AGRICULTURAL BIOTECHNOLOGY AND THE TRANSFORMATION OF WEST AFRICAN AGRICULTURE:
REGIONAL CHALLENGES, ACCESS, REGULATION AND FUTURE PERSPECTIVES

Background document to inform a regional consultation of West African actors to feed into the regional ECOWAS/USAID meeting on agricultural biotechnology (June 2005)

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DRAFT CONSULTATION DOCUMENT TO STIMULATE DISCUSSION AND DEBATE

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This background note compiled by the Sahel and West Africa Club Secretariat/OECD draws together strategic issues on the introduction and adoption of agricultural biotechnology from a range of sources. Section 3 draws heavily on a series of briefing papers listed in the bibliography published by the Institute of Development Studies / Sussex University, UK. (http://www.ids.ac.uk/ids/env/biotech/pubsBriefings.html).

Other sections provide analytical summaries provided by the Sahel and West Africa Club (SWAC) / OECD in consultation with selected experts. We are grateful to Ian Scoones, Fellow at IDS, who has kindly authorised the use and reproduction of sections of documents from IDS. We present additional perspectives and summaries from other individuals and institutions in the annexes to illustrate key issues; these are clearly referenced. We also acknowledge the contributions of Peter Kearns (Environment Directorate, OECD / Secretary, Internal Co-ordination Group for Biotechnology/OECD), Innocent Butare (IDRC/CRDI, Dakar, Senegal), Dr Harold Roy-Macauley (Biotechnology Consultant, West Africa) and Iain Gillespie (STI/BIO, OECD). However, responsibility lies entirely with the authors of this report.
Agricultural biotechnology and the transformation of West African agriculture:
Regional challenges, access, regulation and future perspectives

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I. INTRODUCTION AND OVERVIEW

Agricultural biotechnology and biosafety have become an intensely debated topic at the national and international levels, both in the North and the South. It is an issue of critical importance to Africa. Africa largely “missed out” on the benefits of the green revolution of the 1960s and 1970s that transformed Asian agriculture, and some argue that Africa must now embrace the agricultural biotechnology revolution rapidly to fill the gap. Others urge caution, fearing theoretical implications for human health and biodiversity and potential economic disadvantages for the poor as they become dependent on the purchase of seeds and inputs. This emphasises the need to collate information impartially on the stakes and different perspectives relating to the uptake and application of agricultural biotechnology, focusing particularly on the issues that need to be addressed at the regional level in West Africa. This document aims to provide wide access to a variety of sources that can inform all levels of actors in West African agriculture as they prepare regional frameworks for the introduction of biotechnology in 2005.

It is widely recognised that the international debate on biotechnology is very polarised, particularly its environmental safety and human health implications, public concern continues to exist despite no conclusive scientific evidence to prove that biotechnology can cause harm to human or animal health or the environment. Due to public concerns on unknown risks, some argue that it is necessary to strictly apply a ‘precautionary principle’ and implement stringent biosafety measures. Such concerns are important in OECD (Organisation for Economic Co-operation and Development) countries as well as in West Africa, implying that there is a need for an open debate and concerted effort to improve the information available and engage all stakeholders in the decision-making process on agricultural biotechnology. However, this is not an easy task. For example, Parliamentarians from CILSS countries could not come to a common understanding on the appropriate policy and management related to transgenic agricultural commodities in West Africa during a training session organised by the International Union for the Conservation of Nature (IUCN) and the International Development Research Centre (IDRC) in March 2004.

By way of background, biotechnologies (or biotech) are techniques of modern biology that employ living organisms (or part of organisms) to make or modify products, improve plants or animals or develop micro-organisms for specific uses. Biotechnology has broad applications: it is used in crop development, livestock rearing, environmental activities, human and animal health, and processing.

The development and the implementation of biotechnology requires a number of preliminary conditions such as the availability of sophisticated laboratories, skilled scientists and regulation mechanisms for the use of biotech and to address potential risks and uncertainties related to new technologies. In Africa, only South Africa has already established most of the preliminary elements necessary for an appropriate environment for the implementation of biotechnology.

In West African countries, a series of events, debates and reviews have been prepared on agricultural biotechnology since the year 2000 (see Timeline in Appendix 1). Regional research institutions and organisations based in West Africa, such as CORAF, INSAH/CILSS, IDRC and several national agricultural research institutions have begun to explore the potential and risks associated with agricultural biotechnology. Development agencies, particularly USAID, have provided substantial support to regional actors in the area of agricultural biotechnology in Africa as a whole and West Africa in particular.

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2 Modern biotechnology refers to biotechnology techniques developed relatively recently, mostly from the 20th century onwards as distinct to the practices of cross-breeding etc applied by humans over many centuries.

3 See for example the results of the USAID-funded Agricultural Biotechnology Support Project (ABSP) which has brought together the expertise of US Universities and the private sector on this theme since 1991. See: 
Key international organisations (e.g. FAO⁴) have undertaken studies on agricultural biotechnologies for developing countries. However, the level of development, pace of introduction, and degree of consensus between stakeholders concerning biotechnology differs across West African countries. A regional framework is therefore being built in collaboration with ECOWAS and its member States. However, key actors, particularly civil society, are not fully aware of the opportunities offered, potential risks and stakes concerning the introduction of biotechnology. This lack of information at times contributes to polarised positions on agricultural biotechnology. This document provides basic information to all actors to inform debate and contribute to building a common framework for biotechnology shared across West African actors involved in the agriculture sector.

A review of key documents available on modern agricultural biotechnology indicates that it probably has great potential to assist agriculture in responding to environmental and climatic risks while increasing productivity to meet the consumption and income needs of the West African rapid growing populations. Biotechnology potential includes higher yields, improved nutrition, or resistance to drought, pests and disease. Proponents argue that biotechnology will boost food security for the world’s growing population by raising sustainable food production. It would also provide economic and environmental benefits by reducing the need to expand land area under cultivation, cutting needs for irrigation and limiting pesticide use.

These technologies include both food crop biotechnology as well as animal biotechnology. In Burkina Faso for example, research activities in animal biotechnology are carried out by the National Institute for Environmental and Agricultural Research (INERA) in collaboration with the International Centre for Research-Development on Livestock in Sub-humid Zones (CIRDES) focusing on trypanosomes and embryo transfer. In Ghana, Tissue Culture is being used to explore possibilities of treatment of Newcastle disease and the heartwater cowdriosis (see Alhassan 2002).

However, for many other people, this rapidly developing science raises environmental, social, health and ethical issues. Because modern biotechnology is still so new, much is unknown about how its products may behave and evolve, and how they may affect humans and interact with other species. Hence, adequate safety measures are advocated to protect the environment, biodiversity and human health from theoretical risks. However, there is no obvious reason why LMO crops should impact on biodiversity differently from other types of improved crops (e.g. tissue culture techniques). Particular questions raised by public concerns need to be considered, as identified by UNEP and CBD⁵ (UNEP & CBD, 2003, Biosafety and the environment: an introduction to the Cartagena Protocol)⁶

(i) Could characteristics of certain crops such as a capacity to tolerate herbicides, for example, transfer from transgenic crops to related wild species altering their characteristics?
(ii) Might plants that have been genetically modified to repel pests also harm beneficial insects?
(iii) Could the increased competitiveness of a biotech commodities damage markets for products from biologically-rich ecosystems?

Genetic engineering is a biotechnology tool among others, and it is used where other techniques like conventional breeding have failed. New answers to crop and animal production constraints (e.g. diseases, pests) are regularly needed. Breeders have a variety of tools available to them to resolve technical problems and to address production and processing constraints; genetic engineering can be seen as one of these. But because of public fears and constraints of the potential risks, regional regulatory mechanisms,

⁴ A specific database on biotechnology: “FAO-biodoc” has been set up for developing countries. See the following web site for more details: http://www.fao.org/biotech/
⁵ For more details on the work of UNEP-GEF, which have undertaken a huge amount of work on the implementation of the Cartagena Protocol, including implementation of national biosafety frameworks, see: http://www.unep.ch/biosafety
⁶ For more details see the following web site: http://www.biodiv.org/doc/press/presskits/bs/cpbs-unep-cbd-en.pdf
it has been considered necessary to undertake gradual risk assessments and maximise the information available to all actors from government officials to NGOs and producers.

The development and commercialisation of agricultural biotechnology commodities has profound implications for the transformation of West African agriculture, and particularly for the most vulnerable farmers. For example, genetic engineering may be used to develop new crop varieties which could undermine developing countries’ export markets. An example is the attempt by a company based in the USA to engineer a new variety of rice, based on a Thai variety, which will be grown in Florida.

Critics, sceptical of the capacity of agricultural biotechnologies to meet the needs of vulnerable farmers, question the likelihood that biotechnology can deliver products that would make a significant difference for this category of farmers in the medium or even long term. Even if the technology could be developed, a variety of other factors could inhibit the development of pro-poor biotechnology if not taken into account in agricultural policy: the limited availability of public funds to finance research into products suited to and accessible for vulnerable farmers; the complications of intellectual property arrangements; the costs associated with the purchase of inputs over the long term.

Indeed, international rules on intellectual property rights may sit uneasily with traditional approaches to generating and accessing innovation and ethical concerns regarding the patenting of living organisms. Some countries, such as China and India, have integrated these issues into their agricultural development strategy by providing public funds to develop biotechnology specifically suited to vulnerable farmers. In 2004, China spent $500 million on biotechnology research in over one hundred laboratories and research institutes.

II. AGRICULTURAL BIOTECHNOLOGY TOOLS AND TECHNIQUES

Agricultural biotechnology is a general term that covers a variety of different scientific techniques used to improve the performance of plant materials, animals and agricultural food processing. Some of these techniques were developed some centuries ago (viz: traditional biotechnology), but others are quite recent (viz. modern biotechnology).

- “Traditional” agricultural biotechnology includes techniques that were developed and practised by previous generations over many centuries, such as plant breeding to develop a variety of food crops, and brewing and fermentation techniques to process and preserve raw foods (bread, wine, yogurt or cheese). Such techniques that use the natural processes of living organisms are widely accepted and generally do not cause public concern.

- ‘Modern’ or recent agricultural biotechnology, in contrast, uses techniques of scientific genetic modification and molecular analysis. ‘New biotechnology’ includes genetically modified organisms, living modified organisms, novel foods and feeds.

This Background Document focuses on issues related to ‘modern’ agricultural biotechnology, particularly on products eligible under the Cartagena Protocol in the framework of agricultural transformation. Non-food biotechnology such as processed commodities, pharmaceutical products, and other commodities related to industry and health uses of biotechnology are beyond the scope of this paper.

Three main types of modern biotechnology can be distinguished: genetic engineering; tissue culture; and Marker Assisted Selection (MAS). Further information on each type is given below.

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7 Documents on non-food biotechnology can be found on the following web pages: http://www.nf-2000.org.
2.1. Genetic engineering

Genetic engineering is the introduction of a specific gene from one organism to another in order to give the plant or animal in question a desired characteristic or trait, such as: pest resistance; higher yield; or drought tolerance. It is a process in which the traits or characteristics of an organism are changed by transferring individual genes from one species to another or modifying genes within a species. For example, it is possible to insert genes from a coldwater fish into a tomato to create a frost-resistant plant, or use bacterial genes to make herbicide-tolerant corn or cotton. The results are known as living modified organisms (LMOs), transgenic products or, more popularly, genetically modified organisms (GMOs).

In 2003, 99% of the land area planted to transgenic plants was concentrated in 6 countries: USA, Argentina, Canada, Brazil, China and South Africa. India and the Philippines have also recently increased their production of transgenic crops. The major transgenic crops currently planted are: herbicide tolerant soya (USA, Argentina, Canada, Mexico, Romania, Uruguay and South Africa); insecticide tolerant maize (USA, Canada, Argentina, South Africa, Spain, the Philippines, Honduras, Uruguay and Germany); and transgenic cotton\(^8\) (USA, China, India and South Africa). In West Africa, Burkina Faso has already begun on-station trials of transgenic cotton in partnership with Monsanto. In developed countries, international companies involved in developing and marketing biotechnology, such as Monsanto, Syngenta and Cargill, often have to bear heavy costs in the product development, regulation and validation process for biotechnology products. In many developing countries, partnerships between international agricultural firms, national and regional research institutions will also play a major role in the validation and regulation processes of agricultural biotechnologies. As in developed countries, the costs of regulation and validation of biotechnology products in developing countries are to be covered by these companies and could represent an opportunity for West African farmers.

2.2. Tissue culture

Tissue culture is the regeneration of plants in laboratories from parts of plants not affected by disease. This technique allows the propagation of plants through the placement of small amounts of undifferentiated tissue in an artificial environment. The tissue is placed in an environment that favours the production of roots and shoots, and is later planted normally.

By using tissue culture, the favourable qualities of plants can be precisely controlled, so that each plant is identical for the particular quality being sought, whether it is disease resistance or plant chemical production. This propagation technique of plants is used under sterile conditions, often to produce clones of a plant.

The advantages of tissue culture techniques over traditional methods of propagation are: the production of exact copies of plants that produce particularly good flowers, fruits, or have other desirable traits; the ability to produce mature plants quickly; the production of multiples of plants in the absence of seeds or necessary pollinators to produce seeds; the production of plants in sterile containers which allows them to be moved with greatly reduced chances of transmitting diseases, pests, and pathogens.

The West African Rice Development Association (WARDA, a public international agricultural research centre in Côte d’Ivoire) has used tissue culture to enable African and Asian varieties of rice to crossbreed. The resulting ‘NeW RiCe for AfriCA’ (NERICA) promises several advantages over conventional African varieties, including earlier maturity, improved pest resistance, tolerance to drought and acid soils, and greater height, making it easier to harvest by hand.

\(^8\) There are two types of transgenic cotton: (i) BT (*Bacillus thuringiensis*) cotton and (ii) herbicide-tolerant cotton. China has 35 different varieties of transgenic cotton.
2.3. **Marker Assisted Selection (MAS)**

MAS is a development breeding tool using molecular genetic information in selection. Molecular techniques accelerate traditional breeding programmes through gene tagging and streamline germplasm management to assess population structures in pests. The idea behind marker assisted selection is that there may be genes with significant effects that may be targeted specifically in selection. The technique uses the genetic code as the basis for expression of traits in organisms; for example, traits observed in rice may include height, yield potential, length of growth cycle, resistance to diseases, etc.

The International Institute for Tropical Agriculture (IITA) based in Nigeria has used this approach to develop varieties of cassava resistant to the mosaic disease. This technology allows the rapid identification of desired genetic lines and to discard those that are not. Where it generally takes 7-10 years to develop a cultivar, MAS decreases the development time of these cultivars by several years.

### III. Key Issues Drawn Largely from Briefing Papers on Agricultural Biotechnology by the Institute of Development Studies (IDS), Sussex, UK

This section provides material and key stakes drawn from 13 Briefing Papers prepared by IDS on “Democratising Biotechnology: Genetically Modified Crops in Developing Countries Briefing Series” (available on the following web pages: [http://www.ids.ac.uk/env/biotech/pubsBriefings.html](http://www.ids.ac.uk/env/biotech/pubsBriefings.html)). The purpose of this section is to share issues, concerns and challenges that West African actors need to address when developing and implementing agricultural biotechnology, particularly transgenic organisms.

#### 3.1 Challenges for agricultural biotechnology regulation, biosafety and harmonisation

Uncertainties related to the adoption of transgenic crops have led to precautionary rules and regulation mechanisms to address some of these issues: the appropriate level of protection of the environment or of human health to be achieved; acceptable levels and types of risk; interpretations of what constitutes risk and of available scientific evidence; the workability and effectiveness of risk management measures; and the significance of socio-economic factors related to agricultural biotechnologies.

Despite the need to make careful, informed policy choices, a narrow, technical perspective, where scientists dominate biotechnology regulation committees, remains firmly entrenched in many countries. With such a focus on ‘technical’ issues, biotechnology risk assessments have tended to shy away from broader socio-economic and ethical criteria. The need for context-specific assessments means that assessments and regulatory choices differ for different locations, as opposed to uniformity and harmonisation.

In developing and implementing national and regional biosafety frameworks, West African countries must decide how to deal with the importation of transgenic commodities, whether and how to take the precautionary principle into account and how to address socio-economic considerations. The formulation of national biosafety frameworks, which many countries have recently initiated, and the process towards the development of a regional biosafety protocol, represent important opportunities to consider and address many of these issues. While public consultation is required under the international Biosafety Protocol, few countries (including developed countries) have yet undertaken the type of consultations that are necessary to determine the levels of risk that are considered acceptable to the public, and consequently the measures that are appropriate to achieve the desired level of protection.

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9 A *cultivar* is a plant variety produced from a naturally occurring species that has been developed and maintained by cultivation.
At the international level, the Cartagena Protocol provides countries with an opportunity to assess potential risks associated with transgenic crops and living modified organisms before authorising its importation for the first time (see Appendix 2 for more details on the Cartagena Protocol). Nonetheless, they face particular challenges in the implementation of the Protocol because their capacity to implement, monitor and enforce national biosafety laws remains weak. In addition, national and regional decision-makers need to decide how to address a number of issues left to national discretion in the Protocol, and how to balance their rights and obligations under the Protocol with their commitments to facilitate free trade according to the regulations of the World Trade Organization (WTO).

The relationship between WTO rules and the Biosafety Protocol has become particularly pertinent in the international governance of transgenic crops. Regulatory harmonisation in the international trade of agricultural products and natural resources is often considered to be a positive end in itself, largely because it provides greater predictability. It is promoted and underpinned by international agreements such as the Biosafety Protocol and the WTO Agreements. Pressure for harmonisation also comes from other sources. For example, some developing and transition countries, including Bolivia, China, Croatia, Ethiopia and Sri Lanka, are said to have experienced bilateral pressure from powerful developed countries and trading partners not to implement very stringent regulations on transgenic products and transgenic foods.

While international instruments focus on the environmental implications of biotechnologies, West African countries will need to develop appropriate and feasible mechanisms to address the socio-economic impacts of transgenic commodities, i.e. on incomes, food security and livelihoods.

Box 1: Institutional challenges for agricultural biotechnology regulation

Key challenges for establishing sustainable mechanisms for the regulation of biotechnology include the speed of the approval process, the scope of the process and the implementation policy.

In some cases, governments are under pressure to speed up their processes for approving biotech applications or face the cost of losing or deterring investors. The experience from the UK, India and elsewhere, however, suggests that a rushed process provokes public concern over possibly inadequate consideration of potential social and environmental impacts, and creates perceptions that a technology being imposed from outside.

Existing trade agreements that seek to restrict the nature of risk assessment procedures to narrow ‘sound science’ criteria could make sense for global commodity traders. However, it may not allow for adequate consideration of environmental uncertainties or the possible socio-economic implications of introducing the technology. Leaving the question of biotechnology only to experts is not enough. The question of the nature of the relationship between science, policy and regulation that might work better is essential. Experience from many countries, including developed countries, has shown that biotech policy consultations are often limited to a small group of experts from the scientific community and the private sector. It would be appropriate for governments to engage the public in the design of their biosafety regulations. Meaningful participation requires strategies that create genuine spaces for people to question new technologies.

International agreements and national regulations mean nothing if they are not enforced on the ground. Yet, across the developed and developing world, there is now evidence of illegal growing of transgenic crops and of a seed trade that governments cannot adequately monitor, resulting in costly legal suits and loss of trust in regulatory systems. In India for example, transgenic cotton was commercialised in 2002 and in the same year, it was discovered that an unauthorised variety had been marketed and planted during two growing seasons on an estimated 10,000 hectares in Gujarat and elsewhere, without being detected.

Source: Institute of Development Studies, UK (http://www.ids.ac.uk/ids/env/biotech/pubsBrifings.html)

10 The "Cartagena Protocol" was signed in Montreal at the end of January 2000 as part of the international treaty on biodiversity, for the first time granting countries from the South the right to full information and secure regulation for the trade of genetically manipulated seeds (source: http://www.vifu.de/new/os/allco.html)
In designing regulatory systems, governments are inevitably faced with trade-offs between domestic priorities and international commitments, between a desire to promote biotechnology and a responsibility to mitigate risk. In responding to the mixed messages coming from international organisations, national governments, donors and the private sector, it seems the only way a country can regulate biotechnology to serve its own interests is to formulate a coherent national strategy on biotechnology where the technology and its potential is judged in relation to its ability to advance broader goals such as food security and poverty alleviation. Unless this happens, there is every danger that countries will be reacting to global agendas, rather than pursuing their own national development priorities.

An international framework has been set up under the UNEP, IPPC, WTO and other international institutions to address issues related to potential risks of transgenic commodities (see Appendix 2). The GEF has a financial tool to contribute to the achievement of these objectives. In Europe, regional regulation on biotechnology has been and still is very systematic and effective. Regional organisations in Latin America, the Southern Africa region (via SADC) and in Asian countries have attempted to develop and apply regional regulations. However, these have not always worked effectively.

Given that there is a risk that genetically modified material (e.g. seeds) may be introduced from neighbouring countries, as with the example of Indian cotton above, it is important for West Africa to develop a common and agreed regional regulatory framework to regulate the introduction of biotechnology and transgenic crops. For example, in order to minimise the illegal exchange of seeds, facilitate risk assessments related to biotechnology, and allow for sharing information, results and infrastructure.

The importance of setting up a regional regulation framework through ECOWAS and NEPAD was one of the key recommendations of the sub-regional consultation seminar on biotechnologies in West and Central Africa organised by IDRC, IUCN and the Cheik Anta Diop University (Senegal) in November 2004 (see Appendix 4). This regional dimension to biotechnology is also stressed by the Cartagena Protocol (See Appendix 2) and encourages protection from possible adverse effects, specifically focusing on cross-border movements of genes. Regional organisations such as ECOWAS, CORAF, and potentially the CILSS, play a vital role in helping to define common ground on how to set up regional regulation mechanisms in complementarity with national regulation control and risk assessment mechanisms.

Many African countries also face constraints related to their capacity to monitor and implement biosafety regulation. Countries which have already developed and implemented biotechnology such as Kenya and Zimbabwe have experienced a rapid increase in qualified microbiologists. However, most African countries lack experienced scientists, laboratories and equipment to carry out biotechnology research or biosafety testing. The public research systems of many African countries lack the independent capacity to supplement the shortcomings of private sector-driven biotechnology.

### 3.2 Intellectual Property Rights (IPR) and agricultural biotechnology

Harmonised standards of the Intellectual Property Rights (IPR) protection have been agreed at the global level, mainly through the World Trade Organization’s (WTO) Agreement on Trade-Related Intellectual Property Rights (TRIPs), which requires developing countries to implement strong domestic IPR regimes. International agricultural research and policy networks have also urged developing countries to implement TRIPs as part of a set of enabling policies to promote agricultural biotechnology. However, claims that IPRs are essential prerequisites for innovation in, and technology transfer to, developing countries appear doubtful.
A recent study, by the independent UK Commission on Intellectual Property Rights (CIPR), confirms that IPRs may benefit those developing countries that already possess a fairly high level of manufacturing and innovation capacity. Nonetheless, they bring few benefits for the less developed countries for which the costs of strong IPRs outweigh the benefits in the short term. The CIPR recommends that developing countries should tailor their IPR regimes to their national circumstances and developmental priorities, taking full advantage of the flexibility the TRIPs Agreement allows. Among other recommendations, they are advised to exclude plants and animals from patent protection; explicitly allow farmers to save, re-use and possibly even sell and exchange harvested seeds; allow access to protected varieties for further research and breeding; and resist further attempts in international fora to entrench a global, ‘one-size-fits-all’ IPRs standard.

In practice, few developing countries appear to be following this approach. The reasons for this may be associated with a lack of expertise, leading to a lack of awareness about the available options and the possible advantages of using them. Such countries tend to be the ones most reliant on multilateral, bilateral and even private ‘capacity-building’ support, which generally promotes strong IPR models. In addition, many developing countries have foregone flexibility provided by TRIPs in order to preserve key bilateral trade, aid and investment relationships with developed countries, which support stronger IPRs.

Larger and economically more powerful developing countries like India have been more creative in developing IPRs legislation that is tailored to their needs, including provisions allowing farmers to save, use, re-sow, exchange, share and even sell their seeds.

Lastly, medium and long term perspectives need to be taken into account. For example, the length of time required to negotiate intellectual property rights on transgenic crops or animals, to carry out biosafety testing and to bring transgenic varieties to the market can mean that the background variety into which the transgene is inserted may be ‘out of date’ by the time it is available.

3.3 Equity issues of agricultural biotechnology for vulnerable farmers

The development and commercialisation of agricultural biotechnology has profound implications for developing countries and poor farmers, whether or not they have access to it. Agricultural biotechnology may include adverse as well as beneficial consequences for those who depend on farming. The trend is driven largely by the decisions of research scientists in the private sector and agribusiness, which are naturally more interested in economic returns over time than in poverty reduction, food security and fostering economic development in the short term. The actual effect is determined by the way the technology is applied in practice even if the consequences are not intrinsic to biotechnology.

Box 2: Biotechnology cotton: a success story for poor farmers with possible risks in the medium and long term

Cotton genetically engineered to express the insecticidal toxin Bacillus thuringiensis (Bt cotton) has been celebrated as a success story for poor farmers in developing countries. Transgenic cotton varieties have been adopted by commercial and smallholder farmers in several developing countries, including China, South Africa and India. In 2002, transgenic cotton varieties occupied 20% of the global cotton area and more than half of the national cotton acreage in China. An estimated 90% of smallholder cotton farmers in the Makhatini Flats area of KwaZulu-Natal, South Africa, planted Bt cotton.

Transgenic technology is popular with farmers because it appears to provide effective control of important cotton pests, principally bollworms. Consequently it has been adopted very rapidly and it is now possible to review the experiences of transgenic cotton farmers over several growing seasons. A number of recent studies have claimed there are clear benefits for cotton farmers. In China, transgenic cotton commercialised in 1997 is reported to have contributed to increased yields, financial and labour savings, and a reduction in poisonings linked to pesticide use. The total benefits were calculated at US$334 million nationally, most of which was secured by farmers. In South Africa, the reportedly higher cost of transgenic cotton seed commercialised in 1997 was offset by lower chemical use and yield increases in the order of 20–40%.
However, the experience of India serves as a reminder that the Bt gene cannot protect cotton against diseases or non-targeted pests, which can wipe out profit margins. Paying the higher price for transgenic seeds remains a risky choice, especially for poor-cash producers constrained to produce primarily for home consumption. Research in China has indicated that success in controlling bollworm as the primary pest may lead to their place being taken by an increase in the number of secondary pests such as aphids and red spider mites. The particular ecological dynamics of cotton pests requires dynamic, ongoing management. There is concern in both China and India that pest resistance to the Bt toxin may already be emerging. According to IDEAS Centre (www.ideascentre.ch), there is some data indicating the development of pest resistance after extended exposure to Bt cotton. The risks can be mitigated and can be reduced with proper crop management practices, such as intermittent planting of non-Bt varieties in order to break the selection process in pests that favours Bt-resistant species. Pest refuges are recommended as a way of controlling this problem, but these may be unworkable or ineffective on the tiny plots of land farmed by smallholders. Non-Bt maize is a key refuge crop in China’s Bt cotton growing areas. Policymakers fear that, if Bt maize were commercialised in the north-eastern provinces, seed would quickly travel south and be used in the cotton zones. Having Bt maize and Bt cotton in the same zones could undermine biosafety principals in smaller farms. Further to this, for crops where China is a centre of origin – rice and soya beans, for example – biodiversity concerns cannot be taken lightly.

These specific crop management processes are relatively easy to implement and manage on large farms. On smallholdings, however, the respective practices require co-ordinated action among all producers within defined areas of production. This is a significant issue in Africa where the majority of farms are small family farms, often less than 3 hectares in size. Producer organisations may have a key role to play here.

Access to agricultural inputs remains an important issue. In India and South Africa, the smallholders adopting transgenic varieties tend to be the richer and better-established farmers who have access to productive land and credit, and can afford the higher up-front costs of transgenic cotton-seed. In many countries, cotton is an important export crop that is supported by an infrastructure of input supply and marketing support. In this respect access to input and agricultural biotechnology need to be addressed.

Source: Institute of Development Studies, UK (http://www.ids.ac.uk/ids/env/biotech/pubsBrifings.html) and IDEAS Centre (www.ideascentre.ch).

In most of African countries, and West Africa fits the norm, budgets for public agricultural research sector are under great pressure. At the same time, public sector researchers’ ‘freedom to operate’ is undermined by a battery of legal instruments (intellectual property rights, research contracts, material transfer agreements and so on), that impose extra transaction costs. For the private sector, these costs represent important investments to safeguard future income and preserve key commercial assets, but for the public sector they are a burden on their financial and technical resources, and inhibit their traditional strengths in working collaboratively to generate public goods.

Genetic engineering is attractive to firms because the ability to register exclusive ownership over new varieties makes it more feasible for them to recoup the high costs of biotech research and development. In principle, biotech commodities have the potential to address key problems relevant to food security and poverty in developing countries. However, in practice the transgenic seeds commercialised to date by private companies are more expensive than conventional seeds, tend to be marketed along with a package of other inputs such as proprietary chemicals, and have complex management requirements that might be impracticable on small plots of land. Also, there is a threat that the dependence of poor farmers will increase because they restrict their rights to save seeds from one season to another and exchange seeds with other farmers. As a way of taking into account these issues in their global strategy on biotechnology, the Argentinean plant variety protection (PVP) and the intellectual property rights (IPR) legislation allows farmers to save and re-use their own seeds

Further details are available on the following web pages: http://www.biotech-monitor.nl.
Apart from cotton, the vast majority of the crops and traits commercialised so far have been targeted to respond to the needs of large-scale commercial farmers in the North. Even observers who are favourable towards biotechnology agree that the crops, traits and challenges of interest to poor farmers in developing countries are often neglected.

The private sector’s willingness to engage with projects like vitamin-rice, virus-resistant sweet-potato and the Insect-Resistant Maize for Africa (IRMA) project should be welcomed. But the rarity and small scale of such projects highlight the gap between them and the array of crops and traits already commercialised for developed country markets.

Transgenic seeds are often marketed with an obligation that fresh seeds must be purchased each year; this undermines an important source of insurance – seed-saving and informal exchange between farmers – which in the past has served to protect poor farmers against such risks. Zimbabwean activists have been at the forefront of attempts to protect and ensure access to the genetic resources that form the basis of local livelihoods, culture and knowledge. They succeeded in convincing the African Union to adopt a ‘Model Law’ as a guide to help African countries develop national legislation to protect these rights. This model acknowledges the connection between livelihood, property and social-cultural rights. For countries which have adopted the Model Law, the extensive and complex studies required to develop or use transgenic crops could however make access difficult and the development of transgenic crops and could loose benefits of biotechnologies. Further, transgenic crops cannot resolve problems facing poor farmers without also addressing the complex and deep-seated issues of poverty, land rights, lack of access to credit and weak extension services. All these factors are important in the process of agricultural innovation and the improvement of livelihoods of West African farmers (Zoundi J., Hitimana L. and Hussein K., 2005).

The transgenic crops that are actually on the market require a package of inputs and special management practices, which pose special challenges and risks for poor farmers. They also tend to be crops and traits designed for industrialised, capital-intensive, temperate farming. The so-called ‘orphan’ crops and traits, which could be relevant to family farms, can be neglected. These could include food crops such as millet and sorghum, and traits such as drought resistance, salt tolerance, and nutrient use efficiency. Virus-resistant sweet-potato is projected to boost yields by up to 18%, but this can only be achieved if there is an efficient system of extension and distribution to provide clean planting material to farmers. At present this is lacking in many West African countries.

The international community is tempted to focus on cash crops when debating and supporting the introduction of biotechnology. However, the CORAF programme document on biotechnology in West Africa produced in December 2004 (CORAF/WECARD 2004) and the perception of civil society indicates clearly the potential use of biotechnologies to address diseases and pests for staple food crops such as maize, sorghum, millet and cassava. This potential needs to be explored urgently at the regional level.

IV. EXAMPLES OF APPROACHES TO THE IMPLEMENTATION OF AGRICULTURAL BIOTECHNOLOGY

Many international institutions, including the World Bank and several NGOs, argue that participatory approaches are necessary to address deep-seated causes of poverty. This has strong implications for biotechnology consultations and requires real involvement of the most vulnerable communities in particular in policy processes. Some examples illustrate how this can be done.

In Kenya, tissue culture is being used to produce disease-free plants for banana propagation. A tissue culture project, implemented by public sector researchers at KARI and the Institute of Tropical and Subtropical Crops (ITSC, South Africa), with funding from the International Service for Acquisition of Agri-biotech Applications (ISAAA), has proved to be an effective way of overcoming disease transfer
problems on planting, at least for the first generation of new plants. The project has also **shown the value of linking participatory methods to help define research priorities, with effective extension and distribution networks to facilitate uptake by farmers.**

Technologies are more likely to be successfully adopted if laboratory researchers and end users are linked together from the start of the process of developing biotechnologies. This requires the use of **effective participatory methods to help define research priorities, and effective extension to help apply the new technologies.** This approach has been applied to developing-country biotechnology programmes in the past. For example, a programme sponsored by the Netherlands called the Special Programme on Biotechnology operated in four countries, including Kenya and Zimbabwe, **poor farmers were involved in the priority-setting process for the country programmes, and identified technologies such as biopesticides and biofertilisers, as well as transgenic traits.**

**The African Rice Center** (WARDA12) has used participatory approaches to address gender issues in rice variety selection using modern biotechnology. High yielding varieties with taller plants were created to allow women to harvest rice easily without bending down while having a baby on their back. Other examples from Zimbabwe, China and Cameroon show the importance of engaging the non expert on biotechnology in the consultation process.

**In Zimbabwe,** Consumer groups have drawn attention to their right to evaluate the risk posed by new agricultural biotechnologies and to make an informed choice. Here, rights to information, labelling and issues of liability have emerged as key. Consumer organisations have effectively lobbied for labelling regulations to be adopted, not only on the grounds of safety, but also to ensure that food choices remain consistent with culture and beliefs. This marks an important shift from narrow approaches to risk, where human health and safety are the only considerations.

A rights-based approach emphasises the right of citizens, together with governments, to choose technology that support locally-defined livelihood needs and do not undermine or foreclose livelihood and development options. This validates issues of humanity, culture, society and economy as legitimate concerns in biotechnology regulation and so creates space for a wider range of voices and issues.

In Zimbabwe again, several initiatives focus on local rights to livelihoods and development. Spanning several decades, community- and farmer-focused organisations have developed projects that are based on farmers’ self-defined needs. These include biotechnology projects focusing on fermentation or tissue culture, for example. Recently an NGO-led grouping has begun a process where farmers and other community members actively engage with scientists, corporations, government officials in defining technologies consistent with their livelihood vision.

**In China,** the profile of biotechnology products emerging from research is very different from most other developed and developing country settings. There has been more emphasis on non-transgenic techniques as marker-assisted selection, for example. Crops are being developed taking into account vulnerable farmers concerns like stress tolerant crops suited for dry, low-fertility or saline settings.

Where transgenic commodities have been developed in China, national agricultural research has played an important role. For example, biotech cotton is the most important of these and now accounts for as much as 35% of the cotton grown in China. Around half of this area is planted with varieties developed at the Chinese Academy of Agricultural Sciences (CAAS). Biocentury, the company spun off from CAAS, is now looking to commercialise its products in India, Vietnam and parts of Africa.

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12 West Africa Rice Development Association. This is an intergovernmental research association of African member states. WARDA is also one of the 15 international agricultural research Centres supported by the Consultative Group on International Agricultural Research (CGIAR). See: [www.warda.org](http://www.warda.org)
The other side of Chinese investment in biotechnology has been a policy of regulating the activities of corporations such that they operate through joint ventures with Chinese seed companies, their access to local germplasm is restricted, they must provide demanding comprehensive biosafety assessments and their expansion is carefully monitored.

**Cameroon** has been one of the pioneer countries in Africa with its creation in 1997 of the National Biosafety Committee (NABIC). The mandate of this Committee is to organise and coordinate the development of a national legislation on biosafety. It has 23 members representing eight Ministries, four universities, the national laboratory for quality control, the biotechnology information centre, the World Wildlife Fund (WWF) and representatives from agro-industry. Producer organisations are not represented, but some international NGOs participate as observers in discussions. With the completion of the work of NABIC, Cameroon ratified the Cartagena Protocol in February 2003. The government has also completed legislation on biosafety and this was adopted by the parliament in April 2003. Officially, there is no research programme on transgenic commodities.

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**Box 3: OECD Country experience and Committee work on implementing agricultural biotechnology**

For some 20 years, the OECD, primarily through its Directorate for Science, Technology, Industry (DSTI) and its Environment Directorate and associated Working Groups and Committees, have undertaken much work in OECD countries on biotechnology and living modified organisms (LMOs). To date there has not been a particular focus on West Africa. However, the experience of implementing, debating and regulating biotechnologies can serve as examples for West Africa. Three particular pillars of the approach used by OECD countries could be adapted to needs in West Africa:

- **Formal risk assessments.** For many OECD countries, a framework of formal assessment of impact of transgenic crops on environment and human health has been set up. This enables the regular monitoring of potential risks that may emerge from the introduction of biotechnology so as to inform the public.

- **Building consensus among OECD countries.** A gradual process of consultation and consensus among OECD countries has been set up for most biotech products. A Task Force for Safety of Novel Foods and Feeds exists. At its first meeting held in 1999, it was decided to focus its work on the science-based Consensus Documents on specific biotechnology products or regulatory issues, which are mutually acceptable among OECD Member countries. These documents contain information for use during the regulatory assessment of particular food/feed products. Publications are available electronically at no fee at the following Web address: [http://www.oecd.org/biotrack](http://www.oecd.org/biotrack). However, very few detailed analyses have been undertaken to assess civil society opinions and those of the non-scientific public in general.

- **The Lead Country Approach.** In order to capitalise on early experience, the approach used in the OECD in attempting to build consensus was to draw lessons from countries that have introduced biotechnologies on specific commodities. For example, The USA has been the Lead Country for issues and experience related to the introduction of transgenic cotton.

- The OECD has an **Internal Co-ordination Group on Biotechnology (ICBG)** which shares information across the OECD and its Member countries on biotechnology and co-ordinates efforts of OECD Directorates in this area.

**Source:** Personal Communication from: Peter Kearns, Secretary ICBG, OECD and Iain Gillespie, OECD coupled with information from: [http://www.oecd.org/biotrack](http://www.oecd.org/biotrack)

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13 Documents are available on the following web pages: [http://www.oecd.org/biotechnology](http://www.oecd.org/biotechnology); [http://www.oed.org/biotrack/](http://www.oed.org/biotrack/)
V. STRATEGIC QUESTIONS FOR THE WEST AFRICA REGION REGARDING THE INTRODUCTION OF AGRICULTURAL BIOTECHNOLOGY

From this review, six strategic questions deserve rapid consideration by West African decision-makers, civil society and the private sector in the process of developing regional approaches to biotechnology in West Africa.

(i) What main opportunities might the introduction of agricultural biotechnology provide for the transformation of West African agriculture?

(ii) What risks (e.g. environmental, biosafety, human and animal health risks) need to be addressed and how? Which need to be addressed at the regional level and which at the national and sub-national levels?

(iii) What are the most effective strategies to ensure that all actors, including civil society and producers, are better and impartially informed on the stakes surrounding the introduction of biotechnology in West Africa? Drawing on examples such as the WARDA experience of involving local small farmers in the selection of gene characteristics (see Section 3), how can the use of participatory breeding programmes for biotechnology products be fostered and mainstreamed?

(iv) What regional mechanisms to regulate biotechnology would be useful to complement national frameworks and which organisations are capable of taking responsibility for these? What are their strengths and weaknesses? Indeed, how can West African countries ensure that they can regulate and maintain control of the production of genes originating from West Africa? How can regional ownership of existing plant be preserved over time to avoid loss of these varieties and negative effects on biodiversity?

(v) What distinct approaches need to be developed for the regulation concerning food crops destined for human consumption and other crops developed for other purposes?

(vi) How can access and equity be ensured for all producer groups to approved agricultural biotechnology, particularly vulnerable farmers? Given that introduction of biotechnology requires considerable financial resources and regulatory capacities, are West African States equipped for the task and do they have a sufficient level of commitment to develop, implement, monitor and foster national ownership of biotechnology programmes? This would minimise dependence. Is a regional approach to building such capacities more likely to be effective in addressing this dependence issue? How can a regional framework build on existing capacities and centres of expertise in biotechnology in research centres across West Africa?

(vii) How can the West Africa region best capitalise on the regional expertise available, geographically scattered across National Agricultural Research Institutions and International/Regional Agricultural Research Institutions? What is the most appropriate regional regulation framework that could work, taking into account specific subsidiarities at the regional, national and sub-national levels? What lessons can be learned from the pesticides control mechanism coordinated by the CILSS?
**BIBLIOGRAPHY**


## Appendix 1: Agricultural Biotechnology Timeline in West Africa

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<th>Year</th>
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<th>Objective / Outcomes</th>
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| October 2002- mid 2003 | A regional study conducted by Professor Walter S. Alhassan (IITA) is organised by WECARD to identify state-of-the-art of agribiotechnology in West Africa | Four main outcomes of the study:  
- Harmonisation of rules on biosafety at the regional level will facilitate movement of biotechnology products;  
- The implementation of biosafety requires a range of expertise which do not exist in one country  
- National agricultural research institutions have insufficient human and financial capacity to undertake independent research of biotechnology commodities  
- The region needs to capitalise on research regional results on biotechnology research and experience, undertaken by international and regional agricultural research in collaboration with some national agricultural research institutes |
| November 2003      | A Working Group on biotechnology was set up by WECARD to prepare a detailed document on biotechnology |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| February 2004      | The first WECARD Working Group meeting on biotechnology in Dakar (Senegal) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| June 2004          | A meeting on “science and technology to increase productivity in West Africa” was held in Ouagadougou supported by USAID | During the meeting it was recommended:  
(i) To create a regional centre on biotechnology;  
(ii) To create a partnership between West African institutions and Northern institutions, particularly the USA on Science and Technology;  
(iii) To organise another ministerial conference of agricultural ministers in West Africa, under the auspices of ECOWAS, in Bamako. The purpose of the meeting would be to discuss harmonisation of biosafety rules and the adoption of an action plan to promote biotechnology;  
(iv) To institutionalise such meetings of West African Ministers of Agriculture as a first step to the creation of a ministerial conference of biotechnology. |
| August 2004        | The Second WECARD Working Group meeting on biotechnology in Bamako (Mali) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 4 November 2004    | Conference of West African Ministers of Science and Technology organised by ECOWAS in Abuja, Nigeria | Agriculture and biotechnology, and Intellectual Property Rights were discussed. All ECOWAS members were invited to prepare and actively participate at the meeting on biotechnology scheduled to take place in June 2005 in Bamako (Mali) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 22-24 November 2004 | IDRC organises a regional consultation meeting on biotechnology in Dakar – Senegal – involving West African experts and civil society | The project document aims to give an action plan on biotechnology and biosafety for CORAF/WECARD |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| December 2004      | WECARD publishes a project document on biotechnology and biosafety in West Africa | The purpose is to: discuss harmonisation of biosafety rules at the regional level; the adoption of an action plan to promote biotechnology in West Africa; and the institutionalisation of a ministerial conference on biotechnology. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 13 January 2005    | Meeting in Bamako (Mali) on cotton issues where biotech cotton was discussed |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| June 2005          | ECOWAS Ministerial meeting planned on biotechnology, in Bamako |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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APPENDIX 2: UNDERSTANDING BIOSAFETY IN THE FRAMEWORK OF THE CARTAGENA PROTOCOL
(Source: UNEP & CBD)

The Cartagena Protocol (CP) was adopted in 2000 within the framework of the Convention on Biological Diversity (CBD). This Convention, adopted in 1992 under the auspices of the United Nations Environmental Programme (UNEP) is a global treaty which provides an international framework that addresses biodiversity, ecosystems, species and genetic diversity. The Cartagena Protocol adopted under this Convention recognises the potential of the modern biotechnology for enhancing development with the conditions that it is developed and used with adequate safety measures for the environment and human health. It is in this spirit that a legally binding agreement to address potential risks posed by living Modified Organisms (LMOs) as part of the modern biotechnology was adopted in the Cartagena Protocol. The Cartagena Protocol states clearly that it helps to have: “an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on “transboundary” or cross-border movements”.

The scope of biosafety and the Cartagena Protocol
The CP deals with LMOs intentionally introduced in the environment (seeds, trees, animals and fish). It defines a simplified framework for agricultural commodities for consumption and processing (grain used for food, animal feed and processing). The Protocol does not cover pharmaceutical transgenic products or commodities derived from living modified (LM) crops and animals like cooking oil from living modified corn.

The principal of precaution and biosafety within the framework of the Cartagena Protocol
The Cartagena Biosafety Protocol is based on the precautionary approach and Principle 15 of the 1992 Rio Declaration on Environment and Development stating that, “where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”. This means that a government may decide on the basis of precaution not to permit a particular living modified product to be imported across its borders even if there is insufficient scientific evidence about the potential adverse effects. This principal is applied on three domains:

(i) Biodiversity;
(ii) Human health; and
(iii) Socioeconomic concerns including the risk that imports of genetically engineered foods may replace traditional crops, undermine local cultures and traditions.

Selective example of the Biosafety Catagena Protocol in practice
The Cartagena Protocol has two separate sets of procedures:

(i) For Living Modified Organisms (LMOS) that are to be introduced into the environment (e.g. seeds, live fish), the principle of an Advance Informed Agreement procedure (AIA) is applicable. The exporter gives the government of the importing country detailed written information, including a description of the organism, in advance of the shipment. The importing country acknowledges receipt of this information within 90 days and then explicitly authorises the shipment. However, the absence of a response is not to be interpreted as implying consent. The Export documentation accompanying the shipment must clearly state that it contains living modified products. Governments must also adopt measures for managing any risks identified by risk assessments, and they must continue to monitor and control any risks that may emerge in the future. The AIA is not applicable for LM commodities destined for contained use (for scientific laboratory for example).
(ii) For agricultural Living Modified commodities that are to be used directly as food, animal feed or for processing, a simplified system is applicable. Instead of requiring the use of the Advance Informed Agreement (AIA) procedure, the governments that approve these commodities for domestic use have to communicate this decision to the Biosafety Clearing-House. Countries may make decisions on whether or not to import these commodities on the basis of their domestic law and must then declare these decisions through the Biosafety Clearing-House. However, a country may, under its domestic regulatory framework, and consistent with the objective of the Protocol, decide to subject such Living Modified products to risk assessment and other requirements. When a government agrees to import such commodities intended for direct use as food or feed or for processing, the export document accompanying the shipment must clearly indicate that it “may contain” living modified organisms and that they are not intended for introduction into the environment.

The protocol defines other measures which might be of interest for West African countries:

- While the country importing LMOs is responsible for ensuring that a risk assessment is carried out, it has the right to require the exporter to do the work or to bear the cost.

- In order to promote human skills and institutions needed for assessing risks related to modern biotechnology, biosafety activities under the Cartagena Protocol are eligible for support from the Global Environment Facility – an international fund that was established to help developing countries protect the global environment.

Finally, the CP calls for individuals, communities, NGOs and the private sector to be actively consulted and fully engaged in living modified commodities development and biosafety in order to contribute to the final decisions taken by governments, thus promoting informed decision-making.

Other International agreements related to the Cartagena Protocol

Four separate international standard settings address various aspects of biosafety:

- **The International Plant Protection Convention (IPPC),** which addresses the plant pest risks associated with LMOs and invasive species. Any LMO that could be considered as plant pest falls within the scope of this treaty.

- **The Codex Alimentarius Commission,** which addresses food safety and consumer health. An Intergovernmental Task Force on Foods Derived from Biotechnologies is responsible for developing standards for genetically modified foods and labelling of biotech foods.

- **The World Organization for Animal Health (OIE),** which prevents the introduction of diseases into the importing country. However, it has not yet approved international standards on biotechnology.

- A number of **World Trade Organization (WTO) agreements,** such as the Agreement on the Application of Sanitary and Phytosanitary Measures and the Technical Barriers to Trade Agreement, contain provisions that are relevant to biosafety.

Genetically modified (GM) cotton, a result of technological developments of the 1990s, has the potential of reducing the cost of production and hence increasing profitability of the early adopters of this technology. In fact, GM-type cotton (as well as all other GM products) acts as insurance against pests, insects or weeds. The grower pays a premium for the pest-resistant seed (as they would when buying other types of insurance). If the insect attacks the crop, the grower’s benefit comes through the lower costs from not spraying. For example, the average number of pesticide application used against bollworms in the US fell from 4.6 in 1992-95 to 0.8 in 1999-2001. Furthermore, the grower is likely to experience higher yields because spraying conventional cotton always involves sub-optimal elements and hence yield losses. For example, yield increases due to switching to GM cotton range between 19% (China) to 80% (India). In developing countries there might also be health benefits because small growers spray with hand-held devices and thus, any reduction in spraying would also imply reduction in poisoning risks. On the other hand, if the insect does not attack the crop, growers simply lose their premium (i.e. the cost difference between conventional and GM cotton). Research has shown that, on balance, GM cotton users are much better off compared to users of conventional cotton.

There are two types of GM cotton: Bt cotton and herbicide-tolerant cotton. Bt (Bacillus thuringiensis) is a naturally occurring soil bacterium that has been used as a biological pesticide for many years. The gene that produces the relevant insect toxin has been transferred from that bacterium into the cotton plant. In turn, the plant produces its own toxin and there is no need for the grower to apply pesticides. Herbicide-tolerant cotton is a cotton plant that has been genetically modified to resist a herbicide that would otherwise kill both weeds and the cotton plant. Consequently, the herbicide can be applied without exterminating the cotton plant.

Producing GM cotton is a multi-step and complicated process, which is the reason why most developing cotton-producing countries have not embraced the technology. First, the legal and regulatory framework must be established, which includes issues such as selection of company to undertake trials, pricing issues, copyright of genetic material issues, whether growers are allowed to recycle GM seeds or have to purchase the seeds every year, time duration of the GM license, etc. The second stage involves field trials to develop seeds appropriate to local growing conditions, for example, there are about 35 GM cotton varieties in the United States (US) and 22 in China, each designed for particular pest populations and growing conditions. The third stage involves actual adaptation by the cotton growers.

GM cotton was first grown in the US in 1996. A number of cotton producing countries have introduced GM cotton technology since then including China, India and Mexico in the northern hemisphere and Argentina, Australia and South Africa in the southern hemisphere. Other countries are in the approval process or at the trial stage, including Israel, Pakistan, Turkey, Brazil, Indonesia and Zimbabwe. Major producers have that have not approved GM cotton (as of 2003) are the European Union, Central Asia and Francophone Africa (except Burkina Faso, which is conducting trials) (Cotton Outlook 2004).

Who receives benefits of GM cotton? There are four groups whose welfare is likely to be affected by the use of GM seeds: the companies that manufacture the seeds, the farmers that use them, the farmers that do not use them and end users. Falk-Zepada et al. (2000) estimated that of the $215 million in surplus generated in 1996-98 per year due to the switch from conventional to GM varieties in the US, farmers’ net income increased $105 million while the seed companies received $80 million. Increased cotton output reduced world price generating about $45 million of gains to consumers (both in the US and elsewhere) but cotton farmers in other countries (i.e. farmers that did not use GM cotton) lost an estimated $15 million because of lower cotton prices. The methodology of these welfare effects was based on a standard economic surplus model developed by Alston et Al. (1995).
APPENDIX 4: KEY CONCLUSIONS OF THE SUB-REGIONAL CONSULTATION SEMINAR ON BIOTECHNOLOGIES IN WEST AND CENTRAL AFRICA
(coordinated by IDRC/CRDI, IUCN, and Université Cheikh Anta Diop, Dakar, 22-24 November 2004)

In November 2004, The International Development Research Centre (IDRC) in collaboration with the Université Cheik Anta Diop (UCAD) based in Dakar (Senegal) and the “Mission Union Mondiale pour l’Environnement (UICN-Senegal) – organised a regional consultation seminar in Dakar (Senegal) on biotechnologies in West Africa. The consultation covered the following aspects related to biotechnologies: food security, human health, environment, industries and energy, Intellectual Property Rights related to biotechnologies, regional and international cooperation, private and public sector collaboration, transgenic crops and alternatives. Participants at the seminar came from eight West African countries (Benin, Burkina Faso, Côte d’Ivoire, The Gambia, Ghana, Mali, Nigeria and Senegal) and the Congo, the one country from Central Africa.

At the end of the seminar, the consensus from participants was that West and Central Africa needs to take a step further in the enhancing its research capacity in biotechnologies at the country level. However, participants stressed the fact that Africa should not be a field of experimentation of technologies where risk assessment is not well controlled and monitored. Furthermore, taking account of the importance and specificity of family farms in West African agriculture, technologies that might become a threat for family farms should be carefully identified and avoided (e.g. those that become too expensive, or that are more vulnerable to climatic risks). For this reasons, participants insisted on the urgency of setting up a regional framework for biosafety harmonisation and informed strategies for introducing biotechnologies in the agricultural transformation and development agenda at the national, regional and continental (NEPAD) levels. Recommendations included:

- Create a Pan-African information and communication network related to the uses of biotechnologies, particularly the transgenic commodities;
- Include biotechnology issues into the “science, media and civil society” analysis;
- Urgently train and improve human capacities in genetic engineering, risk management and data analysis, Intellectual Property Rights (IPRs) and international negotiations on trade and agriculture;
- Reinforce equipment and infrastructure to improve working conditions for scientists and foster collaboration between countries and institutions;
- Set up “Bio-ethic Committees” and build their capacities;
- Disseminate recommendations and results of consultations on biotechnology by organising feedback meeting at the national level in different countries;
- Define the role of biotechnology in NEPAD’s objectives, in accordance and coherence with national needs and the priorities of regional organisations (NEPAD, ECOWAS).
APPENDIX 5: SELECTED WEB PAGES ON AGRICULTURAL BIOTECHNOLOGY

http://www.unep.org
http://www.unep.ch/biosafety/
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