ACP Policy Brief 1

ACP REGION MUST HARNESS BIOTECHNOLOGY FOR A BETTER FUTURE

Introduction

African, Caribbean and Pacific (ACP) experts are calling on governments in the ACP region to invest more in science and technology and more specifically biotechnology if the region is to be assured of a better future.

Biotechnology, embraces both life sciences and engineering, and has been used for centuries to produce food and to solve health and environmental problems. It is widely accepted that modern advances in biotechnology hold great promise for addressing key challenges in agriculture, human health and the environment. However, ACP countries lack the resources to make the investments needed in research and product and process development and innovation to harness biotechnology for sustainable social and economic development and wealth creation. Biotechnology when exploited appropriately can improve the collective welfare of the population. ACP countries must therefore act now to avoid being left behind in yet another technological revolution.

ACP leaders have endorsed this principle on previous occasions at various regional and international fora and made commitments to increase investments in science and technology and in particular to adopt biotechnology as a tool for achieving development targets. At the meeting of ACP Science & Technology Ministers and Senior Officials on Research and Technology for Sustainable Development in Cape Town in July 2002, biotechnology was identified as a priority area for ACP countries. At the NEPAD Science & Technology Ministerial Conference held in Johannesburg in 2003, biotechnology was also identified as one of the twelve flagship areas for research and development in agriculture, health, environment, mining and industry. In 2003, CARICOM Ministers mandated the Caribbean Agricultural Research and Development Institute (CARDI) to develop a regional policy on biosafety. In 2005, the CARICOM Minister with portfolio responsibility for Science & Technology provided an Endorsement Statement to support the commercialization of biotechnology in the Caribbean region. In 2005, Pacific biotechnology experts recommended that the role that biotechnology can play in sustainable development and economic growth be acknowledged in the Pacific Plan which outlines the strategy for strengthening regional cooperation and integration of the Pacific region.

This policy brief highlights the importance of harnessing biotechnology for wealth creation and improvement of quality of life in the ACP countries and calls on governments and other key stakeholders to take the necessary policy and legislative action to advance the development of biotechnology in its widest sense.

What is biotechnology?

It refers to any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use (Convention on Biological Diversity, 1992). Biotechnology is not new, it has been employed for centuries in the production of fermented foods such as gari, bread, yoghurt, cheese and beverages such as wine and beer.

What are the uses of biotechnology?

The denominations of "green", "red" and "white" biotechnology highlight its main uses and applications.

"*Green biotechnology*" encompasses a wide range of techniques that consist of culturing plant tissues and/or organs, followed by the multiplication of the relevant plants with desirable characteristics. Genetically identical plantlets are thus available for distribution to farmers, horticulturalists, forestry growers, and nurseries all the year round. It also includes the transformation of plants, crop species and varieties through genetic engineering techniques, leading to what are known as "genetically modified" (GM) crops. In addition, green or agricultural biotechnology also applies to techniques used in livestock husbandry (nutrition and reproduction). Green biotechnology should therefore not only be equated with advances in genetic engineering.

"Red biotechnology" encompasses the genetic engineering techniques that have been used since the mid-1970s to produce drugs and vaccines in micro-organisms, animal cells, and more recently in plants. For example, insulin, human and bovine growth hormones, interferons, cell-growth factors, anti-hepatitis B vaccine and others are being produced in this way. A wide range of diagnostic techniques and veterinary vaccines are produced using red or medical biotechnology.

"*White biotechnology*" refers to a wide range of processes resulting in fermented products and chemicals (e.g. enzymes, biofuels such as ethanol and bioplastics) as well as to the technologies used in recycling wastewater, industrial effluents and solid wastes. These "bioremediation" processes contribute to the abatement of pollution. The extraction of metals from ores with the help of micro-organisms (biomining) is also part of white or environmental biotechnology.

Why the controversy?

Biotechnology as is the case with any technology has its advantages and limitations. Within recent years, the focus has been on modern biotechnology applications and the

food and feed products derived from them. The proponents of modern biotechnology have highlighted the positive impact on agriculture, human health and the environment through increased crop yields, the reduced use of pesticides and herbicides, production of nutritionally enhanced foods and affordable vaccines. However, the contentious debate surrounding biotechnology continues because of the safety, geo-political, trade and ethical issues that have been raised particularly in the public domain. As such, the public now equates biotechnology with GM crops and foods leading to the intense controversy about the perceived risks to human health and environment. Although scientific evidence of the associated risks continues to be debated, there is consensus on the need for effective and continuous monitoring, assessment and management of the potential risks. This highlights the importance of having biosafety regulations in place and ensuring that there is adequate in-country capacity so that all the necessary precautions are adhered to. It should be emphasized that medical and environmental biotechnology and genetically engineered commodities which are not produced for human consumption and which presently have not shown indications of posing any ecological risks, enjoy higher acceptance.

What are the opportunities for ACP countries?

ACP countries are rich in biological diversity, the value and sustainable use of which can be optimized through the appropriate application of biotechnology, for improving food production through plant and animal breeding, bioremediation processes (relying on the diverse native soil and water microflora) and to advance the search for novel bioactive compounds (pharmaceuticals, nutraceuticals, cosmeceuticals).

Additionally, the ACP countries have the requisite competencies within each region, which can be harnessed if the necessary agreements are put in place to facilitate transboundary movement of experts and sharing of facilities. There are several centres of excellence to support biotechnology research and development including molecular biology and genetic engineering at the national and regional levels. For example, the Council of Scientific and Industrial Research in South Africa, Biosciences facility in Kenya, Biotechnology Centre - University of the West Indies, and the University of the South Pacific.

There are several important biotechnology initiatives already in place in the ACP region which need to be fostered and better coordinated. These range from the design and implementation of biosafety regulatory frameworks to micro-propagation projects for the large scale multiplication of crop species, genebanks, molecular marker applications and the production of vaccines. These provide opportunities for knowledge sharing, employment and wealth creation, enhancement of food security and improvement of health.

International and inter-regional co-operation is important for strengthening the research and development (R & D) capacity, development of regulatory frameworks and the commercialization of new products and processes. The ACP region is well placed to benefit from several international cooperation facilities to advance the process but

priorities must be critically evaluated prior to entering into agreements if significant benefits are to accrue.

Are there lessons from within the ACP region?

Over the last thirty years, many developing countries have used biotechnology to meet their technological needs and placed it at the forefront of the policy agenda for social and economic development. Several of these countries are actively participating in biotechnology development and expansion. The following select examples illustrate the steps that some ACP countries have taken to enhance the contribution of biotechnology to developmental goals.

African Region

Several examples of the use of conventional and advanced biotechnology applications can be cited for Africa. These include: insect resistant maize and cotton, virus resistance to potato (viruses X and Y and leaf roll), ring spot virus (RSV) resistance in papaya, rice with resistance to bacterial blight and higher iron and beta-carotene content, tomatoes with elevated lycopene (provitamin A), crops with abiotic stress tolerance genes (such as aluminium- and manganese-tolerant crops) that can grow in acidic soils and tolerate salt and drought, delayed over ripening of fruits and vegetables to reduce post-harvest losses, herbicide-tolerant seeds that allow the use of herbicides to combat weed infestations and thus ease the labour burden for poor women and children and tissue culture for the rapid multiplication of coffee, guava, ginger, papaya, pineapple, and avocado. Biotechnology infrastructure has been developed in some countries.

South Africa is a pioneer within the African continent and ranks high among the developing countries which are leaders in using advanced biotechnology in the production of genetically modified (GM) maize for food and feed and GM cotton, which has met with great success and has been adopted by small-scale farmers. About 3,000 hectares of Bt (*Bacillus thuringiensis*) insect-resistant maize were planted in 1998 and 5,000 hectares in 1999. South Africa is also a leader in applying biotechnology in the mining industry.

After a 10-year research study and using tissue culture, Kenya produced greater and faster yielding bananas of uniform size (ideal for the export market) than naturally propagated bananas. Clean banana planting material was made widely available to the industry. Together with the South Africa's Institute of Tropical and Subtropical Crops, the Kenya Agricultural Research Institute is promoting this technology. The technology is now undergoing on-station and on-farm trials in Kenya's Central Province, and in Tanzania and Uganda. It is expected that the banana tissue culture technology at the farm level in Kenya will increase yields and incomes especially for smallholders. The potential gains in banana income for estate farms are estimated at around 106% while for smallholder this is estimated at 156%. Field trials on genetically modified sweet potato, resistant to the sweet potato feathery mottle virus are being conducted in collaboration with the Danforth Plant Research Centre, St. Louis, Missouri.

The Nigerian government established the National Biotechnology Development Agency (NABDA) and charged it with the responsibility to empower the nation to become self-reliant in the development and application of biotechnology-based products and services. The key programmes include capacity building, research and development, bioresources development, bioinformatics, bio-entrepreneurship, bioremediation and development of collaboration and linkages.

Caribbean Region

The Dominican Republic established the Biotechnology and Biodiversity Centre (Centro de Biotecnologia y Biodiversidad – CIBIO) in 2000 to serve as the national and scientific base for finding biotechnology solutions to the main problems affecting the agriculture, forestry and fisheries sectors. This Centre serves as the base for exploiting modern biotechnologies. Specialized laboratories which focus on tissue culture, molecular biology, molecular diagnostics, germplasm management, industrial biotechnology and nutraceuticals have been established. Emphasis is also being given to human resource development; a new Masters Degree programme has been set-up and protocols have been developed for a wide variety of biotechnology products (biopesticides, medicinal extracts, diagnostic methods, scale-up of tissue culture protocols).

Pacific Region

In recognition of the importance of crop diversity, and the problems encountered when individual countries attempt to maintain their own genetic resources, the Pacific Heads of Agriculture and Livestock Programmes, in 1996, resolved "*to put in place, both in their countries and through regional cooperation, policies to conserve, protect and best utilize their plant genetic resources*." In response to this the Secretariat of the Pacific Community, an inter-governmental organization with a membership of 22 Pacific Island countries, established the Regional Germplasm Centre (RGC) – a regional genebank for the Pacific Community. The Centre uses tissue culture techniques, including cryopreservation, to conserve collections of taro, yam, sweet potato, banana, cassava, vanilla and kava. Biotechnology techniques are also employed to conserve a unique collection of some 700 taro accessions and other important food crops. The RGC can also test for viruses, using facilities at the University of the South Pacific. With this expertise, traditional and improved varieties of all the important crops can be distributed to farmers throughout the Pacific region.

Are there other experiences from outside the ACP region?

Brazil

After thirty years of successful conventional agricultural research, Brazil is becoming a world agri-business superpower, using biotechnology in the cultivation of GM crops (soybeans and cotton), the production of veterinary vaccines and medicines (world's largest exporter of beef), and promoting genomics research (sugarcane, eucalyptus, cattle). In the early 1970's, Brazil invested in the production of ethanol from cane sugar fermentation and its use as a fuel in motor vehicles and is now the leader in this area.

Brazil is also involved in advanced stem cell research and human medicine applications (regenerative medicine). It is among the very few developing countries which are setting up bioclusters i.e. concentrating the bio-industries in key areas of the country. However, there are challenges in balancing the rapid expansion of genetically modified soya bean fields and deforestation such that the livelihoods of indigenous communities are not negatively impacted.

Cuba
Since the early 1980s and consistently over the last twenty years, Cuba has invested in red biotechnology and has become an important producer of biotechnology derived medicines, vaccines and diagnostic kits. The foreign exchange generated through sales of these products is an important contribution to the country's Gross Domestic Product (GDP). Since the 1990s Cuba has placed special emphasis on biotechnology applications to increase agricultural productivity and development of their aquaculture sector.

Egypt
Egypt is exploiting crop biotechnology to produce genetically modified (GM) plants that are resistant to biotic stresses - fungi, insects, bacteria, and pathogenic viruses and abiotic stresses - drought, salinity, and high temperatures. The Agricultural Genetic Engineering Research Institute (AGERI) has produced its first biopesticide, Agerin, based on the insecticidal bacterium *Bacillus thuringiensis* (Bt). Agerin protects a broad spectrum of key agricultural crops and controls a number of biomedically significant pests. Together, with Agricultural Biotechnology for Sustainable Productivity, AGERI conducted field trials of GM potatoes resistant to the tuber moth in 1996 and virus-resistant tomatoes and cucurbits in1997, as well as GM cotton.

What did they do?

The successes gained by countries that have invested in science and technology and more specifically biotechnology are largely attributed, first and foremost to visionary leadership and strong political commitment. In addition, the following factors played a critical role in their success:

- creation of an enabling environment for science, technology and innovation and more specifically for biotechnology to thrive;
- public and / or private investment in science and technology infrastructure and biotechnology programmes;
- promotion of entrepreneurship and provision of rewards for innovators;
- development of key partnerships between public research (universities, national research institutions and centres of excellence), the private sector (industry) and the government; and
- raising public awareness and acceptance of the value and potential of biotechnology applications.

However, it should be noted that their governments and other key stakeholders continue to be called upon to respond to the challenges of ensuring environmental and economic sustainability as the technology advances.

What are the implications for the ACP countries?

For ACP countries to reap the benefits of biotechnology, visionary leadership and strong political commitment are prerequisites followed closely by adequate policy, legal and regulatory frameworks. Biotechnology offers a significant opportunity for: improving health care, meeting food security goals, increasing the availability of potable water, improving efficiency of industrial processes, producing high value-added products from the rich biodiversity, developing sustainable methods for aforestation and reforestation, and bioremediation. ACP countries should therefore not focus only on the issue of the benefits and risks of genetically modified foods but put the necessary biosafety systems in place to reduce the risks to safeguard human health and the environment while simultaneously putting in place additional mechanisms to seize the opportunities and compete in the global biotechnology market place.

ACP countries need to urgently develop appropriate policies, set priorities and strategies and avoid increasing technological dependence by promoting and supporting innovation. ACP countries must address resource limitations and become innovators.

Does the ACP region have the necessary resources?

ACP countries need to build on existing strengths and address inefficiencies. Special attention must be given to strengthening scientific and technical expertise within the ACP region and rationalizing and modernizing existing infrastructure for carrying out biotechnological activities including risk assessments. Facilities for information sharing, public-private partnerships, intellectual property rights (IPR), market studies and foresight analysis are needed to support the knowledge-based environment that is required to support a thriving bio-industry. Financial investment whether from governments and/or private venture capital must be made available. Training across disciplines together with the development of entrepreneurial and management skills are necessary investments to develop the capability needed to compete on a sustainable basis.

Is this an urgent issue for the ACP region?

If ACP countries fail to harness biotechnology, the region will lose the opportunity to better safeguard human health and the environment, generate wealth, upgrade health care systems (using new diagnostics and vaccines), improve food security and quality of nutrition, increase bio-industrial application, and raise the standard of living of ACP citizens. Seizing this opportunity is urgent because biotechnology is being driven to a large extent by market forces in the developed world. The pace of this trend increases the gap between the “haves” and the “have nots”. It is imperative that ACP countries build on and strengthen existing initiatives to increase their involvement in the globalization of biotechnology.

Can regional platforms take the ACP forward?

Yes, biotechnology being a highly competitive industry requires regional cooperation at all levels – inter and intra regional and this can only succeed with national support. Regional cooperation is essential given the high capital investments needed to improve and modernize the physical infrastructure and to have adequately trained and highly skilled personnel available to the ACP countries. In response to appeals made by Ministers in several fora, it is recognized and accepted that regional platforms provide the thrust necessary. Regional bodies in ACP countries such as CARICOM – the Caribbean, the Secretariat of the Pacific Community – the Pacific, NEPAD and Forum for Agricultural Research in Africa (FARA) - Africa, in addition to regional universities and research organizations, to name a few, can be mandated to further articulate and coordinate the important issues for the respective regions for ratification and endorsement by the leaders. Harmonization of regulatory frameworks and IPR regimes, avoiding duplication of efforts and sharing information, knowledge and equipment at the intra and inter–regional levels are the only ways for moving forward.

Can key stakeholders build credibility to harness biotechnology?

Key stakeholders in biotechnology include consumers (civil society), non-governmental organizations, farmers and other private sector entrepreneurs, investors, government (public sector), development partners, knowledge based institutions, scientists.

To build credibility and social acceptance of biotechnology especially agricultural biotechnology, and to ensure that biotechnology contributes to addressing the pressing social and economic needs of ACP countries, a new contract is needed between all stakeholders – between pubic and private research, between scientists and the private sector, between scientists and civil society and policy makers. Such a contract should be based on the following principles:

- open dialogue on biotechnology, its related applications, risks and benefits (e.g. science-based evaluation procedures that objectively determine the benefits and risks of each GM organism on a case by case basis) and on the legal and regulatory systems to gain public confidence in the technology and the related products;

- public and private research co-operation and collaborative partnerships based on a shared agenda, shared responsibility, transparency, mutual trust and profit-sharing;

- harmonization of intellectual property rights legislation to include issues related to access and benefit sharing given the various agreements and treaties which ACP countries have signed and/or ratified e.g. WTO /TRIPS Agreement, Convention on Biological Diversity (CBD) and Cartagena Protocol and the International Treaty on Plant Genetic Resources for Food and Agriculture. This is crucial for the growth of the bioindustry.

What is the role of knowledge based institutions and scientists?

Knowledge based institutions and scientists directly involved in research and development and innovation or in academia have a responsibility to be vigilant, continuously develop knowledge and skills, including communication skills. This would help them to remain at the cutting edge of the advances in biotechnology, better serve as advisors to policy makers, farmers and other entrepreneurs and demonstrate through their research work and publications that the public and private investments in S&T and biotechnology can contribute to solving societal problems and wealth creation. Knowledge based institutions and more specifically scientists need to reassure civil society, government and private sector of their commitment to value the involvement of all stakeholders and to abide by ethical principles as they lead the development of biotechnology in the ACP region.

What is the role of government?

In order to meet national needs, and to be competitive, ACP countries should take a series of measures aimed at creating the right environment for harnessing biotechnology.

Policy, legal and regulatory Frameworks
While ACP countries are at varying levels of establishing biosafety regulatory frameworks, the relevant policies and legislation governing biotechnology, biosafety, and intellectual property protection are largely lacking. ACP countries have the opportunity, through national, regional and international funding mechanisms to establish or strengthen biosafety and IPR frameworks at the sub-regional level for adoption and implementation at the national level. These mechanisms should also be employed for building risk assessment and management capability, taking into account the specific environmental conditions (e.g. rich biodiversity, vulnerability of Small Island Developing States (SIDS), centres of origins of crops, etc.). Public and private sector confidence in the technology will thus be enhanced in its potential to address societal needs. Bilateral and multilateral trade agreements (e.g. WTO Agreements, European Partnership Agreement) and other important conventions and treaties have to be considered when devising suitable policy and legislative frameworks.

Financial support
Although human and financial resources are generally limited in ACP countries, this should not prevent governments from honouring their commitments to increasing investments in science and technology by allocating resources from their national budgets to improve physical infrastructure and human resource capacity, recognizing that funds must be channeled to the development of biotechnology infrastructure within each ACP sub-region to respond to national and regional needs and priorities. This will signal to interested investors (national, regional and international private sector and the donor community) that the ACP region is serious and should pave the way to successful implementation of science and technology based development which is relevant to the region and supported by government commitment. Bilateral and multi-lateral agreements

should also be used to access funding to support national and regional initiatives and national commitments can be used to add leverage.

Public-private partnerships
In order to commercialize biotechnology and encourage innovations in the area, there is need to foster partnerships at the national, regional and international levels. Public and private research and development co-operation and collaborative partnerships are necessary to address key challenges which include:

- the priority needs of the resource-poor farmer and other micro-enterprises and stakeholders whose livelihoods can be put at risk if this technological developmental process is not properly managed;
- the market demands for improved food quality and safety, wider variety and affordable prices;
- the need for new agricultural products e.g. higher yielding varieties, drought and salt resistant varieties given the changing climatic conditions, nutritionally improved varieties, environmentally friendly agro-chemicals and pesticides (e.g. products derived from genomics and proteomics research that complement conventional breeding strategies and enhance their efficiency);
- the appropriate mechanisms which ensure that new products and processes can lead to economic and social development.

Coordination
Due to the cross-cutting and interdisciplinary nature of biotechnology and the policy and trade related issues, there is need for co-ordination of activities led by key ministries (e.g. Environment, Agriculture, Health, Industry, Planning, Finance, Trade, Education and Foreign Affairs), administrations, industries, legal bodies and research institutions. The establishment of an over arching Committee on Science and Technology in each ACP sub-region (where such does not exist or is not fully operational), with specific responsibility for overseeing all biotechnology related developments, from planning to implementation as well as coordinating funding is a possible way forward. Feed-back mechanisms must be put in place to ensure accountability to national governments and the public they represent.

Conclusion

The overall goal is to harness biotechnology for sustainable agricultural production, social and economic development and wealth creation in the ACP region. It is therefore crucial for ACP governments to reverse the current decline in funding for research and more specifically agricultural research and development and to create incentives to promote collaborative partnerships with the private sector and international community. The necessary policy and legal instruments must be put in place to sustain the collaboration and public/private consultations for the benefit of all. Open dialogue must be facilitated and encouraged to continuously inform and update stakeholders, especially civil society. The regulatory framework to facilitate research and development,

technology transfer and trade in keeping with societal concerns must be addressed with urgency.

ACP scientists are encouraged to lead by example and ensure that all stakeholders are brought on board. ACP governments are encouraged to:

- provide leadership;
- increase investments in science and technology including biotechnology;
- support and facilitate regional cooperation for the development of skills and sharing of facilities;
- mandate that the ACP region prioritize its biotechnology agenda; and seek to establish and facilitate mutually beneficial international collaborations to ensure that the ACP region is not left behind in the increasingly knowledge based global economy.

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