

Constraints on the development of biotechnology in Zambia

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Biotechnology can play an essential role in fostering the economic and social development of developing countries like Zambia. However, due to a number of constraints, Zambia is not in a position to exploit the emerging opportunities from biotechnology. Prominent among these constraints are the lack of a biotechnology policy, an insufficient number of trained personnel, a poor science and technology base and very little basic research in universities and research institutions. The challenge Zambia must overcome is to establish a capacity and capability to innovate its own biotechnology as well as to adapt biotechnologies developed elsewhere to the Zambian conditions and environment. Despite all the hurdles and setbacks Zambia will face as she endeavours to enter the world of biotechnology, Zambia cannot afford to be a mere spectator as the rest of the world invests and benefits from the promise of biotechnology.

Key words: Human resource building, infrastructure strengthening, national biotechnology policy.

It is widely accepted that biotechnology can play an essential role in fostering the economic and social development of developing countries such as Zambia (Swaminathan 1982; Sasson 1988; Hobbelink 1991). However, even for the most developed countries it will be many years before the full benefits from biotechnology will be reaped. It is only logical therefore, for developing countries not to expect either an immediate bonanza or an imminent catastrophe. Rather there is an urgent requirement for Zambia to prepare herself now by investing in developing a technical capability in readiness. Then when the environment is ripe for her to benefit from the promise of biotechnology, Zambia will not be caught unawares.

Biotechnology can easily be adapted by countries having a wide range of technological skills. These skills can vary from simple activities such as cell and tissue culture to the highly sophisticated genetic engineering techniques involved in recombinant DNA technology.

While some developing countries are well positioned to exploit the emerging opportunities from biotechnology, owing to a number of constraints Zambia is not among those countries. Among the prominent constraints are lack

of a national biotechnology policy, inadequate numbers of trained personnel, as well as a poor science and technology base.

Biotechnology in Zambia

As a response to the potential of biotechnology, Zambia has initiated national research and development biotechnology programmes (Table 1). In Zambia there are five main institutions which can and are undertaking research and development in biotechnology. These are the National Council for Scientific Research, the University of Zambia, Mount Makulu Agricultural Research Station, Balmoral Veterinary Research Station and the Tropical Diseases Research Centre. Some of the agricultural related biotechnology programmes currently running are shown in Table 1. The direction of the biotechnology programmes is to increase food production and improve the social and economic position of small scale farmers and rural communities.

Constraints

Generally, the institutions undertaking biotechnological research activities face similar problems which hinder the development of biotechnology programmes:

- (i) The major problem is the lack of financial resources

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Table 1. Biotechnology Programmes in Zambia.**A. National Council for Scientific Research Project**

	Comments
a) Induced Mutation Breeding (Tree Improvement Research Centre, 1993/1994): Disease-free potato seed Tissue culture of <i>Uapaca kirkiana</i>	Suitable for large scale production Domestication of wild fruit tree for commercial use; processing of pulp into squash, wine etc. Quality improvement
<i>In vitro</i> propagation of some important Zambian cassava clones	Quality improvement
b) Development and production of microbial starter culture (Food Technology Research Unit, 1994)	Commercialization of traditional fermented foods. Suitable for small scale production
c) Utilisation of sorghum in brewing (Food Technology Research Unit, 1994)	Import substitution of barley
d) Biogas (Kasali 1993)	Alternative energy source to fuel wood in order to preserve the forest; provide a source of organic fertilizer (digested or fermented manure); improve environmental sanitation

B. Central Veterinary Research Institute (Department of Veterinary and TseTse Control services 1984/85)

Activities	Comments
a) Vaccine development and production	Produce vaccines against the following: <i>Haemorrhagic septicaemia</i> ; <i>Brucella</i> (S19); Rabies (canine); <i>Anthrax</i>
b) Antigen production	Diagnosis of <i>Salmonella</i> in poultry
c) <i>Rhizobium</i> inocula	Commercial Soya beans production

C. Mount Makulu Central Research Station (Lewanika & Mulenga 1989)

Activities	Comments
a) Sorghum breeding	Crop improvement and development of brewing, baking varieties
b) Maize streak virus	Development to maize streak virus

and scientific infrastructure. For example, in the last three years the University of Zambia has not included research funds in its budget. Since there is no other source of research funds in Zambia, most university staff are left with no other option. Only a few lucky ones are in a position to obtain external funding for research. The biotechnology Research laboratory at the National Council for Scientific Research was given less funds than it obtained last year and prospects of funding from outside the country is not very bright.

(ii) Lack of national biotechnology policy which outlines specific problems which could be solved using biotechnology.

(iii) Critical shortage of scientists and technicians (Table 2) compounded by the brain-drain to other countries, thus limiting the scope of research activities.

(iv) Non-availability of latest scientific information such as scientific journals, books, proceedings from symposia and workshops as well as monographs on topical subjects. Libraries at the university and research institutions are poorly funded.

(v) Despite the fact that some biotechnology related subjects (microbiology, chemistry, biochemistry, genetics) are taught at the University of Zambia, there is no department of biotechnology at the university to serve as base for the development of biotechnology.

(vi) Biotechnology products and processes are increasingly held under propriety protection by private and public institutions in the developed world making it difficult for countries like Zambia to have access to those technologies.

Constraints of Transfer of Technology: Biogas Technology (Kasali, 1993)

Biogas technology in Zambia is undergoing its adaptation and adoption stages through research and development. So far only demonstration plants have been installed. These are in Lusaka (Kasisi and Chalimbana and Show grounds), Mongu-Lealui, Namwala-Baambwe village, Monze-Silwili Settlement and Njola (seven plants).

The target groups for this technology are rural households (using livestock and poultry manures) and farmers (both peasant and commercial). Although there is a high demand for biogas plants, the dissemination of the technology has not taken off due to the following constraints:

Costs. The costs of installing the plants are beyond the reach of rural dwellers. The estimated cost of a 10 m³ biogas plant suitable for a family of eight persons is K1.2 million (US \$ 3000).

Technical. The lamps currently used give poor lighting. Gas

Table 2. Personnel involved in some projects outlined in Table 1.

Project	Number and Specialization
1. Tissue Culture	1 geneticist 3 technicians
2. Biogas	1 microbiologist 1 materials engineer
3. Development and production of microbial starter cultures	1 microbiologist 1 food technologist/ microbiologist 1 biochemist
4. Utilization of sorghum in brewing	same as in 3
5. Vaccine development and production	1 veterinary officer 3 technicians 5 laboratory assistants
6. Antigen production	1 research scientist 1 veterinary officer

production drops by 30–50% during winter, disturbing gas usage.

Social Cultural. Shortage of labour especially during the farming and cropping season. In some provinces women are not allowed to collect cow dung.

Financial and Manpower Shortages. The project has only two members of staff and is poorly funded.

Non-availability of Locally Manufactured Appliances. Appliances such as lamps and heaters are currently imported. Stoves are manufactured locally but at a low out-put rate.

Solutions

National Biotechnology Policy

The extent to which Zambia benefits from biotechnology will ultimately depend on sound formulation and implementation of a national biotechnology policy. This policy must judiciously scrutinise and identify specific problems which could be solved using biotechnology.

The policy must clearly articulate strategies for solving the identified problems. These strategies must take into consideration the cost-effectiveness of using biotechnology to solve the identified problems as opposed to using traditional and conventional methods.

The onus is on biotechnologists in Zambia to sensitize other scientists, science administrators, consumers, policy makers and potential investors on the role biotechnology could play in the social and economic development of Zambia.

Human Resource Building

Investment in human resources in a continuous process, like any other investment, it should not stop after one gets an academic qualification. Zambia must therefore invest in human resource development by: (i) keeping trained personnel motivated by (a) making sure that laboratories have the necessary infrastructure to enable meaningful research and development and (b) making funds available for scientists and technicians to attend seminars, workshops and short term training courses. (ii) providing good conditions of service and salaries. This is now being addressed through 'the equal pay for equal work' for both local and expatriate personnel.

Infrastructure Strengthening

This can be achieved by: (i) upgrading and strengthening laboratory facilities at Universities and research institutions; (ii) establishing pilot plant facilities.

Conclusion

The challenge Zambia must overcome is to establish a capacity and capability to:

(i) innovate her own biotechnology based on indigenous basic research centred on: (a) traditional farming methods, (b) traditional food processing recipes (c) indigenous medicinal plants.

(ii) Adapt biotechnology processes developed elsewhere which are appropriate for the Zambian conditions.

(iii) Build up indigenous capacity to commercialize imported biotechnology processes effectively.

All the above can only become a reality when Zambia pulls through the economic adjustment she is undergoing and begins to experience positive economic growth.

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