIO Budget for the Definition and Implementation Phase 2006
Estimated Budget in Euros (€)

	Year 1 2006	Year 2 2007	Year 3 2008	Total
1. Governance and Management	€	€	€	€
a. Coordination and management	150 000	-	-	150 000
b. Monitoring and evaluation	80 000	-	-	80 000
c. Public awareness, business development and community liaison	50 000			50 000
				-
2. Building and /or Strengthening the Research Capacity		-	-	-
a. Training Fund				-
b. Competitive Grants for research	50 000			50 000
c. Research Grants for young woman scientists	50 000			50 000
				-
3. Regional Workshops		-	-	-
a. Travel & Accommodation	20 000			20 000
b. Conferences	35 000			35 000
c. Steering committee meetings	45 000			45 000
Funding required for general running, salaries etc.	**480 000**	-	-	**480 000**
4. Equipment required by SANBIO - regionally shared				
a. Laboratory equipment of capital nature		-	-	-
b. Office equipment of capital nature	20 000	-	-	20 000
Total funding required for Definition and Implementation Phase	**500 000**	**-**	**-**	**500 000**

8. ACTION PLAN

A plan of action is proposed for the successful implementation of this business plan

15-02-2006: Comments from the steering committee members and the public will be solicited and incorporated in the business plan.

28-02-2006: Business plan approved by the steering committee.

30-04-2006: Commencement of DST flagship projects

04-04-2007: Interview of the Director

30-04-2006: Complete the ToRs for a consultants to provide feedback on the proposal to the Finnish government and start working on the Finnish proposal

05-05-2006: Furnish SANBio secretariat.

30-05-2006: Appointment of a secretary at the secretariat

25-06-2006: Director to assume duties at the Hub

30-07-2006: Proposal submitted to the Finnish government

01-08-2006: Access CIDA funding for initial for continuation of the flagship project and funding of the secretariat

01-09-2006: Engage in discussions on the legal status for SANBio

12-10-2006: Initiate two projects with other ABI Hubs in preparation for EU funds

08-12-2006: Three proposals submitted to different funding agencies.

30-12-2006: Review of progress made by SANBio

2007

Commencement of Finnish Project together with a one European Union sponsored.

2008

Commencement of a second CIDA sponsored project

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APPENDICES

Appendix 1: Flagship project - Scientifically Validated, Affordable Remedies for the Treatment of Opportunistic Infections (OI) for People Living with HIV/AIDS

The proposed project will be conducted by scientific institutions in the twelve southern African states comprising SANBio (an instrument of NEPAD's African Biosciences Initiative): Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Zambia and Zimbabwe

Introduction

The statistics of people living with HIV/AIDS in Africa are staggering. More than 29 million people in sub-Saharan Africa are HIV-positive. Seventy percent of the world's HIV infections or AIDS cases are in Africa. Twenty million people in Africa have already died of AIDS and about 7 000 more African people die of AIDS every day.

A particular challenge associated with the disease is the treatment of Opportunistic Infections (OI) suffered by all people at different stages of progression of the disease. The treatment of such people using conventional therapeutic interventions is beyond the reach of most governments because of the cost of imported medicines. The availability of effective, safe and affordable herbal treatments for OI will not only improve the quality of life of people living with HIV/AIDS but will even allow a significant portion of those affected by the disease to return to work and contribute to the economy.

The biodiversity of Africa (e.g. plants and mushrooms) is a major resource that has not yet been exploited fully for economic and social benefit of people of the region. The rich heritage of indigenous knowledge on the medicinal plants and mushrooms of the continent may provide leads to effective treatments for OI. Biosciences are the key that can unlock the potential of these indigenous African resources to yield effective treatments for OI.

Africa's botanical wealth

A feature of the species biodiversity of southern Africa is the adaptation to a wide range of diverse ecological niches (such as desert, cold mountainous regions and sub-tropical forest) over many millennia. The African continent is home to approximately 50 000 plants species, which corresponds to nearly 20% of all plants known to man. For example, about 50% of all succulents on earth occur in Africa.

Biodiversity species such as plants and fungi on the African continent are 'ancient', compared to many other parts of the world. The significance of this is that species have had a long time to evolve sophisticated biological mechanisms that catalyse the production of biologically secondary metabolites. It is thought that the cure for many human diseases that cannot be treated effectively by modern medicines can be found in these biologically active secondary metabolites. Examples of plant metabolites are vinblastine and vinchristine, alkaloids from the Madagascar periwinkle that are used in the treatment of childhood leukaemia. It should be noted that even today, approximately 25% of all prescription medicines are directly or indirectly derived from plants, and a further 25% from microorganisms.

Indigenous Knowledge Systems (IKS)

The origin of man is intimately linked to the African continent, in particular southern Africa. Man has therefore been in contact with plant species for a very long time, using plants for food, medicine, shelter, fuel, etc. This knowledge system has been transferred from generation to generation for millennia. IK on the medicinal use of plants can be described as ancient wisdom, but it is also an active system that continues to develop. It is estimated that at least 80% of the population in Africa consult Traditional Healers. Traditional healing is a holistic system of treating a patient therefore the translation of traditional medicines into modern therapeutic agents is not necessarily a straightforward process.

Many of the countries in the region already have some initiatives aimed at analysing, validating and standardisation of indigenous herbal medicine and natural products. However, very little of this knowledge has been recorded, yet it represents an immensely valuable data base that can provide biosciences with insights on how and which type of floral and faunal resources that have potential to be developed for bio prospecting.

The goal of the project is to apply the collective biosciences capability of the Southern African Network for Biosciences (SANBio) to the indigenous knowledge and biodiversity of the region, with the aim of developing treatments of OIs suffered by people living with HIV/AIDS.

Bioprospecting

'Bioprospecting is a systematic scientific research process in search of valuable chemical and genetic constituents of biodiversity.' (Quoted from www.bioprospecting.co.za)

Africa's biodiversity, IKS and biosciences can be combined to create a bioprospecting platform that can compete with the best in the world (Figure 1). Many developed

countries have invested heavily in modern biosciences, and in many developing countries biodiversity and IKS have remained intact, but few countries or regions have successfully harnessed all three components of a bioprospecting programme. SANBio creates a unique opportunity to create a world-class bioprospecting platform that can create economic and social benefit for the region based on scientific investigation of its biodiversity and IKS.

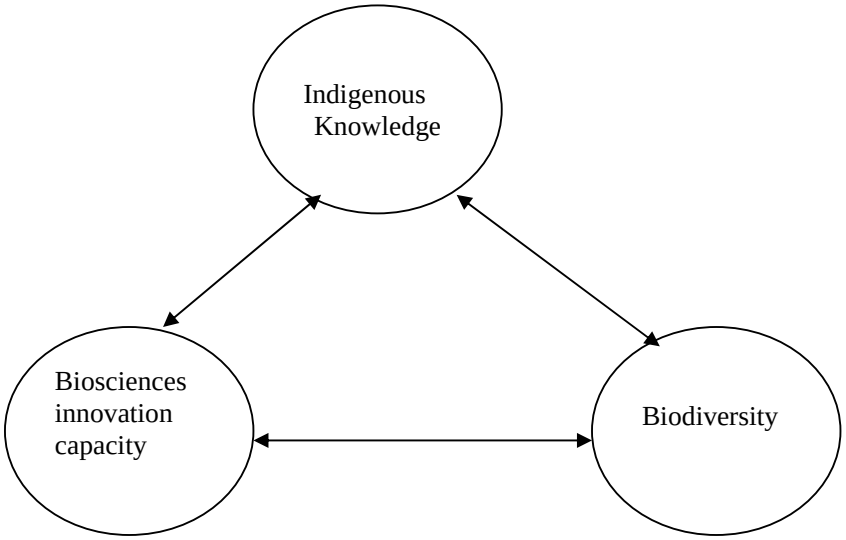

Figure 1. Bioprospecting strategy based on combining IKS, Biodiversity and Biosciences innovation capacity

Table 1. Examples of opportunistic infections that may affect people living with HIV/AIDS

Type of opportunistic infection	**Symptoms**
Cryptosporidium parvum	Chronic diarrhea
Pneumocystis jirovecii pneumonia	Pneumonia
Mycobacterium avium complex (MAC or MAI)	Disseminated infection manifests as fever, weight loss, adenopathy, diarrhea, anemia, neutropenia, and increased liver function tests
Mycobacterium tuberculosis. Pulmonary tuberculosis (TB) infection that attacks the lungs, and can cause meningitis	Fever and respiratory symptoms, is common; extrapulmonary involvement is more frequent in those with advanced HIV disease. Diagnosis is made presumptively based upon clinical presentation and sputum acid-fast bacilli (AFB) stain.
Cryptococcus neoformans (meningitis)	Enlarged mediastinal lymph nodes and a large pulmonary parenchymal nodule
Candidiasis (Thrush):*Candida alba, Candida albicans* (fluconazole-susceptible strains), *Candida glabrata*, *Candida tropicalis*	A fungal infection of the mouth, throat, or vagina. A vicious cycle linked to poor oral intake, weight loss, malnutrition and wasting syndrome, with occasional mortality due to malnutrition

Type of opportunistic infection	**Symptoms**
Gastrointestinal opportunistic infections: oesophageal candidiasis	
Pneumocystic carinii pneumonia (PCP)	Manifests as fever, non-productive cough, and dyspnoea. The chest x-ray usually shows diffuse interstitial infiltrates, but it may be normal in early infection. PCP is generally diagnosed by induced sputum examination
Candida pneumonita	
Vittaforma corneae	
Cytomegalovirus (CMV)	Infection that causes eye disease that can lead to blindness
Cytomegalovirus (pneumonia)	Lymphoid interstitial pneumonitis with persistent respiratory symptoms
Cytomegalovirus encephalitis	Affects both the central and peripheral nervous systems. Neurological manifestations of CMV infection include encephalitis, ventriculitis, myelitis, retinitis, radiculoganglionitis, and peripheral neuropathies retinitis but may also manifest as colitis, oesophagitis, and polyradiculitis. Patients with retinitis complain of non-specific symptoms such as blurred vision
Herpes simplex viruses (HSV-1-oral); (HSV-2-genital)	Oral herpes (cold sores) or genital herpes
Herpes simplex encephalitis	
Herpes zoster virus	Shingles
Influenza	
Human papillomavirus infection	
Leishmaniasis (Leishmania major and Leishmania infantum)	
Acanthamoeba infection	
Malaria	More common and more severe in patients with HIV
Kaposi's sarcoma	
Toxoplasmosis (Toxo) infection of the brain caused by *Toxoplasma gondii*	Focal neurologic signs, seizures, and/or altered mental status. CT or MRI scan shows multiple ring-enhancing brainstem lesions

A significant body of scientific literature is available on the OI listed in Table 1. Prior art on African biodiversity species with possible use as treatments for OI will be determined as part of execution of the project as described in Table 2, to prevent possible duplication of research. In this regard it is noted that the plant *Pyrenacantha kaurabassana* is already in the early stages of development for treatment of shingles and oral thrush and will not be considered as a candidate for development by the project team.

Project goal and guiding principles

The goal of the project is to develop a lead for an effective, safe and affordable treatment for OI suffered by people living with HIV/AIDS.

The guiding principles of the project are as follows:

Maximum participation by all member states in all aspects of the project wherever possible. It is recognized that all countries have the potential to contribute to the three elements of this bioprospecting project:

IKS on use of traditional medicines as treatments for OI;
supply of plant material from the countries' biodiversity;
scientific and technical capability;

Recognition that each member state is the sovereign owner of its own biodiversity and indigenous knowledge.
Creation of maximum opportunity for shared learning amongst participants thereby ensuring development of the biosciences skills base of SANBio participating scientists.

Recognition that as a flagship project of SANBio, the focus will be on delivery, shared learning and the development of suitable modalities for cooperation across the twelve member countries of SANBio.

Project objectives

The objective of the project is to establish research collaboration amongst SANBio members to allow harnessing of scientific expertise, indigenous knowledge and biodiversity to develop new treatments of opportunistic infections suffered by people living with **HIV/AIDS.**

The project has the following specific objectives:

Identification of research institutions in each member state that can contribute to the project;
Collection and evaluation of indigenous knowledge relevant to treatment of OI;
Decision on which biodiversity species (medicinal plants, fungi, etc.) to select for the study in a manner that is as inclusive as possible;
Share access to project information through web-enabled database;
Research (taxonomy, biological evaluation, chemistry, pharmacology, etc.) on selected biodiversity samples;
Sharing of information on the project with the National Focal point for the Convention on Biological Diversity (CBD) or appropriate authorities in each country to ensure transparency and that the project conforms to international as well as country-specific legislation;
Based on outcomes of the project, a plan for Phase 2 work to be undertaken to a point of proof of concept for each treatment will be developed and a document describing possible commercialization models will be created.

The project will aim to establish a technology platform for the scientific evaluation of traditional medicines used to treat OI. This platform will be a significant asset of the region that can be used in future projects that focus on related drug discovery projects based on IKS and plant biodiversity.

The project has an above average chance of success because it will benefit from access to two unique African resources: indigenous medicinal plants and a wealth of traditional knowledge on the use thereof with both areas supported by the collective scientific capability harnessed by SANBio eg CSIR has more than 50 years of natural product chemistry expertise. CSIR-Biosciences also has the only Clinical Supply Unit in Africa capable of manufacturing botanical extracts suitable for clinical evaluation.

Table 2: Project tasks, expected outputs, success indicators and budget per activity for Phase 1

Activity	**Due date**	**Deliverable and Success Indicator (SI)**	**Investment (CAD$)**
Meetings to determine the scope of a technology platform required to scientifically validate claims of treatments for OI Identification and selection of most appropriate participating research institutes per country Decision on operating principles for project such as financial controls, disbursements, etc Interaction with local and international experts in commercial development of therapies for OI Determine which OI to focus on.	End November 2005	Deliverable: Document describing the scope of technology platform to be established, illustrating the role each country will play. Success Indicator: Agreement in principle amongst participants on details of technology platform, operating principles of project, identity and role of research institutes and which OI to focus on.	40 000
Intellectual Property Rights (IPR) arrangements: establish protocols for appropriate agreements with traditional medicine practitioners (TMPs) and communities.	October 2006	Deliverable: Document that describes proposed IPR arrangements. Success Indicator: Agreement amongst participants on financial and non-financial benefits to be shared with owners of IK.	45 000
Identification of medicinal plants and fungi for research and development as natural products for the treatment of OI Literature studies on biodiversity species (e.g. plants, fungi, marine species) traditionally used for OI	June 2006	Deliverable: A web-enabled database containing information on biodiversity species used traditionally to treat OI and selection criteria decided upon by the project team; as well as a registry of owners of indigenous knowledge.	160 000

Activity	Due date	Deliverable and Success Indicator (SI)	Investment (CAD$)
treatment Establishing selection criteria to prioritise biodiversity species for research Interaction with owners of IKS on biodiversity species traditionally used for OI treatment that can be sourced from the region Developing and populating an information management system to safeguard IKS		<u>Success Indicator:</u> A fully functional, web-enabled database that allows secure access by all participants to scientific information and indigenous knowledge relating to the project.	
Collection, taxonomic identification of the selected as well as related biodiversity species, extraction, isolation and characterization of drug leads: Collection, extract preparation and screening of selected and related biodiversity species Bioassay guided fractionation to isolate the active ingredient/s Structure elucidation of active metabolites using LC-MS-MS, GC-MS and NMR	March 2007	<u>Deliverable:</u> Report on identified species and related taxa that occur in the region; results of biological assaying of extracts and chemical profiles of lead/s. <u>Success Indicator:</u> At least one treatment for OI based on a biodiversity species from the SANBio region with proven *in vitro* efficacy and chemical description of biologically active fraction and/or compounds.	205 000
Total cost : PHASE 1			**450 000**
PHASE 2			2M
Proof of concept studies		Pre-clinical data on leads	
Decision on commercialisation strategy		Commercialisation documentation	

(The above project as the Flagship is costed in Canadian Dollars. All other projects are in USA$.)

Assumptions

The project proposal is based on the following assumption:

The deliverable dates for each activity are based on the assumption the project can start during August 2005. If the start is delayed the dates will adjusted accordingly.
Each of the participating countries will send at least two delegates (biological and chemical) that can represent the technical capabilities of the country to the first project meeting to be held before November 2005
New biodiversity species with potential to yield active ingredients for treatment of OI will be identified in one or more of the participating countries.

The project participants will obtain regulatory approval from their respective governments to transfer biodiversity specimens and indigenous knowledge to other member states for research purposes.

Sustainability
The sustainability of the project will be determined by success in obtaining funding for Phase 2. The project has been designed to produce deliverables by the end of Phase 1 that are comprehensive and convincing, in order to attract further funding from donor agencies, the private sector and government bodies for Phase 2.

Risks
The project has specific technical and political risks. Technical risks are limited to the identification of suitable biodiversity species for development as treatments for OI. An example of a low risk case is the development of a fast growing herb as a minimally processed herbal medicine in an economical dosage form such as a tea bag. An example of a higher risk case is the development of a new treatment based on synthesis of a novel, active molecule identified from the bark of a slow-growing tree. The organic chemistry and biological assaying required for the project can be harnessed by combining technical capabilities available in the different participating countries.

The political risk is that not all countries have progressed equally far with the adoption of Access and Benefit Sharing (ABS) legislation required at national level in terms of the Convention on Biodiversity. The lack of ABS legislation may hamper the free exchange of biodiversity samples amongst participants from the different countries.

Resources: participating institutions and scientists

The scientists and their research institutions in each of the participating SANBio countries are the most important resources available to the project. A fully participative process will be undertaken to ensure a comprehensive awareness of the project in all member states. The involvement of scientists, owners of indigenous knowledge and/or project leaders from each of the SANBio countries will be sought. The specific institutions and scientists that can possibly participate on behalf of each of the twelve member countries will be dictated by the needs of the project. The project tasks are described in Table 2 but will be refined through a logic frame process involving representatives of each country at the launch meeting **of the project.**

After approval of this proposal, a comprehensive process will be undertaken to identify all possible participating research institutes in each country. These institutes will all be contacted and informed of the project. Each country is required to conduct an in-country process to decide on representatives to attend the key launch meeting of the project, within the constraints of the budget for this part of the project as proposed in Table 2.

The following preliminary information is provided only as an indication of the nature of organizations that will be informed of the project once approved:

Existing consortia of research institutions and universities:
e.g. The Southern African Botanical Diversity Network (SABONET) is an existing

and particularly valuable resource for the project. This international GEF/UNDP-funded project was implemented by the National Botanical gardens of Southern Africa and is aimed at upgrading facilities and strengthening the level of botanical expertise throughout the subcontinent. The participating countries are Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. The key contacts established by SABONET at the national herbaria in each of the participating countries will be important initial contact points for this project

Government departments:
e.g. Ministry of Science and Technology of Mozambique: The National Director.
Ministry of Industry, Science and Technology of Malawi: Department of Science and Technology South Africa.

Owners of Indigenous Knowledge:
e.g. Traditional Healer Committee: The Chairman. Traditional Healer Solomon Mahlaba, Johannesburg, South Africa
Working Groups for Minorities in Southern Africa (WIMSA), Windhoek, Namibia
National Steering Committee for the Confederation of Traditional Healers Associations, Malawi

Regulatory authorities:
e.g. Department of Environmental Affairs and Tourism, South Africa
The National Research Council of Malawi
The CSIR's Bioprospecting programme has a long track record of successful bioprospecting for new medicinal substances. This Programme collaborates with at least 17 different research institutions in South Africa. The Programme is already involved in a Bioprospecting Memorandum of Agreement (MOA) with Namibia and a similar MOA is being considered by Mozambique.

NABSA. A Network for Analytical and Bioassay Services in Africa facilitates natural product scientists to undertake analytical and bioassay services within member university institutions. The Network office in Southern Africa is housed at the Chemistry Department, University of Botswana.

Appendix 2: Project 1 - Integrating Existing Regional Programmes on Conventional and Traditional Herbal Medicine to Prevent and Treat HIV Infection

1. BACKGROUND AND JUSTIFICATION

HIV continues to be a major global health problem, and sub-Saharan Africa is particularly hard hit, with an estimated 26.6 million people living with HIV/AIDS and approximately 3.2 million new infections reported in 2003 (UNAIDS, 2003). Clearly a massively expanded prevention program is required to curb global HIV infection. Current efforts in southern Africa are focussed on vaccine development, various social behavioural education programmes to control infection, as well as the use of traditional herbal medicine and anti-retrovirals (ARVs) to manage the disease in the infected population. Global efforts to develop effective vaccines have been hampered by the variability of HIV strains, and there is a need for an inward looking strategy at a regional scale to coordinate efforts and pool resources to focus on control measures that target HIV strains that are prevalent in the southern Africa.

This project proposes to consolidate regional activities in HIV infection prevention and treatment by adopting a multidisciplinary and multi-faceted approach which integrates research on preventive and therapeutic vaccine development, development of microbicides to aid control of heterosexual transmission of the virus, regional manufacture of ARV's to enhance broader access to these drugs, the use of herbal medicines to treat HIV related infection, retard disease progression or boost the immune system. New and innovative elements need to be added to the existing portfolio of initiatives, such as novel, cost effective platforms for regional production of molecules of interest such as subunit vaccine candidates, anti-HIV microbicidal proteins and ARVs. In many resource-poor settings within the region, a majority of people living with HIV/AIDS depend on and choose traditional medicine for treatment, and it is therefore essential to integrate herbal medicine through the systematic evaluation of traditional remedies and development of leads including identification of active ingredients.

2. Project goals

The broad goal of this initiative is to consolidate, at the regional level, existing conventional and traditional herbal based initiatives to control and treat HIV infection, while integrating novel approaches to address bottlenecks in production of relevant molecules. The approach has three main sub-goals,

2.1 HIV prevention
Preventive and therapeutic HIV vaccine development
Development of anti-HIV microbicides

2.2 HIV disease management
Therapeutic vaccines
Systematic testing of traditional herbal medicine
Local development of ARVs

2.3 Networking cctivities

Regional consolidation of national networks of laboratory research
Regional consolidation of groups working on clinical trials
Regional consolidation of initiatives of streamlining and systematically testing herbal remedies

3 Project objectives

HIV prevention goals will focus on preventive strategies to curb heterosexual transmission of HIV, which is the prevalent mode of HIV transmission in southern Africa. A multi-pronged approach which enhances support for initiatives to develop multi-component vaccines that are targeted specifically against the Clade C HIV strains that are prevalent in Southern Africa, as well as simpler, achievable approaches such as development of microbicides that will curb heterosexual transmission of HIV by blocking the virus before it can attach to the mucosal surface by which it gains access to the body. In the absence of a preventive HIV vaccine, microbicides are a potent tool in controlling spread of HIV infection and particularly empower women, who do not have the social or economic power necessary to insist on condom use and fidelity.

A major limitation in vaccine and microbicide adoption is access to these molecules at a scale that is relevant to regional demand and a cost that is affordable to regional governments. It is therefore prudent that we explore expression systems for vaccine and microbicidal molecules that are cheaper and relevant for implementation in Africa. Several molecules with capacity to block HIV infection have been identified on a global scale, and the potential of these molecules to curb HIV infection within the region will also be explored. Objectives for HIV prevention can therefore be summarized as;

HIV prevention
Initiation and consolidation of research initiatives focusing on the development of a multi-component anti-HIV vaccine
Development of expression systems for cost-effective local production of HIV subunit vaccines and anti-HIV microbicides
Production of specific vaccine candidate molecules and microbicidal molecules for clinical testing
Identification and validation of compounds from regional biodiversity through the use of indigenous knowledge, with anti-HIV potential

HIV disease management

The annual number of new HIV infections in sub-Saharan Africa is estimated at about 3.8 million new infections per year, adding to 26 million people that are already infected by the virus in the region, and the challenge is to manage the disease and maintain the quality of life for this segment of the population. To this end, we propose the following initiatives;

Initiate and consolidate research initiatives into development of candidate therapeutic vaccines
Consolidate initiatives on the systematic testing of traditional herbal remedies that show potential to boost the immune system in HIV affected individuals
Support initiatives exploring the local development of ARVs

Expected output

At the end of the 5 year period we expect the following outcomes;
Candidate multi-component preventive and therapeutic vaccine candidates identified and preclinical data accumulated
Novel, relevant and cost effective expression systems established in the participating institutions.
Specific microbicidal and vaccine candidates produced from different expression systems and ready for trials in primates
Effective traditional remedies characterized and documented
Leads on anti-HIV compounds from regional biodiversity identified
Enhanced regional interaction between institutions working on HIV prevention and treatment.
Skilled human capital along the value chain of HIV viral characterization and identification of candidate vaccine genes, expression of HIV vaccine and microbicidal molecules and regulatory compliant manufacture of these molecules at a relevant scale.

Success indicators

The success of this initiative will be measured by;
Number of vaccine candidates (preventive and therapeutic) molecules identified and tested in primates
Specific molecules expressed in the novel expression platforms supported by the project produced cost effectively
Patents and publications on HIV related publications from research that is directly supported by the initiative
Number of trained scientists/practitioners at different levels in HIV research

Assumptions

Assumptions that made for the success of this project are that;
Some lead molecules, candidate vaccines and microbicidal molecules will prove to be effective against the regionally predominant Clade C HIV strains
Specific molecules will prove to be amenable to the expression systems being developed
Traditional healers and conventional medicine can set up a policy infrastructure to facilitate development of promising leads from traditional herbal medicine
Regional policies remain conducive for regional cooperation in all the areas proposed

Sustainability

The project is expected to yield several tangible products for HIV prevention and treatment that can be made available to the public that requires them on a cost recovery basis. Further to this, research initiatives that are established under the scope of this project will be required to use the funding they receive to leverage additional funding to support their research programmes and achieve the objectives outlined. Finally it is anticipated that patents arising from research supported under this project will in the medium to long term result in revenues being generated through the licensing and royalties of the relevant technologies.

Potential participating institutions

Republic of South Africa:CSIR Biosciences, South African AIDS Vaccine Initiative (SAAVI), National Institutes for Infectious Disease (NICD) LifeLab (Biotechnology Regional Innovation Centre), IKS Unit of DST to identify Traditional Medicines Institute
Zimbabwe: Medical Research Council, African Institute of Biomedical S&T
Malawi: Malawi AIDS Commission
Mauritius: SSR Medical Resource Centre, University of Mauritius
Lesotho: Lesotho Pharmaceutical Corporation
Angola: Agostinho Neto University (UAN): Faculty of Medicine and Faculty of Science
Mozambique: National Institute for Health
Zambia: University Teaching Hospital, National Institute for Scientific and Industrial Research, Zambia National AIDS Council. The list is not final and additional institutions with relevant expertise will be invited to participate where relevant.

8. Budget

Activity*	**Budget US$**
HIV research and vaccine development	**2 500 000**
Development of microbicides to curb HIV infection	**1 000 000**
To develop drugs and therapies (e.g. ARV)to manage HIV infection	**1 500 000**
To develop novel expression systems for local production of subunit vaccine molecules and anti-HIV microbicides	**1 000 000**
Networking activities	**200 000**
Capacity Building and training of PhD students	**1 200000**
Grand Total Over 5 Years	**7 400 000**

**Human capacity building built into all aspects of the project*

Appendix 3: Project 2 - Reducing the negative impact of tick borne diseases, trypanosomosis and their vectors on livestock production in the Southern African Region.

The proposed project will be conducted by National institutions from South Africa, Botswana, Mozambique, Malawi and Zambia.

Introduction

Improvement of livestock productivity in the developing world is severely constrained by vector-borne parasites and the diseases they cause. Among the most important of these are *Theileria parva* (East Coast fever), *T. annulata* (bovine tropical theileriosis), *Babesia bigemina* and *B. bovis* (babesiosis), *Anaplasma marginale* (anaplasmosis) and *Ehrlichia ruminantium* (heartwater), all transmitted by ticks to livestock, and trypanosomosis transmitted by tsetse flies to man and livestock. While certainly significant, the precise economic impact of these diseases on livestock production cannot be accurately determined. The reasons for this are that the diseases are seldom reported and diagnoses are rarely confirmed. Several millions of animals are nevertheless considered to be at risk. The total annual losses caused by heartwater alone range between US$0.3M and US$31.6M in the SADC countries, of which an average of 71% is due to production losses and 28% due to control costs. Losses due to mortality from these diseases usually occur when susceptible animals are moved to, or are reared where the disease is endemic, when vector control methods fail and when the vectors spread. These diseases therefore constitute a major problem to the introduction of more productive animal breeds in areas where the disease is endemic. Effective protection against these diseases will enable farmers to introduce more productive high-grade breeds that will result in increased productivity and income by ensuring sustainable and profitable production, leading to improved human welfare. Livestock with higher productivity will also reduce the need for large herds and thus benefit the environment. Safer and more effective methods of their control would therefore have a tremendous positive socio-economic and social impact on rural and peri-urban communities.

Babesiosis results in a fatal form of anaemia in cattle. It is caused by the blood parasite *Babesia bovis* that is transmitted by *Boophilus microplus* ticks. Immunisation against babesiosis is achieved using organisms of reduced virulence to vaccinate susceptible cattle. East Coast Fever (ECF) is a fatal disease caused by the parasite *Theileria parva* which infects white and red blood cells and is transmitted by *Rhipicephalus appendiculatus* ticks. The current method of immunisation against ECF is by infection of cattle with live organisms and simultaneous treatment with long acting oxytetracycline. Gall sickness is caused by *Anaplasma marginale* and transmitted by a variety of different tick species and biting flies. *Anaplasma centrale*, a less virulent organism, is used worldwide as a live blood vaccine against gull sickness. *Ehrlichia ruminantium* is the causative agent of the disease called heartwater and develops within cells lining the blood vessels of the host. It is transmitted by ticks of the genus *Amblyomma* to wild and domestic ruminants in sub-Saharan Africa and the Caribbean. Protective immunity against heartwater can be induced in ruminants by infection with ovine blood containing virulent organisms and subsequent treatment with antibiotics to control the infection.

All of these vaccines require a cold chain for storage and distribution and most require intravenous administration. Furthermore the immunity indused against field challenges is partial. Therefore there is a need for development of more efficacious.

Trypanosomes are extra-cellular parasitic protozoa that are transmitted by tsetse flies (*Glossina* spp.) and are responsible for severe disease syndromes in man called sleeping sickness and Nagana in livestock. Since the cessation of the Regional Tsetse and Trypanosomosis Control Programme (RTTCP) in 1997, there has been a resurgence of trypanosomosis in the SADC region. Several efforts to develop an effective vaccine for this debilitating disease have been unsuccessful. Control of the disease relies on efforts to eradicate the tsetse fly, the use of trypanocide drugs and utilization of trypano-tolerant (resistant) breeds of livestock. Thus any disease control strategy will be intimately linked to suppression or eradication of tsetse fly populations. Success will depend on accurate knowledge of the tsetse and trypanosome population structure and dynamics in the affected areas.
A number of diagnostic tests have been developed for the detection of infections caused by vector-borne pathogens. However, the tests are primarily used for research purposes and are not simple, sensitive nor specific enough and therefore have not gained widespread use for routine diagnosis. There is therefore a need to develop sensitive and specific diagnostic assays that can aid in tick-borne diseases (TBD) and trypanosomosis control.

All of the above mentioned TBDs coexist with the tsetse fly in several SADC countries and thus affect the same populations of cattle. Therefore an integrated control strategy for ticks, TBDs, tsetse flies and trypanosomosis will be considered in certain geographical areas.

Project goal

To more effectively apply existing control strategies and develop new tools in order to minimize the negative impacts of ticks, TBDs, tsetse flies and trypanosomosis on animal productivity and welfare, to ensure food security, which will contribute to the alleviation of poverty in the SADC region.

Project objectives
Determine the needs of the collaborating countries regarding diagnosis, surveillance and control of vectors and the diseases that they transmit.
Apply novel technologies to develop a new generation of robust diagnostic methods for epidemiological studies against tsetse and tick-borne diseases .
Develop novel vaccines against heartwater and determine the efficacy of existing vaccines against other TBDs.
Elucidate the epidemiology of TBDs and trypanosomosis and develop disease prediction models.
Train Southern African Veterinarians, Scientists and farmers.

DETAILS OF KEY PROJECT ACTIVITIES

1. ***Project launch meeting.*** Host a workshop to facilitate the identification of institutions/entities in the SADC region that are involved in or require diagnostic and vaccine development and, thus, facilitate collaboration between institutes and countries. Carry out a needs assessment, gap analysis and, according to the outcome

of this, establish a plan of activities and strategies that will lead to effective control of TBDs and trypanosomosis and their vectors. The following countries are earmarked to participate: RSA, Botswana, Malawi, Mozambique, Lesotho and Zambia.

2. ***Immunodiagnostic reagents.*** Monoclonal antibodies (mAbs) directed against epitopes on vector-borne parasites can be used as diagnostic reagents or as probes to locate and identify potential vaccine antigens. Making mAbs by traditional hybridoma technology is however slow, expensive and exceedingly labour-intensive. As a result, there remains a need for new mAbs that can be incorporated into immunodiagnostic tests for tick-borne diseases or used as research tools. Recombinant antibody technology now makes it possible to bypass the immune system and provides a realistic alternative to hybridomas as a means of generating highly specific and reproducible binding reagents. The ARC-OVI has constructed a large semi-synthetic antibody repertoire (the *Nkuku* library) that represents a humoral immune system in a few microlitres of liquid, from which antibodies to virtually any antigen can be selected using relatively simple panning methods. These antibodies can be used in place of traditional mAbs in immunoassays such as ELISAs. Techniques are thus in place to rapidly and cost-effectively supplement any existing mAbs against vector borne diseases and to use these novel recombinant reagents to develop a new generation of robust immunodiagnostic methods for field use.
In this project, ARC-OVI would undertake the research necessary to adapt and deploy the available diagnostic tests, so that they can be used alongside other methods for surveillance and control of vector borne diseases in the SADC region. The target users will be Veterinarians and Researchers in the laboratories and farmers of the SADC countries where the vector borne diseases occur.

3. ***Recombinant vaccine development.*** Researchers at ARC-OVI have identified four vaccine candidates for development of a recombinant vaccine against heartwater. When administered as DNA, they induce complete protection in sheep following needle challenge with live parasites. However only 20% protection was obtained under natural challenge. The project will strive to improve the protection observed under heartwater field challenge.
Several international institutes (ILRI, UF and WSU) are currently involved in the development of improved vaccines for East Coast Fever, Anaplasmosis and Babesiosis. We will therefore collaborate with these institutes, to avoid duplication, in efforts to get any new vaccines validated and deployed in the SADC region.

4. ***Molecular epidemiology of TBDs and tsetse-transmitted trypanosomosis.***
New and existing diagnostic tools will be used to monitor tick-borne pathogens and trypanosomes in the collaborating countries. We will establish the prevalence of different trypanosome species/subspecies in defined areas to be covered in field epidemiological surveys. In South Africa we will use different sets of primers in PCR to determine the species/subspecies of trypanosomes in: tsetse saliva, mouth parts and guts and in buffy coats made from blood of livestock and wildlife. We will determine the genotypes of the trypanosome species causing livestock morbidity in the surveyed area and develop markers for use in programs directed at the control of this disease. We will also determine the response of the trypanosomes to veterinary drugs approved for use in treating animals suffering from the disease. This information will allow the veterinarians working in the affected areas to predict the effectiveness in the use of the drugs to control disease outbreaks. Evidence-based advice will be given to

the government authorities and other individuals concerned on how best to manage interactions between wildlife and livestock to minimize adverse effects.

5. ***Determination of tsetse fly dispersal by population genetics.*** With any envisaged control strategy, some aspects of the biology of the insect vector must to be taken into account. Tsetse fly populations have a tendency to inhabit isolated areas of suitable habitat and as a result have a discontinuous distribution of sub-populations within larger areas. The flies, however, have the ability to move between such areas of suitable habitat (determined to be up to 21 km in 5 days) and consequently have the potential to reinvade areas where the target population(s) have been eradicated or suppressed. It is of great importance to determine the dispersal potential of populations in regions that are targeted for tsetse control by any means. Dispersal characteristics can be determined physically by release and recapture of marked insects but this is a time consuming and expensive procedure. By applying population genetic analysis methods that determine gene flow between populations, the dispersal of flies can be measured indirectly.

The prime objective of the proposed work will be to develop tsetse population genetics as a means to assess population isolation and gene flow between populations, and to monitor the source of flies emigrating from other areas. No institution is undertaking similar work in the SADC region. Tsetse will be sampled from specified areas at different seasons within each target area. Samples will be processed for application of a series of genetic markers and geometric morphometry of head, wings, and external genitalia. Initially, the various population markers would be cross-validated against existing species classification based on morphological characters, and then analysed for geographical and seasonal population clustering using GIS thematic mapping techniques. This would be an interactive process, assessing the relative value of different markers and the level of geographical and seasonal stability of the populations.

The long-term aim is to build high resolution tsetse distribution maps at the population level, in order to plan optimal placing of barriers during the course of control interventions, and to monitor the likely source population of any flies subsequently encountered in intervened areas. The main research objective of this proposal however, is to validate the most appropriate genetic and morphological markers for such studies, and to develop scientific capacity to continue the work into other areas in the future. The proposed academic network will therefore emphasise training in population genetics, use of GIS and population modelling, and international collaboration between academic institutions and control services.

6. ***Training and capacity building.*** Several students will receive formal training to obtain higher degrees (two MScs and one PhD per country). Researchers from the collaborating countries will receive training in diagnostic and vaccine development methods, and practical application of the tools and control strategies in the field. Because community participation is recognized as the cornerstone in any sustainable technology transfer policy the livestock owners will be involved at all levels of the project. This will require farmer education and training on control strategies, information on diseases, vectors and cost benefits. Exchange of information workshops will be organized regularly for all the role players.

7. ***Integrated vector management.*** There is no single or potential control option that will provide the ideal means to control ticks and tsetse flies and therefore, an integrated approach is seen as the way forward. A pilot project to this effect will be carried out in South Africa where ticks and tsetse coexist and control is currently by the application of chemicals on cattle. Diagnostic tools will be used to monitor tick-borne and trypanosome transmission and to monitor endemic stability to TBDs. We will apply the socio-economic and epidemiological data and develop models to help advice on the appropriate cost-effective and environmentally acceptable control strategies.

8. ***IKS.*** Indigenous livestock care involved the use of natural products available in the community to take care of livestock health. These products are extracted from plants (leaves, bark, roots and wood) and mineral soils. The system has been practiced in all parts of the region but has been marginalized by western systems. These IKS practices need to be promoted given the high cost of western livestock health care products.

Outputs

A document describing the needs and planned strategies for the participating countries.
A panel of simple, user friendly and specific diagnostic tools that can be used by farmers.
Novel vaccine against heartwater and efficacious vaccines against other TBDs.
Decision support systems for control of vectors and the diseases they transmit.
Models of integrated disease control.
Trained veterinarians, scientists, providers and farmers.
Publications in peer reviewed journals and reports in popular media.

Innovation potential

Affordable new generation vaccines and diagnostic tools available in the market.

Assumptions

All countries identified will participate.
Each participating institute/country will send one delegate to the project launch meeting to represent their technical capabilities.
Adequate funding will be available to effectively carry out the said activities.
The developed technologies and products are acceptable to the participating countries.
A commercial partner will be interested to upscale, manufacture and distribute the developed products.

Risks

It may not be possible to develop effective vaccines or simple and specific diagnostic tools for these diseases due to the limitations of the existing technologies.
Infrastructure constraints may hamper vaccines that require a cold chain.
Products may not be acceptable to the governments of the target countries.
The economy of the participating countries may deteriorate to such an extent that the project cannot continue.
The commercialized products and services are beyond the means of the target population

Sustainability

Commitment from the respective governments to support and implement the findings/outputs of the project.
The people who benefit from use of the products are willing to pay for the developed products.

Project activity, deliverable, success indicators and budget per activity

Activity/Milestone Details		Start month	End month	Deliverable	Success Indicator	Budget (US$)	Total Budget 5 years (US$)
1	Project launch/planning meeting Needs assessment and strategy planning for each collaborating country	1 2	4	Document describing the needs and planned strategy of control	MOU between collaborating countries	20,000	40,000
2	Immunodiagnostic development	6	60	Immunodiagnostic reagents and tools Publications	Adoption, utilization and commercialization of diagnostic tools	250,000	1,000,000
3	Vaccine development to TBDs	6	60	Live, inactivated and recombinant vaccines Publications	Effective control of TBDs	600,000	3,000,000
4	Epidemiological surveys and rapid appraisal of impacts	12	60	Decision support systems Publications	Decrease in disease incidence and vector populations	250,000	1,000,000
5	Pathogen characterization and control strategies	12	60	Diagnostic and vaccine candidates Publications	Efficient vaccines and diagnostic tools	100,000	500,000
6	Integrated control strategies and models	36	60	Decision support systems Publications	Decrease in disease incidence	100,000	200,000
7	Training	12	60	2 x MSc; 1 x PhD Per country	Trained individuals working effectively towards disease control	200,000	800,000
8	IKS	6	48			50,000	250,000
9	Conference attendance/ travel	12	60	Posters and presentations		20,000	100,000
	TOTAL						

Resources: participating institutions and scientists
South Africa:
The Agricultural Research Council (ARC) works within the framework of the Department of Agriculture, Directorate of Veterinary Services. The Onderstepoort Veterinary Institute (OVI) is a component institute of the ARC and will be coordinating the project. Currently the ARC-OVI is involved in research and development of novel vaccines and diagnostic tools, surveillance and production of live vaccines against TBDs. This laboratory will coordinate and conduct the research and deployment of control strategies in tick and tick-borne diseases. In addition to

these activities they will be involved in training of veterinarians, researchers, service providers and farmers.
Dr A.J. Musoke, Research and Technology Manager, Agricultural Research Council – Onderstepoort Veterinary Institute, Private Bax X5, Onderstepoort, 0110, South Africa. Tel +27-12-5299338, Fax: +27-12-5654667, e-mail: MusokeT@arc.agric.za.

Botswana:
The NVL is the only veterinary laboratory in Botswana, and has diagnostic and food hygiene sections. The government has recently increased the capacity of the laboratory to support the dairy industry. This laboratory will participate in research and deployment of control measures in tick and tick-borne diseases. In addition to these activities they will be involved in training of veterinarians, researchers, service providers and farmers. K.E. Baipoledi, National Veterinary Laboratory, Private Bag 0035, Gaborone, Botswana, Tel: 3928816, Fax: 3928956, kbaipoledi@gov.bw.

Malawi:
A vaccine production centre was built in Lilonqwe under the sponsorship of FAO and the sole purpose was to produce vaccines against TBDs. The main activities are to provide technical services to country programmes on TBDs and related maters. They train veterinarians in veterinary epidemiology and economics. They will be involved in research and deployment of novel vaccines and diagnostic tools against TBDs, developed in this proposal. In addition to these activities they will be involved in training of veterinarians, researchers, service providers and farmers. Dr M. Mulumba, Director, Centre for ticks and Tick-Borne Diseases, Private Bag A-130, Lilongwe, Malawi.

Mozambique:
The CVL in Maputo and 9 provincial laboratories mostly perform parasitological services and epidemiology of TBDs and tsetse and trypanosomosis control. They will be involved in deployment of diagnostics and vaccines of TBDs and tsetse and trypanosomosis research and control. In addition to these activities they will be involved in training of veterinarians, researchers, service providers and farmers. Dr M.R. de Silva, Director – National Veterianry Institute, P.O. Box 1922, Maputo, Mozambique. Tel: 258-1-475161, Fax: 258-1-475172, e-mail: reislsilva@hotmail.com

Zambia: The collaborating centre is Central Veterianry Research Institute, Balmoral. They are involved in the deployment of live vaccines against TBDs and epidemiology of tsetse and trypanosomosis. In addition to these activities they will be involved in training of veterinarians, researchers, service providers and farmers. They will be involved in deployment of diagnostics and vaccines of TBDs and tsetse and trypanosomosis research and control. In addition to these activities they will be involved in training of veterinarians, researchers, service providers and farmers. Dr. S. Kabilika, Ministry of Agriculture and Co-operatives, Central Veterinary Institute, Balmoral, P.O. Box 33980, Lusaka, Zambia.

Collaborating advanced and international Research Institutes

ILRI – The International Livestock Research Institute has the mandate to enhance the wellbeing of the present and the future generations in developing countries through research to improve sustainable livestock production. The contact scientist is Dr J. MacDermott. P.O. Box 30709, Nairobi, 00100, Kenya. ILRI has expertise in the development of recombinant vaccines against Theileriosis and epidemiology of trypanosomosis. They have developed molecular based diagnostic tools for TBDs and trypanosomosis. We shall be collaborating with them in these areas.

Washington State University and University of Florida are renown academic institutions located in the USA and have a long standing interest in the development of control strategies of diseases in the developing world. They are currently involved in the development of recombinant vaccines and molecular based diagnostic tests for TBDs (heartwater Babesiosis and Anaplasmosis). We have ongoing collaboration in heartwater and anaplasmosis and we shall be expanding this collaboration to include the other TBDs.

Appendix 4: Project 3 - Development of nutritionally enhanced sorghum and millet for arid and semi-arid areas of southern Africa

Executive summary

This project is designed to address directly the requirement to increase the productivity of two orphan annual under-utilized crops that are important for the livelihoods of people leaving in local communities in Africa. Sorghum (*Sorghum bicolor*) and pearl millet (*Pennisetum glaucum*) have been selected as model crops for this project because of their unique characteristics. The nutritional traits that will be introduced will be vitamin A and E, amino acid: lysine and methionine and micronutrient zinc and iron. Three different approaches will be used to introduce these traits into sorghum and millet. The first approach will be the genetic engineering approach which will involve transformation of sorghum and millet with genes known to improve the nutrition of these crops. The second approach will be by non-conventional mutational breeding using gamma irradiation or cyclotron mutagenesis to enhance nutrition. While the third approach will be by conventional breeding using introgression breeding to introduce the traits of interest into locally accepted and adapted lines in the different regions. Capacity building embedding scientific excellence in nutrition will play a significant role in this project.

Introduction and justification

Sorghum and millet are the second and third most important cereal crops in Africa and on world basis they rank fifth and sixth respectively. They are grown in the harsh semi-arid tropics of Africa where inadequate rainfall and lack of irrigation make production of other cereal crops difficult to sustain. A general impression is that research to improve sorghum and millet has generally lagged worldwide because they are not grown as food crops in the developed world. In the past decade or two, therefore, activities of international donor-sponsored research programs, such as the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) and INTSORMIL have increased in the region and been a major source of research support to African National Agricultural Research System (NARS) attempting to improve sorghum and millet-based technologies. However, despite their importance in African agriculture, little is known about the extent of the research effort by African NARSs to improve sorghum and millet technologies.

Impacts of Sorghum and Millet Research

Research efforts carried by these international donors have been directed towards improved yield of these crops. The available evidence on the release and adoption of improved sorghum and millet varieties in Africa is still very limited. Research programs are under increasing pressure to increase the adoption of these varieties and quantify their impacts, if they are to continue to receive donor and government support for their research. A few Southern African countries, notably, South Africa, Zimbabwe and Zambia have started using these improved varieties and the immediate advantage that they are experiencing is the high tonnage per hectare that they are harvesting.

In 2003, the global area harvested to sorghum was 47 million hectares of which 24 million hectares are cultivated in Africa. Total sorghum production in Africa is 20 million metric tones. Sorghum is consumed in the form of stiff or thin porridges, as a steam-cooked product, such as couscous or as a beverage. It is the main cereal in

many arid and semi-arid countries in Africa. The consumption data on sorghum and millets can be considered as only the best estimates that are available, as production data from small subsistence farms are difficult to obtain in any country (FAO). It is also likely that grain distribution and consumption throughout the semi-arid tropical regions vary widely among seasons, communities and families.

Nutritional deficiencies of sorghum as staple food. Sorghum and millet grains have a nutritional profile similar to corn and other cereals (Shewry and Halford, 2003), i.e. it shares the typical nutritional deficiencies of cereal grains, a low content of the essential amino acids lysine, threonine, tryptophan and sulphur amino acids; and a low bio-availability of iron and zinc. Therefore, a diet, based mostly on sorghum or millet, is not adequate to meet the nutritional growth or maintenance requirements for children and adults and needs to be supplemented with essential amino acids and micronutrients.

Micronutrient malnutrition and biofortification. Billions of people in developing countries suffer from an insidious form of hunger called micronutrient malnutrition. Vitamin A deficiency is the leading contributor to child mortality in developing countries. This key nutrient is crucial for effective functioning of the immune system. Though on the decline as a result of supplements, vitamin A deficiency still affects the ability of 250 million children to fight off deadly diseases such as HIV/AIDS, malaria and diarrhoea. It is also the single most important cause of blindness among children (Potrykus, 2003). Molecules of the vitamin E class are essential components of the human diet because they perform numerous critical functions including quenching and scavenging various reactive oxygen species and free radicals and protecting polyunsaturated fatty acids from lipid peroxidation (Shintani and DellaPenna, 1998). Iron and zinc deficiencies are the most widespread nutritional disorder in the world affecting around 3.5 billion people. Iron and zinc and amino acid deficiencies impair immunity, making humans susceptible to infections and risks of complications during childbirth and pregnancy. Also, these deficiencies profoundly impair the child development.

A sustainable intervention strategy is to enhance vitamins, amino acids and minerals in the crops that are grown and consumed regionally through genetic engineering or mutation breeding. Once the plants are developed and being grown by farmers, there are no costs year in and year out of buying the fortificants or supplements because the crops will be sustainable and will be grown in rural communities that generally do not benefit from fortification programmes (Bouis, 2002). A delivery system of this nature will be acceptable in Africa if there is ownership of the final product, a robust regulatory environment, risk assessment, public acceptance and buy-in from the governments.

The second technique that will be used to produce new lines will be the cyclotron mutagenesis technique. In these techniques, all sorts of mutations will result after treatment. It is hoped that some useful traits like drought resistance may occur after treatment. Drought is one of the most difficult challenges faced by resource-poor farmers and agriculture in general. It is a complex stress extensively studied but poorly understood by plant scientists. The sustainability and predictability of crop production in Africa is already severely restricted by environmental factors particularly drought. Moreover, it is predicted that Africa is heading for a period of even more prolonged drought, which researchers warn could be among the most

severe in decades. For example, the current drought situation in countries like Zimbabwe, Namibia and many other Southern African countries is worsening. Remedies have to be taken to avoid starvation of children and livestock. Many African countries depend on rain-fed agricultural systems for crop production. The recent inconsistency in rainfall patterns in Africa has resulted in crop failure and famine. The need for improved crop plants with greatly enhanced tolerance to water deficits is thus real and urgent in the drier parts of Sub-Saharan Africa.

Background information
Research on nutritional enhancement of orphan crops through a genetic engineering approach is currently been carried out at the Hub. Over the past six years, as a result of European Union funding on sorghum and millet, this group has perfected the techniques of transforming orphan crops. The Hub is well equipped with modern facilities in genetic engineering research and is currently participating in a Bill and Melinda Gates sorghum nutrition enhancement project.

Cyclotron mutagenesis
A combined project between a team of leading institutions in Southern African and a Japanese team will be using the techniques of cyclotron mutagenesis to mutate African crops like sorghum, millet, cowpea and maize. The mutants will be screened for different biotic and abiotic stresses. This project will start in December 2005. The mutagenesis work will be carried out in Japan and the mutants will later on be brought to Southern Africa for further evaluation.

Integrating Indigenous Knowledge Systems (IKS) into developing a nutritionally enhanced sorghum and millet
Sorghum and pearl millet have been the staple foods in Southern Africa for millennia. Both are hardy and drought-tolerant, more suitable for semi-arid environments than maize or wheat. Largely small-scale subsistence farmers produce both. Various indigenous methods of production, harvesting, processing and storage of sorghum and millet are still widely used, particularly in those parts of the semi-arid tropics where sorghum and millets are grown primarily for human consumption. These knowledge systems form an important base for the improvement of sorghum and millet in the region.

Project goal
The goal of this project is to develop sorghum and millet varieties that are drought tolerant and have elevated levels of essential amino acids; lysine and tryptophan; vitamins A and E; iron; and zinc which are deficient in sorghum and millet. Taking cognizance of the limitations of classical breeding in the area of nutrition in fortifying sorghum and millet with these essential amino acids, vitamins and minerals, our strategy will rely on genetic engineering and mutation breeding.

Project objectives
The project objectives are:
To utilize recombinant DNA technology in developing clean constructs and vectors with the genes that impact amino acids, vitamins and minerals.
To grow and evaluate greenhouse and field grown transgenic plants.
To use the technique of cyclotron mutagenesis in producing new sorghum and millet lines with useful traits that will add value to sorghum and millet.

To use introgression breeding approaches to select elite varieties that are both adaptable and acceptable to target geographic regions.
To develop regulatory, public acceptance and biosafety strategy for laboratory-based and field-grown plants.
To develop capacity in GM and mutation breeding techniques.

Currently only South Africa, Zimbabwe and Malawi are strong in genetic engineering, biosafety and risk assessment analysis on GM crops. The remaining nine countries are still catching up with these technology. This project will be used bridge the gap with the remaining nine countries in the region.

Expected outputs
Sorghum and millet transformed/mutant seeds with elevated levels of vitamin amino acids and micronutrients that will be used by small and medium size farmers.
Increased public acceptance of GM and mutant crops in Africa.
Capacity developed to implement these technologies in the different SADC countries.

Success Indicators
The technology should be adapted and accepted by local communities.
Involvement of commercial partners to take the technology further.
More biosafety and risk assessment scientists trained in the SADC countries.
Buy in from the different governments
MSc and PhD students trained in the region

Assumptions
Existing projects will accommodate new partners in the region.
Communities will accept GM and mutant crops
Point mutations may occur when embryos are used for selection

Sustainability
Africa will stop depending on foreign aid for biofortication programmes
The technology could be used to introduce new traits of interest into other crops

Participating Institutions
RSA: CSIR Biosciences
ZIM: Biotechnology Research Institute, Crop Breeding Institute
MAL: Chitedze Research Station
MRU: Food and Agricultural Research Council
LES: Department of Agricultural Research
ANG: Institute of Agricultural Research
MOZ: Eduardo Mondlane University (Molecular Biology Lab),
ZAM: National Institute for Scientific and Industrial Research, Zambia Agricultural Institute, School of Agricultural Sciences

Indicative Budget

Activity	**Amount US$**
Vector construction and transformation	600,000
Molecular analysis and consumables	1,270,000
Cyclotron mutagenesis	550,000
Greenhouse and field studies	580,000
Conduct an audit of Indigenous methods and techniques of production, post harvest, different sorghum varieties and storage operations in the different countries of the region	200,000
Training of 5-7 MSc and PhD students from the region	2,000,000
Total	**5,200,000**

Appendix 5: Project 4 - Establishment of a network on fish biodiversity of inland waterbodies of southern Africa

Introduction and justification

About 12% of all animals live in freshwater, representing about 42% of the world's fishes and 25% of the world's mollusks. Freshwater ecosystems harbour about 44,000 of the world's 1,868,000 described species. This constitutes a high species-rich group of habitats because fresh waters occupy only 0.8% of the Earth's surface. Species decline in these ecosystems is due to habitat loss, degradation, water withdrawal, overexploitation and pollution and introduction of non-native species. Most of these factors usually occur in combination and mainly accelerated by human activities.

Globally, freshwater fisheries are the most heavily exploited aquatic resources, producing about a quarter of the world's food fish (some 20 million tonnes per year) from less than 0.01% of the world's water resources. In southern Africa fisheries play a very important role as source of food, income and employment. For example, in the Caprivi Region, local human population heavily rely on subsistence fishery as an affordable protein source. In Malawi, fish contributes about 4 per cent to the country's Gross National Product (GNP), employing over 300,000 persons and nearly 1.6 million people derive income from fishing, fish processing, marketing and trading, boat and gear making and allied industries. According to FAO, freshwater catches in 12 SADC countries steadily increased from 168 000 tonnes in 1961 to 598 000 tonnes in 1986 and have stabilized between 600 000 and 700 000 tonnes per annum. The increases over time are due partly to exploitation of new water bodies (e.g. Lakes Kariba and Cabora Bassa) and fishing previously untouched stocks, as is the case with small pelagics. On the other hand, fishing pressure on already exploited stocks has continued to increase during the same period although with large variations among water bodies.

The freshwater ecosystems of southern Africa contain some of the world renown fish biodiversity hotspots, for instance, Lake Malawi harbours more than 500 endemic fish species. These have been subjected to extensive exploitation to the effect that the stocks have generally declined and diversity at both species and genetic levels has been affected. The situation is worsened by the fact that the inland waterbodies of the region are poorly studied hence the existing species diversity is not well documented. Unless the biodiversity is known, it remains a challenge for the region to develop appropriate and effective biodiversity management strategies. The Southern African Development Community (SADC) Protocol on Shared Water Systems and Protocol on Fisheries require that state parties take appropriate measures to regulate the use of living aquatic resources and protect the resources against over-exploitation while create an enabling environment and build capacity for sustainable utilisation of fisheries resources. Establishment of an aquatic biodiversity programme for inland water bodies of Southern Africa should therefore provide a platform for implementing provisions of these protocols through knowledge generation and designing measures for preventing continuous destruction of stocks.

Riverine fish species in the region require urgent attention. While several international research and development projects have focused specifically on the open water and nearshore systems of lakes, elements of the fish stock that utilise inflowing rivers for spawning barely have been investigated. Consequently the riverine species biodiversity has been poorly understood and the value of riverine fish stocks grossly underestimated. The breeding behaviour and habitat utilisation of *Serranochromis robustus* in the Zambezi River system have only recently been investigated, while riverine fishes of inflow rivers of Lake Malawi such as *mpasa (Opsaridium microlepis*) are feared to be endangered due to fishing of breeding populations that swim upstream to spawn. Surveys of riverine species of Zambia suggest that drainage patterns have significantly influenced the genetic lineage of the populations of the same species and/or genus and yet extensive species introduction that has taken place in Zambia may pose danger of introgression leading to genetic contamination of indigenous gene pools in the drainage systems.

With decline in capture fisheries and increasing demand for fish due to recent campaigns to promote fish consumption among traditionally non-fish-eating communities, aquaculture production has been adopted by most countries in southern Africa. Genetic improvement of farmed fish is limited due to shortage of expertise and limited support for research and development. Yields from aquaculture are therefore low due to lack of improved strains for dissemination to farmers. Genetic diversity of cultured populations is also low due to unwitting hybridization which leads to introgression and due to inbreeding depression because of small population sizes in the farms. Lack of genetic knowledge has unfortunately resulted in poor quality genetic material being farmed which responds poorly to inputs like improved feed and other improved husbandry. The aquaculture industry in southern Africa has also been a major but “silent” source of genetic pollution because of inadvertent introduction of fish from one water body to another without proper knowledge of genetic population structure of the various stocks and genetic uniqueness of populations in the various ecosystems some of which are not connected.

Research on fish biodiversity has been carried out but has generally lacked continuity due to limited number of scientists trained to conduct such surveys and lack of infrastructure. There is need to generate a critical mass of scientists that can conduct fish biodiversity research and development and provide information on management of species. A network on fish biodiversity of inland waterbodies of southern Africa would therefore reverse the situation by generating information on which decisions can be based, develop a critical mass of individuals that will carry out research on fish biodiversity assessment, and provide shared research facilities for carrying out inventories and genetic improvement programme for aquaculture.

Establishment of a fish biodiversity network for southern Africa
The network will contribute to improving the capacity of member countries in developing and disseminating improved strains for aquaculture, and providing data and information on fish biodiversity for developing management strategies of inland aquatic ecosystems. It will address social and environmental concerns related to genetic improvement. The network will also increase interaction and collaboration between the region and advanced research institutions.

The overall objective of the regional network is to link the institutions in the member countries and other organizations involved in fish genetics research and development.

Through formation of the network, there will be better coordination and strengthening of inland fisheries and aquaculture biodiversity and genetic improvement research within the region. The networking will facilitate collaborative research among institutes working with the common goal of enhancing aquaculture production through genetic improvement and conservation of biodiversity of riverine and other inland waterbodies populations. The network will tackle issues on intellectual property rights (IPR) and conservation of aquatic germplasm in the context of genetic improvement.

Programme goals
The goals of the programme are to provide the required biodiversity information through establishing a regional network of experts and institutions on biodiversity assessment, genetic improvement and collating information on status and distribution of biodiversity throughout the inland waters of southern Africa.

Objectives
In order to achieve the above goal the immediate objectives are:
To improve knowledge about biodiversity of inland lakes and riverine fish resources and the interactions between fish resources and riparian communities
To develop competence and capacity in Southern Africa for sustainable management of lake and riverine fishes
To improve the capacity of local public and private institutions in southern Africa to conduct basic and applied research in different areas of aquatic biodiversity
To enhance the application of indigenous knowledge in managing fish resources.

Need to identify the water bodies or ecosystems that will be covered. Which ones have been studied and which ones have not been studied?

Expected outputs
Knowledge about biodiversity of inland lakes and riverine fish resources and the interactions between fish resources and riparian communities generated
Competence and capacity in southern Africa for sustainable management of lake and riverine fishes developed
Capacity of local public and private institutions in southern Africa to conduct basic and applied research in aquatic biodiversity improved
Use of indigenous knowledge in managing fish resources improved.

The main feature of this programme will be in the following thematic areas:
Fish and other aquatic animal biodiversity assessment
Genetic improvement of cultured species
Application of indigenous knowledge systems in fish biodiversity assessment and management
Socio economic studies related to conservation of fish resources.

Success Indicators
What are they? List some!

Assumptions
Inland waterbodies provide immense benefits for the livelihoods of many of the world's poor but unless these benefits are realized, in dollar values, it remains extremely difficult to convince national governments, private sector and policy makers to invest in conservation of aquatic biodiversity. Fishes from most of the inland waters, especially rivers, are consumed within rural households and never enter the formal markets.

Sustainability
The sustainability of the network will depend on commitment of members and having a well developed work plan, adequate funds, champions, coordination. It should be able to link the various initiatives in the field of aquatic biodiversity at the national and regional levels into a coherent plan.

Participating Institutions
Establishment of the network would be championed by the following institutions in the region; Bunda College and Chancellor College of the University of Malawi, Fisheries Research Unit of Malawi Fisheries Department, Department of Ichthyology and Fisheries Science of Rhodes University, University of Fort Hare, South African Biodiversity Institute, School of Natural Sciences at the University of Zambia, and University of Namibia. The World Fish Centre, IUCN-ROSA and the Norwegian Institute for Nature Research will be some of the collaborating regional, international and developed country partners.

Indicative Budget

Activity	**Amount US$**
Establishment of the network	600,000
Fish and other aquatic animal biodiversity assessments	2,500,000
Genetic improvement of cultured species	2,000,000
Application of indigenous knowledge systems in fish biodiversity assessment and management	300,000
Socio economic studies related to conservation of fish resources	300,000
Total	**5,900,000**

Appendix 6: Project 5 - Southern African indigenous knowledge systems in biosciences initiative for Networking and research

Introduction and justification
Indigenous Knowledge (IK) refers to a distinctive body of knowledge and skills including practices, technologies that have been developed over many generations outside the formal educational system, and that enables African communities in their specific environments to survive. Indigenous knowledge (IK) is a significant resource, which could contribute to the increased efficiency, effectiveness and sustainability of the development process in the Southern African region and the continent. It is a key element of the social capital of the poor and constitutes their main asset in their efforts to gain control of their own lives. For these reasons, the potential contribution of IK to locally managed, sustainable and cost-effective survival strategies should be promoted and supported in the development process. The role of indigenous knowledge in innovation and economic value of biosciences for sustainable development and community livelihood, which need to be promoted through research and networking in the region and the continent is shown in the following areas.

Indigenous knowledge and agro biodiversity represent a strategic force to combat the concurrence of food and nutrition insecurity and AIDS impact among poor communities. Their roles in household food security and nutrition, as well as in coping with evolving conditions such as the HIV/AIDS impact, have been poorly recognized and supported by both governmental and non-governmental organizations. The effective integration of indigenous knowledge in agro biodiversity activities for food security and AIDS mitigation at household and community levels, therefore, requires thorough documentation and research. Due to the nature and urgency of the problems of food insecurity, nutrition and HIV/AIDS in the region and the continent, participatory and grassroots-oriented research is needed to better advance the understanding and share the results among different stakeholders in the region and the continent. Key research issues include documenting the role of agro biodiversity and indigenous knowledge in local communities coping strategies including emerging grassroots initiatives that integrate agro biodiversity, food security, and HIV/AIDS mitigation, as the basis for further action and co-operation
Sustainable agriculture has emerged as a key issue in agricultural development and natural resource management in the region because of widespread land degradation. Experience in various countries of the region and the continent indicates that the utilization of indigenous knowledge by small-scale farmers has made great contribution toward successful implementation and adoption of innovations developed in various research institutions. Farmers can be excellent conservators of biodiversity. Small-scale, resource-poor farmers in various countries using indigenous knowledge, breed local crop varieties for improved production using informal innovation systems. They often employ their own taxonomy, encourage introgression, select, hybridize, field test, record data and name their varieties.

Polyculture is the norm in farming systems in many parts of the region and the continent. It is an indigenous strategy to promote diet diversity, income generation, production stability, and minimization of risk, reduced insect and disease incidence, efficient use of labor, intensification of production with limited resources and maximization of returns under low levels of technology. These characteristics of polycultures that make them desirable for sustainable community livelihood tend to be

ignored by western agricultural researchers. But recently research concerning polycultures has blossomed and some of their benefits are becoming clear.
In different parts of the region, fishing provides the source of livelihood of large numbers of people, but it tends to be neglected by government and other development agencies. Traditional knowledge and technology based upon generations and lifetime experiences reflected and manifested in a variety of norms, institutions and networks have reduced the uncertainty and helped fishermen accommodate risks in fishing. The survival of the fishing industry in the various countries of the region has depended more on traditional skills, knowledge, techniques of combining occupations and applications of efficacious rituals rather than modern knowledge and technology whose impact has/is negligible. Traditional knowledge and associated technologies have made the fishing occupation sustainable over generations. Various countries in the region fishermen/women at the lakes and along the rivers have over the years developed their own methods of conserving and distinguishing among fish species based on morphometric characters and fish behaviour. This knowledge has been passed on from several generations but has not been well documented.

Indigenous livestock care is a system where indigenous products available in the community are used to take care of livestock health. It is a system, which uses natural products, thus protecting the environment. Indigenous livestock health care products are extracted from plants (leaves, bark, roots and wood) and mineral soils. The system has been practiced in all parts of the region. The introduction of western livestock drugs marginalized the use of these indigenous livestock health practices. However, in many areas of the region indigenous livestock health care is still in practice. The strategic uses of plants, especially trees not only provide medicinal compounds, but also fodder and other benefits beyond that of soil rehabilitation and conservation. These IKS practices need to be promoted given the increasing unavailability and increasing prices of western livestock health care products.
Although wild mushrooms form a significant part of the traditional diet of many African families in the region and the continent, mushroom culture is not widely practiced. This is despite the fact that Africa is home to one-quarter of the world's mushroom species, many of which could, in theory, be cultivated. Traditionally in most African countries, women and young girls collected wild mushrooms at the start of the rainy season. In this way, knowledge of which mushroom species are edible was passed from generation to generation. There is an increasing realization among different communities on the importance of mushroom production. Mushroom projects are now developing in various countries in sub-Saharan Africa. Mushroom production has not only provided a new cash crop, but it is also providing a means of recycling waste materials. The trend is most countries is to involve women and youth in these projects because they are the ones most affected by unemployment and poverty.

In the area of human health care, indigenous knowledge and associated biological resources are becoming the basis for the management of ill health and various types of diseases such as HIV/AIDS, Malaria, TB, etc. The African communities' use of herbal medicine is based on a confluence of two factors: their belief in the efficaciousness of their herbal medicine, and the high cost and inaccessibility of western health care.
Another important area where indigenous knowledge makes a significant contribution in community livelihood is in water management. Water scarcity in arid and semi-arid areas of the region poses a grave threat to the well being of people. The

conventional approach to this problem has been to emphasize western technologies over indigenous forms of water management, without seriously considering the potential benefits of the latter, which have evolved with the local environment and are specifically adapted to local conditions. The majority of the indigenous people in the region possess accumulated practical knowledge of their arid environment through experience and productive activity. They have used various sustainable water management systems and methods, which enable them to secure food, income, employment, and social welfare, diversifying crops and preserve animal and crop species over the years. Therefore, the involving of indigenous people, and their knowledge of local conditions and techniques, can be used to protect and supplement dwindling government and non-governmental financial ad other resources.

With regard to the importance of promoting research and network initiatives among different countries and institution in the region and the continent, although IK has proven its validity over centuries there are areas where scientific validation may be required prior to the sharing of such IK practices beyond the original context and location. A case at hand is herbal medicine, where validation could help to provide assurances of safety and effectiveness. Experiences from various countries in the region demonstrate that functioning partnerships in R&D in various areas of the biosciences covering community-based organizations, NGOs, academia, the private sector, government, and the donor institutions can significantly enhance the chances of success in the use of IK for development. IK need to be developed by integrating indigenous knowledge practices into local, national, regional, or even global development efforts.

However, experience has shown that one institution or country alone cannot do this. Therefore, partnerships are needed to support this process at all levels. This is due to the increasing realization that IK in the biosciences offers the region and the continent with development models that are both ecologically and culturally sound. The globalization process, however, has made it imperative that Africa's indigenous knowledge systems, particularly in science and technology, as a tool for promoting sustainable community livelihoods, cannot be ignored. Africa is increasingly seen as part of the global village. The challenge for Africa is to create the right environment for research and development in IKS.

A number of IKS in bioscience human and infrastructure capacity building networking activities are already taking place the various countries of the region including South Africa, Malawi, Zambia, Lesotho, Mozambique, Angola, Namibia, Zimbabwe, Seychelles, Mauritius, etc. The activities covered include establishment of government accredited under- and postgraduate IKS teaching and research programmes; government IKS policy development; commercialization of indigenous plants and fruits; fisheries/aquaculture; ocean biodiversity; IKS in human and animal health research.

The holistic nature of IK implies that it is inter-disciplinary and cuts across all the other flagship areas identified by NEPAD Science and Technology. The IKS in biosciences research and development activities, which are taking, place at individual, institutional and national levels, need to be coordinated so that they can contribute to the sustainable development of the region and the continent. The establishment of a regional network is seen as one of the ways of mobilizing scientific, technical and financial resources for

promotion of research and development in the region.

Project goals
To setup a viable IKS network within the biosciences initiative that will effectively contribute to sustainable development in the region.
To unlock the full potential of African Indigenous Knowledge Systems within the biosciences through research and innovation.
Project objectives
To promote cross-country sharing of information on IKS in the biosciences within the Southern African Network on Biosciences through networking and partnerships;
To promote R&D of IKS in the biosciences;
To enhance publicity and awareness of the role of IKS in biosciences within the Southern African Network on Biosciences;
To promote capacity building of IKS in biosciences through education and training;
To facilitate the development of policy and legislative frameworks of IKS in the biosciences;
To promote the utilization of IK in bio-sciences for innovation and economic value;
To promote the use indigenous knowledge in plant biotechnology, human and animal health, fisheries and aquaculture, water management, mushroom production and utilization in the Southern African Network on biosciences

Indicative Budget

Activity	**Amount (US$)**
1. Inventory of IKS Best Practices in Bio-Sciences	240.000.00
2. Database of IKS in Biosciences institutions and stakeholders (researchers, practitioners, etc.)	720.000.00
3. Development of a website, journal and newsletter of IKS in biosciences	100,000.00
4. Establishment of country Information centers of IKS in Biosciences	600.000.00
5. Launch awareness campaigns of IKS in Biosciences within the regional initiative	360.000.00
6. Facilitation of the streamlining of teaching curriculum and methodology for formal and informal education of IKS in the biosciences	30.000.00
7. Network Co-ordination	450.000.00

Success Indicators

The number of partnerships in the initiative established in the region over a period of time
The number of countries in the region with established policy and legislative frameworks for IKS in the biosciences
The number of institutions and countries in the region with viable research and training programmes for IKS in biosciences
An operative website serving all the partner countries
An established regional journal on IKS in the biosciences

Assumptions

All the Governments in the region are committed and supportive to the cause of the Regional Initiative in terms of finance, policy and capacity building.
The participating individuals and institutions in the Initiative will develop viable projects for implementation
All countries, individuals and institutions in the region interested in the role of IKS in the biosciences will have the opportunity to participate actively in the initiative.

Sustainability

Monitoring and evaluation: The monitoring and evaluation of the projects will be done at two levels; Level one will be at country level in which the Ministries/ Departments responsible for IKS, Bio-Sciences in collaboration with the country IKS representatives will monitor and evaluate the implementation of the respective projects. The country IKS representative will produce audited quarterly progress reports to be submitted to the regional coordinating unit.
Government support & commitment: The proposed projects and the Biosciences network initiative require Government support and commitment for the participating institutions and projects in terms of both finance and policy.
Capacity building: The sustainability of the projects in the initiative will depend on the availability of well-trained and capacitated human resource in all the partner countries. This will require that capacity building be an integral part of the networking and partnerships.

Participating Institutions
North West University - South Africa
Department of Science and Technology, South Africa
National Institute of Health, Ministry of Health, Mozambique
Department of Science and Technology, Lesotho
University of Malawi
University of Botswana,
Midland University, Gweru, Zimbabwe
Univesity of Swaziland, Swaziland).
Other countries, individuals and institutions in the region interested in the projects identified above will also be part of the network and other activities in the initiative.

Appendix 7: Project 6 - Enhancement of capabilities of gene banking facilities in southern Africa

Introduction

Africa is endowed with rich and diverse biological resources. The continent has a flora estimated at 40-60,000 higher plant species, of which about 35,000 are endemic to the continent, that is occur nowhere else on earth. These have enormous value for indigenous populations and commercial enterprises, and for development of tourism. Wild food plays an important role in food security for rural people, and is also, increasingly, a commercial commodity which is traded nationally and regionally. Rural and urban populations across Africa depend largely on medicinal plants, often collected from the wild, for their health needs, due to preference or lack of affordable alternatives.

The Southern Africa region houses 17 centres of plant diversity as identified by the World Conservation Union (IUCN) and the World Wildlife Fund (WWF). Over 30 000 species of flowering plants and ferns occur in southern Africa, and more than 46% of all succulent plants on earth are found in this region, 60% of which are endemic. Most of Southern Africa's Endemic plants are concentrated in only few relatively small and well demarcated areas, known as Centres of Endemism. For example, one of the most significant concentration of plants in the world is the Cape flora Kingdom in the south west Cape. The Cape Flora Kingdom contains 3% of the world's plant species. Of the 9 600 species of vascular plants in this area, about 70% are endemic. Similarly, the Succulent Karoo, shared between South Africa and Namibia, is the richest desert in the world, with 40% of its 4 849 species being endemic to this area., forest ecosystems, most of them facing some threat, and mountain ecosystems.

However, plant genetic resources of cultivated crops and wild plants are being lost at an alarming rate due to human activities such as clearing land for cultivation, deforestation for various products, burning, urbanization and industrialization, over-harvesting of selected species, spread of alien species, etc. According to the IUCN Red List of Threatened plants, 2 652 plant species occurring in Southern Africa are threatened, that is face extinction. Thus there is an urgent need for the region to strengthen and improve on its conservation strategies, while at the same time promote the sustainable utilization of these vital resources for socio-economic development of its people.

The conservation, evaluation, documentation and utilization of plant genetic resources have long been recognized as a matter of insurance and investment necessary to:
sustain and improve agriculture and forestry through plant improvement and development techno-packs through biotechnology;
keep open future options as a buffer against harmful environmental change. The diverse trees, shrubs, herbaceous plants and grasses, contribute significantly to environmental stability, protecting soils from degradation and protection of water catchments;
as raw materials for scientific and industrial innovation and as important sources of medicine, food, fodder, timber, fuel wood, etc.;
to prevent species extinction and minimize plant genetic erosion; and
to maintain the ecosystem.

In 1988 the SADC region recognized the need to conserve the region's plant genetic resources by establishing a regional genebank, known as the SADC Plant Genetic Resources Centre (SPGRC) based at Chalimbana, Lusaka, Zambia. The regional genebank was further tasked to coordinate the establishment of national genebanks in each of the SADC member states. To-date nearly all SADC member countries have a genebank, although the majority of them lack the capacity to manage the valuable resources they are mandated to handle.

The conservation of plant genetic resources is not as easy as it may seem to be. There are key and crucial considerations which should be kept in mind when protection and conservation strategies are planned and implemented. These include: 1. Biological issues, such as reproduction systems of the plants, population size, species diversity, plant diversity, etc. 2. Economic considerations, keeping in mind the dependence of indigenous people on these resources for their livelihood and survival, thus calling for integrated conservation measures, and 3. Social/cultural considerations, which necessitate the involvement of local communities, who are the storehouse of the vital knowledge of these resources and their traditional value. Thus any management systems must integrate biological and ecological knowledge, as well as socio-economic needs of the different stakeholders, for daily livelihood, local and national economic development, and a healthy sustainable environment.

African small-scale farmers in various parts of the region have over the years accumulated a lot of knowledge with regards to different plant varieties for food security and sustainable livelihoods. Indigenous peoples have also discovered a vast array of medicinal and food plants, and are still using many of these through the generations. The local farmers have selected most of these plant varieties because their superior characteristics in terms of taste, viability in storage, disease and pest resistance, short gestation periods for harvest. There is a great concern that this knowledge and the plant varieties are being lost at a fast rate. Furthermore, the small-scale farmers, who are the knowledge holders as cultivators and conservers, are not recognized as both cultivators and conservers of the agricultural gene pool and as breeders who have bred several successful varieties in their local communities and environments

In order for the Southern Africa region to be able to properly conserve its genetic resources, it must build the capacity to do so. The region needs to build the capabilities and strengthen the regional gene banking facilities at the SPGRC so that it can effectively implement the regional genetic resources conservation strategy developed some years ago, while at the same time strengthening capabilities of the individual national plant genetic resource centres (national genebanks). This project is intended to address these concerns, by working very closely with other regional initiatives such as the Southern Africa Botanical Diversity Network (SABONET) which involves all, but two of the twelve countries of the Southern Africa Biosciences network. The SABONET project has made significant achievements in the compilation of national plant checklists, production of botanical inventories for centres of diversity, regional and national collecting expeditions, computerization of herbarium specimens, support of postgraduate studies in systematics, biodiversity research projects, regional and national training courses and workshops, implementation of threatened plants programmes in botanical gardens and the compilation of Plant Red Data Lists (Huntley, 1998). An annotated checklist of ethno-

medicinal flora of Southern Africa has also been published as Volume 13 in the Strelitzia series, which is a major outcome of the MEDBASE project. The information gathered through SABONET and other regional initiatives presents a valuable resource in the region's initiative to enhance the capabilities of gene banking facilities in the SADC region with respect to wild plant genetic plant resources and prioritization of them for conservation using modern technologies.

However, gene banking facilities in the region are faced with a number of constraints which need to be addressed if the region is to succeed in its effort to conserve its plant genetic resources. These constraints include:
lack of capacity in the genebanks to handle vegetatively propagated plant species and those that are least known agronomically;
lack of capacity to undertake molecular characterization which is very important in determining within and between populations diversity, and for enhancing the utilization of genetic resources for socio-economic development;
limited or lack or of tissue culture capacity for micro-propagation of plant materials;
limited adequately trained human resource with competence in modern technologies applied to conservation of some plant genetic resources such as root and tuber crops and forest resources;
loss of indigenous knowledge, and inadequate protection of intellectual property rights and benefit sharing;
unsustainable and destructive methods of harvesting wild genetic resources;
limited bio-prospecting initiatives that can successfully harness Southern Africa's bio-resources for socio-economic development of the people of the region;
limited or lack of collaboration between genebanks and institutions in the region with respect to genetic resource utilization for socio-economic development; etc.

Passport data generated at the regional genebank and the national genebanks on conserved plant genetic resources is mainly based on botanical descriptors. This does not provide detailed information of the species diversity and often may lead to unnecessary duplicate samples being conserved. Modern technologies using molecular techniques (diagnostics, fingerprinting, and marker assisted breeding) can unlock the wealth of valuable information contained in genetic resources that may improve effective utilization of these resources through scientific research, plant product development using biotechnological tools and for plant breeding, while at the same time improve on the conservation strategies of these resources through the application of modern conservation techniques, especially for those plant species that are difficult to conserve as seeds, and those that are least known agronomically. Capacity to propagate asexually reproducing plants such as sweet potatoes and cassava, as well as most forest plants whose seeds cannot be stored and propagated easily, is lacking at the SPGRC and in most of the genebanks in the region except for South Africa, and to some extent Angola and Namibia. Capacity building in tissue culture techniques would significantly enhance the propagation of such plant species, and thus increase the range of plant species that can be handled by the genebanks.

Thus enhancing the capabilities of the regional Plant Genetic Resources Centre (SPGRC) and strengthening the region's network of national genebanks by addressing the above mentioned issues is the best way of achieving the region's conservation strategy, and ensuring sustainable utilization of the region's bio-resources.

Goal
To enhance and contribute towards the conservation and sustainable utilization of Southern Africa's bio-resources for socio-economic development of people.

General objective
To broaden and enhance the management capacities of existing genebanks of the Southern Africa region through application of modern technologies of conservation of plant genetic resources and their sustainable utilization, while at the same time widening the range of plant species that can be conserved.

Specific objectives
The project will aim at attaining the following specific objectives:
To build capacity in the use of modern technologies such as cryopreservation, at the regional and national genebanks for the conservation of plant genetic resources, thereby widening the range of plant genetic resources which can be conserved by the genebanks.
To build capacity for handling vegetatively propagated plant species at the regional genebank and its network of national genebanks across the region;
To build capacity in molecular characterization of genetic resources in order to unlock the wealth of genetic information contained in them;
To develop mechanisms for networking and collaboration between genebanks and relevant institutions in the region regarding utilization of conserved genetic resources for scientific research and plant improvement;
To identify genetic traits of economic importance through the use of molecular techniques thereby enhancing the utilization of genetic resources kept in the regional genebanks;
To utilize indigenous knowledge in promoting sustainable utilization of southern Africa's plant genetic resources for food, medicine, fodder, timber, fuel wood , etc.

Project activities
In order to attain the above stated objectives the following activities will be undertaken:
Strengthening of competences needed by the regional genebank as well as national genebanks, necessary for effective management of plant genetic resources using modern technologies such as *in-vitro* conservation;
Building capacity for handling vegetatively propagated plant species and molecular characterization of genetic resources, through training courses and workshops as well as provision of necessary equipment where needed;
Developing mechanisms for collaboration and networking between genebanks and other relevant institutions including the private sector, that will enhance effective use of existing biotechnology laboratories and other facilities to add value to conserved genetic resources through development of improved plant varieties and development of high value products;
Documenting and applying indigenous knowledge systems (IKS) to enhance effective utilization of plant genetic resources in the southern Africa region.

Expected outputs

Capacity building is achieved at regional and national levels, and that most genebanks have competencies needed to effectively manage plant genetic resources;
Detailed passport data (botanical and molecular characterization) of plant genetic materials kept in genebanks;
Elaborate techniques available for use by genebanks for vegetatively propagated plant species and other plant species that are difficult to propagate using seeds;
There is increased participation of regional research institutions and universities in joint activities with the regional and national genebanks, with more passport data being freely made available to scientists, and private entrepreneurs wishing to develop technology packages for plant products development;
Modern techniques such as cryopreservation or in-vitro conservation are adopted for vegetatively propagated plants and those seed producing plants that are difficult to store in the form of seeds;
Genebanks in collaboration with other institutions have detailed documented indigenous knowledge on practical applications/uses of conserved plant genetic resources, in addition to genetic passport data of these resources.

Success indicators

Evident vibrant network of genebanks in southern Africa with a spirit of regionalism that enhances sharing of information and exchange of genetic resources;
Genebanks have capabilities and competencies needed to manage plant genetic resources as shown by readily available and improved detailed passport data records and documented indigenous knowledge;
More vegetatively propagated plant species and other plant species are conserved in genebanks;
Increased community participation in *in-situ* and on-farm conservation programmes across the region;
Improved plant establishments or populations of target plant species in the wild as a result of the use of more sustainable and less destructive harvesting methods;
More collaboration and sharing of information between genebanks and research institutions and universities, as well as the private sector, thus enhancing effective utilization of conserved plant genetic resources;
Improved access to indigenous knowledge on the utilization of plant genetic resources.

Assumptions

Resources (human, financial and physical) are available to undertake the identified activities;
Communities are willing to participate in the conservation efforts;
There is willingness on the part of national governments to support these efforts and sustain the programmes;
Institutions in the region including the private sector are willing to collaborate with the regional and national genebanks;
Genebanks in the region will readily avail genetic materials to research scientists to enhance their utilization for scientific research and plant breeding;

Indicative Budget

Activities	**Amount (US$)**
1. Strengthening competences of genebanks in modern conservation technologies.	**1 000 000.00**
2. Capacity building in molecular characterization and micro-propagation techniques.	**1 500 000.00**
3. Utilization of conserved materials for research and plant product development for socio-economic development of the region	**1 500 000.00**
4. Documentation and application of indigenous knowledge of conserved genetic resources in the region's genebanks.	**1 000 000.00**

Sustainability

In order for the project activities to be sustained beyond the donor funding period of this the following has to be done:

The southern Africa region already has network of national genebanks coordinated by the SADC Genebank (SPGRC).

Recently, the SADC member states agreed to bring the SPGRC closer to SADC Secretariat by aligning the salaries of the staff to the rest of the SADC secretariat The additional support to the SPGRC is in recognition of the fact that the conservation of the region's plant genetic resources is an important undertaking necessary for socio-economic development of the region and for sustaining the region;

There exists good will among the regional members states to support the initiative;

Other regional initiatives such as SABONET and MEDBASE will complement significantly to enhancement of capabilities of genebanks in the region especially with respect to identifying useful, but threatened plant species that require urgent steps for their conservation and protection.

Participating institutions

Participating Institutions in the project will include the SADC Regional Genebank (SPGRC) which will play a major coordination role as well as all the National Genebanks of the participating countries. Other participating institutions will include National Herbaria, Botanical and Forestry Research Institutes, Universities, the private sector, as well as such regional networks such as SABONET and MEDBASE.

Appendix 8: Project 7 - Developing Technoparks for Producing Indigeonous Mushrooms in Southern Africa.

Executive summary

The Background: The Project will have implementing partners in the twelve SANBio, countries viz., Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Zambia and Zimbabwe.

The Vision: The Project will uplift the productivity and dignity of Africa's people in selected rural communities, especially women, who carry the heaviest burden of Africa's poverty. It will, additionally, promote sustainable livelihoods in selected peri-urban communities, refugee camps, and in orphanages harbouring children whose parents died of HIV/AIDS and other causes. It will, furthermore, provide new enlightenment and new direction to the unemployed youth, many of whom have lost direction, and are increasingly being dragged into drug addiction. This will be through promoting public awareness on unrealized wealth in one of Africa's most ubiquitous, most precious, most invaluable, yet most neglected and ignored natural resource: MUSHROOMS!

The Activities: The Project will enlighten the selected communities that mushrooms constitute a special creation whose members play a vital role in the recycling of the valuable minerals found in the vegetation around us, contain species which are edible, very tasty, and very nutritious; and species with a strong medicinal potency. Some of the medicinal mushrooms contain a cocktail of unique biomolecules with anti-cancer and immune-boosting attributes, which, indeed show great potential as a possible remedy for some of the incurable diseases of our time, and also as a source of preventive medicine therapies. Some are already being researched as potential candidates for addressing the HIV/AIDS challenge. Many African communities, indeed, know what edible species of mushrooms occur in their ecosystems, but are not aware of the fact that some of the species can be farmed.

Mushroom Trade Statistics:
Current World Market Value of cultivated edible mushrooms: **US$25-28 billion**.
Current World Market Value of medicinal mushrooms and their value-added products, e.g., nutriceutical capsules: **US$8-9 billion**.
Current World Market Value of wild mushrooms harvested from symbiotic associations with insects (e.g., *Termitomyces* mushrooms), and with roots of various plants *(e.g., truffle* mushrooms): **US$3-4 billion**.
Thus the global picture stands at US$40 billion a year. Africa's share in this rapidly growing trade, is less than 1%. **(Source : S.T. Chang, 2004).**

Nutritional Value of Mushrooms:
Mushrooms are rich in protein (20 to 40% in oyster mushrooms),in vitamins; in unsaturated fatty acids (70% of all fats are unsaturated in some), in inorganic mineral nutrients (e.g., iron, zinc, and calcium), and also in fibre. Thus they are excellent for promoting good health.
Many mushrooms are medicinal, and can be used for addressing a wide range of human health problems. For example: Some are effective in regulating blood pressure, in moderating the body's cholesterol level, in treating cardiovascular disorders; some are effective as immunomodulating agents; some are known to be

hepatoprotective, to serve as a kidney tonic, a nerve tonic, and stress reducing agents. *Ganoderma lucidum* (Reishi) and *Lentinula edodes* (Shiitake) are leading researched mushrooms with regard to their medicinal potency.

Mushroom Production: World trends:
1978 production: **1,060,000 tonnes.**
1990 production: **6,158,400 tonnes.**
2002 production: **12,250,000 tonnes.**

The Project will share with selected members of poor disadvantaged communities, technologies on the cultivation of mushrooms: both edible and medicinal mushrooms. This will be through organizing mushroom farming training courses and workshops; establishing mushroom farming demonstration centres (in rural and peri-urban communities); developing, publishing, and disseminating reader-friendly advocacy publications on mushroom farming (and, where necessary, getting these translated into local languages). The Project will work closely with the communities through designated collaborating national institutions (e.g., National Universities and Research Centres in the participating countries), whose facilities will be upgraded to enable them to provide effective national leadership in mushroom farming technology diffusion to the rural people. The collaborating national implementation centres will be assisted to develop capacity for developing and maintaining mushroom cultures, supplying mushroom "seed" (spawn) to the farming communities, and sharing with the mushroom farmers the know-how on mushroom cooking, post-harvest crop handling, processing, packaging, and marketing.

The Project will assist the farmers to establish Mushroom Growers Associations, which will facilitate the sharing of information on mushroom farming technologies, and on the marketing of the farmed and harvested mushrooms. The project will also sustain a good working relationship with Government leaders and agricultural extension officers in the participating countries, with a view to enlightening them on the fact that mushroom farming is an important, innovative, and profitable agricultural activity hitherto neglected in Africa, but whose time has come: an activity with strong promise towards addressing Africa's poverty challenge, towards promoting the socio-economic empowerment of women and the youth in society, towards promoting the nutritional and health status of children in the communities, and of HIV/AIDS victims, through promoting the eating of the farmed nutritious mushrooms, and especially nutriceuticals from species with immune-boosting potency.

The Project will facilitate the involvement of the private sector and Non-Governmental Organisations (NGO's), especially with regard to the component on mushroom processing and marketing (e.g., canning, drying, and production of flavoured and packaged mushrooms for soups, and for nutriceutical capsules with immune-boosting potency): both for local, regional, and global markets. For this component, the project will stimulate the cultivation of partnerships with experienced mushroom processing business enterprises in East Asia (e.g., Japan, China) and elsewhere. The Project will promote the establishment of a Regional Mushroom Research Laboratory, at the University of Namibia, building upon the modest infrastructure developed during the Project's Pilot Phase. The laboratory will have a strong working relationship with relevant national research centres. The key activities of the laboratory will include the following: co-ordination of research on the

collection, identification and preservation of African mushroom germplasm from the continent's various agro-ecological zones; co-ordination of research on the biology, ecology, population dynamics, and mycorrhizal associations of Africa's unique mushroom biota, e.g., the Kalahari truffle mushroom (*Terfezia pfeilii*) found only in the Kalahari desert; and also on the ecology of *Termitomyces titanicus*, the world's largest termite mushroom, found in Zambia, Tanzania, and perhaps also in DR Congo. These have great potential for entry into world trade. Additionally, they should be seen as a part of our global heritage.

The choice of the mushrooms: First, the Project will focus on the oyster mushrooms, *Pleurotus ostreatus* and *P. sajor-caju*, which are edible, and very tasty, and whose global popularity is rapidly increasing. Another reason for this choice is that the mushrooms can be grown in the tropics, on a wide range of lignocellulosic crop residues and wastes, which are readily available in Africa's rural communities, virtually at no cost. Additionally, the mushrooms grow very fast, permitting harvesting to take place within four weeks since "seeding" the substrates with mushroom spawn. The choice thus allows quick investment returns; hence they are ideal for poverty reduction and community development strategies. Also importantly, oyster mushrooms are easy to grow, and Africa's rural people can easily assimilate the technologies involved in their cultivation. Furthermore, the Pilot Phase of the Project established that oyster mushrooms grow very luxurianty on substrates prepared from water hyacinth biomass, which is very abundant in many riverine communities on the continent, where it is conceived as a nuisance, and as a serious environmental problem. The harvesting and use of water hyacinth as a substrate for mushroom production, will serve to demonstrate that through research and the adoption of appropriate strategies, we can transform many of Africa's problems into profitable community development, and economically empowering opportunities.

Secondly, the Project will promote the cultivation of the medicinal mushroom *Ganoderma lucidum* ("Reishi" in Japanese, and "Lingzhi" in Chinese), both for cash income, and also for use as a potent medicinal remedy. *Ganoderma lucidum* is the most versatile and one of the most potent medicinal mushrooms known. Widely distributed in the continent's various agro-ecological zones, *Ganoderma* mushrooms in Africa have, to a large extent, been neglected resources. This has largely been due to people's ignorance on their strong medicinal potency. But in East Asia, *Ganoderma* mushrooms have been used as medicine for over two millennia, and, today, they support multimillion-dollar business industries with a strong presence in global trade. Scientific research in Japan, China, Korea, and elsewhere, on the natural products of *Ganoderma*, is increasingly revealing that *Ganoderma* natural products comprise a cocktail of over 200 biocompounds, which appear to work together in synergy, as an orchestra, towards generating a wide range of health benefits to the body, when used as nutriceuticals. These include antitumour, antiviral, hepatoprotective, immunomodulating, and other body benefits. Indeed *Ganoderma* products are currently being tested clinically as potential immune-boosters for HIV/AIDS victims. Thus its cultivation in Africa may provide an affordable relief to millions of individuals afflicted by HIV/AIDS.

Multisectoral nature of the project: From the preceding paragraphs, it will be seen that the project is multisectoral in scope. For example:
In transforming lignocellulosic residues and wastes (which are currently often burnt to ash) into substrates for cultivating mushrooms, we are addressing the problem of

environmental degradation and pollution. And since the farmed mushrooms are edible and nutritious, we are also addressing the issue of food security and human health.
In transforming the lignocellulosic residues into substrates for the cultivation of medicinal mushrooms, we are also addressing human health challenges.
In using the mineralized organic residues left after harvesting the farmed mushrooms as agrofertilizers, and also as livestock feed supplements, we are promoting enhanced agricultural crop productivity, and also food security.
In teaching the communities technologies involved in mushroom farming e.g., using crop residues, and other categories of under-utilised biomass, such as water hyacinth, and in the production of value-added products from the farmed mushrooms, we are promoting community education and skills development; we are generating new income; we are reducing poverty; we are cleaning up the environment; and we are promoting sustainable livelihoods.
Research will be conducted on improving the current procedures and also in introducing new varieties into the communities.
Because of the multisectoral and multidisciplinary nature of the project, the interest of several UN agencies (e.g., UNDP, UNOPS, UNU, UNESCO, FAO) and African Governments (e.g., SADC countries) has been captured, towards supporting the various components of the project vision, in one way or another.

Success indicators: The Project will build upon the success achieved during the Pilot Phase of the UNDP/UNOPS Regional Project, which has already demonstrated that mushroom farming in Africa is possible, using locally available agricultural crop residues. The focus now will be to extend the technologies to rural communities, to HIV/AIDS orphanages, to refugee camps, and to involve more people through Government agricultural extension networks. The project will enhance the research and the delivery capacity of the national implementing institutions, through training more mushroom farming scientists, and assisting them to publish advocacy publications to be distributed to farmers, and, where necessary, publishing them in local languages. In summary, the success indicators will include the following:
Mushroom farming training courses and workshops organised for each participating country:
one training course per year for scientists from Phase Two countries;
one advanced training workshop per year for scientists from Phase One countries.
Trained mushroom scientists and extension personnel organizing regular extension services, and training mushroom farmers in rural and peri-urban communities.
One Regional Training Workshop organised per year, enhancing the sharing of experiences, successes, problems, and special breakthroughs, bringing together leaders of mushroom farming activities from each participating country.
Laboratory infrastructures of designated implementing national centres upgraded, enabling them to serve as effective national mushroom “seed” (spawn) centres, supplying high quality mushroom cultures to rural and peri-urban farmers.
Mushroom farming demonstration centres established in rural and peri-urban communities, enhancing mushroom farming technology diffusion.
Mushroom farming advocacy publications and cultivation production manuals developed and published, at appropriate levels: for mushroom scientists and extension officers; and for rural communities (translated into local languages), to enhance quality production.
Disadvantaged women, youth, orphans, and displaced refugees in selected communities, empowered with mushroom farming technologies, and actively

involved in mushroom farming, marketing, and securing a good income from their mushroom sales.
Mushroom Growers Associations established in the communities.
Farmed mushrooms readily available in local markets; consumption of mushrooms by households increased.
A Regional Mushroom Research Laboratory in place; national mushroom research laboratories also in place and functional; research agenda on selected unique African mushroom biota with greatest potential for national, regional, and global trade, mapped out; collaborative research activities on the commercialization of the most promising mushroom biota, initiated.
The incorporation of organic residues left after harvesting the farmed mushrooms as organic agricultural crop fertilizers, and as livestock feed supplements in the mushroom farming rural communities, practised; and environmental regeneration enhanced.

PROJECT DURATION: FIVE YEARS
STARTING DATE: JANUARY 2005
MANAGEMENT ARRANGEMENT: REGIONAL
TARGET BENEFICIARIES: RURAL AND PERI-URBAN DISADVANTAGED COMMUNITIES IN 12 COUNTRIES IN THE SADC REGION
TOTAL BUDGET PROJECTED: US$ 5.0 MILLION (US$1.0 MILLION PER YEAR)