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Biotechnology Product Development Partnerships: Emerging Institutional Capacities in East Africa

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Abstract: The present article analyzes the various policy issues related to the product development in biotechnology, including role being played by the public and the private sector. The public sector plays a key role in the African countries in term of providing R&D support to the project meant to, address the needs of small-scale farmers. The paper focuses on East Africa. It attempts to identify key challenges being faced by small-scale farmers in access technology and running agribusiness sector with support of biotechnology. The regulatory and other related issues are also analyzed.

Keywords: East Africa, Agribusiness Sector, Public–Private Partnership and Technology Transfer.

Introduction and Background

The present articles summarizes a series of studies conducted in East African countries (Ethiopia, Kenya, Tanzania, Uganda) to analyze product development in biotechnology, including public- and private sector roles and interactions in technology transfer. The work was conducted as part of the BIO-EARN[1] programme. The principal objective of BIO-EARN is to build national capacity and competence in biotechnology, biosafety and biotechnology policy in East African countries.

This research was initiated against the background that economically advanced countries experience a rapid rise in the number of research partnerships involving commercial firms, universities, non-profit organizations, and public institutions. In plant biotechnology,

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public-private collaboration is usually emphasized in order to ensure that the products from agricultural research actually reach farmers' fields. Considering the time and costs involved in technology dissemination and regulatory processes, it is essential that roadmaps toward product development and farmer interaction – and potential roadblocks – be conceived early in the R&D process. The local and international private sector would play a key role in this process, given their increasing experience in commercial development and eventual release of GM crops. However, examples of successful public-private partnerships in plant biotechnology in developing countries are still rare. Particularly in Africa, information is scarce as to the current trends in private investments in research, what incentives drive successful partnerships in technology transfer, and what constraints they face.

As eloquently stated in a recent report by the InterAcademy Council[2]:

"For-profit organizations — propelled in large part by the globalization phenomenon that favors the fast, the nimble, the businesslike, and the educated — have now become the world's predominant force in applying science and technology (S&T) to the production and distribution of new goods and services. In 2000, the private sector's share of investments in research and development worldwide was 62 percent." (p.71)

The report also acknowledges that:

"This dominance is likely to continue and expand in the foreseeable future, although the private sector in the developing world is not yet significantly contributing to research and development. Actually, it is important to recognize that in many developing nations the most important entities involved in research and development may well be publicly owned for-profit entities, which frequently have the capacity to be viable partners in ventures of research and development and may be quite competitive in regional markets." (p.71)

In most part of Africa, R&D in the public sector is critical in order to address the needs of small-scale farmers. However, to a large extent the public sector has been unable to deliver technology and improved varieties to farmers. Public-private partnerships could therefore be an increasingly important conduit in Africa for delivering appropriate technologies.

The BIO-EARN studies provide a first exploration of the issues with regard to biotechnology product development in Eastern Africa, and

aim to contribute to an enhanced understanding of how the "Valley of Death" can be crossed. Markham (2002)[3] defines the "Valley of Death" as the gap between a technical invention or market recognition of an idea and the efforts to commercialize it. BIO-EARN-supported research has yielded technical inventions for which, in some cases, markets can be easily recognized. However, a lack of structure, resources and expertise prevents such projects to drive across the valley. In East Africa and most other developing countries, it is generally recognized that policy reform is key to creating an *enabling environment* for product development from research inventions. While this general recognition may be obvious, there is a great need to better analyze what type of policy reform and associated capacity building is needed to facilitate technology product development.

Following an initial phase of methodology development and literature review, inventory and orientation, a small number of cases were selected for further analysis (see Table 1) in each country. The case studies were selected on basis of their potential to highlight and analyze the key issues involved in product development, although some of them involve non-biotechnology applications. Following the development and review of structured questionnaires, in-depth interviews were held with key informants on each of the selected cases. Several focus group meetings were held in each country to better explore emerging issues, and to provide review of draft reports. Final draft reports were made available as background documents for a regional policy seminar in November 2003.

Summary of Findings

The East African country reports[4] comprise a rich source of information on policies affecting biotechnology product development, and the factors influencing product development partnerships as summarized above. This paper will not attempt to summarize each study, but pick a number of salient points emerging from the set of reports.

The countries involved in these studies differ substantially with regard to available biotechnology capacity, and presence of a vibrant local private sector. Kenya stands out as a country with a nascent, but diverse biotechnology R&D sector and industry, and with significant experience in public-private sector collaboration. The other three countries — Ethiopia, Tanzania and Uganda — are clearly less advanced, which explains why these studies focused on case studies involving

Table 1: Overview of Case Studies Analyzed in East Africa

Kenya	Tanzania	Uganda	Ethiopia
• 14 partnerships analyzed in agriculture (7), health (4) and environment (3); 3 selected for in-depth study	• HORTI Tengeru (Public) and ALSEED (Private) collaboration in developing and marketing of vegetable seeds	• Kaweri Coffee Plantation and Kawanda Agricultural Research Institute (KARI): coffee micropropagation	• Ethiopian Seed Enterprise
• KARI – CIMMYT – Syngenta Foundation Insect-Resistant Maize for Africa (IRMA) project	• ARI Mlingano (Public) and Katani Limited (Private) collaboration in implementing the meristematic tissue culture project (MTC)	• AgroGenetics Laboratory and KARI: coffee micropropagation	• Assela Malt Factory: Research-farmers partnership in malt barley production
• ICIPE development and marketing of Neem-based bio-pesticides		• Harvest Farm Seeds and NARO: hybrid seed production	• Kaliti Food Share Company – EARO – farmers production of durum wheat
• KEMRI Hepatitis B diagnostic kit		• Maganjo Grain Millers, Makerere University and KARI: "Nutri-Porridge"	• National Veterinary Institute: vaccine production

Source: Bio-Earn studies on Product Develpment Partnerships in Ethiopia, Kenya, Tanzania and Uganda.

micropropagation or even non-biotechnology applications and products.

In addition, particularly in countries such as Ethiopia, economic liberalization and commercial enterprise are fairly recent phenomena, leading to the selection of the concept "product development" partnerships, predominantly involving non-commercial and public actors, rather than "public-private" partnerships in a strict sense. Selected case studies primarily involved applications and products in agricultural production, much less in other economic sectors, reflecting the economic importance of agriculture and food production in East Africa.

Success factors: The Case of Kenya

With regard to public-private partnerships, Kenya presents an interesting case in point, where an initial inventory of partnerships yielded an extensive record, as summarized in Table 2. Kenya has clearly benefited from over two decades of public, often donor-supported, investments in biotechnology, resulting in an active biotechnology R&D sector scattered over a wide range of institutions. Key research entities include the Kenyan Agricultural Research Institute (KARI), the University of Nairobi, as well as a number international research centers. A detailed analysis of national biotechnology R&D capacity and associated policy issues can be found in Odame *et al*. (2003).[5]

While research efforts may be diverse, the number of products that have reached the market is still very limited. Respondents involved in the BIO-EARN study on Kenya generally attributed this issue to the lack of a clear government policy and priorities for biotechnology, and limited support to bring research results to a commercial level.

Still, the Kenya study points to a number of factors that clearly encourage product development, such as:

1. The country's economic importance as a regional center for agricultural products and services, attracting international private-sector investments and technology transfer from, e.g., Monsanto and Syngenta. A well-known case involves the collaboration between Monsanto and KARI for the genetic transformation of sweet potato, in order to generate virus-resistant transgenic lines. Transgenic lines based on local sweet potato varieties have been tested through field trials in Kenya, but apparently the project has been terminated for technical reasons.

2. The active presence of a number of international agricultural research centers (IARCs), such as ILRI[6], ICIPE[7], CIMMYT[8] and others, and international initiatives specifically aimed at agricultural technology transfer such as ISAAA[9] and AATF.[10] All IARCs in the country have well developed relationships with national research entities and outsource part of their research to them. For Kenya, this has been a major channel to access new agricultural and environmental technologies. As a collaborative effort between KARI, CIMMYT and the Syngenta Foundation, a project is underway to develop transgenic, insect-resistant maize varieties in Kenya.
3. A well developed public agricultural research organization, KARI, plays a vital role as a partner for private-sector businesses and international centers, as illustrated above.
4. An emerging local agri-business sector: Compared to other East African countries, Kenya has a growing agri-business sector, particularly in the cutflower industry. The Kenya Seed Company survived seed sector de-regulation in the 1990s and is now an active partner in variety testing and seed multiplication. In addition, tissue-culture capacities exist in companies such as Genetic Technologies Limited and the Tea Research Foundation.
5. Managed by the Kenya Plant Health Inspection Service (KEPHIS), Kenya has a functional system for seed certification and plant breeders' rights, which greatly facilitates the introduction of new plant materials. KEPHIS is responsible for overall quality control of agricultural inputs and products; its functions include phytosanitary inspectorate services and GMO biosafety decision-making for importation and confined releases of genetically modified plants.
6. The BIO-EARN study conducted in Kenya clearly shows the growing experience in the public sector and universities in dealing with the protection of intellectual property rights, through material transfer agreements (MTAs), contracts and other forms. This trend is confirmed by the cases included in Table 2 below.

Common constraints

The studies conducted in BIO-EARN countries also identified a number of important constraints to product development, which are found across the four countries in different intensities. These factors are summarized below.

East African governments have issued several policies and strategies at a macro-level, that have firmly established the transfer from centrally planned economy towards a more liberal market-oriented and decentralized economic system in which private investments could play a dynamic role in the economy. Quite a number of structural and fiscal reforms such as deregulation of price controls and foreign exchange, removal of restrictions on private investment, reduction of tariff rates, measures to raise revenues and establishment of market interest rates were undertaken to streamline the macroeconomic management. With regard to the agricultural sector, this has included often drastic reforms recently. For example, in Ethiopia, the privatization of 114 food-industry state enterprises and state farms is under way.[11] All countries emphasize the need for a growing role of the private sector in rural development, which is reflected in recent agricultural and rural development policies — such as Uganda's "Plan for the Modernisation of Agriculture" — and seed policy reforms.

However, the necessary mechanisms for the implementation of new government policy are not yet in place. As noted in the study on Ethiopia, "The regulations and laws for some of the policies lack the necessary detail. There is no adequate capacity and capability to monitor the implementations of the regulations. Protection of ownership of new technologies is not fully guaranteed. This may discourage private investors who may want to make profitable business in biotechnology since initial investment cost is very high and sustainability of the business is doubtful."

The above issues are compounded by the fact that, as expressed by private-sector respondents involved in the studies, decision-making in government is generally considered to be too bureaucratic and sluggish. More time and efforts will be needed on the part of government agencies to correct this situation. In East Africa, until recently, the public and private sectors often viewed each other with "antagonism, suspicion, and confrontation". Considerable lack of mutual trust exists about the capacities of the public sector and motives of private firms that engage in partnerships, even when the efforts have substantial public benefits. In Kenya, one of the administrators interviewed from the private sector said, "we fear investing in the public sector because of the uncertainty and slow speed at which things operate".

As a result, the development of biotechnology applications and products is still very much a public-sector affair. While a number of

Table 2: Kenya: Summary of Partnerships and Products by Sector

Sector	Institution	Type of product	Partners	Type of agreement	Type of Partnership
Agriculture	Kenya Seed Co. Ltd.	Maize Hybrid 625® KFA®	KARI	MoU Distribution Contract	Private - Public Private - Private
	Monsanto (K) Ltd.	Transgenic Sweet Potato	KARI	MTA/Trust	Private - Public
	ICIPE	Neemroc® biopesticide	KARI Saroneem GTZ	Service contract Service contract Commercialization) MoU	Public – Public Public - Private Public - Public
	ILRI	Tileria®	Merial Commercial Partners	Service contract (Commercialization)	Public - Private
	Syngenta	Primagram -Gold®	KARI	Service Contract (Field Trials)	Private – Public
	KARI	Maize Hybrid 614D®	CIMMYT Kenya Seed Co. Ltd.		
	Saroneem Ltd.	Neemroc®	KARI Coastal Community GTZ	Service Contract (Screening, Testing and Demonstration) Informal MoU	Public – Private Public - Private Public - Private
Health	KEMRI	HepCell-B®	JICA	MoU	Public – Public
	Cosmos Ltd	Artesunate®	None	None	None
	ICIPE	Neemroc®	KARI Saroneem GTZ	Service contract Service contract (Commercialization) MoU	Public – Public Public – Private Public-Public

Table 2 continued

Table 2 continued

Sector	Institution	Type of product	Partners	Type of agreement	Type of Partnership
	Saroneem	Neemroc	KARI	Service Contract (Screening, Testing and Demonstration)	Public – Private
			Coastal Community	Informal	Private -Public
			GTZ	MoU	Private -Public
Environment	ICIPE	Neemroc	KARI	Service contract	Public – Public
			Saroneem	Service contract (Commercialization)	Public - Private
			GTZ	MoU	Public - Public
	Saroneem	Neemroc	KARI	Service Contract (Screening, Testing and Demonstration)	Public – Private
			Coastal Community	Informal	Private -Public
			GTZ	MoU	Private -Public
	KEFRI	Eucalyptus Grandis	Kenya Gatsby Charity Foundation	Undetermined	Public – Public
			Mondi Forest Co.	Material Transfer Agreement	Public – Private
			ISAAA	MoU	Public - Public

Source: Kirea *et al.*, 2003

institutions have initiated research in various aspects of biotechnology, most of them lack the human, financial and infrastructure resources to sustain the research beyond the short- to medium-term and link them effectively to economic benefits or market prospects. For the private sector, it is generally unclear as to what economic benefits may be derived from investing in biotechnology product development. Public-sector capacity to enter into public-private partnerships was reported to be limited too.

Finally, the regulatory environment with regard to biotechnology was found to be unclear. Specifically with regard to biosafety regulations, the situation in East Africa is still evolving. Countries such as Ethiopia and Tanzania are in the process of establishing biosafety policies and procedures, while Kenya and Uganda are introducing reforms to their *interim* regulatory structures under existing laws, moving towards national biosafety bills, primarily as a result of ratifying the Cartagena Protocol on Biosafety. In all countries, securing approvals for advanced biotechnology research and confined trials is a time-consuming and uncertain feat. To date, only Kenya authorized the conduct of confined field trials — for genetically modified sweet potato, maize, cotton, and a rinderpest vaccine — and no commercial releases of GM products have occurred. In addition, BIO-EARN countries, like most developing countries, are commonly characterized by having weak, ineffective or inadequate enforcement of intellectual property (IP) protection. This can also become an obstacle for a public institution aiming at using IP for the protection of research results and transferring them to the private sector. The challenge is particularly significant in the case of agricultural biotechnology, because IP legislation in the countries involved in the study tends to deny protection for novel plant varieties, animals and biological processes to produce them. They are therefore considered inadequate to give effective protection to the developers of the new biotechnology products.

Recommendations

Recommendations from completed reports, and our analysis in this article point to potential future efforts — through research, training and policy advocacy — in the following areas:

1. Developing and implementing clear national policies, legal framework, and regulatory guidelines for biotechnology R&D: Governments should stress the importance of putting into

operation the recent policies to encourage innovation and private-sector investment in research and development, and work towards a clear regulatory environment for biotechnology in East African countries.

2. Strengthening of the local private sector: Respondents from the local private sector, who are interested in investing in biotechnology products, are currently financially weak. There is a need to provide support such as credit facilities and venture capital. The level of taxes on export crops and on capital items such as land and processing plants should reduced, increasing the profitability of agri-business.
3. Financial incentives to promote private-sector investment in R&D programs: Governments should provide services and incentives that can attract the participation of the private industry in biotechnology R&D. In particular, it is proposed that tax incentives be introduced and extended to firms investing in new products or new biotechnology techniques. Incentives like tax holidays, VAT reduction or even exemption can stimulate the private industry to import modern equipment needed for investment in advanced biotechnology applications. Government and donor-funded venture capital initiatives are needed, to catalyze public–private partnerships and technology dissemination.
4. Introducing organizational reforms in public organizations to facilitate R&D partnerships: Most product-development partnerships analyzed in the BIO-EARN studies operate under informal arrangements or memorandums of agreement. In public research organizations, opportunities and mechanisms have to be created to improve technology transfer to the private sector. The increasing number of universities and public R&D institutes in East Africa appointing individuals responsible for managing intellectual property and technology transfer might improve the situation. Institutional policies will be needed that reward researchers by sharing in the financial gains realized through successful technology transfer, as well as the establishment of venues for business development based on public discoveries, e.g., business incubators or science parks.
5. Designing capacity-building and awareness programmes to stimulate entrepreneurship and business development: In order to reduce a skills gap between the public and private sector,

institutional managers should receive training required for developing and implementing public-private partnerships. This will have to include, among others, drawing up business plans as well as contract and financial management. The public sector needs to strengthen its ability to negotiate with the private sector to draw up and manage contracts. The public sector also needs to strengthen its ability to manage intellectual property (IP) issues, including development of institutional IP policies facilitating technology dissemination and public-private partnerships.

Endnotes

1 BIO-EARN: East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development. URL: www.bio-earn.org

2 IAC 2004.

3 Markham, 2002.

4 Kasonta, J. *et.al*. 2003, Kirea, S. *et al*. 2003, Tumushabe and Akol. 2003, Simane, Woldu and Egziabher. 2003

5 Odame, 2003.

6 ILRI: International Livestock Research Institute

7 ICIPE: International Centre of Insect Physiology and Ecology

8 CIMMYT: International Maize and Wheat Improvement Center

9 ISAAA: International Service for the Acquisition of Agri-biotech Applications

10 AATF: African Agricultural Technology Foundation

11 Simane et al., 2003.

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