HOUSEHOLD AND NATIONAL FOOD SECURITY IN SOUTHERN AFRICA

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BIOTECHNOLOGY: ITS POTENTIAL IMPACT ON FOOD SECURITY IN SOUTHERN AFRICA

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INTRODUCTION

I am a Scotsman, and a scientist by origin and training, but I am a Zimbabwean and an optimist by choice. I have two little girls who were born in Harare and they go to Groombridge school near the University. Perhaps that introduction allows me to ask a ridiculous question of you all. If you met a fairy with a magic wand or a genie who popped out of a bottle--as happens in the stories I read to my girls--what would you ask for if either one of them granted you the traditional three wishes? I shall give you my own answer a little later on.

Mahatma Gandhi once said, "There is enough in the world for everyone's need, but not for everyone's greed." His grandson, Rajmohan Gandhi has a habit of adding, "If everyone cared enough and everyone shared enough, then surely everyone would have enough." Food security has a lot to do with shifting the motives of men from predominantly selfish towards a degree of unselfishness. Some try to legislate and fail. So what to do? I am not unaware of the weaknesses of human nature, yet biotechnology offers a stunning array of movable genes and organic products that could transform our agricultural and rural health care potential. We need, and biotech could provide, a quantum leap in agricultural effectiveness and in primary health care. There are genes--or are they genies?--available in bottles today that, given competent scientists working for our advancement, could transform our lives here in Africa.

My rather crude needs analysis, from a survey of newspaper and radio and TV suggests the following aspects of food security that biotech might help on:

- We have unpredictable rainfall and a long dry season. An increasing proportion of the national herd of cattle each year finds it hard to make it through to the next rains. We need cattle fodder that can be grown and stored locally.
- Many SADCC countries play host to many refugees. I have heard it estimated that 250,000 might have died of starvation last year in Mozambique. That generates insecurity and hunger that must be resolved. We need to grow more food--there and here.
- As the price of beef goes up, the amount of protein our children receive goes down. We need more and cheaper animal and vegetable protein.

Our rural people are very quick to adapt a good thing. Witness how Zimbabweans have taken to hybrid maize, to Moneymaker tomatoes, to planting

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eucalyptus, even to growing Burley tobacco. If biotech has anything good to offer, I believe our peasants are wiser than we in choosing what they want and need. We need to make the offer, demonstrate what is available. Maybe it is cheeky of a *muzungu* to say so, but I have observed this over eleven years of commitment to Zimbabwe. Some biotech could be transferred to rural schools and growth points.

WHAT IS BIOTECHNOLOGY?

My assigned topic is "Biotechnology and its potential impact on Food Security in Southern Africa." Biotechnology can and does encompass many things. As it is currently rather trendy, it seems to encompass almost anything to do with biology, agriculture or medicine.

My definition will, however, be fairly narrow--simply because today I have been allotted 20 minutes. Biotech is an assembly of modern techniques which gives us skills in two broad areas: tissue culture and recombinant DNA manipulation. First, tissue culture allows us to culture, keep alive, animal and plant cells in the lab, in the petri dish, in the test-tube, under sterile conditions--which permits growth and development of those cells.

Some of these cells can be manipulated with hormones and nutrition and physical conditions to express their totipotency, i.e., their inherent ability to develop from a single cell into a whole plant, a normal plant. If you start with one cell you get one plant, but if you start with a thousand cells (e.g., leaf mesophyll cells) you can potentially finish with a thousand plants, a thousand copies, a thousand clones of an original cell. I speak of plants because in some plants this is now routine. In animals, cloning is confined to a few experimental animals derived from embryos removed, split, cultured, and reinserted into the mother. When brought to term, the mother delivers cloned identical sibs (twins, triplets, etc.). In humans, no one has dared try as yet, but it is technically possible.

Some cells in culture can be manipulated to force them to express desirable biochemical products like insulin or growth hormone. Yeasts and bacterial cells are good at this kind of thing.

Yet other cells can be fused to combine the characters carried by the two somatic parents. Thus, a lab in Nottingham Power has combined the bright colours of one parent with the scrambling habit of the other. He has produced a novel species of petunia to satisfy the lovers of hanging baskets who are longing for a beautiful petunia that cascades, falling gracefully over the side of the basket.

Some human cell lines can be fused to generate new cells that are both immortal (they can live forever in the test-tube because one parent was a cancer cell) and are able to produce some useful antibodies, also forever, because the other parent was a spleen cell). These products are called monoclonal antibodies and they are revolutionising diagnostics and could dramatically help primary health care capabilities.

The second group of techniques has to do with manipulation of DNA. Biochemists can analyse the genetic programme of life, the DNA in the cell--or at least bits of it. Then, they are in a position to synthesise genes to order--designer

genes. If you have done the work and know the sequences of the DNA, you can make the gene. You can also steal genes from one organism and offer them to the organism of your choice. Thus, you can take single genes fished out of a scruffy useless plant and sew them into a crop plant of your choice.

APPLICATION OF BIOTECHNOLOGY IN THE SADCC REGION

So much for the theory. I shall describe three practical examples of relevance to Zimbabwe and SADCC.

Disease-free clonal planting material.

In vegetatively-propagated plants, you start with good clean disease-free planting material. This goes for potato, sweet potato, strawberry, cassava, yam, *tzedza*, and many more stem- and root-propagated crops. It also goes for all flowers and fruits that are propagated by cuttings, many of which have a large export potential.

Normally, in the first cropping season you get a good yield, but then disease begins to take its toll--bacteria, fungi, viruses, and mycoplasms enter, debilitate the plants and travel round in the tubes reaching all parts. So next year, you plant with infected material and lose maybe 10-20% of your yield. The year after, it is down another 20% and the year after you are making a loss. Inputs exceed output. Our communal farmers never get clean stock to plant with, so their yields tend to be terrible. If you plant rubbish, rubbish will grow.

Comparatively low biotech--a tissue culture lab--can clean up the diseased material and redistribute it as disease-free plants. We have the capability and the product at UZ's Crop Science Department now for potato, cassava, and strawberry--plus some carnations and orchids and even hops--if you should want them. We need funding and capital to gear the potential up into a service or a business. To prove it is possible, I have started a plant biotech factory on a shoestring and the products will be marketed in 1989.

Introduction and multiplication of new varieties.

If someone elsewhere selects or engineers a good new variety, tissue culture will first allow you to import disease-indexed, phytosanitarily inspected material simply and with minimum risk. Second, it will allow you to multiply from a few plants, or even just one, to have a million within a year (or maybe two). We are in the process of doing this for sweet potato from South America, Asia, and Nigeria and also with carnations from Europe. On the way, with an early batch of 36 plants, we can carry out variety trials. By the time the trials give their verdict, we can have large quantities of each line multiplied and ready for release. In this way, you can save several years between acquisition and release. Similarly, you can multiply-up promising new varieties of, say, potato that your own breeders are producing so that while they are being tested in field trials, you have them multiplying in the lab--again saving several years of bulking-up prior to release.

These are two important services--the production of "disease-free" clean stock-

and the ability to import and multiply elite foreign lines--without which no SADCC country should be. The alternative costs you millions in lost production because you are always starting with poor material, or in lost opportunity because you never get to use the best of other nations' breeding and selections.

Genetic improvement by adding genes to established varieties.
This opportunity is the one that we should all consider carefully. How would you like stemborer resistant maize? How would you like a cotton crop that resists the pink bollworm? How about potato, or tomato, or tobacco crops that are totally unaffected by a chosen herbicide? (This means that instead of spraying 2-6 times to protect your crop from weeds you can spray only once or twice and your crop is not even set back a day by the herbicide).

These are not fairy tales, not dreams, not wishful thinking, or ivory tower discussion points. The technology is available now, the resistant plants exist. I have seen them and handled the plants in other people's labs in Europe and America. The vital genes are becoming available, perhaps even in the public domain. I supervise a Zimbabwean student working on one of these revolutionary improvements. Another student is setting about cloning elite coffee for the Coffee Growers Association. A third is multiplying cassava he has selected that yields in excess of 40 mt/ha/year.

This year Zimbabwe is proposing to spend Z$17 million on herbicide and Z$ 20 million on insecticide. This year Zimbabwe will lose Z$10 million of its maize crop to the stemborer--whatever insecticide the farmers might pour on to destroy it. The pink bollworm will gobble up, despite sprays if you can afford them, many more millions worth of our peasant farmers' yield of cotton.

POTENTIAL ECONOMIC AND SOCIAL IMPACT OF BIOTECHNOLOGY

For three million dollars, we could build a Biotech Institute. We could employ Zimbabwean scientists and pay them a decent salary to do exciting work. It could be self-financing in three years because it would save a large slice of that $Z37 million and all of that Z$10 million I mentioned earlier. We could then supply high-quality planting material and genetically-improved seed for Zimbabwe, for SADCC if they wish, and for Africa. We could even train the scientists needed to sustain this kind of effort in our neighbouring countries. The seed produced would have, permanently, the added qualities of resistance to chosen viruses, chosen caterpillars, chosen beetles, selected herbicides, and maybe one day chosen fungi. Please take note that what we are looking at here is a reduction in chemical inputs; a reduction in foreign exchange needs; a reduction in labour on the farm; a reduction in disappointments when insects consume a hard-won yield; and a reduction in chemical excesses assaulting the soil, the water, and the environment. Also, of major significance is that all these reducing factors will bring the use of these modified

seeds and plants into the grasp of the rural, communal farmer. His (her) main difficulty is said to be lack of cash to buy inputs: as we reduce the need for these very inputs, we bring the fruits of good biotech to the rural doorstep or at least the local school, or store, or growth point.

At this point, I should say that well-considered and well-planned endeavours with good biotech could be one of the means to the end of "sustainable development" that was so ably argued for by the *Brundland Report* and by the Technical Advisory Committee (TAC) of CGIAR in its 1988 *Report on Sustainable Agricultural Production*.

A fourth example, for which we have no time, is the big question of genetically-engineered vaccines. Four separate vaccines for malaria are on trial right now in pilot work. The early ones are not yet too effective, but they will improve. Big teams are working on schistosomiasis vaccine. A French team has tested one successfully on mice, rats, monkeys, and baboons. We await eagerly the news of careful human trials. In fact, should we not offer to help in the testing? Can you imagine an Africa free of malaria, free of bilharzia, free of these debilitating, parasitic diseases? That is my dream, those are the three wishes I would ask of my good fairy--or is it the scientist with his genie captured in his mysterious bottle? I would ask for a chance to play a part in ridding Africa of hunger, of disease, and then with a bit of luck and an honest administration, we could also eliminate the burden of debt.

HOW IS ALL THIS POSSIBLE?

Biotech can be used for good and for bad. We could engineer terrifying new weapons. We could irresponsibly release crazy combinations. Some high tech applications could put some of the third world crops out of business. Vanilla and cocoa are being worked on. The answer is not to ban it or to boycott it, but to design sane policies putting biotech to work for our interests before other users gain a monopoly.

In this context, I have some guidelines that I personally aim at when deciding what to do with my time:

- o If we grow enough food for our own nation, we will insulate ourselves from world economic forces that we cannot control, so we generate the dignity that springs from self-respect.
- o If we export more than we import, we create autonomy where not even the World Bankers will want to tell us what to do. So comes self-sufficiency.
- o If we choose to help our neighbours where we can, we will generate self-control at home, and reap future security in our region.

To achieve the potential described above, we need:

- o a Biotech Institute;
- o master's programme in Biotech in SADCC;
- o to negotiate for access to the genes of interest to us (this involves honouring plant breeders' rights and international patent law); and
- o decent funding for graduate students and post-doctoral candidates to tackle these exciting goals.

I intend to give it a go--and am looking for anyone who wants to help.

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