

STATE OF THE ART BIOTECHNOLOGY AND BIOSAFETY IN KENYA

J. S. WAFULA
Kenya Agricultural Research Institute (KARI)
P.O. Box 57811, Nairobi, Kenya

ABSTRACT

This paper discusses national biotechnology priorities and biosafety regulatory policies for Kenya. National and international institutions practising biotechnology in Kenya are listed together with the specific biotechnology activities, including tissue culture micropropagation and plant transformation.

Key Words: Biotechnology priorities, regulatory policies, tissue culture, transformation

RÉSUMÉ

Ce papier discute des priorités nationales de biotechnologie ainsi que des politiques régulatrices de biosécurité pour le Kenya. Les institutions nationales et internationales pratiquant la biotechnologie au Kenya aussi bien que leurs domaines d'intérêt y compris la culture tissulaire, la micropropagation, et la transformation de plantes sont listés.

Mots Clés: Priorités en biotechnologie, politiques régulatrices, la culture tissulaire, transformation

INTRODUCTION

Biotechnology offers tremendous opportunities and inexpensive solutions to some of the pressing problems in agriculture, medicine, industry and the environment. Great advances have been made in the developed world in the development of new products through biotechnology, while efforts to harness such technologies are just beginning to emerge in the developing countries.

Kenya has been identifying the need and considering national priorities for application of biotechnology for more than a decade, and various workshops and seminars have been held to discuss policy and technical matters relating to the use of biotechnology in the country. As a result of these discussions, considerable awareness has been

created and many research institutions within the national agricultural research system are at present involved in biotechnological activities, especially those employing tissue culture micro-propagation. Biotechnology-led national biosafety guidelines are now under preparation to facilitate enhancement of agricultural, medical and industrial development while safeguarding human health and environmental integrity.

THE STATUS OF AGRICULTURE IN KENYA

Agriculture constitutes the dominant sector of Kenya's economy contributing about 33% of the Gross Domestic Product (GDP) and providing the greatest portion of foreign exchange earnings.

The sector employs about 70% of the national working labour force. It provides food, other basic household requirements and raw materials used in industries.

The most important components of Kenya's agriculture are crops and livestock, although forestry is rapidly becoming a significant contributor to the national economy as well as the protection of the environment. As shown in Table 1, agricultural contribution to the GDP has not only been increasing over the years but has also remained high above other sectors of the economy. An examination of the agricultural commodities produced in Kenya show that cereals like maize, wheat, sorghum and millet; tuber crops such as sweet potato, Irish potato and cassava; legumes

like beans and peas; cash crops, particularly tea, coffee, sugarcane, cotton, pyrethrum and sisal; horticultural crops including cutflowers, fruits and vegetables; and livestock products, especially milk, meat, hides and skins, constitute the most important crop and livestock products (Table 2). However, there has been a general decline in the sale of many of the major crops and livestock. The poor performance in the crop and livestock sectors has been due to various factors including frequent droughts, high input prices, poor marketing incentives and lack of appropriate technologies for agricultural development. In addition, agriculture in Kenya is plagued by a host of pests and diseases such as streak viruses, weevils, leaf blights, animal diseases and pests, which work to reduce yields. The methods employed in addressing problems of agricultural development and food production in Kenya are still largely based on traditional approaches of breeding, disease and pest control. As a result, the agricultural sector continues to suffer poor performance and low productivity.

The emergence of biotechnology and its ease of integration with conventional plant and animal breeding provides a direct means of reducing problems of sustainable productivity.

STATUS OF BIOTECHNOLOGY APPLICATION IN KENYA

The focal points for application of biotechnology in agricultural research and development in Kenya are the national agricultural research institutes together with the national universities. Table 3 shows the present status of agricultural biotechnology application in various research institutions in Kenya. It is apparent that only tissue culture micropropagation is widely applied in the various institutions. No plant transformation through genetic engineering has been initiated so far in the country, except through collaboration with advanced laboratories outside Kenya. This does not mean that Kenya does not wish to employ modern biotechnology in the improvement of crop production. The government's science and technology policy is to incorporate the new biotechnology into national agricultural research and development systems.

The main factors contributing to the delayed

TABLE 1. Agricultural component contribution to Kenya's Gross Domestic Product (x '000)

Sector	1984	1988	1991
Agriculture	1,244	1,920	2,235
Forestry	32	61	107
Fishing	10	20	32
Manufacturing	460	752	987
Trade, restaurants, hotels	439	433	947
Transport	250	433	598
Finance	150	501	86

TABLE 2. Sale of major agricultural products (x '000)

Product	Unit	1990	1992
Maize	Tons	527.7	324.1
Wheat	Tons	78.5	125.9
Rice	Tons	-	14.2
Cotton	Tons	18.8	2.8
Coffee	Tons	111.9	88.4
Tea	Tons	188.1	-
Sisal	Tons	39.3	34.1
Sugar cane	Tons	4.3	3.7
Pyrethrum	Tons	136.4	165.4
Milk	Millilitres	359.0	220.0
Slaughtered cattle	Head	969.0	921.0
Slaughtered sheep and goats	Head	1,345.0	1,278.0
Slaughtered pigs	Head	83.0	81.0

TABLE 3. Status of plant biotechnology application in Kenya

Biotechnology	Major commodity	Institution
Tissue culture micropropagation	pyrethrum, flowers, potato,	KARI, Oserian
	strawberry, flowers, sugarcane	University of Nairobi
	bananas	Jomo Kenyatta University, KARI
	trees, nitrogen fixation	KETRI, University of Nairobi
Plant diagnosis through molecular technology	maize	ICIPE
Plant transformation	sweet potato	KARI collaborating with outside institutions

institutionalisation of crop improvement through genetic engineering have been limitations in national capacity and capability as well as the need to define national priorities for biotechnology application in crops. These issues are at present being defined to enable Kenya's entry into the use of bio-engineering.

A number of institutions have made remarkable advances in the application of biotechnology in the development of hybridoma and DNA-based

animal disease diagnostic tests and recombinant DNA (rDNA) multivalent vaccines. As shown in Table 4, some institutions have begun development of molecular diagnostic tests against various viral, protozoal and helminth diseases. These include monoclonal antibody-based Enzyme Linked Immunosorbent Assays (ELISA) against rinderpest, rabies, lumpy skin disease (LSD) and Nairobi sheep disease (NSD), as well as monoclonal ELISA tests and DNA probes against theileriosis, trypanosomiasis, babesiosis and heartwater at the Kenya Agricultural Research Institute (KARI), the Kenya Trypanosomiasis Research Institute (KETRI) and the International Livestock Research Institute (ILRI).

Much progress has been made by KARI towards development of virus vectored-multivalent vaccines and already some products are awaiting testing in laboratory animals. In addition, KARI is participating in collaborative evaluations of animal recombinant vaccines developed outside Kenya.

The locally based international agricultural research centres, particularly the International Centre for Insect Physiology and Ecology (ICIPE), International Livestock Research Institute (ILRI), and the International Potato Centre (CIP) are also carrying out research in crops and livestock involving rDNA and molecular biology techniques. ICIPE is employing molecular and cellular biology methods in characterisation of tick and protozoa parasites while ILRI is carrying out research involving mapping of the bovine genome, development of subunit *Theileria* vaccine and numerous DNA and monoclonal based diagnostic tests for protozoal infections (ILRAD, 1994).

TABLE 4. Status of biotechnology in animal health research in Kenya

Institute	Biotechnology application	Disease
KARI	Monoclonal ELISAs	Rinderpest, Rabies, LSD
	DNA-Probes Recombinant Vaccines	Babesia, Heartwater Capripox-Rift Valley, NSD, Haemonchosis
KETRI, ILRI, University of Nairobi	Monoclonal ELISA, Submit vaccines	Trypanosomiasis Theileriosis

NATIONAL PRIORITY SETTING FOR BIOTECHNOLOGY

Although many research institutions in Kenya have been involved in biotechnology research for sometime, most of them do not have well defined programmes addressing national priorities. Biotechnology application can be a very expensive undertaking and should thus be focused on issues that impact significantly to national needs. Determination of the relevance and national priorities for biotechnology have been critical prerequisites to any significant expenditures and resource allocation for biotechnology.

The main objectives for setting national research priorities for agricultural biotechnology in Kenya have been to identify important constraints to productivity and to ensure that biotechnology offers comparative advantage over existing traditional methods. The national body responsible for the identification of national priorities for biotechnology has been the National Advisory Committee on Biotechnology Advances and their Applications (NACBAA). Established in 1991, NACBAA identified national research priorities to include the application of tissue culture for plant micropropagation, nitrogen fixation for various plants, development of modern diagnostic tests for plant and animal diseases, development of cheap and robust novel vaccines against animal diseases, and the production of energy by biomass (NACBAA, 1991).

More recently, there was another national constraint identification and priority setting process in Kenya developed through a cooperative Kenya/Netherlands biotechnology programme. The approach taken by this effort was different from that of NACBAA in that it employed a participatory bottom-up problem identification and priority setting procedure. In both cases national research institutions would take the responsibility for project formulation and implementation within the context of the overall national priorities and in accordance with their specific research mandates.

BIO SAFETY IMPLICATIONS FOR KENYA

Although most of the research activities currently underway in Kenya do not involve genetic alterations, rapid advances are being made in the field of development of genetically modified organisms. Many laboratories are becoming increasingly involved in research employing rDNA technology, particularly in animal health, or are using organisms which should be handled under more stringent biosafety conditions. There is currently a general consensus in the country to develop national biosafety guidelines to safeguard research and developments in biotechnology. The National Council for Science and Technology which is under the Ministry of Research, Technical Training and Technology is presently preparing national biosafety guidelines. Up till now KARI is apparently the only institution in Kenya which has formulated institutional guidelines on biosafety. These are aimed at guiding biotechnological applications at laboratory level (KARI, 1994). KARI's biosafety guidelines have been circulated to the local and international scientific community for critique before finalisation and general adoption. It is hoped that KARI's initiatives will be emulated by the other national institutions, particularly after the establishment of the national guidelines on biosafety.

REFERENCES

- KARI, 1994. Kenya Agricultural Research Institute. Guidelines for Biosafety in Biotechnology. KARI, Nairobi, Kenya.
- ILRAD, 1994. *1993/94 Annual Report*. ILRAD, Nairobi, Kenya.
- NACBAA, 1991. National Advisory Committee on Biotechnology Advances and Their Applications. Ministry of Research, Technical Training & Technology, Nairobi, Kenya.