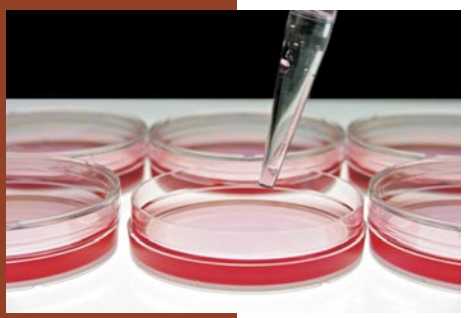
June 2007

International Centre for Trade and Sustainable Development



Biotechnology: Eastern African Perspectives on Sustainable Development and Trade Policy

ICTSD

International Centre for Trade and Sustainable Development

AFRICAN TECHNOLOGY POLICY STUDIES NETWORK

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Published by

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Acknowledgements

This collection of papers was prepared as part of the project *Building Capacity on Trade and Biotechnology Policy-Making* being implemented by the International Centre for Trade and Sustainable Development (ICTSD). The project aims to strengthen the capacity of developing countries to better formulate their biotechnology strategies and priorities related to trade and sustainable development, and integrate them into national, regional and international policy-making processes. This work was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada and the Directorate General for Development Cooperation (DGIS), Ministry of Foreign Affairs of the Netherlands.

The editors are Heike Baumüller (Programme Manager – Environment and Natural Resources at ICTSD during the production of this publication) and Maurice Bolo (Research Officer, ATPS), working on the initiative of Ricardo Meléndez-Ortiz and under his guidance and with the support of colleagues, including Christophe Bellmann, Andrea Leary, Marie Chamay, Moustapha Kamal Gueye and Tamara Asamoah at ICTSD and Osita Ogbu and Sheila Maina at ATPS.

ICTSD and ATPS would like to thank the many people who have provided critical imput into this book's production, not least the authors who have shared their perspectives and expertise on some of the key issues confronting Eastern African countries when designing biotechnology and trade policies. The book was originated at the very rich, frank and generative conversation at ICTSD/ATPS regional dialogue – held in 2006 in a most wonderful setting in Jinja, Uganda – in collaboration with the African Union and the New Partnership for Africa's Development. ICTSD would also like to thank the various reviewers who provided comments on draft chapters.

For more information about ICTSD's programme on biotechnology, visit www.trade-environment.org

For more information on ATPS, visit www.atpsnet.org

ICTSD and ATPS welcome feedback and comments on this document. These can be forwarded to Marie Chamay, mchamay@ictsd.ch and Maurice Bolo, mbolo@atpsnet.org.

Citation: ICTSD and ATPS (2007) *Biotechnology: Eastern African Perspectives on Sustainable Development and Trade Policy*, International Centre for Trade and Sustainable Development, Geneva, Switzerland and African Technology Policy Studies Network, Nairobi, Kenya.

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ISBN 978-2-8399-0281-6

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ACRONYMS

AATF	African Agricultural Technology Foundation
ABSF	African Biotechnology Stakeholders Forum
ABSP	Agricultural Biotechnology Support Program
ACTS	African Centre for Technology Studies
ADRI	Animal Diseases Research Institute
AGOA	African Growth Opportunity Act
AGT	Agro-Genetic Technologies
AHBF	Africa Harvest Biotechnology Foundation
AI	Artificial Insemination
AIA	Advance Informed Agreement
ARI	Agricultural Research Institute
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ATPS	African Technology Policy Studies Network
AU	African Union
BCMNV	Bean Common Mosaic Necrotic Virus
BCMV	Bean Common Mosaic Virus
BeCA	Biosciences Eastern and Central Africa Initiative
BIO-EARN	East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development
Bt	*Bacillus Thuringiensis*
BTA	Biotechnology Trust Africa
CAADP	Comprehensive African Agricultural Development Programme
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CBPP	Contagious Bovine Pleuro-pneumonia
CCPP	Contagious Caprine Pleuro-pneumonia
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Centre

COMESA	Common Market for East and Southern Africa
CONSENT	Consumer Education Trust
COP/MOP	Conference of the Parties serving as the Meeting of the Parties
COSTECH	Commission for Science and Technology
EAC	East African Community
EASTOC	East African Science and Technology Council
ECABIO	Eastern and Central Africa Biotechnology and Biosafety Programme
ECAPAPA	Eastern and Central Africa Programme for Agricultural Policy Analysis
ECF	East Coast Fever
ELISA	Enzyme Linked Ammunosorbent Assay
EMA	Environmental Management Act
ERSWEC	Economic Recovery Strategy for Wealth and Employment Creation
EU	European Union
FAO	Food and Agriculture Organization
FFP	Food, Feed or for Processing
GDP	Growth Domestic Product
GEAC	Genetic Engineering Approval Committee
GM	Genetically Modified
GMO	Genetically Modified Organism
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ICIPE	International Centre for Insect Physiology and Ecology
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICSU	International Council for Science
ICT	Information and Communication Technologies
ICTSD	International Centre for Trade and Sustainable Development
IEC	Information Education and Communication
IFAD	International Fund for Agriculture Development
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority on Development
IIAT	International Institute of Tropical Agriculture

ILRI	International Livestock Research Institute
INIBAP	International Banana Programme
IP	Identity Preservation
IPPC	International Plant Protection Convention
IPR	Intellectual Property Right
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ISO	International Organization for Standardization
ISPM	International Standards for Phytosanitary Measures
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KARI	Kenya Agricultural Research Institute
KBIC	Kenya Biotechnology Information Centre
KEPHIS	Kenya Plant Health Inspectorate Service
LMO	Living Modified Organisms
LSD	Lumpy Skin Disease
LVEMP	Lake Victoria Environmental Management Project
MAS	Marker-assisted Selection
MOA	Ministry of Agriculture
MOET	Multiple Ovulations followed by Embryo Transfer
MTA	Material Transfer Agreement
NAARI:	Namulonge Agricultural and Animal Production Research Institute
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NBAC	National Biotechnology Advisory Committee
NBC	National Biosafety Committee
NBF	National Biosafety Framework
NBFP	National Biosafety Focal Point
NCC	National Co-ordinating Committee
NCST	National Council for Science and Technology
ND	Newcastle Disease
NEMA	National Environmental Management Authority

NEPAD	New Partnership for Africa's Development
OAU	Organization of African Unity
OIE	World Organization for Animal Health
PBS	Program for Biosafety Systems
PCR	Polymerase-Chain-Reaction
QTLs	Quantitative Trait Loci
R&D	Research and Development
RABESA	Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa
RATES	Regional Agricultural Trade Expansion Support
REC	Regional Economic Community
RPPOs	Regional Plant Protection Organization
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
RVFV	Rift Valley Fever Virus
S&T	Science and Technology
SADC	Southern African Development Community
SPS	Sanitary and Phytosanitary
SRA	Strategy for Revitalizing Agriculture
SUA	Sokoine University of Agriculture
TBT	Technical Barriers to Trade
TFDA	Tanzania Food and Drugs Authority
TLB	Turicum Leaf Blight
TPRI	Tropical Pesticides Research Institute
UNBS	Uganda National Bureau of Standards
UNCST	Uganda National Council of Science and Technology
UNEP-GEF	United Nations Environment Program — Global Environment Facility
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VICRES	Lake Victoria Research
WARFSA	Water Research Fund for South Africa
WFP	World Food Program
WTO	World Trade Organization

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FOREWORD I

International trade is increasingly confronting societies with the need to make hard decisions on the consumption and use of biotechnology products, particularly in the field of agriculture, calling for an urgency to accelerate the capabilities of African and other developing countries to generate viable options to deal with such a reality. In the context of Eastern Africa, as in many other developing country regions, biotech products are present through trade or imported through emergency in-kind food aid, and they flow across into borders and within the region. At the same time, these countries need to put in place biotechnology regulatory frameworks to fulfil their obligations under the Cartagena Protocol on Biosafety, which they are parties to, while ensuring compatibility of their regulations with WTO rules, such as those governing the application of sanitary and phytosanitary measures. Moreover, countries wishing to grow biotech crops will need to set up systems to comply with stringent labelling and traceability requirements of trading partners such as the EU or China. These developments are threatening to dominate national biotech agendas and priority-setting, even more so in the absence of well-developed policies to guide biotech development and trade.

Spurts of attention on biotechnology have been generated by a few controversial cases but, by and large, on a daily basis the complex issues involved roam adrift inciting anxieties both about the effects of genetically modified organisms (GMOs) on the population, the economy and the environment, and about the eventual missed opportunities for Africa's technological development plus concerns over its struggles for food security and against crippling poverty.

The situation of uneasiness with GMOs is not exclusive of developing societies. It is indeed still fluid within and among industrialised countries as well. At the heart of these debates are the choices that societies, and segments within them, have made and how to best respond to and support them. Indeed, good and effective policy is the expression of aspirations of societies, which in the context of sustainable development, relate to their environment, their social fibre and their economies. Societal and individual choices need to be facilitated primarily through consequential policy and institutions, at the national and regional levels. In the globalised world of today, they also require articulation in international rules and economic integration schemes.

The issues associated with biotechnology remain remarkably complex and highly challenging for both policy-makers and stakeholders. The approach to the issues should be informed by this fact and by awareness of what happens elsewhere, and not only by the institutional and capacity limitations facing Eastern African countries. Most of the anxieties about biotechnologies concern the potential ramifications of biotech use for public health, the natural environment, socio-cultural specificities and the economics and political economy of biotechnology production and trade. Some aversion is related to mistrust and the capacity and competencies of authorities and regulators to respond to consumers' fears. But to be fair, this same situation persists even in countries where there is an established tradition of credibility and reliability in the food and product safety system.

In the area of biotechnology we operate against a backdrop of scientific inconclusiveness. Even if no evidence exists today of adverse public health impacts of GMOs, consumers in most countries

across the world seem to emphasise their preference for disclosure and information and continue to indicate that they would like to reserve their own judgement, and be enabled to exercise their own choice. So even if we were to refer ourselves to the risk assessment and management bodies and systems of other countries, as some suggest, local policy would still need to respond to prevailing anxieties.

With respect to the environment, the situation is further complicated by the fact that scientific uncertainty is not limited to the bearing of GMOs generally on the environment. Most daunting is that in essence little or no science exists yet on impacts of GMOs on specific ecosystems with due regard to their particularities, in this case tropical Eastern African ecosystems. In fact, literature seems to agree that proven low or no risks, derived from the introduction of GMO seeds or crops in a certain ecosystem, does not rule out ecological problems of their release in another.

The international legal frameworks we have crafted through collective but reciprocal bargaining processes in the past few years and on which we rely today are not designed to provide precise prescription for national policies. This is partly due to deliberate efforts to keep them ambiguous or retain flexibilities and space to allow countries to choose what their societies direct them to pick from the policy toolboxes.

In the context of biotechnology, the two main instruments of international co-operation – the Cartagena Protocol on Biosafety of the Convention on Biological Diversity and the WTO's Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) – are aimed at facilitating trade in GMOs, not at regulating their use and commercialisation, albeit there is general pre-ambulatory language on safety in the Cartagena Protocol. And they reflect different approaches: while the Biosafety Protocol is built to privilege precaution, the SPS Agreement refers to international standards, which in the case of biotechnology are yet to be established. While the first allows for socio-economic considerations to be used in according caution, the SPS Agreement is strict on natural science-based reason. Furthermore, neither provide clear guidance with respect to labelling – an issue of critical importance to many.

The Cartagena Protocol allows for the use of labels ("countries may label") but remains undefined concerning thresholds to use and triggers. The SPS Agreement is mostly concerned with avoiding discrimination at the border or in the internal market between GMO suppliers, following trade law principles of national treatment. Moreover, many features of the Cartagena regime remain up for negotiation, including liability regimes and conflict management procedures, and the relationship between the two legal frameworks is not clearly spelled out. WTO compatibility of measures that nations may choose to adopt such as the mandatory nature of labels or traceability allowed by the Biosafety Protocol or quantitative restrictions or bans on imports based on the Protocol's sense of precaution, remain blurred.

Africa, as well as other developing countries, is expected to develop its own policies and institutions within those broad frameworks. In this context, a critical question is whether new institutional infrastructure at the domestic level is really necessary because it seems to be promoted by some projects aimed at implementing obligations derived from international conventions. Or whether, the existing architecture, traditionally used to regulate on safety concerning food, seed and new

varieties, should be strengthened with new capabilities. Such concerns become particularly relevant in a context of limited resources that warrant greater attention to institutional efficiency.

Two additional points with respect to socio-economic considerations and the political economy of commercial use and trade in GMOs are worth raising. The use of agro-biotechnology, particularly of the first industry-driven generation of recombinant DNA technology, naturally raises earnest issues related to the conversion of agricultural activity. Eastern Africa's soils and biodiversity including those around and in the valleys along the Nile, whose source is near where we met for the biotech dialogue that generated this book, have through millennia contributed major crops to world welfare and nutritional intake, including coffee, sorghum, wheat, yam and millet. Wild plants were domesticated and turned into food crops by African farmers for the benefit of all through a system of sharing of seeds and species prevailing until today. Most African agriculture remains of a subsistence nature and most farmers grow food and non-cash crops. Introduction of agro-biotech suggests a shift to cash crops and industrialised agriculture. This combined with reforms of agricultural policy and economic models, could also soon lead to export-led use of soils and farming. This is not an insignificant socio-cultural transformation. It is for decision-makers and other stakeholders to decide whether this transformation is necessary and therefore desirable and at which pace to engage in it.

Similarly, consumers all over the world, as this is not exclusive to Africa or developing countries, have reacted in the past few years to what they perceive as technology whose purpose is centred in the seed and biotech industry or the producer, but does not intentionally target consumer or broader public interests or needs. Perhaps, this could start changing now as we move into what some have dubbed a second generation of biotechnology – indeed, one of the most heartening involves technological development efforts in Eastern Africa. Such generation uses quality and so-called functional and nutraceutic traits, promising to become a critical source of products centred on health concerns, addressing, for instance, vitamin and protein deficiencies or environmental features such as draught and desertification. If policy and science at all levels promote and make these benefits of technology possible and effectively respond to expectations, "anxieties" would be well tackled.

These are obviously complex issues and require careful and integrative responses. The participants in the Jinja dialogue as well as the collection of cutting-edge papers presented in this volume brings together diverse voices from Eastern Africa – representing a variety of stakeholder groups and perspectives – to reflect on different aspects of a coherent biotechnology and trade policy: Can agricultural biotechnology contribute to poverty alleviation? What additional capacities might be needed to take advantage of the technology while ensuring its safe use? Are stakeholders and the media in Eastern Africa aware of and engaged in these debates? What are the implications of biotech use for Eastern African countries' trade interests? Does the Cartagena Protocol adequately address Africa's biosafety concerns?

By examining such a wide variety of issues, the dialogue and the ensuing collection of papers is aimed at providing those making and influencing policies at the intersection of biotechnology, trade and sustainability with a comprehensive overview of key policy areas – in Eastern Africa and beyond – to enable the formulation of coherent policies. Moreover, it offers a platform for leading thinkers

from Eastern Africa to share their concerns and aspirations with policy stakeholders around the world in an effort to help raise awareness and support the insertion of their perspectives in global debates and policy-making. We trust that audiences all over will find these papers stimulating reading that will inspire further reflection and debate.

Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

FOREWORD II

The central theme of this book revolves around the intersection of trade and biotechnology policies and their contribution to sustainable development in general, but more specifically, from an Eastern African perspective. These issues are at the heart of the on-going debates on the potential role of biotechnology to solve some of Africa's developmental challenges, notably, food security and ecosystem sustainability.

Sub-Saharan Africa is facing widespread food crises, much of which is attributed to stagnant or sluggish growth in the agricultural sector. Environmental degradation, deriving from increased deforestation rates and biodiversity loss, and a decline in investment in agriculture, especially in technology development and transfer, worsens the already grim picture.

The benefits of biotechnology and, specifically, agricultural biotechnology, are now at the forefront of international interest as having great potential to influence and benefit agriculture, forestry and fisheries. Many scientific studies have pointed to the promise of biotechnology as an instrument of development and its potential to solve Africa's challenges.

Several countries, especially South Africa, Kenya and Egypt are putting in place structures for research and development in biotechnology. Improvements in productivity are beginning to emerge from the applications of conventional and modern biotechnology in some of these countries. It is important to note that many African countries still lack policies and standards on development, handling and commercialisation of biotechnology-derived products. Moreover, cross-border movement of goods, including foods with genetically-modified (GM) content can easily lead to unintended introduction of GM products into these countries. Trade amongst neighbouring countries presents another avenue for movement of biotechnology products between countries.

Differences in country policies, regulatory capacities and technical expertise are likely to undermine trade between countries and delay the benefits envisaged under regional integration. This situation necessitates a regional approach and consensus on biotechnology and biosafety policies.

The perceived promises and perils of biotechnology are now under intense public scrutiny. The debate is complex, and often inconclusive. In Africa, as elsewhere, the debate is still polarised between pro- and anti-GM crusaders. The polarised nature of this debate has clouded the benefits from non-controversial aspects of biotechnology such as tissue culture (TC) which has successfully been applied with demonstrated benefits to African farmers.

African countries must develop appropriate policies for biotechnology and endeavour to identify key national priorities for biotechnology, bearing in mind the needs of the resource-poor who depend on agriculture for livelihood. This approach should consider national development policies, private sector interests, market possibilities, technology diffusion mechanisms and linkages. Various stakeholders should be involved in the formulation of national biotechnology policies, strategies and plans.

The African Technology Policy Studies Network (ATPS) has been supporting policy research on various aspects of biotechnology and embarked on a comprehensive biotechnology programme since 2004 with support from the Rockefeller Foundation. The ATPS biotechnology programme seeks to provide a forum for African scientists, policymakers, civil society, farmers, private sector players, and other

stakeholders to objectively debate the issues, share knowledge, experiences, expertise and voice their concerns on the potential of modern biotechnology to solve Africa's problems.

I trust that the collection of papers in this book, carefully selected from a wide range of African stakeholders and professionals, reflect the views and opinions from Eastern Africa regarding the potential of biotechnology and its implications on trade and regional integration. I hope this book will enlighten and further promote objective and informed debate on biotechnology, trade and sustainable development in Africa.

Dr. Osita Ogbu
Executive Director, ATPS

1. STATUS OF BIOTECHNOLOGY POLICY-MAKING, REGULATIONS AND DEVELOPMENT IN EASTERN AFRICA

Charles F. Mugoya, Eastern and Central Africa Biotechnology and Biosafety Programme (ECABIO) of the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA)

1. Introduction

Many countries in Eastern Africa suffer chronic seasonal or annual food shortages and are among the poorest in the world. According to the International Food Policy Research Institute (IFPRI), the population in the region is likely to double by the year 2015, against a backdrop of declining food availability per capita. Modern technologies, including biotechnology, could offer ways of increasing productivity to meet the projected increased demand for food.

Biotechnology in Eastern African countries has been highlighted as having the potential to contribute to the food security and poverty alleviation goals of these countries. However, biotechnology applications can only occur under conditions of an enabling regulatory environment. Consequently, countries in the region have taken steps to develop their national regulatory frameworks to ensure the safety of humans and the environment in the application of biotechnology. With support from the UNEP-GEF Project for the Development of National Biosafety Frameworks, the countries have established interim biosafety regulatory regimes, which are currently being formulated and tested (UNEP-GEF, n.d.).

The testing of the instruments, through for example confined field trials, has been seen as the best approach for determining whether the systems being developed meet the United Nations Program/Global Environment Facility (UNEP-GEF) criteria which stress that a biosafety regulatory system should be understandable, workable, equitable, fair, adaptive and enforceable.

This collection of papers analyses the status of biotechnology policy-making, regulations and development in Eastern Africa, focusing particularly on Kenya, Tanzania and Uganda.

2. Review of Eastern African biotechnology policies

Biotechnology is recognised within the national comprehensive development frameworks in all the Eastern African countries as a strategic area for research and development (R&D) and indeed investment. Biotechnology is seen to fit within the national poverty reduction strategies with a target of increasing agricultural productivity, ensuring food security, improving human health and preventing environmental degradation.

This recognition also features in the national science and technology policies, which acknowledge the vital role and enormous opportunities presented by biotechnology in revolutionising the countries' socio-economic development. However, despite this recognition, the application of modern biotechnology in Eastern Africa is still far from being a reality as it is constrained by the lack of an enabling policy environment.

The groundwork for drafting biotechnology policy frameworks and capacity building for their implementation was initiated in 1998

through the BIO-EARN Programme — the East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development.

Each of the countries participating in this programme has developed (draft) national policies on biotechnology and biosafety. Kenya, Tanzania and Uganda are now at different stages of adopting these policies, in:

- Mainstreaming biotechnology into national development plans and strategies, such as poverty reduction strategies and plans;
- Identifying national priority areas for biotechnology research;
- Investing in strategic biotechnology research including human resources and infrastructure at public institutions;
- Facilitating product development and technology transfer; and
- Providing a clear regulatory framework and ensuring that regulations are enforced.

In ***Kenya***, the biotechnology and biosafety policy was developed with support of the UNEP-GEF project through which a national co-ordinating committee of stakeholder representatives was established to develop the policy.

The policy embraces four main areas:

- Regulatory needs related to environment, agriculture, socio-economic considerations crop and animal protection, biosafety, ethics, standards and consumer rights;
- R&D issues including institutional strengthening and manpower development;
- Biotechnology product development and consumption including issues of seed production, industrial commercialisation and trade; and
- Co-ordination and collaboration.

The policy was adopted in 2006.

In ***Uganda***, progress on the biotechnology and biosafety policy has been notably slow but extremely consultative. Co-ordinated by the Uganda National Council for Science and Technology (UNCST) and with funding from the UNEP-GEF Project, a multi-stakeholder national co-ordinating committee (NCC) was put together and charged with formulation of the draft policy. This draft policy was then discussed at various workshops. Copies of the policy document were also circulated to all key ministries and sectors for comments. The NCC then discussed the comments received and incorporated them in a revised draft document before submitting it to the government for approval.

The resultant draft policy explicitly states that it has been developed with "a vision to make Uganda a country fully and safely utilising biotechnology in sustainable national development within the context of the Poverty Eradication Action Plan and the National Vision for Development." The policy seeks to address the safe and sustainable development and application of biotechnology in Uganda through:

- Capacity building in human resources and infrastructure;
- The creation of an effective legal and regulatory framework;
- Establishment of a well co-ordinated institutional framework;
- The promotion of industrial application and commercialisation of biotechnology processes and products following international standards including those on trade;
- Raising public awareness of biotechnology opportunities and challenges;
- Creation of effective mechanisms for biosafety regulation including risk assessment and management; and
- Establishment of meaningful linkages and partnerships in biotechnology development.

The draft policy envisions the establishment of an inter-ministerial National Biotechnology Advisory Committee (NBAC) composed of senior-level representatives of key institutions in biotech development to:

- Develop and oversee the implementation of the National Biotechnology Programme;
- Develop a strategic action plan for the programme and propose national budgets for biotechnology development and ensuring their inclusion in the national budget and expenditure framework;
- Establish the necessary instruments for effective policy implementation;
- Develop and review management of the programmes, ensuring adherence to biosafety guidelines; and
- Approve national and sectoral priorities.

The draft policy recommends the development of a formal Biosafety Implementation Plan to accompany the Biotechnology and Biosafety policy as it moves toward parliamentary adoption. The Plan is meant to deal with all subjects under the policy including human resource capacity, industrial application, legal and regulatory framework, bio-ethics, biosafety, financing, public awareness, infrastructure, and more.

The draft policy is still awaiting government approval.

In ***Tanzania***, the biotechnology and biosafety policy framework was developed prior to the adoption of the Cartagena Protocol and is embedded in the National Environmental Policy (1997). Paragraph 32 of the policy stipulates the need to undertake actions for the conservation and sustainable use of biological resources to prevent the loss of biodiversity and states explicitly that "Strategic measures shall be put in place for the *development of biotechnology*, especially to ensure fair and equitable sharing of the results and benefits arising out of utilisation by foreign recipients, of genetic resources originating from Tanzania, and *biosafety*."[emphasis added]. The policy also provides for the carrying out of environmental impact assessments as a biosafety mechanism.

In 2001, the government of Tanzania established a National Biotechnology Advisory Committee (NBAC) to advise it on matters concerning biotechnology. One of the major responsibilities of this Committee has been the preparation of a comprehensive draft national biotechnology policy. The main objective of this policy is to ensure that Tanzania has the capacity to capture the benefits arising from the application of biotechnology in health, agriculture, industry and environment while protecting and sustaining the safety of the country's population and environment.

Some of the specific objectives, as contained in the draft biotechnology policy document are to:

- Co-ordinate implementation of bio-technology strategies;
- Create a centre of excellence for development of industrial biotechnology capacity in Tanzania;
- Institute innovative financing of biotechnology inventions, innovations and services;
- Establish intellectual property rights (IPR) on biotechnology innovations and services;
- Develop programmes for the conservation and development of genetic resources;
- Develop optimum institutional and human resources; foster public-private sector partnerships and linkages; create awareness and correct the public perception of biotechnology; and
- Strengthen national and international collaboration and develop ethical consideration relating to biotechnology.

The draft biotechnology policy document has been circulated to different stakeholders for comments and input and is awaiting government approval.

3. Review of Eastern African biotechnology regulatory frameworks

Tanzania, Uganda and Kenya have all been working to establish national biosafety regulatory systems. The frameworks that have been developed differ in their details but share the same ultimate goal — to ensure adequate protection of the environment and human health from activities involving genetically modified organisms (GMOs).

Kenya was the first country in the region to draft biosafety regulations and guidelines when it passed the National Council for Science and Technology (NCST) Act back in 1998. The regulations covered the importation or release of GMOs and establishment of the National Biosafety Committee — a multi-stakeholder team whose role is to advise the Kenyan government on all issues dealing with biosafety and biotechnology.

Since the regulations in their current form are inadequate, Kenya has had to rely on a number of other pieces of legislation to enforce various aspects of biosafety. These laws include the Food, Drugs and Chemical Substances Act, the Science and Technology Act, the Crop Production and Livestock Act, the Plant Protection Act, the Seeds and Plant Varieties Act, the Fertilizers and Animal Foodstuffs Act, the Pest Control Products Act, the Meat Control Act, the Cattle Cleansing Act, the Pig Industry Act, the Animal diseases Act, the Fisheries Act, the Merchant Shipping Act, the Wheat Industry Act, and, the Suppression of Noxious Weeds Act. A number of these laws contain stipulations that affect the policy on the export or import of GMOs of the release of GMOs into the environment. However, the Environmental Management and Co-ordination Act, enacted in 1999 is perhaps the most recent and relevant instrument for the regulation of biosafety. Specifically, section 53(2) of the Act empowers the National Environmental Management Authority (NEMA) to prescribe biosafety measures necessary to regulate access, development and transfer of biotechnology.

Kenya has also recently drafted a Biosafety Bill in an attempt to consolidate all the necessary regulatory stipulations in one document. This Bill promises to provide a holistic legal mechanism for the government to assess and address environmental risks posed by GMOs in Kenya. The Bill will establish the National Biosafety Authority as the supreme biosafety organ for biosafety in Kenya. It will also set forth legal requirements to obtain approvals before conducting activities with GMOs and will stipulate requirements for applicants, the risk assessment process, and the role of different regulatory agencies in ensuring compliance. This draft Bill is currently awaiting government approval.

Like Kenya, ***Uganda*** started drafting its biosafety regulations during 1998-99 as part of the National Biosafety Framework (NBF) under the UNCST. The NBF was approved by the Ministry of Lands, Water and Environment in March 2001. Through the NBF, the UNCST was given the mandate to act as a competent authority for biotechnology and biosafety and to provide the overall policy framework within which science and technology (including biotechnology) is promoted and facilitated in the various sectors in Uganda.

Through the NBF process, a number of existing sectoral legislation were identified as capable of addressing and enforcing various aspects of

biosafety, including plant protection, animal and human health. These included the Food and Dug Act, the Animal Diseases Act, the Pharmacy and Poisons Act, the Plant Protection Act, the Public Health Act, the National Drug and Authority Statute, the National Medical Stores Statute, the UNCST Statute, the National Agricultural Organization Statute.

One of the key issues that arose during implementation of the NBF was the question whether there was adequate legal authority from the UNCST Statute to support the development of biosafety regulations under this Statute. Consequently a decision was taken to prepare a dedicated Biosafety Bill to provide for a holistic regulatory mechanism for biotechnology in Uganda. The Bill has been drafted by the NCC and is being finalised for submission to government.

In ***Tanzania***, there is no single legislative instrument addressing biosafety concerns. Instead, there are various pieces of sectoral legislation covering plant protection, and animal and human health, environmental protection and natural resource management which implicitly address issues of biosafety. The following are some of the legislation and other legal instruments that can be invoked to regulate the application of biotechnology in the country: The Plant Protection Act, the Tropical Pesticides Research Institute (TPRI) Act, the Plant Protection Act, the Veterinary Act, the Animal Diseases Act, the Fertilizers and Animal Feedstuffs Ordinance, the Tanzania Food, Drugs and Cosmetics Act, the Merchant Shipping Act, the Tanzania Civil Aviation Act, the Fisheries Act, the Forest Act, the Beekeeping Act, the Wildlife Conservation Act, the Tanzania Commission for Science and Technology Act, the Tanzania Bureau of Standards Act, the Industrial and Consumer Chemicals (Management and Control) Act, the National Environment Management Act and the National Environmental Policy.

In 2004, Tanzania received developed a NBF which envisages the development of policy and regulatory directives for GMOs targeted for implementation under the various enacted laws. For example, a confined Field Trial Directive (Schedule 18) has been developed for appending to the regulations of the Plant Protection Act 1997.

The Directive will be enforced by inspectors at the Tropical Pesticides Research Institute using standard operating procedures which have also been developed. Other directives are planned to be developed as the need arises. This makes Tanzania's interim biosafety regulatory system somewhat different from those of Uganda and Kenya.

Eastern African biotech regulatory systems have been developed with full public participation in the design processes. The three countries highlighted here have continued to use interim measures to test the systems and have used advisory committees to provide expert advice. However, notwithstanding these measures, the regulatory environment is still unclear and the biosafety regulations in Eastern Africa are still evolving as the countries move slowly towards national biosafety bills.

4. Review of Eastern African biotechnology development

Kenya is perhaps the only country that has had familiarity with regulatory dossiers but its experiences are limited to contained use and confined field trials as no scale up or commercial release experiments have been carried out as yet. Kenya has authorised the conduct of confined field trials for GM sweet potato, maize, cotton and rinderpest vaccine. Uganda, on the other hand, has made only one regulatory approval so far — for transgenic banana expressing resistance to Black Sigatoka, a leaf spot disease.

However, although no single biotechnology crop commodity has been commercialised in Eastern Africa, extensive research elsewhere shows biotechnology's potential to address production constraints on commodities such as maize, potato, rice, tomato, papaya, pepper and strawberry. The transfer of biotechnology applications for these crops in the region is therefore a very real opportunity. On the other hand, there are other crops such as beans, millet, cassava and sorghum that are very important to the region but on which hardly any research has been done to find biotechnology solutions to address production constraints.

In 2003, the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) embarked on an exercise to define priority areas of importance as far as biotechnology R&D are concerned and came up with nine priority areas:

1. Development of protocols for regeneration and rapid multiplication of planting materials including diagnostic systems;
2. Development of ways to produce larger numbers of quality livestock breeds in a short timeframe;
3. Acquisition of isolated genes, novel germplasm and biotechnologies;
4. Development of new genes/markers and transformation protocols to address production constraints and/or to improve food quality and other characteristics in the region;
5. Characterisation, evaluation and conservation of existing crop, animal, and soil organism germplasm;
6. Development of capacity to utilise biotechnology (human, infrastructure, information and communication technologies, bioinformatics);
7. Development of policies and legal frameworks to enable the utilisation of biotechnology (biosafety, IPR, strategies);
8. Development of biotechnology product delivery pathways; and
9. Development of awareness of biotechnology and its place in integrated agricultural research for development.

As a starting point in policy development, these priority areas have been embedded in the various biotechnology polices and strategies being developed by the countries in the region and are being used by the region's institutions to formulate research programmes. In addition, various regional programmes such as those of BIO-EARN, the Eastern and Central Africa Biotechnology and Biosafety Programme (ECABIO), BIO-EARN, the Biosciences Eastern and Central Africa initiative (BeCA) and the centre of the Consultative Group on International Agricultural Research (CGIAR) have started referring to these priorities to define their research calls for their competitive research grants programme activities.

Among the ASARECA countries, ***Kenya*** stands out as the country with probably the largest concentration of active biotechnology research programmes, which are underway in various public and private institutions. The Kenya Agricultural Research Institute (KARI) in collaboration with Monsanto started developing a transgenic virus-resistant sweet potato back in the early 90s and research is now at field trial stage. Currently, locally adapted varieties are undergoing field-testing under containment. Plans are also underway to transform other local varieties for resistance to sweet potato feathery mottle virus and other sweet potato virus complexes.

KARI is also collaborating with the Syngenta Foundation and the International Maize and Wheat Improvement Center (CIMMYT) to produce transgenic maize lines expressing various *Bacillus thuringiensis* (Bt) *Cry* gene constructs for determining efficacy against

maize stem borer species in laboratory studies. Of the genes tested, the gene encoding Cry1Ab appears to be effective against all stem borer species except *Busseola fusca*. Field trials are underway to screen local Bt strains under confinement conditions for *Cry* proteins with greater effect on *B. fusca*.

Another collaborative effort between KARI, the Danforth Plant Sciences Centre and Monsanto aims at producing transgenic cotton and cassava resistant to cotton bollworm and cassava mosaic disease respectively and the products have been approved for confined on-station field trials.

Kenya is also more advanced in the field of animal biotechnology R&D, compared to its neighbours Uganda and Tanzania. At the KARI Animal Vaccine Centre, DNA vaccines and diagnostic procedures for animal diseases are being developed. These include a recombinant vaccine against Rift Valley Fever Virus (RVFV) now under evaluation in sheep, cattle and goats. Other vaccine research for diseases like Contagious Bovine Pleuro-pneumonia (CBPP), Contagious Caprine Pleuro-pneumonia (CCPP), and Heart Water is quite advanced. In the area of diagnostic research, latex agglutination diagnostic kits for CBPP, CCPP, RVFV, and Newcastle Disease Virus (NCDV) are being developed for field use, and are being evaluated for effectiveness. A diagnostic kit for Lumpy Skin Disease (LSD) has already been commercialised.

At the International Livestock Research Institute (ILRI), the headquarters of which are in Kenya, research is at a very advanced stage to develop a vaccine against East Coast Fever (ECF) through the use of recombinant DNA techniques. The technology has been patented, but is only 50 percent effective and more research is underway. ILRI has also developed diagnostic kits for tick-borne diseases and trypanosomes, which they package and sell to customers (mostly donor organisations conducting disease control programmes in Africa) at prices that allow for cost recovery. Recombinant DNA techniques are also being used at ILRI to develop markers for quantitative trait loci (QTLs) in cattle and sheep. Of specific interest are QTLs that are responsible for maintaining productivity under adverse conditions such as disease, environmental stress and low-quality feed.

In the area of marker-assisted breeding, several activities are taking place in Kenya. KARI is developing markers for QTLs, determining drought resistance and resistance to stem borers. The International Potato Center (CIP) and International Maize and Wheat Improvement Center (CIMMYT) have been using marker-assisted breeding for improvement of potato and corn, respectively. The International Centre for Insect Physiology and Entomology (ICIPE), while not producing recombinant organisms itself, is working with transgenic maize (Bt maize) to conduct risk assessment studies. ICIPE and the University of Nairobi also have projects ongoing to screen local strains of Bt for activity against important pests.

In ***Uganda***, a modest start to biotechnology and molecular biology in general has begun. There are a number of biotechnology activities going on under the National Agricultural Research Organization (NARO), Makerere University and at one private research laboratory — the Med Biotech Laboratories. Most of the genetic engineering approaches are being explored through collaborations between Ugandan institutions and international centres. The International Banana Programme (INIBAP) is collaborating with NARO and the Catholic University in Leuven, Belgium to develop banana varieties with resistance to Black Sigatoka (*Mycosphaerella fijiensis*), Banana Weevil (*Cosmopolites sordidus*) and a complex of nematodes (*Pratylenchus* spp.

and *Helicotylenchus* spp). Another initiative at the Department of Crop Science of Makerere University is undertaking molecular characterisation of sweet potato viruses and is exploring genetic engineering methods to modify cassava starch for industrial uses. These two projects are being used to build capacity through training of doctoral students in molecular biology techniques. KARI and the Namulonge Agricultural and Animal Production Research Institute (NAARI) are developing a tissue culture methodology to enable regeneration of Eastern African Highland bananas via somatic embryogenesis. This effort will serve as the basis for building transformation methods. KARI is also collaborating with International Centre for Tropical Agriculture (CIAT) to conduct molecular characterisation of strains of Bean Common Mosaic Virus (BCMV) for the purpose of developing diagnostic tools.

There are also a few applications of biotechnology in the livestock sector. Researchers at the Livestock Research Institute (LIRI) in Tororo are working in collaboration with the Department of Veterinary Parasitology and Microbiology at Makerere University on cloning and sequencing genes in trypanosomes that confer resistance to currently used drugs.

Biotechnology activities in ***Tanzania*** are taking place at several institutions. Molecular marker techniques for germplasm characterisation and disease diagnosis are taking place at the Agricultural Research Institute (ARI) of Mikocheni. The Institute has been conducting studies on genetic diversity and fingerprinting of different crops such as coconut, cashew, coffee, sweet potato and cassava. The Faculty of Agriculture at Sokoine University of Agriculture (SUA) has established a tissue culture laboratory for training purposes and for mass propagation of crops such as bananas. These activities are also taking place at ARI Mlingano, Horti Tengeru, ARI Uyole and ARI Ukiriguru. These institutes are in the process of developing capacities in the application of tissue culture techniques for mass propagation of different crops (pyrethrum, sisal, coffee, cassava, banana and some horticultural crops). Kizimbani Agricultural Research and Training Centre in Zanzibar is also involved in banana mass propagation through tissue culture.

In the field of animal biotechnology, the Faculty of Veterinary Medicine at SUA is involved in livestock disease diagnostics for *Theileria parva*, *Mycobacterium bovis* and *Mycoplasma* species. The ASARECA ECABIO Programme is supporting genetic diversity studies in livestock animals such cattle, sheep, goats and chicken to facilitate the identification of more productive and disease-resistant breeds. In addition, the Animal Diseases Research Institute (ADRI) of the Ministry of Water and Livestock Development is applying enzyme-linked immunosorbent assay (ELISA) techniques and monoclonal antibodies for rapid sero-diagnosis of animal diseases such as CBPP and Foot and Mouth Disease.

In the area of industrial and environmental biotechnology, the Applied Microbiology Unit of the University of Dar es Salaam is carrying out research on environmental biotechnology applications such as waste management, i.e. biodegradation and bioremediation. The Faculty of Chemical Engineering of the same university is also involved in industrial biotechnology applications.

There are also a number of 'resident' centres belonging to the ***Consultative Group on International Agricultural Research (CGIAR)*** that collaborate with national agricultural research systems institutions in Eastern Africa to develop different biotechnologies. These include:

- The East African Regional Programme of the International Institute of Tropical

Agriculture (IITA) based in Kampala, Uganda, in conjunction with the Danforth Center and ECABIO has ongoing collaborative biotechnology research projects on cassava.
- The regional hub for eastern and southern Africa of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), based in Nairobi, is involved in research on drought tolerance and pest resistance in sorghum.
- CIAT is involved in biotechnological research on cassava germplasm characterisation.
- At CIMMYT, studies are being conducted on virtually all important traits of maize and wheat. The Insect Resistant Maize for Africa (IRMA) project launched in 1999 by CIMMYT and KARI has just been concluded.
- CIP is undertaking studies on viral resistance, pest resistance and germplasm characterisation on sweet potato.

The programme that has had he greatest political impact on biosafety capacity building in the Eastern African region is the UNEP-GEF Implementation of the NBF project. This project has played a leading role in assisting Eastern African countries to design, set up and operate a system for evaluating and minimising risks associated with biotechnology applications. The main objectives of the first or enabling phase that ran from 2001 to 2004 were to:

- Assist in the establishment of national biosafety frameworks;
- Promote information sharing and collaboration, especially at the regional and sub regional level; and
- Promote collaboration with other organisations to assist capacity building for the Cartagena Protocol.

The key achievements of the UNEP-GEF project in the three Eastern African countries highlighted here include:

- Policy development;
- Regulatory development;
- Development of procedures for handling GMOs including risk assessment and management training;
- Development of biosafety inspections and monitoring and enforcement; and
- The creation of mechanisms for public participation, awareness and information database development including website development.

5. Regional co-ordination on biotechnology policy-making, regulation and development

Although nascent biotechnology research has clearly taken root in Kenya, Uganda and Tanzania, its genesis can be traced back to a concerted regional-level co-ordination that started in 1998 with the ***BIO-EARN Programme***.

The BIO-EARN Programme was initiated with the goal of developing capacity and competences for partner countries (Ethiopia, Kenya, Tanzania and Uganda) to effectively and efficiently use modern biotechnology in agriculture, industry and in environmental management. The focus of the programme has been capacity building (human resources and research infrastructure) in biotechnology R&D. Administered through the National Councils of Science and Technology acting as national focal points, the programme has addressed some of the major problems and opportunities for biotechnology in Eastern Africa, including biotechnology R&D, and biosafety and biotechnology policy-making. In this way, the programme has facilitated close collaboration between scientists, policy-makers and the private sector and acted as a catalyst in stimulating regional collaboration between research and policy institutions.

The programme is now entering its third phase and has recently commissioned four major

projects on agricultural, environmental and industrial biotechnology and biopolicy. One of the projects is geared towards developing biotechnologies to ameliorate biotic and abiotic stresses in sorghum through marker-assisted selection (MAS) with a special focus on breeding for resistance to *Turcicum* leaf blight (TLB), anthracnose and drought tolerance. The programme is also aiming to enhance breeding for tolerance to aluminium toxicity and Phosphorus acquisition efficiency using MAS and developing multiple stress-tolerant sorghum varieties for drought, Aluminium toxicity, anthracnose and TLB. Another project aims to generate knowledge and innovations to enhance the management of biotic stresses of cassava and sweet potato as well as contribute to the development of novel cassava starches in Eastern Africa. A third project aims to develop efficient technologies for the sustainable treatment of high-strength wastewater in Eastern Africa. The fourth project aims to develop improved technologies to utilise industrial and agricultural waste for bio-energy and value-added chemical production. BIO-EARN will also implement activities to enhance product development opportunities and supportive policies.

In 2000, the ***Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)*** started planning a comprehensive regional programme in biotechnology and biosafety which resulted in the establishment of the ***ASARECA Biotechnology and Biosafety Programme (ECABIO)*** as a central regional co-ordination centre for regional biotechnology R&D. With resources from USAID and EU, the programme's first task was to undertake a priority setting exercise and this is being used widely in defining regional priorities in biotechnology and biosafety for the region. In 2005, the programme launched a competitive grant scheme as a mechanism for facilitating R&D, with four pilot grant projects.

The pilot projects selected comprise:

- A project to bring the benefits of genomics and systems biology to maize fields through gene discovery and access for genetic transformation addressing drought stress tolerance in Eastern and Central Africa. The goal of this project is to improve food security in the sub-region.
- Another project on marker-assisted breeding of the stay-green trait of sorghum to enhance terminal drought tolerance in Eastern Africa. This project is geared at increasing food security of households in sorghum-growing, drought-prone areas of Eritrea, Kenya, Ethiopia and Sudan.
- Another project is examining how to exploit the genetic differences of indigenous Eastern African cattle breeds to enhance vaccination responses. This project is geared at developing protocols based on biotechnology for characterisation and utilisation of indigenous disease-resistant livestock breeds through the identification of local cattle breeds/genotypes that are resistant to ECF and the immunological biomarkers for protective immune responses to ECF vaccination.
- The fourth project is applying marker-assisted selection (MAS) for the improvement of Bean Common Mosaic Necrotic Virus (BCMNV) resistance in common bean (*Phaseolus vulgaris*). This project aims at developing high-yielding bean varieties of major market classes that combine and/or are resistant to BCMV under environments prone to BCMNV.

The ECABIO Programme is also involved in regional biotechnology and biosafety activities such as:

- Facilitating dialogue among national biosafety committees (NBCs) and promoting policy linkages in relevant sectors;

- Nurturing the implementation of effective national biosafety mechanisms;
- Facilitating networking in biosafety;
- Strengthening capacity in biosafety risk assessment, risk management and biosafety communication;
- Developing a roster of regional scientific and socio-economic expertise;
- Facilitating biosafety research to addresses gaps in risk assessment and risk management knowledge;
- Assisting countries with IPR policy development; and
- Enhancing public awareness and advocacy in biotechnology and biosafety.

The programme is now collaborating with the East African Community (EAC), the Common Market for Eastern and Southern Africa (COMESA) and the Program for Biosafety Systems (PBS) to establish regional mechanisms for sharing biosafety information and expertise and facilitating regulatory harmonisation.

The ***Biosciences Eastern and Central Africa (BecA)*** is an initiative of the New Partnership for Africa's Development (NEPAD), geared at establishing a state-of-the-art platform to support Eastern and Central African countries to develop and apply bioscience research and expertise to produce technologies that help poor farmers secure their assets, improve their productivity and income and increase their market opportunities. The initiative is focusing on capacity building for bioscience research by providing a platform for the African scientific community to conduct cutting-edge research and human resource capacity building on IPR, biosafety and regulatory issues. The initiative also serves as a platform for forging partnerships with other bioscience initiatives elsewhere in Africa and worldwide.

The ***Rockefeller Foundation's Biotechnology, Breeding and Seed Systems for African Crops program*** has been supporting biotechnology research across Africa since 2000. The three main categories of research supported are marker-assisted breeding, tissue culture, and genetic transformation. Several biotechnology laboratories have been established in Africa, and numerous students are receiving training at Ph.D. level in biotechnology applications for African crops. Support for biotechnology applications is primarily focused on efforts where previous attempts at conventional breeding have failed.

The ***Agricultural Biotechnology Support Program (ABSP)*** focuses on development and commercialisation of selected GM crops and is assisting countries to develop product commercialisation packages which integrate activities on research and technology development, policy and technology transfer, commercialisation, and outreach/ communications on GM crops. The programme has been instrumental in a number of activities including the overseeing of the ASARECA pilot biotechnology competitive grants system, and the development and institutionalisation of IPR policy frameworks and technology transfer. The programme is also backstopping the banana and cassava biotechnology projects in Kenya and Uganda.

The ***Biotechnology Trust Africa (BTA)*** is a regional non-profit trust registered in Kenya and dedicated to the promotion of biotechnology R&D in agriculture, health, industry and environmental management in Africa. It uses a bottom-up approach to improve agricultural production, health services, industry, and policy and encourages sustainable environmental practices in Africa.

The ***African Biotechnology Stakeholders Forum (ABSF)***, a Kenya-based non-governmental organisation founded in 1999, is a forum that brings together biotechnology stakeholders

to regularly debate and dialogue on issues surrounding biotechnology. It has been a visible player in promoting public understanding of biotech issues and facilitating informed participation in the global, regional and national debate. It lobbies for active implementation of biosafety systems through regularly briefing packages for policy-makers, journalists and the mass media (radio, TV and press). It has also organised several roundtable meetings on biotechnology for different groups. The organisation has been effective in educating editors and science reporters in developing informational materials suitable for diverse audiences.

The ***African Center for Technology Studies (ACTS)*** with headquarters in Kenya is engaged in advocacy on biotechnology and bio-policy.

Africa Harvest Biotechnology Foundation (AHBF) programmes focus on technology development, communications and capacity building.

The ***Program for Biosafety Systems (PBS)***, co-ordinated by IFPRI and implemented through a consortium of public, international, regional, and local organisations in developing countries, aims to address several challenges facing less developed countries, including:

1. The need to foster an efficient regulatory environment characterised by transparency and stability;
2. How to provide an effective system that ensures accountability and stakeholder participation, thus building public confidence in decision-making;
3. How to better rationalise biosafety regulations with other ongoing strategies and frameworks for food safety, seed and phytosanitary regulation, importation, and other relevant laws and/or regulations;
4. The need to develop acceptable criteria to weigh risks/benefits while considering agricultural productivity, environmental, and human health concerns;
5. The need to improve implementation of the Cartagena Protocol on biosafety at national and regional levels; and
6. How to respond to the other needs for biosafety at an international level (such as those relating to Codex Alimentarius, Sanitary and Phytosanitary measures (SPS) and the International Plant Protection Convention (IPPC)).

The ***International Service for the Acquisition of Agri-biotech Applications (ISAAA)*** facilitates the transfer of crop biotechnology applications from industrial countries for the benefit of developing countries. ISAAA facilitates national programmes to develop a policy environment conducive to the application of biotechnologies and promotes public understanding of scientific advances in crop biotechnology.

6. Regional efforts in biosafety harmonisation

Perhaps with the exception of some unlabelled biotechnology products arriving in Eastern Africa through food aid, there are no raw biotechnology commodities on the Eastern African market, as trade in biotechnology products is nonexistent at present. Consequently the region's countries do not have any experience with regulatory approvals for biotechnology products for their markets and this issue has heightened the need for regional efforts in biosafety harmonisation.

Attempts have been made to establish harmonised regional biosafety standards in Eastern, Central and Southern Africa since 1993. Although some of the efforts have ultimately led to the establishment of regional focal points, the development of a harmonised regional biosafety structure has not materialised. This has been

attributed to the fact that countries in the region are at different stages in the development of their national biosafety guidelines, and have diverging opinions on the safeguards necessary to protect national sovereignty. Nonetheless, the need to harmonise the biosafety regulations appears to be recognised at both national and regional levels.

In 2003, the heads of the National Councils for Science and Technology in Uganda, Kenya and Tanzania began working together as the East African Science and Technology Council (EASTCO). One of the proposals made at its initial meetings was to explore the possibilities of collaboration between members of the respective national biosafety committees in Eastern Africa and possibly the definition of joint risk assessment and management approaches.

Alongside these efforts, a regional policy on biotechnology and biosafety has been discussed at several regional meetings. During meetings of the Ministers of Agriculture in COMESA in 2001, 2004 and 2005, countries were urged to undertake consultations and develop a regional policy. The Comprehensive African Agricultural Development Programme (CAADP) of NEPAD has voiced similar concerns.

In response to these concerns, a ***Programme entitled the Regional Approach to Biotechnology and Biosafety (RABESA)*** in the Eastern and Southern Africa Region was mooted and endorsed at the COMESA/ECA Maize Trade Policy Conference in Nairobi in September 2003. At the COMESA Agriculture Ministers' meeting in 2005, the ministers directed that consultations should continue on this matter.

RABESA was designed to examine the potential ramifications of GMOs on trade, food security and access to emergency food aid in the COMESA and ASARECA countries. The overall objective of the initiative is to generate and analyse technical information required to inform COMESA and ASARECA countries on regional biotechnology and biosafety policy choices and options.

Specific objectives are to:

1. undertake stakeholder analysis in the ASARECA/COMESA countries, highlighting opportunities, challenges, views and positions related to their engagements in trade, GMOs and food security;
2. estimate the impacts of GMO crops on farm income in the ASARECA /COMESA region;
3. analyse the commercial risks that ASARECA/ COMESA countries are likely to face in the destination export markets both regionally and internationally if permission to plant GMO crops was granted;
4. estimate the impact of precautionary GMO policies on access to emergency food aid and food security in the ASARECA/COMESA region; and
5. identify a range of regional biosafety policy options for decision-making on issues of GMOs and trade in ASARECA/ COMESA countries.

ASARECA's Eastern and Central Africa Programme for Agricultural Policy Analysis (ECAPAPA), the Program for Biosafety Systems (PBS) and the African Centre for Technology Studies (ACTS) are technically supporting COMESA in the implementation of the RABESA initiative.

At a COMESA regional workshop in Kenya in May 2006 on biosafety and biotechnology in the Common Market for Eastern and Southern Africa, the findings of the RABESA studies were presented to stakeholders with the intention of seeking ways to evolve regional positions on the issues under contention. The meeting made three recommendations for regional policy on GMO-related areas:

The ***first*** area was the regional policy on the ***commercial planting of GMOs***. Here, a centralised regional assessment was recommended but the decision was left to individual countries. The reasons given for such a centralised regional assessment included:

- It would create standardised and more transparent procedures;
- It would be more cost effective; and
- It would enable the sharing of resources, information and expertise.

The ***second*** area was the regional policy on the ***commercial trade policy in GMOs***. Here, advice and information from a central regional clearing-house was recommended but again the decision was left to individual countries. The reasons given for this recommendation included:

- It would be more cost effective;
- It would encourage co-operation in assessing issues;
- It would assure national commitment;
- It would enhance information-sharing and capacity building.

The ***third*** area was the regional policy on ***GMO food aid***. Here, it was recommended that guidelines be developed at regional level, with the decision to be taken at the country level on a case-by-case basis. This move would facilitate the transit of food aid in neighbouring states and the provision of food to the needy.

The meeting also made other general policy recommendations at a regional level:

- The development of one or more regional centres of excellence in biotechnology and biosafety;
- The establishment of a panel of experts to provide technical advice on issues pertaining to the development, handling and management of GMO's in the region;
- Efforts to increase public awareness of GMOs at the national level;
- Capacity building in the field of biotechnology and biosafety; and
- Proactive action by the COMESA secretariat on issues of collaboration and co-operation with the African Union, other regional economic communities, international organisations and other relevant entities in raising the region's capacity in the area of biotechnology and biosafety.

The ***East Africa Community (EAC)*** has recognised the need for an efficient biosafety system to guide development in this area. The EAC's Council of Ministers established a Technical Committee of Experts to address biosafety issues and come up with an EAC regional policy on GMOs.

The Community has also already taken concrete steps on institutional and policy issues including the conclusion of a Common Agriculture and Rural Development Policy and Agriculture and Rural Development Strategy. In addition, the EAC has prepared other key documentation and agreed on common or harmonised policies including on Sanitary and Phytosanitary (SPS) measures, farm input standards, measures and procedures, and regional seed policy harmonisation mechanisms. Related to this, a project on Control of Trans-boundary Animal Diseases has been prepared and is in the process of implementation. Finally, the EAC Protocol in Environment and Natural Resources Management contains provisions related to biotechnology issues that will guide investments, trade and operations in biosafety frameworks.

At a macro policy level, Eastern African countries have put in place the requisite policies and strategies for liberalised market-oriented and decentralised economic systems in which

private investments could play an important role. The necessary structural and fiscal reforms have also been undertaken to streamline the macroeconomic management. However, in spite of all these efforts, the countries have yet to put in place the necessary mechanisms to implement pronounced government policies. Furthermore, the development of biotechnology applications and products is still very much a public sector affair. Most research institutions continue to lack the human, financial and infrastructure resources to sustain their research or link them effectively to market prospects. More often than not, the regulation and laws for some of the policies lack sufficient detail. There is also a lack of capacity to monitor the implementation of existing laws or new regulations.

Furthermore, the protection of new technologies is not fully guaranteed and this is likely to discourage private investors who may want to pursue biotechnology-related businesses. In addition, the governments are still too bureaucratic and sluggish, as has been observed in the efforts to implement the East African Customs Union.

However all is not lost. The significant strengthening of infrastructure and human capacity in Eastern African countries has resulted in a strong platform for regional collaboration and has facilitated the mobilisation of policy-makers and scientists in the region, thus contributing to a more efficient and rapid capacity building process. In effect, countries and institutions have made more progress in the capacity building process than in the policy development arena. Through existing regional programmes there is a nascent regional collaboration effort to tackle many of the common problems and future opportunities in the region. In this regard, stimulating the much-needed dialogue between the policy-makers and scientists on research and policy issues, both nationally and regionally will contribute to more robust adoption and application of biotechnology in the region.

7. Addressing the gaps in biotechnology policy frameworks in the region

Looking at the current biotechnology policy frameworks in Eastern Africa, the following four main gaps need to be addressed.

1. There is a need to create an overall policy environment in Eastern Africa that is conducive to investment and commercialised agriculture. In this respect, government investment in the commercialisation of agriculture is crucial.
2. There is a need to strengthen partnerships between the public and private sectors. This requires considerable investment confidence between Eastern African countries and the private sector. Multilateral donors will need to play an important role in creating sufficient dialogue between the two parties to provide an enabling environment for investment in biotechnology products.
3. Eastern African governments need to overcome the infrastructure problems that are currently constraining agricultural productivity and/or making commercial agriculture unprofitable. These constraints include poor road networks, insufficient electricity supply and limited water supply.
4. There is a need for collaborative efforts from all NARS and regional stakeholders of Eastern African countries and other development partners to generate and disseminate information to support biotechnology. Collaboration from ministries of health, environment, industry, trade, and science and technology will be important in creating an environment in the region that will help countries' populations benefit from biotechnology products while minimising potential risks.

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2 POVERTY ALLEVIATION THROUGH AGRICULTURAL DEVELOPMENT: A ROLE FOR BIOTECHNOLOGY?

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1. Introduction

Poverty is a multi-dimensional problem, encompassing a lack of food, inadequate income, and vulnerability to other socio-economic risks and limitations. The Eastern African region has high levels of poverty, with the proportions of Kenya's, Tanzania's and Uganda's populations subsisting on less than one dollar a day standing at 50, 51 and 69 percent, respectively (IFAD, 2001). Poverty rates are generally worse in rural areas. More than three-quarters of the poor in Africa live in rural areas and are dependent on smallholder agriculture and related trade and crafts for their livelihoods.

Agriculture is also vitally important for the economies of African countries. The share of agriculture to GDP is 29.7 percent in Kenya, 46.2 percent in Tanzania and 49.5 percent in Uganda (IFAD, 2001). Similarly the contribution of agriculture in terms of employment is 80 percent in Kenya, 84 percent in Tanzania and 85 percent in Uganda (IFAD, 2001).

However, African countries face serious challenges in their agriculture sectors. Agricultural growth on the continent has been slowing down considerably during the last three decades, due mostly to problems of drought, land degradation, pests and diseases. Inadequate policies, poor marketing infrastructure and poor technology have also played a role in Africa's low food production. At the same time, the prices of commodities, which account for the bulk of Africa's exports, have fallen by nearly a third since 1995 (Båge, 2001). Agricultural subsidies in developed countries, currently six times larger than total foreign direct investment flows, distort agricultural markets and inequitable international trade regimes restrict the growth of agricultural exports (Båge, 2001).

Against this background of weak agricultural performance, the challenge of rural poverty alleviation appears daunting. New approaches are needed, to expand production in order to improve food security and meet the increasing demands for food at the local, national and regional levels. Increasing productivity requires the modernisation of smallholder agriculture. However, modernisation alone is not enough. The region's countries also need to invest in marketing and infrastructure, and establish policy environments conducive to agricultural development.

This paper will look at the role that biotechnology can play in advancing agricultural development and alleviating poverty in the Eastern Africa region – focusing on Kenya, Tanzania and Uganda.

Agricultural research and development policies in Eastern Africa

The agricultural research policy environment in Eastern African countries is currently weak. Research institutes need to present their case to policy-makers to show how supportive policy environments and adequate financial resources for agricultural research would support the current thrust to improve agricultural productivity. The focus here should be on improving research policy formulation, research planning and research organisation and management.

In ***Tanzania***, the Division of Research and Development of the Ministry of Agriculture and Food Security is responsible for co-ordination and overall ministerial research policy. It also plays a liaison function between the government, councils of the research organisations and other scientific bodies outside the Ministry of Agriculture and Food Security which are engaged in agricultural research. The Division of Research and Development is currently discussing the possible establishment of an independent National Agricultural Research System (NARS) as has been done in the other Eastern African countries. Tanzania is the only country in the region where research is still being undertaken within government structures, although they are using a client-oriented research approach.

In ***Uganda***, the government initiated a new National Agricultural Research Policy in 2003, in line with the plan for modernising the country's agriculture sector. The government sees the transformation of the sector from subsistence to commercially-oriented production as a key strand of its poverty eradication strategy. This push for modernisation is to focus on agro-processing and other off-farm activities such as agricultural commodity marketing, as well as cheaper and more efficient production of raw materials. The modernisation strategy is multi-sectoral, involving central and local governments and public, private sector and civil society organisations.

The new policy aims at restructuring the National Agricultural Research Organisation (NARO) to establish the NARS, whereby the National Agricultural Research Council will co-ordinate and oversee all aspects of agricultural research in Uganda. The Council will establish a research fund that could be used by all research organisations. NARO will then concentrate on the co-ordination and management of public research institutes. The Council and the Uganda National Council for Science and Technology will be responsible for future formulation of research policies in Uganda.

In ***Kenya***, moves to strengthen the country's agricultural research policy are included in the Economic Recovery Strategy for Wealth and Employment Creation (ERSWEC) and the Strategy for Revitalizing Agriculture (SRA). The ERSWEC (2003-2007) focuses on the creation of wealth and employment for Kenyans. This is a major shift away from the previous focus on poverty reduction and food security. The strategy identifies agriculture as the leading productive sector and states that agricultural research will continue to play a leading role in providing the required improved varieties and breeds.

The Strategy for Revitalizing Agriculture (2004-2014) gives details of how the agricultural sector will respond and contribute to the ERSWEC. The vision of the government in this regard is to transform Kenya's agriculture into a profitable commercially oriented and internationally and regionally competitive economic activity that provides high quality gainful employment to Kenyans. This will be achieved within a framework of improved agricultural productivity and farm incomes while conserving the land resource base and the environment. With respect to agricultural research, the strategy recognises the need for partnerships and integration of the capacities in the country to achieve synergies, complementarities and economies of scale. In view of this, the Kenya Agricultural Research Institute (KARI) is charged with the responsibility of promoting an integrated NARS, composed of research institutes, universities, commodity foundations and the private sector. KARI is developing the vision, mission and policy of the NARS.

Given the shift in the Eastern African region to the commercialisation of agriculture,

the countries have no option but to use biotechnology as one of the tools for their research and development activities. This calls for the governments to establish biotechnology policies and strategies for increased investment in biotechnology.

Public and private partnerships for biotechnology research

Public agricultural research programmes in many developing countries and the centres of the Consultative Group on International Agricultural Research (CGIAR) are facing declining financial support. The public research organisations have not been able to convince their governments to allocate adequate funding for biotechnology, given the heated public debates about genetically modified organisms (GMOs) and declining donor interest to fund agricultural research programmes. In addition, some of these organisations also lack capacity to undertake biotechnology research and development.

On a global scale, biotechnology research is dominated by the private sector, which owns the technologies that focus on crops and traits of importance for commercial farmers in large, profitable markets. These technologies benefit commercial production in the developed world, and have limited spillover benefits for the commercial sector in the developing world. Despite this, there is a considerable amount of biotechnology research in the private sector that is producing knowledge, research tools, genes and GM varieties that are useful to the poor in developing countries (FAO, 2004).

This provides opportunities for public-private sector partnerships, in which each sector can focus on its area of expertise and strength and can capitalise on the contribution of the other. However, as biotechnology research is proprietary in nature, there is a need for incentives for these kinds of public-private sector partnerships. In particular, governments in the Eastern African region should:

- establish stable regulatory and intellectual property right (IPR) regimes;
- raise awareness among consumers about the potential benefits of GMOs and take other steps to encourage private sector investment in biotechnology research of relevance to the poor;
- recognise public sector research institutes that could co-operate with similar institutes in developed countries, to enable them to gain access to knowledge, research tools and germplasm for biotechnology research of relevance to the poor;
- ease restrictions on the trade in inputs required for biotech research, such as chemicals, hormones and equipment.

Successful partnerships between NARS, CGIAR and private sector companies will take advantage of the assets and values of each partner. Thus, for example, the NARS have the germplasm and varietal assessment infrastructure and the positive public image, while the private sector companies have the technology, access to capital markets, economies of market size, and skills in dealing with regulatory agencies The CGIAR centres, for their part, have germplasm, breeding programmes, and networks for global germplasm exchange.

The research work of these partnerships will rely on technologies being donated, negotiated and traded between the different partners. The African Agricultural Technology Foundation (AATF), based in Nairobi, could help broker the negotiations between the region's NARS and the private sector in setting up these partnerships.

2. Role of conventional research in agricultural development

Conventional research has contributed substantially to past successes in the agricultural sector, through the introduction, testing, promotion and production of crops and animals, and the maintenance of animal health services (FAO, 2004). Conventional research has contributed to the remarkable progress made in hybrid maize production, high quality disease resistant varieties of export crops, improved tree species and forest management techniques (FAO, 2004).

In the 1960s, the green revolution was responsible for an extraordinary period of growth in food crop productivity in the developing world. A combination of plant breeding, agronomy, and pathology together with infrastructure and market development and appropriate policy support fuelled this progress.

The major breakthrough in yield potential that kick-started the green revolution came from conventional plant breeding, including agronomy and pathology. The focus of these programmes was to raise yield potential for the major cereals (maize, rice and wheat). But no research or elite germplasm was available for many of the crops grown by poor farmers in less favourable agro-ecological zones (e.g. millets, sorghums, cassava, pulses). It was not until 1980 that modern higher yielding varieties were developed for those crops. Other traits that have been developed through conventional plant breeding include resistance to a wide spectrum of insects and diseases, tolerance to a variety of physical stresses, quick maturing crops, and enhanced taste and nutritional qualities.

The CGIAR centres have been the predominant source of improved germplasm developed from conventional breeding approaches for cereals. The international flow of this germplasm, based on informal exchanges among plant breeders that are generally open and free of charge, has enabled national agricultural systems to achieve enormous efficiency gains in their crop development programmes.

However, the green revolution and other advances have only marginally improved the small-scale farming systems in Africa generally and Eastern Africa in particular, since the high-yielding varieties require inputs such as fertilisers and other chemicals. Social scientists have criticised the green revolution for not being resource-neutral, while environmentalists have criticised it for the potential damage to long-term productivity that could result from excessive use of pesticides, fertilisers and mono-cropping.

Concerns about the conservation and management of genetic resources and IPR issues including the potential risks of bioprospecting have created roadblocks to the free and informal exchange of germplasm. Requirements such as Material Transfer Agreements (MTAs) and legal frameworks are causing difficulties and delays.[1] Developing countries are becoming more careful to prevent bioprospecting of their germplasm and organisations that have developed gene technologies are quick to patent them. Both these trends mean that germplasm exchange, which was critical to the success of the green revolution, is no longer freely available.

[1] *MTAs are agreements between the provider and recipient of biological material on how, when and for what purpose the material can be used. MTAs cover issues such as the ownership of derivatives and modifications of the material, transfer of risk, and confidentiality of research results.*

3. Role of biotechnology in agricultural development

Biotechnology is being used to address problems in all areas of agricultural production and processing. Biotechnology applications focus, for example, on raising and stabilising yields, improving resistance to pests and diseases and tolerance to abiotic stresses such as drought, salinity, low soil fertility, and enhancing the nutritional content of foods. Biotechnology is also being used to develop low-cost, disease-free planting materials for crops such as cassava, banana, sweet potato and potato, and new tools for the diagnosis and treatment of plant and animal diseases and the measurement and conservation of genetic resources. Biotechnology speeds up breeding programmes for plants, livestock and fish, and expands the range of traits that can be addressed. Biotechnology therefore has much to offer as a complement to conventional research.

The current and emerging uses of biotechnology in crops, livestock, fish and forestry provides an understanding of the technologies and the ways in which they complement and extend other approaches. The following are some of the existing and potential applications of biotechnology.

Cell and tissue culture and micropropagation

Micropropagation involves taking small sections of plant tissue or entire structures such as buds and culturing them under artificial conditions to regenerate complete plants. It is also useful for maintaining valuable plants, breeding otherwise difficult-to-breed species, speeding up plant breeding and providing abundant plant material for research and other uses. Micropropagation for crop and horticultural species is now the basis of a large commercial industry involving hundreds of laboratories around the world. In Eastern Africa, there are many laboratories that are generating disease-free bananas, citrus, sweet potato and cassava. Kenya has the highest number of laboratories including commercial ones that have specialised in mass propagation of clean planting materials. Compared with vegetative propagation through cuttings, tissue culture offers higher multiplication rates and disease-free properties.

In vitro selection

In vitro selection refers to the selection of germplasm by applying specific selection pressure to tissue culture under laboratory conditions. There is a useful correlation between in vitro responses and the expression of desirable field traits for crop plants, most commonly for disease resistance. In Kenya and Uganda in particular, this is being used in coffee and tea breeding.

Molecular markers

Reliable information on the distribution of genetic variation is a pre-requisite for sound selection in breeding and conservation programmes. Genetic variation of a species or population can be assessed in the field and by studying molecular and other markers in the laboratory. This combination is quick and reliable. Molecular markers are identifiable DNA sequences, found at specific locations of the genome and associated with the inheritance of a trait or linked genes. Molecular markers are used for marker-assisted selection, understanding and conserving genetic resources and genotype verification.

Marker-assisted selection has the highest benefits with traits that are controlled by many genes, such as fruit yield, drought, disease or

insect resistance, wood quality, milk and meat production. This tool uses genetic linkage maps to locate and select for genes affecting traits of economic importance in plants or animals.

Molecular markers can also be used to measure the extent of variation at the genetic level within and among populations. This is of value in guiding genetic conservation activities and in developing breeding populations for crops, livestock, forestry and fisheries.

Molecular markers have been widely used for identifying genotypes and for the genetic fingerprinting of organisms. Fingerprinting has been used for the identification of clones in advanced tree-breeding programmes. It has also been used to identify endangered species and determine the parentage of domestic animals.

Genetic engineering

When the desired trait is found in an organism that is not sexually compatible with the host, it may be transferred using genetic engineering. In plants, the most common method for genetic engineering uses the soil bacterium Agrobacterium tumefasciens as a vector. Researchers insert the desired gene or genes into the bacterium which then infects the host plant. The desired genes are transmitted to the host along with the infection. Gene guns can also be used instead of the bacterium. In this case, the desired gene is coated with gold or tungsten particles and the gun is used to shoot the gene into the host at high velocity. There are three distinct types of genetic engineering.

- "Distant transfer" where genes are transferred between organisms of different kingdoms, e.g. bacteria into plants.
- "Close transfer" in which genes are transferred from one species to another of the same kingdom, e.g. from one plant to another.
- "Tweaking" in which genes already present are manipulated to change the level or pattern of expression.

Most of the transgenic crops planted so far have incorporated only a very limited number of genes aimed at insect resistance and herbicide tolerance. Work on drought tolerance is currently underway.

Artificial insemination and multiple ovulation and embryo transfer

Advances in artificial insemination (AI) and multiple ovulation followed by embryo transfer (MOET) have already had a major impact on livestock improvement programmes since they speed up the process, reduce the risk of disease transmission and expand the number of animals that can be bred from a superior parent (the male in the case of AI and the female in the case of MOET). While artificial insemination has been used in the Eastern African region for a long time, embryo transfer has been limited to large-scale agricultural or research institutions. In Kenya, breeders' associations have made extensive use of embryo transfer, even to export breeds to other countries, as embryos.

Diagnostics and epidemiology

Plant and animal diseases are difficult to diagnose because the symptoms may be misleading or even entirely absent until serious damage has occurred. Advanced biotechnology-based diagnostic tests now make it possible to identify disease-causing agents and monitor the impact of disease control programmes to a degree of precision that was not previously possible. Molecular epidemiologists characterise pathogens by nucleotide sequencing which enables their origin to be traced. Enzyme linked immunosorbent assay (ELISA) and polymerase

chain reaction (PCR) techniques are much used in this regard.

Vaccine development

Genetically engineered vaccines are being developed to protect fish and livestock against pathogens and parasites. Recombinant vaccines, produced through biotechnology, can offer advantages over conventional vaccines in terms of their safety, specificity and stability. Today, quality vaccines are available for Newcastle Disease, classical swine fever, rinderpest etc. Advances in biotechnology in this area will make vaccine production cheaper and will therefore improve supply and availability for smallholders.

Animal nutrition

Biotechnology applications have resulted in animal nutrition aids such as enzymes, probiotics, single cell proteins and antibiotic feed additives that are already widely used in intensive production systems worldwide to improve the availability of nutrients from feeds and the productivity of livestock and agriculture. Gene-based technologies are being increasingly employed to improve animal nutrition, either through modifying the feeds to make them more digestible or through modifying the digestive and metabolic systems of animals to enable them to make better use of the available feeds.

Biotechnology applications in Eastern Africa

The following examples illustrate how biotechnology has been used to address specific problems related to agricultural production in the Eastern Africa region.

(i) Micropropagation represents a means of regenerating disease-free banana plantlets from healthy tissues. In Uganda, Tanzania and Kenya, banana shoot tips have been successfully micropropagated through tissue culture. An original shoot-tip is heat treated to destroy infective organisms and then used through many cycles of regeneration to produce daughter plants. In addition, sweet potato, sugarcane, pyrethrum, trees, citrus, and flowers are being produced in the region through tissue culture.

(ii) Marker-assisted selection has been applied in Eastern Africa to develop drought tolerant and insect pest resistant maize lines, as well as other applications such as for maize streak resistance.

(iii) Genetic engineering has been able to develop insect resistant maize expressing the natural insecticide Bacillus thuringiensis (Bt) toxin. Contained trials for Bt maize and cotton are currently underway in Kenya. This technology can be used by both small-scale and commercial farmers and has also been used by a consortium of scientists to develop a cassava variety resistant to cassava mosaic virus. Trials of the transgenic cassava are also being conducted in Kenya. South African scientists in the University of Cape Town are using the genes from Xerophyta viscosa, “the resurrection plant”, which can tolerate long periods of dehydration and requires only 72 hours after rain to restore its chlorophyll content. Results from crops containing genes from this plant show marked tolerance to dehydration, heat and salt. If this can be replicated with staple crops in sub-Saharan Africa, small-scale farmers will definitely benefit from the technology.

(iv) Striga weed (or “witch weed”) has been the bane of many farmers. The weed attacks the roots of plants such as maize and sorghum, slowly strangling them. Furthermore, it is impossible to remove this weed via conventional means. Field trials in

Kenya using a non-modified maize variety resistant to the herbicide "Imazapyr" have proven successful. The maize is coated with the weedkiller, which prevents striga from attacking the maize. AATF is brokering the transfer of this technology to seed companies in Africa. It will be grown like any other seed, and will assist millions of small farmers, including those in the Eastern African region, to increase their maize production.

Success stories of biotechnology in agricultural development in Eastern Africa

The main problems facing agricultural production in Eastern Africa are technical and socio-economic in nature. The technical problems include abiotic stresses such as drought, land degradation leading to low soil fertility and/or salinity and acidity, and biotic stresses such as pests and diseases and inadequate technology. The socio-economic problems include inadequate policies in agriculture, poor marketing infrastructure, lack of micro-credit, poor distribution and high costs of inputs, and lack of value addition.

The existing and potential biotechnology applications as listed above are able to address most if not all these technical problems. They can also influence development of policies including those on biotechnology, biosafety and, to some extent, intellectual property rights. The development of these policies and legislations are, in turn, likely to stimulate the review or development of other policies and legislation to strengthen agricultural production.

GMOs are not yet commercialised in Eastern Africa, but the following are under confined trials in Kenya: Bt maize, Bt cotton, transgenic cassava and transformation of local sweet potatoes against viruses. In addition to their own trials on Bt cotton, Tanzania is also initiating trials for transgenic tobacco and Uganda for transgenic bananas.

Two cases which can illustrate how biotechnology applications can help increase agricultural production and alleviate poverty are discussed below.

Pest and disease resistant banana

As well as being the most popular eating fruit sold in Africa, banana is also an important staple food. The cooking varieties are popular especially in Eastern Africa and banana has become an important food security crop, as it can provide a continuous supply of fruit even under low input regimes.

Economically, the most important banana pests are weevils and nematodes and fungal diseases such as black sigatoka. These are spread through infected banana suckers or soils.

Several laboratories, including some private ones, were set up in Eastern Africa to tackle these pest and disease problems and the use of tissue culture technology for the region's bananas was initiated in the late 1990s. Experiences from the International Service for the Acquisition of Agri-biotech Applications (ISAAA) in Eastern Africa indicate that the tissue culture technology package has substantially reduced yield losses caused by pests and diseases at the farm level. The technology has made it possible for farmers to have access to large quantities of pest- and disease-free planting material that is early maturing (12-16 months compared to 24-36 months for conventional banana plants), and better yielding (40-60 tonnes/hectare compared to the 15-20 tonnes/hectare of conventional material). Moreover, uniformity

in orchard establishment and simultaneous plantation development has made marketing easier to co-ordinate and enabled banana growing to be transformed from subsistence level production to a commercial venture (Wambugu and Kiome, 2001).

In order to help the farmers of Eastern Africa to afford the relatively more expensive tissue culture plantlets, ISAAA initiated a micro-credit scheme in the region in 2000. ISAAA reports that the initial results were overwhelming, with a planting material demand of more than 100,000 plants in just one season. Although the recommendation was for 80 plantlets per farm, this has not been widely achieved due to the limited availability of clean plantlets and the small size of many farms. However, an average of 41 plantlets per farmer has been achieved, which is considerably greater than the 10 or so that were bought without the availability of credit. Moreover, farmers who originally bought a small number of plantlets on credit have been coming back for more (ISAAA, n.d.).

According to ISAAA, the average baseline income per farm in the areas studied was USD 40 per month. The projected additional income following adoption of tissue culture banana is USD 25 per month, representing a 38 percent increase in disposable income per family per month. This is enough to make a substantial difference to a family's standard of living. The repayment rate is currently 95 percent, which is comparable to the best repayment rates achieved in the world (ISAAA, n.d.).

Endophyte-enhanced banana tissue culture developed by the International Institute for Tropical Agriculture and disseminated through public-private partnerships in Uganda and Kenya is also promising to become a useful tool for improving banana production (see Box 2.1).

Tissue culture techniques have thus proved valuable in increasing the productivity of banana production for consumption and income generation. With improvements in marketing infrastructure, capacity building on value addition and provision of micro-credit, tissue culture for bananas and other fruits will be able to help reduce poverty in some parts of the Eastern Africa region. Countries in the region should start from this biotech tool to build up to GMO technology.

A Newcastle disease vaccine

Poultry is important in meeting the economic and social obligations of rural households, particularly in poor families where poultry keeping can help alleviate poverty and improve food security (Hoffman and Ottee, 2005). Poultry not only accounts for a large share of the animal protein sources available to poor rural families, but also provides manure and pest control. One of the most serious diseases affecting poultry worldwide is Newcastle disease (ND).

Biotechnology has enabled scientists to develop vaccines that help to protect poultry, especially chicken, from ND. The use of vaccinations in indigenous chicken production in Tanzania has been estimated to allow households with 10-15 chickens to generate an income of between USD 563 and USD 1000 per year (Salum *et al.*, 1999). Similar benefits have been recorded in Kenya and Uganda.

ND vaccines have therefore played a significant role in alleviating poverty and meeting the basic needs of poor households. A thermostable ND vaccine is now on the market and if a rural micro-credit scheme, similar to that for tissue culture bananas, was available, it would help the region's farmers to purchase the vaccine.

Box 2.1: Using biotechnology to increase banana production: Examples of public-private partnerships in Uganda and Kenya

Lack of clean planting material is a major constraint for banana production in Eastern Africa. Declining yields have been associated with an increasing incidence of soil borne pests and diseases. Through the research initiatives of the International Institute of Tropical Agriculture (IITA), endophyte enhanced banana cultures have been developed. Endophytes are organisms that live within plant tissues without causing any harm to the plant and can protect the plant against pests and diseases. They can also facilitate increased nutrient uptake to promote growth. This biological control using microorganisms has been widely promoted as an alternative to chemical pesticide use.

The critical step in developing endophyte technology is the isolation of the organisms and identification of the pests they target. A few plants yield a vast array of endophytic strains. Banana tissue cultures can then be inoculated with the identified strains and greenhouse tested for resistance to the target pests before being tested in farmers' fields.

In order to produce these tissue cultures, initially for research, IITA engaged in public-private partnerships with Agro-Genetic Technologies, a private company in Uganda, and Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Kenya. These partnerships have proven to be critical vehicles for dispersing endophytic technology to farmers. In the Ugandan case, AGT has developed locally operated nurseries and demonstration gardens for sales and training, respectively. The nurseries make the disease-free tissue culture plantlets available directly to the farmer. By stopping farmers from sourcing plantings from clippings, the nurseries help to prevent the spread of pests and diseases. This system also facilitates knowledge distribution and job creation. However, insufficient sales due to lack of awareness among farmers and inadequate distribution channels have made plantlets expensive since they have so far not been produced and sold at a sufficient scale.

The dispersion of endophytic plantlets in Kenya has been more successful due to a greater scarcity of planting material. JKUAT developed a training program and created banana tissue culture nurseries in key areas of the Mount Kenya region which are operated by farmer groups as private businesses. These nurseries distribute the enhanced plantlets and knowledge to local farmers. Follow-up studies have found that many farmers in the area have been able to switch from subsistence to commercial banana farming because of increased yields made possible by the entophyte enhanced banana plants.

These public-private partnerships have made considerable progress in bringing research and technologies to Kenya and Uganda. Collaboration with JKUAT and AGT forced IITA to think commercially and develop the most effective ways of bridging its research with application, furthering their goal of sustainable food production in tropical Africa. Based on IITA's experience, public-private partnerships should be developed at an early stage when the ultimate goal is to facilitate technology transfer to small-scale farmers.

Source: Dubois *et al.*, 2006.

4. Conclusions

Biotechnology applications such as tissue culture and vaccine production and use have proven potential to increase agricultural productivity in the Eastern Africa region both for home consumption and income generation, thereby contributing to poverty alleviation. To be truly effective however, these technologies will need to be accompanied by empowerment of farming households, including through improved marketing infrastructure, credit provision, and capacity building for value adding.

It is important to remember that biotechnology should be used as a complement to, rather than a replacement for, conventional agricultural research. Modern biotechnology must be incorporated into agricultural research and development programmes and must focus on the urgent needs and priorities of the region's small-scale farmers.

Many producers in Eastern Africa are small-scale and resource-poor, and for such producers some biotechnology innovations may be inappropriate. For example, animal reproductive technologies, such as embryo transfer, that are common in developed countries require capital infrastructure beyond the reach of these farmers.

Transgenic crops, by contrast, may be relatively easy for Eastern Africa's farmers to adopt because the technology is embodied in the seed, rendering it the most scale-neutral and easily transferable form of agricultural technology.

Some transgenic crops, especially insect-resistant cotton, are yielding significant economic gains to small farmers as well as important social and environmental benefits, through the changing use of agricultural chemicals (FAO, 2002). AATF was established to broker the transfer of this technology between companies and African states, to enable countries to obtain the technology cost-free or at least at substantially lower cost.

Eastern African countries are currently awaiting the enactment of their biosafety frameworks. Once these frameworks are made into law, the national regulatory agencies will play a larger role in ensuring compliance of the regulations for the development of biotechnology. Already in Kenya, where contained trials are being conducted on several GM crops, the regulatory agencies are very strict in the monitoring of these trials. All three countries in the region are Members of World Trade Organization (WTO) and signatories to the Cartagena Protocol on Biosafety, so have an obligation to develop regulations for biotechnology and trade.

Even though transgenic crops have been delivered through the private sector in most cases, the benefits have been widely distributed among industry, farmers and consumers. This suggests that the monopoly position enjoyed by the private biotech firms, and defended on the grounds of Protection, does not automatically lead to excessive industry profits. Nonetheless, the experience of other countries suggests that special efforts will be required to ensure that poor farmers have access to biotechnology products. In Argentina, for example, the uptake of Bt cotton has been slowed down by the control which the technology suppliers had on seed availability and the high prices charged for the Bt seeds (FAO, 2004). In contrast, adoption rates of Bt cotton in China have been high, partly because the seed costs were kept to a reasonable level due to strong competition in the market between the transgenic cotton produced by the private sector company and the public sector (FAO, 2004). The China case clearly illustrates that public sector involvement in research and development and in the delivery of biotech products can help ensure that poor farmers have access to the new technologies and an adequate share of the economic benefits.

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3. BIOTECHNOLOGY CAPACITY BUILDING NEEDS IN EASTERN AFRICA

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1. Introduction

Modern biotechnology is revolutionising production in both industry and agriculture. Biotechnology has the potential to provide answers to some of the most intractable development challenges facing developing countries, including agricultural production, health, nutrition and the environment. However, the development of a healthy biotechnology industry and, more generally, a bio-economy, needs to be based on strong scientific and entrepreneurial foundations. A bio-economy can be defined as an economy that embraces the development and application of biotechnology and takes advantage of the benefits which advances in modern biotechnology can offer. Unless developing countries can achieve basic capacity to acquire, adapt and harness biotechnology techniques, they may not realise the benefits of this powerful technology.

This paper seeks to identify biotechnology capacity bottlenecks that could be hindering developing countries from effective exploitation of biotechnologies and development of their own bio-economies. The paper analyses the status of biotechnology in developing countries, with particular reference to Eastern Africa, and attempts to identify the available capacities, current and future efforts in capacity building in the region, and limitations and gaps in capacity building. The paper also analyses the approaches and experiences of emerging economy countries, to draw some lessons of relevance to Eastern African countries. Finally, the paper suggests some strategies for tackling the challenges facing Eastern African countries in building their biotechnology capacity and developing their bio-economies.

2. Current limitations to biotechnology development in Africa

In 1998, African Governors of the World Bank observed that "Africa is a continent rich in natural resources but lacking the capacity to transform that potential into a standard of living that would enable the African people to become full partners in the global economy" (World Bank, 1998). As a result the continent is poorly integrated into the innovation-based global economy. By 1997, Africa's share of global trade had fallen to one percent from the three percent recorded in the mid-1950s (EIU, 1997) and is estimated to be falling further (Adubifa, 2000). The continent continues to be highly vulnerable to commodity prices and global economic developments (APIC, 2000).

Emerging technologies including biotechnology offer new prospects for bringing a large number of developing countries into the global economy (Juma and Konde, 2005). However, achieving this will require adoption of a global biotechnology governance regime and the strengthening of developing countries' technological capacities to access biotechnology and manage the risks and benefits associated with its use.

In most African countries, adoption and application of biotechnology is still a long way away. The benefits it could bring for agriculture, the environment and livelihoods remain a dream. In contrast, in India, where

biotechnology applications have been adopted, field trials with hybrid Bacillus thuringiensis (Bt) cotton have shown an 80 percent yield increase (Qaim and Zilberman, 2003). Researchers in the Eastern African region and Sub-Saharan Africa in general need to strengthen their capacities not only to develop genetically modified organisms (GMOs) adapted to their ecological conditions, but also to negotiate with third parties for the importation and utilisation of patented genes and technologies.

Although biotechnology may be a powerful strategy for sustainable development in the 21st century, its full potential can only be realised if it is accompanied by effective government action to provide incentives, research and regulation. Biotechnology uses a wide range of disciplines and its safe application draws on various scientific and technical skills, combined with effective policy, regulatory and institutional frameworks that can facilitate its sustainable use and safe deployment. The main prerequisite, however, is that there must be the necessary workforce, infrastructure and policy environment for biotechnology deployment (Brink et al., 1998). Many developing countries lack these basic requirements. Lack of capacity is partly due to the inability of developing country governments to allocate adequate financial resources to research and development as well as an overall lack of commitment to science and technology (S&T) (Gopo and Kimeri-Mbote, 2005). In many African countries, commitment to S&T is below 0.01 percent of GDP. Their capacity building needs cannot be considered in the narrow context of biosafety, which only deals with the risks posed by the spread of GMOs. This calls for an integrated capacity building and management strategy for biotechnology that is mutually supportive and complementary.

Another hindrance to the development, adoption and utilisation of biotechnologies arises from limited public awareness about these new technologies and growing public concern over their safety. International campaigns launched by some environmental groups are appealing to the public and governments to reject biotechnology and biotechnology products. However, their conclusions are based on non-scientific arguments, exploiting the fear of the unknown and taking advantage of the low levels of understanding of biotechnology issues.

The public has the right to be informed and the responsibility to learn about biotechnology and how to deal with it. It is important that the public and private sectors jointly undertake awareness campaigns through exhibitions, publications and media to address public concerns on the biosafety issues of biotechnology products and applications. Education is another means to demystify biotechnology and avoid misunderstandings or extremist positions. Thus, effective adoption and use of biotechnologies largely depends on active involvement of scientists, entrepreneurs, financiers, policy-makers, journalists and the general public.

3. The need for biotechnology capacity

A huge variety of agricultural products moves between countries through international trade. For products of modern biotechnology, there may be regulatory compliance implications related to their trade. Compliance requirements may relate to the status of the product approval or decision of the food manufacturer regarding labelling of the final product in a specific country. Biotechnology products have entered the international market in the past ten years. During this period, countries have begun addressing safety and identification requirements for the new products. This process has involved a review of the adequacy

or applicability of their existing broader regimes for conventional product categories to the new products. The need for capacity building in biosafety arises particularly when a country has an operating biotechnology sector. Capacity is then needed for everything from ensuring safety in the research laboratory to addressing long-term environmental and food safety concerns.

In several African countries, basic infrastructure and facilities are unavailable even for the simplest tissue culture techniques such as micro-propagation. Reliable power supplies and modern communication systems, such as telephones, fax and access to e-mail and the Internet, are also lacking or inefficient in large parts of Africa. This seriously hampers the acquisition of the necessary knowledge and its application in the rapidly developing field of plant biotechnology. Only a few countries in Africa have the capacity to produce transgenics and these countries are still struggling to commercialise these products and ensure that they reach the end-user. Bridging this gap requires the formation of partnerships with the private sector, producer organisations or government institutions to enable the technology/product to be delivered to the market (James, 1996).

4. Status of biotechnology infrastructure and human resources in Eastern Africa

The status of biotechnology infrastructure and human resource in Eastern Africa is presented in Tables 3.1 and 3.2 The data show the following common characteristics among the four countries involved:

- inadequate numbers of trained personnel in modern biotechnology-related areas;
- few and inadequately equipped laboratories to effectively engage in biotechnology research; and
- minimal private sector involvement which further limits the commercialisation of biotechnologies and their products.

Table 3.1: Status of biotechnology infrastructure in Eastern Africa

TECHNOLOGY	ETHIOPIA	KENYA	TANZANIA	UGANDA	TOTAL
Tissue culture	1	17	5	6	29
Modern biotechnology applications	4	9	2	5	20
Biofertilisers	1	2	0	1	4
Biopesticides	1	1	0	1	3
Fermentation	0	3	0	0	3
TOTAL	7	32	7	13	59

Source: Wekundah, 2003.

Table 3.2: Biotechnology human resource capacity in Eastern Africa

TECHNOLOGY	ETHIOPIA	KENYA	TANZANIA	UGANDA	TOTAL
Tissue culture	11	28	17	10	66
Modern biotechnology applications	4	18	23	18	63
TOTAL	15	46	40	28	129

Source: Wekundah, 2003.

These findings confirm the need for African countries to develop human resource capacity and research infrastructure to enable them to produce biotechnologies and products and to handle imported engineered products.

5. Biotechnology capacity building efforts in Eastern Africa

Before 1999, efforts to harness biotechnology for development in the Eastern Africa region were largely limited to Consultative Group on International Agricultural Research (CGIAR) institutions, other international research institutes and bilateral arrangements with the north. Since the launch of the East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIO-EARN) in 1999, the biotechnology research landscape has substantially changed, with a number of new actors complementing the efforts of the BIO-EARN Programme.

The key actors in the region involved in biotechnology research for development and their areas of focus include:

- The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) — which works on commodity crops;
- The Biosciences for Eastern and Central Africa (BecA) — a New Partnership for Africa's Development (NEPAD) initiative which acts as a state-of-the-art platform to support Eastern and Central African countries to develop and apply bioscience research and expertise to produce technologies;
- The CGIAR Centres and international agricultural research centres (IARCs) — that are collaborating with national agricultural research systems (NARS) to develop different biotechnologies;
- The Programme for Biosafety Systems (PBS) — a United States Agency for International Development (USAID)-funded programme that assists countries to enhance their biosafety policy, research and capacity;
- The emerging presence of private sector biotech companies focusing on mass propagation and dissemination of tissue culture planting materials;
- The Rockefeller Foundation-funded Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), which focuses on

human resource capacity building through MSc and PhD training;
- Bilateral co-operation efforts; and
- The Eastern African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIO-EARN), which focuses on capacity development in agricultural, environmental and industrial biotechnology, biopolicy, biosafety and infrastructure development.

The actors involved in the fields of industrial and environmental biotechnology include:

- The Lake Victoria Environmental Management Project (LVEMP);
- The Sida-funded Lake Victoria Research (VICRES) initiative focusing on wetlands and land-use;
- ASARECA research on water quality monitoring,
- the Water Research Fund for South Africa (WARFSA) which supports research related to water use and conservation technologies; and
- the UN-HABITAT funded "Sustainable Cities Initiative" which supports capacity building in manpower for waste management.

With regard to biopolicy development, the key actors include:

- The African Agricultural Transfer Foundation (AATF), whose focus is to facilitate access to patent technologies;
- The Agricultural Biotechnology Support Program (ABSP II) which facilitates access to GM technologies;
- The Programme for Bio-safety Systems (PBS) which is supporting capacity building activities for biosafety implementation, biosafety research and public awareness;
- The Bio-Safe Train project which focuses on capacity building for risk assessment of transgenic crops – training at MSc and PhD levels and supporting biosafety infrastructure such as containment structures; and
- The UNEP-GEF project supporting the development and implementation of national biosafety frameworks.

There are also a number of non-governmental organisations (NGOs) involved in biotechnology activities, especially in public awareness raising and information dissemination and policy development. These include, for example:

- Biotechnology Trust Africa (BTA);
- African Centre for Technology Services (ACTS);
- International Service for the Acquisition and Application of Ag biotech (ISAAA);
- African Biotechnology Stakeholders Forum (ABSF) which is engaged in advocacy and public awareness activities and acquisition of technologies; and
- African Technology Policy Studies Network (ATPS) which focus on generating research results for policy decision-making.

Private sector involvement in the field of biotechnology is just emerging in the region. There are currently a few private sector institutions such as the Genetics Technology Ltd. (see Box 2.1) and African Harvest in Kenya and Agrogenetic Laboratories Ltd. in Uganda. This small but active sector focuses among other things on commercialisation of the technologies including promotion of mass propagation and dissemination of tissue culture planting materials.

Collaborative efforts of the BIO-EARN Programme: Over the past five years, the BIO-EARN Programme has equipped 14 laboratories in the region and graduated 20 PhDs in biotechnology-related fields (see Table 3.3) and six MSc students in biosafety. Fifteen

Table 3.3: Biotechnology human resource capacity built under the BIO-EARN Programme

THEMATIC AREA	ETHIOPIA	KENYA	TANZANIA	UGANDA	TOTAL
Agricultural biotechnology	3	2	2	4	11
Environmental biotechnology	1	0	1	1	3
Industrial biotechnology	0	2	1	0	3
Biosafety	1	1	1	0	3
TOTAL	5	5	5	5	20

Source: www.bio-earn.org

network institutions were assisted through the installation of infrastructure for information and communication technology, easing access to and dissemination of information.

During the period from 2006 to 2009, the BIO-EARN Programme aims to graduate another eight PhDs and 20 MSc students in various biotechnology thematic areas.

In addition to the PhD and MSc training, the BIO-EARN Programme has also run short courses in biopolicy and biosafety, in collaboration with advanced institutions, to help prepare the region to effectively engage in biotechnology for national and regional development. Since 1999, these courses have trained over 55 and 130 individuals in biopolicy and biosafety respectively. In an effort to create an enabling policy environment, the programme has also undertaken public awareness raising efforts through national and regional seminars which addressed issues relating to biopolicy, biosafety, technology transfer, intellectual property and public-private partnerships.

Similar efforts are being made through the Rockefeller Foundation-funded programmes, bilateral co-operation agreements and other initiatives. While these efforts have slightly improved the 2003 situation, a critical mass of human resource and infrastructure has yet to be achieved in the region.

6. Gaps in biotechnology capacity building in Eastern Africa

The current gaps in capacity building for effective engagement and full exploitation of biotechnology opportunities include:

- Building a critical mass of technological expertise, including adequate laboratory capacity and highly trained personnel;
- Establishing accredited testing and certification facilities;
- Building capacity in intellectual property rights issues and the institutionalisation of IP;

- Organisational coherence, including the rationalisation and harmonisation of national and regional policies and their implementation;
- Regulatory issues also need to be harmonised and information shared to minimise duplication and reduce costs;
- Enhancing public participation, awareness and confidence through the use of different means of communication, consultation and engagement;
- Communication strategies and training methods and modules need to be developed.

7. Challenges for biotechnology capacity building in Eastern Africa

Retention of personnel: A serious constraint facing Africa in general is the loss of skilled personnel who have received training in developed countries and have added to the brain drain. Working opportunities in Africa are often inadequate and training gained abroad is often not attuned to local needs because of the different research and infrastructural environments in many African countries. As a result, the demands and opportunities present in African countries often remain unanswered. This is further exacerbated by attrition due to HIV/AIDS.

Inadequate budgetary support by national governments: Up to now there has been minimal input by national countries in the development of the biotechnology industry. The industry has been mainly supported by various development partners. However, this support is dwindling and the long-term future of the industry is at risk, especially in the absence of national policies on biotechnology and biosafety. If the biotechnology sector is to effectively contribute to national development, national governments will need to make a serious commitment to providing it with financial support.

Lack of a conducive policy environment: Most African countries lack, or are in the process of developing, policy frameworks and institutional arrangements to deal with the challenges of biotechnology. The absence of such policies and legal frameworks is holding back the development of biotechnology in Africa.

8. Biotechnology capacity building experiences from other developing countries

Developing countries have used a variety of approaches to develop their biotechnology industries and build their biotech capacities (see Box 3.1). Analysis of these cases shows that the necessary building blocks for a bio-economy include the development of institutions, infrastructure, human resources, collaborative linkages with national and international players, technology development and commercialisation. In all cases, investment in and support to the biotechnology sector by national governments is a prerequisite for the successful development and contribution of the biotechnology sector to national economic development.

Capacity building experiences from international organisations such as the World Bank indicate a number of implementation weaknesses that have limited the effectiveness of these programmes (see Box 3.2). These weaknesses include, for example, insufficient attention to the development of a relevant curriculum and assessment of learning outcomes, and a failure to focus on establishing the necessary linkages between tertiary education, policy reform and the private sector labour market. Developing countries will need to address these issues as they build their own biotechnology capacities.

Box 3.1: Developing country approaches to biotechnology capacity development

Republic of Korea

The Republic of Korea developed a complete biotechnology industry strategy addressing all the core sectors such as human resources, institutions, research facilities, financial needs, marketing and management capabilities. The strategy involves public and private sector partnerships and support for local capabilities to access international centres to stay abreast of new developments.

The plan started with building research and development (R&D) capacity, followed by a focus on commercialisation and marketing capabilities. The biotechnology sector imported most of the enabling technologies such as fermentation, vaccine and drug production capabilities and exported drugs, vaccines and diagnostic kits. The country adopts focused programmes on manpower training locally and abroad. For example, the Korean government plans to train 13,000 nanotechnology specialists by 2010 at home and abroad. This field is seen as likely to benefit biotechnology as well as information and communication technologies.

In addition, the Korean government has set up offshore centres and the "Korea Biovalley" has been established to foster collaborative research between institutions and individual scientists. The aim here is to foster technology transfer and marketing opportunities for biotechnology products and services. As an added incentive, researchers in government-aided institutions are allowed to establish firms to facilitate smooth transfer of technology or innovations with high tacit knowledge levels.

Cuba

Over the past twenty years or so, Cuba has invested about USD 1 billion in biotechnology with about 1.2 percent of GDP expenditure on R&D. In return, Cuba's biotechnology centres have produced, among other things, at least 160 medical products, 50 enzymes and probes for plant diseases (Elderhorst, 1994). By 1998, the biotechnology sector was the fourth main foreign exchange earner, making up to USD 290 million. The Cuban biotechnology industry is a closed network or cluster of supportive institutions. This structure promotes recombination of knowledge and is cost-effective.

Cuba developed a manpower base in medical sciences through training programmes at home and abroad since the early 1960s. This manpower formed the backbone of the biotechnology industry. The Cuban government has been able to retain its highly educated human resource through motivations such as according them free education and health services and subsidised food and housing.

China

China has invested in modern biotechnology through the National Natural Science Foundation and the Chinese Foundation for Agricultural Scientific Research. Through these efforts, skilled manpower was trained and research facilities were equipped. Scientists have been exposed to research and training centres and/or funding opportunities in developed countries through collaborative programmes such as those of the Rockefeller Foundation, the McKnight Foundation and the European Union-China collaboration. Their participation in global projects such as the Human Genome Project has greatly contributed to their developmental efforts in biotechnology.

Pakistan

The government of Pakistan has steadily supported modern biotechnology since 1981 when a centre of excellence in molecular biology was first created. Despite resource constraints, the government encourages cutting-edge research in biotechnology and provides adequate funding to a number of biotechnology institutes to undertake major projects, particularly with regard to transgenic plants, microbial fermentation, conversion of biomass for production of fuel, diagnostic and drug/vaccine development. By 2000, Pakistan scientists had developed transgenic cotton, rice and chickpeas varieties that are resistant to pests and viruses, and tolerant of high salt concentrations. To encourage further research and development, the Ministry of Science and Technology approved a USD 643,000 grant in 2003 for a three-year biotechnology research project focusing on enhancing biotechnology development and commercialisation of biotechnology products.

Source: UNCTAD, 2004.

9. Strategies for developing a bio-economy

Priority setting

Biotechnology is a diverse field in its range of applications and the multiplicity of procedures in each sector. It is therefore important to set research priorities to provide focus and establish milestones for research initiatives. Priority setting is a difficult exercise, in the face of limited resources and manpower and overwhelming conflicts of interests on which problems should be tackled first. Priority setting also runs the risk of limiting research to one area, thus ruling out the ability to benefit from expertise and facilities in other areas. Biotechnology focus, capacity building and policy programmes in Africa are strongly inclined to the agriculture sector, even when health is also an important area for biotechnology application. There is therefore a need for countries to re-examine their priorities and address crucial areas where they have comparative advantage in biotechnology applications.

Box 3.2: Lessons from World Bank experience in human resources development for science and technology

Assessment of the World Bank S&T capacity building efforts through basic and tertiary education have shown that:

- attention to science education has been limited at the primary and secondary levels in both policy dialogue and lending. The support provided has typically prioritised equipment over teacher training, curriculum development, and assessment.
- sufficient attention was not given to improving learning outcomes in science. International assessments of student learning outcomes needed to be better integrated into the World Bank's support for science.
- the overlap between academic training and research and the private sector stands as an important nexus of capacity building and use. Tertiary education systems are often the final stage of training for labour market entrants with advanced scientific skills. Creating the right "backward" linkages to the broad reform agenda for tertiary education (e.g. quality assurance, finance, coverage, equity, institutional governance and management, and diversification) and the "forward" linkages to the private sector are critical steps to ensuring the successful use of S&T expertise for social and economic ends.

Lessons learned from fostering partnerships between the private and public sectors serve to reinforce the notion that successful S&T capacity building requires linkages between these two spheres.

Source: Watson *et al.*, 2003; OECD, 2000

Human resource development

Human resource availability has been identified as one of the key elements of successful biotechnology development. The abundance of scientists with intellectual capital and the flexibility of interactions between academia and industrial clusters are important factors in accelerating growth of the biotechnology sector. The strength of basic research capabilities determines biotechnology product design and development (Henderson et al., 1999). Experiences from several emerging economies have shown that these countries have combined local training programmes with international training opportunities to build a critical mass of human capacity.

To overcome the lack of funding for infrastructure and personnel development, some governments have formed biotechnology venture capital firms (e.g. Chrysalis Biotechnology and Bioventure in South Africa) or provided direct finances to private sector institutions (e.g. Republic of

Korea and India). Rather than setting up an expensive state-of-the-art facility to meet all their biotechnology needs, countries with limited biotechnology capabilities could use universities and other such centres for research purposes and industrial partners for development, production and marketing requirements as long as regulations clearly stipulate the relationships, benefits and privileges of the various players.

Achieving progress in human resource development for biotechnology depends on an enabling policy environment. Policies that foster human resource development in science and technology seek to accomplish four major goals:

- Provide the broad basic science education that makes a human resources base scientifically literate, imparting both everyday skills and intellectual abilities needed for an informed citizenship;
- Stimulate interest and prepare adequate numbers of young people to pursue careers in science and technology as well as provide opportunities for life-long learning and skill renewal;
- Educate a diverse labour force and develop skills for various purposes at various levels of sophistication; and
- Encourage the conduct of research and advanced training that creates the knowledge and highly trained specialists needed to advance the frontiers of knowledge and applications.

Sound human resources development for S&T begins with science education at the primary and secondary levels. These include curricula that are appropriate and science programs tailored to the developmental needs of students and their societies, the use of goals and standards for student achievement to guide the design, implementation and assessment of all elements of the science program, and provision of support systems for teachers that align with the goals of the science program.

A major challenge facing developing countries is how they can meet the growing demand for tertiary education while simultaneously improving quality and relevance, within shrinking public budgets. Another critical issue in tertiary education is how to balance public support for foreign and domestic training to strengthen domestic capabilities while avoiding the brain-drain of individuals educated at public expense.

Managing capacity development

Development of entrepreneurs is another important element of biotechnology development. In many developed countries, incubator facilities and technology transfer offices are now available in most research facilities operated by universities, non-profit and government-funded institutions. These offices identify inventions, determine their value, define their protection and suggest alternatives to commercialisation. Most developing countries, especially in sub-Saharan Africa, do not have well-established technology transfer, management and marketing systems. Biotechnology has, most often, been treated more as research tool rather than as an industry. These issues of technology transfer, management and marketing need immediate attention to link up with research and development if the bio-economy is to be developed.

Regulatory capacity development

Establishment of a strong, flexible and effective regulatory regime is of prime importance. Regulatory policies are still emerging in most developing countries, although basic regulatory procedures have emerged at national, regional and international levels, encompassing biosafety,

intellectual property rights and trade in various biotechnology products.

Weak regulatory regimes may lead to indiscriminate distribution of biotechnology products, while strict regulatory regimes may hinder technology transfer, adoption and development. However, there is growing recognition of the need to balance protection to encourage innovations, public access to advanced technology and protection to conserve traditional knowledge.

There may be need for harmonisation of local regulations to meet the minimum international norms to enhance trade and development of biotechnology products and services. Countries need to develop strong and trusted regulatory regimes that are transparent enough to dispel suspicions, especially in the wake of bioterrorism and abuse of intellectual property, be it traditional or modern.

While intellectual property rights regimes may exist both at a national and regional level, biosafety and bioethics have remained at a national level even in developed countries. Nonetheless, it is possible for countries to establish a regional biosafety regime to cut the cost of the biosafety review process and development, and concentrate limited human resources and facilities. Such a move may encourage trade in regional biotechnology products and services or those imported into the region.

Technology acquisition and diffusion capacity

Technological development involves three stages: development of capabilities to (i) operate production efficiently; (ii) create new production systems; and (iii) produce novel products (Dahlman et al., 1985). Technology development also involves the application of foreign technologies in production, the assimilation of technology by diffusion and adaptation and improvements of the technology by local experts (Kim, 1980). This suggests that developing countries need to accumulate foreign technology to enhance production and then improve its performance to achieve greater efficiency and produce novel technological capabilities. A country's ability to build on these technologies depends on political will, and strong scientific and industrial foundations. A country with a strong manufacturing base could easily reconfigure it to meet the needs of biotechnology production processes.

International alliances for capacity building

One of the most significant developments in the structure of the global biotechnology industry is the development of networks involving partnering activities (Mytelka, 1999). These networks are products of complex inter-linkages between a wide range of institutions, designed to build capacity, reduce the risks associated with the development of new products, improve the policy environment, and facilitate information exchange. More specifically, these partnering arrangements help to provide sources of financing through licensing and upfront fees for R&D expenses, reimbursement of expenses for partnered products and services, royalties, profits and other "success fees" associated with the achievement of certain milestones. Such arrangements are particularly important in areas with limited access to other forms of financing, such as venture capital.

Even where venture capital is available, these arrangements still serve an important risk-reducing function (Juma and Konde, 2005).

Policies for stimulating demand for knowledge in the private sector

To be effective, highly skilled human resources for science and technology must act within a structure in which the private sector requires and seeks knowledge. Countries that have transformed their economies and dramatically improved income levels have done so by improving the technological performance of their industries within supportive investment climates. Demand for knowledge in the private sector should not be limited to classical industrial sectors such as manufacturing. It is equally important to stimulate this demand in areas such as agricultural productivity, health services, energy services and natural resource management, in both private firms and government institutions. The creation of shared infrastructure for new firms in the form of technology parks or "incubators" can be a means of promoting the desired interactions, but such ventures have a mixed empirical record of success.

Policies to promote adequate ICT infrastructure

Information flows are an essential part of the overall structure that promotes the use of knowledge. Adequate information and communication technologies (ICT) infrastructure is now indispensable to ensure access to the global stock of knowledge and information on which innovation depends. ICT infrastructure has created new channels that route information more efficiently, reducing transaction costs and making possible new and/or greater economic opportunities. In research specifically, new technologies for information storage, organisation and sharing are changing the nature of research in a number of fields. New disciplines such as bioinformatics concern themselves exclusively with the discovery and organisation of massive quantities of data on living organisms.

The nexus between private industry, educational systems and the public sector stands to gain as well from improvements in ICT capability, as connectivity fosters communities of knowledge and practice capable of addressing innumerable cross-sectoral development-related objectives.

10. Conclusions

In order to effectively develop a bio-economy, developing countries, and Eastern African countries in particular, need to develop a biotechnology sector. Rapid advances in knowledge pose a formidable challenge for developing countries' capacities to update their technological stock. Capacity building projects should aim at developing a critical mass of experts at all levels through long-term theoretical and practical training rather than short-term workshops/seminars.

Countries should also implement bottom-up tailor-made human resource development programmes at various levels for handling, transport, processing, packaging and sale of commodities. Deliberate efforts to retain the developed human capacity should be instituted and ways of channelling capacity to local levels opened. All capacity building strategies should be integrated within the overall management of biotechnology so that they are mutually supportive and complementary. This calls for visionary policies in decision-making and infrastructure and human capacity development.

The increasing demand to ensure global standards in production, manufacture and trade in biotechnology commodities and complex

domestic and international regulations require a continuing system of administration. This involves high investment and countries may be required to enter into complex public-private partnerships and develop the legal, institutional and executive acumen that is necessary to foster biotechnological innovation and its application. Meeting global production standards necessitates the setting-up of notified state-of-the-art testing and certification facilities. While such facilities are expensive to set up and require skilled human resources, the development of regional alliances to develop regional and sub-regional facilities is a possible means of sharing the financial burden (UNCTAD, 2004).

The countries of Eastern Africa also need effective negotiating strategies for creating favourable conditions for technology transfer, trade and sustainable development. The current international trade system hinders the participation of developing countries through subsidies and bureaucratic procedures, and is expensive to access. These issues need to be addressed if international trade in bio-resources is to be of benefit to developing countries.

A modest investment in biotechnology capacity building offers excellent business development opportunities for national and international biotechnology research and commerce. The biotechnology industry in developing countries is expected to grow in the next couple of years as has been the case with information technology. However, biotechnology is a hardware-intensive sector requiring highly skilled intellectual scientists along with high investment. There is always a long incubation period before returns on the heavy investment can be realised. This therefore requires innovative ideas and a strong desire to carry forward any success story in biotechnology.

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4. STAKEHOLDER AWARENESS AND PARTICIPATION IN BIOTECHNOLOGY POLICY-MAKING IN EASTERN AFRICAN COUNTRIES

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1. Challenges for stakeholder involvement in biotechnology policy-making

Global adoption of modern biotechnology has been hampered by a series of controversies and disagreements over the risks and ethics involved. The seeds of discord can be traced back to insufficiently transparent decision-making processes and low levels of stakeholder awareness.[1]

Today, public participation in science and technology policy-making has become an important trend in many Western countries. Indeed, in many settings around the world, including Eastern Africa, modern biotechnology has often been the subject of the first experiments in participation in science and technology policy-making. A central motivation for this has been public unease about many of the applications of gene technology, and general public distrust of officials, scientists and industry in the management of risks. Raising stakeholder awareness and ensuring participatory decision-making have therefore been seen as ways to rebuild public trust in how the risks of biotechnology are managed.

Participation, in this context, refers to various forms of involvement of citizens in general and stakeholders in particular in social processes surrounding decisions on biotechnology policy-making. Participation — essentially a means of political inclusion — can serve different functions such as the integration of different social perspectives or interests, the legitimisation of outcomes, the legal protection of persons affected, or the rationalisation of policy-making.

Using participatory approaches to decision-making, in areas such as science and technology where the public sector has often run the show, has encountered several obstacles. Positively changing the status quo requires stakeholder awareness and assurance, first to build bridges of trust, then to facilitate informed participation in decision-making. Putting in place these building blocks for effective participation is a delicate and slow process. Nonetheless, these elements are crucial if biotechnology is to achieve its potential to contribute to advances in agricultural and industrial production and human health.

This is very relevant to the Eastern Africa region which is becoming increasingly immerged in the global economic and social environment. The region is changing fast with the development of the new information age and groundbreaking technologies, of which biotechnology is only one example. This makes it all the more important to involve stakeholders at all levels, to help them keep abreast of — and have a say in — these new developments. Biotechnology policies in the region need to promote human development and poverty reduction. The policies also need to take account of the views of consumers and other stakeholders that will likely be affected by their implementation.

A decade's worth of consumer activism in the biotechnology and biosafety fields has focused

on raising consumer awareness, enhancing stakeholder involvement and simplifying biotechnology terminology for the benefit of the general public. However, these efforts have come up against many challenges and have had very limited impact. Many stakeholders still have little or no idea of the nature of biotechnology research or its relevance to their lives and to broader society.

Much more needs to be done to bring biotechnology out of the science lab and into the public domain, to facilitate better understanding and appreciation of its potential applications and its safe use. Debates and information-sharing events need to be organised on a national and regional level to foster awareness among the current and potential beneficiaries of biotechnology in Eastern Africa, to empower them to make informed decisions and choices and provide feedback to biotechnology providers, researchers and policy-makers.

2. Current policies on biotechnology and biosafety in the region

Most Eastern African countries have developed legislative frameworks for biotechnology, including draft policies, laws and institutional structures. However the current status of these frameworks varies considerably from country to country, depending on the prioritisation and policy focus of each nation. Some countries are at the early stage of developing laws while others are already using their existing frameworks to carry out field trials on genetically modified (GM) crops such as maize, sweet potato and cotton.

Below is a brief comparison of the institutional frameworks for biotechnology of the three countries that comprise the East African Community (EAC), namely Kenya, Tanzania and Uganda. All three countries have developed their respective national biotechnology and biosafety frameworks through UNEP-GEF support as parties and signatories to the Cartagena Protocol on Biosafety.

Kenya

- Uses existing regulations and guidelines for biosafety in biotechnology operating at ministerial level. Has finally adopted a compressive national policy to guide research, development and trade in biotechnology products. The policy covers all biotechnology applications including tissue culture and micropropagation, biopesticides and biofertilisers, bioremediation, livestock technology, DNA marker technology and genetic engineering. A biosafety bill is due to be presented to parliament for debate.
- Currently the country is engaged in research and development trials on GM products such as sweet potato, maize, cotton and cassava at the Kenya Agricultural Research Institute (KARI) and vaccines against rinderpest and rift valley fever using existing framework mechanisms.
- The adoption of biotechnology has been undertaken to help improve the quality of human welfare, maximizing productivity in agriculture and industry, and also protecting environment, conserving biodiversity and bioprospecting

Tanzania

- Has draft biotechnology and biosafety policy, legal, regulatory and institutional framework to facilitate modern biotechnology utilisation for national development.
- Currently the country is making arrangements to facilitate research and development trials on Bt cotton using existing framework mechanisms.

Uganda

- Has draft biotechnology and biosafety policy, legal, regulatory and institutional framework to facilitate modern biotechnology utilisation as a tool for national development.
- Currently the country is engaged in research and development and a number of initiatives are underway for trials on GM banana and Bt cotton at the National Agricultural Research Organization (NARO) facilities in Kawanda using existing framework mechanisms.

Box 4.1 highlights the major policy objectives of Kenya's and Uganda's biotechnology framework.

Box 4.1: Biotech policy objectives in Kenya and Uganda

Kenya

- To promote public understanding of the potential benefits of biotechnology;
- To stimulate bilateral and multilateral cooperation for biotechnology procurement, development and commercialisation;
- To prioritise, promote and coordinate research in basic and applied sciences;
- To promote sustainable industrial development for the production of biotechnology driven products;
- Create enabling administrative and legal frameworks for biotechnology development and commercialisation;
- To develop mechanisms for the provision of sustainable funding for biotechnology research and product development;
- To facilitate capacity building for intellectual property access and protection and biosafety;
- To support the development and retention of human resources in science, innovation and biotechnology;
- To stimulate collaboration among public, private sectors and international agencies in order to advance biotechnology both locally and internationally; and
- To establish mechanisms to address ethical issues relating to biotechnology.

Uganda

- To build and strengthen national capacity in biotechnology research and development;
- To promote the utilisation of biotech living products and processes as tools for national development;
- To provide a regulatory and institutional framework for biotechnology development and applications;
- To ensure public and environmental safety in biotechnology development and application; and
- To determine measures for risk assessment and management for all biotechnological application.

The three EAC countries have initiated a process of harmonisation of their biotechnology and biosafety policies, legal and regulatory frameworks, and research and development protocols. As members of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), these countries have agreed to centralise product assessment, information-sharing and guidelines on the commercialisation of GM products in the region.

It is interesting to note that in Tanzania and Uganda, the debate on biotechnology is mainly confined to food and agriculture, unlike Kenya where discussions have also addressed issues related to animal health. The medical, environmental and industrial elements are usually absent from the debate, or are dealt with in passing, as secondary issues. Nevertheless, biotechnology is gradually becoming considered a cross-cutting tool and its relevance to other sectors is emerging, as evidenced in recent policy documents.

3. Stakeholder awareness and participation in the region

Awareness of modern biotechnology in Eastern Africa is relatively low and in some circles it is regarded as an elitist subject matter (see Box 4.2).[2] Most stakeholders are unaware of biotechnology itself and the few mechanisms that exist to address public concerns over biotechnology through national legal and regulatory frameworks with reference to the Cartagena Protocol on Biosafety and the Convention on Biological Diversity (CBD).

While it is widely recognised that stakeholder awareness of biotechnology is important, initiatives to strengthen this are scarce on the ground. Biotechnology programmes typically include an awareness-raising component but these are often cut back during implementation or even dropped altogether as they are deemed too expensive to undertake in full.

Similarly, stakeholder participation in biotechnology in the three EAC countries is relatively weak. Nonetheless, there has been an appreciable improvement in participation over the past decade. A survey in Uganda reveals that most stakeholders are willing to participate in biotechnology and biosafety initiatives as long as they see some potential benefits of this participation and as long as they are provided with the requisite knowledge and a transparent feedback mechanism.

In Tanzania scientists are now calling for financial support to enable them conduct a countrywide study to find out the level of biotechnology awareness.

4. Media awareness, participation and coverage

The media in the Eastern African region is generally a trusted source of information for the general public. Unfortunately, since those working in the media are in many respects similar to other stakeholders, media awareness, participation and coverage of biotechnology are quite limited.

Coverage of biotechnology issues in the electronic or print media typically originates from two sources — the pro and anti biotech camps, who have kept a lively conflict simmering in public through this media coverage. It has been observed that the majority of articles on biotechnology are reports from interested individuals or institutions on specific activities. There are very few cases of self-initiated media coverage or articles by journalists focusing on creating awareness of biotechnology.

Indeed, a 2005 survey report by the UK-based Panos Institute (Panos, 2005), which examined media coverage on GM crops in five developing countries including Kenya, showed that news stories on GM crops often lacked critical analysis of the issues at stake and rarely represented the farmer's view. According to the survey, Kenya was one of the countries where the media tended to toe the government line on GM crops and where the non-English media carried very little coverage at all of GM issues.

Very few journalists in the region have scientific backgrounds and are able to effectively report on the complex subject of biotechnology. Fortunately, through the on-going debate a few journalists have taken up biotechnology reporting in a serious way. They have enrolled in biotech reporting training and have attended numerous forums on biotechnology to enhance their reporting skills and increase the scope of coverage of modern biotechnology. The African Biotechnology Stakeholders Forum (ABSF) has organised a series of month-long journalist training courses for science journalists to enhance their biotechnology reporting.

There have been some interesting trends in biotechnology reporting in the region since 2000. An analysis of relevant archives and web sites reveals that low coverage of biotech in 2000-2002 was followed by a gradual increase in 2003, peaking in 2004. Subsequently, a gradual decline was observed from 2005, reflecting the

Box 4.2: Stakeholder awareness of biotech in Eastern Africa

Kenya

In a survey of public opinion on biotechnology among residents of Nairobi that was conducted in September 2001 by the African Biotechnology Stakeholders Forum (ABSF), it was found that 70 percent of the people are aware of biotechnology. In particular the youth (age 18-30 years) appeared to have a reasonable understanding of, or expressed desire to know about genetic modification. Only eight percent of the people interviewed had knowledge about GMOs at the gene and cloning level.

In addition, half of the participants were generally positive about biotechnology especially if the technology will help improve food security and health. The respondents had learnt of biotechnology through electronic and print media. The survey also revealed that the public may not accept information on products produced through biotechnology directly from private companies.

Uganda

According to a baseline survey entitled *Stakeholder Awareness on Biotechnology in Uganda*, carried out in May 2003, more than half of the stakeholders consulted (including consumers, farmers, scientists, lawyers, parliamentarians, regulatory authorities, government departments, the media,

decline in the debate on biotechnology during the same period.

Specialist media on biotechnology in the Eastern African region include newsprint, magazines and newsletters, which focus mainly on food and agriculture. These include, for example, *Farmers Voice* in Uganda, *Biosafety News* in Kenya, and *KUZA*, a newsletter produced by Monsanto.

Other biotech media channels are magazines and e-newsletters developed by institutions and circulated internally and externally through networks, mailing lists or list serves. These institutions which generate and disseminate biotech information include, for example, the Uganda National Council for Science and Technology (UNCST), the National Agricultural Research Organization (NARO) of Uganda, the East African Regional Programme and Research Network for Biotechnology, Biosafety, and Biotechnology Policy Development (BIO-EARN), the Kenya Agricultural Research Institute (KARI), ABSF, The International Service for the Acquisition of Agri-biotech Applications (ISAAA), and the Kenya Biotechnology Information Centre (KBIC). In some cases, the biotech information from these institutions is adopted or republished by the print media or used as a basis for discussion and debate in the electronic media.

academia, businesses, consumer organisations, NGOs, farmer associations, trade unions and professional associations) conceded that they had little or no knowledge of biotechnology. In the same survey, 95.6 percent expressed a willingness to learn and know more about biotechnology while 52.9 percent said they would be prepared to participate in biotechnology initiatives.

Tanzania

In a study entittled "Building bridges" that was done in January – June 2006 by Dr. John Kasonta, Principle Scientific Officer with the Commission for Science and Technology (COSTECH) of Tanzania,it was found that a third of the people interviewed were aware of biotechnology and two thirds had heard about biotechnology. The study also found out that a sizable proportion of respondents was unaware of ethical issues related to biotechnology and its application. A third thought that biotechnology was unethical while close to 50 percent dreaded its negative impacts. While some respondents felt it was too early to adopt biotechnology adopted in Tanzania, the majority emphasised the need for conducting research in order to build capacity as well as educating the young people to help prepare Tanzania for genetic engineering.

The study was aimed at establishing the level of community understanding on various aspects of biotechnology and assisting in designing appropriate approaches in information dissemination. It involved policy makers, scientists, researchers, public, non-governmental organisations, civil society and traders.

Sources: UNCST, 2003a; ABSF, 2001.

5. Strengthening stakeholder awareness and participation in biotechnology policy-making

Efforts to enhance public awareness and involvement in biotech policy-making in the region will require:

- a change of attitude by the decision-makers;
- political commitment and support from the bureaucracy;
- increased investments in stakeholder awareness and networking programmes; and
- promotion of enabling stakeholder involvement mechanisms and legal frameworks.

If these measures were adopted and effectively implemented, they would fertilise and enrich the few existing initiatives in this field. In the long run, they would help facilitate informed decision-making, adoption and safe application of modern biotechnology to address the societal challenges present in Eastern African countries.

Baseline surveys

An institution or country wishing to design and implement an effective stakeholder awareness and participation programme on biotechnology policy-making needs to start by conducting baseline studies to elicit the needs, attitudes and perceptions of the key stakeholder groups and their desired topics and channels of communication on biotechnology. The findings of these baseline studies can provide the rationale and basis of stakeholder awareness and participation programmes, and can help ensure that the follow-up activities are focused, participatory, informed, result-oriented and sustainable.

Stakeholder awareness forums

Following on from the initial baseline survey, a series of stakeholder forums can be conducted to facilitate open discussion on biotech issues. The forums should be interactive and bring together a diverse range of stakeholders including, for example, policy-makers at the executive, legislator, regulatory and local government levels; farmers and farmers' associations; traders and traders' associations; community based and civil society organisations; media houses; consumers and consumer representatives.

The forums need to be results-oriented, focusing on the developments and challenges of biotechnology, including the potential benefits and risks of the technology and positive experiences in the application of biotechnology in the agriculture, health, environmental and industrial sectors. The forums can be very effective in building stakeholder confidence and trust in the process of biotechnology policy-making.

Box 4.3 describes a series of such forums in Uganda, which provided a good foundation for any future work on stakeholder awareness and involvement in biotechnology policy-making.

Information, education and communication materials

Biotech information, education and communication (IEC) materials are a cornerstone of efforts to strengthen stakeholder awareness and participation in biotechnology policy-making. The content of biotech IEC should include basic information on biotechnology as well as indications of how stakeholders can

Box 4.3: Dialogues on biotechnology and biosafety

In 2003, the Consumer Education Trust (CONSENT) of Uganda conducted six district-level dialogues on Uganda's biotechnology and biosafety policy. These dialogues aimed at increasing awareness and facilitating consultation, and were conducted on behalf of UNCST under the UNEP-GEF Project Support for the Implementation of the National Biosafety Framework in Uganda (see www.biosafetyuganda.org).

In preparing for the dialogues, CONSENT simplified and translated biotech materials to make them more accessible for the participating stakeholders and invited Agro-genetic Technologies (a tissue culture development and mass propagation company) to bring to the dialogues some of their products such as test-tube-propagated bananas, to show some real-life applications of biotechnology.

The stakeholders who participated in the dialogues appreciated these efforts to make biotechnology more meaningful a subject. They were able to effectively participate in the dialogues, asking pertinent questions on the policy and, at the same time, raising their own awareness of the issues.

Several dialogues on biotechnology have also been done in Kenya by ABSF in several districts in the country in collaboration with the National Council of Science and Technology and KARI. As a result, tissue culture farming has deeply taken root in banana growing areas. Cotton growers and stakeholders are now demanding that they be allowed to grow Bt cotton.

For further details see UNCST, 2003b.

source further information, provide feedback and participate in specific processes.

The biotech IEC materials can be in form of policy briefs, fact sheets, pamphlets, flyers, posters, brochures, postcards and stickers. They should be disseminated to the respective stakeholders, their impact monitored, responses evaluated and then redesigned where necessary. To be effective, the material should be clear, accurate, verifiable, compatibility, user-friendly, action-oriented and translatable to simpler documents, with particular emphasis on the local context.

Raising media awareness

As mentioned above, there is a lack of solid, unbiased and scientifically-based reporting of biotechnology by the region's media. There is therefore a need for sensitisation and training of the media to improve their coverage of biotech issues. These efforts should target media managers and journalists reporting on agriculture, health, consumer-related issues, business and relevant policy issues. Journalists from established media houses should be invited to participate and the impacts of the training and sensitisation efforts should be monitored to

assist the planning of future events. The topics covered in these sessions should include the need for objectivity, the science and technology behind biotech concepts, the benefits, risks and concerns surrounding biotechnology, the policy framework, and experiences in biotech applications. The trainings should be relevant to the local situations and, if possible, should include field visits to biotechnology institutions and facilities.

Another strategy to consolidate media awareness and capacity to report on modern biotechnology is a joint programme bringing together the media and scientists. There is a great need for scientists to communicate their work clearly, accurately and simply to the media and these kinds of joint programmes can facilitate this by improving the relationship between scientists and communicators. Science institutions might also think about employing or teaming up with communications agencies to enhance their communication of their objectives and activities.

Multi-media awareness campaigns

On the basis of the above-mentioned activities (baseline surveys, stakeholder discussion forums, IEC materials and media trainings) a comprehensive multi-media awareness campaign is crucial as a means of further enhancing public awareness and participation in biotechnology processes. Such a campaign may consist of some or all of the following elements.

Posters: Posters should be designed as simple visual aids with text in the major languages of the country/region and containing appropriate awareness-raising messages.

Newspaper articles: Newspaper articles can be used to target the general public, or press releases, briefings and conferences can be developed to feed the media with key messages.

Newspaper infomercials: Infomercials using awareness-raising materials and proceedings from talk-shows can be placed in different newspapers, covering the major languages of the country.

Specialised newsletters: Biotechnology newsletters from institutions working on biotechnology should be made available to the general public, wither in print or as e-newsletters. Emphasis should be given to making them user-friendly, given the weak reading culture in the region. It is worthy noting that Eastern African countries' Internet connections are growing, with Tanzania recording a 150 percent rise in users in 2005 and currently having 300,000 users. Kenya saw a rise of 200 percent from 500,000 users in 2004 to 1.5 million in 2005 and Uganda's Internet users number well over 200,000.

Radio and television programmes: The electronic media in Eastern Africa commands the largest audiences of all the mass media channels, due to their ability to reach audiences far away from the source of transmission. The proliferation of FM radio technology, and to some extent television, has greatly enhanced the accessibility of information to most corners of the region's countries. In using these media for biotech awareness programmes, messages can be packaged as pre-recorded commercials or spots — short messages that can be aired on radio. In addition, special interactive programmes could be used in the form of live radio or television phone-in talk shows with knowledgeable panellists. Short documentaries could also be developed locally or adopted from outside the region. Box 4.4 shows a possible script layout for a radio and television awareness programme, developed by UNCST.

Box 4.4: UNCST radio and television awareness programme script layout

1st Programme

1. Introduction of biotechnology and biosafety from a scientific background.
2. What are the components of biotechnology?
3. What are GM products and how are they made?
4. Types of biotechnology – GM products.
5. Why make GM products?
6. Biotechnology as a tool for development.

2nd Programme

7. Biotechnology uses in food, agriculture production, healthcare & medicines, environment, industry and research.
8. Potential benefits of GM products.
9. Public concerns about GM products/technologies.
10. Can the concerns be addressed?

3rd Programme

11. The role of the Biotechnology & Biosafety Policy and legal framework.
12. Global and East African initiatives and Uganda's position and approach towards safe application of biotechnology.

4th Programme

13. Are biotechnology – GM products appropriate for Uganda?
14. What can stakeholder do and how can they get involved in policy-making?
15. Where to get accurate scientific information on biotechnology and biosafety?

6. Crosscutting issues

Networking

Co-operation and networking of stakeholders through the establishment and maintenance of links is important for a sustainable regional biotechnology stakeholder awareness and engagement campaign. Networking can also help create uniformity of purpose among stakeholders. In this regard, leading agencies or component authorities in Kenya, Tanzania and Uganda need to make every effort to align their activities in the field of biotechnology by, for example, sharing information between and amongst stakeholders and facilitating collective participation in programme activities where possible.

Public participation and awareness

Current public debate on the commercialisation of agricultural biotechnology products, especially in Europe, has underscored the importance of public participation in risk assessment and decision-making pertaining to genetically modified organisms (GMOs). The rapid pace of technological change and the wide-ranging nature of the perceived effects of biotechnology necessitate much greater public participation in policy-making. A number of industrialised countries have launched programmes aimed at including the public in technology assessment and decisions involving the use of biotechnology in agriculture. The issue is not simply one of providing scientific information to the public, but rather of building trust between science and society. Intermediary programmes and institutions concerned with the social aspects of biotechnology could be established to build such trust. While informed and effective public participation remain crucial requirements in this arena, the need to maintain confidentiality about proprietary commercial information constrains the nature and extent of this participation. Where the boundary should lie between privately and publicly held information pertaining to GMOs continues to be an area of debate in determining the appropriate level of public participation in decision-making.

Information exchange and experience sharing

For information without proprietary constraints, national and international agencies are increasingly using modern communication technologies, such as the Internet, to disseminate information on regulations and risk assessments of genetically modified organisms. While such communication technologies are important mechanisms and their use is likely to grow in the future, excessive reliance on them could prevent those countries with the least capacity and the greatest need for risk-related information from having timely access to the latest knowledge about biosafety. Complementary measures should therefore be adopted, including the establishment of biosafety clearing houses within national and international agencies. The use of such intermediary institutions as bridges for sharing information and experience between various sections of society and across countries needs to be enhanced. In particular, intermediary institutions could facilitate the task of monitoring risk assessments and decisions pertaining to biotechnology products as an important means of accumulating knowledge. While a number of national agencies have begun monitoring activities, the results of these efforts have not been consolidated into regional or global biosafety assessments. Such assessments could be useful in disseminating the lessons learned about different GMOs and facilitating experience and information sharing among countries.

7. Strategy

The Eastern African countries need to reach out and involve as many stakeholders as possible, either directly or indirectly, using simple and result-oriented participatory methods to ensure success of the awareness initiatives on biotechnology. Implementing authorities should apply result-oriented methods in line with the objectives of:

- Involving as many knowledgeable and informed stakeholders as possible.
- Tapping the abundant local and international expertise available.
- Collecting accurate information from requisite institutions to facilitate the awareness and information dissemination programme.
- Applying simple methods and participatory approaches for qualitative and quantitative results together with a feedback mechanism.
- Using existing infrastructure for cost effectiveness, capacity building and sustainability.
- Networking to enhance and facilitate information dissemination.
- Reviewing existing materials on the subject and use of the same during implementation of new programmes.

8. Conclusions

Any process initiated on behalf of or in the name of the public (stakeholders), must meaningfully involve them. Among the key stakeholders, consumers are the largest economic group in the economy, affecting and affected by almost every public and private economic decision. However, they are the only important group whose views are often not heard.

Beneficiaries from biotechnology should at all times be consulted, informed, sensitised and engaged in all process pertaining to issues that would affect or have potential to affect them. This enhances informed decision-making, implementation, adoption and feedback for improved processes related to biotechnology.

ENDNOTES

1 A stakeholder is generally defined as someone with a direct or indirect interest in a particular issue. For the purposes of this chapter, the term 'stakeholders' refers to consumers, the general public, policy-makers, regulators, business, academia, scientists, and the media.

2 It should be noted here that, in Uganda at least, the few public awareness initiatives that have been implemented have focused mainly on the elite and urban levels of society. The situation could be the same for Kenya and Tanzania judging from reports and presentations from both countries.

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5. STANDARD-SETTING ON BIOTECHNOLOGY AND TRADE IN THE EASTERN AFRICA REGION

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1. Introduction

Advances in modern biotechnology today offer opportunities to deliver genetically engineered products for the agricultural, medical and industrial sectors. Since the initial commercialisation of biotech crops in 1996, the global planted area of these crops soared from 1.7 million hectares in six countries to 102 million hectares in 22 countries in 2006 (James, 2007). A total of 10.3 million farmers planted biotech crops in 2005 and the International Service for the Acquisition of Agri-biotech Applications (ISAAA) projects that this number is likely to reach 20 million farmers in about 40 countries by 2015 (James, 2007).

However, biotechnology is not a panacea for revolutionising agriculture and industry. There are a number of concerns and public policy issues that are directly linked to the rapidly advancing 'gene revolution'. In some quarters, modern biotechnology is regarded as a capital-intensive venture that would not serve the needs of smallholder farmers. Others argue that genetic modification (GM) technology is a profit-driven venture pushed by multi-national corporations of the West without much relevance to food security problems in developing countries. There are also ethical concerns regarding the alteration of the genetic make-up of organisms and the patenting of life forms. Most importantly, anxiety persists in some parts of the world with respect to the environmental and food safety risks of genetically modified organisms.

These risks are considered particularly serious since modern means of travel, trade and communications have changed the world, allowing enormous increases in the global movement of people, commodities and pests and diseases (IPPC, 2001). Natural and national borders that once were effective barriers to the spread and introduction of unwanted organisms or materials are now under pressure from the high volume of international traffic. As a consequence, the global community is treating this cautiously and has developed co-operative mechanisms to protect people, animals, plants and the environment from risks posed by pests, diseases, toxins and other hazards that may be attributable to genetic engineering.

It must be pointed out however that no conclusive evidence regarding possible cases of harm has been reported for the last ten years that GM crops have been commercialised. Transgenic crops and food derived from them have been judged safe to eat, by the International Council for Science as well as several intergovernmental governmental and national regulatory agencies (ICSU, 2003). Nonetheless, ongoing scientific evaluation of the long-term environmental and health effects of genetic engineering is required.

While scientists generally agree on the nature of the potential risks arising from widespread planting of transgenic crops, there is no consensus on the likelihood and consequences of such risks. Genetically modified organisms (GMOs) are therefore a subject of regulatory oversight the world over and Eastern Africa is no exception. Accordingly, in Eastern Africa, biotechnology

is regulated through national legislation and also through international instruments, agreements or other co-operative mechanisms that offer guidelines, recommendations or standards establishing precise rules to be met by contracting parties.

2. Biotechnology standard-setting based on national frameworks

Uncertainty regarding food and environmental safety of GM products has spurred various efforts aimed at ensuring safe development, transfer and application of biotechnology and its products in all countries of Eastern Africa. Generally, most countries in the region are formulating policies and legislative frameworks for governing GMOs. Some countries such as Kenya, Uganda and Tanzania have gone ahead with development of regulations and guidelines for biosafety in biotechnology, based on existing laws, pending promulgation of explicit biotechnology policy or biosafety laws (see Table 5.1). The situation remains fluid and any standard-setting efforts in biotechnology will certainly need to wait until the draft legislations come into force. For now, the operational standards for biotechnology in Eastern Africa emanate largely from international treaties and conventions to which some countries in the region are contracting parties.

3. Biotechnology standard-setting based on international frameworks

There are several major intergovernmental mechanisms setting the standards for biotechnology in which some countries in

Table 5.1: The status of biosafety regulations in Eastern African countries

COUNTRY	FRAMEWORK	GUIDELINES	GM LEGISLATION
Burundi	Yes	No	No
D.R. Congo	Yes	No	Draft
Eritrea	Yes	No	No
Ethiopia	Yes	No	Draft Policy
Kenya	Yes	Yes	Draft law
Madagascar	Yes	No	Draft Policy
Rwanda	Yes	Yes	Draft Bill
Sudan	Yes	No	Draft
Tanzania	Yes	Yes	EMA, 2004*
Uganda	Yes	Yes	Draft law

Source: Mugoya (2006)

**Environmental Management Act No. 20 of 2004*

Eastern Africa actively participate. Participation at such fora is important as it can contribute to defining public perception and acceptance of biotechnology. In addition, rules and standards set at the international level often become the yardstick for resolving undesirable trade barriers and other causes of trade disputes between countries. For instance, the lack of an internationally agreed standard for the labelling of biotech foods has led to varied and often incompatible national labelling policies which could easily become a recipe for trade barriers. This is best illustrated by the recent refusal by the European Union to approve American biotechnology-derived corn, which has resulted in a drop in US exports of GM corn to Europe worth USD 300 million in the late 1990s to less than USD 10 million in recent years (Agrifood Awareness, 2006).

This section describes biotechnology standard-setting mechanisms by four international organisations: the International Plant Protection Convention (IPPC); the Codex Alimentarius Commission; and the World Organisation for Animal Health (OIE). A brief reference is also made to the World Trade Organization (WTO) and the International Organization for Standardization (ISO), a non-governmental organisation that governs worldwide standardisation of tradable commodities, and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity. Typically, the standards developed under these international frameworks have the following features: (i) they are designed to protect the environment and human heath without unduly hindering international trade; (ii) they are designed to be transparent and to be in harmony with international regulations for trade, so that their application should not amount to artificial trade barriers; and (iii) they are developed on the basis of the best scientific knowledge available — this implies that they are subject to revision following advances in scientific knowledge.

IPPC and standards for biotechnology

The International Plant Protection Convention, a multilateral treaty for co-operation in plant protection, aims to secure common and effective action for preventing the introduction and spread of pests of plants and plant products, and to promote appropriate measures for their control. The Convention, which as of September 2005 had 139 contracting parties including several countries of Eastern Africa, is administered by the United Nations Food and Agriculture Organisation (FAO) and implemented through the co-operation of member governments and Regional Plant Protection Organisations (RPPOs). The Convention is a legally binding international instrument requiring member governments to co-operate through development and adoption of International Standards for Phytosantinary Measures (ISPMs), and the supply and sharing of information on pest risk analysis.

Development of an ISPM is a multi-stage process that comprises the draft stage, consultation stage and approval stage and lasts at least 12 months. A Standards Committee oversees the standard-setting process and assists in the development of ISPMs by agreeing on the elemental specifications for draft standards and checking drafts before and after consultation.

Since November 1993 when the first ISPM was approved, a total of 24 standards covering a wide range of topics have been adopted (see Table 5.2). With respect to biotechnology, ISPM Number 11 was developed to address *Pest Risk Analysis for Quarantine Pests Including Analysis of Environmental Risks and Living Modified Organisms (LMOs)*. The Standard provides details for the conduct of a pest risk analysis to determine if pests under consideration are quarantine pests, and also includes guidance on evaluating the potential phytosanitary risks posed by living modified organisms to plants and plant products.

Table 5.2: International Standards for Phytosanitary Measures, as of September 2005

ISPM No. 1 (1993)	*Principles of plant quarantine as related to international trade*
SPM No. 2 (1995)	*Guidelines for pest risk analysis*
ISPM No. 3 (2005)	*Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms*
ISPM No. 4 (1995)	*Requirements for the establishment of pest free areas*
ISPM No. 5 (2005)	*Glossary of phytosanitary terms*
ISPM No. 6 (1997)	*Guidelines for surveillance*
ISPM No. 7 (1997)	*Export certification system*
ISPM No. 8 (1998)	*Determination of pest status in an area*
ISPM No. 9 (1998)	*Guidelines for pest eradication programmes*
ISPM No. 10 (1999)	*Requirements for the establishment of pest free places of production and pest free production sites*
ISPM No. 11 (2004)	*Pest risk analysis for quarantine pests, including analysis of environmental risks and living modified organisms*
ISPM No. 12 (2001)	*Guidelines for phytosanitary certificates*
ISPM No. 13 (2001)	*Guidelines for the notification of non-compliance and emergency action*
ISPM No. 14 (2002)	*The use of integrated measures in a systems approach for pest risk management*
ISPM No. 15 (2002)	*Guidelines for regulating wood packaging material in international trade*
ISPM No. 16 (2002)	*Regulated non-quarantine pests: concept and application*
ISPM No. 17 (2002)	*Pest reporting*
ISPM No. 18 (2003)	*Guidelines for the use of irradiation as a phytosanitary measure*
ISPM No. 19 (2003)	*Guidelines on lists of regulated pests*
ISPM No. 20 (2004)	*Guidelines for a phytosanitary import regulatory system*
ISPM No. 21 (2004)	*Pest risk analysis for regulated non-quarantine pests*
ISPM No. 22 (2005)	*Requirements for the establishment of areas of low pest prevalence*
ISPM No. 23 (2005)	*Guidelines for inspection*
ISPM No.24 (2005)	*Guidelines for the determination and recognition of equivalence of phytosanitary measures*

Source: IPPC website (www.ippc.int)

Codex Alimentarius Commission

The Codex Alimentarius Commission, established in 1963 and administered by the joint Food Standards Programme of the FAO and the World Health Organization (WHO), sets sanitary and technical standards for food safety, including food standards for commodities, codes of hygienic or technological practice, limits for pesticide residues in foods, and standards for contaminants and food additives. The main purpose of Codex is to protect the health of consumers and to ensure fair trade practices in food trade. It also sets food labelling requirements and establishes scientific procedures for the sampling and analysis of food products. In doing so, Codex standards assist in harmonising and facilitating the trade in food products. Some 44 African countries including those from Eastern Africa participate in Codex standard-setting processes (see Table 5.3). In July 2003, the Codex Alimentarius Commission adopted three biotech-related standards developed by the *Ad Hoc Intergovernmental Task Force on Food Derived from Biotechnology*, including principles for the evaluation of food derived from modern biotechnology (FAO/WHO, 2003a) and on guidelines for the conduct of food safety assessment of food derived from recombinant-DNA plants (FAO/WHO, 2003b) and foods produced using recombinant-DNA microorganism (FAO/WHO, 2003c). A fourth document on labeling provision for food and food ingredients obtained through certain

Table 5.3: African countries membership to Codex Alimentarius Commission

Angola	Gabon	Namibia
Benin	Gambia	Niger
Botswana	Ghana	Nigeria
Burkina Faso	Guinea	Rwanda
Burundi	Guinea Bissau	Senegal
Cameroon	Kenya	Seychelles
Cape Verde	Lesotho	Sierra Leone
Central African Republic	Liberia	South Africa
Chad	Madagascar	Swaziland
Congo	Malawi	Tanzania
Democratic Republic of Congo	Mali	Togo
Republic of Côte d'Ivoire	Mauritania	Uganda
Equatorial Guinea	Mauritius	Zambia
Eritrea	Morocco	Zimbabwe
Ethiopia	Mozambique	

Source: Codex Alimentarius Commission website (www.codexalimentarius.net)

techniques of genetic modification or genetic engineering remains under discussion (FAO/WHO, 2003d).

The Codex guidelines indicate that the safety assessment process for a transgenic food should be conducted through comparing it with its traditional counterpart (the concept of substantial equivalence) which is generally regarded as safe because of a long history of use. If any concern is identified, the risk associated with it should be characterised to determine its relevance to human health a protocol that requires the description the host and donor organism and characterisation of the genetic modification, assessment of toxicity, allergenicity and compositional analysis.

Despite the robustness of this comparative approach to food safety assessment, the Codex method has attracted some criticism for not fully taking into account the possible unintended effects of genetic modification (FAO, 2004). Most scientists agree however those transgenic foods should be assessed on a case-by-case basis, focusing on the particular product rather the process by which it was created. They emphasise that the safety of GM foods should be assessed conclusively before they are put on the market since post-market monitoring is likely to be difficult, expensive and may be confounded by the complex genetic variability of consuming populations (FAO, 2004).

World Organisation for Animal Health (OIE)

All countries in Eastern Africa are OIE members. OIE deals with animal health and zoonoses (diseases and infections which are naturally transmitted between vertebrate animals and humans), and sets sanitary standards for the international movement of animals and animal products. The purpose of OIE is to guarantee the sanitary safety of world trade in animals and animal products. OIE standards referring specifically to biotechnology are limited to vaccines created through biotechnological processes. Countries have also discussed the possibility of developing a standard for the creation of cloned animals and animals that have been genetically engineered to produce chemicals or medicines

World Trade Organization (WTO)

The World Trade Organization is the global international organisation dealing with rules of trade between nations. At its heart are the WTO agreements, negotiated, signed and ratified by the bulk of the world's trading nations including all countries in Eastern Africa. The goal of WTO is to help producers of goods and services, exporters and importers in the fair conduct of their businesses. Two agreements under the WTO have particular relevance to biotechnology standard-setting process: (i) the Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures and (ii) the Agreement on Technical Barriers to Trade (TBT).

The WTO SPS Agreement covers all measures taken by Member countries to protect human, animal and plant health from risks arising from food additives, toxins, pests and diseases. Accordingly, WTO contracting states are obligated to ensure that any SPS measures they apply are either based on existing international standards (including those of the IPPC, Codex and OIE) or justified through a risk assessment conducted in accordance with the provisions of the SPS Agreement. In either case, SPS measures should not be more trade restrictive than required. From a policy standpoint, the SPS Agreement is a compromise that respects Member countries' sovereign rights to take

measures to protect public health within their borders, so long as they so in a manner that does not overly restrict trade.

The TBT Agreement covers all technical regulations, standards and conformity assessment procedures that do not fall directly under the SPS Agreement. The agreement attempts to extricate the trade-facilitating aspects of standards from their trade-distorting potential by obligating Member countries to ensure that technical regulations and product standards do not unnecessarily restrict international trade. On that account, the TBT Agreement attempts to strike a delicate balance between the policy goals of trade facilitation and national sovereignty in the application of technical regulations. The agreement works towards this end in three ways: (i) it encourages the practice of 'standard equivalence' between countries; (ii) it promotes the use of international standards; and (iii) it mandates Member countries to establish enquiry points and national notification authorities in order to answer questions about relevant regulations and notify other nations of new regulations.

Cartagena Protocol on Biosafety

The Cartagena Protocol on Biosafety has its origins rooted in the text of the global Convention on Biological Diversity (CBD). Article 19, paragraph 3 of the CBD Convention text provides for the development of an international legally binding instrument to address the issue of biosafety (CBD 2000). The Protocol was negotiated for several years (1995 to 2000) and was finalised and adopted in Montreal in January 2000, heralding a significant step forward in providing an international regulatory framework to reconcile the respective needs of trade and environmental protection with respect to modern biotechnology. Specifically, the Protocol applies to the transboundary movement, transit, handling and use of all living modified organisms (LMOs) that may have adverse effects on the conservation and sustainable use of biological diversity, or pose risks to human health. The Protocol provides rules for facilitating Advance Informed Agreement (AIA) for first-time transboundary movement of LMOs intended for environmental release, and provides for the labelling of GM elements in commodity shipments destined for the food chain. All countries in Eastern Africa, except Burundi, have acceded to the Protocol (see Table 5.4). However, it is worth emphasising that the Protocol sets only minimum standards for biosafety based on the precautionary approach and on the need to undertake science-based risk assessment when deciding whether to approve the development, handling, transport, use, transfer and release of any LMOs. It further requires contracting parties to … *take necessary and appropriate legal, administrative and other measures to implement its obligations … to ensure that the development, handling, transport, use, transfer and release of any living modified organisms are undertaken in a manner that prevents or reduces the risks to biological diversity, taking also into account risks to human health*. To date, domestication of the Cartagena Protocol on Biosafety among the countries of Eastern Africa is one of the challenges that remain to be resolved.

International Organization for Standardization (ISO)

ISO is a non-governmental organisation responsible for developing a specialised system for worldwide standardisation. This is achieved through affiliation of national and international standard-setting bodies. All standards bureaus of participating countries take part in the development of International Standards through their designated technical committees.

Table 5.4: Status of Eastern Africa countries with respect to the Cartagena Protocol on Biosafety

COUNTRY	CARTAGENA PROTOCOL	DATE EFFECTIVE
Burundi	Not signed	—
D. R. of Congo	Accession	23 June 2005
Eritrea	Accession	10 Marc 2005
Ethiopia	Signed/ratified	24 May 2000/ 09 Oct 2003
Kenya	Signed/ratified	15 May 2000/ 24 Jan 2002
Madagascar	Signed/ratified	14 Sep 2000/ 24 Nov 2003
Rwanda	Signed/ratified	24 May 2000/ 22 Jul 2004
Sudan	Accession	13 June 2005
Tanzania	Accession	24 April 2003
Uganda	Signed/ratified	29 May 2000/30 Nov 2001

Source: Mugoya, 2006.

4. Policy options for harmonising GMO regulations in Eastern Africa

As described above, most countries in the Eastern Africa region are at some stage of formulating policies and legislative frameworks for governing GMOs. They all seem to be in agreement that regulation of GMOs requires oversight nationally and internationally. There are many mechanisms for GM regulation, some just evolving and others fully-fledged internationally accepted instruments. Owing to the natural, economic and socio-technical disparities among countries of the world, there is need for policy harmonisation in developing and enforcing the various GM regulatory standards and frameworks.

While there is agreement about the need for a GMO regulatory framework, there are differences in opinion about how strict it should be, as this is influenced by issues such as costs, perceived risks and benefits of GMO release, enforceability and credibility of the regulatory framework. In addition, as will be discussed below, the varied approaches available for GM regulation can also have far-reaching implications on inter-country trade and distribution of food aid during emergency situations. However, nowhere is policy harmonisation on regulation of GMOs more appropriate than on the African continent where ecological, ethnic, cultural and commercial considerations transcend the national boundaries of many nation states. Yet governments must be acknowledged for rightfully wanting to preserve their right of handling GMO regulation by setting up

appropriate regulatory systems and standards of their own before seeking ways to harmonise regulations on a regional or continental scale (Paarlberg, 2006).

Attempts at harmonisation generally seek to combine and adapt widely disparate views, principles and practices in order to attain a particular effect. In practice, harmonisation of rules, regulations or standards can take a long time and much consensus-building effort. The process of harmonisation cannot be realised overnight. A parallel can be drawn with the multi-stage process that characterised the harmonisation of various sectors resulting in the evolution of the European Union (EU) from a regional economic agreement among six neighbouring states in 1951 to today's supranational and integrated organisation of 25 countries across the European continent.

According Paarlberg (2006), African governments woke up to the need for regional thinking on their GMO policy frameworks following debates that heightened in 2002 regarding the importation of GM maize as food aid. Before then, African countries and especially those in Eastern and Southern Africa had received food-aid maize supplies from GM maize-producing countries without controversy. In 2002, however, a number of countries, mostly those in which biosafety regulatory frameworks were either lacking or poorly developed (Mozambique, Lesotho and Malawi) took policy decisions that limited the importation of food aid with GM content. Officials in those governments singled out GM crops for tighter biosafety regulation not because of perceived risk but simply because of their novelty. The rejection of Bt maize food aid by Zambia that year — even as the country faced the most serious famine in many years — was the most high-profile example of these new policy decisions. Elsewhere in Africa, other governments slowed down on the field testing or commercial release of GM crops, to avoid not only any unknown biosafety risks, but also some perceived trade-related risks likely to emanate from the principal trading destination of African commodities — the European Union.

One regional initiative, the Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa (RABESA), designed to examine the potential ramifications of GMOs on trade, food security and access to emergency food aid in the region, serves as an important model from which lessons can be learnt regarding the harmonisation of GM regulations. The RABESA initiative proposes a two-pronged approach that could either take the form of 'tight' or 'loose' harmonisation of regulations for GMOs. These options are explained in detail below.

Tight harmonisation of regulations

Tight harmony through centralised approvals

Tight policy harmonisation can be achieved through a system of centralised food and biosafety approvals. A group of countries forming a regional economic community (REC) might decide to create a single region-wide approval committee empowered to decide which GMOs can be planted or imported into the region as a whole. A common policy would then prevail throughout the region.

One advantage of this approach would be reduced costs through avoidance of redundant country-by-country application, testing and approval efforts. All applicants for biosafety and food safety approval in the region would go to a single committee, perhaps constituted within the REC's Secretariat, or within the African Union (AU). Following this approach, low-capacity states in the region would be spared the expense of setting up a separate national

approval system, and it would be possible to concentrate capacity-building investments in the operation of a single and highly capable region-wide system.

However, the major disadvantage of this approach is that regulatory decisions in an expansive region are inherently difficult to centralise. For scientific reasons, most GMO biosafety issues are better addressed locally, to take into account the highly specific ecosystems and ecosystem variability. Food safety issues could perhaps be responsibly handled by a single regional or continental approval committee, but biosafety issues require at least some localised environmental screening and scrutiny.

Paarlberg (2006) further notes that the question of sovereignty could also militate against this approach. Few states in a region may be willing, at present, to hand over sovereign choice on issues of this kind to a single regional committee. Recent practice in the COMESA/ASARECA region has been to defend the right of different states to make separate (and possibly different) sovereign choices when regulating the import or planting of GMOs, and not just in the region. The state sovereignty approach is also implicitly endorsed by the 2000 Cartagena Biosafety Protocol, which establishes the grounds on which importing countries may refuse imports of living GMOs (LMOs). In the special case of imports of GMO food aid, the state-by-state approach has also been explicitly endorsed by the Southern African Development Community (SADC) and accepted by the World Food Programme (WFP). In a May 2003 statement, the WFP Executive Board said country offices would be "expected to comply fully with existing national import policies, whatever form they may take"(Paarlberg, 2006).

The AU also endorses state sovereignty in this policy area. In June 1999, the Organisation of African Unity (OAU), forerunner to the AU, convened a group of biosafety specialists to draft an African Model Law on Safety in Biotechnology. This document was finalised in May 2001 and endorsed by the OAU Council of Ministers in July 2001. This model (which is not legally binding) was being offered to member governments as a possible template for developing their own separate biosafety laws. The AU hoped that the result would be greater similarity of legal systems across the continent, but it has not yet proposed supplanting national sovereignty with a centralised system of region-wide approvals of specific GMOs.

In 2003, the AU Executive Council did consider a report that proposed "an Africa-wide biosafety system throughout the continent". This report cited the likelihood that GMOs approved in one country could easily cross boundaries into neighbouring countries, and thus called for "a co-ordinated regional approach to biosafety legislation as well as to its implementation…" (AU, 2003). Regional harmonisation has thus been endorsed in Africa as an overall objective, but there has not yet been any clear endorsement of tight harmonisation through a "centralised approval" approach.

Tight harmony through mutual policy recognition

An alternative means of achieving tight regional harmonisation is through the creation of a mutual policy recognition system, similar to the system that used to be employed by the EU (now replaced by an EU-level assessment). Such a system for a tight harmonisation of GMO policies relies not on a single region-wide set of approval procedures. Rather, under this mutual policy recognition approach, if one member government in the region grants approval for the import or planting of a GMO crop, then that approval — if there is no objection from other

member governments — automatically becomes a generalised approval throughout the region.

Under this system, an applicant in the EU seeking to place a GMO on the market could submit an application (called a "notification") to the competent national authority (typically the biosafety committee) of any EU member state. This notification should include a full evaluation of the environmental risks. The national authority then issued either a favourable or unfavourable opinion in the form of what is called an "assessment report". If the opinion was favourable for placing the GMO on the market, then that member state informed other member states via the EU Commission. The other member states and the EU Commission then examined the assessment report and could issue observations or objections. If there were no objections, the GMO could be placed on the market throughout the EU.

Between 1995 and 1998, the EU was able to operate this mutual recognition system with few member government objections, and a total of 18 GMO products were given region-wide approval. By 1998, however, anti-GMO activist campaigns had driven the governments of some member countries to begin objecting to all new GMO approvals. Member governments such as Austria, France, Luxembourg, Italy and Greece began not only to block new approvals, but also to retroactively ban from their own markets some GMOs that had already been approved community-wide.

Given these recent experiences in Europe, a regional harmonisation system based on mutual policy recognition may not be the best option for African countries to consider. In a setting where decisions are likely to be political as well as technical, with at least some governments likely to disagree, such a system would be prone to paralysis, as has been the case in Europe. Applicants will seek out governments in the region that are most likely to give approval, but those approvals will then be either blocked at the regional level or flouted and defied by other national governments not yet ready to approve any GMOs.

Another disadvantage of this mutual policy recognition approach is that it would require the creation of an elaborate set of new institutions at the regional level, including new scientific committees and a technically competent regulatory committee representing all member governments. The approach would also require region-wide agreement on a qualified majority voting system for the operation of the regulatory committee.

Tight harmony through pre-emptive disapproval

A third possible path to tight harmonisation is through the application of a pre-emptive decision to approve no importation, research, or commercial planting of GMOs anywhere within a region (Paarlberg, 2006). Under this approach, the case-by-case scrutiny of applications referred to above would be unnecessary. Policy would be harmonised around a pre-emptive decision to approve nothing. This would take the form of declaring the region GMO-free. Under this policy path, the need to co-ordinate national approvals on a case-by case basis would be eliminated as there would not be any approvals in the first place. Similarly, there would be no need to invest in infrastructures such as laboratories, greenhouses on confined trials sites for biosafety experiments, beyond perhaps a GMO detection facility and policing capacity to enforce the regional ban on GMOs. This approach would also give comfort to importers of African products in GMO-sensitive countries in Europe.

However, a study carried out under the RABESA initiative established that even if all European importers begin to shun all exports from the COMESA region for fear of GM presence or GM contamination, the total dollar value of all commercial exports likely to be lost would be negligibly small (Paarlberg, 2006). Indeed the bulk of agricultural exports from African destinations comprises coffee, tea, sugar, cocoa, oil palm and a range fruits and vegetables — essentially crops not yet being grown in GMO form for commercial marketing anywhere in the world. So even the most sensitive importers would have no justifiable reason to shun these products after, say, an African country begins planting GMO crops such as GMO cotton or maize. Furthermore, a regional choice to remain GMO-free would take away from farmers all present and future options to gain higher incomes from the commercial adoption of GMO crop varieties. Adopting such a pre-emptive disapproval approach would also reduce or complicate the importation and distribution of food aid during emergency situations and, given the porous nature of borders, would be exceedingly costly to enforce.

A loose harmonisation of regulations

Given the difficulties associated with the tight harmonisation policy options, the RABESA study suggests considering a 'loose' harmonisation alternative. Loose harmonisation could be achieved by setting a common minimum standard of precaution for a given region regarding GMOs, allowing member states the option of exceeding that minimum if they wished, provided that this is scientifically justified and that they honour a minimum set of obligations towards their neighbours. This approach mirrors the provisions of the Cartagena Protocol on Biosafety and is thus considered to be not overly demanding a standard since nearly all African countries are signatories to the Protocol.

On signing the Cartagena Protocol, contracting parties obligated themselves in accordance with Article 8g of the Convention on Biological Diversity and Article 2 of the Protocol to….*take necessary and appropriate legal, administrative and other measures to implement obligations to ensure that the development, handling, transport, use, transfer and release of any living modified organisms…are undertaken in a manner that prevents or reduces risks to biological diversity, taking also into account risks to human health*. Some of the obligations of being a signatory to the Protocol have far-reaching implications for capacity building (for, for instance, conducting risk assessments or raising public awareness) which are still far from being realised in many African countries that are contracting parties to the Protocol. Meeting the requirements of the Protocol remains a challenge that has to be addressed urgently to pave the way for loose harmonisation of regulations for GMOs in Africa. Other pertinent matters that need improvement in Africa include general support for involving the public in GMO regulatory processes, informing the public about GMOs (including the labelling of GM products), and ensuring transparency of the regulatory processes.

A 2003 FAO-led e-mail conference on "Regulating GMOs in developing and transition countries", in which 44 people from 20 countries participated, echoed the same sentiments, urging some kind of loose harmonisation of regulatory frameworks (FAO, 2003). There was general consensus that harmonisation of regulatory systems across countries is important (and that existing international agreements/guidelines can assist in this context), but that it should also be possible to retain some country-specific elements within these systems. Co-ordination and harmonisation of GMO regulation between the different relevant government ministries within a country was also cited as important. The conference recommended that developing

countries wishing to establish a GMO regulatory framework can learn a lot from, but do not need to model it on, the existing regulatory frameworks in developed countries.

5. Conclusions

Countries in Eastern Africa are at various stages of development regarding the application and regulation of modern biotechnology. Some such as Kenya and Tanzania appear to have progressed to the extent of having successfully conducted confined field trials with GM crops. In contrast, the rest of the countries in the region have chosen to first develop functional national biosafety frameworks as a prelude to concerted research and development activities on GM crops. Nearly all the region's countries participate in biotechnology standard-setting fora such as IPPC, Codex, OIE as well as at the Conference of Parties serving as Meeting of Parties (COP/MOP) to the Cartagena Protocol on Biosafety. However, participation at such fora has tended to be passive with hardly any common agenda for the region. This will need to change sooner rather than later. The region needs a co-ordinated approach to standard-setting, especially now considering the increasing emphasis on the need for harmonisation of regulations for GMOs. Rather than the question being *whether or not to regulate GMOs*, as was typically the case several years ago, the mood in many parts of the world is shifting to *just how can regulations for GMOs be harmonised for operational effectiveness?*

Fortunately, Eastern Africa is already considering the challenge of harmonising GM regulations. Indeed, efforts such as the RABESA initiative by COMESA countries need to be hailed as a step in the right direction. However, it is worth pointing out that the process of harmonisation is frequently a slow and time-consuming exercise, as the gradual evolution of the EU clearly demonstrates. Harmonisation requires the setting and implementation of standards. Countries in Eastern Africa should therefore brace themselves for setting standards on modern biotechnology, backed by amongst other things common mechanisms for risk assessment, decision-making, information-sharing and dispute settlement.

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6. IMPLICATIONS OF GMOs ON MARKET ACCESS AND TRADE IN EASTERN AFRICA

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1. Introduction

The high adoption rate of Genetically Modified (GM) crops in the last one decade has surpassed those of any other agricultural technology in history. In 2006, about 10.3 million farmers in 22 countries (11 developing countries and 11 industrial countries) were engaged in the planting of GM crops. Agricultural crops for which GM varieties have been commercialised are soybean, maize, cotton, canola (rape), squash, papaya, tomato, Irish potato rice and Alfalfa.

In 2006, the global market value of GM crops was USD 6.15 billion, representing 16 percent of the USD 38.5 billion global crop protection market in 2006 and 21 percent of the USD 30 billion 2006 global commercial seed market. The accumulated global value for GM crops for the eleven-year period, since the first GM crop was commercialised is estimated to be USD 35.5 billion (James, 2007). These figures show that GM crops are rapidly pervading the global economy. The trade implications of their diffusion cannot be ignored or trivialised.

As the area under GM crops continues to burgeon in both developing and developed countries, one of the concerns at the top of policy debates is the extent to which diffusion of GM crops is likely to affect trade in export markets. Destinations such as the European Union, where the level of caution and consumer scepticism is high, have attracted a lot of attention. In Africa, the dilemma facing countries is how to harness the maximum benefits from GM crops while minimising the risks involved — preserving their trade interests and niche markets. The mainstream thinking has been that adoption of genetically modified organisms (GMOs) would mean a blanket rejection of all agricultural commodities exported.

The purpose of this chapter is to contribute to a more informed understanding of the implications of commercialising GMOs on market access and imports in Eastern Africa. No country in Eastern Africa has approved GMOs for commercial planting. For that reason, there is no evidence to demonstrate that countries have faced market access barriers as a result of planting GMOs. To a large extent, analysis in this paper employs the forecasting approach by making projections based on a wide range of possible scenarios.

The biotechnology revolution and economic integration in Eastern Africa

Kenya, Uganda and Tanzania share national boundaries and are bound together by their membership of the East African Community (EAC), which comprises these three countries. The vision of regional integration within the EAC is to create wealth, raise the living standards of all people of Eastern Africa and enhance international competitiveness of the region. From 2001 to 2005 the EAC devoted much attention to achieving a Customs Union and a Common Market. The Customs Union was launched in December 2004, marking the introduction of common external tariffs and internal tariffs for extra-regional imports and intra-regional trade. One of the objectives of

the Customs Union is to harmonise and simplify customs procedures and documentation.

The instruments establishing EAC recognise the fact that Kenya, Uganda and Tanzania belong to more than one trading bloc and have subscribed to a number of regional agreements and blocs such as the African Union (AU), the Common Market for Eastern and Southern Africa (COMESA), the Southern African Development Community (SADC) and the Intergovernmental Authority on Development (IGAD).[1] EAC believes that membership of multiple bodies can lead to complementarities that can steer faster economic development in Africa. At the international level, the EAC countries are parties to numerous binding and non-binding regimes including the Convention on Biological Diversity (CBD), the World Trade Organization (WTO) and the African Growth Opportunity Act (AGOA). The EAC countries are also signatories to the Cartagena Protocol on Biosafety, the main international regime that is concerned with the introduction, safe handling and use of GMOs. Due to their membership to multiple regional and international bodies, the EAC sees the harmonisation of its three members' trading policies as one of the mechanisms to ensure consistency and promote market access.

Agriculture is one of the main economic activities in Eastern Africa and efforts relating to the promotion of agricultural productivity have been placed at the top of EAC integration priorities and processes. For instance, the creation of a Common Agricultural Policy (CAP) for EAC countries has been proposed. The agriculture sector in the region is facing many challenges including production constraints at the farm level. In exploring a range of technological options that can supplement conventional tools, the potential of agricultural biotechnology has been recognised even though reservations and resistance from some quarters still prevail. The issue of possible market access barriers in key export destinations has preoccupied debates on the costs and benefits of biotechnology in many African countries including the Eastern African region. However, the magnitude of the anticipated or perceived risks remains to be analysed and understood in concrete terms. By examining the composition and monetary value of commodities exported, this paper attempts to cast light on the trade-related ramifications and market access barriers that may result from the introduction and commercialisation of GMOs in Eastern Africa. The paper takes a positive perspective on agricultural biotechnology because of the fundamental importance that agriculture as a sector holds in the region. In addition, applications of biotechnology in industrial and environmental settings are yet to be fully exploited.

Policies and regulatory regimes for GMOs in Eastern Africa

An assessment of the research and development status of GMOs in Eastern Africa reveals that Uganda and Tanzania are at a nascent stage in their application of modern biotechnology; these two countries have not yet introduced any GM crop for research purposes. Kenya is further advanced, as evidenced by its contained and confined trials of *Bacillus thuringiensis* (Bt) maize, Bt cotton, transgenic sweet potato and GM cassava. However, no GM crop in Kenya has moved beyond the trials stage and been released for commercialisation. It is expected that Bt maize and Bt cotton will be the first crops to be commercialised in Kenya and probably in Eastern Africa.

The three EAC countries are parties to the Cartagena Protocol on biosafety. Subsequently, they are required to put in place legal and administrative measures to comply with the various provisions of the Protocol. In the last five years, significant progress has been made

in domesticating some of the requirements of the Protocol. For instance, the three countries have identified designated competent authorities and national focal points to deal with matters of biotechnology and have formulated national biosafety frameworks. Biosafety guidelines and regulations have been developed to handle introduction, trials and commercialisation of GMOs. The countries have also developed biosafety guidelines and regulations which outline comprehensive procedures for the introduction, safe handling, and commercialisation of GMOs. A few years ago, Kenya and Uganda initiated processes that led to the drafting of national biotechnology policies. Kenya's national biotechnology policy was approved and adopted by the Cabinet in late 2006. Tanzania's policy statement on biotechnology is embedded in the National Environmental Policy of 1997.

Kenya's policy on biotechnology states that the government has identified biotechnology as an important tool and vehicle for the realisation of its objectives to create employment, reduce poverty and improve food security. The section of the policy dealing with industry and trade recognises that existing trade agreements and market requirements may affect modern biotechnology products. It is therefore important that market factors are taken into consideration. To give the policy a legal face, Kenya has prepared a draft biosafety bill which is in the pipeline for enactment into law by parliament.

Uganda's draft policy document on biotechnology and biosafety was produced after extensive consultations with various stakeholders from government ministries, departments, academic researchers, farmers, consumers, private sector, local and foreign experts and civil society. The draft policy is still pending cabinet approval. The policy recognises the potential of biotechnology to contribute towards food security and envisages the vital role that biotechnology can play in addressing national challenges in areas such as health and sustainable natural resource use and socio-economic development. The policy also emphasises the safe application of biotechnology. The risk assessment and management section of the policy states that the government, through a national competent authority, shall ensure that GMOs and GMO products sold in or imported into or through Uganda are labelled accordingly.

In Tanzania, the National Environmental Policy (1997) recognises the importance of conservation and sustainable use of biological resources. The policy states that, "strategic measures shall be put in place for the development of biotechnology, especially to ensure fair and equitable sharing of the results and benefits arising out of utilisation of foreign recipients, of genetic resources originating from Tanzania." The Tanzania Environmental Management Act of 2004 (EMA) which was enacted in 2005 under the Ministry of Environment provides the legal framework for regulating GMOs. Tanzania has prepared Environmental Management (Biosafety) Regulations that stipulate measures for the development, handling and use as well as the importation and exportation of GMOs and their products (Republic of Tanzania, 2005).

2. Implications of commercialising GMOs on export trade in Eastern Africa

Most African countries have traditionally exported commodities such as tea, coffee, cocoa, pyrethrum, sugar, tobacco, bananas and a wide range of horticultural products to numerous countries around the world. Genetically modified varieties for most of these traditional exports have yet to be developed, and it will be a long time before there is any commercial interest in developing GM varieties

of these crops. The product development pathway for GMOs shows that it takes about ten years for a product to pass through the various steps before it is placed on the market. Development of GMOs is also a massive capital and research intensive investment. It costs between USD 200 and USD 400 million to develop a GMO (Sinai, 2001).

As mentioned earlier, African countries including Kenya, Uganda and Tanzania are preoccupied with the notion that the introduction of any GM crops in their territories may automatically bring on a blanket embargo on all their agricultural commodity exports. While this view is strongly held, it has not been adequately supported by facts and figures. Other concerns revolve around the anticipated high costs of labelling, traceability and segregation of GMOs to comply with diverse requirements in the export markets. Economic analysis work is currently underway on the trade implications of GMOs in Africa. The Regional Approach to Biotechnology and Biosafety Policy in Eastern and Southern Africa (RABESA) commissioned ground-breaking work revolving around the implications of introducing GMOs on trade, access to emergency food aid and farm income gains.[2] RABESA was developed by the Common Market for Eastern and Southern Africa (COMESA) following concerns that transboundary movement of GMOs in the region may impact on trade among member states unless a regional policy mechanism is put in place to mitigate such eventualities. Kenya, Uganda and Tanzania are among the six case study countries covered by RABESA. The others are Ethiopia, Egypt and Zambia.

This section attempts to analyse and demystify the ramifications of introducing GMOs into Eastern Africa and commercialising and exporting GMOs that are available globally under current trade flows to current markets. Some of the GMOs that are being grown widely that may have implications on export trade include soybean, maize and cotton. In the whole of Africa, it is only South Africa that is growing GMOs on a commercial scale. A few other countries are following suit, including Kenya which has introduced GM crops for research trials and may decide to commercialise some or all of them, depending on the outcomes of the trials.

The magnitude of potential trade losses is simply illustrated by examining the total dollar value of agricultural commodity exports and the proportion of this export value that risks being rejected in market destinations that treat GM commodities with sensitivity. The fact that GMOs can affect trade is axiomatic. Consignments of agricultural exports originating from a country that has commercialised GMOs would be treated with suspicion and generally expected to contain GMOs even in cases where such consignments contain only GM-free products. While the foregoing is undisputed, the unresolved enigma revolves around the seriousness of the anticipated risk for each and every country that has introduced GMOs or is likely to do so in the years ahead. The scenario for Eastern Africa is mapped by closely examining exports in relation to GM crops that are available globally and also those ones that might be of interest to Eastern Africa.

Table 6.1 shows the total dollar value of conventional agricultural food and feed products exported to various destinations from the three Eastern African countries in 2003.[3] The share of the exports that might be rejected as 'possibly' GM-sensitive commodities comprises agricultural commodities whose GM counterparts have been approved globally for commercial planting. They include soybean, maize, cotton, canola, squash, rice, papaya, tomato and Irish potato. The most dominant GM crops in terms of adoption rates are soybean, maize, cotton and canola. Calculation of the share of exports that might be rejected is based

on the assumption that if the three countries commercialised the aforementioned products, all exports of food and feed products associated with the crops in question would be rejected by all importing destinations including relatively sensitive destinations such as the European Union. This is the scenario with which most African countries are preoccupied. As shown in the Table, the share of the total export value that might be rejected translates to 1.1 percent for Kenya, 6.5 percent for Uganda and 6.2 percent for Tanzania. In a more realistic and probable scenario it can be assumed that only Europe would reject exports of commodities that may possibly be GM. In this case, the decline in exports from the three countries would be less than 1 percent.

This low level of trading risk exposure stems from the fact that most of the agricultural export commodities of these three countries that importers may reject as possible GMOs go to other African countries. Hence it can be deduced that Eastern African countries will continue growing and exporting these traditional commodities to current markets in the foreseeable future without fears of any drastic reduction in foreign exchange earnings. Any reduction in earnings will be caused by other factors such as declining or fluctuating prices for commodities such as coffee on the world market. Some decline caused by the introduction of GMOs may apply in some cases but the magnitude of the losses incurred would be negligible and secondary in nature. This observation is supported by the experience of South Africa which is the only country in Africa that is growing GMOs on a commercial scale.

Europe still remains South Africa's primary trading partner. Exports of non-GM commodities (for instance horticultural commodities) from South Africa to Europe have not declined in the recent past. Trends show that the area under GM crops and the number of farmers planting them in South Africa has been steadily increasing. Any significant decline would have resulted in farmers abandoning the cultivation of GM crops. In addition, authorisations that have been granted for placing Bt cotton and certain varieties of Bt maize and GM soybean both for food, feed and planting in the EU is a

Table 6.1: Agricultural food and feed product exports from Kenya, Uganda and Tanzania (2003) and the share that might be rejected by GM-sensitive export destinations

COUNTRY	TOTAL VALUE OF AGRICULTURAL FOOD AND FEED PRODUCTS (USD MILLION)	PROPORTION THAT MIGHT BE REJECTED AS GMOS (USD MILLION)	SHARE OF THE TOTAL THAT MIGHT BE REJECTED (%)
Kenya	1291	14.6	1.1
Uganda	116	7.6	6.5
Tanzania	408	25.6	6.2

Source: UN Comtrade, 2003.

strong indication that a total ban on imports of GMOs is an unlikely scenario.

Tables 6.2, 6.3 and 6.4 below present the commercial export risk profiles of three commodities — maize, cotton and soybean. These commodities were selected for the analysis as together they represent the bulk of global agricultural commodity trade and constitute a large proportion of global agricultural production. In addition, they are among the top GM crops with the highest adoption rates globally (James, 2007). Eastern African countries have also demonstrated interest in Bt cotton and Bt maize. In Kenya, Bt maize and Bt cotton are undergoing research trials. In Tanzania, the Tropical Pesticides Research Institute (TPRI) in collaboration with the International Centre for Insect Physiology and Ecology (ICIPE) are considering introducing Bt cotton in the southern highlands where production of cotton was banned because of exorbitant losses caused by the bollworm. Uganda has also been contemplating the pros and cons of introducing and commercialising Bt cotton and Bt maize. Applications to introduce Bt cotton and Bt maize were submitted to the Uganda National Council for Science and Technology (UNCST) in 2000, although none was approved for research trials since at that time policy framework and biosafety regulations were not yet formulated and the necessary facilities for trials were not yet available (Wafula and Clark 2005).

Table 6.2 reveals that the largest share of exports of maize and maize products from Eastern Africa is confined within the African region. Exports within Africa account for almost 99 percent of the total, showing that the region's potential commercial maize export, in fiscal terms, is highly concentrated in Africa. Europe as a GM-sensitive destination accounts for the least share of maize and maize products exported (only 0.20 percent). The Middle East accounts for 0.45 percent while the share for Asia is 0.27 percent.

Although Europe ranks as the most GM-sensitive destination, this situation is not static and the degree of Europe's sensitivity to GM commodities is likely to fall in the future. For

Table 6.2: Export of maize (meal and hulled) from Kenya, Uganda and Tanzania (2003)

EXPORT COUNTRY	EXPORT VALUE PER DESTINATION REGION (USD)			
	Europe	Middle East	Asia	Africa
Kenya	2, 059	27, 234	0	2, 636, 183
Uganda	5, 720	0	0	6, 867, 441
Tanzania	50, 867	104, 245	78, 446	18, 826, 182
Total per destination	58, 646	131, 479	78, 446	28, 329, 806

Source: Comtrade, 2003.

Table 6.3: Export of cotton seed, oil and cake from Kenya, Uganda and Tanzania (2003)

EXPORT COUNTRY	EXPORT VALUE PER DESTINATION REGION (USD)			
	Europe	Middle East	Asia	Africa
Kenya	0	0	0	30, 481
Uganda	0	0	0	0
Tanzania	63, 410	424, 918	151, 882	1, 843, 858
Total per destination	63, 410	424, 918	151, 882	1, 874, 339

Source: Comtrade, 2003.

instance, recent trends show that a number of European countries are opening up their territories to GMOs. Countries such as Spain, Slovakia, Romania, Germany, Portugal, France and the Czech Republic are growing GMOs, in particular Bt maize, on varied scales (James, 2007).

Another development that signifies the evolving dynamics in the EU is the lifting of a five-year moratorium on genetically modified foods by authorising importation of biotech maize known as Bt-11 to be sold as tinned sweet corn on supermarket shelves in the EU. The authorisation was granted in May 2004. The EU Health and Consumer Protection authorities contend that GM sweet corn has been subjected to rigorous risk assessment and has been scientifically proven as being as safe as any conventional maize (Smith, 2003).

Although the situation is changing for the better, Europe still exhibits some of the most stringent and watertight mechanisms for regulating GMOs in the world. This includes adoption of recent measures such as regulation number 1830/2003/EC concerning traceability and labelling of genetically modified organisms and traceability of food and feed products produced from genetically modified organisms. These two measures came as an amendment to Directive 2001/18/EC which was adopted in 2003. The regulation requires labelling of all foods produced from GMOs. In many countries, products made from GM ingredients or derived from GMOs do not require mandatory labelling because there is no modified DNA present in the final product. In the EU however, foods and feeds have to be labelled irrespective of the presence of modified DNA or proteins. Labels would be required for any food item that has been produced using GMOs even whey they cannot be detected after processing. With regard to traceability, the regulation requires that GMOs must be traceable throughout the entire production and distribution process (Nuffield, 2004). Existence of traceability requirements in the EU markets subjects exporters to numerous hurdles. The measures are likely to be applied indiscriminately even

for products that are substantially equivalent or whose safety is not questionable, such as tinned sweet corn.

Table 6.3 shows the export profile of cotton and cotton products such as cotton cake and oil. Exports from Eastern Africa to other African countries account for the largest share of exports (74.5 percent) followed by the Middle East (17.0 percent) and Asia (6.0 percent). Europe accounts for only 2.5 percent of the exports. It is unlikely that exports of cotton lint (a non-food commodity) will generate health and environmental concerns. On the other hand, products such as cotton cake and oil may be treated with caution because they can be used for food or feed.

Analysis of soybean and soybean product exports (see Table 6.4) shows that the Africa region is again the dominant export destination, accounting for 99.7 percent of exports from Eastern Africa. Europe accounts for the least share of exports, only 0.03 percent. Exports to the Middle East and Asia are also relatively negligible, representing 0.06 percent and 0.11 percent respectively. The available evidence shows that Eastern African countries can still tap market opportunities for soybean in Asia and Europe. Recent data from UN Comrade shows that the US has been exporting huge consignments of soybeans to a number of countries. For instance in 2004, the US exported soybean to China (valued at USD 2.3 billion), Japan (USD 1 billion) and Germany (USD 3.4 million).

It should be noted that the US grows GMOs without a policy of segregation. The value of exports from the US to China, Japan and Germany would have been extremely low if market access conditions were stringent because of sensitivity to GM soybean.

Another relevant development is the process underway in Romania to join the EU. Romania is a dominant producer of GM soybean. In 2005, about 90 percent of the area under soybean in Romania was genetically modified. Given that Romania is the third-largest producer of soybean in Europe after Italy and Serbia Montenegro, the progressive area under GMOs in the country

Table 6.4: Export of soybean and related products from Kenya, Uganda and Tanzania (2003)

EXPORT COUNTRY	EXPORT VALUE PER DESTINATION REGION (USD)			
	Europe	Middle East	Asia	Africa
Kenya	599	0	0	1, 000, 605
Uganda	0	0	0	645, 069
Tanzania	0	1,286	2,133	256, 667
Total per destination	599	1, 286	2,133	1,902, 341

Source: Comtrade, 2003.

has important policy and trade implications regarding commercialisation of GM soybean in EU member states (James, 2005). The case of Romania should give some hope and assurance to countries from other parts of the world that are currently exporting soybean or are likely to target the EU in the future as a market for soybean and soybean products.

3. Implications of commercialising and exporting possible future biotech products

Export crops with biotech potential

As mentioned in Section 2 above, genetically modified varieties for most of the traditional export crops of Eastern African countries (including, for example, coffee, tea, and horticultural commodities) have yet to be developed. However, it can be speculated that GM varieties for such crops might be developed in the future and Eastern African countries may be interested in introducing and commercialising them.

Some biotechnology developments have been made in the floriculture industry (one of the most lucrative sectors for Eastern Africa, in terms of foreign exchange earnings). Since flowers and other ornamental plants are grown for aesthetic or non-food purposes, there may be less potential for public concern with regard to transgenic flowers. The world's first GM carnation was developed in Australia in 1994 by a company known as Florigene, working jointly with a Japanese company, Suntory. The flower has since been approved for commercial use in many different countries including Holland, the US and Japan. The carnations have been modified to exhibit blue/violet-purple colouring which conventional breeding has failed to achieve. Other benefits that the transgenic flowers can provide include a prolonged shelf life, especially for distant transit purposes.[4]

The economic importance of the floriculture industry in Eastern Africa can be seen particularly in Kenya, which is a leading exporter of flowers in the world and benefits tremendously from the flower industry, compared to Uganda and Tanzania. The floriculture industry earns Kenya an average of about USD 200 million annually and accounts for 8 percent of the country's total export earnings. Kenya exports into the EU market over 60,000 tonnes of flowers annually and commands about 25 percent of the market (Bolo, 2006). The Netherlands and the UK are the key export destinations in Europe. In Asia, Japan is a major trading partner. In 2003, Uganda's flower exports to Europe were valued at USD 800,000 while Tanzania's flower exports amounted to USD 7.2 million (UN Comtrade, 2003). Currently, there are no indications of Eastern African countries switching to transgenic flowers in the near or distant future. Even if they did, the underlying risks would be less severe compared to those associated with food crops such as coffee. However, if the worst case scenario was to be assumed, what would be the impact on the economies of Eastern African countries? If exports of flowers from Eastern Africa to Europe were to be rejected because they are genetically modified, then Kenya would suffer massive losses. The impact on Tanzania and Uganda would be less catastrophic.

There are no signs of interest among the leading life science companies such as Monsanto in developing genetically modified varieties of coffee — another important export for the Eastern Africa region, However, if such a product were to be developed, R&D efforts would likely focus on producing coffee beans with reduced caffeine content. Demand for decaffeinated coffee is increasing and at the moment coffee is decaffeinated via expensive

industrial processes which compromise flavour. However, before any biotech companies invest in product development of a widely consumed commodity such as GM tea or coffee, they would first conduct research on consumer acceptability of the product. If commercial opportunities appear bleak, the companies would have no incentive to invest.

Eastern African countries are leading exporters of coffee to Europe. In 2003, Kenya exported unroasted coffee valued at USD 62 million to EU countries, of which Germany and Switzerland were the most important. The other major export destinations were the US and Canada. In the same year, Tanzania exported unroasted coffee valued at USD 27 million to Portugal, Greece, Switzerland, the US and Japan. Uganda exported coffee valued at USD 30 million in the same year, and its main trading partners were Switzerland, the UK and Germany. While it might take more than a decade before genetically modified coffee is developed and commercialised, it is possible to construe a scenario whereby Eastern African countries grow and export GM coffee or tea. As discussed in Section 2, a large share of exports of maize, cotton and soybean from Eastern Africa goes to other African countries, implying that the potential trade-related risks for GM varieties of those particular crops is relatively high within the region. For coffee, tea and flowers, however, the converse is true. A significant share of the export of these crops goes to Europe and some Asian countries such as Japan — where markets are relatively sensitive to GM commodities. If GM coffee were to be introduced and commercialised, the magnitude of export risks in terms of reduced foreign exchange earnings is likely to be high.

In 2003, Kenya exported slightly more than 50 percent of Eastern Africa's coffee exports to Europe. If the trend is sustained and in the event that Kenya adopts GM coffee in future (assuming that GM coffee will be developed), Kenya will be the biggest loser if market access is denied. In GM receptive destinations such as Canada and the US, coffee consumers are likely to show less concern and therefore no significant changes in the flow of trade might be expected.

Costs and challenges of complying with biosafety requirements

The Cartagena Protocol on Biosafety is an evolving instrument as demonstrated by continued discussions and negotiations on the implementation of its various provisions. In April 2006, the third Conference of the Parties serving as the Meeting of the Parties to the Biosafety Protocol (COP/MOP-3) was held in Brazil. The meeting pushed for detailed requirements for documentation and labelling of GMOs. Consequently, parties are obliged to label consignments indicating that they "contain GMOs" or "may contain GMOs" depending on their capacity and systems to identify and document accordingly. The aim of the labelling and documentation provisions of the Biosafety Protocol are to ensure that sufficient information about GMOs is made available to importing countries so that they can make appropriate arrangements and informed decisions on how to handle such consignments (Foster and Galeano, 2006).

Parties should take note of the cost and capacity required to enforce and comply with the testing, labelling and documentation requirements of the Protocol, as well as conditions in the export destinations which may exceed the minimum requirements of the Protocol. Studies have demonstrated that labelling and documentation of GMOs is a very costly affair. In the US and Argentina, sampling and testing to indicate that a cargo "may contain" GMOs would cost USD 1 million. If the exporters are required to

identify and quantify individual varieties, the labelling and testing costs for maize alone, would be four times more (IPC 2005). Countries in Eastern Africa will be confronted with the cost of identifying, documenting and labelling consignments to show that they contain or may contain GMOs. To show that a container contains GMOs implies the need to test each cargo exported for its GMO content and the level of concentration of GM events in that cargo. It might not be prudent to indicate that a cargo contains GMOs simply because GM coffee, tea or flowers have been commercialised in a particular country. Not all agricultural exports from a country growing a couple of GMOs are likely to be contaminated. Countries that grow GMOs but lack adequate capacity or resources for identification and testing, are therefore likely to indicate that a cargo "may contain" GMOs.

Other challenges relate to the logistics and possible delays in shipping commodities. Indirect compliance costs can be in the form of demurrage costs occasioned by delays. Polymerase-chain-reaction (PCR) tests can take two to three days to complete. This can be complicated further if tests done in the exporting country are contested at the arrival port in the importing country. While some developed countries may be able to inspect, test and clear cargoes with minimal delay, countries in Eastern Africa lack the requisite capacity to accelerate the process. Customs authorities are not equipped or trained to process documentation for GMOs and this could also contribute to delays.

Complying with traceability requirements will be another formidable challenge. It demands capacity to trace products through the entire production and distribution chains. Traceability mechanisms may exist for some conventional products but requirements for products that contain GMOs or are derived from GMOs do not currently exist. It might take several years before the required capacity is assembled. Documentation costs are largely fixed, irrespective of the size of the shipment, so the cost per tonne would be higher for small shipments than for large ones. The testing cost is largely the same for both small and large cargoes. However, due to economies of scale, the cost per tonne declines, as cargoes get bigger. For example, the cost of testing for five GM events using the PCR method would be around USD 7.50 a tonne for a cargo of 100 tonnes but only USD 0.02 for a 50,000-tonne cargo (Foster and Galeano, 2006). Large exporters would end up paying relatively less for testing than small exporters. For the export of grains to destinations outside Africa, the countries of Eastern Africa can be categorised as exporters of small shipments. For commodities such as tea, coffee and flowers, however, they can be categorised as large exporters and therefore the testing and documentation costs would be relatively low because of economies of scale and the nature of the products exported.

Identity Preservation (IP) is an issue of concern as far as trade, testing and documentation of GMOs are concerned. IP refers to the process by which a crop is grown, handled, delivered and processed under controlled conditions for various reasons, including the prevention of commingling of GM and non-GM products (United Soybean Board, 2001). The cost of meeting IP requirements depends on the varied GM tolerance levels that countries have fixed. For instance, the threshold level for GMOs in Japan is five percent while the common threshold level for the EU countries is one percent. Studies in Canada and Argentina have estimated that meeting a five percent threshold adds three percent to the cost of delivering grain to the end-user. The cost rises to around eight percent if the threshold is set at one percent. In Australia, identity preserved cottonseed was estimated to cost an additional USD 60 a tonne

compared to conventional cottonseed when exported in 20-feet containers. This amounts to an increase of around 20 percent in the export supply price (Foster and Galeano, 2006).

4. Prospects of export trade in GMOs through market diversification

This section looks at the implications of commercialising and exporting existing biotechnology products to new markets that Eastern Africa countries might diversify to if their preferential access to current markets such as the EU is diminished. There is a significant export growth potential for Kenya in non-traditional markets in North America and Asia. For instance, Kenya's share of the global market for cut flowers is 4.3 percent, but it holds less than one percent of the US and Canadian markets. While market diversification is a good mechanism for spreading risks, the lack of uniformity in sanitary measures may be a hindrance to diversification in promising markets even in countries such as the US that exhibit a permissive stance towards GMOs and products processed from GMOs. The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) states that each country has the right to determine the level of food safety that it deems acceptable or the level of protection that deems adequate. In the US, phytosanitary regulations stipulate that risk assessments must be conducted and these may take several years. The cost involved is also relatively high (Mupotola, 2005).

Eastern African countries could also exploit commercial opportunities for producing and exporting soybean to markets in the Middle East and Asia, where market opportunities have been shown to exist. China is one country which offers an alternative and less stringent export destination for Eastern African countries. The Chinese market is huge and fast-growing. In 2004, the US exported soybeans valued at USD 2.3 billion to China. The demand for protein meal and vegetable oil in China continues to rise. Increased demand for poultry, beef and pork is driving the consumption of meal, which in turn is increasing demand for soybean imports. China's own production of oil seeds has not kept pace with the growing demand for vegetable oils and protein meals. To export products that contain or may contain GMOs to the Chinese market, Eastern African countries will have to comply with biosafety regulations that the Ministry of Agriculture (MOA) has put in place. In 2002, the MOA issued three sets of relevant regulations related to the safety of GMOs. These regulations are "Implementation Regulations on Safety Assessment of Agricultural Genetically Modified Organisms", "Implementation Regulations on the Safety of Import of Agricultural Genetically Modified Organisms" and "Implementation Regulations on Labelling Agricultural Genetically Modified Organisms". The regulations require safety certification of all domestic and imported GMOs, and labelling of GMOs and processed products containing GMO materials. Importation of agricultural GM products is handled through the issuance of certificates from the MOA after safety assessments and technical review. For instance, in 2004, China issued 17 biosafety certificates to Monsanto, Bayer, Syngenta, and Dupont. These certificates allow the use of GMO soybeans, rapeseed, maize and cotton as processing raw materials (Xiu Feng, 2005).

While a window of opportunity exists, it has been estimated that labelling and requirements for certificates could be costly. For instance, it is estimated that it will cost USD 50/tonne to get US soybeans labelled, to obtain safety certificates and documents, compared to USD 18-20/tonne at present. This may cause consumer prices for soybeans to surge and the volume of imports to drop (Agriculture and Agri-Food Canada, 2004).

Another promising export destination is Japan. The UN comtrade database shows that soybean valued at USD 1 billion was exported to Japan in 2004. GM foods in Japan are regulated by the Labelling Standard for Genetically Modified Foods and the Specifications and Standards for Foods, Food Additives and other related products administered by the Ministry of Health, Labour and Welfare. Labelling is required for GM agricultural food and feeds including soybeans, maize, potato, rapeseed and cotton seed. Exempted from labelling are processed foods where GM is not a main ingredient and foods derived from but no longer containing GMOs such as soybean oil or cotton oil. As cooking oils do not contain any protein, it is unlikely that oil produced from GM soybeans will have GM traces.

India is another prospective market destination. In India, three out of every five bottles of branded refined oil is produced from soy. India imports more than 2 million tonnes of soy annually (Times of India, 2006). In 2004, the US exported soybean oil valued at USD 24.2 million to India. In May 2006, India's Genetic Engineering Approval Committee (GEAC), the country's main regulatory body, approved GM soybean oil derived from Round-Up Ready Soybean. This decision will allow importers to seek a one-time, trait-based approval for oil instead of seeking approval each time a consignment of oil is imported into the country (GEAC, 2006).

Another market possibility could be Vietnam. It is one of the countries in Asia that do not exhibit any ban or stringent regulations for GMOs. It is reported that Vietnam imports large quantities of several commodities that have significant biotech content. As domestic cotton production can provide only 10 percent of the cotton demand for the textile industry, over 100 thousand tonnes of cotton from different countries is imported from countries such as the US. Vietnam also imports about one million tonnes of soybean meal for the animal industry. Some of the corn and soybean imported from countries such as Argentina and US could be genetically modified. Decree No. 178.199/QD-TTg released in 1999 requires that biotech products produced in Vietnam or imported must be labelled. However, no threshold levels have been fixed (United States Department of Agriculture: USDA, 2005).

While labelling of GMOs is soon going to be a mandatory requirement in many market destinations, it does not necessarily imply that GMO food or feed products will be prohibited. The purpose of labelling in many cases would be to help consumers make informed decisions.

5. Implications of commercialising GMOs on intra-regional trade in Eastern Africa

This section reflects on the implications of commercialising biotech products in one Eastern African country on other countries in the region under current and possible trade flows. It also reviews the capacities and policies of the three countries to control cross-border trade in products that may contain GMOs.

The importance of commodities such as cotton and maize has been recognised by the COMESA and EAC. Maize is a principal food security commodity that dominates both formal and informal trade in Eastern and Southern Africa. According to FAO and COMESA estimates, total maize consumption in the region is over 14 million tonnes per year with an average annual growth rate of three percent (COMESA, 2003). The EAC development strategy for 2001-2005 advocates the liberalisation of maize trade. COMESA, in collaboration with EAC and the Regional Agricultural Trade Expansion Support (RATES), has been exploring options for fostering

regional maize trade. One of the strategies proposed is a 'maize without borders' concept involving harmonised policies and regulatory frameworks to facilitate increased movement of maize across borders (COMESA, 2003).

Efforts to promote trade in cotton in the COMESA and EAC region have also been noted. In 2005, the first Regional Cotton and Textile Executive Summit was held in Nairobi. The meeting resolved that a regional integration policy has to be adopted and a regional trade federation formed to promote a regional supply chain, address key policy issues and build a platform for reducing constraints in regional trade in cotton.

As evidenced by Tables 6.1, 6.2 and 6.3, exports of crops for which biotech varieties could potentially be introduced and commercialised in Eastern Africa are largely destined to other African countries. These figures strongly indicate that EAC countries should be more concerned about possible commercial export risks associated with intra-regional trade. For instance, less than five percent of maize produced in Kenya, Uganda and Tanzania is exported outside Africa. The share of maize traded intra-regionally (i.e. within Africa) is 98 percent for Kenya, 96 percent for Tanzania and 99 percent for Uganda. In addition, intra-regional trade seem to be overtaking the share of exports to the industrialised world. For instance, the COMESA region may soon overtake the EU as an important export market for Kenya and Uganda in commodities such as maize, beans and bananas.

In 1991, 41.5 percent of Kenyan exports were destined to the EU and 17.5 percent to COMESA. By 2004, the EU share of Kenyan exports had reduced to 30 percent and the COMESA share increased to over 33 percent (Linden, 2006). In the case of Uganda, exports to the EU declined from USD 309 million in 1998 to USD 185 million in 2002, while the share going to COMESA was on the rise in the same period (Wagubi, 2005).

As borders are porous and effective mechanisms and infrastructure for monitoring transboundary movement of GMOs are often absent, Bt maize and Bt cotton can easily be transhipped from one country to another either formally or informally. In the case of maize, farmers in the importing countries are likely to plant some of the maize kernels as seeds. Kenya is ahead of Uganda and Tanzania in research involving GM crops. If Kenya commercialised Bt maize and Bt cotton ahead of Tanzania and Uganda, the chances of trade disputes erupting are high unless policy instruments are put in place to address transboundary movement of such commodities.

As mentioned above, the EAC and COMESA are pushing for increased regional integration and free trade areas. However, with some countries moving ahead with the commercialisation of GMOs and others considering adoption of a GM-free stance, the unrestricted and rapid movement of commodities such as maize may not be realised. In the absence of mutually acceptable regional arrangements and policies, some EAC countries may decide to go for stringent identification, testing and labelling procedures. This would drastically slow down smooth cross-border flow of essential commodities. If the importing country has to test maize consignments to confirm whether or not they contain GMOs, it would result in high costs and delays in delivering the commodities, due to the lack of adequate regulatory systems and testing facilities. It may also require laboratories and trained personnel to be put in place at ports of entry to perform the tests. The additional costs of exporting essential commodities such as maize could significantly increase the cost of food in the importing countries whose purchasing power is already very low.

While no arrangements for handling GMOs exist at the level of EAC, the three countries are members of the COMESA/ASARECA-driven the Regional Approach to Biotechnology and Biosafety Policy in Eastern in Southern Africa (RABESA) initiative known which is aimed at exploring policy options and choices at the regional level for handling trade in GM products. This is in line with article 14 of the Biosafety Protocol which legitimises regional co-operation in matters related to transboundary movement of GMOs. The article states that "parties may enter into bilateral, regional and multilateral agreements and arrangements regarding intentional transboundary movements of GMOs provided such arrangements do not result in a lower level of protection than that provided by the Protocol."

Review of policies and capacity to handle trade in GM products

Kenya

The government of Kenya has no official policy that stipulates how commercial imports or food aid shipments with GM content should be handled (Nyameino, 2005). At the same time, there is no decree that puts a stringent ban on importation of GM commodities as food aid or for commercial purposes. Kenya's policies regarding the importation of food aid with GM content are important for other states in the region, since some of Kenya's land-locked neighbours (including Uganda) also depend on imports through Kenya's port of Mombasa. Although an elaborate GM policy is yet to be operationalised in Kenya, importers are required to declare GM status in the import declaration form. Infrastructure and capacity to test for the presence or absence of GMOs in consignments at the ports of entry has been lacking but is being developed. The Kenya Plant Health Inspectorate Services (KEPHIS) regulators and inspectors have been trained at the International Livestock Research Institute (ILRI) on quick detection methods for GM testing. In addition designated laboratories for testing have been identified.

Tanzania

Tanzania's port of Dar es Salaam is also a point of entry for commercial imports and food aid to other states in the region including the Great Lakes Region. The government of Tanzania is still formulating and defining its policies toward GMOs, including GMO imports. As the situation stands now, the government has no institutionalised capacity to test imports for GM content upon arrival in Dar es Salaam (Mwinjaka et al., 2005). As a member of SADC, Tanzania has subscribed to the Community's guidelines on biosafety which state that GM food aid can be imported provided it is milled before distribution to the intended beneficiaries. This policy is stipulated in the draft biosafety regulations. In November 2004, a parliamentary committee expressed a preference for a more stringent policy. Aware that GMO food aid may be moving through the country by road and rail, the government specifies that these shipments should move in leak-proof containers (ACF, 2004).

The draft biosafety regulations require labelling and notification to identify whether or not food or imported products contain GMOs. GMOs intended for direct use as food, feed or for processing will require prior notification and approval before placing on the market. The importing party should provide the risk assessment report of the GMOs in question. All GMOs subject to intentional transboundary movement should be labelled, handled, packaged and transported under conditions of safety. Any person who intends to export GMOs or products of GMOs should provide to the National Biosafety Focal Point (NBFP) a

written Advance Informed Agreement (AIA) of the competent authority of the importing country (Republic of Tanzania, 2005).

Although the biosafety regulations have been drafted, their implementation and enforcement remains a major challenge. The ports of entry do not have trained personnel or the necessary equipment to test whether the imported commodities contain GMOs. Institutions such as the Tanzania Bureau of Standards (TBS), the Tanzania Food and Drugs Authority (TFDA) and the Tropical Pesticides Research Institute (TPRI), which are responsible for food quality and biosafety, do not have adequate expertise particularly in testing GM food or GM products. This is in spite of the fact that they play a key role in such matters as quality assurance, standardisation and forensic services in the country.

Due to these limitations, the possibility of GM food being imported either on commercial terms or as food aid for consumption cannot be ruled out.

Uganda

The government of Uganda is aware that some of the maize entering the country as food aid could be genetically modified. In some years, Uganda imports maize from countries such as US, Canada and Argentina which plant GMOs without segregation or labelling. The Food and Drugs Act deals with standards for food and drugs, but does not cover biosafety concerns regarding GMO foods. Since 2003, the government's policy has been to accept this maize without any clear milling requirement, but with the specification that it should be used "strictly for consumption" rather than cultivation (African Centre for Biosafety, n.d.). In 2003, the President of Uganda approved the importation of processed GM products strictly for consumption but not as seeds for planting. It is reported that the presidential decree was informed by a task force of scientists appointed to investigate the safety history of GMOs (Wafula and Clark, 2005).

Cereal imports account for more than half of Uganda's total food imports. Vegetable oils, including soybeans, which are imported and then processed locally into oil and meal, account for one-sixth of the country's total food imports. However, the quality and safety of donated food is inadequately monitored. With liberalised trade, the possibility that some of the products (such as soybean oil) may have been processed from GMOs cannot be ruled out. Uganda's infrastructure and capacity to test GMOs at the ports of entry is still weak. The Uganda National Bureau of Standards (UNBS) is the body mandated with responsibility for ensuring that quality and safety standards for imported products such as maize are met. Although quarantine regulations are currently being enforced, UNBS does not have adequate human capacity and infrastructure to fully monitor and test for the presence of GM food imports at points of entry in Uganda.

Options for regional harmonisation of policies on GMOs and trade

Under the aegis of the RABESA initiative, a range of policies have been proposed for regional harmonisation of issues related to the handling of GMOs. These policies fall into two distinct clusters. The first cluster refers to policies of "tight" harmonisation while the second cluster proposes a flexible approach which would facilitate "loose" harmonisation. Tight harmonisation can be realised through a variety of mechanisms such as centralised approvals, mutual policy recognition or pre-emptive disapproval (Paarlberg, 2006). The proposed policy options will be deliberated on at various policy organs of COMESA before being

narrowed down to the most appropriate and feasible option for subsequent adoption and implementation.

Centralised approval is characterised by creation of a single region-wide approval authority with powers to decide which GMOs can be released for commercialisation and which can be imported into the region. Although this policy option has advantages such as allowing one policy to prevail throughout the region and enabling the sharing of resources, it may encounter political hurdles especially if some countries are reluctant to surrender national decision-making sovereignty to a single committee. A second mechanism for instituting tight regional harmonisation might be the creation of a mutual policy recognition system modelled around the EU biosafety regime. The EU system relies not on a single centralised approval committee, but instead on a single region-wide set of approval procedures. Under this arrangement, if one country in the region grants approval for the import or planting of a GM crop, then that approval, if there are no objection from other member governments, automatically becomes a generalised approval throughout the region. If there are reservations, then these are addressed through a decision-making process involving mutually recognised institutions such as scientific expert committees and regulatory committees composed of representatives from member countries. For political and scientific reasons, this mechanism may not work optimally in African countries because of disparities in scientific and technological capabilities. For countries to subscribe to such a regional arrangement, they would need to have a high level of trust and confidence in the regulatory systems of member countries. In addition, applicants would seek governments in the region that are most likely to fast track approvals, but those approvals would then either be blocked at the regional level or rejected by countries that wish to maintain a cautious and slow-paced momentum to the introduction of GMOs (Paarlberg, 2006).

The third pathway to tight harmonisation would be to reach a decision at the regional level that indiscriminately bans all GMOs for import, research or commercial planting anywhere in the designated region. The need to co-ordinate national approvals on a case-by-case basis would be eliminated, because there would be no national approvals. This approach also eliminates the need to invest resources in GMO screening and approval capacity at the national or regional level. The only technical capacity needed would be detection and policing capacity, to enforce the regional ban on GMOs. This approach would also have some attraction if it could reduce the commercial export risks that might arise if GMO crops were planted in the region. Importers in GMO-sensitive countries in Europe and elsewhere would be less likely to shun exports from a GMO-free region. Some of the costs that countries would pay by implementing such a policy include denying farmers opportunities to harness the potential economic, social and environmental gains associated with adoption of GMOs. The policy would also result in diminished access to commercial food imports and food aid required under emergency circumstances.

Under the loose harmonisation option, a common minimum standard of precaution on GMOs would be fixed for the entire region. The flexible nature of the arrangement would allow individual states to exceed that minimum standard if they wish, so long as their action does not adversely impact neighbouring countries. The Cartagena Protocol on Biosafety would be a useful minimum standard for loose policy harmonisation. Article 11 of the Protocol stipulates procedures for living modified organisms (LMOs) intended for direct use as food, feed or processing. Transboundary movement of such products is not subject to

the stringent AIA which applies to LMOs that may eventually end up in the environment (CBD, 2000).

If the minimum Cartagena Protocol standard were adopted as a regional standard, international biosafety obligations would be honoured at minimum cost to trade or scientific research. This is based on the premise that most African governments including the three Eastern African countries have signed and ratified the Biosafety Protocol. By doing so, they have demonstrated support for its principles as well as their intention to become legally bound by it. But when governments go above the Cartagena standard, for example by banning all LMO imports or by demanding milling of GMO maize or perhaps by demanding labelling, they might be required to take on at least two obligations toward their neighbours in the region. First, they might be required to give the World Food Programme (WFP) advance warning of any new import bans, or of any new milling or labelling requirements. This would give WFP the time needed to make adjustments in the sourcing of food aid, and to mobilise the financial resources that an adjustment in sourcing or a requirement for milling or labelling would likely entail. Second, they might be required, particularly if they are port-of-entry countries for land-locked neighbouring states, to make an exception and revert to the minimum Cartagena Protocol standard when GM food aid or commercial imports are being trans-shipped through their territory to neighbouring states facing emergency humanitarian crises or to camps holding refugees (Paarlberg, 2006).

6. Conclusions

This paper has examined the implications of introducing and commercialising GMOs on trade in three Eastern African countries (Kenya, Uganda and Tanzania). Currently none of these countries has approved any GMOs for commercial planting. However, concerns persist among producers, exporters and other stakeholders involved in the export trade of agricultural commodities that commercialisation of GMOs could significantly reduce the volume and value of agricultural commodities exported to GM-sensitive destinations such as the EU. Analysis of commodities produced and exported from Eastern Africa shows that if the three countries approved planting of Bt maize, Bt cotton or GM soybean, for instance, the magnitude of commercial export risk in destinations outside Africa would be relatively small in monetary terms — since these crops are largely traded intra-regionally. The three countries export more of traditional cash crops such as tea, coffee and flowers to markets in the EU, Asia and the Middle East, and it is here therefore that the magnitude of commercial export risk is lower.

Intra-regional trade in GM-sensitive commodities implies that if one of the three countries granted approval to commercialisation of Bt maize or Bt cotton, trade disputes would be likely to erupt — especially if some countries decided to reject imports of agricultural commodities on the grounds that they could be contaminated with GMOs. This would impact negatively on current efforts aimed at facilitating unrestricted movement of commodities, such as the 'maize without borders' concept and the Free Trade Area arrangements that are being negotiated.

The foregoing implies that regional co-operation in matters relating to the transboundary movement of GMOs is extremely important. For Eastern African countries to benefit from biotechnology, they will have to co-operate and formulate policies that mitigate the potential risks associated with GMOs, while at the same time promoting trade. Landlocked countries such as Uganda rely on other port-of-entry countries for both commercial imports and

food aid shipments of various commodities. In the absence of mutual understanding and co-operation, rapid transboundary movement of commodities that "contain" or "may contain" GMOs would be hampered. Therefore mutual trust and harmonisation of biosafety procedures might be necessary to minimise the high costs associated with testing GMOs at the ports of entry. If tests are done in the exporting country, it might not be cost effective for the importing country to duplicate the process.

The range of policy options for regional harmonisation reviewed in this paper strongly brings out the advantages of loose harmonisation. This policy option is anchored on the provisions and principles of the Biosafety Protocol to which most African countries are parties. In particular, trade disruptions would be minimised since the current or potential transboundary movements of GMOs within the Eastern and Southern region are intended for food, feed or processing, rather than for planting. This is commercially important for countries in Eastern Africa, as the commercial export risk analysis has demonstrated that most future exports of GMO products from states in the region are likely to go to other African countries, rather than to export destinations beyond Africa.

It has been noted that the three countries are part and parcel of the RABESA initiative which seeks to reconcile the potential impacts of GMOs on trade, food security and access to emergency food aid through crafting regionally accepted policies in Eastern and Southern Africa. While this is recognised as a step in the right direction, much more should be done within the circles of the EAC to handle exports and imports of GMOs. Capacity building is a prerequisite to facilitate a coherent and co-ordinated approach to comply with detection, inspection, labelling and traceability requirements in export market destinations. Any measures put in place should complement the interventions that are already underway.

ENDNOTES

1 While Kenya and Uganda are members of COMESA, Tanzania belongs to SADC.
2 Data used in this paper draws on RABESA reports III and IV.
3 The term 'conventional' is used because no GM crop has been commercialised by any of the three countries.
4 For further details, visit www.florigene.com.au and www.suntory.com.

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7. RISK MANAGEMENT AND LIABILITY UNDER THE CARTAGENA PROTOCOL ON BIOSAFETY: PRIORITIES FOR EASTERN AFRICA

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1. Introduction

The Cartagena Protocol on Biosafety is an international legally binding instrument (under the auspices of the Convention on Biological Diversity) that seeks to protect biological diversity from the potential risks posed by living modified organisms (LMOs). The Biosafety Protocol uses the term 'living modified organism' (LMO) instead of the more commonly used 'genetically modified organism' (GMO). LMOs are defined as is "any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology".

The Protocol addresses safety issues in the handling and use of LMOs and takes into account not only potential adverse effects on biodiversity and the environment, but also risks to human health. The Protocol focuses particularly on the transboundary movement of LMOs. It distinguishes between LMOs for intentional introduction into the environment and LMOs destined for direct use as food, feed or for processing (LMO-FFP) which are subject to slightly different procedures.

The Protocol was adopted on 29 January 2000 and came into force on 11 September 2003 following the 50th ratification. As of March 2007, the Protocol has 140 parties, 39 of which are from Africa.

The Protocol requires parties to put in place the necessary institutional, policy and legal frameworks to enable them to fulfil their obligations under this instrument. It also provides for the Advance Informed Agreement (AIA) procedure, whereby a country is supposed to be notified prior to the transboundary movement of LMOs into its territory so it can make informed decisions before agreeing to the import of such organisms. Where the importing country has insufficient information on which to make an informed decision, it can request further information or invoke the precautionary principle to prohibit the import.

As part of the measures to prevent or minimise harm to the environment, biological diversity and human health, the Protocol has provisions on, among other things, risk assessment, risk management, identification and labelling, and liability and redress.

This paper highlights these provisions of the Protocol and considers them from the standpoint of developing countries, with a particular focus on Africa. The paper outlines some of the main challenges facing these countries in their implementation of the Protocol's requirements and the protection of their own interests.

2. Risk assessment and risk management

Provisions of the Protocol

Risk assessment (provided for under Article 15 of the Protocol) is supposed to be carried out based on information provided during notification and other scientific evidence in order to identify and evaluate the possible

adverse effects of LMOs on the conservation and sustainable use of biological diversity, also taking into account risks to human health. Risk assessments are to be carried out prior to decisions regarding the deliberate release of LMOs into the environment (and may be also demanded if necessary for LMO-FFP).

Article 16 of the Cartagena Protocol on Biosafety provides for risk management measures to be undertaken before or after decisions to release LMOs into the environment. Under this Article, parties are required to establish and maintain appropriate mechanisms, measures and strategies to regulate, manage and control risks identified in risk assessment provisions associated with the use, handling and transboundary movement of LMOs.

Parties are also required to take appropriate measures to prevent unintentional transboundary movement of LMOs, and to ensure that each LMO (regardless of whether imported or locally developed) has undergone an appropriate period of observation, commensurate with its life cycle or generation time, before it is put to its intended use.

Following the third meeting of the Conference of the Parties serving as the Meeting of the Parties to the Cartagena Protocol on Biosafety (COP/MOP-3) in March 2006, parties and other governments and relevant organisations were requested to provide the Biosafety Clearing House with additional links to databases and information sources relevant to risk assessment and risk management. They were also called upon, where possible and appropriate, to translate relevant information into one or more languages that are commonly used internationally. This was with a view to better informing other parties, especially developing countries, about risk assessment and risk management, to enable them to make more informed decisions and to help lead to improved biosafety.

COP/MOP-3 further encouraged parties and other governments, in submitting risk assessment summaries, to include details of how particular challenges have been addressed and how existing information has been used to support risk assessments.

Parties and other governments were further encouraged to put in place mechanisms for ensuring sharing of information among government agencies and other stakeholders at national and regional levels dealing with, among other topics, the environment and human health issues related to biosafety.

At the same time, it was recognised that there may be a need for further guidance on specific aspects of risk assessment and risk management in addition to that provided in paragraph 6 of Annex III of the Protocol. It was therefore decided to consider this need for further guidance at COP/MOP-4, to be held in Germany in 2008.

COP/MOP-3 also noted the need for adequate financial resources for capacity building for implementing the risk assessment and risk management provisions of the Protocol. It therefore urged parties, other governments and other relevant organisations to promote South-South and North-South partnerships to strengthen parties' capacities in this field.

The meeting also encouraged parties and other governments to invite tertiary training institutions to develop and expand training programmes for biosafety professionals, and to promote, develop and exchange scholarship programmes related to biosafety. The meeting encouraged donor countries and agencies to assist developing countries in this endeavour.

Possible challenges for African countries

Most African countries are still in the process of putting in place the necessary institutional, administrative and legal frameworks to fulfil their obligations under the Cartagena Protocol. In general, African countries' capacities to handle LMOs is still lacking or inadequate, and the trained professionals they do have are often poorly motivated, overworked and constantly being lost to better-paying fields or employers.

At the same time, there is tremendous pressure on developing countries to simply accept LMOs even before their laws are finalised and the liability questions streamlined; and to make their regulations as lenient as possible (through "technical assistance" or tying LMO acceptance to aid, including emergency food aid). Such pressures can lead to these countries either disregarding or toning down their response to the risk assessment and risk management provisions and requirements.

3. Identification and labelling of LMOs under the Cartagena Protocol on Biosafety

Provisions of the Protocol

Article 18 of the Protocol deals with handling, transportation, packaging and identification of LMOs. Labelling is necessary as it enables the importing country to trace possible causes of harm and is thus directly linked to liability and redress. Without labelling, it would be very difficult to tell whether the harm being witnessed resulted from a given LMO. If LMOs are clearly labelled, it becomes easier to monitor their movements in the supply and distribution and food chains, as well as in ecosystems. Furthermore, labelling also gives the consumer the option of choosing what to buy and the confidence of knowing whether the products they are buying contain LMOs. Labelling also enables a receiving or transit country to institute the appropriate risk management measures in case of an accidental release, and to put the right substance to the correct or recommended use. Labelling is also instrumental in facilitating the work of regulators in checking a given LMO against the list of those approved in their country. Labelling does away with the need for regulators to investigate or sample and test each and every consignment, and thus helps avoid unnecessary delays. Labelling is therefore essential for the smooth trade in and exchange of GM commodities and products.

Article 18.2 sets out the necessary documentation which parties are required to provide to accompany the transboundary movement of LMOs. The Protocol distinguishes three sets of requirements, depending on the intended use of the LMO in question. These distinctions relate to:

a) *LMOs-FFP*. In this case the accompanying documentation should clearly identify that they "may contain" LMOs and that they are not intended for deliberate introduction into the environment. The documentation should also identify a contact point for further information.

b) *LMOs destined for contained use*. In this case the documentation should clearly identify them as LMOs; and specify any requirements for their safe handling, storage, transport and use. Again, the documentation should provide a contact point for further information, including the name and address of the individual and institution to whom the LMOs are consigned.

c) *LMOs that are intended for intentional introduction into the environment of the party of import and any other LMOs within the scope of the Protocol*. Here the documentation should clearly identify them as LMOs, and specify their identity and relevant traits and/or characteristics, as well as any requirements for their safe handling, storage, transport and use. The documentation should also give the contact person for further information and, as appropriate, the name and address of the importer and exporter. Finally, the documentation should also contain a declaration that the movement is in conformity with the requirements of the Protocol applicable to the exporter.

COP/MOP considered the provisions of Article 18.2(a), (b) and (c) at its first, second and third meetings and made further prescriptions and elaborations to the information required to accompany shipments of LMOs. Regarding documentation requirements for LMOs-FFP, Parties allowed for two options.

Thus, in cases where the identity of the LMO is known "through means such as identity preservation systems", the shipment should be labelled as containing LMOs-FFP. In cases where the identity is not known, the "may contain" label would continue to apply. In both cases, exporters would be required to provide the common scientific or where available commercial names of the LMOs that are contained or may be contained in the shipment as the case may be, as well as the transformation event or unique identification code.

Labelling of LMOs is to be reviewed again at the fifth meeting of the Conference of the Parties, with a view to adopting a more precise labelling regime at its sixth meeting.

Possible challenges for African countries

From the standpoint of developing countries in Africa, the labelling regime may pose considerable challenges. LMOs not destined for intentional introduction into the environment may still end up being released into the environment by accident or by omission, especially in Africa where most LMO-FFPs would be sold in open markets, using open containers and transported on open trucks with high chances of spillage.

Labels may not mean much to an illiterate farmer. Whatever looks appealing to the eye and taste may end up being planted (even when not meant for planting).

African countries also face the challenge of determining the acceptable thresholds of contamination or co-mingling of GM and non-GM organisms. Even if thresholds are set, enforcement would require rigorous monitoring and sample testing using specialised equipment which is still unavailable in most African countries. Inadequate human resources to use any equipment that may be available is likely to be another challenge.

Furthermore, it is quite common for commodities to enter countries in Africa through un-gazetted entry points facilitated by traders in the informal sector. The quantities per person may look small but the total number of such informal traders is often high and the quantities of commodities entering in this way are therefore large.

Another challenge likely to face African countries is the heavy reliance of the international community on the Biosafety Clearing House, an Internet-based information sources. Internet connectivity in most African countries is still unreliable, which, coupled with erratic power

supplies, could hinder the smooth flow of information and trade.

4. Liability and redress under the Cartagena Protocol on Biosafety

Liability and redress relate to what would happen if the transboundary movement of LMOs caused damage. These issues generated interesting debate during the Biosafety Protocol negotiations. Proponents of biotechnology argued that the technology was very safe, but were wary when developing countries proposed provisions for liability and redress in case the unexpected happened. No agreement was reached during the negotiations on the need for, and form a liability and redress mechanism should take.

Article 27 of the Protocol states that:

"the Conference of the Parties, serving as the meeting of the parties, shall at its first meeting adopt a process with respect to the appropriate elaboration of international rules and procedures in the field of liability and redress for damage resulting from transboundary movement of LMOs, analysing and taking due account of the on-going processes in international law on these matters, and shall endeavour to complete this process within four years."

Pursuant to the above article, COP/MOP-1 in its decision BS-1/8, established an Open-ended Ad hoc Working Group of legal and technical experts on liability and redress. The working group has so far held two meetings and deliberated on a broad spectrum of issues. Without pre-empting and pre-judging the outcome of the negotiations of the working group, there are a number of issues that are pertinent to African countries. Some of the key issues are discussed below.

Critical issues on liability and redress provisions

Scope

The rules need to have a broad scope, to cover damage or harm resulting from the transboundary movement (including transit), handling, and all forms of use of LMOs, be it for research, trade, food, feed or processing or for release into the environment, whether deliberate or inadvertent. The rules should apply to damage to biodiversity, its conservation and sustainable use, loss of income or livelihoods, cultural and spiritual values related to biodiversity, soil and water quality, air quality, impairment of health, damage to food security etc.

Standard of liability and channelling of liability

The preference of most developing countries has been for strict liability as opposed to fault-based liability. This means that redress or compensation would take place as long as harm has occurred, regardless of whether the applicant was at fault. The process of proving who was at fault can be difficult in court, especially where damage occurs many years down the road, or where, as in developing countries, record-keeping is poor.

Liability should be channelled to all those who were involved in the supply chain that led to the damage in question. Apportioning liability solely to the last person whose activities led to the damage in question may not be fair as weaknesses could have been inherent in the technology. Take the example of a seed retailer who sells GM seeds to farmers and these seeds end up causing harm to traditional varieties or escape and damage indigenous biodiversity. If liability is restricted to only the retailer, s/he may not only have inadequate resources to

cover the required compensation, but may also have had no capacity to understand the possible risks associated with the GM seed in the first place. Yet the originator of the technology or the multinational company that owned the technology and hence reaped most of the profits from its sale could have known of these risks and should therefore be equally liable. The entire supply chain should be held liable, with the proportion of the responsibility being determined on a case-by-case basis.

The apportioning of liability in this way would ensure responsible actions throughout the supply chain and would also ensure that enough resources are available to provide the necessary compensation. To prevent some of the culprits avoiding liability by changing businesses frequently, or to cover cases of death or bankruptcy, biotechnology companies and dealers should be required to contribute to a kind of trust fund while they are still in operation. This would ensure that there will be resources to compensate the victims even after many years.

Nature of the liability and redress rules

In order for the liability and redress rules to be effective, they would have to be in the form of a legally binding international treaty. This is particularly important for developing countries with little influence to bear on multinational biotech companies. These countries would find it near to impossible to bring a defaulting multinational company from a developed country to account. So, if the rules are to be respected and credible to all parties, they would need to have the force of law.

Limitation in time

Given the long time that ecological damage takes to manifest itself, especially in the case of GM trees and other organisms with long life cycles, there should be no time limitation for liability, as long as it can be proved that damage occurred and that it can be reasonably related to the cause. However, limits could be placed on the maximum time that can elapse between the damage becoming apparent and the claim for compensation. This time period should not be too short, to take account of the logistical constraints facing developing countries that may lead to some delays.

However, given the short life span of human beings and that of some companies, the liable person/company may no longer be available by the time damage occurs and the aggrieved party claims compensation. For this reason, there would again be need for the establishment of a LMO trust fund, from which victims of LMOs would be compensated. The fund would be contributed to by the companies and LMO dealers while they are still in operation.

Possible challenges for African countries

Developing countries, including those in Africa, would find it very difficult to prove the causality of damage since they lack the resources required to set up long-term monitoring programmes. They also have a chronic lack of reliable baseline data on which they could base such monitoring systems. Without robust monitoring systems, these countries would be unable to establish whether damage was caused by a particular LMO or by the combination of a particular LMO with other phenomena such as natural ecological processes.

Another possible challenge to developing countries such as those in Africa, relates to their weak capacity to undertake valuations of their biological diversity, due to a severe lack of ecological economists working in these countries. Capacity building for biodiversity

valuation should therefore be started now, even while the rules are still being negotiated. This would help ensure that developing countries are ready not only to implement the provisions of the Protocol but also to benefit from them.

COP/MOP-3 welcomed the progress made by the working group and approved three five-day meetings to take place prior to COP/MOP-4, and urged developed country parties and other donors to provide voluntary financial contributions to support participation of developing countries in the meetings of the working group.

5. Conclusions

The provisions in the Cartagena Protocol on Biosafety relating to risk assessment, risk management and those on liability and redress are clearly closely linked. There is a need for countries, especially developing countries such as in Africa, to put in place effective risk assessment and risk management regimes if they are to minimise the potential risks associated with modern biotechnology, while exploiting its potential benefits.

However, provisions on risk assessment and risk management cannot be effective unless there is an equally effective mechanism for identification and labelling (to ensure traceability through the supply and food chains as well as in the living ecosystems) is an integral part of the entire process of acquisition, transfer and application of the technology. Traceability is equally critical in liability and redress to enable harm to be linked to the right cause and hence qualify for redress. Developing countries therefore need to take all these factors into consideration before approving the introduction of GMOs into their food chains or ecosystems.

Furthermore, the issue of liability and redress is a very important component of the Cartagena Protocol on Biosafety. The successful completion and implementation of the international rules on liability and redress may be the test of the Protocol's effectiveness. Failure by the proponents of modern biotechnology to accept full liability may imply that they themselves are not sure of its safety.

Developing countries, for their part, need to prepare themselves for the protracted negotiations as the stakes could be high. However, these countries' positions could be undermined if the rules are not inclusive of the interests of both the developers, applicants and users of biotechnology. Developing countries, including those in Africa, therefore need to ensure effective representation and participation in the negotiations to see that their interests are integrated into the rules being negotiated.

The importance of the liability rules is perhaps greatest in Eastern Africa, where high levels of biological diversity exist and where human populations are heavily dependent on this biodiversity for their livelihoods. Any damage to biodiversity would therefore have severe impacts on people's livelihoods and food security.

Appendix I

Summary and Recommendations, Eastern African Dialogue on Biotechnology Policy-making, Trade and Sustainable Development, 15-17 February 2006, Jinja, Uganda

ICTSD
International Centre for Trade and Sustainable Development

AFRICAN TECHNOLOGY POLICY STUDIES NETWORK

Organised by the International Centre for Trade and Sustainable Development (ICTSD) and the African Technology Policy Studies Network (ATPS)

Co-hosted by the African Union (AU) and the New Partnership for Africa's Development (NEPAD)

The *Eastern African Dialogue on Biotechnology Policy-making, Trade and Sustainable Development*, held from 14-17 February 2006 in Jinja, Uganda, brought together a wide range of stakeholders — including from government, intergovernmental organisations, civil society groups, academia, industry and the media — from the Eastern African region (including from Kenya, Uganda, Tanzania, Eritrea, Zambia and Zimbabwe) to explore approaches and options for coherent, informed and inclusive policy-making on trade, biotechnology and sustainable development at the national, regional and multilateral levels.

Countries in the Eastern African region are still in the process of formulating their national policies and strategies related to biotechnology and translating them into national and regional approaches and multilateral negotiating positions. The need to respond and adapt to the international developments — including a myriad of trade interests, obligations and pressures — threatens to dominate national agendas. This raises the urgent need for understanding and asserting the space for domestic policy-making in biotechnology supportive of the countries' self-defined sustainable development objectives.

Formulating Public Policy Objectives related to Biotechnology Recommendations addressed to governments

African governments should be more proactive in analysing and identifying their short, medium and long term needs, policy gaps and priorities. These priorities should ideally be developed with the participation of relevant actors in the public and the private sectors. Countries' policies and strategies for biotechnology development should be based on clearly identified public policy objectives that are specific and formulated through participatory processes. These could include:

- Ensuring food security, including access to safe and sufficient food
- Increase agricultural productivity, rural development and poverty alleviation
- Promote economic growth through diversification in to high-value products and technological development
- Promoting public health and food safety
- Conserve, sustainably use and equitably share the benefits of biodiversity

Making Sure Biotechnology Enhances Public Policy Objectives Recommendations addressed to governments

Achieving these objectives will entail addressing and integrating a range of policy areas and instruments in order to develop a coherent biotechnology policy framework. Some areas and instruments to be addressed include:

- Science & Technology development and mechanisms to identify and acquire strategic technologies;
- Capacity building: establish technology targets to promote national capabilities, focusing on key industries (incl. infrastructure, institutional, human resources);
- Biosafety and quality standards;
- Consumer protection and safety;
- Agriculture, Environment and natural resources;
- Trade, value addition and economic growth;
- Private sector input on policy formulation;
- Intellectual property rights: improve capabilities to mitigate the potential negative effects of stronger ownership rights on intellectual property;

- Education/multidisciplinary human capital;
- Information and communication;
- Finance and resource mobilisation;

Recommendations addressed to national and regional actors

Action on these policy instruments will be required at both the national and regional levels. At the *national level*, countries could focus on:

- Mechanisms for labelling to facilitate consumer choice (incl. enforcement)
- An enabling policy environment for biotech development;
- Inter-institutional / ministerial collaboration;
- Raising public awareness;
- Regulatory, human resources, institutional and infrastructure development;
- Fostering partnerships (public-private, private-private);
- Providing sufficient funding for research and access to the technology.

At the *regional level*, partnerships, such as NEPAD, and regional economic agreements should be considered as a means to achieving developmental goals. Commercial considerations should be balanced by social, environmental and cultural objectives. National governments and regional institutions should:

- Harmonise national policies and strategies for a regional agenda (incl. to facilitate trade);
- Develop joint negotiating positions by providing a common forum to formulate strategy, articulate and prioritise issues;
- Set up a process of consultations to promote coherent interaction between the national regional actors to develop and promote:
  - Joint research & development activities
  - Joint standard-setting
  - Joint risk assessments
  - Joint monitoring of impacts and benefits
  - A regional biosafety clearing house

Ensuring Public Participation and Awareness

Successful implementation of domestic, regional and international policies and regulations can only be achieved through integration, coordination and cooperation among all stakeholders. This will involve raising awareness of the risks and benefits of biotechnology and promoting official national multi-stakeholder consultation processes that include networks of farmers associations and civil society groups. All parties concerned with science and technology — industrial leaders and researchers, academia, financial institutions and the government — should also be engaged to determine, over a period, the technological course and needs for their country.

Recommendations addressed to governments

- There is a need to strengthen dialogue among all national actors in the preparation of national public policy objectives and biotechnology policies;
- Governments should involve local grassroots groups in reaching out to farming communities by creating broad awareness-raising programmes using mass media that target rural areas;
- To ensure informed participation by the public, governments should articulate in understandable language the uses, benefits and underlying impacts of biotechnology and improve information dissemination to all stakeholders.

Policy Coherence in Biotechnology

To support technology upgrading in Eastern African countries, governments must put in place institutional mechanisms for comprehensively evaluating and setting science and technology priorities and making sure responsibility for relevant policies is coordinated between ministries and institutions.

Building coherence with trade policy

National and regional biotechnology policies will need to be integrated with trade obligations (eg WTO rules) and trade interests. Some concerns and issues include:

- WTO rules do not necessarily reflect national trade interest due to limited capacities in developing counties to formulate and promote national negotiating positions;
- WTO rules place the onus of justifying biosafety measures on the importer (in the absence of international standard); developing countries often lack capacity to do that;
- Dumping of GM food aid can displace local producers;
- Biotech standards in export markets can constitute trade barriers and hinder market access;

- Inadequate intellectual property systems can foster the misappropriation of genetic resources and traditional knowledge, and hinder the fair and equitable sharing of benefits arising from their use.

Recommendations addressed to governments

- Enshrine policy coherence between the different areas of policy to take into account biotechnology development and applications;
- Entrust one body with analysing technology needs monitoring implementation at the broad economic level of S&T strategies;
- Harmonise governments' financial support and align it with nationally or regionally defined public policy goals;
- Devise a mechanism to promote coherent interaction between the national, regional and multilateral policies and trade regimes.

Financial Resources and Funding for Biotechnology
Recommendations addressed to governments and financial institutions

One of the main constraints affecting the implementation of effective biotech regulations and the development of biotechnology has been inadequate funding. Governments should review and adapt laws and commercial regulations to enhance funding for biotechnology policy-making and development by:

- A commitment to dedicate a fixed percentage of government budgets to biotechnology. This could be a Biotechnology Fund to co-finance research and development by industry;
- Offering special credit lines for biotechnology and providing both financial and non-financial services by entering into partnerships that enhance commercialisation including through venture capital initiatives.
- Providing incentives and encouraging banks to report on the composition of their loan portfolios dedicated to biotechnology;

Technical Assistance and Capacity Building

Capacity building policies and programmes should be reviewed so as to make them work in support of public policy objectives through biotechnology development as an integral part of national and regional biotechnology policies. There is a need for an agreement on a common underlying vision for capacity building to provide sustainable capacity support for specific needs of the productive sector at various levels. Assessing local technological competence (SWOT analysis) to overcome weaknesses would serve a valuable function in raising awareness and building consensus.

Recommendations addressed to governments, regional actors and international institutions

Build capacity to ensure adequate human and institutional capacities for biotechnology development and mainstream biotechnology policy by:

- Strengthening linkages and understanding between the scientific and policy-making communities;
- Enhancing capacities needed to articulate and assess policy choices and options related to biotechnology;
- Developing and putting in place a system to address issues related to liability and redress;
- Taking an integrated approach to biotech-related capacity building by engaging a broad range of actors, including scientists, policy-makers, economists, regulators, agricultural producers, industry and the media;
- Providing adequate laboratory capacity and high quality personnel with necessary skills needed to effectively exploit the opportunities offered by the biotechnology, including by building regional and sub-regional testing and certification facilities;
- Fostering close interaction between education and industry for assessing and communicating evolving needs is a basic feature of human capital development;
- Focusing capacity building strategies towards long-term education programmes through universities and strategically selected on-the-job training to build a critical mass of technological expertise;
- Develop a critical mass of experts at all levels through organised long-term theoretical and practical training both formal and informal;
- Ensuring that Research & Development meets international standards and quality;
- Providing analytical input into policy-making, *inter alia* on the risks and benefits of biotechnology, esp. in Africa; environmental impacts in different ecosystems; impacts on trade; market opportunities; and market entry and market access barriers.
- Developing capacity on intellectual property rights issues and its institutionalisation.

Appendix II

Participants at the dialogue "Eastern African Dialogue on Biotechnology Policy-making, Trade and Sustainable Development"

The dialogue took place in Jinja, Uganda, on 15-17 February 2006

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ICTSD

International Centre for Trade and Sustainable Development

ICTSD's project on "Building Capacity on Trade and Biotechnology Policy-making" aims to strengthen the capacity of developing countries to better formulate their biotechnology strategies and priorities as they relate to trade and sustainable development, and to integrate them into national, regional and international policy-making processes. Related publications include:

- Biotechnology: Addressing Key Trade and Sustainability Issues. By ICTSD, 2006.
- Trading in Genes: Development Perspectives on Biotechnology, Trade and Sustainability. Edited by Ricardo Meléndez-Ortiz and Vicente Sánchez. ICTSD and Earthscan, 2005.

For further information, visit http://www.trade-environment.org/page/ictsd/projects/biotech_desc.htm.

ABOUT ICTSD

Founded in 1996, the International Centre for Trade and Sustainable Development (ICTSD) is an independent non-profit and non-governmental organisation based in Geneva. By empowering stakeholders in trade policy through information, networking, dialogue, well-targeted research and capacity building, the Centre aims to influence the international trade system such that it advances the goal of sustainable development.

ABOUT ATPS

The African Technology Policy Studies Network (ATPS) is a multi-disciplinary network of researchers, policy-makers, actors in the private sector and other end-users interested in generating, promoting and strengthening innovative science and technology policies in Africa. With a regional secretariat in Nairobi, the network operates through national chapters in 23 African countries, with an expansion plan to cover the entire sub-Saharan Africa.

One of the objectives of the network is to disseminate research results to policy-makers, legislators, the organised private sector, civil society, mass media and farmers' groups through publications, dialogue and advocacy.

ATPS is supported by a growing number of donors including the International Development Research Centre (IDRC), the Carnegie Corporation of New York, the Rockefeller Foundation, the World Bank, the OPEC Fund, Ford Foundation, Coca-Cola Eastern Africa, the African Development Bank, and the Royal Dutch Government.

For further information, visit www.atpsnet.org.

www.ictsd.org