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Assessing the Impacts of Agricultural Biotechnologies in the Tropics

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Abstract

The application of biotechnology-based products to respond to critical needs in the agrifood and environmental management sectors of developing countries is an integrated set of activities designed to identify opportunities for biotechnological innovations, and to overcome key bottlenecks to their effective application.

This decision reflects recognition of the need for careful, rigorous analysis of the social, economic, and environmental impacts of agricultural biotechnology applications. From the outset, it was felt that this should be a crucial part of the overall work program, an essential complement to activities geared to promoting the transfer and application of specific biotechnology-based products, and improving the capacities of biotechnology-based enterprises.

Understanding the way in which biotechnology applications affect socioeconomic and environmental variables is not simply an academic exercise. Impact assessment data is important to a range of decision-makers: from public sector research agencies involved in supporting biotechnology research; to regulatory bodies charged with granting approvals for the introduction of specific products; to a range of private sector and nongovernmental actors faced with decisions regarding future investments in the adoption and application of biotechnology-based products.

Unfortunately, the very diversity of interests at stake complicates the task of assessing the impacts of particular biotechnology applications. The impact analysis approach the issue from differing perspectives and with differing needs in terms of the type of information and level of detail they require. The point of view and methodological approach of a university-based research are likely to differ widely from those of a regulatory official. More broadly, it will underscore the need for a consultative approach to impact assessment to ensure that the broadest possible range of interests is reflected in the analysis. This is essential not simply to improve the quality of analysis but also to ensure a strong constituency of public support for resulting policy decisions. Ensuring a balance between scientific rigor and public participation is by no means an easy task, but it is essential to ensure the effectiveness and credibility of impact assessment exercises.

Introduction

In the developing countries, traditional food processing practices can be classified as biotechnologies. A few products such as cheese, bread, and wine are now produced on an industrial scale, but many more are still made exclusively on a small scale at village or household level in rural areas. Traditional biotechnology products and practices have been adapted over generations in response to changing demands of the market- place. The environment in which traditional biotechnology must survive is becoming more competitive as subsistence economies

are transformed into market-oriented ones. Rising income and the emergence of the new middle class are creating a demand for new products. For example rice and wheat that are faster to prepare and are more refined in taste are gradually replacing sorghum and millet. Similarly demand for vegetable and meat products like meat and milk is increasing.
To meet the demands for new products, traditional biotechnologies are adapted or new ones are developed. Systematic evaluation of the socioeconomic impacts [of agricultural biotechnology] in developing countries is therefore still in its infancy. Also considerable variation exists among economic models for impact evaluation so that any prediction of socioeconomic impact of biotechnology in developing countries must be regarded with great caution (Cohen, 1994).

The volume and quality of work in this field has improved considerably in the past 4–5 years. But, at the same time, the need for impact assessment has also grown, as the pace of introduction of biotechnology-based products has begun to quicken. In addition, there is increasing concern to include an analysis of the environmental impacts of agricultural biotechnology applications alongside socioeconomic analysis, adding yet another wrinkle to the already complicated task of impact assessment. Even where there is agreement over the objectives and uses of impact evaluation, there is still a great degree of uncertainty about just how to organize and carry out such research. A cursory look at any of a number of recent reviews of the literature in this field confirms this fact. One of the notable facts to emerge from the present survey is the extreme scarcity of rigorous studies analyzing the economic and social effects of biotechnology in advanced industrialized and Third World countries. While studies on the use of biotechnology in various application areas and countries abound, there are very few good studies that examine effects. In part this is due to the complexities that are an inherent part of any rigorous study of effects. Again, the task that lies ahead is in significant measure one of refining approaches and methodologies (Fransman, 1991).

Methodological Approaches

The kinds of methodological approaches applied in the analyses of the impacts of agricultural biotechnology in developing countries showed a considerable variation in terms of the kinds of approaches recommended their potential applications, and their requirements in terms of data-gathering and statistical analysis. An overview from existing studies of the impact of agricultural biotechnologies in the developing world followed a pattern that provides a good indication of the range of existing works on the subject. They also illustrate the diversity of possible levels of analysis — from the broad impacts of biotechnological advances, to in-depth analysis of the impacts of specific biotechnology applications on development at the national and local levels. The steps in the analysis examined anticipated patterns of public (professionals) response to the new technology. Even in cases where survey data on public opinions toward biotechnology is not available, national and international regulatory standards were used as a proxy for public opinion.

In the case of new products, analyses were more complicated. In addition to secondary sources, some small-scale survey work was required, either direct public opinion surveys, or interviews with representatives of consumer advocacy groups and/or other experts. Data were collected on food availability, perceived environmental or human health impacts, and levels of trust in the government's regulatory process. As a final step, efforts were made to arrive at an understanding of aggregate impacts, based on the work undertaken. This impact assessment exercise also devoted some attention to the kinds of policy responses that could be employed to deal with the anticipated impacts — actions to encourage or discourage use of particular technologies, compensation to disadvantaged groups, regulatory reform, R&D policies, and consumer education. A survey aimed at assessing biotechnology capacity of Nigeria for agricultural research was conducted between June and July 2004 using a structured questionnaire, interviews and personal visits of some universities, polytechnics and national research institutions situated in strategic locations in Nigeria. Though a general deterioration of facilities in most universities was

noted, there are quite a number of institutions identified to be capable of applying some biotechnology tools to improve agricultural production in Nigeria. There are well-trained Nigerian researchers in the country who when supplied with tools in biotechnology and financial support to carry out well-focused or coordinated research can help propel the country towards self-sufficiency in agricultural production.

Results and Discussion

The following gives the current focus of each institution's biotechnology research activities.

a. UNAAB Biotech Center : Training, Marker-assisted breeding, Biodiversity
b. OAU Animal Biotechnology Laboratory,- Biodiversity, characterization, conservation
c. NACGRAB: Biodiversity: seed conservation, gene bank storage
d. FUTA: Feed development and enhancement, diagnostics
e. LAUTECH: biofertilizers, feed development
f. UNILAG: Bioremediation
g. NAPRI: breeding
h. NVRI, Vom: Vaccine production
i. Federal Polytechnic, Ado-Ekiti: Feed and food processing, alternative feeds (plasma protein, blood meal)
j. UNILORIN: Diagnostics, marker-assisted breeding
k. FEPA/ZERI: Biogas, insecticide and acaricide extractions
l. UI Department of Veterinary Medicine: Diagnostics
m. UNIBEN: Biodiversity, Marker-assisted breeding
n. FIIRO: Aflatoxin, food and feed fermentation
o. NIFFR: Hybrid and polyploid catfish (Clarias and Heterobranchus)

SWOT Analysis of Nigerian agricultural biotechnology resources

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
1. Biotechnology Capacity	Not sufficiently trained in DNA or genetic analyses	Trainable scientists and technologists- lesser time to train	Brain drain, those who stay got frustrated and lackadaisical; others are given administrative posts that stole their time doing science or creative work
	Others who lack training join the biotech band-wagon	Scientific outlook of doing things	No focus
2. Equipment availability			Ill-trained technicians and biotechnologists
	Too expensive to maintain	Attractive to investors both industrial and development investors	Lack of funds to put to maximum use
	No funds to maintain		
	No structure for fast and less bureaucratic procurement of chemicals and materials		
3. Infrastructure			
	Oftentimes too much investments in buildings	Space for solar energy utilization, Industries can be invited to rent space or engage in collaborative ventures	Government spending too much on buildings, insufficient funds for maintenance
	Lack of reliable water and electric supply		No funds for research, no continuity of projects
			Abandonment after projects funds are exhausted

4. Floral and faunal biodiversity	Underutilization, facilites for conservation not sufficient Genetic erosion due to indiscriminate breeding with exotic species	Good sources of genes for insect, disease, pest, drought, etc. –good genetic base for gene isolation	Endangered species-threat of extinction

Source: Omitogun O.G and R.O Osoniyi (2005)

Conclusion and Recommendation

There is a general scenario of slow development of the application of biotechnology tools in increasing livestock productivity in Nigeria because of poor infrastructure and limited or inadequate funding. There is an obvious lack of coordination of biotechnology research in the country, although it was gathered that the government is harmonizing biotechnology research efforts in the country. It is sad to note that well-trained scientists who chose to stay in the country have become redundant because of lack of opportunities to do research that will stimulate and motivate them. Modern biotechnology research is quite expensive and capital intensive, but providing equipment is not enough. Many well-equipped laboratories found in some research institutes, universities and polytechnics have become 'white elephants' because of lack of materials or consumables to utilize these equipment. Oftentimes a machine stops functioning for months because of a small accessory that needs repair or replacement. A 'SWOT' analysis gives an overall view of the capacity for agricultural biotechnology in the tropics.

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