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Agriculture: Africa's "engine for growth" - Plant science and biotechnology hold the key

Strategies for enhancing biotechnology innovations for crop improvement in Kenya

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Summary

Kenya is a developing country whose economy depends largely on agriculture. However, agricultural production remains highly inefficient and cases of hunger and malnutrition are rampant. Biotechnology promises to enhance agricultural production significantly and Africa, for which Kenya is part, is seen as a major potential beneficiary. Despite this projection, little biotechnology research is carried out in Kenya. Other than the use of tissue culture, Kenyan agriculture remains traditional, routine and lacking in profit. There is need to facilitate innovative research if biotechnology is to be used profitably. This article addresses constraints hindering the exploitation of biotechnology in Kenya and provides possible solutions to these problems. The potential areas of interest where researchers stand to contribute most are highlighted and strategies for stimulating successful research projects, especially from upcoming scientists are further discussed.

Key words: Kenya, biotechnology innovations, innovative research, Africa

Introduction

Agriculture plays a big role in Kenya's economy and contributes about 23.8% of the country's gross domestic product (GDP) (CIA World Factbook, 2009). Only 20% of Kenya's land is considered arable while the remaining 80% is either arid or semi-arid and therefore characterized by low, erratic rainfall and periodic droughts. Kenya regularly suffers long periods of drought, resulting in huge crop failures and cases of famine are rampant given the dependence on rain-fed agriculture. The current debate on climate change highlights increased threat to crop production due to global warming and that Africa, for which Kenya is part, will be the worst affected. The environmental concerns include prevalence of drought and floods (UNEP, 2009). There is urgent need to seek alternative means of maximizing crop production and to develop technologies that would mitigate the likely hazardous environmental effects.

One promising area is the use of biotechnology for crop improvement. Agricultural biotechnology promises greater crop productivity (Qaim & Zilberman, 2003), sustainable environment (Braun & Amman, 2003) through less pressure on agricultural land and consequently less pressure on forests, less environmental damage by reduction in the use of synthetic pesticides (Krimsky & Wrubel, 1996), lower food prices and enhanced crop attributes. Crops that are drought- and soil salinity-tolerant have been developed through biotechnology while the significant contribution of biotechnology to agribusiness has also been demonstrated (Clark *et al*., 2002). In fact, biotechnology has been viewed by many as a potential second green revolution.

Constraints to biotechnology adoption

Biotechnology is a research-intensive industry requiring highly trained and dedicated scientists, expensive laboratories and manufacturing facilities, sufficient money and time to see a project through from its initial discovery to its implementation (Davis & Wales, 2003). These factors probably explain why biotechnology research is still in its infancy in Kenya, a developing country. Although the Kenyan government has trained a good number of scientific manpower in the life sciences sector, there is huge brain drain (Mohamoud, 2005) due to lack of incentives to retain the trained scientists to contribute to the country's economy. Other factors that have been blamed for the lack of biotechnology adoption in Kenya include lack of equipment and funding, lack of awareness, and lack of laws regulating the use of biotechnology facilities and products. With the recent passing of the biosafety bill into law, a whole new chapter in Kenya's biotechnology research has been opened.

Kenya stands to gain from agricultural biotechnology by focusing on drought tolerance, pests and disease resistance, improved soil attributes, and improved nutritional value. No doubt, several similar projects have been carried out successfully in the past in other countries and Kenya can learn a lot from such countries. Nevertheless, innovative research must be encouraged to make biotechnology more specific to both the Kenyan farmers' and consumers' needs. Innovation in biotechnology has been described as the sequence of activities by which an idea is transformed into a commercial product (Hall & Bagchi-Sen, 2002).

Strategies for enhancing biotechnology innovations in Kenya

Several studies have been done in many countries to understand innovation performance in the biotechnology industry. In Kenya, the following factors are considered as the best strategies toward a more innovative crop biotechnology industry:

1. *Increased public investment to research*

   Most public research institutions in Kenya do not undertake research due to lack of funds. The Kenyan government spends less than 0.5% of its GDP on Science and technology. In comparison, the United States of America (USA), which is the world leader in innovations, has been spending about 2.6% of its GDP on research and development with the current president pledging to increase that to 3% (Kanaracus, 2009). Increased funding for biotechnology would generate more interest in the subject and create need for more awareness, thereby leading to development breakthroughs.

2. *Building on entrepreneurial capabilities*

   There is great need for the government and the private sector to come up with projects that would translate the raw scientific knowledge among students and researchers into economic production.

3. *Reversal of the brain drain and/or retention of skilled professionals at home*

   There are several government-trained Kenyan scientists currently contributing to the wealth of other countries. According to the United Nations, an African professional working in the United States contributes about $150,000 per year to the US economy. Such Kenyan scientists in the diaspora should be persuaded to go back and contribute to their country by creating an environment conducive for research. The government should come up with programmes that will empower skilled scientists on their return home, at the same time continuously rewarding them for every breakthrough. While the government may argue that this would be an expensive process, they are already spending a lot of money to hire expatriates to fill the gaps that such brain drain has caused. Indeed, the Kenya-based Research and Development Forum for Science-Led development in Africa (RANDFORUM) has been exploring ways to repatriate intellectuals.

4. *Strengthening of supportive institutions and associated networks*
   There will be need for Kenya to set up her own centres of excellence and credible institutions for enhancing biotechnology innovations. There are a few centres of excellence in Kenya, but these are internationally run and Kenyans may have very little say on the management. Consequently, research products from these institutions seldom trickle down to the small-holder farmer. There is no doubt that with better organization, Kenyans themselves can set up similar centres, and carry out research that is more relevant to their own needs.
5. *Domestic and international collaboration*
   Currently, biotechnology research in Kenya is carried out by universities, national and international research institutes. Each of these institutes works more or less independently and therefore holds different views to different subjects. As a result, there is lack of consensus on how best to handle and respond to national research problems. There is also very little international collaborations. Research shows that collaborations between different bodies carrying out similar projects enable such entities to grow in their areas. The Kenyan government can promote more national collaboration through specific joint funding programs. International collaborations would also be necessary to enable technology transfer and broaden insights that would lead to more discoveries.
6. *Promotion of small biotechnology firms*
   Small biotechnology firms are almost non-existent in the Kenyan biotechnology industry. The industry is dominated by large international firms. This absence of small firms can be attributed to difficulty in finding financing. There is virtually no structured system of venture capital, which would otherwise make it possible to supply financial resources to support the setting up of start-up companies. Elsewhere, there is evidence that small- and medium-sized enterprises play a crucial role in the advancement of biotechnology industry (Kang & Lee, 2008). The government and the various finance institutions in Kenya should encourage the development of competitive small firms.
7. *Participatory research*
   Future research strategies in Kenya must consider the fact that resource-poor farmers have a contribution to make to the development of new technologies (Reece & Sumberg, 2003). For that reason, all agricultural biotechnology innovations will need to be linked to the farmers' and consumers' needs. Examining the needs and concerns of the farmers and consumers and then developing strategies or guidelines that would fit to their situation would be the best way of re-thinking innovation. Reece & Sumberg (2003) highlighted the fact that contribution of both farmer and researcher to innovations would be increased if the task of developing new technologies were passed on to farmers at the earliest stage at which doing so were feasible.
8. *Development of an explicit policy towards biotechnology*
   Educating Kenyan policymakers concerning the need to support and invest in biotechnology is a necessary step towards development of biotechnology-friendly policies. With such awareness, the government can contribute more by creating a regulatory environment that is more conducive to the development of biotechnology, introduce relevant tax breaks, improve the Kenyan patent system, and introduce import/export controls which promote the transfer of technology from more advanced countries.

Conclusion

Biotechnology has opened up opportunities that the Kenyan government can greatly benefit from. However, an interdisciplinary approach must be taken during implementation of various programs to ensure its success. The government has the biggest role to play to make it a success.

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