Postscript

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Adam Rutherford's blog in the UK's *Guardian* newspaper[1] speaks of how scientists responsible for many of the major scientific advances of the modern era are accused of playing God. '*It's not exactly clear what "playing God" actually means*,' he says. '*If playing God involves developing technologies that cure diseases, clean up pollution and create new forms of fuel, then these potential benefits need to be considered without the burden of vague, simplistic soundbites.*'

This restless quest for knowledge is nothing new. It means that science never stands still or can claim to be complete. Therefore this collection of essays is but a small part of what is happening in Africa, namely, African scientists working in African laboratories and using biosciences for African farming, and in particular for African smallholder farmers.

An impressive example is the International Institute for Tropical Agriculture (IITA) with headquarters in Ibadan, Nigeria and multiple centres in 15 African countries.[2] As a member of the Consultative Group on International Agricultural Research (CGIAR), it is a partner in the Cowpea Productivity Improvement Project, a public–private partnership project that brings together a variety of public, private, research, funding and advocacy organisations.[3]

Plans are currently under way to backcross a selected resistant cowpea strain into a local variety, but further developments depend on the adoption of a National Biosafety Law. If successful the Nigerian cowpea experiment could be used as a model for other West African nations, as in Burkina Faso and Ghana.[4] Nigeria is the largest producer and consumer of cowpea in the world; about 5 million of the total 12.76 million hectares of land are devoted to cowpea, which everywhere is grown mainly by women on small plots of land. It is the most important indigenous African legume in Nigeria because of its ability to grow in drought-prone areas and improve soil fertility. Cowpea pod borer (*Maruca vitrata*) is particularly detrimental to the success of the crop, with reports of crop yield losses as high as 70–80 per cent; overall, insecticides have been ineffective.

In Ghana, the confined field trials (CFTs) of genetically modified rice, cowpea and sweet potato are expected to last for at least three years. They will allow scientists to critically analyse seed quality and ensure the desired traits have been successfully introduced before being recommended for commercial production. The development of GM sweet potatoes aims to combat malnutrition in rural areas by increasing their content of essential amino acids, while GM rice varieties are needed to improve tolerance to drought and salinity in fields that have accumulated salts over the years, forcing farmers to abandon the land.[5]

Journalists provide an all-important link between the discoveries of scientists and their uptake into farming practice. Local African journalists who are B4FA.org Media Fellows[6] write of the encouraging expansion of plant breeding within the continent.

Government involvement

East African highland cooking bananas are a unique type of starchy banana that for centuries has been a major staple for millions of people in the Great Lakes region of East Africa. The crop suffers many productivity constraints that have led the national research systems to adopt advanced breeding techniques in order to provide resistant varieties for poor farmers. Scientists from Uganda and Kenya are engaged in an ongoing experiment in which green pepper genes, a gift from Academica Sinica, Taiwan, have been introduced into local bananas to enable them to resist the banana bacterial wilt (BBW) disease which is fast killing the crop and destroying livelihoods.[7] How this occurs is the subject of intensive research in public and private-sector laboratories as there is currently no commercial chemical, biocontrol agent or any resistant variety that could control the spread of BBW. Dr Andrew Kiggundu of the National Agricultural Research Laboratories, Kawanda points out that even if some BBW-resistant GM varieties were available soon, the legal requirements to guide implementation of the National Biotechnology and Biosafety Policy have yet to be passed. There is a growing realisation that governments play a key part in ensuring both safety and support for the future commercialisation of GM bananas and other African crops that have been bred to resist chronic diseases.

Michael J. Ssali in Uganda's *Saturday Monitor* (24 November 2012) speaks of the country's challenges – rapidly growing population, smaller plots due to fragmentation, exhausted soil mainly because of bad farming practices, farmers who lack the knowledge and financial capacity to apply modern methods to increase yields, and a small national budget for agriculture. But he reports how Ugandan researchers are hard at work to find ways to protect the crops that feed so much of their population. Conventional plant breeding cannot always solve the problems so biotechnology and GM crops have a role to play, particularly for crops as challenging to breed as cultivated bananas, which do not produce seeds and have to be propagated by cuttings.[8]

Even so, once one breakthrough has been achieved, it is a truism that another problem is often around the corner. Dr Africano Kangire of the Coffee Research Centre at Kituuza, Uganda, speaks of coffee wilt disease-resistant varieties which are now available through conventional plant breeding techniques. But then a new problem has surfaced – the black coffee twig borer – a new challenge that is fast reducing coffee yields.[8] So the task of the scientist is to keep one step ahead of the game.

Henry Lutaaya, a B4FA Media Fellow who writes for *Sunrise* in Uganda, says that increasing his knowledge and awareness about plant breeding was one method for beginning to take action about Uganda's food security: '*Journalists had the opportunity to learn about plant breeding concepts such as hybridization, tissue culture, genetically modified organisms.*' One of the most interesting aspects

International collaboration

A theme throughout the essays is the success of international collaboration.[9] Over 50 per cent of the world's cassava production occurs in Africa where cassava is used not only as food, feed and beverage but for products such as paper, wood, textiles and biofuels. The goal is to improve cassava's resistance to the viral diseases, cassava brown streak disease (CBSD) and cassava mosaic disease (CMD). This involves testing resistant varieties in the field for their stability against disease, and obtaining regulatory approval for making them available to smallholder farmers. The Virus Resistant Cassava for Africa (VIRCA) project engages the National Crops Resources Research Institute, Uganda, the Kenya Agricultural Research Institute (KARI), Kenya, and the Donald Danforth Plant Science Center, USA. Results under greenhouse conditions have been promising, as also have confined field trials in East Africa. The long-term aim is to deliver royalty-free improved planting materials for farmers. Scientist Dr Douglas Miano of KARI also emphasises that the VIRCA project helps to build the capability of local scientists in crop biotechnology; it is an application to an African crop by African scientists.

was the discovery that Uganda is itself a leader in plant breeding and biotechnology research – and the answers to Uganda's food security may very well lie in the hands of its own talented crop of researchers.[10]

In conclusion, we can look back to how farming emerged between hunting–gathering and settled agriculture about 10,000 years ago.[11] How our ancestors started to till the fields, plant the first seeds and select the best plants which began to change the genetic composition of plant populations. How this led to a gradual divergence between wild and cultivated members of plant species.

But in these essays we fast-forward to brilliant scientists of the present century who hunt for genes and gather knowledge about plant breeding – what information genes carry, what they do, how they can be selected, how they are controlled, and how they can be marshalled to help the challenges of a planet threatened by overpopulation, overconsumption and unequal distribution of its wealth and resources.

But there is a difference between acquiring knowledge and information and possessing wisdom,[12] and there is a proverb which says: '*Wisdom is supreme, therefore get wisdom. Though it cost you all you have, get understanding*'.[13] As science, technology and innovation bring to society their successes and rewards, they demand to be handled wisely[14] with structures of oversight and transparency of communication that ensure they are sustainable, safe and acceptable for consumers – all of us!

These essays are central to the B4FA project (www.b4fa.org) which has been designed to enlarge understanding of how the biosciences can help farming and food security in Africa. It seeks to capture the idea about which Nobel Laureate, Sydney Brenner, wrote recently: '*The whole of biology must be rooted in DNA, and our task is to discover how these DNA sequences arose in evolution and how they are interpreted to build the diversity of the living world. Physics was once called natural philosophy; perhaps we should call biology "natural engineering"*'.[15]

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References

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