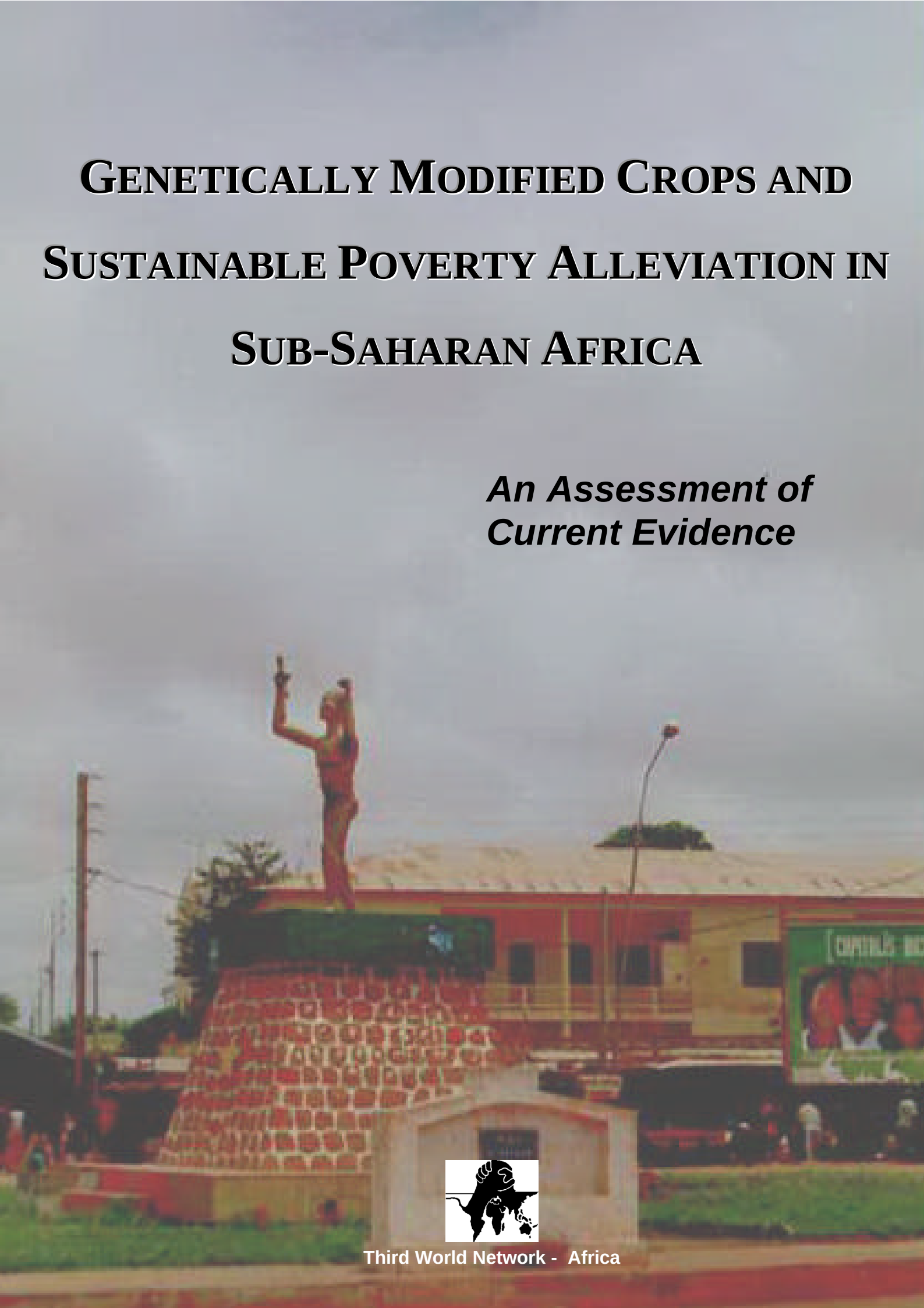
GENETICALLY MODIFIED CROPS AND SUSTAINABLE POVERTY ALLEVIATION IN SUB-SAHARAN AFRICA

An Assessment of Current Evidence



Third World Network - Africa

Genetically Modified Crops and Sustainable Poverty Alleviation in Sub-Saharan Africa

An Assessment of Current Evidence

Aaron deGrassi

Abstract:

This paper recasts the debate over biotechnology by moving past overly general hyperbole, and instead empirically evaluating current experiences with genetically modified crops in Africa. The debate is moved from hypothetical risks, to actual results. The 'appropriateness' of GM cotton, sweet potatoes, and maize is evaluated using six criteria widely accepted in crop breeding: demand led, site specific, poverty focused, cost effective, and institutionally and environmentally sustainable. Virus-resistant sweet potatoes are not demand driven, site specific, poverty focused, cost effective, or institutionally sustainable. The environmental sustainability of modified sweet potatoes is ambiguous, but not great. B*t* cotton scores low on criteria of demand drive, site specificity, and institutional sustainability. It has ambiguous poverty focus and cost effectiveness. Environmental sustainability is currently moderate, but could potentially be moderate to strong. For B*t* maize, the analysis shows low demand drive, cost-effectiveness, and institutional sustainability. It is too early too detect unambiguous site specificity or poverty focus. Environmental sustainability is currently low to moderate, but could potentially be raised. I conclude by examining potential reasons for considerable attention to these three crops despite their generally inappropriate nature for poverty alleviation in sub-Saharan Africa.

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Executive Summary

This paper goes beyond the debates about hypothetical potential benefits and/or risks of genetically modified crops for small farmers in sub-Saharan Africa. I identify five widely accepted criteria for evaluating conventional crop breeding, and apply these to three heavily publicized genetically modified crops either currently grown or nearing release: stem borer-resistant Bt maize, weevil resistant Bt cotton, and virus resistant sweet potato. The five criteria include: demand-led, site-specific, poverty-focused, cost-effective, and environmentally and institutionally sustainable.

The Criteria
Simply because technologies exist is not sufficient reason to utilize them—criteria are needed to select which technologies are best to develop and disseminate. Crop breeding has come to recognize that different farmers in different areas have different constraints, so agricultural research will have to generate **site-specific** varieties. To ensure that research programs respond to farmers' diverse, changing priorities, research must be led by the **demands of poor farmers**. Further, they recognize that these constraints encompass not only technical measures, such as yield, or pests, but socio-economic ones such as marketing, or labor requirements. Increasingly, researchers are **focusing their attention on poor farmers** facing difficult agro-ecologial and socio-economic conditions. Gone are the days when new technologies were thought desirable simply by virtue of being new or 'modern'; there is now a recognized need to prioritize and choose the most **cost-effective** technologies among the many at our disposal. **Environmental sustainability** encompasses not just second-generation affects of the Green Revolution (such as pesticide affects on ecology and human health), but also basic problems such as soil fertility. Donor fatigue has illustrated the need for **institutional sustainability**.

Sweet Potatoes
Virus resistant sweet potatoes are being developed jointly by the Kenyan Agricultural Research Institute (KARI) and Monsanto, with additional funding from USAID and the World Bank. The initiative was not the result of farmers priorities or preferences, but, rather, resulted from pressure and existing technology of Monsanto and American scientists. This inattention is understandable given the poor links between researchers, extensionists, and farmers in Kenya. Indeed, many farmers already have virus-resistant sweet potatoes, and for many others, different problems, such as weevils, are more important.

To date, one unpopular variety has been genetically modified with a protein protecting against an American strain of the virus. The variety has not been tailored to meet farmers numerous site-specific preferences for sweet potatoes (there are more than 89 different sweet potato varieties in Africa).

Sweet potatoes are an important food security crop, particularly for women, and are grown predominantly in East Africa (Uganda, Rwanda, Burundi, Kenya, and Tanzania). Poverty in these areas, however, does not result from inadequate sweet potato varieties, but rather from corruption, HIV/AIDS, declining migrant incomes, declining commodity prices, armed conflict, and large inequalities in land, wealth and income. Kenya, for instances, reportedly loses 180 times more money to corruption than to sweet potato viral diseas. In the face of these constraints, the benefits of the new sweet potato are relatively insignificant.

While econometric evaluations forecast a significant rate of return on the project (using a maximum projected yield gain of 18%), it did not consider opportunity costs. The sweet potato project is now nearing its twelfth year, and involves over 19 scientists (16 with PhDs) and an estimated $6 million. In contrast, conventional sweet potato breeding in Uganda was able in just a few years to develop with a small budget a well-liked virus-resistant variety with yield gains of nearly 100%.

In terms of environmental sustainability, as with the examples below, GM-resistance in sweet potatoes is conferred by one gene, and hence one would expect, according to the principles of evolutionary ecology, that new resistant pests would evolve. Evolution of pest resistance will depend however on the extent of selection pressures (which depends partly on how widely distributed the Bt varieties become).

The dependence on Monsanto for funding lowers the institutional sustainability of the project. The project has resulted in considerable training of KARI scientists in biotechnology transformation methods, and in bio-safety testing. However, such discipline-specific capacity building in biotechnology may produce a 'lock-in' affect diverting resources from other potentially productive issues and methods.

Cotton

Cotton differs somewhat from the other two crops because it was not developed in collaboration with a public agricultural research institute. Rather, Monsanto developed Bt cotton for American farmers, and then transferred the technology to large farmers in South Africa, and it has now reached the handful of smallholder cotton farmers in South Africa. The agricultural research and extension system in South Africa has historically been biased towards large, commercial, white farms, and is only slowly being transformed. It remains heavily top-down, gender biased, unable to reach poor farmers with relevant messages or forums. Smallholder demand was insignificant in the development of the technology.

The Bt cotton used in Makhathini was not tailored to the area or poor farmers at all. The variety was simply transferred from the US, where it was developed for large farmers and their main pest, the American bollworm. In South Africa, however, the pink bollworm prevails. Also, the Bt cotton varieties had smooth leaves, in contrast to South African hairy leaf varieties, and are thus susceptible to damage from jassids. Other new pests, such as sting bud, have appeared on the Bt cotton.

Poverty in the area is not caused by poor cotton technology, and, in fact, the new technology may be impoverishing smallholders by contributing to over-production, and hence lower prices, in South Africa and worldwide. Since the introduction of Bt cotton in South Africa, prices have fallen by 40%, and more than 60,000 farmworkers in the cotton sector—one of the poorest segments of society—have lost their jobs. Flood-related cotton crop failures have left small farmers who adopted the expensive modified cotton with debts of $1.2 million. However, poverty in Maputaland—the area where the Flats are located—results not from inadequate technology, but rather from seven factors related to the lack of political and economic power of poor rural South Africans: unequal land holdings and slow redistribution, authoritarian nature conservation, elitist tourism, declining off-farm wages, declining international commodity prices, HIV/AIDS, and undemocratic traditional authorities.

The effectiveness of the technology appears to have been over-rated. Proponents claim using Bt eliminates 9 sprayings, evidence shows it eliminates only 2-5. The amount of labor saved is also unclear. Alternative technologies, such as Integrated Pest Management, or agro-ecological measures, have not been explored to their full extent.

With regard to environmental sustainability, Bt cotton has reduced pesticide usage—with benefits to the environment and human health—but there are concerns regarding the impact upon natural enemies, as well as the possibility of evolving resistance to the Bt protein. Refuges and gene stacking/pyramiding could help delay this resistance, but have not been implemented/developed so far. Cotton does not have relatives in Africa from which 'super weeds' could evolve. Hence, overall, environmental sustainability is moderate, and could be stronger.

As a largely private marketing venture, there has been little institutional capacity building. A Monsanto-funded farmer school has not produced any significant innovations. It has not helped to reform—and may have exacerbated—South Africa's disconnected and top-down system of agricultural research and extension.

Maize

The Syngenta Foundation is supporting work at KARI with CIMMYT (the International Maize and Wheat Improvement Center) to develop Bt maize that is resistant to the stem borer through the Insect Resistance Management in Africa (IRMA) project. Several varieties have been developed by CIMMYT in Mexico, and are awaiting bio-safety clearance to begin testing in Kenya.

Like the sweet-potato case, the deficiencies of the Kenyan RE system have impeded a demand-led approach. The Syngenta Foundation—a merger incorporating Novartis—has a poor record of supporting client-driven public agricultural research institutes, as illustrated by the Cinzana research station in Mali. The extent of damage by stem borers was repeatedly over-estimated based on ad hoc guesses. No rigorous assessments were done before the project was started of the extent of damage by stem borers, nor of whether farmers felt they were a significant problem. When the project did survey 30 villages throughout the country, none identified stem borers as the most pressing constraint upon maize production. As with sweet potatoes, project surveys found that many farmers were already using their own resistant varieties.

Scientists have transformed several maize varieties with different Bt strains—developed initially by Novartis and CIMMYT—able to protect against 3 types of stem borers. However, they have yet to engineer protection against the most important stem borer in Kenya, which affects 80% of the country's maize crop. Rural surveys have identified potential suitable local varieties to transform, but due to biosafety procedures, none have been engineered yet. Farmers prioritize numerous different characteristics of maize, and to be acceptable, numerous different appropriate varieties will have to be identified and successfully transformed.

Maize is one of the most important crops in Africa, and is a basic staple for much of southern and eastern Africa, where stem borers predominate. However, stem borers are a relatively insignificant contributing factor to poverty in these areas. Of greater importance are other agronomic constraints—such as droughts, low soil fertility, and the weed *Stiga*—as well as

other socio-economic and political constraints—such as corruption, HIV/AIDS, poor transport, unequal land tenure, and political repression.

The cost effectiveness of the project is still based on ballpark projections. In contrast, other less generously funded projects have used a range of techniques and already proved capable of protecting against stem borers in farmers fields. As early as two decades ago, conventional crop breeders had identified and were working to improve borer-resistant varieties. Farmers have long used their own techniques, such as disposing of crop residue, changing the time and type of crop planted, or adding soil, pepper, or ash into leaf whorls. Biological control methods—supported by the Dutch government—have been used to control the Asian stem-borer by introducing a wasp that is its natural enemy from Asia. The International Center for Insect Protection and Ecology (ICIPE) coordinated this project and the Asian wasp has now established itself in Kenya, Uganda, Tanzania, Mozambique, and several other countries, and is rapidly expanding. ICIPE has also developed economically viable 'push-pull' methods of intercropping using grasses that repel borers out of maize fields and pull them towards farm edges, and that have the added benefits of restoring soil fertility, reducing *Striga*, and providing livestock fodder. The methods—which have shown to reduce borers to negligible levels—have been tested in farmers' fields and are already being adopted.

There are serious concerns regarding the environmental sustainability of Bt-maize, given the likelihood of evolved pest resistance. The IRMA project is attempting gene stacking, as well as using conventionally developed resistance. Refuges may exist by default, but could disappear with widespread cross-pollination with Bt varieties. Another possibility is that the composition of stem borers may shift, so that African types (to which Bt maize is still susceptible) become more prevalent, as already observed in some areas.

The institutional sustainability of the project is very similar to the sweet potato project, with complete reliance on company funding, and the possibility of a locked-in focus on genetic engineering of certain traits.

Summary

To summarize, virus-resistant sweet potatoes are also not greatly demand driven, site specific, poverty focused, cost effective, or institutionally sustainable. The environmental sustainability of modified sweet potatoes is ambiguous. B*t* cotton scores low on criteria of demand drive, site specificity, and institutional sustainability. It shows ambiguous results in poverty focus, and cost effectiveness. Environmental sustainability is currently moderate, but could potentially be moderate to strong. For B*t* maize, the analysis shows low demand drive, cost-effectiveness, and institutional sustainability. It is too early too detect unambiguous site specificity or poverty focus. Environmental sustainability is currently low to moderate, but could potentially be raised.

There has been a great deal of excitement over these new engineered crops despite their low suitability. **The maximum gains from genetic modification are small**, much lower than with either conventional breeding or agroecology-based techniques. The heavy publicity may be due to the politicized international debates about genetically engineered crops. In particular, biotechnology firms have been eager to use philanthropic **African projects for public relations purposes**. Such public legitimacy may be needed by companies in their attempts to reduce trade restrictions, biosaftey controls, and monopoly regulations.

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List of Abbreviations

ANC	African National Congress
Bt	Bacillus *thuringiensis*
CIP	Centro International del Potato
CIAT	Centro International de la Agricultura Tropical
CIMMYT	Centro International del Mejoramiento del Maíz y Trigo.
EU	European Union
GM	Genetically Modified
ha	Hectares (1 ha = 2.47 acres)
ICIPE	International Center for Insect and Pest Ecology
IFP	Inkatha Freedom Party
IITA	International Institute of Tropical Agriculture
IMF	International Monetary Fund
IPM	Integrated Pest Management
IRDP	Integrated Rural Development Project
IRMA	Insect Resistant Maize for Africa
ISAAA	International Service for the Acquisition of Agri-Biotech Applications
KARI	Kenya Agricultural Research Institute
KCC	Kenya Cooperative Creameries
KZN	KwaZulu Natal
R&E	Research and Extension
SDI	Spatial Development Initiative
SPCSV	Sweet Potato Chlorotic Stunt Virus
SPVD	Sweet Potato Virus Disease
SPFMV	Sweet Potato Feathery Mottle Virus
USAID	United States Agency for International Development
WTO	World Trade Organization

1. Introduction: Criteria for Evaluation

The global debate over genetically modification is particularly heated, and even more so when it comes to the potential for gain or harm in Africa. This paper seeks to contribute to grounding this debate in empirical evidence, rather than proclamations or speculations. There is a great wealth of experience from which all interested parties can learn—few people, for instance, are aware that transgenic sweet potato research has been conducted for the past 13 years. I recast the debate by focusing less on hypothetical health and ecological risks and experience from elsewhere, with more of an emphasis on examining the current potential of those genetically modified crops that, according to proponents of genetic engineering, hold the most promise for alleviating hunger, poverty and environmental degradation in sub-Saharan Africa. I evaluate how "appropriate" each technology is for sustainable poverty alleviation, using six criteria: demand led, site specific, poverty focused, cost effective, and environmentally and institutionally sustainable.

It is important to evaluate the appropriateness of different technologies for poverty alleviation in Africa. Simply because technologies exist is not sufficient reason to utilize them—criteria are needed to select which technologies are best to develop and disseminate. An analogy might clarify the point: one would not use lasers to cut tomatoes, simply because lasers seem more "advanced" or "scientific," when a good-quality knife would do the job much better, and at a fraction of the cost. The crucial point is not to choose between "science" *or* "superstition," or between "new technology" *versus* "old tools." Rather, this report addresses some crucial questions that all involved need to ask: Which type of science? Which type of new technologies? Who decides? And how?

Demand Led

The concept of participation by poor people in the projects and policies that affect their lives has now become widespread in the practice of international development. Participation in decision making, implementation, and evaluation has numerous benefits, including ensuring effective use of resources, ensuring ownership, mobilizing local resources, building local capacity, and ensuring responsiveness and accountability.[1] Participation has also come to be seen as a fundamental right of citizens.[2]

Farmer participation and "demand" is also now recognized as critical to ensuring appropriate agricultural research for small farmers.[3] The World Bank's strategy for rural development emphasizes "demand-driven and financially sustainable national research and extension systems."[4] A major technology review by the UN Economic Commission for Africa stresses "giving a voice in priority setting to membership-groups that are truly representative of resource-poor farmers."[5] "Demand-driven, participatory and pluralistic national agricultural research systems" are emphasized by Africa Strategy document of the foremost worldwide research network, the Consultative Group on International Agricultural Research (CGIAR).[6]

The consequences of not involving farmers in determining research priorities have become clear. Some of the most-experienced analysts of crop research have shown (quite to their own dismay) that scientists' priorities have, by and large, come to be determined *not*

according to organized analyses and expression by poor farmers' of their own needs. Rather scientists' research topics and methods are determined, in practice, in a scattered fashion by the particular interests of each individual researcher. These interests involve peer recognition in international scientific circles, their colleagues' interests, journal literature, bureaucratic promotion, sources of funding, unresolved scientific enigmas, demands of larger and more influential farmers, disciplinary training, and allegiance to one commodity or another.[7]

Already, "citizens' juries" have been conducted, in which different spokespeople present their case for or against biotechnology, using evidence and before a jury, much like an informal courtroom.[8] These forums can help to share differing viewpoints, encourage awareness and involvement in priority setting and decision making. However, they can also be shallow, token exercises allowing companies and governments to claim they have consulted "the people," as appears to be the case with the British national debate.[9]

To transmit farmers' demands, one needs a democratic government, and a decentralized system of research and extension (R&E) and strong, representative, well-linked farmers organizations.[10] By "decentralized" is meant a system wherein significant powers and resources have been securely transferred to local governments that are representative and downwardly accountable to, and bureaucrats responsive to, their constituents. Two dangers in decentralization are that central powers will resist transferring powers or resources, or powers and resources will be transferred to local actors that are not accountable, representative or responsive.[11]

Site Specific

Farmers have multiple constraints that are highly site- and farmer-specific. Thus, demand-led research should address these constraints, whereas research motivated by other reasons is likely either to not be adopted, to be adopted only by certain groups, or to have unintended consequences where it is adopted.[12] Examples are rife: hybrid maize taking too long to mature, Asian rice easily overcome by African weeds, new millets failing on infertile soils, prolific cassava too large to process.[13] If new crops are to be adopted and benefit poor farmers, the crops must be attuned to biophysical constraints, which can include soil fertility, growing season, rainfall, diseases, weeds, and pests. They must also be well suited to socio-economic factors, such as time of planting, amount of labor needed to sow, harvest, process, market, etc. These factors vary between farms and farmers, as well as over time.[14] Much research seriously underestimated the extent of farmer diversity, not least within households, as scholars of gender clearly showed.[15] It sought to identify homogeneous "target groups" to which blanket recommendations could be given.[16] Addressing farmer diversity entails tailoring research innovations to site-specific requirements.

Poverty Focused

This criterion encompasses two considerations: (1) research addresses crops that are grown by poor farmers, and that have significant potential for alleviating poverty; (2) research will only be effective if there is a conducive environment—shaped by external factors beyond the farm field—making production of the crop (and production in general) profitable or not.[17]

Early agricultural research was concerned with aggregate food supply—important for national security—and focused on a few main crops grown by relatively large farmers in favorable conditions. The African famines of the 1970s and 1980s—caused by a confluence of political repression, perverse domestic and international economic fluctuations, and lower rainfall—had the effect of focusing more attention on technical measures to improve the productivity of small-holding African farmers. Emphasis grew on targeting agricultural research to farming systems of the poor, with their complex combinations of obscure crops, and difficult bio-physical and socio-economic conditions.[18]

Agricultural researchers subsequently lost sight of the importance of broader economic and political conditions in determining the viability of farming. Research became dominated by agronomists and scientists and their narrow technical concerns. Slowly but surely they entrenched a blindness towards the ways in which economic policies and political structures influence farming systems and productivity improvements.[19]

Using a "poverty focus" criterion encompasses whether the constraints addressed by each GM project are actually underlying or root causes of poverty. If they are not, then the GM solutions will remain superficial solutions. In fact, they may exacerbate poverty by giving false hope, by giving the illusion that governments are responding to the needs of the poor whilst officials deepen political malfeasance and unfavorable economic policies.

Cost Effective

Two issues are actually contained in this criterion: the more narrow concern with the economic viability of the technology at the farm level, and the broader concern with finding the most productive allocation of scarce research funds.

In agricultural research there has frequently been an over-emphasis on measurements of short-term yield of one crop per hectare. What matters to farmers is the expected returns to their inputs (which, in addition to land, include cash, inputs, and labor). Developing farm accounting models that actually reflect farmers' site-specific conditions and constraints can often be extremely difficult for formal economists to model, given the changing, diverse mix of factors that even a single farmer must take into consideration.[20]

One has to take into account different technologies that might achieve the same objective. Particularly in developing countries, there are tradeoffs in research, and finances, capital, human expertise, and intellectual energy that go towards developing one technology, limit the amount that can be devoted towards another. It is thus of crucial importance to study the poverty alleviation potential of different technologies, and focus on those ones that are most promising.

However, many studies evaluating the impact of research programs fail to consider the "opportunity costs" of allocating funds to one project versus another. Instead, analysts focus on a measure called the Rate of Return (RoR–essentially an account weighing benefits against costs over time).[21]

Environmentally Sustainable

Much of the concern has been with the so-called "second generation" effects of the Green Revolution, and over-use of agro-chemicals, such as pesticides, herbicides, and chemical fertilizers.[22] Gains in productivity did not prove sustainable, as new pests evolved resistance, and soil health broke down.[23] Excessive use of these inputs was uneconomical and had adverse affects on human health and ecology. However, in Africa, some argue the problem of sustainability has to do with too little use of inputs, rather than too much.[24]

What this criterion is used to evaluate is the net impacts of GM trait. Much of the debate on biotechnology has focused on the impacts of outcrossing, and of the effects of introducing new levels and forms of chemical expressions into ecosystems. These are important matters, but have not been studied adequately. Other crucial considerations include the likelihood of the development of resistance by pests to genes. Equally, one has to consider non-germplasm effects, for example on the use of soil fertility or agro-chemicals. I also consider impacts on human health here.

Institutionally Sustainable

Institutional sustainability means that sustainable sources of funding have been secured for technology planning, development, evaluation, adaptation, and extension into the future. There are already too many innovations that have been developed by researches, but have been neither disseminated nor adopted—they remain "on the shelf."[25]

Attention to institutional sustainability is crucial because many national agricultural research and extension systems already lack the basic funds, staff, equipment and organizational experience to effectively carry out even rudimental activities.[26] National systems have suffered from a lack of political commitment by national governments to funding agricultural research, as well as dramatically declining donor assistance to agriculture during the 1990s. Further, structural adjustment programs in the 1980s and 1990s entailed pursuing balanced budgets, and often expenditure had to be cut. At the same time, the number of scientists has been increasing—justifiably, given that increasing numbers of people and challenges—with a consequent reduction in funding per scientist.[27]

Consequently, the bulk of funding for biotechnology research and development comes through foreign donors—50% of the funds in Kenya, and 67% in Zimbabwe, for example.[28] The adverse impacts of un-coordinated, poorly monitored donor funding on the responsiveness and downward accountability of public services is increasingly being recognized.[29] Governments become accountable to donors, rather than their citizens. Policies and programs are changed to fit project funding cycles, rather than peoples' needs.[30] When projects are cut short due to unsustainable funding, the result is fragmentation, unfulfilled expectations, failure to capture learning-by-doing benefits, and bias towards early adopters.

Continued donor financing of "stand alone" agricultural research and development projects is out of line with the general shift towards budgetary support and participatory national planning.[31] A review of the World Banks' Sustainable Financing Initiative for agricultural

research in Africa emphasizes donor cooperation and coordination, as well as "the need not to overlook various investments in continued human resource and organizational capacity building."[32] Coordination at the national level must also be match at the sub-regional and regional levels by participating in various area-based and commodity-based research networks, such as the East African Rootcrops Network (EARNET).

Applying the Criteria

The arguments for biotechnology have been framed in relatively crude terms, perhaps because much of the critiques of biotechnology have also been simplistic. Conventional planning, evaluation, and priority-setting criteria and methodologies have not hitherto been well used with regard to genetically modified crops, at least for Africa.

The following three case studies examine the most advanced programs to develop and/or disseminate GM crops for small farmers in sub-Saharan Africa. It is important to note that genetic modification is one form of biotechnology—others include tissue culture, molecular markers, and embryo rescue. The results of this study should are thus limited to genetically modified crops, rather than to the use of biotechnology more generally. However, the criteria used in this evaluation are equally applicable to development and dissemination of other non-GM agricultural biotechnologies.

2. Virus-Resistant Sweet Potatoes

The Portuguese brought sweet potatoes from South America to Africa several hundred years ago, and it has subsequently been adopted and adapted by farmers, primarily in eastern and central Africa. Sweet potatoes engineered with a gene coding for resistance to Sweet Potato Feathery Mottle Virus (SPFMV) are perhaps the most widely cited example of the benefits that genetic engineering holds for African farmers.[33] Florence Wambugu, a Kenyan scientist turned advocate has publicized the project in several pro-biotech editorials in *Nature* and *The New York Times*, has appeared on *CNN* and the American television shows *60 Minutes* and *NOVA*, and has recently authored a book on the subject, *Modifying Africa*. Beyond Wambugu's stories, the project has garnered enormous publicity, and some rather fantastic claims have been made.

Sweet Potato Feather Mottle Virus (SPFMV) does not cause significant problems on its own, but when it combines with another potato virus—Sweet Potato Chlorotic Stunt Virus (SPCSV)—it forms the damaging Sweet Potato Viral Disease (SPVD), which can reduce a plant's yield by up to 80%.[34] The plant becomes stunted, with distorted veins and leaves. However, SPVD, although a nuisance in some cases, is not a primary constraint on sweet potato production, nor is it a significant cause of food insecurity, let alone famine. SPFMV is only one relatively small factor among many problems that constrain production.

Demand Led

Closer examination reveals that the sweet potato project resulted from pressures by American officials and business, rather than through a participatory process by the Kenyan agricultural research and extension system designed to meet poor farmers' needs.

The sweet potato project began in 1991 as the idea of three American men: Ernest Jaworski and Robert Horsch at the US-based seed and agro-chemical transnational company Monsanto, and Joel Cohen at the United States Agency for International Development (USAID).[35] The sweet potato was one of the first crops to receive significant work involving genetic modification. C.S. Prakash, a prominent and lively pro-biotech figure in current debates, began his foray into agricultural biotechnology by attempting to transfer Bt into sweet potato in order to provide resistance against weevils.[36] In a previous project, also widely publicized as a pro-poor public-private partnership, Monsanto had transferred its transgenic virus-resistant sweet potato technology to Mexico, but the GM varieties appear to have been taken up only by large-scale commercial farms.[37]

The three Americans recruited a Kenyan scientist, Florence Wambugu, who had recently finished her PhD thesis in England on sweet potatoes. USAID funded a three-year post-doctoral position for Wambugu at Monsanto.[38] Wambugu and two additional American men decided to focus on SPFMV. They would attempt to protect against the virus by inserting a coat protein gene from a clone of the American SPFMV strain *rc*, which they obtained from Dr. Jim Moyer at North Carolina State University. Monsanto, with facilitation and financial

support from USAID, worked with Kenyan scientists from the Kenyan Agricultural Research Institute (KARI), who traveled to Monsanto's laboratories in St. Luis, Missouri.

A Kenyan scientist, Duncan Kirubi, at a Monsanto laboratory in St. Luis, with a company biologist, Maya Kaniewski.

Wambugu claims that she chose to research SPFMV because the crop "is a major staple. It is always there in the backyard if there is nothing else to eat. My mother grew it. I know it." Without much empirical support, she claimed, "there was a well-defined need to generate resistance to the virus."[39] However, at that point, no studies had been made measuring the incidence of SPFMV in any of the countries in Eastern Africa. Nor had farmers' organizations identified the disease as a central priority.

Those were the American pressures, but what about African demands? If the researchers had consulted with farmers, they would have found that many farmers were already using varieties resistant to both SPFMV and SPVD.[40] In a survey of seven districts in Uganda and Tanzania, for instance, 75% of farmers said they had access to virus-resistant landraces.[41] A popular local variety, *New Kawogo*, is actually both SPVD-resistant and high yielding.[42] Other varieties, while not completely resistant, can recover strongly from SPVD.[43] Unfortunately, neither KARI nor Monsanto have made any efforts to explore the possibility of promoting local resistant varieties through farmer-to-farmer exchanges.

In fact, it is the exotic varieties of sweet potato—introduced for their early maturation and purportedly high yields—that are susceptible to the disease.[44] Consequently, incidence of disease varies dramatically: in some sampled fields it is as high as 68%, in others only 0.2%.[45] Where plants are susceptible and are infected, farmers simply remove the affected individuals and plant clean cuttings—this is routine in East Africa and has been successfully executed on half a million hectares in China (although there are questions regarding the rate of re-infection during the first season).[46] A regional network on sweet potatoes noted "above all, the lack of clean and good quality seed from improved varieties hampers increase in yield and the expansion of potato and sweet potato production."[47]

Assessments of agricultural research in Uganda have repeatedly emphasized the importance of involving farmers in evaluation, priority setting, research and dissemination if new technologies are to be adopted and effective.[48] The importance of farmer participation and demand was also stressed by the World Bank as a key lesson from its past projects in Uganda—the largest sweet potato producer in Africa: "Greater involvement of stakeholders in research planning and budgeting, including research priority setting, budgeting and assessment of results obtained, ensures the relevance of the research programs."[49]

In fact, the World Bank noted, the crucial problem was *not* the need for more, better, or high-tech research, but stronger linkages with farmers:

> The low productivity observed in Ugandan agriculture today is not the consequence of a lack of research activity … With regard to the lack of available technologies, this is a problem which does not currently exist in Uganda … The low productivity of Ugandan farmers can be traced to a lack of adequate interface between research and extension, on the one hand, and farmers on the other. Correspondingly, at present, farmers' needs do not sufficiently drive the orientation of research and extension efforts (causing lack of relevance) …[50]

The same is true in Rwanda.[51]

In Kenya the situation is even worse. Since 1982, four major World Bank projects totaling almost $60 million have attempted to make the Kenyan agriculture and research system function to help poor farmers; they have largely failed. A recent review by the Operations Evaluation Department is scathing:

> The Kenyan system lacks a focus on farmer empowerment. It is based on a traditional top-down supply-driven approach that provides little or no voice to the farmer … Inappropriate incentives and the failure to incorporate mechanisms to give farmers a voice have led to a lack of accountability and responsiveness to farmers' needs. This is evident in the mismatch between what farmers want (advice on complex practices) and what they get (simple agronomic messages) … The system as implemented has been ineffective, inefficient, and unsustainable.[52]

Indeed, the Kenyan Government noted as long as seven years ago, "For important crops such as maize, sorghum and [sweet] potato, KARI now has considerable "on the shelf" technology in terms of improved varieties and better cultivation practices." The problem, again, was poor linkages with poor farmers:

> Several "on the shelf" technologies have not been adequately tested and evaluated by farmers for their relevance and acceptability. In other cases the delivery system (e.g. for seeds and other planting materials) are inadequate and require further work … Problems [in NARP I] were also encountered due to insufficient adoption of improved technologies developed by research.[53]

A study of the sweet potato process noted that it "did not directly involve farmers, especially women farmers, in the setting of the research agenda."[54]

KARI's priority setting exercises have been based heavily on expert opinion and statistical analysis, with only marginal poor farmer input into, to say nothing of control of, the research agenda.[55] The World Bank had begun a second phase of its agricultural research project in the country precisely in order to expand "participation of farmer clients" through a farming systems approach. If KARI is to be effective, the Bank noted, it must ensure "increased farmer involvement in identifying production constraints and in implementation of on-farm adaptive research" and "more effective collaboration with the extension service."[56] However, none of this happened with the GM sweet potato project. The project not only suffered from the agricultural R&E system's deficiencies, it exacerbated them.[57]

Site Specific

In terms of desirable traits in sweet potato varieties, farmers generally place higher priority on early maturation and on the ability to do well on low-fertility soils, rather than on resistance to SPVD.[58] Major agronomic production constraints or issues include:

- weevil infestation
- maturation rate
- spread timing
- timing of storage root initiation and enlargement
- *Alternaria* stem rot
- Moles
- drought tolerance
- storage problems (pests, rot, disease)
- dry matter content
- processing labor
- flavor
- soil fertility requirement
- vitamin A content (orange and mushy vs. whiter and starchier).[59]

The importance of each of these constraints varies across different places, times, and farmers. In Northern Uganda, for instance, SPVD is rare, and farmers grow varieties that are not resistant to the disease. However, storage of sweet potato is particularly important, as prices in the north can rise dramatically during the dry season—reportedly by more than 230% over just three months.[60] Conversely, in districts in the south, SPVD is more common, and so farmers grow resistant varieties.[61]

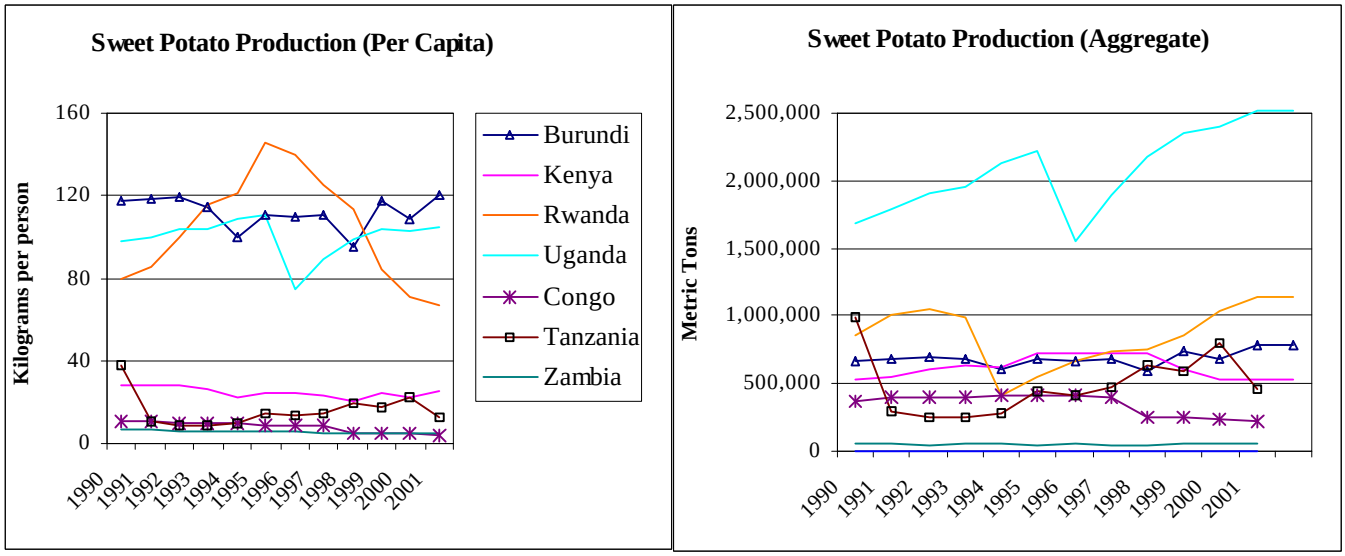
Different types of sweet potatoes

Eleven years on, the Monsanto-KARI project resulted in modifying only a single Kenyan variety of sweet potato (the CPT-560 line), out of an original eight lines attempted.[62] The CPT-560 line was described as "not the most popular variety," by Dr. Gichabe, Director of KARI's biotechnology program.[63] In contrast, there are over 89 different species of sweet potato grown in East Africa alone.[64] Four-year field trials began in August of 2000 in several districts. Whereas some speculated a modified variety could be released by early 2002, it now looks unlikely before 2008.[65]

It is so far not clear who will distribute the new varieties—public extension workers or private dealers—nor whether poor farmers will have access. Wambugu has reportedly sought funding to disseminate the modified sweet potatoes.[66] Evaluations of past experiences have shown that KARI and other parastatals have not been efficient when attempting to supply certified sweet potatoes.[67]

Poverty Focused

This section examines the relative importance of SPFMV in contributing to poverty in Kenya and eastern Africa. While sweet potatoes are an important crop for many poor people, SPFMV is not an underlying cause of poverty in the region. Only in Burundi, Rwanda, and Uganda are sweet potatoes important primary staples.[68] In these countries, general agricultural production has been severely limited not by SPFMV, but rather by war, massive displacement of farmers, and international struggles over diamond and precious metal revenues. Even in Uganda, farmers have been reluctant to devote much time or investment to the crop because it does not fetch good prices.[69] Sweet potatoes are minor crops in Kenya, Liberia, Tanzania, Congo, and Sierra Leone.



Source: FAOSTAT

Kenya

Perhaps the most ambitious claim about sweet potatoes was made several years ago: 'Transgenic Sweet Potato Could End Kenyan Famine.'[70] However, this is a gross misrepresentation. The famine, according to FAO, mainly afflicted pastoralists who do not grow or even eat sweet potatoes. Furthermore, the food crisis was in no way caused by SPVD, but rather, as FAO notes, was "the result of a combination of cumulative livestock losses, falling livestock prices and sharply rising cereal prices."[71] GM sweet potatoes have little potential to help the three countries currently hardest hit by the famine in southern Africa – Zambia, Malawi and Zimbabwe – since the crop is not widely grown there and SPFMV is rare. Famine, in each of these countries, is much more a product of corrupt and autocratic government, as predicted by Amartya Sen, recipient of the Nobel Prize in Economics. Exaggerations such as this are surprisingly common.

In Kenya, the vast majority (roughly 75%) of sweet potatoes are produced in the two Western-most areas: Nyanza and Western Provinces. Sweet potatoes are grown mainly by women, are highly nutritional, and yield well under marginal conditions.[72] They are, in this sense, key food security crops. However, sweet potato farms make up only 1.9% of Kenya's arable land.[73]

However, deep poverty is generally concentrated elsewhere—primary amongst politically insignificant pastoralists in the conflict-ridden arid North and North-West.[74] Lowland areas with difficult, low-potential conditions in the east and on the coast will not benefit significantly.

The Western and Nyanza Province have relatively good agricultural potential and have high average population densities. Many areas have since the 1920s colonial times been major exporters of migrant labor to plantations and urban centers, with remittances or earnings used to invest in land, cash crops, and, importantly, children's education (to obtain high-paying jobs, and, hopefully, greater remittances). Other areas are major maize-producers, important dairy production, and farmers grow cash crops such as maize coffee, rice, cotton, tea, sugar, and tobacco.[75]

There is nonetheless considerable concern over agriculture and hunger in these sweet potato-producing districts, but these problems are largely driven by other factors that, with the exception of declining soil fertility, are largely non-technical:[76]

- HIV/AIDS
- gender inequities
- growing inequalities in access to and control over income, wealth and land
- corruption
- lack of credit
- cattle raiding
- unsafe drinking water
- erratic rains
- expensive and spotty government education and health services
- volatile maize and cattle markets
- declining tea, cotton, sugar and coffee prices
- restructuring of the fishing industry
- declining off-farm wages
- tighter urban labor markets
- poor transport

Corruption in Kenya, for example, reportedly wastes £600 million each year, or roughly *180 times* as much money as is estimated to be lost due to sweet potato viral disease.[77]

To take another example, in the Western and Nyanza Districts, sugar production provides income to an estimated 10 million people, but liberalization in 1997 allowed cheaper, subsidized foreign imports to flood the market.[78] Many of the sugar estates and processors were racked by corruption, not least the now defunct parastatal Kenya Sugar Authority.[79] Five of the seven factories have gone into receivership, and farmers are owed two billion Kenyan Shillings, sparking protests throughout the countryside.[80]

Milk markets have become more volatile and inaccessible. Milk marketing was liberalized, allowing competition with the corrupt state monopoly Kenya Cooperative Creameries (KCC).[81] KCC was directed by President Moi's second son, Raymond, before its collapse, with reports of corruption and fighting between Rift Valley and Central Province factions.[82] However, private companies have been unable to process more than half as much as KCC.

Furthermore, cheap milk imports boomed after liberalization 1992, which also triggered KCC's collapse into receivership in 1998 with 1.8 billion Shillings of debt. KCC's director made desperate, but ultimately unsuccessful attempts to sell the Co-op to international companies—such as Nestle (Switzerland), Parmalat (New Zealand), and Clover—whilst leaving employees uncompensated, and producers unpaid and stranded without buyers as the majority of KCC factories were shut.[83]

The role of Kisumu—the largest town in the region, situated on Lake Victoria—as a port and rail entrepôt has declined with the 1977 break up East African Community. Cheap imported clothing and cotton have forced the closure of local plants such as Kisumu Cotton Mills, one among 90 firms that have gone asunder.[84] Also important are the growth of the weedy water hacynth on Lake Victoria and the European Union's (EU) rejection of fresh fish from Lake in 1997.[85]

Inequitable gender relations impoverish many women in the area. In growing crops for cash, men make demands on women's labor, and their reluctance to share land impinges upon women's ability to grow food crops generally, and sweet potatoes in particular.[86] Men also restrict Luo women's trading activities. The poorest households have little education and consequently receive low incomes from off-farm or migrant labor, or are unable to obtain any at all.[87]

This description of gender relations illustrates—along with fishing difficulties, transport problems, and sugar and dairy corruption and liberalization—some of the root causes of poverty in the sweet potato-producing areas of Kenya. Genetic resistance to SPFMV consequently will not significantly improve food security or alleviate poverty. There are, however, political functions that the much publicized high-tech venture plays.

The purported benefits GM sweet potato project may be politically useful if they divert attention from the ways in which President Daniel Arap Moi's regime has subjugated the western region because it is a hotbed of opposition. Poverty in the western districts in large part stems from the fact that the Moi Administration, consistently rated one of the most corrupt in the world, had little political commitment to these western districts during his twenty-year rein.[88] Much of the opposition to the Moi regime was based in the two provinces (the Central Province is another major pocket). In fact, Moi—a Kalenjin—began his political career by battling against Luhya over land in the western "White Highlands."[89] In the early 1970s, Moi had been opposed by Oginga Odinga—a Luo from the West—and his Kenyan Peoples' Union party. Odinga and others accused the KANU—with its controlling Kikuyu elites—of land grabbing when the lucrative Central Province lands were redistributed from white to African farmers. Upon becoming president in 1978, Moi, unlike his predecessor Jomo Kenyatta, did not have lucrative land resources to use as political patronage. Consequently, Moi used the food crises of the early 1980s in attempting to gain political control by waging "legal and economic warfare" against opposing farmers' associations.[90] Moi consistently attempted to divide and conquer the Luhya, whilst simply arresting prominent Luo, particularly after a coup attempt in 1982 and rising criticism in 1986. To stay in power once elections were announced in 1992, Moi rigged district boundaries and election rules to defuse opposition in the western provinces.[91] In the run up to the 2002 elections, Moi attempted to co-opt the opposition by promoting Nyanza MP Christopher Obure—who as Minister of Agriculture opened a major maize biotechnology conference in Nairobi in 2000—to Foreign Minister. Obure has been criticized for the poor roads and schools, and lack of electricity and employment in his district, but used the biotechnology conference to instead

emphasize population growth and droughts.[92] Once we understand this political context, we can see how official Kenyan support for the sweet potato project formed one of the Moi Administration's well-documented attempts to divert attention away from its crippling political repression and economic subjugation of the western regions.[93]

East Africa

This section will examines whether SPFMV is a significant cause of poverty in the other major areas of sweet potato consumption, particularly Uganda, Rwanda, and Burundi. In summary, these three countries are heavily dependent upon coffee, and producer prices have dropped dramatically over recent years.[94] All have been embroiled in wasteful conflicts over recent years—driven by corrupt elites, transnational companies, and rebel factions—that have killed millions and impoverished millions more.

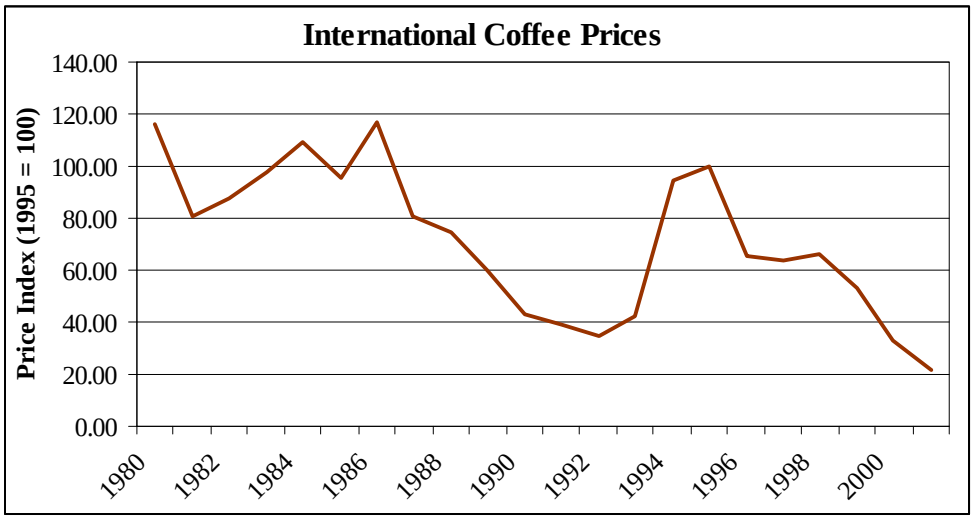
Food crops (sweet potatoes among them) are important, particularly for women, and reportedly constitute 65% of agricultural GDP.[95] Sweet potatoes are most important in the teso, montane, and banana/coffee farming systems in Uganda.[96] There are few published sources ranking the specific agronomic constraints that most affect the poor in Uganda. Nontheless, as mentioned above, many farmers already use virus-tolerant or resistant varieties, so it is not clear that viruses significantly contribute to poverty in the country.

Socio-economic and political causes of poverty are clearer.[97] Issues emphasized in Uganda's widely praised Participatory Poverty Assessments include gender relations, governance, geographic isolation, insecurity, corruption, and costly services.[98] After being mired in repression and conflict for decades, in the 1980s President Museveni halted major conflict (though substantial unrest continues), and undertook reforms (including raising producer prices, decentralization, and improving transport) that helped boost the economy.[99] AIDS is a significant problem, but is being addressed through ambitious campaigns (though costly and limited health services may preclude better diagnosis and treatment). Formal financial services are more prominent in the central and south-western provinces, and seriously lacking for poor, rural areas.[100] Despite the fact that the vast majority of the population are farmers, the government spends only 1-3% of its budget on agriculture; in contrast, 13-20% is spent on the military.[101]

Poverty in Uganda is deepest amongst the agro-pastoralists in the north of the country, where conflict has eliminated human resources, forced migration, destroyed infrastructure, depleted livestock, and generally disrupted livelihoods for decades.[102] Uganda has also been mired in an international war in neighboring Democratic Republic of the Congo. Uganda supported Laurent Kabila's rebel movement in ousting Mobutu Sese Seko, but when Kabila turned against his supporters in 1998, Uganda funded another group of rebels to oust Kabila himself. Elites in the Ugandan government, military and business—such as President Museveni's brother—seek to capture some of the war treasures in the Congo under the pretext of protecting border security.[103]

Declining coffee prices have hit the rural poor in Uganda hard. Coffee accounts for 40-50% of Uganda's export revenues, and provides income for a large proportion of the population. Economic liberalization of coffee marketing the 1980s and 1990s increased farmers share of world prices, but also exposed them to volatile markets. Consequently, while farmers responded to reforms and political stability by investing heavily in coffee bushes to increase

production, their efforts have been met by falling prices. International market prices have fallen due to rising production by Vietnam and Brazil, using new technology and exploiting natural resources. Large conglomerates such as Nestlé that control global coffee markets have been able to capture significant profits by selling high and paying farmers little.



Mathew Matoli, coffee farmer, Tanzania

Source: International Monetary Fund (2003)

In sum, existing evidence on agronomic constraints in Uganda suggests that SPVD is not a significant cause of poverty. Socio-economic and political causes are clearer, and include gender relations, disruptive and wasteful armed conflict, declining coffee prices, and poor health and education services.

Much the same applies to Rwanda and Burundi, the two other major producers and consumers of sweet potatoes in Africa. In terms of agronomic constraints, soil fertility had been identified both by Rwanda's Poverty Reduction Strategy Paper, as well as other technical studies.[104] Poor rains from 1997-2000 were reported as a possible reason for dropping sweet potato production.[105]

Before the 1994 genocide, Rwanda was seen as a star developing country.[106] However, civil conflict has also plagued Rwanda long before the genocide, constraining agricultural production and food security. Military spending rose, constituting 38% of the budget by 1992. In 1993, conflict displaced up to a million people. The genocide the following year displaced nearly 4 million. The tragic horror of the Rwandan genocide need not be recounted here.[107] Extremely pertinent now, however, is the ongoing involvement in the war in the Congo. Rwanda has kept troops there, with considerable government expenditure, ostensibly to protect its borders from rebel incursions, but invariably to take part in looting of the precious minerals.

Another important, but seldom recognized, cause of poverty in Rwanda is the grossly unequal social and economic structure. Land inequality had risen during the 1980s, as administrative elite were able to evade land purchase restrictions and acquire substantial areas.[108] Half of all land was owned by the richest 15% of farmers, according to a National Agricultural Survey.[109] The state limited people's mobility and initiative through "residence permits,

zoning regulations, restrictive labor practices, copius taxes, and police harassment," as well as trading licenses.[110] The government has historically allocated relatively little of its budget to rural development.

Another factor is the declining price of coffee, Rwanda's most important export (tea prices have fallen as well). Consequently, from 1991 to 2002, the number of farmers growing coffee dropped by 36%.[111]

Much the same could be said about Burundi. Burundi has suffered from repeated coup d'etats, involvement in regional conflicts, and 6 years of economic sanctions imposed by neighboring countries.[112] Roughly 300,000 people have been killed in the 10 years of civil war, with 1.2 million people displaced by the war.[113] Only in 2000 was a peace agreement signed, but fighting has continued to flare up. Burundi consistently spends between 20-30% of funds on military/security.[114] Coffee provides 80-90% of foreign exchange earnings.[115] Tea is also grown, but on large plantations. By 2000, coffee production had dropped by 50% since 1992-6.[116] HIV/AIDS is also becoming significant, with rates reach 20% in urban areas.[117]

These pressing constraints of land and social inequality, poor services, declining commodity prices, HIV/AIDS, corruption, and conflict create poverty amongst sweet potato producers and consumers of East Africa. There is little hard evidence that SPVD contributes to poverty in these areas.

Cost Effective

At the farm level, there is currently no evidence about the performance of transgenic sweet potatoes. The most recent account, published in January of this year, makes no mention of state of the trials. KARI researchers have refused to state how the trials, now in their third year, have performed.

At the level of allocating research funds, an examination of the time, money, and human resources spent on the GM sweet potato project shows very low cost effectiveness, particularly compared with conventional breeding. Total spending on the 25-year project is estimated at nearly $6 million.

Early descriptions overstated the potential gains to production. Accounts of the transgenic sweet potato have used low figures on average yields in Kenya to paint a picture of stagnation. An early article stated 6 tons per hectare—without mentioning the data source—which was then reproduced in subsequent analyses.[118] However, FAO statistics indicate 9.7 tons, and official statistics report 10.4.[119]

As for gains in production, an article at the launch of the trials reported that eradicating sweet potato virus would boost Kenyan output by up to 60%.[120] Curiously, the same article also suggested farmers could reap yields of 56 tons per hectare, or 830% times the reported current national average of 6 tons per hectare. Another estimate puts yield increases at 40%.[121] In fact, the only actual supported figures for potential increases are based on interviews (largely with project staff) and a single survey of several dozen farms.[122] Maximum gains in national production from SPFMV resistance are estimated—on the basis of this unsystematic data—to be 18%.[123]

In contrast, a conventional breeding program in Uganda was able to produce a new, high-yielding resistant variety in just a few years at a small cost that also raised yields by roughly 100%.[124] Clearly, even the haphazard estimates of hypothetical yield gains are much lower than with conventional breeding.

This contradicts several important claims: that SPFMV "is a classic example of a problem that cannot be solved through conventional breeding," and that "the time and money spent actually developing GM varieties are less than for conventional varieties."[125]

Estimates of value of the economic benefits from the modified sweet potatoes vary – some put it at US$ 5 million per year, while another commentator wildly speculates a total of US$ 500 million.[126] If distributed equally amongst Kenya's population, the estimated US$ 5 million per year gains would be the equivalent of raising average income by 0.3%.

The project has taken 10 years to get to the first on-station trials, and has required at least 19 scientists, 16 of which have Ph.D.s, and the support of 10 institutions.[127]

The opportunity costs appear great, given that there are other promising lines of research for controlling the disease. The high gains from conventional breeding utilizing local resistant germplasm were mentioned above.

Additionally, where farmers should want to invest in specifically confronting SPVD, there exist multiple Integrated Pest Management (IPM) methods to tackle the insects that transmit the viruses.[128] Aphids transmit SPFMV, while whiteflies transmit SPCSV, and two must combine to produce the damaging SPVD.[129] However, most research and development on control methods of has gone to generating and using insecticides, which remain unaffordable for poor farmers in Africa.[130] In fact, whiteflies and aphids are both recognized as secondary pests—often induced by excessive use of pesticides—which flourish in cotton and tobacco monocultures.[131] Hence, there is a pressing need to focus other means. Some of these involve managing the insect vectors.[132] An important review of viral diseases by African scientists concluded, "prevention is better than cure in the control of plant virus diseases. Since controlling vector pests is the right strategy for sustainable control of plant viral diseases, it is vital at this stage for … farmers to utilize the concept of Integrated Pest Management (IPM)."[133]

Addressing the whitefly problem would also help combat the more than 90 disease-causing viruses carried by the fly, most notably, the devastating cassava mosaic disease that has ravaged central Africa. Whiteflies are the vectors for transmitting multiple diseases, and hence developing IPM strategies have a synergistic effect. In fact, highly successful effort by the International Institute of Tropical Agriculture (IITA) with biological control of the Cassava Green Mite.[134] Addressing each crop in isolation is thus relatively redundant and not the most efficient use of resources; though this has proved useful in distributing disease-resistant cassava plants.[135]

Some important steps have been taken to address this gap in research on alternative methods to control aphids and whiteflies. The International Potato Center and IITA have been coordinating whitefly control projects. In 1996 a system-wide whitefly IPM project was established, led by the International Center for Tropical Agriculture (CIAT). They noted that "The [whitefly] pest problem on one crop, such as beans, cannot be tackled in isolation … A

properly coordinated response, commensurate with the scale of the problem, is clearly long overdue."[136] There are numerous possible agronomic methods to control whiteflies, including:[137]

- crop-free periods
- rotations
- planting dates
- plant density
- intercropping
- mulching
- fertilization
- irrigation

Biological control also holds promise, since there are over 114 natural parasites of whiteflies, and using natural enemies has already shown to reduce whitefly populations in farms.[138]

However, despite the promise of these projects, novel techniques protecting sweet potatoes against whiteflies have been halted due to lack of funding.[139] It thus appears the focus on genetic engineering in the sweet potato project has diverted time, money and attention from other important avenues of research. A narrow focus on genetic modification means researchers ignore other productive scientific opportunities and hence do not make the most effective use of scarce research resources.

In using such a disproportionate share of scarce resources to produce such an insignificant (and unnecessary—as discussed above) result, the case of SPFMV exemplifies how the excitement over certain genetic engineering procedures can divert financial, human, and intellectual resources from focusing on productive research that meets the needs of poor farmers.

Environmentally Sustainable

Transgenic sweet potatoes also illustrate how biotechnology can perpetuate the conventional one-constraint-one-gene approach rather than integrated pest management (IPM) principles based on agricultural ecology. SPFMV is only one of more than 14 known sweet potato viruses. SPVD results only when a plant is infected simultaneously by two distinct viruses, transmitted separately by aphids and whiteflies.

The project also violates the tenets of ecology by relying on one gene and one crop variety. There is a danger in using a one-gene approach, particularly since there are many different strains of SPFMV.[140] This is especially disconcerting, given that KARI has used an coat protein protecting against an *American* strain of SPFMV, whilst researchers have already established that "Ugandan SPFMV isolates can overcome resistance that is effective against SPFMV occurring elsewhere."[141] Subsequent tests were performed with African strains of the virus, but the results have not been published.[142] Dr. Gichabe, current Director of Biotechnology at KARI, would not comment as to whether the GM varieties provided resistance.

A further complication is that the damaging SPVD results when another virus lowers the resistance to SPFMV. Consequently, the "extent to which CPTO 560 will control the complex virus remains uncertain."[143]

No pesticides are used in producing sweet potatoes, so there is no question of beneficial reductions. There is little possibility of a "super-weed" developing, since sweet potatoes are generally spread by vine propagation, rather than pollination.

Institutionally Sustainable

The project, which, again, has yet to produce any usable results, has had to rely on the support of some of the most powerful development institutions in the world, as well as an array of other smaller ones:

- United States Agency for International Development
- World Bank
- KARI
- Agricultural Biotechnology Support Program
- International Potato Center
- Monsanto
- University of Missouri
- International Service for the Acquisition of Agri-Biotech Applications (ISAAA)
- Agricultural Research Fund
- Mid-America International Agriculture Consortium

While each of these institutions gets to make pleasing claims about "collaboration" and "private-public" partnerships, the reality is more one of diverting resources, financial dependence, and burdensome "gifts." The most damning aspect is that the project has done little to address institutional collaboration where nearly everyone recognizes it is most needed: in the links between Kenya's researchers, extensionists, and farmers. Serious concerns must be raised about the ability of the Kenyan R&E system to disseminate appropriate varieties of the Bt sweet potatoes. In fact, the project may have exacerbated the bias of researchers in Kenya towards lab work on characteristics that are not farmers' most pressing needs.

Financially, the project has first and foremost depended on Monsanto's donation of roughly $4 million dollars to the project (less than 0.1% of Monsanto's total expenditure in 2000), whilst USAID has added $238,000.[144] Though USAID ceased direct funding of the project in 1994 due to its own budgetary constraints, it continued indirect funding through the ABSP project and its 'Mid-America International Agriculture Consortium' training program.[145] The World Bank then picked up funding through its Agricultural Research Fund (ARF).

In accessing the ARF, however, it was noted that KARI's financial management facilitates "disbursement of funds and accountability" in relation to the "broad donor community." It took advantage of ambiguous legal mandate to collaborate with other institutions—such as the World Bank, and Monsanto—involved (directly or indirectly) with agriculture in "setting of national research priorities." USAID provided $521,000, Britain's Overseas Development Administration £50,000, while the World Bank provided $49,000.[146] Ironically, a recent

evaluation of more than 30 years of World Bank experience in the agricultural sector in Kenya noted that the central problem was a lack of "ownership" by Kenyans.[147]

No support has been given to other research institutions working on sweet potato research, such as those in Uganda and Rwanda that are heavily lacking funds. The World Bank has argued, in contrast, "[agricultural] projects in Rwanda and elsewhere underscore the need to pay greater attention to capacity building, particularly among lead public institutions."[148] There is an urgent need for institutional strengthening: "During the genocide, ISAR [Institut des Sciences Agronomiques du Rwanda] was virtually devastated. Many of the senior staff were killed, vehicles were stolen and the buildings and laboratories were looted."[149] Monsanto has not provided even a single dollar to help restore institutional infrastructure in Rwanda, arguably the one country in the world where sweet potatoes are the most important. Nor has Monsanto helped strengthen regional research networks such as the Eastern Africa Rootcrops Network (EARNET). Such regional farmer-to-farmer networks and sharing have been crucial sources for generating and extending new varieties that have allowed farmers to overcome diseases and constraints throughout the Twentieth Century.[150]

The project's extreme dependence upon large donations by a private corporation does not bode well institutional stability. Monsanto may stick with the project for the sake of appearing committed, but is unlikely to give significant support to the more tedious work of actually extending the sweet potato, not to mention other crops in other countries. Such private-public "partnerships" may not in fact be replicable; they may be well intentioned but ultimately misguided and misleading one-off gestures designed less to help poor farmers than to garner favor with the public in both developed and developing countries.

Conclusion

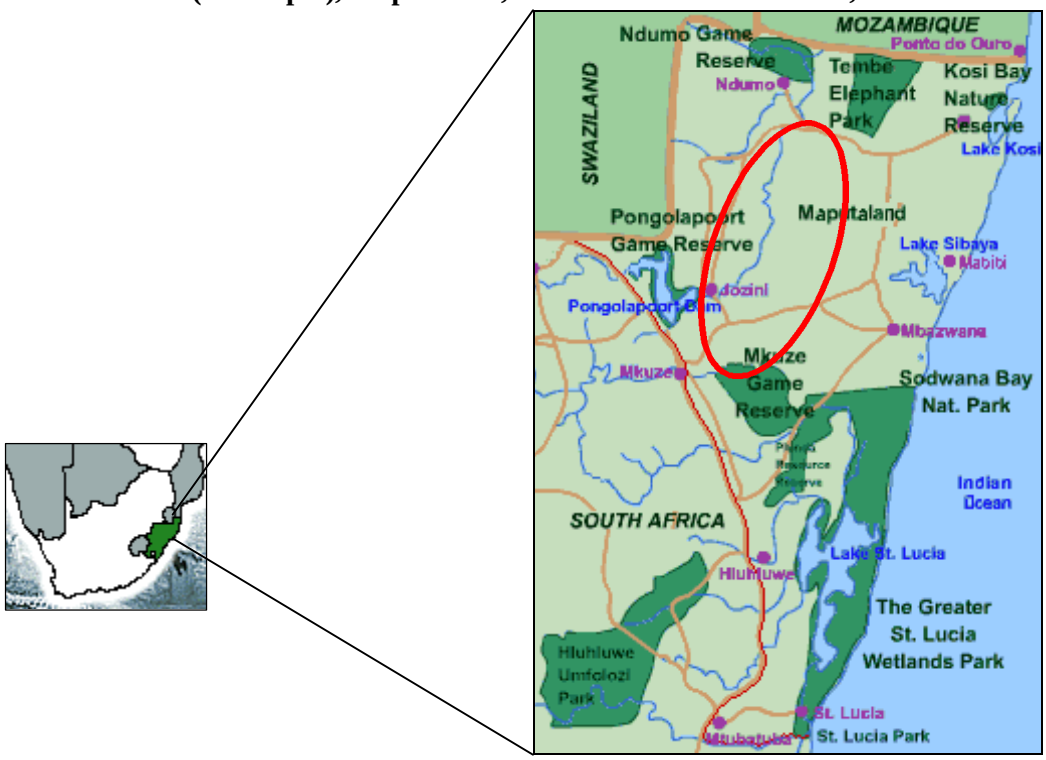
Transgenic virus-resistant sweet potatoes have garnered enormous publicity for their potential to alleviate poverty in Africa, but further detailed examination shows they are inappropriate for that task. The project has suffered from, and possible exacerbated, the top-down nature of research and extension in Kenya. Consequently, the sweet potatoes are being engineered with traits that poor farmers did not rank as of great importance, and for which there are already effective existing varieties. Only one sweet potato variety has been transformed, but farmers require different varieties adapted their specific bio-physical and socio-economic conditions. The years of research, millions of dollars, and scientific attention focused on genetic modification have been extremely ineffective when compared with conventional crop research programs. Poverty in sweet potato producing areas stems from other agronomic constraints, as well as from overriding social and political maladies, such as corruption, conflict, hostile markets, and social inequality. Neither the technology, nor the institutional arrangements utilized in developing the technology appear sustainable. In sum, on each key criteria, transgenic sweet potatoes appear to be an inappropriate method of agricultural research for poverty alleviation.

3. Bt Cotton in South Africa

Strong claims abound in media accounts, conferences and scholarly literature about Bt cotton's potential to alleviate poverty and degradation in Africa. During the 1990s, St. Louis-based seed firm Monsanto captured much of the American cotton market with its Bollguard™ cotton, which is engineered with to secrete its own pesticide using a protein-producing gene from a natural soil bacterium Bacillus *thuringiensis* (B*t*). The new technology could have important poverty effects by impacting cotton production and markets, particularly since cotton is a major export crop for many poor countries in Francophone West Africa, and is also grown in southern and eastern Africa.[151] All of the claims about Bt cotton's potential in Africa, however, draw on the experience of cotton in the Makhathini Flats, in the north-eastern corner of South Africa, documented by a two year survey performed by researches at the University of Reading in the UK. There has been almost no critical analysis of the experience of Bt cotton in South Africa by advocacy groups.[152]

When South African farmers switch to Bollguard™, Monsanto argues, they reduce the costs, time, and negative environmental and health risks associated with conventional pesticides.[153] "The region has become an example to the world of how plant biotechnology can help the smallholder farmers of Africa," reads Monsanto's website.[154] Steven Smith, Chairman of the Agricultural Biotechnology Council, an industry lobby group, has stated, "small farmers are realizing huge economic benefits."[155] CropGen argues "The Makhathini Flats is a good example of how an area which was not agriculturally viable has been transformed into a thriving agricultural community through a government-backed project and the introduction of

The Makhathini Flats (red ellipse), Maputaland, North East KwaZulu Natal, South Africa



GM crops."[156] Academics claim "If there was widespread use of the Bt variety across the continent, it could generate additional incomes of about six billion Rand, or US$600 million, for some of the world's poorest farmers."[157] The strongest claims about the benefits of B*t* cotton are assembled in a brochure produced by the International Service for the Acquisition of Agri-biotech Applications (ISAAA)—a non-governmental lobby group funded by Monsanto and a handful of other companies that dominate world seed markets.[158]

Demand Led

Bt cotton differs from the other two crops considered because it was developed purely by a private company, Monsanto, with the collaboration of DeltaPine. The cotton had been developed for American farmers, and then extended to large South African farmers, before finally reaching smallholders in Makhathini. Thus, the technology development process was not driven by smallholders expressing their needs and priorities to researchers or extensionists. Monsanto tested the cotton at research stations, and it seemed to work well on large farms, but other than that, no surveys were done, no adaptive trials were performed, no evaluations were conducted. "Although there is a government extensionist next door to Vunisa, they are not responsible for cotton production. This is left the hands of the Vunisa. There has been no research done so far, as they are private extensionists."[159]

Cotton harvesting on the Makhatini Flats ©Glen Davis Stone

In contrast to the wide-publicity made of the Makhathini case, the local farmers have not even been fully informed about the characteristics of the cotton. Conversations revealed that

many were not explained that it was genetically engineered, that refugees were required in the contracts, nor that insect resistance may develop.

This lack of client-orientation is understandable in the broader context of the South African agricultural research and extension system. Historically research and extension were heavily biased towards large, white, male-run commercial sector. While some of the best R&E services in the area are at the Mjindi Irrigation scheme, even there they are top-down and ineffective: "essentially a one-way communication model with very limited feedback."[160] Empirical research shows little evidence of significant impacts of R&E on poverty alleviation, and that the amount of extension was irrelevant to the success of cotton farmers in northern KwaZulu Natal (KZN) districts.[161]

A Farming Systems Research unit has been established in KZN, but it remains small and inexperienced and confined to a few areas. There remains a strong belief that techniques and technologies developed for large-scale white-owned plantations can simply be shifted to black smallholders.[162] Recent policy, however, aims to focus on building a new class of entrepreneur black farmers.

The corporate-driven, top-down orientation is evident in South Africa's National Strategy on Biotechnology, which was developed hastily over two months, and included consultation with a large commercial farmers' association and Monsanto, Syngenta, and other biotechnology corporations.[163] The serious problems with the agricultural extension services in north-eastern KwaZulu Natal, and South Africa more broadly, have been confirmed by several in-depth studies:

> extension delivery services still use traditional top-down and gender-bias methods of technology transfer of agricultural and rural development knowledge. Consequently, extension services fail to reach the majority of the rural households with relevant information to enhance rural livelihoods … people's indigenous knowledge is not taken into consideration in planning and implementation of agriculture and rural development programmes. Because the context of the rural households is not analysed by the extension services and the value of local knowledge not appreciated, the introduction of the new technologies fails. The end-users of the extension services are regarded as passive beneficiaries of the service, and in turn they tend to accept the traditional approaches.[164]

> Situated within an expert driven, reductionist paradigm of agricultural development, most homeland extension staff lacked practical farming skills, and their expertise was extremely limited, and often quite inappropriate to the needs of their clients … The extension methodologies taught were based upon invalid models of innovation and learning, and were invariably top-down in their application and administration … although the emphasis is now on smallholder problems (often defined by scientists), the approach is one of the scientists developing technical solutions, which then need to be transferred to the smallholder.[165]

The result of little consultation with poor farmers in developing the technology is that it is not tuned to the bio-physical and socio-economic circumstances.[166] I now turn to examine the site specificity of the technology.

Site Specific

Given that there was little "farmer demand" or "client consultation," the Bt cotton variety introduced was not altogether suited for the farming conditions of the Makhathini Flats. J Clark Cotton Company is reported to have first introduced cotton in Maputaland in 1978.[167] The Reading survey did show that farmers prioritized insect pests as one of the major problems, together with excessive rain, and drought as major agronomic problems, with access to capital the most significant non-agronomic obstacle.[168] However, the Bt cotton technology that was introduced around 1997 was simply an extension of technology developed already for large farmers in the US and their main pest, the American bollworm. In South Africa, however, the pink bollworm prevails.[169] In addition to bollworms, aphids and jassids (also known as leafhoppers) are also important pests. Cotton varieties with 'hairy' leaves that repelled jassids had been introduced in the 1990s in the Flats. However, the new transgenic cotton variety—DeltaPine's NuCOTN 37-B with Monsanto's Bollguard™ Bt gene—had smooth leaves, resulting in increased damage from jassids.[170] New pests, such as sting bud, have appeared (as is reported in China). Additionally, herbicide-resistant cotton has been introduced, even though almost none of the small farmers on the Flats use herbicides.[171] Indeed, over 90% of the applications to test GM crops have been for insect- or herbicide-resistant varieties.[172] As a leading South African biotechnology scientist described, "Essentially, GM crops were developed for commercial farmers."[173]

Given the lack of client consultation, and the low to moderate site specificity, one may well ask the question, why then have small farmers adopted the variety? Indeed, nearly 90% of small farmers were reported to have adopted the Bt variety by 2001. Partly because there are reductions in the amount of labor needed to apply pesticides. Also, strong promotion and marketing by Vunisa—the only cotton buyer and seller, and only source of credit in the region—is likely to have had a strong impact. The political support behind Bt cotton is also very strong, and, as the description below shows, politics have a long been very influential in shaping how, what, and where people farm in Maputaland.

Poverty Focused

It is ironic that cotton farmers have become the cause célèbre of pro-poor biotechnology publicity because there are only a handful of small cotton farmers in the country (roughly 3,500 out of South Africa's 40 million people), and poor agricultural technology is a relatively minor factor contributing to poverty.[174] 95% of cotton is produced on large-scale plantations, and the entire cotton sector altogether only constitutes 1% of the national economy.[175] Smallholder farmers using Bt cotton represent less than 5% of the District's population and their cotton farms constitute only 0.7% of the area of the Flats.

In South Africa, almost three fourths of the poor live in rural areas, and nearly all the population in Maputaland is rural, according to the 1991 Census (which missed substantial numbers of migrants).[176] However, the case of the Makhathini Flats powerfully illustrates the fallacy of assuming that people in rural areas sustain their livelihoods through family-owned farms or through agriculture alone, and hence that agricultural technology is the root cause of poverty. In north-eastern KwaZulu Natal, where the Flats are located, agriculture contributes only 10% of the total value of economy.[177] Black South Africans have long been involved in heavily regulated systems of migration to mines, plantations, and industries, and this system, combined with forced removals, created much of the poverty in the countryside. The

following analysis shows how poverty in Maputaland results from a combination of seven forces: a devastating dam and irrigation scheme, top-down planning favoring large-scale farms, elitist tourism, authoritarian conservation, persistent land inequality, declining employment and wages on- and off-farm, over-production, and HIV/AIDS. In this context, Bt cotton is irrelevant at best, and at worst is lowering wages and job prospects for agricultural laborers, who are some of the most impoverished people in South Africa.

The Pongolaaport Dam and the Mjindi Farming Irrigation Scheme

Poverty in Maputaland is *not* an automatic result of harsh farming conditions and inadequate cotton technology. The Pongolapoort Dam and the Mjindi Irrigation Scheme have contributed to poverty by disrupting the water cycle and agro-ecology, dispossessing people of their land, and wasting scarce government revenue.

The Makhathini Flats cover 677,800 hectares (ha), of which 15.6% are high potential (with fertile soils). The state owns 27% of the land in the Flats (covering all irrigated land, and most high potential land).[178] At the foot of the Lebombo Mountain Range lies the town of Jozini and the nearby irrigation scheme, "Mjindi Farming," which draws its water from the Jozini/Pongolapoort Dam. The Dam has the capacity to irrigate 11,200 ha, but only 3,900 ha are currently irrigated and farmed by roughly 290 farmers.

The Pongolapoort/Jozini Dam

Both the scheme and dam are apartheid relics. When the nationalist white government came to power in 1948, it ushered in an era of "Grand Apartheid." The government's strategy was partly centered around job creation, particularly for ex-soldiers. The need to create jobs led the government to begin constructing Pongolapoort dam in 1962—at that time, it was the largest in South Africa. The dam would provide irrigation water for white farmers to grow sugar cane (which was incorrectly predicted to become scarce). Potential irrigable land was estimated generously at 70,000 ha. However, sugar price dropped, and difficulties arose around the prospect of inundating Swaziland territory with water, so that the dam, finished in 1972, was only filled in 1984 after a cyclone.

The authoritarian apartheid government did no assessments of the possible impacts of the dam on the estimated 70,000 Tembe-Thonga people that living in the area affected by the dam.[179] Numerous fishers and farmers doing floodplain agriculture lost their livelihood after the dam was built.[180] Before the river was dammed, it would flood and recede in November and February, allowing productive and diversified agriculture and livelihoods. Flooding would feed and fill approximately 70-95 "pans" (lakes or ponds) that make up one quarter of the 10,000 ha of the floodplain.[181] The seasonal floodwaters supported dense populations of fish, crocodiles, hippos, and waterbirds, as well as the livelihoods of rural people who used the water for crops, fishing, and livestock.

The dam and its artificial flow created new flood risks and altered the floodplain hydrological cycle, with the effect of desiccating higher floodplain areas, extending the inundation into other areas areas, and increasing erosion.[182] Poorly designed outlets prevented simulating natural releases unless the reservoir had large amounts of water. By the early 1980s, authorities unsuccessfully attempted renewed water releases, but these releases were based largely on technical fishery studies without community consultation.[183] Consequently, after black farmers had suffered through the drought years of 1982 and 1983, the government released the cyclone waters of 1984, flooding maize crops, and further impoverishing people in the area. By 1987, resources users—farmers, fishers, livestock keepers, women, and health-workers/traditional healers—had formed water committees to negotiate with the Department of Water Affairs about the timing and size of water releases from the dam. The KZN government saw the groups as a subversive threat to its power and tried to dismantle them. For example, an important local NGO, the Mboza Village Project (started in 1983) was accused of being ANC-aligned since it opposed mandatory staff membership of IFP and attempted to have its members elected locally rather than appointed by regional authorities.[184] Since the late 1980s, improvements have reportedly been made: "more recent releases have been much more successful, as their timing was agreed by stakeholder committees through a participatory approach to flood management."[185]

However, it is not only the Dam's disruption of the hydrological cycle of the area that has had an impact; the irrigation scheme proved devastating as well. By 1980, the apartheid government was considering using irrigable land for Zulu farmers as part of its attempt to establish separate black "homelands." Initially, more than 4,000 irrigation scheme farmers were planned, which would have necessitated relocating the majority of the other blacks in the Flats—this plan was shelved due to potential widespread resistance.[186] As it became clear a large settler scheme—of either whites or blacks—would not work, the apartheid government considered annexing a large portion of all of Maputaland into Swaziland, but backed down due to political resistance.[187] Instead, an irrigable area of roughly 3,000 ha was designated, and farming blocks of 5 ha, then 10 ha, were allocated, first to 150 farmers, subsequently increased to a total of roughly 290 farmers. Scheme farmers were selected after interviews to find those with preferred skills and background. After most farmers failed to pass the governments' criteria, the requisite scores were lowered in order to get enough farmers. To qualify, farmers also had to prove KwaZulu citizenship, and consequently many local dryland farmers were excluded. Eighty percent of the scheme farmers thus came from outside of the area, frequently from white farms from which they had been expelled.[188] The previous communities living on the irrigation scheme land—some 4,500 families—were forcibly removed. Because the scheme land was defined as state land and they as squatters, the families received no compensation.[189] They were moved to "resettlement" camps, such as Sibongile, without schools, clinics, or potable water—like the millions of other blacks in the 1960s to the 1980s who were forced off their land, off of white farms or out of cities and into crowded and barren "homeland" areas controlled by often despotic traditional authorities.[190]

The scheme turned out to be very unprofitable, with top-down control and a large waste of government expenditure. Prior to 1988/89, the South Africa Development Trust Corporation (STK) made all decisions on planting, irrigating and managing crops. The government (DDA) handed out loans that were often unpaid. Thereafter, farmers were required to sign loan contracts and take management decisions, though training was minimal. Much of the equipment became run down or went missing. By 1993, the 260 farmers on the scheme had acquired debt of more than R3.1 million, rising to R16 million by 1998 (largely from land,

water, and input costs). Management problems led to pressures to restructure the scheme, and so by 1999, after a consultant's report, the government decided without community input or consultation to require farmers to purchase the land, which they fiercely rejected. Other difficulties have arisen as well: prosperous scheme farmers purchased more cattle and thereby raised pressures on the grazing lands upon which poorer farmers depended; poorly maintained irrigation canals helped spread malaria.[191]

Why was such an ill-suited and ill-managed scheme—which impoverished many lives in the Flats—so doggedly pursued (in a manner very similar to current plans)? The answer lies in scheme's role in apartheid politics. The scheme—now a recognized disaster—was supposed to be *the* growth-point for region. The apartheid government desperately needed some activity that would substitute for central government spending (on health, education, and transport). The government was prepared to spend huge sums of money on the scheme—an estimated 400 million Rand in the 1980s—in order that the rice and cotton export products would eventually enable KwaZulu to survive as "an independent ethnic nation" without further support from the central government.[192] It was also hoped that the middle-class farmers on the scheme would provide stability to the Bantustan in a time of political turmoil and underground warfare.[193] Thus the scheme was designed to help politically and economically sustain inequitable apartheid plans. I now examine the South African government's recent proposals for the Makhathini area, which mimic older plans in their top-down methods and their focus on large farmers, minimal government spending, and export production.

Top-Down Planning and Large-Scale Bias

Another reason for the persistent poverty in Maputaland is in the South African government's development strategy and methods, which are encapsulated in the current major initiative to develop Maputaland: the Lembobo Agri-Tourism Spatial Development Initiative (SDI). The Initiative seeks to use the many nature reserves in the area for eco-tourism to generate employment and revenue (see below), as well as to develop large-scale commercial farming. This high-publicity initiative is an attempt to show poverty alleviation results in the midst of fierce political competition with the Inkatha Freedom Party (which has ruled KZN since 1994), as well as constraints on policy dictated by local elites and international institutions such as the World Bank and IMF. Consequently, the SDI has been announced with great grandeur and promises designed to elicit support, but has suffered from top-down planning and a focus on large farms and elite tourism enterprises. In this sense, the SDI carries on the legacy of past initiatives: an earlier IRDP to promote development through afforestation, cattle, handicrafts, cashews, and eco-tourism; invitations for large agribusiness schemes by Lohnro, Legard, and Anglo-American; a coconut plantation scheme that required removals (from Hlomula, west of Kosi estuary); and, of course, the Mjindi scheme.[194]

The SDI and other preceding plans have failed to alleviate poverty because they are simply showcases, designed quickly by top-level officials to garner political support. Employment creation in the area is promised during elections, but then unfulfilled. In the 1980s, the apartheid government unveiled plans for eco-tourism development, but the issue was put on the backburner (partly due to conflict between the IFP and ANC). Frustrated communities called for creating jobs by pursuing a 1989 bid for platinum (titanium?) mining by Richards Bay Minerals, which was rejected after the most expensive Environmental Assessment ever.[195] The capital-intensive mining would have been unlikely to create many jobs, but it

does illustrate people's demands for jobs. Once the ANC government won power in the 1994 elections, it again put on hold the issue of creating jobs in the region through ecotourism. Key eco-tourism operations in the area threatened to close if there was no progress.[196] The 1999 elections led to renewed promises.[197] President Mandela himself launched the Lubombo SDI in May of 1998.[198] After the elections, the SDI again faded, (though the road was begun and is now partly completion, and the anti-malaria campaign has had some success).[199] Concerns for the tourism industry (and hence lack of jobs) were aired again after 4x4 vehicles were banned from the beaches.[200] Recently, with elections again in 2003, a new agricultural project has been announced. "These initiatives," experts on SDIs rightly observe, "owe more to political dynamics than a desire for community development."[201]

Since 2002, the agricultural plans for the Flats have made headway, partly because the ANC has been engaged in a fierce battle for control over KZN. The ANC and IFP had signed a coalition agreement in 1998; this followed the politically motivated ethnic-tinged conflict in the 1980s and early 1990s—supported with weapons and money from the nationalist government—that had led to over 10,000 deaths.[202] The ANC has allowed the IFP three positions in President's Mbeki's cabinet, with IFP leader Buthelezi becoming Minister of Home Affairs. However, the ANC-led government invoked an uproar from the IFP when, in early 2002, it announced it would change laws in order to allow provincial assembly members to switch parties. The IFP holds a slim majority in the province's assembly, and the law could allow IFP defections—which the ANC was cultivating—that could switch control over the province. It was in the heat of this political battle that the Inkatha-dominated KZN government announced its own plans in early 2002 (and released them with fanfare in October) for a Green Revolution in the province similar to the major transformations of China and Korea.[203] Subsequently, the IFP, still in jeopardy, threatened to dissolve parliament. By January 2003, the ANC government had reportedly promised to withdraw the amendment.[204]

The fact that the SDI is driven by political maneuvering and neo-liberal economic policy has resulted in a top-down process of preparing and announcing the plans. The plans have largely been conceived over the past three to four years by Nared Singh, the provincial Minister of Agriculture and Environmental Affairs, who reportedly took them up as a "personal challenge."[205] Singh hired private consultants, Urban-Econ and Zakhe, to draw up specific proposals. He and the consultants did not consult communities—the plans were "entirely based on desk top research and on existing reports and comments"—and officials instead are now making appeals for support from investors around the world.[206]

The shortcomings of the top-down methods and politically motivated, neoliberal strategy are evident in the transport component of the SDI. Planners see roads as important simply to facilitate the movement of tourists and export-related agricultural inputs and outputs. A major road has been partially completed passing along the eco-tourism reserves from Durban to Maputo, and 11 smaller roads into Maputaland are planned. Although the road-construction related jobs were widely touted, there is little evidence these went to workers from the area. Moreover, the people on the Flats were not consulted, and little has been mentioned to local communities about improving transport to basic necessities such as shops, water sources, schools, or clinics.[207]

The shortcomings are also apparent in the agricultural plans, which will use large portions of land and capital, but will create few permanent jobs and may increase conflicts with poorer households in the area. The SDI seeks again to resuscitate plans to utilize the Jozini Dam to

boost agriculture in the region. The Mjindi scheme—which, as discussed above, is burdened with debt—is to be restructured, with land leased to farmers. A number of other exciting sounding plans have been announced, but have not yet materialized:

- Increase Coastal Cashews' orchard from 600 ha to 850 ha
- R1 billion sugar mill
- R150 million cassava starch factory at Manguzi
- R200 million for 100 ha orchid greenhouse near Mjindi
- R80 million grapefruit packhouse near Ndumu
- R275 million fish-farming venture (partly focused on tilapia and catfish)
- R40 million essential oils scheme
- Paprika production near Ndumu
- 1,500 ha organic sugar
- Small irrigated banana production
- Timber production (on 45,000 ha)[208]

The one project that has come to fruition continues the bias towards large-scale monocropping of cotton. The government provided R6 million to help establish a joint venture between Danish investors and a South African company, Noordelike Sentrale Katoen. In 2002, the venture opened a local gin worth R30 million with a projected capacity of processing 100,000 tons of cotton. The partnership's business plan was for between 4,000 and 6,000 ha of cotton to be planted on previously undeveloped land controlled by the Nyawo Traditional Authority. Wheat would be a winter crop. The newly formed company, Makhathini Cotton (Pty) Ltd, now says it aims to cultivate 10,000 ha of cotton. While it expects between 5,500 and 9,100 low-paid seasonal jobs to be created eventually, the project will generate only 79 permanent jobs.[209]

The new agricultural plans and land reform strategy are focused on bringing benefits to large farmers in the Makhathini Area.[210] "Emergent" farmers that are already relatively wealthy are to be given land and R10 million worth of subsidies to buy tractors for planting, weeding and harvesting, even as thousands of impoverished agricultural laborers in the area are out of work.[211]

For the amount of government spending to entice private investment, relatively few jobs are forecasted. The government is reported to be spending R600 million on the SDI, but the Initiative—including *both* the agricultural projects and tourism facilities (described below)—is estimated to create *maximum* of only 4,000 permanent jobs for two districts' population of roughly 300,000.[212]

The development on large-scale, commercial farms not only provides few jobs, it heightens conflicts with poorer farmers in the area who use land for both cash and subsistence crops. Cotton farmers have been bolstered politically by the coverage of Bt issue, and have used their leverage to time water releases to their benefit, but disrupting the planting/working/harvesting cycle of poorer and/or food-crop farmers.[213] Conflict has been increasing between expanding emerging farmers and the majority dependent on numerous activities to sustain their livelihoods. Tensions over grazing land began in the 1980s.[214] The expansion of commercial farmers onto environmentally fragile land (such as river banks, wetland pans) has endangered the resource-based livelihood activities of others in the area.

Bt cotton has changed balance of social power in the area and consequently planting patterns. Early planting varies due to varying rains, but generally around September. The late planting date is early December, or at worst, January. Farmers using mechanical ploughing may plant later if they cannot access ploughs. Cotton is then harvested 5-7 months later, from April to June—a cycle longer than the subsistence crops grown in the area. With the publicity the Bt cotton and development projects have garnered, the well-organized Ubombo Farmers Association, which grows most of the Bt cotton in the area, has been able to successfully pressure the government to release water early, thereby reducing water availability at crucial times for subsistence cropping previously set in consultation with small farmers to suit their food needs.[215]

Elitist Tourism

Tourism is very similar to biased agriculture in the area because it has impoverished people and continues to offer few opportunities. For decades government and businesses have claimed that developing tourism increases revenue and generates thousands of jobs.[216] Hence, tourism is the other major component of the Lembobo SDI, and like the agricultural plans, is being pushed by high-ranking official and politicians. "Our government through the Lubombo SDI, is launching tourism investment opportunities of a scale and grandeur unparalleled in Africa," remarked Deputy President Zuma in a speech opening the first road section.[217]

Tourism in South Africa boomed with the economic surges in the USA and UK, and now, with the country's declining exports, occupies an important source of foreign exchange propping up the falling Rand. The government's tourism strategy is to use initial public investment to lure in massive private investment, which in turn is expected to provide jobs and revenue. Redevelopment funds to create or upgrade tourist facilities in Maputland—such as lodges and camps and beaches and trails, craft centers, boutique hotels—are said to "provide the backup for substantial private sector funds to flow into the region."[218] SDI plans call for adding 7,000 tourist beds to the 11,000 beds there in 1999. A R40 million malaria campaign was conducted to make the area more amenable to tourists. Also proposed was a R2.8 million craft project to market to tourists and thereby provide employment and income. Park redevelopment is expected to create 4,000 jobs, according to the KZN Minister for Economic Development and Tourism, Michael Mabuyakhulu.[219]

Drive-in campground, St. Lucia

In addition to improving facilities, the nature researves in the area have been integrated. On the southern coast, 300,000 ha of parks and land were consolidated to form the Greater St. Lucia Wildlife Park (GSLWP), which was declared a UNESCO World Heritage Site in 1999. In June of 2000, the Lubombo Transfrontier Conservation Area was launched, combining Ndumu, Tembe, and Mozambiquuan Elephant Reserves.[220] It is the largest coastal reserve in the world and is expected to attract more tourists than the famed Kruger National Park.[221]

Tourism on the Jozini Dam: the Shayamanzi Houseboat

However, despite these grand plans, private investment has not been as forthcoming as expected. Where investment has occurred, it has not provided as many jobs or as much revenue as predicted. A recent study on Maputaland found, for instance, that compared with agriculture, tourism generates less revenue per hectare, less employment per hectare, and lower wages per hectare. Twenty tourism operations in southern Maputaland generated only about a 1,000 jobs (771 direct, 385 indirect).[222] Indeed, the St. Lucia Park was said to be operating at R19 million *loss* per year in 1999.[223]

While there are some worthy pro-poor tourism projects, these are few and far between; most tourist facilities remain enclaves of wealth. The SDI's tourism plans have been pushed by senior politicians, rather than emerging from community initiative. Consequently, there is a lack of lack of coordination between government institutions, which often have been slow to initiate anything. When plans do come through, they often provide only a few jobs—some skilled, most low-paid and generally with little room for advancement. The jobs that do arise are concentrated on the coast and near reserves: 85% of tourist beds are within 10 kilometers (km) of the main N2 road running along the coast.[224] Consequently, the extreme poor rarely get jobs at tourism businesses.[225] Experience from another tourism SDI in the Wild Coast south of Maputaland has shown how "Communities face numerous obstacles to their effective participation in tourism, which are not being addressed by the programme."[226]

The persistence of poverty in Maputaland is thus directly related to the inability of poor people to benefit from the millions of dollars that flow through the region's elite tourism facilities. Moreover, these lucrative tourism businesses are based upon nature reserves that were formed by dispossessing local people of their land and access to water, forestry, and animal resources, as I now describe.

Authoritarian Conservation

The planned tourism strategies actually draw off of a much longer history of authoritarian environmental conservation. Conservation plans, real or proposed, have moved people off land and disrupted their livelihoods: "nature conservation and the formation of reserves … has meant unequal access to environmental resources by different users, leading to poverty and underdevelopment among large sectors of the population."[227] There are numerous major reserves in the area: Mkuzi Game Reserve (1912); Ndumu Game Reserve (1924, expanded 1947 and 199x); Malangeni Forest Reserve (1950); Costal Forest Reserve (1952); Pongolapoort Public Nature Reserve; Tembe Elephant Park (1983); Kosi Bay Nature Reserve (1988); Hluhluwe Umfolozi Park; and the recently consolidated Greater St. Lucia Wildlife Park (1999) and Lumbombo Transfrontier Conservation Area (2000).

Kosi Bay Estuary, northern Maputaland

The St. Lucia Park was first declared in 1895. Fishing was prohibited (in some forms) from Lake St. Lucia, though illicit gill netting began in 1960s.[228] In the 1970s, roughly 3,000 people were removed from a strategic missile range near Lake St. Lucia and brought to Mbazawana.[229] The nearby Coastal Forest Reserve, established in 1952,

displaced some 1,500 people. In 1947, Natal Parks Board expanded Ndumu reserve border, removing people from 1,000 ha, reducing access to river water and land, relegating them to areas agriculturally poor areas of sand forest.[230] In Mkuze as well, there have also been conflicts between conservation and development conflicts in Mkuze.[231]

North of the Kosi estuary—where local people had invested in fish trapping networks in Kosi Bay— families were also moved from Ntlangweni for a planned, but un-built, fish factory.[232] In 1988, 700 people were then removed when 11,000 ha were declared a Nature Reserve.

The threat of conservation was often enough to make people move, as did several hundred people near Ndumu reserve.[233] These threats posed a very significant force because there have been repeated plans to extend and expand the nature reserves.[234] There were plans began as early as 1947-49 (with coming to power of Afrikaner government and formation of Natal Wildlife Society). During the late 1940's, there was talk of a mega-park, "the great Maputaland dream," which would rival Kruger National Park. Around 1988, serious consideration was given to joining the Tembe Park and Ndumu Reserve, potentially affecting between 150 families and 1,150-3,000 people, mainly from the Mbangweni Corridor of sand forest, who had moved in the 1940s from the Pongola-Usuthu river junction.[235] The plans for a greater Maputland park then gathered steam around 1989/90, and finally came to fruition in 1999 and 2000.[236]

Land Dispossession and Slow Redistribution

The massive inequalities and injustices in South Africa's land distribution are present in Maputaland as well. At least 30% of the people in Maputaland have been removed from their land at least once.[237] Some people removed from other areas—such as Msinga district, Reserve 4 (near Richards Bay), and Louwsburg/Ngotshe (in 1976-8)—have settled in Maputaland.[238] In KZN, some 7,000 large farms make up roughly half the land, while the majority 3 million black South Africans have less than a third of the land. Only about half of the poor households in KZN own any land at all. Those that do cultivate land have small plots. Only a little over a third of the poor in KZN have livestock.[239]

To help remedy past injustices and current massive inequalities in assets, South Africa has pursued a three-pronged land reform strategy encompassing restitution of appropriated land, redistribution of land, and reform of land tenure. While the numerous critiques of land reform in South Africa will not be reviewed here, the experience of land reform in Maputaland does illustrate some of the same disappointing trends nationwide.

Land restitution has been slow, intermittent, and scanty. Given the political pressure to constitute integrated reserves for eco-tourism, however, there are several claims that have been settled or reached the final stages of negotiations: Ndumu Game Reserve (Mbangweni and Mathenjwa Claims), and the Tembe Tribal Authority claim for Tembe Elephant Park (displaced in 1982) and the Coastal Forest. Detailed investigations are proceeding around parts of Lake Sibiya, Mabibi (Manguzi) Forest, Sileza Forest, and Manzengwenya Plantation. To take one example, the slow pace of the Ndumu land claim caused communities to threaten to invade the reserve. This prompted government officials to try to by-pass the formal land-redistribution process by proposing, in 1998 and 2000, to allow agriculture on 200 ha of the reserve during the rainy season. Under media pressure, the proposals were retracted, but

resentment and tension remain, along with vandalization and arrests. The land claim was settled in 2000, but for less than two thirds of the claiming families.[240]

Little progress has been made in the government's plans to redistribute land through a market-based system that is premised on transfers from "willing sellers" to government-assisted "willing buyers." From 1997-2000, for example, only 1.8% of the 5 million hectares of KZN farmland available for redistribution was actually transferred to disadvantaged South Africans.[241] The figure is even lower at a national level. Resources were not the problem: the Department for Land Affairs had extra money for land redistribution that sat unspent. After the deadline for land claims expired on 31 December 1998, the redistribution process was put on hold in 1999, and the Department's budget was reduced and it developed a new strategy, which, unlike the former one, included little public consultation.[242] The new strategy, entitled Land for Rural and Agricultural Development (LRAD), emphasizes 'entrepreneurial' farmers, with larger grants for wealthier farmers. The previous ceiling on income of applicants was transformed into a required minimum $500 contribution, with a prerequisite that land recipients be "full-time farmers." In KZN, the state has 275,000 ha to redistribute—much of it in and around the Makhathini Flats—but this is to go largely to some 1,000-1,400 'emergent' farmers[243]

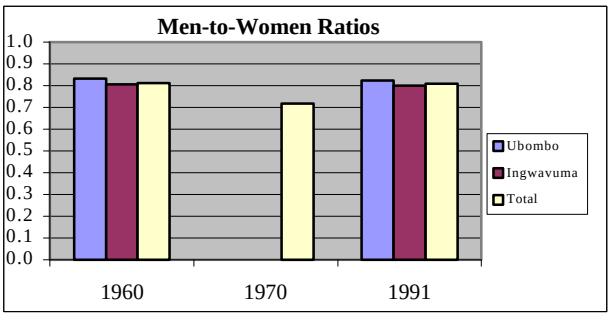
The shape and affects of land tenure reform in the area are presently unclear. The current Land Tenure Reform Bill will transfer state land to communities under rules set by administrative boards, of which 25% of the members will be traditional authorities. Traditional authorities want greater control, whilst other critics are skeptical of the Bill's imposition of individual land ownership.[244] The KZN government's plans for the Flats include clarifying rights on the Flats, but resolving land conflicts in the immediately surrounding areas will be difficult. Traditional authorities retain significant control—there are some 14 traditional authorities in the Ingwavuma and Ubombo Districts with 451,284 ha—and are often unrepresentative, unaccountable and unresponsive.[245] Impoverished refugees from the Mozambiquan civil war, for instance, have had difficulty accessing land from traditional authorities.[246] If the experiences of land restitution and redistribution are anything to go by, inequities in land access and ownership will continue to be a major force perpetuating poverty:

> On the basis of the budgets provided for land reform, and performance to date, it can be safely concluded that the effective aim of the government is a modest transfer of agricultural land—probably no more than 4% in the 15 years from 1994—limited to areas voluntarily released by existing landowners and favouring a small minority of the rural black population, selected on the basis of their skills, material resources and entrepreneurial attitude … The policies adopted by government have left the structure of the rural economy largely intact and, in the case of liberalisation of agricultural markets and cuts in agricultural support services, have contributed to a climate that is hostile to emerging, resource-poor farmers.[247]

Given the magnitude of land problems in South Africa and Maputland in particular, Bt cotton holds very little potential to significantly reduce poverty, and as described below, may in fact be widening and deepening poverty. Moreover, the heavily publicized dissemination of Bt cotton may serve to divert public attention from the government's failed attempt at land reform. Scientists and researchers discussing Bt cotton without regard to the land issue have the effect of consciously or unwittingly downplaying the massive injustices and inequalities of the past and present.

Declining Pensions and Off-Farm Wages

Studies on Bt cotton farming have also failed to examine vitally important employment linkages with urban areas. A significant factor contributing to poverty in the Makhathini Flats is the decline in off-farm wages, since many households have long depended on migrating family members bringing or sending back remittances. As one study noted, "Rural livelihoods in KwaZulu-Natal, as elsewhere in South Africa, are keyed to wage earning, and wage earning has been withdrawing because of the weakness of the macro-economy."[248] A recent major survey showed that about half of the poor people in KZN are households with an adult migrant. With regard to the Flats specifically, another study found that 56% of households had absentee migrants—often the household head—involved in urban employment.[249] Pensions have also been a long-standing major source of income in the area, and about a third of the poor in KZN on a pension income.[250] Since the early 1900s, and possibly earlier, migration has been an important fact of life for many in Maputaland. British colonial taxes forced people to seek wage employment. Subsequently, the austerity of the apartheid system forced many people into heavily controlled system of migration to plantations, mines and industries. Most migrants were and are men, and their absence is illustrated by census statistics showing Maputaland to be disproportionately female.[251] And yet, neither technology development and extension nor larger development plans explicitly take women or gender into account.[252]



The government's revised macro-economic strategy—the market-based Growth, Employment and Redistribution (GEAR) program—has not produced its predicted economic growth or poverty alleviation. Thousands of retrenched workers have lost their jobs or seen real wages fall.[253] These include the many men from the Makhathini area who go to work (often on contract) in Empangeni or Johannesburg.[254] It is logical to seek work in these places since most of the economic wealth generated in KZN is concentrated in manufacturing in lower Umfolozi (Empangeni).[255] However, stiff competition and reduced subsidies and protection have reduced employment in the main export industries in Richards Bay and Empangeni, which are based on paper and printing, followed by iron and steel (based on large smelters and coal shipments).[256] Two experts on the area correctly conclude, "It seems clear, then, that labour-intensive farming is a marginal economic activity … labour migration increasingly represents the most cost-effective form of labour deployment and survival … It is clear that the rural areas do not provide us with a self-contained economy"[257]

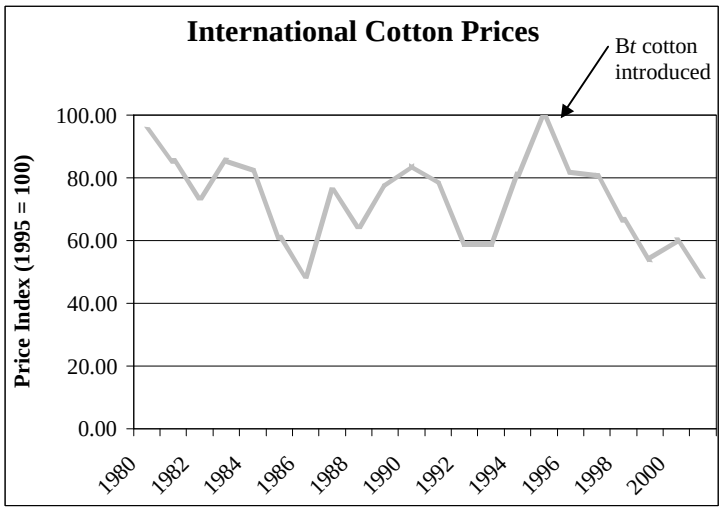
Over-production

Another force impoverishing the poor in KwaZulu Natal is the declining profitability, wages, and employment prospects in the agricultural sector, stemming from national and global inequalities in production and marketing, new technologies, over-production, and low prices.[258] KZN has long been the heart of South Africa's sugar industry (KZN produces 80% of the country's sugar), with plantations concentrated on the KZN coast roughly from Durban to Richard's Bay. In 1998, there were 35,000 small-scale growers producing 20% of total

output, whilst 2,000 large-scale farmers produced the remainder.[259] The concentration of land and machinery in production is also mirrored in increasingly concentrated sugar marketing and processing. Three giant South African sugar firms have been buying out mills, reducing the number of competitors from 75 to 15; they now own all but one mill in KZN.[260] With declining competition, these buyers have been able to pass on transport costs to producers.

In addition to growing industry concentration, the sugar sector has been hit by declining prices resulting from cheap, subsidized sugar that has been flooding the market after import liberalization. The United States and European Union subsidize their sugar farmers with more than $1 billion each day. This cheap sugar began to threaten South Africa's producers when the government initiated industry deregulation in 1994 under pressure from the World Bank, US and IMF. Prosperous white farmers have been able to shift into high-value export crops, but poorer black farmers and agricultural laborers are left with few viable alternatives. Neighboring Swaziland to lost 16,000 jobs in sugar due to low prices.[261] Coca Cola plants in South Africa now find it cheaper to buy their sugar from Brazil. Studies have shown that eliminating wealthy countries' tariffs on sugar imports would increase international prices for farmers by 63%.[262]

Like sugar, cotton is also facing massive global over-production and low prices—prompted by Developed Countries' heavy subsidies and new technologies such as Bt varieties—leading to deeper and wider poverty in the South African countryside. B*t* cotton is being adopted by wealthy subsidized agribusinesses in the US and numerous farmers in China, reducing world prices that are already at lowest levels in decades.[263] When representatives of West African cotton farmers issued a statement last year, they worried that global over-production was "threatening the survival of the cotton sector."[264] Since the introduction of B*t* cotton in South Africa in 1998, the price of cotton in South Africa has fallen almost 40%.[265] Indeed, because Bt cotton is a labor-saving technology, impoverished farmworkers face unemployment while the benefits of Bt cotton accrue to wealthy large commercial farmers who can cut labor costs.[266] "Labour is the agricultural sector's largest cost item," said Japie Gobler, head of Agri-SA, an association of the large-scale farming sector that was the backbone of agricultural apartheid.[267] Since 1998, more than 58,000 cotton-farm workers—among the poorest people in South Africa—have lost their jobs.[268] This staggering fact has gone unnoted in every study on Bt cotton in South Africa, which have all focused exclusively on the small-farm sector and ignored the plight of agricultural laborers on cotton plantations.



Source: IMF, *International Financial Statistics*

HIV / AIDS

The commitment by Thabo Mbeki to biotechnology—through its support of the South African Agricultural Research Council, and its reported R180 million support to private-sector biotechnology development—stands in stark contrast to his avoidance (or even concealment) of the devastating affects HIV/AIDS.[269]

Given the continuation of these enormously important constraints—devastating irrigation schemes, top down planning, elitist tourism, authoritarian conservation, persistent land inequality, declining wages, over-production, and HIV/AIDS—it is blatantly misleading to suggest that simply introducing GM cotton has transformed the impoverished areas of Maputland into a "thriving agricultural community," as CropGen suggests.[270]

Cost Effective

There are numerous strong-sounding claims about the economic benefits of Bt cotton for smallholders in Makathini, but more detailed examination calls these claims into doubt. All of the claims about Bt come from either from Monsanto or from a single, un-representative survey conducted from 1998/99 to 1999/2000. Rather than draw a random sample, researchers handpicked 100 respondents with the assistance of Monsanto. The unrepresentative nature of the survey is illustrated, for example, by the fact that it was composed of 42% women, whilst women actually make up about 54% of the population. Furthermore, over 75% of the respondents were over 40 years old, but the area actually has many young people—50% of the population is below 19.[271] Even this small set of data is contradictory however.

For example, it is not clear exactly how many farmers are using Bt cotton, nor how the number is actually determined. A farmer association leader speculates there are 5,000 small farmers, ISAAA estimates 3,600 in Makhathini, university researchers say 3,000, and CropGen says 2,500.[272]

The area planted to Bt cotton by smallholders is likewise disputed. ISAAA implies that small farmers have been using the technology on a hundred thousand hectares. Agricultural Biotechnology in Europe—an industry coalition—suggests 5,000 ha of "smallholder cotton." The survey team suggests 3,000 ha.[273]

In addition to conflicting data on the area and numbers of farmers, the profits gained by switching to Bt cotton are unclear. CropGen says farmers gain $113 per hectare.[274] Monsanto says farmers gain an extra $90. ISAAA argues that switching to Bt allows farmers make an extra $50 per hectare. University researchers calculate $35, whilst the survey team found farmers gained only $18 in the second year, but in the first year "Bt cotton *nonadopters* were actually $1 per hectare better off."[275]

Claims about pesticide savings appear to be exaggerated. While ISAAA claims that farmers normally apply pesticides 10 times per season, surveyors state that the figure is lower,

between 5 and 8 treatments.[276] So while the industry suggests that using B*t* cotton eliminates 9 sprayings, the survey found farmers saved only 2 to 5.[277] In fact, farmers spend more money on the engineered seeds—which are twice as expensive as conventional ones—than they save by reducing pesticides.[278] The concerns about the growing prevalence of other pests were mentioned before. Also important to note is that since pest protection depends upon cotton producing high levels of Bt toxins, the crops may be susceptible during the middle and end of the season, and during times of stress (for example, under low soil fertility, or low rainfall), when less Bt is generated. Consequently, "The effectiveness of *Bt* cotton is therefore extremely variable and highly dependent on the specific population dynamics of the range of pests and beneficial insects in each agro-ecosystem, as well as the levels of *Bt* toxin in the plants."[279] Industry scientists are attempting to address these concerns by introducing additional genes. These questions have not been seriously studied in Africa however.[280]

Monsanto may also overstate the labor saved by replacing pesticides with genetically engineered protection. It suggests that farmers walk "at least 20km" in applying normal amounts of pesticides to one hectare, but some experts say the distance can be half that.[281] Regardless, many farmers do not walk the distance themselves, but rather hire people (usually men) to do the spraying for them.[282]

If the results thus seem ambiguous, one is left the question of why roughly 90% of farmers are reported to have adopted Bt. Part of the reason is that farmers' main constraint is credit, and credit was, until very recently, only available through the local monopoly, Vunisa, which is heavily promoting Bt cotton.[283] Vunisa's credit in turn comes from grants by the pro-biotech government administration. Further influencing farmers decisions is the storm of publicity around Bt cotton; reporters, photographers, and cameramen have been brought from around the country, Africa, and the world to the Makhathini by Monsanto to document Bt cotton-adopting farmers. In addition, political pressure to adopt was exerted through the farmers associations in the area. T.J. Buthelezi, chairman of a federation of farmers' associations, for instance, unconditionally embraced the technology: "I wouldn't care if it were from the devil himself," he remarked.

Where it has been adopted, there is now evidence that the Bt cotton has not only failed to solve Makhathini farmers' problems with debt, it has actually deepened and widened indebtedness. As mentioned above, even farmers on the irrigation scheme had become mired in R16 million worth of debt by 1998. Makhathini farmers grow cotton in a context of both extremely variable market prices, and varied rainfall—precisely the sort of highly risky conditions that leave farmers heavily indebted. The plans to grow cash crops in the area have not come from the communities themselves. Rather, they have descended from the echelons of government in Durban and Pretoria, in collaboration with large multinational businesses.

Because most poor farmers do not have enough cash to purchase B*t* seed, they contract with Vunisa Cotton, a South African supplier that holds a monopoly in the area on sales and purchases of cotton seeds and chemicals. Vunisa loans seeds to farmers on the condition that farmers sell their harvested crop back to the company at 20-40% of the world market price.[284] If market prices fall, or weather devastates the crop, farmers risk becoming locked into debt with the company. Vunisa—which is part of the giant OTK consortia (with profits of R230 million) and is the sole cotton buyer in Swaziland—participated in a state subsidized credit scheme that began in 1996.[285] The scheme encountered problems of non-payment—as occurred with similar schemes in Swaziland—and was terminated in 1998, with some R50 million losses to the state, R10 milllion of which were owed by Vunisa.[286] With Bt cotton,

farmers must spend even more than before in order to obtain high yields, and they consequently face greater risks should the crops fail. In 2000, the floods that ravished Mozambique waterlogged the fields and destroyed the crop, leaving Makhathini cotton farmers indebted by $1.2 million. Late rains in 2002 damaged the cotton crop again, leaving more farmers deeper in debt.[287]

Cost effectiveness at the research level remains unstudied. There are however, substantial projects for producing organic cotton—which has greater market demand—in Africa.[288]

Environmentally Sustainable

Claims about the environmental character of Bt cotton in South Africa have been based on speculation because not a single environmental impact assessment has been performed. The case of Bt cotton would appear to present ambiguous environmental sustainability because it reduces conventional pesticide use, whilst simultaneously presenting a "one-gene" approach to pest control. On the positive side, ISAAA has reported an increase in red frog species in the area, though there is no hard data to support or contradict this statement. A reduction in the number of injuries due to pesticide poisoning has been reported.[289] There is little risk of outcrossing to wild weed relatives is low, since there are no real weedy relatives of cotton in Africa. South Africa's wild cottons do not crossbreed with commercial cotton, according to John Hoffman, head of the government's regulatory body, the South African Committee on Genetic Engineering.[290] Farmers have begun using a new pesticide that is designed to complement the Bt cotton.[291]

On the other hand, cotton in Makhathini and the rest of South Africa is simply monocropped over vast hectares year after year. While there is some *de facto* intermixing with food crop plots, there appears to be little concerted effort to use integrated pest management to control bollworms and other pests. This absence of techniques that take into account agro-ecological sciences is perhaps to be expected from the conventional, top-down, reductionist nature of South Africa's research and extension system. Nor are there any refuges. The evolution of a resistance pest, or the invasion of resistant pests that have evolved elsewhere is thus highly likely. There is also the possibility that eliminating bollworm may give rise to other predators, such as whiteflies or mites. The effects of the Bt protein on non-target organisms and human health have not been investigated or publicized in South Africa.

Institutionally Sustainable

In contrast with the other examples here, Bt cotton is a purely commercial commodity. The same varieties are promoted to large, commercial farmers and smallholders alike. Moreover, the promotion, adoption and evaluation of Bt cotton has depended upon very extraordinary institutional support. Utilization has depended upon subsidized credit from the South African Government. Promotion depends upon Monsanto and Vunisa's heavy publicity over a relatively small area. Even evaluation of the profitability of the cotton has depended upon foreign researchers funded by foreign donors (the UK's Department for International Development, and the Rockefeller Foundation).

There was little coordination between public and private institutions to develop, test and market the variety. The only remotely institutional work is Monsanto conversion one of its

research stations into the "Buhle Farmer's Academy," which has reportedly trained more than 120 farmers. However, Monsanto provides all of the funding, and is using the Academy as an example of how the company is "very involved in the social and economic improvement of local agricultural communities."[292] There is no evidence that the "Academy" has produced any useful results, or that it is more than a showpiece for Monsanto. The development of Bt cotton has involved no measures to remedy the deficiencies of the research and extension service in KZN.

Conclusion

To summarize, Bt cotton was not developed in response to demands by poor farmers; rather it was developed by a large transnational company for relatively wealth commercial farmers in the developed countries. Nonetheless, Bt cotton shows moderate site-specificity for poor farmers in South Africa. However, inadequate cotton technology is largely irrelevant to rural poverty in South Africa, and in Makhathini poverty stems more from the disruptive dam and irrigation scheme, top-down planning favoring wealthier farmers, elitist tourism, authoritarian nature conservation, land inequality compounded by slow land reform, declining pensions and off-farm wages, overproduction, and HIV/AIDS. The direct impacts of Bt cotton on small farmers are ambiguous, but the indirect impacts on rural poverty are overwhelmingly negative. Environmental sustainability is low, but could potentially be moderate if refuges and/or gene-stacking function. Because Bt cotton was developed by a private company, institutional sustainability of technology development in South Africa has been negligible.

4. Bt Maize

Maize is arguably the most important crop grown in Africa.[293] Scientists at the Nairobi-based Insect Resistant Maize in Africa (IRMA) project are developing genetically modified Bt maize in the hope that it will resist the stem borers pests. Borers reduce yields of maize, sorghum and sugarcane by boring through stems, leaves and cobs. There are several different types of stem borers (see page __ below), but the most important are the 'African' maize stem borer Busseola *fusca*, and the 'Asian' maize stem borer Chilo *partellus*. If the Bt maize is released, it will be nearly impossible to prevent spread of the Bt gene throughout farmers fields because of the highly varied and informal nature of farming.[294] Thus, of the cases considered in this report, Bt maize has the potential for the largest alteration of farming, environment, and livelihoods. The international seed company Syngenta has financed (and provided some technical assistance to) the IRMA project, which is conducted by KARI with the assistance of the International Maize and Wheat Improvement Center (known by its Spanish acronym CIMMYT).

IRMA project literature so far has either been strategically ambiguous, or has over-estimated losses due to stem borers. The project coordinator suggested that "More than 60% of the maize area in Eastern and Southern Africa suffers from devastating pest infestations each year," but does not say where he got these figures, nor what he means by "devastating."[295] Other consultants state "attack by stemborers and other insect pests is consistently cited as a major constraint on maize production everywhere in the country", but do not include any references supporting that statement.[296] A Syngenta journalist states that in Kenya "borers destroy a significant part of the maize crop every year," without explaining how much is "significant."[297] When it comes to quantifying actual losses, Florence Wambugu claimed borers destroy 40% of the maize crop.[298] CIMMYT suggests that damage estimates range from 15-40% of the national crop.[299] Syngenta suggests losses are as high as 26%, (or a total of 330,000 tons).[300] Another Kenyan scientist states Bt maize would save 15% of farmers' crop (giving 400,000 tons).[301] When a survey was done, it showed stemborers reduced national production by 13.5%. Subsequently a figure of 12.9% has been calculated from farmers' estimates, though "the accuracy of their estimates has not been tested."[302]

Maize stemborer

Despite these different, conflicting estimates, dozens of popular reports unequivocally cite the $90 million in benefits Bt maize is purported to bring. "In Kenya, stem borers cause 15% maize grain yield loss valued at US$90M annually," says one American newspaper.[303] "Project seeks to eliminate production losses of US$90 million," says a project report.[304] However, these accounts ignore internal warnings about the quality of this estimate: "These crop loss figures, however, need to be interpreted with caution, especially since variance is high and sample size small."[305] The data in fact extrapolated nationally from statistically insignificant trials.[306] Crop losses varied from 8.5% in lowlands, to 16% in the moist transitional zone. Prices varied also, which gives "an estimated loss of $25 and $60 million."[307]

Demand Led

The previous discussion of sweet potatoes already noted the deficiencies of the Kenyan agricultural research and extension system. The IRMA project has confirmed these deficiencies, and may in fact be exacerbating them.[308] We must ask, why the focus on maize pests—as opposed to drought resistance, the weed *Striga*, low soil fertility, or early maturity—and why the focus on particular Bt constructs (which fail to protect against African borers).

The IRMA project has focused on maize and on non-African stemborers because it is driven not by demands of Kenyan farmers, but by previous work of Syngenta and CIMMYT. CIMMYT approached Syngenta to support the project.[309] The first planning meeting was held in 15-20 August, 1999. The company Syngenta effectively owes its existence to transgenic corn resistant to stem borers in the United States. The company is actually an amalgam of several companies, of which one, Ciba, was the first to develop and release Bt corn in the US to protect against the European Stem Borer and the South Western Corn Borer. Novartis was facing several difficulties when it decided to support the IRMA project: a lawsuit by Monsanto over patent infringement, and criticism regarding its partnership agreement with UC Berkeley, signed in 1998 for 30 million (which it subsequently decided not to renew).[310] Though Klaus Deninger, Director of the Syngenta Foundation, claims says Syngenta does not have "the slightest economic interest in the project."[311]

CIMMYT, particularly its Economics Program, was a leader among the relatively conservative world of international agricultural research in developing methods of farmer consultation. However, CIMMYT's Applied Biotechnology Center (ABC) has not followed suit, and may in fact be reversing course: the IRMA project has not arisen from the needs or demands of Kenyan farmers (as described above), but rather from innovations at the ABC. The Center had begun transforming tropical and sub-tropical maize with various genes, and it is these maize lines (rather than Kenyan maize) and these Bt constructs that are being used in Kenya (even though they do not protect against African stem borers).[312] Despite the fact that no studies had been done asking farmers and attempting to measure losses and the significance of the problem, Daivd Hoisington, director of biotechnology at CIMMYT, remarked, "KARI and CIMMYT are taking this [project] on full steam and are totally committed."[313]

Indeed, the biotechnology projects may be weakening KARI's responsiveness to farmers' needs. "Our idea," described John Wafula of KARI's network of research stations, "was to replace this situation with a central facility …"[314] Even the World Bank refused to fund the restructuring because it deemed it too expensive, but KARI was able to get funding from CIMMYT, the British, and Monsanto.

At a national level, the project has conducted several Participatory Rural Appraisals on maize throughout the country, but these have only served to illustrate the severe lack of client orientation. Of the 30 villages the project surveyed across the country and its agro-ecological zones, none ranked stemborers as the most important constraint on maize production.[315] The surveys were partly designed to find productive varieties that could be transformed and then distributed to farmers. However, in conducting surveys and crop experiments, the IRMA project team came to recognize the poor links between farmers and Kenya's research and extension system: "[there was] substantial discrepancy between farmers and breeders'

evaluation of new varieties."[316] When KARI researchers brought farmers to research stations to compare their preferences with researchers' they found "no correlation between farmers' and breeders' selections."[317] Indeed, when staff conducted an appraisal in Western Kenya, one of farmers' main complaints, after soil fertility and lack of cash, was poor extension services.[318]

Syngenta's Experience at Cinzana

A glimpse at Syngenta's record of supporting public crop research in Africa further illustrates biases towards station breeding and a lack of a focus on farmer needs. For two decades, Syngenta (and its predecessors, Novaritis and Ciba Geigy) has funded 70% of the costs of a 280-hectare research station at Cinzana, in the Segou region of Mali.[319] The Foundation claims that the Station—opened in 1983 with support from the Malian Government, ICRISAT, USAID, and CIBA-GEIGY foundation—"has taken on model value for Mali and other countries of the Sahel"[320] It has been cited as a model of international cooperation, of how the private sector can support research oriented towards small-scale poor farmers.

Scientists and expertise were supplied by the International Center for Research In the Semi-Arid Tropics (ICRISAT), and Mali provided staff. In 1990 USAID and ICRISAT stopped support in order to focus on regional centers; CGIAR provided $1.7 million for 1990-95. Expatriate experts are flown in periodically for a few days, but the staff is otherwise Malian. The members of the Board of Directors represent the project funders and Malian agricultural research leaders, and meets formally once a year to give direction and support to station director.

The site was chosen because it had several major types of soil, an accessible road, and was close to villages. During construction, designers discovered insufficient water, so a Swiss engineering team constructed pipeline and pump to bring water from 7 kilometers away, which provided irrigation and was praised for promoting hygiene and allowing winter experiments and seed growth. There are housing facilities (for thesis students, and information exchange), a conference room, 50 animals for traction, training (skills from India). Likewise, fencing provides protection: "In the Malian countryside, freely roaming animals frequently damage farmers' fields by eating plants or walking through fields [especially irrigated plants in the winter]. The precession of agricultural research cannot tolerate such damage." Consequently that station surrounded its grounds with 10km of 1.6m high fencing, with gates for vehicles and pedestrians—not exactly conducive to farmer participation.

The structure of research was very top-down, centralized, and conducted under unrealistic conditions; the result was inappropriate varieties. Before 1985, all research was done on station, and designed by agronomists in the capital, Bamako. They began by testing millets from India and North America. The intercropping techniques they developed failed on farm because of differences of soil fertility (the same millet variety yielded 2-3 ton on station but only 1 ton off), and because "many millet and sorghum varieties developed on station gave significantly lower yields than local varieties." Later more scientists came to Cinzana because of "its attractive infrastructure." "Broad, national in scope," annual meetings were held to review the previous years research and to approve the research program for the next year.

Although shifting somewhat more on farm, it remained limited. Around 1985, management pressure urged that the centrally located agronomists design on-farm trials. By 1991, on-farm experiments were "designed, executed and reported entirely by Cinzana staff." In 1993, had stations with live-in staff in three villages. By 1995, there were at least 50 on-farm locations, as well as a program that "plants several demonstration fields along major roads and entrances to weekly markets." The on-farm agronomist liaises with regional extension agents, participates in extension planning, training, and demonstration. Regional extension agencies are funded by the World Bank and IFAD. There is apparently little farmer participation or influence over the research agenda; rather research is top-down, with new technologies "confirmed through on-farm tests" after 10 years station-based breeding. Syngenta began to recognize problems, but has been unable to fully remedy them: "more small-scale farmers were not taking advantage of the technical innovations presumably because they perceived that the tests of new technologies in the experimental fields were simply taking place at their farms rather than with their involvement"[321]

Site Specific

After understanding the lack of farmer demand in the design of the project, we can now comprehend how the project has failed so far to develop crop varieties with traits that are specific to farmers' bio-physical and socio-economic conditions. In fact, KARI helped develop new varieties that were highly susceptible to stem borers, and for decades worked with extension agents on dissemination and advice that farmers should adopt these susceptible varieties. The reason for this was that because poor farmers had little say KARI's over research methods, scientists at KARI's stations freely used insecticides during their breeding trials, and hence failed to notice the borers.[322]

As described above, Syngenta had already developed Bt maize to protect against stem borers (in particular one type, C. *partellus*) prevalent in the United States and other areas of large industrial farming. A major problem is that the dominant stem borer in Kenya, B. *fusca*, is resistant to that the Bt constructs used by Syngenta and CIMMYT.

Finding an effective Bt construct is only part of the problem, however. Developing a Bt variety that farmers actually prefer, and getting it out to them is another major difficulty. Some of the important characteristics of maize include:

- OPV/hybrid
- Dent/semi-dent/flint/semi-flint
- White/yellow
- Maturation (extra early/early/ medium/late/extra late)
- Ecology (lowland tropics/ subtropics/mid-altitude areas/ highlands/temperate)
- Drought tolerance
- Soil fertility requirement
- Striga tolerance
- Pest and disease tolerance
- Cost of seed
- Low lodging
- Easy threshing
- Cooking qualities (boiling, roasting, grinding/pounding)

- Husk cover
- Taste
- Grain size
- Cob size
- Cob rot
- Recyclability

Once Bt varieties are developed, they will have to be crossed with suitable local maize in order to transfer the Bt gene (each variety will not have to be individually transformed).[323] The Kenyan agricultural research systems does not have a good track record in developing and disseminating varieties that suit poor farmers' diverse needs. The very first hybrids were (late-maturing) designed for the moist highlands. The vast majority of varieties have been late-maturing for high elevations, with only a few medium and early-maturing ones for low and medium altitudes.[324] Farmers in western Kenya, for instance, ranked early maturity as the most important trait after yield.[325] The transport infrastructure and regular and adequate moisture in the highlands allowed farmers there to use fertilizer, and hence high-yielding fertilizer-responsive varieties.

Poverty Focused

Whether Bt maize is poverty focused in a more difficult question because the crop is widely grown, not only within Kenya, but within southern, eastern, indeed all, of Africa. There is a dearth of studies examining whether maize research is poverty-focused.[326]

Throughout southern Africa, farmers may well be more concerned by other agronomic problems:[327]

- Low and/or erratic rains
- Low soil fertility
- Striga
- transport costs
- other pests (weevils, moles, rats, termites, aphids, moths, bollworms, black beetles, cut worm, chaffer grub, squirrels, birds, monkeys, crickets, grasshoppers, porcupines, pigs.)
- storage
- lack of processing facilities
- head smut
- maize streak
- market prices for selling and/or buying
- availability
- lack of cash
- lack of credit
- lack of labor
- lack of farm tools
- fake seeds
- livestock

Kenya

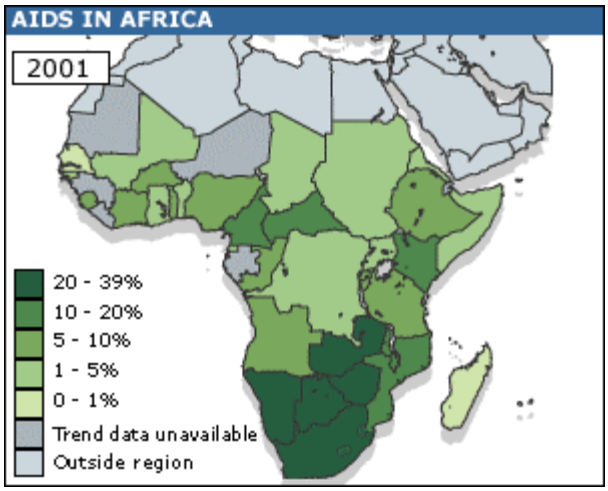
In Kenya's lowlands, farmers do not generally plant maize, preferring hardy sorghum and millet. In arid areas (85% of Kenya is arid or semi-arid) and mid-altitude areas (700-1400 meters), stem-borer losses are relatively low, farmers generally do not plant modern varieties, and, with liberalization of maize marketing, are planting less and less maize at all.[328] Farmers here overwhelmingly wanted drought tolerance, early maturity, high yields, resistance to weevils, well-sized cobs and seeds, roughly in that order.[329]

While deep and intractable poverty may be concentrated in the conflict-ridden arid regions, there are significant numbers of poor farmers in high potential zones in Kenya, according to the World Bank.[330] However, in these zones, the most prevalent borer is B. *fusca*—which, as noted earlier is resistant to Bt maize.[331]

Lower maize prices would benefit the poor who are net buyers of maize. Nearly 80% of poor farmers are net buyers of maize. They could reap significant gains—some say __ million a year—if the government ceased artificially inflating maize prices—through state purchases, import tariffs, and price supports—and thereby favoring net-sellers of maize.[332]

South Africa

Most of the Bt maize currently used in South Africa is grown by large-scale commercial plantations. In 1999, South Africa granted commercial use permits for Bt maize from Monsanto and Pioneer. The maize was the yellow type, and was used mostly for animal feed, but also for cereals. 70,000 ha were planted in 2001. That year, approval was granted to plant Bt white maize for human consumption, and some 100,000 ha were harvested in 2002.[333] Currently, 15-20% of South Africa's total maize production is reported to be GM.[334] There are no studies documenting whether this Bt maize has had a beneficial or negative affect on poor farmers and households. However, as discussed above, rural poverty in South Africa has much more to do with several other factors, most importantly policy and infrastructure biases towards large-scale commercial farmers, inequitable land distribution, declining wages and employment on- and off-farm, over-production, and HIV/AIDS. In fact, many of these factors are significant causes of poverty throughout the region.



Southern and Eastern Africa

The issue of poverty in southern and eastern Africa is much too complex to describe fully here, several important factors stand out. These include political repression—as with Zimbabwe's Mugabe, Malawi's, Zambia's Mwanamasa, and until recently Kenya's Moi. Corruption is rife in these countries as well. Radically unequal land distribution also plagues the area, particularly Zimbabwe, South Africa, Kenya and Malawi. AIDS continues to become an enormous cause of impoverishment all over

the region. Civil conflict and declining commodity prices across Africa have hindered poverty alleviation.[335]

Marketing of maize at all levels from local to regional suffers from numerous problems. Past state marketing systems were heavily distortionary, reforms have only been partly implemented, the private sector has generally responded poorly, and the market-based reforms have failed to ensure the poorest of the poor are not left behind.[336]

If the Bt maize provides protection, poor farmers could gain by adopting the technology, but adoption will depend upon reforming seed systems that currently fail to reach poorer, marginal farmers (except in Zimbabwe, and somewhat in Kenya). Poor farmers that are net buyers of food may, however, benefit if increased yields lead to lower food prices.[337] There is little danger that farmers will lose international market share if GM maize is adopted, since almost no countries (and even fewer poor farmers) export significant amounts of maize.[338]

Cost Effective

As described above, there have been numerous speculations as to the value of damage done by stem borers in Kenya. For other regions, and indeed Africa as a whole, the figure is simply too complex to know. Nonetheless, IRMA project results show Bt maize does not protect fully yet against B. *fusolea*, which is the predominant pest in the Moist Transitional Zone where 80% of the Kenya's maize is produced.[339]

Resistance to Different Borers by Different B*t* Constructs

Borer / **Bt construct**	Chilo *partellus* (Asian)	Busseola *fusca* (African)	C. *orichalcocililiellus* (coastal)	Sesamia *calamistis* (pink)	Eldana *sacharina* (sugarcane)
Cry1B	X		X		
Cry1Ab	X		X	X	X
Cry1Ab-1B	X		X	X	X

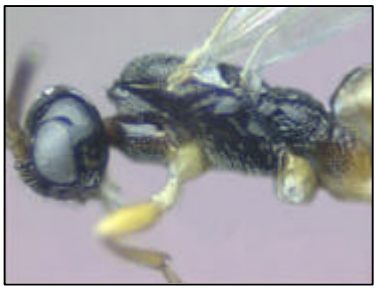
At the level of allocating research resources, the cost of achieving transgenic resistance is likely to be high, since the maize must not only be transformed, but appropriate varieties must be extended to farmers. Consideration of costs must also include other foregone opportunities for research and development. The IRMA project has occupied the time of more than 60 staff, including 30 researchers.[340] They have diverted resources, not to on-farm testing or farmer participation in research, but rather to new labs, greenhouses and testing facilities for KARI.

The opportunity cost of devoting such resources to Bt maize development is very high because—as discussed above—other constraints besides stem borers are often of greater importance to poor farmers in Kenya and elsewhere. These traits have not received due attention simply because they are not important to the large corporation funding the project. Each dollar spent, each hour used, and each mind harnessed to work on Bt maize must be siphoned away from work on other more pressing constraints such as drought resistance, soil fertility requirements, and resistance to *Striga*.[341]

Even with regard to stem borer research itself, there are at least three more robust and more effective methods to control borers that do not use genetic engineering: biological control by natural enemies, control through farming practices such as push-pull methods, and through conventional resistance.

Biological Control

One effective method for controlling the Asian stem borer has been to introduce its natural enemy from Asia, the wasp Cotesia *flavipes*. This method was initially attempted in the late 1960s in Kenya without much accomplished, but has since been successfully pursued by the International Center for Insect and Plant Ecology (ICIPE), based in Nairobi, and the wasp is now established in Kenya, Mozambique, Tanzania, Uganda and several other countries in southern and eastern Africa.[342]



Cotesia *flavipes*

Because the wasp C. *flavipes* controls only the Asian stem borer C. *partellus*, ICIPE researchers have introduced other stem borer enemies, such as the pupal parasitoid *Xanthopimpla stemmator* to control B. *fusca*, which is already mildly controlled by an African predator, C. *sesamiae*, and, to a lesser extent, numerous other natural enemies of stemborers that prevail in wild areas.[343]

The impacts of these different borer-predators will depend on the distribution of the borers themselves. B. *fusca* prevails in the higher (above 800-1500 meters), more moist areas, whilst C. *partellus* dominates drier, low-elevation areas (though there is some overlap). There is some evidence that C. *partellus* is expanding its coverage.[344]

Stemborer Distributions in Kenya

C. *partellus*	South East Lowland Tropics and Arid Areas
C. *partellus*	Below 1500m in Highlands and eastern moist transition zone.
B. *fusca*	Above 1500m in Highlands and eastern moist transition zone
B. *fusca*	Northwest highlands and moist transition zones
B. *fusca* & C. *Partellus*	Lake Victoria area (moist midaltitude, and southwest of moist transitional zone)

C. *partellus* is present in the Zimbabwe lowveld and parts of the middleveld, and eastern Tanzania. B. *fusca*, meanwhile, is present in Cameroon, the Zimbabwe highveld, and Lesotho.[345]

Releasing natural enemies is relatively a low cost venture—the entire ICIPE project has received just a small fraction of the amount given to the IRMA project—but provides widespread and sustainable benefits. The natural enemies, once released, will need little further support. Biological control of the stem borer can significantly reduce crop damage, but will not completely eliminate the pest. It can be complemented by new farming methods and conventional breeding for resistance.

Conventional Breeding for Resistance

As early as 1983, scientists had confirmed that some local Kenyan varieties were resistant to C. *partellus*.[346] In fact, when IRMA researchers did participatory assessments in western Kenya to study the potential demand for stem-borer-resistant Bt maize, they found that some farmers were using local varieties (*Nyamula* and *Shipindi*) that were already resistant to borers.[347] Harish Kumar, an Indian scientist who has worked on stem borers for decades reviewed past scientific work and concluded "sources of resistance have not been utilized effectively to develop SSB resistant varieties/hybrids for use by poor farmers."[348] In fact, there are almost no breeding programs in southern or eastern Africa attempting to harness indigenous germplasm that is resistant to stem borers.[349]

Genetic resistance can involve resistance (when the plant kills the pest, known as "antibiosis," or just reduces feeding or tunneling), avoidance (when pests are repelled), or tolerance of plants to leaf damage/deadheart/stem tunneling (when yield is unaffected). IRMA cites as some of the difficulties with conventional breeding, "limited genetic variation, difficulty in maintaining a quantitative trait, and dealing with two organisms, pests and hosts."[350]

IRMA is planning to insert the B*t* gene into germplasm already bred by conventional means to be resistant to borers. However, the germplasm they intend to use is one developed at CIMMYT, Multiple Borer Resistant (MBR) variety, which again was designed to protect against borers in the US and Europe (though incidentally did turn out to provide some resistance to C. *partellus* and B. *fusca*).[351]

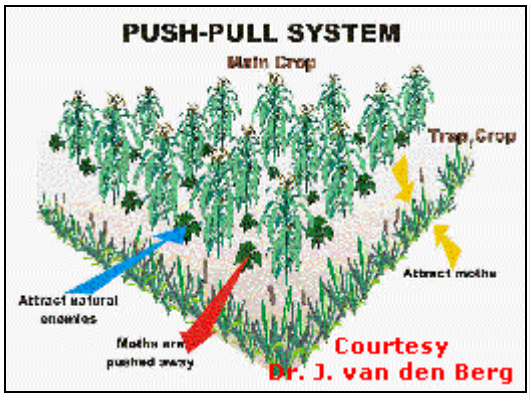
Some varieties, such as Kidhune, have very high resistance, but may need to be adapted to suit farmer preferences (it is a yellow flint).[352] Scientists at ICIPE bred a more suitable variety (an early-to-medium maturing white maize), which they found "highly resistant to *C. partellus* larvae damage" via antibiosis.[353] The ICIPE researchers sought funding from CIMMYT and the Rockefeller Foundation, but the program was closed. IITA has developed at least five varieties that are resistant to the pink stem borer and the sugarcane borer, and successfully tested them in on-farm trials in Nigeria.[354] Trials in Cameroon showed that some local landraces were even resistant to B. *fusca*.[355] Other trials in South Africa showed lines highly resistant to B. *fusca*.[356]

Indeed, when the project coordinator was asked if he would have done anything differently, he responded that he would have emphasized "identifying insect-resistant material in conventionally bred varieties. If we had done more work in this direction last year, the farmers would now be able to use the improved seed."[357]

Farming Techniques

Closer attention to the ecology of the stem borer has revealed several highly effective and economically efficient methods to keep the pest under control. Basic principles of agronomy and ecology hold: the incidence of stem borers is greater in maize monocrops.[358]

Consequently, the most effective agronomic method of controlling stem-borers (all types) is a system of intercropping called "push-pull" farming, developed by scientists at the Kenya-based International Centre for Insect Phyusiology and Ecology (ICIPE). By researching African ecology and consulting farmers, scientists helped design a system in which maize is inter-cropped with plants that repel the pest (silverleaf and molasses grass), while other plants (napier grass or sudan grass) that attract and kill the insect are sown on the edges of the field.[359] On-farm trials of push-pull reduced maize losses from 40% to 5%; yields increased by roughly one ton per hectare. Researchers have facilitated visits amongst farmers to assist people's own evaluations, and sharing of experiences, lessons and difficulties. After only a few years of research, development and extension, the system has already been adopted by thousands of farmers, in seven districts in Kenya, and several districts in Uganda, South Africa, and Malawi.



In a "Push-Pull" field, a trap plant (pull) is planted as a border and a repellant plant (push) is intercropped with maize crop

This agroecological method has the added benefit of suppressing the *Striga* parasitic weed and providing livestock fodder.[360] The researchers worked with farmers to ensure that the technology is suitable. Some labor is involved in establishing the crops, as are seeds, of course, but these inputs are small, divisible, and well remunerated. Once established, the intercrops need little care. They must be trimmed, but farmers cut simply sell the valuable fodder and leave purchasers to do the cutting themselves. In fact, the added benefits of livestock fodder have been an unexpected aspect of the technology attracting many farmers.[361]

Like any technology, "the push-pull method has to be adapted to regional conditions," noted Hans Herren, ICIPE's Director.[362] In the densely populated moist highlands, less silverleaf is needed since there is less *Striga*, and researchers have identified different species of silverleaf suited to different agro-climates.

There is even more potential to build upon and adapt push-pull methods for different circumstances and environments. Other assessments by IRMA researchers found that farmers use a range of techniques that have been little investigated:

> ash mixed with fine soil applied in the funnel or a combination of soil, ash and tobacco … *mathira (Gricidia latifolia)* leaves and water concoction applied in the

funnel, ground *muthiga* bark, mixed with pepper and water and the concoction applied in the funnel.[363]

Other agronomic means of control include:

- disposal of crop residue (by burning or burial)[364]
- planting early[365]
- tillage and mulching (though not with old stalks)
- spacing
- intercropping
- crop rotation (for example, with legumes)
- botanical control using neem solutions

Agronomic means of control can take advantage of the fact that the incidence and severity of stem-borers also depends on a range of other factors, including, time of planting, stover management, rainfall levels (low rain may weaken tolerance). Several other grasses in other areas are being explored for their effects upon stem borers.[366]

Environmentally Sustainable

The environmental sustainability of Bt maize in Africa is low, because there are no great environmental benefits of Bt maize (in contrast to cotton), but there is a great likelihood that stem borers will develop resistance, or that other resistant pests will increase to fill the vacuum left by stem borers—even the IRMA project administrators admit this, and there is already evidence of shifts in the prevalence of borers after the introduction of the predatory wasp C. *flavipes*, which attacks C. *partellus*.[367] While the diverse fields and farming systems of Africa may serve as a *de facto* refuge for stem borers (for example sugar cane can serve as refuge), these factors also make gene flow very difficult to control. Since there are large areas of commercial farmland without refuges, these would favor the development of resistant pests, which could then infest areas that do have refuges (planned or not).[368] The tenets of evolutionary biology, as well as voluminous experience elsewhere, suggest that large monocultures of maize which all contain the same gene for borer resistance—transgenic or conventional—are an invitation for the insects to evolve the ability to overcome this resistance.[369] So, these measure are likely to be of limited effectiveness. The use of Bt maize may also interfere with natural and biological regulation of pest populations. The risk of Bt out-crossing to weeds is low, since there are no weedy wild relatives of maize in Africa.

The effects of Bt-maize on natural enemies are unknown in Africa. The IRMA project is studying the issue, having collected some data on natural enemies, but yet to test the effects of Bt maize.[370] The effects on wasps are particularly important, since experiments have shown borer populations increase when predators are eliminated.[371]

Institutionally Sustainable

IRMA is collecting all the local varieties encountered and keeping them in the National Gene Bank, in collaboration with the International Plant Genetic Resources Institute.[372] No efforts have been made to facilitate exchanges of varieties between farmers.

The project is entirely funded by a $5 million dollar donation by Syngenta, with technical assistance from both Syngenta and CIMMYT. While the project has resulted in increased facilities, as well as training and biosafety knowledge, organization and legislation, there is again the danger that these investments have been disproportionately focused on genetic engineering to the neglect of other potential areas of research.

There appears to have been almost no coordination with South Africa, which has already released both white and yellow Bt maize for cultivation.

There is little assurance that funding will be available over the long term to deal with issues that may arise from dissemination. Syngenta, however, has continued funding to the Cinzana station, though donor funding is questionable - SARI Further there are no regional frameworks in place addressing potential issues of cross-border gene flow.

Conclusion

In sum, the IRMA project has low demand drive, cost-effectiveness, and institutional sustainability. It is too early too detect unambiguous site specificity or poverty focus. Environmental sustainability is currently low to moderate, but could potentially be raised. The project could have the largest impact, because maize is perhaps the most important single crop on the continent. The project however appears to have been driven by scientists and corporate donations from the West, rather than poor farmers' priorities. It bodes poorly for future public-private partnerships, given this lack farmer involvement, as well as the unsustainable nature of a one-off grant. Other important means of borer control have not received sufficient resources due to the focus on genetic modification.

5. Conclusion

In concluding, I briefly summarize the findings of the preceding sections, and then examine implications arising from the material. Specifically, having shown that the three GM crops analyzed above are inappropriate for poverty alleviation, the large amount of publicity they have garnered is attributable to carefully crafted and well-financed media campaigns by GM advocates. Various people have participated in these campaigns, each for their own reasons. Politicians have latched on to biotechnology to illustrate their otherwise absent commitment to the poor. Academics have found another fad. Corporations try to sell their products. Scientists have projects that need funding. The result of this unjustified publicity is muted debate and diminished capacity to select and develop appropriate science and technologies for poverty alleviation in sub-Saharan Africa.

To summarize, virus-resistant sweet potatoes are also not demand driven, site specific, poverty focused, cost effective, or institutionally sustainable. The environmental sustainability of modified sweet potatoes is ambiguous. B*t* cotton scores low on criteria of demand drive, site specificity, and institutional sustainability. It shows ambiguous results in poverty focus and cost effectiveness. Environmental sustainability is currently moderate, but could potentially be moderate to strong. For B*t* maize, the analysis shows low demand drive, cost-effectiveness, and institutional sustainability. It is too early too detect unambiguous site specificity or poverty focus. Environmental sustainability is currently low to moderate, but could potentially be raised.

As mentioned in the first section, while this survey examined only genetic modification, other types of biotechnology such as molecular markers or tissue culture could be equally evaluated with the criteria used here.

Maximum Possible Increases in National Production

Sweet Potato	18%
Bt Cotton	27%
Bt Maize	13%

The maximum possible production increases—according to project staff themselves—are displayed in table above. These maximum gains from genetic modification are small, much lower than with either conventional breeding or agro-ecology based techniques. What might explain the high commitment of resources given the low relevance, sustainability, demand and poverty focus? The answer is that governments and corporations have mobilized funding as part of high-stakes international dispute over biotechnology, in essence rendering African agricultural research projects—and our understanding of poverty dynamics on the continent—pawns in the conflicts of the powerful.

Summary of Cases and Criteria

	Sweet Potatoes	*Bt Cotton*	*Bt Corn*
Demand-led	Low – driven by Monsanto, KARI & USAID	Low – commercial product for large farmers	Low – driven by KARI, CIMMYT & Syngenta Foundation
Site-specific	Low – one unpopular variety	Moderate	Not currently available
Poverty-focused	Low	Low – limited gains; harmful indirect affects	Low
Cost-effective	Low – unproven effectiveness; high opportunity costs	Ambiguous – costs borne by company; gains for poor farmers unclear; negative for rural poor	Low – limited effectiveness; high opportunity costs
Environmentally-sustainable	Low to moderate	Ambiguous – reduces pesticides, but avoids IPM	Low, possibly higher if gene stacking works, depending on adoption and refuge
Institutionally sustainable	Low – high-donor funding; some institutional capacity building	Low – little to no local capacity building; foreign control	Low – high donor funding; some capacity building

Trade Wars and Media Campaigns

To crack open lucrative markets worldwide, biotechnology corporations are seeking public legitimacy for genetically engineered crops by turning their PR machines upon small farmers in Africa. Industry-funded groups are increasingly using Africans to misinform publics in both industrialized and developing nations.

Monsanto and the handful of other corporations who dominate the international trade in agricultural inputs had staked their future on transforming themselves from inputs and pharmaceuticals to the 'life-sciences.'

In Europe's lucrative markets, however, the biotech industry has been rebuked by a moratorium on genetically modified organisms.[373] If the ban was lifted, US agribusinesses could reap $300 million a year on corn exports alone; total biotech exports could figure in the billions.[374] Monsanto, whose stock fell almost 50% during 2002, joined farm lobby groups in

pressuring the Bush Administration to take action in the World Trade Organization (WTO) against Europe. They hope the case will establish a precedent prohibiting GM-restrictions throughout the world.[375] Because relations between the US and EU are already tense—over Iraq and US farm subsidies and steel tariffs—the biotech industry has turned to a more subtle public relations drive to gain European acceptance of GM.

They have begun using "the poverty card," suggesting that Europe's resistance "impedes the global use of a technology that could be of great benefit to farmers and consumers around the world."[376]

In the US Congress, the interests of American exporters are clearer: "We have been told to expect good news on behalf of American agriculture," said a spokesman for the Speaker of the House of Representatives.[377] The Director of Public Policy at the American Farm Bureau Federation described, "We rely on export markets for one-third of our crops; this [ban] is a nightmare."[378]

Biotechnology companies had earlier come under scrutiny in several high-publicity episodes. First, Novartis (now Syngenta) signed a controversial deal with the University of California at Berkeley, giving the company influence over the course of academic research and rights to patent resulting innovations in exchange for a $25 million grant. Second, Starlink GM corn, which had not been approved for human consumption, wound up in many granaries and food products. Later, experiments seemed to show that GM corn had negative impacts upon secondary insects, such as the Monarch butterfly. Then research revealed that GM corn had found its way in to farmers' fields in Mexico—the place of origin and center of diversity for maize—despite prohibitions on the crop. After this story made it to the cover of the influential weekly magazine *Time*, scientists suggested that it was just a matter of time before seed banks preserving genetic diversity became contaminated with GM corn. Recently, the US has been condemned for providing exclusively GM food aid, when countries facing food shortages have specified they would rather prefer the unmodified supplies widely available in the US, in Africa and throughout the world.[379]

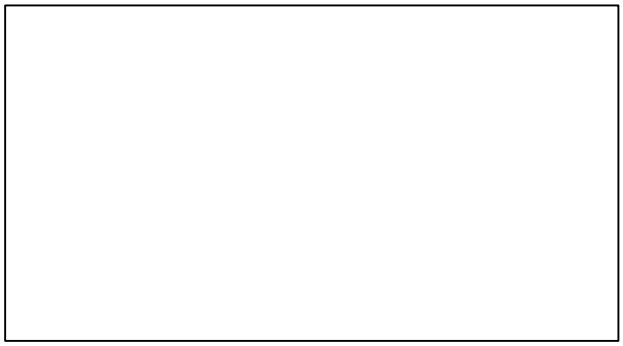
Under threat in an industry that depends on a positive popular image, minimal and friendly regulations, and generous public financing, biotechnology corporations joined together to devote $50 million dollars to a publicity campaign.[380] Corporations have bussed in pro-GM protestors, invented fictitious front people to level slander, and turned towards Africa has proof that genetic modification is essential to end world hunger.[381]

Finding African "Representatives"

To bolster its claims about the benefits of biotech crops, Monsanto has funded T.J. Buthelezi, a clean-shaven, middle-aged black farmer from Makhathini, to act as an African representative. He has told of his positive experiences with Bt cotton (in terms suspiciously similar to Monsanto press releases) at conferences and events around the world.[382] In October 2001, Buthelezi met US Congress members and attended a Summit by the US Corporate Council on Africa. Several months later, Monsanto paid for him to have lunch with US Trade Secretary Robert Zoellick at the company's office near Pretoria.[383] In August of last year, Buthelezi and Monsanto organized pro-biotech booths, interviews and rallies at the World Summit on Sustainable Development in Johannesburg. Buthelezi's name and face now commonly appear on the internet and briefings for policy makers.[384] In May 2003,

Buthelezi was by Zoellick's side when the Trade Secretary formally announced a US WTO case against EU restrictions on GM imports. A month later, the Administrator of USAID, Andrew Natsios, described Buthelezi before a Congressional panel on plant biotechnology in Africa.

"B*t* Buthelizi": large farmer, hired spokesman?



South African farmers flown in by Monsanto to attend a private conference in London

However, Buthelezi's experience may be unique. The Council for Biotechnology Information calls him a "small farmer," and others describe his life as "hand-to-mouth existence." Administrator Natsios called described him as a "small farmer … struggling just at the subsistence level." However, independent reporters have revealed that, with two wives and more than 66 acres, he is one of the largest farmers in Makhathini and chairs the area's farmers' federation encompassing 48 farmers' associations.[385]

For Monsanto, Buthelezi and his stories are part of the firm's declared strategy of "gaining global acceptance of biotechnology."[386] Just before President Bush's May 2003 speech claiming that Europe's import restrictions exacerbate African hunger, Monsanto flew four black South African GM crop farmers to London, where they spoke at a private conference hosted by the Commonwealth Business Council, before heading on to Denmark and Germany. Like Buthelezi, these "representative farmers" read statements carefully scripted by Monsanto and own dozens of acres of land. Several actually spend most of their time working at their day jobs as school administrators. Others pro-biotech campaigners have caught on: CropGen, for instance, celebrates another South African farmer, Mbongeni Nxumalo.[387]

These South African farmers—whom representatives of Monsanto and other businesses call "basically representative farmers" and "representatives of the African smallholding community"—are plucked from South Africa, wined and dined, and given scripted statements about the benefits of GM.[388] In an area where most farmers cultivate just a few hectares, and only half the population can read, Monsanto's "representative" farmers are school administrators and agricultural college graduates, owning dozens of hectares of land.[389] Monsanto has been criticized for using these farmers as a part of a deliberate attempt to distort public debate on biotechnology.[390] Critics have coined the nickname "Bt Buthelezi," to illustrate this farmer's unconditional support to Bt cotton: during a trip to

Monsanto's headquarters in St. Louis, Buthelezi was quoted as saying, "I wouldn't care if it were from the devil himself."[391]

For several years, Monsanto has attempted to cement the adoption of GMOs in Africa. In 1998, the company bought out Cargill's seed operations in Africa.[392] A year later, Monsanto attempted to purchase a majority share in Zimbabwe's main cotton company in order to produce GM cotton seeds for Zimbabwe, South Africa, and Egypt.[393] After being turned down in Zimbabwe, Monsanto unsuccessfully tried Zambia and Tanzania. It has since worked its way in to Kenya and Uganda and is attempting to introduce transgenic cotton there during the next growing season.[394] Monsanto has pursed similar strategies with biotech maize in Uganda and South Africa.[395]

But Monsanto's activities in Africa make better public relations than actual business. The impoverished continent accounts for only small percent of Monsanto's sales (company representatives would not say how small). But Africa is fruitful for the firm's lobbying.

In addition to establishing a newsletter and website for African biotechnology issues, Monsanto has recently paid journalists to visit Makhathini to "admire the virtues of B*t* cotton."[396] It has also tried to convince Zimbabweans now considering Bt cotton through videos, field trips, and presentations.[397] Adds in magazines tout the experience, and at the 2002 World Summit on Sustainable Development in Johannesburg, Monsanto organized the presence of Makhathini farmers at the conference for pro-biotech rallies and dinner outings.[398]

Florence Wambugu, the Kenyan sweet potato scientists, has become an influential advocate for the biotechnology industry. After her work with Monsanto and KARI, she headed ISAAA's Africa office, before establishing her own A Harvest Biotechnology Foundation International. Wambugu recognizes however, that "it [the modified sweet potato] has no commercial value to Monsanto, except as PR."[399]

ISAAA has created a Knowledge Center in Kenya with the primary purpose to "facilitate a knowledge-based, better informed public debate."[400] The group has also spun off a number of innocuously named pro-biotech NGOs, such as the African Biotechnology Stakeholders' Forum and African Biotechnology Trust.[401] Pro-biotech Western aid agencies have joined with theses organizations to quietly conduct one-sided conferences at up-scale venues around the continent, such as Kenya's Windsor Golf and Country Club, aimed to swing high-level officials in favor of GM.[402]

But critics charge these forums are facades for large corporations.[403] The NGOs consist of a website and a few staff, they charge. They also point out that ISAAA is funded by Agro-Evo, Bayer, Cargill, Dow, Monsanto, Novartis, Pioneer, Syngenta, in addition to a dozen Western governmental aid agencies. The Board of Directors likewise has contained top biotech company executives, such as Wally Beversdorf, head of R&D at Novartis (now Syngenta).

ISAAA, however, has no representatives from African farmer organizations.[404]

"There's a lot of propaganda," said Tewolde Egziabher, head of Ethiopia's Environmental Protection Authority in an interview with Greenpeace, "but there's absolutely no proof that these [transgenic] plants are more prolific."[405] In 2000, Egzhiaber issued a joint letter by groups in Africa criticizing the "misleading simplification" of a British documentary, which,

he argued, used "the image of the poor and the hungry from our countries" in order to "push a technology that is neither safe, environmentally friendly nor economically beneficial to us."[406]

After publicity of Iraq War subsided, the Bush administration renewed its campaign against regulations on GM. President Bush argued that EU's policies are harming poor African countries. The US Senate simultaneously passed a bill prohibiting financial aid for combating HIV/AIDS to those countries that decline GM food aid.[407] Consequently, the Bush Administration has been accused of using the name of the poor ("poor-washing"), particularly Africans, in order to put a positive spin on its efforts to increase American exports.[408]

The Consequences

The result of these high-profile media campaigns is that actual empirical analysis of GM crops in Africa suffers. The link between EU regulations and African hunger was quickly criticized as far-fetched and misleading.[409] There is little empirical evidence to support the claim that EU measures have "caused many African nations to avoid investing in biotechnologies, for fear their products will be shut out of European markets."[410] African countries export neither maize nor sweet potatoes to Europe. The only potentially affected crop would be GM cotton, but South Africa does not export cotton to the EU; in fact, it imports cotton because it cannot meet domestic demand.[411] Countries have not adopted biotechnologies not because of EU restrictions, but rather for other reasons, such as lack of suitable technologies, and lack of regulatory laws and capacity. Consequently, no sub-Saharan African nation joined the US's challenge to Europe's ban, and even Egypt withdrew from the complaint.[412] In contrast, 20 African countries have filed petitions against the United State's own cotton subsidies.[413]

Another surprising example of advocacy trumping facts is C.S. Prakash, the influential biotechnology advocate who has advised the US Trade Representative. Prakash has repeatedly cited sweet potatoes as a positive example of the benefits of GM for African countries, but has confessed to having no knowledge of the results of scientific trials in Kenya.[414]

Also demonstrating the lack of empirical analysis, a major report on biotechnology by the UN Economic Commission for Africa drew its conclusions based primarily on hypothetical benefits and risks.[415] During writing, the report was reviewed by numerous institutions in the United States, such as the World Bank and Harvard University, but not by a single organization in Africa, let alone representatives of poor farmers.[416]

Academics have not generally been as illuminating as one would hope. On the one hand, applied researchers involved with biotechnology do not have access to outside critical information, or fear it may jeopardize future funding or research. On the other hand, the whims of academia mean that non-project scholars focus on developing new theories and summarizing others' debates, rather than detailed, empirical evaluations. One consequence is the aforementioned overemphasis on novel risks in lieu of the more standard measures utilized in this report.[417]

Moving Forward

If most analysts now agree that biotechnology is not a panacea, nor a "magic bullet" that will on its own solve hunger, the next question we must ask is, "how effective a tool is it?" The evidence compiled in this report shows that while genetic modification may constitute a novel tool, in Africa it is a relatively ineffective and expensive one. Cash-strapped scientists working with poor farmers in Africa might well regard genetic modification as a waste of time and money. The evidence assembled here supports the view of a South African commentator: "There are better ways to feed Africa than GM crops."[418]

In fact, the language of biotechnology as a tool one can "choose" or "not choose" may obscure crucial decisions about planning and democratic priority setting. Some analysts suggest that the best approach is to simply let farmers choose whether they like conventional or GM crops best. This simple suggestion is misleading for several reasons. First, it is a wasteful and irrational to invest huge sums of resources to develop many sorts of technologies, and then when the technologies are completed, let farmers choose which they prefer. Experience has shown it is much better to involve farmers in the process of developing technologies, rather than merely choosing between end products. Secondly, where cross-pollination is likely (as with maize, but not cotton or sweet potatoes) and marketing channels messy, then neither farmers nor consumers will be able to choose whether they plant and/or consume transgenic varieties.[419]

I have aimed not spell out policy recommendations in this conclusion, except one: to increase the influence of poor farmers over technologies and policies. The standard criteria laid out in the introduction of this paper need much greater attention and action. In this regard, the Institute of Development Studies has conducted noteworthy research on *Democratising Biotechnology*.[420] Poor farmers should shape processes of developing technologies, as well as dissemination and regulation. In addition to technologies, poor farmers should also have influence how agricultural policies are formulated, interpreted, implemented and enforced. Of course farmers organizations are not perfect, and there are great cleavages between rich and poor, female and male growers, so an important activity is helping ensure such organizations are representative of and accountable to poor farmers.[421]

There is no singular "African" position, nor should there be. Select high-ranking officials have given their public approval to biotechnology, such as Nigeria's Minister of Agriculture, Thabo Mbeki, the president of the African Academy of Science, and former President Moi. However, just as many others have taken opposing positions, such as the president of Zambia, and the head of Ethiopia's Environmental Protection Agency. Advocates and critics sometimes seek out unsavory bedfellows, such as lauding Zambia's corrupt and authoritarian government, simply for rejecting contaminated maize, or, vice versa, lauding the equally corrupt Moi regime for supporting GM.[422] As one Kenyan commentator stated, "There clearly is no democracy in this matter."[423] To suggest that there is or should be one singular "African" point of view, is to seek to undermine the very thing that is most needed: constructive debate for deliberative democracy to sustainably address the diverse and site-specific needs of Africa's poor farmers.

Picture Credits

La Place du Paysan.[424]
Monsanto sweet potato lab.[425]
Sweet potatoes.[426]
Coffee farmer.[427]
Whitefly.[428]
Camp.[429]
Kosi Bay.[430]
Houseboat.[431]
AIDS distribution.[432]
AIDS protest.[433]
Cotesia *flavipes*.[434]
T.J. Buthelezi.[435]

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Endnotes

[1] See World Bank's participation sourcebook at http://www.worldbank.org/wbi/sourcebook/sbhome.htm.
[2] See, e.g., Cornwall (2000); Cornwall and Gaventa (2001).
[3] See Amanor (1990); Buhler et al (2002); Chambers et al (1989); Merril-Sands and Collion (1994); Okali et al (1994); Scoones and Thompson (1994).
[4] World Bank (2002b: 50).
[5] UNECA (2002: 110). See also Glover (2003).
[6] CGIAR (2000: 4).
[7] Albert et al (20004, 33-35); Collinson (2000); de Janvry and Dether (1985: 76-77); Eponou (1996: 2); Kaimowitz (1992); Norman (1980: 9); Purcel and Anderson (1997); Sims and Leonard (1989).
[8] Pimbert and Wakeford (2002); Pimbert et al (2001).

[9] BBC (2003); The Western Mail (2003); Daily Post (2003); Daily Telegraph (2003).
[10] See AKIS (2000); Smith (2001);.Ruttan and Binswanger (1978: 380-381); World Bank (2000a). De Janvry (1978: 317) notes "the response of the public sector research and extension programs to farmers' demands is likely to be greatest when the agricultural research system is highly decentralized …" Cf. Masters (2003).
[11] See Ribot (2002)
[12] Chambers (1983; 1997); Richards (Richards 1985); Sumberg et al (2003); Collinson (2000).
[13] See, respectively, Hassan and Karanja (1997); Richards (1997); ISNAR et al (1995); Guyer (1997).
[14] For several examples see Brookfield and Padoch (1994); de Steenhuijsen Piters (1995); Dorward et al (1996); Guyer (1996; 1997); Scoones (2001); for a more overall review, see Chambers (1997).
[15] See Moock (1986); Poats et al (1988); Feldstein and Poats (1989); Stoop (2002: 9).
[16] Harrington and Tripp (1984); Shaner (1984).
[17] See, e.g. Brader (2002).
[18] See, *inter alia*, Collinson (2000). See also TAC (1978).
[19] deGrassi (2001); Baker (1993); Berry (1986); Little (1985).
[20] Anaman (1988); for the example of environmental sustainability, see Byerlee and Murgai (2001). See also Richards (1989; 1993).
[21] Anandajayasekeram et al (1997); Alston et al (1995); Horton (1986).
[22] TAC (1988); Conway and Barbier (1990); Conway (1997).
[23] Cassman and Pingali (1995); Pingali et al (1997).
[24] Reardon (1998).
[25] Tripp et al (1990); Stoop (2002).
[26] Eicher (2001).
[27] Tabor (1995); Pardey et al (1995).
[28] Falconi (1999).
[29] Devarajan et al (2001); Morss (1984); Moore (2001).
[30] See Albert et al (2000).
[31] Jones and Lawson (2000); McGee et al (2002).
[32] Bingen and Brinkeroff (1999: 38).
[33] Business Day (2001); Fish (1998); ISNAR (nd); Shapiro (1998); Kithure (2001); Lewis (1999); The Nation (2002); Ndiritu (1999); Wafula (); Wambugu (1999);Wanyama (2003); Serageldin (1999: 389); Schroeder (2000); USAID (nd).
[34] Gibson et al (1997); Karyeija et al (1998b).
[35] Hinchee (1998: 91).
[36] Prakash (1994); Prakash and Varadarajan (1992). However, as Smit (1997) notes, indigenous cultivation practices in Uganda provide relatively effective protection against weevils, as well as smoothing harvesting.
[37] Kuyek (2000).
[38] Wambugu (2001: 49).
[39] Wambugu (2001).
[40] Aritua et al (1998); Gibson et al (1997). Karyeija et al (1998a). See Hahn et al (1981) for SPVD resistance in Nigerian cultivars.
[41] Gibson et al. (2000).
[42] Gibson et al. (2000).
[43] Mwanga et al. (2002: 246).
[44] Carey et al. (1997); Aritua et al (1998); Karyeija et al (1998a); Aritua et al. (2000).
[45] Ibid.
[46] Gibson et al. (2000); Feng et al (2000); on re-infection, see Wambugu (1991).
[47] Profile of an ASARECA Network: The Regional Potato Research Network, http://www.bugwood.org/asareca/html/tatar1.html
[48] Sserunkuuma (1999).
[49] World Bank (1998a: 4). From 1992-1998 the World Bank had pushed a top-down Training and Visit system in Uganda.
[50] World Bank (2000b: 3, 7).
[51] The World Bank (2001: 5) writes "The capacities of current research and extension institutions to generate and disseminate agricultural technologies are quite weak" and emphasizes the "necessity for considerably greater involvement of beneficiaries in the design and dissemination of farming technologies." Reviews of past major agricultural projects noted a key lesson was "ensuring demand-responsiveness of extension services and thereby adoption of extended technologies" (14). World Bank (1999b: 5) emphasizes the lesson of "full consideration of the stakeholders' views and the needs and demands of local users." See also Uvin (1998: 118-139).

[52] World Bank (1999a). See also World Bank (1999c); Guatam (2000).
[53] Mudavadi, W. Musalia *Letter of Sectoral Policy: National Agricultural Research Project Phase II (NARP II)*, in World Bank (1996).
[54] Odame (2002: 2775).
[55] Kamau et al (1997).
[56] World Bank (1996: 68).
[57] And yet, John Wafula, a past director of KARI's Biotechnology Program, still claimed biotechnology research was "needs-driven" (quoted in Wambugu 2001). Likewise, Dr. B. Odhiambo, also at KARI biotechnology, claims with no support "In Kenya, agricultural biotechnology is embraced on demand driven initiatives based on priority needs in Agriculture" (nd). And Andrew Natsios, Administrator of USAID, testified before a Congressional Panel that "USAID's programs in biotechnology reinforce the ability of Africans to make their own decisions. Everything we do in biotechnology is done collaboratively – from problem identification and priority setting to aiding the development of policies designed to establish risk assessment programs and protect intellectual property. Our programs are demand driven. Our partners want and need the strategic uses of biotechnology …" (see http://www.house.gov/science/hearings/research03/index.htm).
[58] Although occasionally it is poor soil fertility that makes the plant weak and susceptible to disease, and new susceptible varieties have been introduced precisely because they were early maturing. See IITA (1992: 79-83).
[59] See also Ewell (nd); Hagenimana et al (1999a); Hall and Devereau (2000); Hall et al (1998); Smit (1997). Also, Bangwe (1997) reports that for farmers in Southern Zambia, "the potential for expansion of sweetpotato production is constrained by; (i) vine propagation and maintenance; (ii) limited market potential; (iii) bulkiness, perishability and low value per weight and; (iv) difficulty in long term storage" (7.10).
[60] Hall and Devereau (2000: 277).
[61] Aritua et al. (1998).
[62] Dr. N. Gichabe, Director of Biotechnology at KARI, personal communication, 06 February, 2003; Hinchee (1998); See also J. Wafula (2000), cited in Gibbons (2000). Cf. Odame et al (2002: 2774).
[63] Dr. N. Gichabe, Director of Biotechnology at KARI, personal communication, 06 February 2003. Though Odhiambo (nd: 4) states KARI is transforming "local popular sweetpotato varieties for resistance to SPMV using improved gene-constructs that has [*sic*] the local *cp*-gene of the Kenyan isolate of SPFMV.
[64] Blundell (1992), cited in Karyeija et al.(1998a).
[65] The trials are taking place in Kakamega, Kisii, Mugua, Embu, and Mtwapa (PanAfrican News Agency 2000); Mungai (2000); Odame et al (2002); Dr. N. Gichabe, Director of Biotechnology at KARI, personal communication, 06 February 2003.
[66] Cook (2002).
[67] GTZ study cited in Odame et al (2003).
[68] Sweet potatoes have gained in importance partly as a result of the spread of the debilitating cassava mosaic disease.
[69] Low (1997).
[70] Mungai (2000).
[71] FAO (FAO 2000). See also Hendrickson et al. (1998).
[72] Hence it may be partly so important because women have less access to and control over cash income, which is dominated by (migrating) men.
[73] Qaim (1999: 3).
[74] Hendrickson et al. (1998). The regional distributions are: maize (highland Kakamenga), coffee (Central Nyanza, northern Kisumu, northern Seme, Gem, near Mt. Elgon), rice, cotton (Siaya), tea (Kisii; Kericho), sugar (Bungoma, Kakamega, Kisumu, Mumias, Chemelil, Miwani, Muhoroni, Nzoia, South Nyanza, Awendo and Siaya), and tobacco (Kuria and Migori) (the latter two involving contract-farming schemes.
[75] Nyong'o (1981); Buch-Hansen and Marcussen (1982); Chacha (2001); Heald (1991); Kennedy and Cogill (1988).
[76] Argwings-Kodhek (1995); Francis (1995); Gibbon (2001); Heald (1999); Omamo (1998); Orvis (1993; 1997); World Bank (1995).
[77] Associated Press (2003); using the $5 million per year figure given by Qaim (1999).
[78] Raworth (2002); Somerville (2002).
[79] East African Standard (2003).
[80] The Nation (The Nation 2003).
[81] The Nation (2000); Makabila and Nambafu (2003).
[82] Opala (2001); The Nation (2001b); Mwangi (1999).
[83] A few factories, however, were temporarily reopened. See Fowler (2002); Miring'uh (2003b); Njuguna (2002b; 2002a); Ogodo (2002); Mwangi (2001); Opala (2001).
[84] The Nation (2001a).

[85] Gibbon (2001).
[86] Hagenimana et al (1999b); Francis (1995).
[87] Francis and Hodinott (1993); Orvis (1997).
[88] Bates (1989); Steeves (2002).
[89] Throup (1987).
[90] Bates (1987).
[91] Fox (1996).
[92] CIMMYT, "Without protection from insects, no field of dreams for Kenyan maize producers," www.cimmyt.org, accessed 28 Jan. 2003; East African Standard (2002) "Obure faces a stiff challenge" 14 Oct.; Kebati, Onderi (2002) "Three injured in Bobasi clash" The Nation 10 Dec. UN Integrated Regional Information (2001) "Moi brings opposition party into cabinet" 11 June, http://allafrica.com/stories/200106110360.html.
[93] Haugerud (1990).
[94] Charveriat (2001); Gresser and Tickel (2002).
[95] Kidd (2001).
[96] Kidd (2001: 7).
[97] Though there has been considerable critical analysis of the PRSP process in Uganda (2002). A number of characteristics of poverty beyond low income have arisen from these exercises (e.g. the list given by Kidd 2001: 10-11).
[98] Kidd (2001: 11).
[99] Reinkika and Collier (2001); Sserunkuuma (1999).
[100] Kidd (2001).
[101] Foster and Mijumbi (2002: 9).
[102] E.g. Clapham (1999); Payne (1998); Okidi and Mugambe (2002). See also FEWS (1997).
[103] UN report, April 16 2001.
[104] Government of Rwanda (2002); Donovan et al (2002); Clay et al (1998); Clay et al (1995).
[105] Donovan et al (2002: 10). "Diseases" are also mentioned, but no sources are given, and there was no response to my inquiries on the issue.
[106] Uvin (1998).
[107] See, e.g. Des Forges (1999).
[108] Uvin (1998: 110-115); Uvin also shows how World Bank statistics on poverty and inequality were inaccurate.
[109] Cited in Uvin (1998).
[110] Uvin (1998: 115).
[111] Loveridge et al (2003).
[112] Mthembu-Salter (1999).
[113] Demers (2003).
[114] World Bank (2002a: 7).
[115] http://www.cia.gov/cia/publications/factbook/geos/by.html
[116] World Bank (2002a: 6)
[117] World Bank (2002a: 8).
[118] Mungai (2000), cited by Odame et al (2002).
[119] Qaim (1999: 5).
[120] PanAfrican News (2000).
[121] Wambugu (2001), cited in Odame et al (2002: 2774).
[122] Qaim (1999: 2).
[123] Qaim (1999).
[124] Gibson (2002).
[125] Wambugu (2001: 50, 51).
[126] See Qaim (1999).
[127] Lewis (1999).
[128] Rafie et al (1999); USDA (1996).
[129] Karyeija et al (1998b).
[130] Naranjo (2001); Gerling et al (2001).
[131] Castle (1999); Eveleens (1983); Cisneros and Mujica (1999); Carey et al (1999).
[132] Cisneros and Mujica (1999).
[133] Abo and Alegbejo (1997: 69).
[134] IITA (1997); see also Gabre-Madhin and Haggblade (2001).
[135] Legg (1999); CIAT (2001).

[136] 'Sustainable Integrated Management of Whiteflies as pests and vectors of plant viruses in the tropics: An SP-IPM task force led by CIAT', online.
[137] Hilje et al (2001).
[138] Gerling et al (2001: 791-792).
[139] Personal communication, Lisbeth Riis, May 2003.
[140] Kreuze et al. (2000); Karyeija et al (2001).
[141] Karyeija et al. (1998a). More specifically, a SPFMV-resistant variety developed by CIP (clone 420026) appeared susceptible to Ugandan isolate of SPFMV (1998b: 6).
[142] Hinchee (1998); Wambugu (2001: 50).
[143] Odame et al (2002: 2774); Qaim (1999: 13).
[144] USAID (nd); Monsanto Company (2002).
[145] Hinchee (1998)
[146] World Bank (1996: 78-79)
[147] World Bank (1998b).
[148] World Bank (2001: 14). World Bank (1999b: 5) emphasizes the lesson from past project of ensuring "greater attention paid to institutional reform and capacity building."
[149] http://www.isar.cgiar.org/atdt/About/Abouta.htm
[150] Karyeija et al (1998b: 10).
[151] Other research is in progress on the possible affects of Bt cotton outside of South Africa. Cf. Elbehri and McDonald (2003); Traore et al (2001).
[152] The exception is Kuyek (2002).
[153] Bennet (Bennett 2002; nd).
[154] Monsanto (2002).
[155] Smith (2002).
[156] CropGen (2002: 2)
[157] Thirtle et al. (2003).
[158] ISAAA (2002a).
[159] Ismael et al (2001b).
[160] Bembridge (1991).
[161] See, respectively, Machethe and Mollel (2000); Wheeler and Ortmann (1990).
[162] van der Ploeg et al. (1994), cited in Oettle et al. (1998: 68).
[163] Republic of South Africa (2001: 6, 79).
[164] Mtshali (2002).
[165] Oettle et al. (1998: 63, 24). On irrigation scheme farmers see Nel et al (1998).
[166] On research and extension in South Africa, see also Jiggins (1997); Norman et al (1994); Bembridge (1991); Bembridge et al. (1983); Botha (1994); Botha and Treurnicht (1997); Taylor (1988; 1999; 2000).
[167] Bembridge (1991).
[168] Ismael et al (2001a: 7).
[169] The scientific name of the tobacco budworm is Helicoverpa virescens, American bollworm is Helicoverpa armigera, and the pink bollworm is Pectinophora *gossypiella*.
[170] Hofs and Kirsten (2001: 16). This occurred in Zimbabwe also [Keeley and Scoones contexts 2003]. The Bt toxin only affects caterpillars, leaving cotton susceptible to sucking pests.
[171] Van der Walt (nd).
[172] UNECA (2002: 110).
[173] Koch (2003).
[174] The 3,500 figure is given by Hofs and Kirsten (2001).
[175] Kirsten and Gouse (2002: 7); Ismael et al (2002: 2).
[176] McDonald and Piesse (1999: 2).
[177] Uthungulu District (nd: 50-51).
[178] The Flats of Maputaland is one of the few areas that is not owned by the Zulu king. In June of 1998, the cabinet decided to transfer state land (except for the scheme) to the KwaZulu government, as first proposed in the early 1970s by the consolidation commission (AFRA 1988: 2).
[179] DFID (2000: 66).
[180] WCD SA scoping report.
[181] Heeg and Breen (1982: 2).
[182] Bruwer et al (1996).
[183] Derman and Poultney (1984); Breen (1989); Adams (1992: 202); Bruwer et al (1996).
[184] Bruwer et al (1996: 203).
[185] DFID (2000: 8).

[186] Derman and Poultney (1987: 561).
[187] SPP (1983159-163; 537-8).
[188] AFRA (1988: 5); Bembridge (1991).
[189] The northeast of KZN was actually inhabitated by people paying tribute to Thonga chiefdoms, but were grouped with Zulu's when the British handed Zululand over to Natal settler government in 1897. The land was defined as stateland, and inhabitants as squatters (SPP 1983).
[190] AFRA (1988); SPP (1983); Hart (2002).
[191] AFRA (1988: 5, 7).
[192] AFRA (1988: 3).
[193] Ibid, 4; see also Bembridge (1991); Berkeley (2001).
[194] A'Bear (1991); CORD (1989: 10).
[195] Kruger et al (1997); Walker (1999).
[196] Poultney and Spenceley (2001: 15).
[197] Mail and Guardian 1997 'The Scramble'
[198] "Speech by President Nelson Mandela at the Launch of the Lubombo Spatial Development Initiative", online
[199] Though the Department of Health has been racked by allegations of corruption and fraud. See Fredericks (2002).
[200] Daily Dispatch (2002); Jubasi (2002).
[201] Ashley and Wolmer (2003: 43).
[202] Berkeley (2001).
[203] KZN Dept of Ag, "New investments are being considered for the Makhathini Flats" 17 Oct. 2002, Press Release, online; KZN Dept of Ag "Agricultural Development Plan for the Makhathini Flats" 16 Oct. 2002, Press Release, online, http://agriculture.kzntl.gov.za.
[204] Phillips (2003b; 2003a).
[205] Ross (2002).
[206] Urban-Econ and Zakhe (2002: 1.2); Horner (2002); KZN Department of Agriculture, "Minister appeals for International support for the Provinces Green Revolution," Press Release, http://agriculture.kzntl.gov.za/media_releases/2003/10_mar_03.asp 10 March 2003.
[207] Derman and Poultney (1987: 55-56). The cross-border Lubombo Spatial Development Initiative will connect the Flats with Maputo, Richards Bay, Durban, Guateng and Johannesburg airport. Roadwork involves a R211 million upgrade of road (completed by September 2002) from Richards Bay to the Swazi border; R234 million construction of Lubombo spine road linking Hluhluwe to Maputo; 11 access roads; and a new border station with Mozambique. In 2000, the first 44 km from Hluhluwe to Lowe Mkuze was completed at a cost of R60 million. The second 42 km phase (R45 million) from Lower Mkuze past Mbazwana was launched in 2000.
[208] "Agricultural Development Plan for the Makhathini Flats," Press Release, 16 Oct 2002, online.
[209] R100 million cotton/winter wheat project under way on Makhathini Flats, 25 march, SABC news (2002) Local farmers in Jozini thrive on new cotton project 3 Danish investors to invest R100-million in KZN agriculture" 19 April 2001, online, gopher://gopher.anc.org.za/00/anc/newsbrief/2001/news0420. See also http://agriculture.kzntl.gov.za/media_releases/2002/25_mar_f.asp http://www.makcotton.co.za, accessed 31 March 2003.
[210] See e.g. Horner (2002).
[211] KZN Dept of Ag "KZN to take practical steps toward achievement of a Green Revolution," Press Release, 21 December, online, http://agriculture.kzntl.gov.za/media_releases/2002/21_dec_02.asp.
[212] 4,000 figure cited in "Transfrontier Protocol paves way for cross-border conservation" 22 June 2000, online.
[213] See Taylor (1988: 477-8") on cropping cycles.
[214] AFRA (1988).
[215] Wellmann (2000).
[216] AFRA (1990: 23-4).
[217] http://www.anc.org.za/ancdocs/history/zuma/2000/jz1111.htm.
[218] Salgado (1999).
[219] Ibid.
[220] Greater St. Lucia Wetland Park Authority Information Sheet, 17 Sep. 2002, online.
[221] Jordan (2001).
[222] Oldham et al (2000).
[223] Salgado (1999).
[224] http://www.anc.org.za/ancdocs/history/zuma/2000/jz1111.htm.
[225] Binns; Kepe et al (2001); Koch et al (1998); Spencely (2003); Poultney and Spenceley (2001); Mahlati (2000); Brennan et al. (2001).
[226] Kepe et al (2001: 3).

[227] Koch et al (1998: 812).
[228] Crook and Mann (2002).
[229] Zingel (1984: 8).
[230] Poultney (2001).
[231] Andren (2001).
[232] Zingel (1984: 7).
[233] Zingel (1984: 8).
[234] Wulfsohn (1991: 502); AFRA (1990: 248-250); A'Bear et al (1993: 6), after Vara (1989).
[235] See AFRA (1990: 33); Green (1996). At an international level, South Africa was covertly fighting a war with the FRELIMO movement, which had liberated Mozambique in 1975. The Mbangweni Corridor was suspected of being a training ground for Renamo solidiers, giving pressure to create and extend border reserves that could be more easily patrolled. Also the army took land around Lake St. Lucia for a missile testing range, displacing more than 3,000 people in 1974-79 to a barren resettlement center at Mbazwana (SPP 1983: 243, 261-7; Green 1996; Poultney 2001). Growing unemployment in democratic South Africa has led to nationalist resentment of foreign workers, and hence tighter border security (also against weapons and drugs smuggling).
[236] Wolmer (2003); Draper and Wels (2002); Bruton and Cooper, cited in AFRA (1990: 38); Clark (1989); Jordan (2001). Sunday Tribute (1989).
[237] CORD (1989).
[238] Zingel (1984: 9); AFRA (1988: 8); SPP (1983: 76).
[239] Roberts (2000).
[240] Poultney and Spenceley (2001); see also Jordan (2001). Green (1996) reports that Poultney tried to broker deal whereby people would move south, but gain access to part of the Pongola River in Ndumo Reserve.
[241] Lynne and Darroch (2001).
[242] Lahiff (2003).
[243] The Mercury (2000); Horner (2002).
[244] Moore and Deane (2003).
[245] Ntsebeza (1999).
[246] Bruwer et al (1996: 207).
[247] Lahiff (2003: 48).
[248] Cross et al (1996: 174); cf Kirsten et al (1998) and Lipton et al (1996).
[249] Derman and Poultney (1983: 20).
[250] KIDS; Zingel (1984: 8); Derman and Poultney (1987).
[251] Uthungulu District (nd: 32); Heeg and Breen (1982: 62); Derman and Poultney (1987: 556-557).
[252] Todes and Posel (1994).
[253] Bond (2000); Weeks (1999); Fine and Rustomjee (1996); Habib and Padayachee (2000).
[254] See, e.g. Mills (1986); Derman and Poultney (1987).
[255] Uthungulu District (nd: 50-51).
[256] Aniruth and Barnes (1998); Binns and Nel (2002).
[257] Derman and Poultney (1987: 560, 562, 563).
[258] Taylor and Cairns (2001); Mather (1998); Crush (1998); Jeeves and Crush (1997).
[259] Oettle et al (1998: 69).
[260] http://www.tradepartners.gov.uk/text/agriculture/south_africa/profile/overview.shtml.
[261] Somerville (2002).
[262] Raworth (2002). Lipson (2002); Nicola (2002).
[263] Watkins and Sul (2002); Pray et al (2001); Pray et al (2002); Frisvold and Reeves (2003).
[264] Watkins and Sul (2002).
[265] http://www.cottonsa.org.za/index_sa_graph.html
[266] Capital costs for large farmers are cut as well (Kirsten and Gouse 2002).
[267] Quoted in "Agri SA criticises new minimum wage" *SouthAfrica.info*, 3 December 2002, http://www.safrica.info/doing_business/businesstoday/businessnews/192242.htm
[268] Cotton SA (2002). See also Seria (2002).
[269] Krige (2003).
[270] CropGen (2002).
[271] Urban-Econ and Zakhe (2002: 2.1).
[272] http://www.acton.org/ital/ppolicy/environment/GWN/2003/gwn3.html, accessed March 2003; ISAAA (2002a); Hofs and Kirsten (2001); CropGen (2002: 2).
[273] ISAAA (2002a); Agricultural Biotechnology in Europe (2002: 9); Thirtle et al (2003).
[274] CropGen (2002: 1) gives the figure in pounds, which were converted using the exchange rate on 1 October 2002.

[275] Thirtle et al (2003: 725), my emphasis; Kirsten and Gouse (2002). Monsanto data is from Thirtle et al (2003), calculated using an exchange rate of 1 Rand = 0.0195 USD on 1 Oct 2002. Contrast the testimony of Robert Horsch, a Monsanto Vice President, that average earnings increased by 77% in 1999-2000 for GM versus conventional varieties (http://www.house.gov/science/hearings/research03/jun12/horsch.htm, accessed 14 June 2003).
[276] Ismael et al (2001a: 6); a figure of 6-10 is given Gregory et al (2002: 32).
[277] Andrew Bennet, Monsanto employee, quoted in TVE person (2002) 'High Tech Harvest – Why Have South Africa's Cotton Farmers Embraced GM cotton?', http://tv.oneworld.net/tapestry?link=2517, accessed 23 Dec, 2002; Scott (2002: 9); Ismael et al (2001a: 11).
[278] Ismael et al (2001a); Ismael et al (2002: 3).
[279] Mayer (2002: 16).
[280] As documented by Scoones and Keeley (2003b; 2003a).
[281] Bennet (2002; nd); compare Kirsten and Grouse (2002: 8).
[282] Thirtle et al (2003: 722).
[283] A company has entered the market, see http://www.makatinicotton.co.za, see fn. 209 above.
[284].Ismael et al (2001a4-5, 18-19); Y. Ismael, personal communication, 29 Oct., 2002.
[285] OTK (2003) *Annual Report 2002*, http://www.otk.co.za/about_otk/financial%20results/eng/group%20at%20a%20glance.pdf; South Africa Land Bank (1999) *Annual Report 1999*. http://www.landbank.co.za/infocentre/anrep98/chapter04.html
[286] See Swaziland Central Bank Annual Report 1998/99 http://www.centralbank.sz/report2000/ar2000_04.html; South Africa Attorney General (1998) Report of the Auditory General on the financial statement of Vote 5 - Agriculture for the year ended 31 March 1998, http://www.agsa.co.za/Reports/Votes/RP177_1998.pdf; Swaziland Government (1999).
[287] Dempster (2003). Cf. Reynolds (2003).
[288] Ton (2002; 2003); Williamson (2003).
[289] Thirtle et al (2003: 730).
[290] IPS (1999).
[291] Thritle et al (2003).
[292] Monsanto (2002).
[293] See Byerlee and Eicher (1997).
[294] Cf. Charrier et al (1998).
[295] Mugo et al (2002).
[296] Mwangi and Ely (2001: 1).
[297] J. Burgi, "Breaking the stem borer's power," www.syngentafoundation.com.
[298] Wambugu (2001: 7).
[299] CIMMYT "Without protection from insects, no field of dreams for Kenyan maize producers"
[300] www.syngenta.com/en/social_responsibility/case_stud.asp, accessed 28 Jan. 2003.
[301] B. Odhiambo (nd) "Current issues in biotechnology research and training: Biotechnology activities in Kenya Agricultural Research Institutions: Opportunities for improved agricultural productivity."
[302] De Groote (2002: 95).
[303] Raghavan (2003).
[304] CIMMYT, "IRMA Project," http://www.cimmyt.org, accessed 28 Jan 2003.
[305] de Groote [de groote 2001 /d /ft ": 7"].
[306] De Groote et al (2002a).
[307] De Groote Direct 2002 /ft ": 9" /d].
[308] As Odame et al (2003) note "In essence, the two projects have contributed to the technical capacity building for KARI scientists, but they are yet to show a shift in the behaviour of these scientists towards closer interaction with user groups in priority setting in agricultural biotechnology."
[309] J. Burgi, "Breaking the stem borer's power," www.syngentafoundation.com.
[310] Abate (2002); Schevitz (2002); Jennings (1997); MacIlwain (1998).
[311] Quoted in J. Burgi "The goal is more important than the path", www.syngentafoundation.com, accessed 28 Jan, 2003.
[312] Bohorova et al (2001); Bohorova et al (1999).
[313] Quoted in CIMMYT 'Without protection," www.cimmyt.org.
[314] Quoted in Wambugu (2001: 19).
[315] Bett and De Groote (2002); Mose et al (2002); Odendo et al (2002); Okuro et al (2002); Wekesa et al (2003).
[316] De Groote et al (2002b: 22).
[317] De Groote et al (2002c: 94, 94).
[318] Odendo et al. (2002).

[319] Unless noted, this sub-section draws on ISNAR et al (1995).
[320] http://www.syngentafoundation.com/research_station.htm
[321] http://www.syngentafoundation.com/cinzana_future_challenges.htm
[322] Omolo (1983: 105).
[323] Dr. Stephen Mugo, CIMMYT coordinator for the IRMA project, personal communication __ May, 2003.
[324] Hassan (2001); Hassan and Karanja (1997).
[325] Odendo et al. (2002).
[326] For example Hassan et al (2001) focus on use of different germplasm lines, rather than poverty alleviation.
[327] On soil and water conservation research, see *East African Agricultural and Forestry Journal* 65 (1&2).
[328] Nyoro et al (1999: 38) state, "The largest shift out of cereal production has been along the coast, in the Marginal Rain Shadow Zone, Western Lowlands, and Eastern Lowlands. Formerly, with controls on inter-district movement of maize, there may have been heightened incentives to achieve cereal self-sufficiency, which may have encouraged cereal production in these grain-deficit areas … The only area where the majority of households stated that they have increased their involvement in cereal production since market liberalization was the High-Potential Maize Zone."
[329] Bett and De Groote (2002).
[330] World Bank (1995: 18-20).
[331] De Groote [De Groote 2001 /d]; De Groote et al [De Groote et al 2002 /d].
[332] Jayne et al (2001).
[333] NAMPA-AFP (2002). See also Reuters (1999).
[334] Reynolds (2002).
[335] Ng and Yeats (1996).
[336] Jayne et al. (2002).
[337] Jayne et al. (2001), though this equation is by no means automatic (2002).
[338] Only South Africa and Botswana export more than 5% of national production (FAOSTAT, based on 1995-2001 average).
[339] Protection was put at 60% (Mugo 2001 IRMA 2(1)); Burgi, "Breaking stem borer's power'; 'Superstition and science' De Groote et al (2002a: 6). Though according to Mugo (2001, IRMA 2(1)), C. partellus is most widely distributed and destructive in Kenya. For similar results from South Africa see van Rensburg (1999; 2001).
[340] S. Mugo, "The project design has proven solid," wwww.syngentafoundation
[341] See Banziger and Diallo (2001). Indeed, greater soil fertility may strengthen resistance to and/or tolerance of stem borers (1992: 367).
[342] The research was funded by the Netherlands Directorate General for International Cooperation project on "Biological Control of Insect pests in Subsistence Crops Grown by Small-Scale Farmers in Africa," the Rockefeller Foundation, and the Forum on Agricultural Resource Husbandry. There have been difficulties in establishing C. Flavipes (see Kfir 2001): it cannot survive frosts (for example, it has not worked well in South Africa's highveld.): it lays eggs on B. *fusca*, but they do not always hatch—though cf. Cugala and Omwega (2001: 286) and Cugala et al (1999) in Mozambique; Sohati et al (2001: 323) for Zambia, Getu et al (2001) for South Africa, in which there may be either a different strain of C. *flavipes* or of B. *fusca*; there may not be enough other species to feed on; competition with indigeneous C. *sesamiae* (mating produces infertile offspring); researchers' failure to recognize established C. *flavipes* (perhaps confused with confuse with S. *calamistis*. These difficulties point to a need to understand methods to keep population high during non-crop period (Songa et al. 2002).
[343] Another is the larval parasitoid *Sturmiopsis inferens*. Mohyuddin (1971); Ngi-Song et al (1995); personal communication, William Overholt, March 2003.
[344] Guofa et al (2001).
[345] Ndemah et al (2001); Chinwada et al (2001); Cugala and Omwega (2001); Nsami et al. (2001); van den Berg and Ebenebe (2001).
[346] Omolo (1983). Ampofo et al (1986) found resistant maize varieties to C. partellus. Later research found resistance to C. partellus was inherited moderately (Ajala 1992).
[347] Odendo et al. (2002).
[348] Kumar (1997: 348), though Kumar does support GM.
[349] S. Ajala, personal communication, April 2003.
[350] Mugo et al (2001).
[351] The MBR line is resistant to the southwestern corn borer (SWCB), sugarcane borer (*Diatrae saccharalis*, European corn borer (*Ostrinia nubilalis*), and the fall armyworm (*Spodoptera frugiperda*) (2001).
[352] Ajala et al. (1995).
[353] Mutinda and Ajala (1998). The variety was ICZ3 or IC-90-W1.

[354] The varities are TZBR Comp 1, TZBR Comp 2, TZBR Eld 4 C0, TZBR Eld3 C2, TZBR-WC1. See http://www.iita.org/research/high2000/proj9.htm and IITA (2000) Project 4 Improving Maize–Grain Legume Production Systems in West and Central Africa, in IITA (ed.) Annual Report. See also Schulthess and Ajala (1999).
[355] S. Ajala, personal communication, 8 April 2003.
[356] Agricultural Research Council, Grain Crosp Institute: Project Abstracts – Crop Protection, http://www.arc.agric.za/institutes/gci/main/projects/abstracts/cropprotection/cpproject3.htm, accessed 7 April, 2003.
[357] Dr. Stephen Mugo, quoted in J. Burgi, "The project design has proven solid," www.syngentafoundation.com.
[358] Ogol et al.'s (1999) three-year study in coastal and western Kenya found that a simple maize-*Leucaena* intercrop significantly reduced that maize stem borer infestation compared to a monocropped field.
[359] funded by Gatsby Charitable Foundation, Global Environmental Facility, Rockefeller Foundation, DfID.
[360] Lorch (2000); Khan et al (2000).
[361] Dr. Lester Wadhams, personal communication, 9 April 2003.
[362] Quoted in Burgi, J., "Biotechnology can be useful," www.syngentafoundation.com, accessed 28 Jan. 2003.
[363] Okuro et al (2002: 6), citing Matiri and Ndubi (2002).
[364] Extensionists tell farmers not to burn crop residues, however, on the rationale that it will decrease organic matter content and will spread bushfires (though it may save labour and increase available potassium by increasing soil pH).
[365] Gebre-Amlak et al (1989); Early planting helps ensure plants are past the most susceptible stage (mid-whorl) before moth activity becomes significant (van Rensburg et al 1985).
[366] Ndemah (2002); Haile (2002)
[367] William Overholt, personal communication, 20 March 2003. The widely distributed C. *partellus* that is susceptible to Bt maize spread into areas once dominated by other borers (2001), of which B. *fusca* is resistant to the Bt gene and could thus increase its prevalence in the absence of competitors. See also van Rensburg (2001) on the ability of B. *fusca* neonate larvae to survive on maize silks.
[368] Mwangi and Ely (2001).
[369] Altieri (2001); Mellon and Rissler (1998).
[370] Dr. Stephen Mugo, CIMMYT coordinator for the IRMA project, personal communication 22 May 2003. Dr. WilliamOverholt, personal communication, 20 March 2003.
[371] Kfir (2002).
[372] De Groote et al. (2002b).
[373] The Economist (2002) 'The Grim Reaper', 22 Aug.
[374] Reuters (2002a); King (2002b).
[375] Reuters (2002a; 2002b); King (2002b; 2002a).
[376] Robert Zoellick, quoted in US Trade Representative (2003).
[377] Quoted in Crutsinger (2003).
[378] Quoted in Becker and Barboza (2003).
[379] Greenpeace (2002); Friends of the Earth International (2003b); Patel (2002).
[380] Barboza (2000).
[381] Monbiot (2001; 2002a; 2002b; 2002c); Matthews (2002); Pearce (2002).
[382] Gilbert and Lee (2001). See also Buthelezi (2001).
[383] King (2002b); Council for Biotechnology Information (2002).
[384] E.g. FEST (2002); see also http://www.makcotton.co.za.
[385] Council for Biotechnology Information (2002); Taitz (1999); Dispatch Online (2002).
[386] Monsanto Company (2002: 32).
[387] CropGen (2002).
[388] Remarks by Shadrack Mabuza, Small Holder Development Manager of Monsanto-owned Carnia, and Peter Longworth, Director of the Commonwealth Business Council, respectively.
[389] The farmers included Mr. Nhlela Phenious Gumede, Mr. Lazarous M. Sibiya, Ms. Thandiwe Andrettah Myeni, and Mr. Richard Sithole.
[390] Dan Taylor, remarks at CBC meeting.
[391] Gilbert and Lee (2001).
[392] Pesticide Action Network Updates Service (2002) 'Monsanto sales down, CEO Out and Weed Resistance Up', 20 Dec, http://www.panna.org.
[393] Zimbabwe Independent (1999; 1998).
[394] The Monitor (2002) 'Uganda to Grow GM cotton – Monsanto' (Kampala), 7 Sep; Ngatya, Kikonyogo (2002) 'Scientists Disagree on Biotech Cotton', *New Vision* (Uganda), 13 Feb.

[395] Mutuma-Lule, A. (2002) 'Museveni Warned Over GM Foods', *The East African* (Nairobi), 11 Sep.; Kisambira, Edris (2002) 'Farmers Assured About GM Seeds', *New Vision* (Kampala), 20 Sep.; Cook, Louise (2000) 'Monsanto Buys All of Sensako', *Business Day* (Johannesburg), 14 Dec.
[396] TVE person (2002) 'High tech harvest', op. cit. See website http://www.monsantoafrica.com and newsletter at http://www.monsantoafrica.com/kuza/default.htm.
[397] Keeley and Scoones (2003b; 2003a).
[398] Pearce (2002); Bates (2002); M'Mbijewe (2003).
[399] Quoted in Fred Pearce 'Feeding Africa', www.punjabilok.com/agriculture/africa1.htm, last accessed 26 Jan. 2003.
[400] ISAAA (2002b: 27).
[401] At an international level, there are numerous pseudo independent organizations as well, including The Science Media Centre, the Agricultural Biotechnology Council, International Policy Network, the Institute of Ideas, Sense about Science, and the Scientific Alliance (2003).
[402] E.g. AfricaBio Conferences (www.africabio.org), a USAID conference in Ghana (Corey 2000), the UNIDO Consultative Meeting in Nairobi, Kenya, 20-23 March, 2003 (Miring'uh 2003a).
[403] Kuyek (2000).
[404] ISAAA (1999) 'Bi-Annual Report, 1997-1999', http://www.isaaa.org/Publications/about_isaaa/Biennial_report99/Biennial_report99.htm, accessed 23 Dec., 2002; ISAAA (2002) 'ISAAA in Brief', http://www.isaaa.org/us/inbrief.htm, accessed 23, Dec., 2002.
[405] Interview, Greenpeace, *208 Recipes Against Hunger*, http://www.txinfinet.com/ban-gef/01/9/9-11.HTML#4
[406] quoted in Tayton (2000).
[407] See Sharma (2003).
[408] Food First (2003).
[409] Becker and Barboza (2003); McAfee (2003).
[410] Bush (2003).
[411] Likewise, other countries such as Zambia and Uganda export cotton to South Africa and India; mostly West African cotton producers export to Europe, though US-textile import liberalization from the passage of the African Growth and Opportunity Act may increase trade to the US.
[412] The U.S. is acting with Argentina, Canada, and Egypt (withdrawn), with third parties including Australia, Chile, Colombia, El Salvador, Honduras, Mexico, New Zealand, Peru and Uruguay (US Trade Representative 2003; Friends of the Earth International 2003a).
[413] EU Business (2003); ISPNews (2003).
[414] E.g. US Department of State (2002) "Biotech can be useful development tool, scientists say," *Press Release* 9 May, http://usinfo.state.gov/topical/global/biotech/02050901.htm. Personal communication, C.S. Prakash, 2 Jun. 2003. Prakash (2000b; 2000a).
[415] UNECA (2002: 80).
[416] UNECA (2002: ix).
[417] E.g. Altieri (2001); Tait and Bruce (2001); Wales and Mythen (2002); Wolfenbarger and Phifer (2000); Beck (1992; 1995; 1999); Wynne; Lash et al (1996); Krimsky and Golding (1992).
[418] Krige (2003).
[419] Mwangi and Ely (2001).
[420] http://www.ids.ac.uk/biotech.
[421] Romhane (2001); Bratton and Bingen (1994); Gubbels (1993); Beaudoux et al (); Schneider (1988); Rondot and Collion (2000).
[422] e.g. ISAAA-AfriCenter "New Challenges for Biotech in Kenya," 31 Jan 2003, http://www.isaaa.org/kc/CBTNews/2003_Issues/Jan/CBT_Jan_31.htm#new; compare Wainaina (2000).
[423] Howie (2001); Wainaina (2000).
[424] © Aaron deGrassi.
[425] http://www.ssu.missouri.edu/iap/Harambee/07_Partners.html.
[426] http://www.cipotato.org/sweetpotato/sweetpotato.htm.
[427] http://www.cafedirect.co.uk/growers/africa_coffee.php.
[428] http://www.ceris.purdue.edu/napis/pests/swf/index.html.
[429] http://www.kznwildlife.com/stlucia_dest.htm.
[430] http://www.tourism-kzn.org/picttour/maputa.html.
[431] http://www.shayamanzi.co.za/opening_1.htm.
[432] http://news.bbc.co.uk/1/hi/world/africa/2870279.stm.
[433] http://news.bbc.co.uk/1/hi/world/africa/2764677.stm.
[434] http://www.uky.edu/~mjshar0/genera/Cotesia/flavipes.html.
[435] http://www.makathinicotton.co.za.

References

A'Bear, D.R., C.H. Henderson, A.M. Little, C.L. Louw, and J. Mander (1993) "Management of Natural and Human Resources Through Community Development in North Eastern Natal, South Africa (Occasional Paper No. 121),"*Colloquium of the International Association for Community Development.* Pietermaritzburg: Institute of Natural Resrouces, University of Natal.

A'Bear, D.R.A. (1991) "Maputaland Integrated Rural Development Programme - A Case Study," *Occasional Paper No. 92*, Durban: University of Natal, Institute of Natural Resources.

Abate, T. (2002) "Agriculture, Biotech Mix Uncomfortably," *San Francisco Chronicle* 23 Dec.

Abo, M. E. and M. D. Alegbejo (1997) "Strategies for Sustainable Control of Viral Diseases of Some Crops in Nigeria," *Journal of Sustainable Agriculture* 10 (2/3): 57-.

Adams, W.M. (1992) *Wasting the Rain: Rivers, People and Planning in Africa*. Minneapolis: University of Minneapolis Pres.

AFRA (1988) "Mjindi/Makhatini: Removals, Resistance & 'Development'," *Association for Rural Advancement Newsletter* 3: 1-8.

-------- (1990) "Maputaland: Conservation and Removals," *Special Report No. 6*, Pietermaritzburg: Association for Rural Advancement.

Agricultural Biotechnology in Europe (2002) "The Environmental Impact of Agricultural Biotechnology," *Issue Paper No. 3*, Agricultural Biotechnology in Europe.

Ajala, S.O. (1992) "Inheritance of Resistance in Maize to the Spotted Stem-Borer, Chilo Partellus (Swinhoe)," *Maydica* 37: 363-369.

Ajala, S.O., L.M. Smith, and A. Odulaja (1995) "Potential of Kenyan Local Maize (Zea Mays L) Germplasm As a Source of Resistance to the Spotted Stem Borer Chilo Partellus (Swinhoe)," *Tropical Agriculture* 72: 297-302.

AKIS (2000) "Decentralizing Agricultural Extension," *Agricultural Knowledge & Information Systems Good Practice Note*, Washington, DC: World Bank.

Albert, H., P. Bisset, and K.O. Marfo (2000) "Introducing Farming Systems Research in a National Agricultural Research Institute: Experience at the Savanna Agricultural Research Institute, Nyankpala, Ghana," *GTZ Project Number 92.2293.6*, GTZ.

Alston, J.M., G.W. Norton, and P.G. Pardey (1995) *Science Under Scarcity: Principles and Practices for Agricultural Research Evaluation and Priority Setting*. Ithaca: Cornell University Press.

Altieri, M.A. (2001) "Genetic Engineering in Agriculture: The Myths, Environmental Risks and Alternatives," *Special Report No. 1*, Oakland: Food First Books.

Amanor, K.S. (1990) "Analytic Abstracts on Farmer Participatory Research," *Agricultural Administration Unit Occasional Paper No. 10*, London: ODI.

Ampofo, J.K.O., K.N. Saxena, J.G. Kibuka, and E.O. Nyangiri (1986) "Evaluation of Some Maize Cultivars for Resistance to the Sem Borer *Chilo Partellus* (Swinhoe) (Lepidoptera: Payralidae) in Western Kenya," *Maydica* 31: 379-389.

Anaman, K.A. (1988) *African Farm Management: Principles and Applications With Examples*. Accra: Ghana Universities Press.

Anandajayasekeram, P., W. A. Masters, and J. F. Oehmke (1997) *Impact Assessment of African Agricultural Technology Development and Transfer: Synthesis of Findings and Lessons Learned*. Washington, D.C.: USAID.

Andren, H. (2001) "Wetland Resource Use in the Rainbow Nation - a Pot of Gold or a Lot of Problems? A Case Study of Obstacles in Sustainable Resource Management in the Mkuze Wetlands, KwaZulu-Natal, South Africa," *Minor Field Studies No. 146*, Swedish University of Agricultural Sciences: Uppsala.

Aniruth, J. and J. Barnes (1998) "Why Richards Bay Grew As an Industrial Centre: Lessons for SDIs," *Development Southern Africa* 15 (5): 829-849.

Argwings-Kodhek, G. (1995) "Siaya: Stagnation in a low-potential, small farm district." In, S. Pearson and others (eds.) *Agricultural Policy in Kenya: Applications of the Policy Analysis Matrix.* Ithaca: Cornell University Press, pp. 191-213.

Aritua, V., E. Adipala, E.E. Carey, and R.W. Gibson (1998) "The Incidence of Sweet Potato Virus Disease and Virus Resistance of Sweet Potato Grown in Uganda," *Annals of Applied Biology* 132: 399-411.

Aritua, V., O.M. Olanya, R. El-Bedewy, and P.T. Ewell (2000) "Yield and Reaction of Non-Indigenous Sweetpotato Clones to Sweetpotato Virus Disease in Uganda,"*International Workshop on Sweetpotato Cultivar Decline.* pp. 48-54.

Ashley, C. and W. Wolmer (2003) "Transformation or Tinkering? New Forms of Engagement Between Communities and the Private Sector in Tourism and Forestry in Southern Africa," *Sustainable*

Livelihoods in Southern Africa Research Paper No. 19, Brighton: Institute of Development Studies.
Associated Press (2003) "Figture Put on Kenya's Corruption," *The Guardian* 30 May.
Baker, D. (1993) "Inability of Farming Systems Research to Deal With Agricultural Policy," *Journal of FSR-E* 4 (1): 67-83.
Bangwe, L. (1997) *Agricultural Change Under Structral Adjustment and Other Shocks in Zambia. Working Paper*. Bath, UK: University of Bath, Centre for Development Studies.
Banziger, M. and A.O. Diallo (2001) "Stress-tolerant maize for farmers in sub-Saharan Africa." In, CIMMYT (ed.) *Maize Research Highlights 1999-2000.* Mexico City, DF: CIMMYT.
Barboza, D. (2000) "Industry Moves to Defend Biotechnology.(Public Relations Advertising Campaign to Ease Fears Over Genetically Altered Foods)," *New York Times* April 4: C6(N), C6(L).
Bates, R. (1989) "The Reality of Structural Adjustment: A Sceptical Appraisal." In, S. Commander (ed.) *Structural Adjustment and Agriculture: Theory and Practice in Africa and Latin America.* London: James Currey, pp. 221-227.
Bates, R.H. (1987) "The politics of food crises in Kenya." In, M.G. Schatzberg (ed.) *The Political Economy of Kenya*. New York: Praeger, pp. 75-92.
Bates, R. (2002) "Traders, Farmers Unite at Summit Protests," *Washington Times* 28 August.
BBC (2003) "'Chaotic' GM Debate Begins," *BBC News* 3 June.
Beaudoux, E., A. Bourque, M.-H. Collion, J. Delion, D. Gentil, C. Kabuga, J. Schwettman, and A. Shah "Farmer Empowerment in Africa Through Farmer Organizations: Best Practices," *AFTES Working Paper No. 14*, Washington, DC: World Bank.
Beck, U. (1992) *Risk Society: Towards a New Modernity*. London: Sage.
-------- (1995) *Ecological Enlightenment: Essays on the Politics of the Risk Society*. Atlantic Highlands, NJ: Humanities Press.
-------- (1999) *World Risk Society*. Cambridge: Polity Press.
Becker, E. and D. Barboza (2003) "Battle Over Biotechnology Intensifies Trade War," *New York Times* 29 May.
Bembridge, T.J. (1991) "Characteristics of Cotton Farmers in Makhatini," *Development Southern Afriac* 8.
Bembridge, T.J., G.J. Steyn, and J.L.H. Williams (1983) "Evaluation of the KwaZulu Extension Service," Alice: Fort Hare University Press.
Bennett, A.L. (2002) "The Impact of Bt-Cotton on Small Holder Production in the Makhathini Flats, South Africa," www.monsantoafrica.com/reports/bt_report/btcottonreport.html:
-------- (nd) "Efforts to Expand Genetically Improved Cotton in Africa," Washington, DC: ICAC.
Berkeley, B. (2001) *The Graves Are Not Yet Full: Race, Tribe and Power in the Heart of Africa*. New York: Basic Books.
Berry, S. (1986) "Macro-policy implications of research on farming systems and households." In, J. Moock (ed.) *Understanding Africa's Rural Households and Farming Systems.* Boulder, CO: Westview, pp. 199-216.
Bett, C. and H. De Groote (2002) "Participatory Rural Appraisal for Pest Assessment in Semi-Arid Eastern Kenya," *Socio-economic Working Paper No. 02-03*, Nairobi: IRMA.
Bingen, R.J. and D.W. Brinkerhoff (1999) "Agricultural Research in Africa and the Sustainable Financing Iniative: Review, Lessons, and Proposed Next Steps," *Report prepared for SDI, USAID, and the World Bank*, Bethesda: Abt Associates, Inc.
Binns, T. and E. Nel (2002) "Tourism As a Local Development Strategy in South Africa," *Geographical Journal* 168 (3): 235-247.
Blundell, M. (1992) *Collins Photo Guide: Wild Flowers of East Africa*. London: Harper Collins.
Bohorova, N., R. Frutos, M. Royer, P. Estanol, M. Pacheco, Q. Rascon, S. McLean, and D. Hoisington (2001) "Novel Synthetic Bacillus Thuringiensis," *Theoretical and Applied Genetics* 103 (6/7): 817-826.
Bohorova, N., W. Zhang, Julstrum P., S. McLean, B. Luna, R.M. Brito, L. Diaz, M.E. Ramos, P. Estanol, M. Pacheco, M. Salgado, and D. Hoisington (1999) "Production of Transgenic Tropical Maize With *Cry1Ab* and *Cry1Ac* Genes Via Microprojectile Bombardment of Immature Embryos," *Theoretical and Applied Genetics* 99: 437-444.
Bond, P. (2000) *Elite Transition: From Apartheid to Neoliberalism in South Africa*. Pluto Press: London.
Botha, C.A.J. (1994) "The Institutional Restructuring of Agricultural Extension in South Africa: The Applicability of Alternative Extension Approaches," *South African Journal of Agricultural Extension* 23: 68-77.
Botha, C.A.J. and S. Treurnicht (1997) "Converting South African State Extension Services: A Sustainable Development Framework," *South African Journal of Agricultural Extension* 26 (31-52).
Brader, L. (2002) "A Study About the Causes for Low Adoption Rates of Agricultural Research Results in West and Central Africa: Possible Solutions Leading to Greater Future Impacts," *Report No. SDR/ISC:IAR/02/22*, Washington, DC: CGIAR Interim Science Council.

Bratton, M. and R.J. Bingen (1994) "Farmers' Organisations and Agricultural Policy: Introduction," *African Rural and Urban Studies* 1 (1): 7-29.
Breen, C.M. (1989) "Research in Maputaland: An Overview (Paper Presented at the Cord Workshop on Research and the Environment, 11-12 May)," *OCcasional Paper No. 27*, Duran: University of Natal, Institute of Natural Resources.
Brennan, F., G. Allen, and D. Harrison (2001) "Community-based econtourism, social exclusion and the changing political economy of KwaZulu-Natal." In, D. Harrison (ed.) *Tourism and the Less Developed World: Issues and Case Studies.* Wallingford: CABI Publishing, pp. 203-221.
Brookfield, H. and C. Padoch (1994) "Appreciating Agrodiversity: A Look at the Dynamism and Diversity of Indigenous Farming Practices," *Environment* 36 (5): 7-20.
Bruwer, C., C. Poulteney, and Z. Nyathi (1996) "Community based hydrological management of the Phongolo floodplain." In, M.C. Acreman and G.E. Hollis (eds.) *Water Management and Wetlands in Sub-Saharan Africa.* IUCN: Gland.
Buch-Hansen, M. and H.S. Marcussen (1982) "Contract Farming and the Peasantry: Cases From Western Kenya," *Review of African Political Economy* 23: 9-36.
Buhler, W., S. Mores, E. Arthur, S. Bolton, and J. Mann (2002) *Science, Agricuture and Research: A Compromised Participation*. London: Earthscan.
Bush, G. (2003) "Commencement Address at Coast Guard," *Press Release* 21 May: http://www.whitehouse.gov/news/releases/2003-05/print/20030521-2.html.
Business Day (2001) "Research Prompts Exchange," *Business Day* 29 Aug.
Buthelezi, T.J. (2001) "A South African farmer's experience with Bt cotton." In, J.S. Wafula and D.M. Kimoro (eds.) *Opportunities for Reviving the Cotton Industry in East Africa Through Biotechnology: Stakeholders Meeting (ABSF Document No. 2).* Nairobi: ABSF.
Byerlee, D. and C.K. Eicher (eds.) (1997) *Africa's Emerging Maize Revolution*. Boulder: Lynne Rienner.
Byerlee, D. and R. Murgai (2001) "Sense and Sustainability Revisited: The Limits of Total Factor Productivity Measures of Sustainable Agricultural Systems," *Agricultural Economics* 26: 227-236.
Carey, E. E. (1999) "The Causes and Control of Virus Diseases of Sweetpotato in Developing Countries: Is Sweetpotato Virus Disease the Main Problem." In, *CIP Program Report, 1997-1998.* Lima, Peru: CIP, pp. 241-248.
Carey, E. E.et al (1997) "Program 1: Collaborative Sweetpotato Breeding in Eastern, Central and Southern Africa." In, *CIP Program Report, 1995-1996.* Peru: CIP.
Cassman, K.G. and P.L. Pingali (1995) "Extrapolating trends from long-term experiments to farmers' fields: The case of irrigated rice systems in Asia." In, V. Barnett, R. Payne, and R. Steiner (eds.) *Agricultural Sustainability: Economic, Environmental and Statistical Considerations.* London: John Wiley & Sons.
Castle, S.J. (1999) "Agricultural Intensification and Pest Outbreaks: A Reappraisal of Events in the Sudan Gezira," *Annals of the Entomological Society of America* 92: 840-852.
CGIAR (2000) "Strategy for the Consultative Group on International Agricultural Research in Sub-Saharan Africa," *Report No. MTM/00/08*, Washington, DC: CGIAR Secretariat.
Chacha, B. K. (2001) From Pastoralists to Tobacco Peasants: The British American Tobacco (B.A.T.) and Socio-Ecological Change in Kuria District, Kenya, 1969-1999. Ottawa: IDRC.
Chambers, R. (1983) *Rural Development: Putting the Last First.* ITDG: London.
-------- (1997) *Whose Reality Counts? Putting the Last First*. London: Intermediate Technology Publications.
Chambers, R., A. Pacey, and L. Ann Thrupp (eds.) (1989) *Farmer First: Farmer Innovation and Agricultural Research*. London: Intermediate Technology Publications.
Charrier, A., J. Sanou, and B. Gouesnard (1998) "Incidence Agro-Ecologique De La Diffusion De Plantes Cultivees Transgeniques Dans Les Regions Tropicales," *Cashiers Agriculture* 7 (6): 556-560.
Charveriat, C. (2001) "Bitter Harvest: How the Poor Are Paying for the Slump in Coffee Prices," London: Oxfam (http://www.oxfam.org.uk/policy/papers/coffee/coffee.doc).
Chinwada, P., C.O. Omwega, and W.A. Overholt (2001) "Stemborer Research in Zimbabwe: Prospects for the Establishment of *Cotesia Flavipes* Cameron," *Insect Science and its Application* 21 (4): 327-334.
CIAT (2001) "CIAT in Perspective 2000-2001," Calo: CIAT.
Cisneros, F. and N. Mujica (1999) "Biological and Selective Control of the Sweetpotato Whitefly, *Bemisia Tabaci* (Gennadius) (Hom.: Aleyrodidae)." In, CIP*CIP Program Report, 1997-1998.* Lima, Peru: CIP, pp. 255-264.
Clapham, C. (1999) "The Lord's Resistance Army." In, C. Clapham (ed.) *African Rebels.* London: James Currey.
Clark, J. (1989) "Two Game Parks Are to Be Established," *The Star (South Africa)* 29 Sep.
Clay, D. and others (1995) "Promoting Food Security in Rwanda Through Sustainable Agricultural Productivity," *International Development Paper No. 17*, Ann Arbor: Michigan State University,

Agricultural Economics Department.
Clay, D., T. Reardon, and J. Kangasniemi (1998) "Sustainable Intensification in the Highland Tropics: Rwandan Farmers' Investments in Land Conservation and Soil Fertility," *Economic Development & Cultural Change* 46: 351-378.
Collinson, M. (ed.) (2000) *A History of Farming Systems Research*. Wallingford and Rome: CABI Publishing and FAO.
Conway, G. (1997) *The Doubly Green Revolution*. New York: Penguin.
Conway, G. R. and E. B. Barbier (1990) *After the Green Revolution: Sustainable Agriculture for Development* . London: Earthscan.
Cook, L.J. (2002) "Millions Served: While the West Debates the Ethics of Genetically Modified Food, Florence Wambugu Is Using It to Feed Her Country," *Forbes* 23 Dec.
CORD (1989) "Overcoming Apartheid's Land Legacy in Maputaland (Northern Natal)," *Working Paper No. 3*, Durban: Centre for Community Organisatoin, Research and Development, University of Natal.
Corey, C.W. (2000) "U.S.-Africa Biotechnology Conference to Be Held in Ghana: Experts to Discuss Advantages of Biotechnology in Agriculture," *Washington File* 7 Nov.: http://usinfo.state.gov/topical/global/biotech/00110701.htm.
Cornwall, A. (2000) "Beneficiary, Consumer, Citizen: Perspectives on Participation for Poverty Reduction," *SIDA Studies No. 2*, Stockholm: SIDA.
Cornwall, A. and J. Gaventa (2001) "From Users and Choosers to Makers and Shapers: Repositioning Participation in Social Policy," *Working Paper No. 127*, Brighton: Institute of Development Studies.
Cotton SA (2002) "South Africa - Economic Injury Due to Low Cotton Prices," *15 March*, http://www.icac.org/icac/govt_measures/documents/injury/south_africa.pdf: Cotton SA.
Council for Biotechnology Information (2002) "Small Garmer in Africa Gets Big Gains From Bt Cotton: T.J. Buthelezi Says Bt Cotton Improves Yields and Earns More Money for His Family," *Online* : http:www.whybiotech.com/index.asp?id=2109, accessed 23 Dec., 2002.
Crook, B.J.S. and B.Q. Mann (2002) "A Critique of and Recommendations for a Subsistence Fishery, Lake St. Lucia, South Africa," *Biodiversity and Conservation* 11: 1223-1235.
CropGen (2002) "Growing GM Cotton in South Africa: A Small-Hold Farmer's Experience," *GM Viewpoint October* , CropGen.
Cross, C., L. Luckin, T. Mzimela, and C. Clark (1996) "On the edge: Poverty, livelihoods and natural resources in rural KwaZulu-Natal." In, M. Lipton, F. Ellis, and M. Lipton (eds.) *Land, Labour and Livelihoods in Rural South Africa.* Durban: Indicator Press, pp. 173-215.
Crush, J. (1998) "The Long-Averted Clash": Farm Labour Competition in the South African Countryside," *Canadian Journal of African Studies* 32 (1): 404-424.
Crutsinger, M. (2003) "U.S. to Bring WTO Case Against EU on Genetically Modified Foods," *Washington Post* 13 May.
Cugala, D. and C.O. Omwega (2001) "Cereal Stemborer Distribution and Abundance, and Introduction and Establishment of *Cotesia Flavipes* Cameron (Hymenoptera: Braconidae) in Mozambique," *Insect Science and Its Application* 21 (4): 281-287.
Cugala, D., W.A. Overholt, D. Giga, and L. Santos (1999) "Performance of *Cotesia Sesamiae* (Cameron) and *Cotesia Flavipes* Cameron (Hymenoptera: Braconidae) As Biological Control Agents Against Cereal Stemboreres in Mozambique," *African Crop Science Journal* 7: 1-6.
Daily Dispatch (2002) "4x4 Beach Ban Raises Tourism Fears in KZN," *Daily Dispatch* 24 Jan.
Daily Post (2003) "Debate on GM "Window Dressing"," *Daily Post* 4 June.
Daily Telegraph (2003) "Debate Is Deemed Shambolic Failure," *Daily Telegraph* 4 June.
Das, R.J. (2002) "The Green Revolution and Poverty: A Theoretical and Empirical Examination of the Relation Between Technology and Society," *Geoforum* 33: 55-72.
De Groote, H. (2002) "Maize Yield Losses From Stemborers in Kenya," *Insect Science and its Application* 22 (2): 89-96.
De Groote, H., C. Bett, L. Mose, M. Odendo, J.O. Okuro, and E. Wekesa (2002a) "Direct Measurement of Maize Crop Losses From Stem Borers in Kenya, Preliminary Results From the 2000-2001 Season,"*7th Eastern and Southern Africa Regional Maize Conference.*
De Groote, H., L. Muhamed, M. Odendo, J.O. Ouma, S. Wachira, and J.M. Wanyama (2002b) "IRMA Impact Assessment and Socio-Economics Workgroup: Activities and Results 1999-2002," Nairobi: KARI and CIMMYT.
De Groote, H., M. Siambi, D. Friesen, and A. Diallo (2002c) "Identifying farmers' preferences for new maize varities in Eastern Africa." In, CIMMYT (ed.) *Quantitative Analysis of Data From Participatory Methods in Plant Breeding.* Mexico, D.F.: CIMMYT.
de Janvry, A. (1978) "Social structure and biased technical change in Argentine agriculture." In, H. Binswanger

and V.W. Ruttan (eds.) *Induced Innovation: Technology, Institutions and Development.* Baltimore: Johns Hopkins University Press, pp. 297-326.
de Janvry, A. and J.J. Dethier (1985) "Technological Innovation in Agriculture: A Political Economy of Its Rate and Bias," *Study Paper No.* Washington, DC: CGIAR.
de Steenhuijsen Piters, B. (1995) Diversity of Fields and Farmers: Explaining Yield Variations in Northern Cameroon. Netherlands: Wageningen Agricultural University, Department of Agronomy.
deGrassi, A. (2001) "(Mis)Understanding Change in Agro-Environmental Technology in Africa: Charting and Refuting the Myth of Population-Induced Breakdown,"*27th Annual African Studies Center Symposium, 'Technology and Development in Africa'.*
Demers, E. (2003) "The Burundian Civil War - 10 Years on," Oslo: Norwegian Refugee Council.
Dempster, C. (2003) "Cutting Their Cloth: South Africa's Cotton Business Is Being Stifled by Falling Prices and Subsidised American Cotton," *BBC Focus on Africa Magazine* Jan-March: 38-40.
Derman, P.J. and C. Poultney (1983) "The Social Dynamics of Smallhold Farming in the Siphondweni District of the Makhathini Flats," *Report S-92*, Pretoria: Human Sciences Research Council.
-------- (1984) "Local Attitudes to the Administration of Pongolapoort Dam Waters," *Occasional Paper*, Report to the Department of Environment Affairs:
-------- (1987) "Agricultural Reconstruction in a Consumer Society: The Mboza Village Project," *Development Southern Africa* 4 (3): 553-598.
Des Forges, A.L. (1999) *"Leave None to Tell the Story": Genocide in Rwanda*. New York: Human Rights Watch.
Devarajan, S., D.R. Dollar, and T. Holmgren (2001) "Aid and Reform in Africa," Washington, DC: World Bank.
DFID (2000) "Managed Flood Releases From Reservoirs: Issues and Guidance," *A submission to the World Commission on Dams*, London: Environment Research Program, Infrastructure and Urban Development Division, Department for International Development.
Dispatch Online (2002) "Africa Focus on Biotechnology," *Dispatch Online (South Africa)* 2 August: http://www.dispatch.co.za/2002-08/02/features/FARM1.HTM (accessed 23 Dec, 2002).
Donovan, C., E. Mypisi, and S. Loveridge (2002) "Forces Driving Changes in Rwandan Smallholder Agriculture 1990-2001," *Food Security II Research Report*, Ann Arbor: Michigan State University, Agricultural Economics Department.
Dorward, A.R., J. Kydd, and C. Pouton (1996) "Modeling Diversity, Change and Uncertainty in Peasant Agriculture in Northern Malawi," *Agricultural Systems* 51: 469-486.
Draper, M. and H. Wels (2002) "Super African Dreams: The Mythology of Community Development in Transfrontier Conservation Areas in Southern Africa," *Ecotourism and Nature Parks in East and Southern Africa.*
East African Standard (2003) "Sh98m Allegedly Looted From the Defunct KSA," *East African Standard* 27 Jan.
Eicher, C.K. (2001) "Africa's Unfinished Business: Building Sustainable Agricultural Research Systems," *Staff Paper No. 2001-01*, East Lansing: MSU Department of Agricultural Economics.
Elbehri, A. and S. McDonald (2003) "Transgenic Cotton and Crop Productivity: A General Equilibrium Analysis of West and Central Africa,"*Productivity, Public Goods and Public Policy: Agricultural Biotechnology Potentials.*
Ely, A., H. De Groote, and S. Mugo (2002) "Socio-Economic, Ecological and Policy Impact Assessment in the Introduction of a Transgenic Staple Crop Variety to the Developing World - the Insect Resistant Maize for Africa (IRMA) Proect, Kenya," *International Conference on Impacts of Agricultural Research and Development: Why Has Impact Assessment Research Not Made More of a Difference.*
Eponou, T. (1996) "Partners in Technology Generation and Transfer: Linkages Between Research and Farmers' Organisations in Three Selected African Countries," *Research Report No. 9*, The Hague: ISNAR.
EU Business (2003) "Four African Nations to File WTO Complaint Against US, EU Over Cotton Subsidies," *EU Business* 5 May.
Eveleens, K.G. (1983) "Cotton-Insect Control in the Sudan Gezira," *Crop Protection* 2: 273-287.
Ewell, P.T. (nd) "Sweetpotato Production in Sub-Saharan Africa: Patterns and Key Issues," Lima: CIP.
Falconi, C.A. (1999) "Agricultural Biotechnology Research Capacity in Four Developing Countries," *Briefing Paper No. 42*, ISNAR.
FAO (2000) "Special Report: Crop and Good Supply Situation in Kenya," *GlEWS Report, 10 July*, Rome: FAO.
Feldstein, H.S. and S.V. Poats (eds.) (1989) *Working Together: Gender Analysis in Agriculture*. West Hartford: Kumarian Press.
Feng, G., G. Yifu, and Z. Pinbo (2000) "Production and Deployment of Virus-Free Sweetpotato in China," *Crop Protection* 19: 105-111.
FEST (2002) "Use of GM Cotton by a Small-Scale Farmer in KwaZulu Natal," *Science and Government* 1.

FEWS (1997) "The Challenge of Growth and Poverty Reduction," *Famine and Early Warning System Report*, Washington, DC: World Bank.
Fine, B. and Z. Rustomjee (1996) *The Political Economy of South Africa: From Minerals-Energy Complex to Industrialisation*. Boulder, CO: Westview Press.
Fish, K. (1998) *Corporations and NGOs: Forging Strategic Alliances*. Speech Given to InterAction Forum 98, April 29, 1998, Washington D.C.: http://www.interaction.pair.com/md/articles/may1898/f98fish.html.
Food First (2003) "United States Tries to Force-Feed Europeans With Biotech Crops," *Press Release 13 May*, Oakland: Food First.
Foster, M.M.P. (2002) "How, When and Why Does Poverty Get Budget Priority? Poverty Reduction Strategy and Public Expenditure in Uganda," *Working Paper No. 163*, ODI: London.
Fowler, P. (2002) "Milking the CAP: How Europe's Dairy Regime Is Devastating Livelihoods in the Developing World," *Briefing Paper No. 34*, Oxford: Oxfam.
Fox, R. (1996) "Bleak Future for Multi-Party Elections in Kenya," *Journal of Modern African Studies* 34 (4): 597-607.
Francis, E. (1995) "Migration and Changing Divisions of Labour: Gender Relations and Economic Change Koguta, Western Kenya," *Africa* 65 (2): 197-216.
Francis, E. and J. Hoddinott (1993) "Migration and Differentiation in Western Kenya: A Tale of Two Sub-Locations," *Journal of Development Studies* 30 (1): 115-145.
Fredericks, I. (2002) "Foreign Minister's Sister Accused of R1.8m Fraud," *Sunday Times* 27 Oct.
Friends of the Earth International (2003a) "Egypt Withdraws From WTO GM Complaint; US-Led Trade War Coalition Starts to Crumble," *Press Release FOEI (Brussels)* 28 May.
Friends of the Earth International (2003b) "Playing With Hunger: The Reality Behind the Shipment of GMOs As Food Aid," Amsterdam: Friends of the Earth International.
Frisvold, G.B. and J.M. Reeves (2003) "International Impacts of Bt Cotton Adoption,"*"Productivity, Public Goods and Public Policy: Agricultural Biotechnology Potential," The 7th International ICABR Conference.*
Gabre-Madhin, E.Z. and S. Haggblade (2001) "Success in African Agriculture: Results of an Expert Survey," Washington, DC: IFPRI.
Gautam, M. (2000) "Agricultural Extension: The Kenya Experience (an Impact Evaluation)," *Operations Evaluation Department Report*, Washington, DC: World Bank.
Gebre-Amlak, A., R. Sigvald, and J. Pettersson (1989) "The Relationship Between Sowing Dates and Maize Stalk Borer, Busseola Fusca (Fuller), Infestation and Damage on Maize in Awassa, Ethiopia," *Tropical Pest Management* 36: 279-281.
Gerling, D., O. Alomar, and J. Arno (2001) "Biological Control of *Bemisia Tabaci* Using Predators and Parasitoids," *Crop Protection* 20 (9): 779-799.
Getu, E., W.A. Overholt, and E. Kairu (2001) "Distribution and Species Composition of Stemborers and Their Natural Enemies in Maize and Sorghum in Ethiopia," *Insect Science and Its Application* 21 (4): 353-359.
Gibbon, P. (2001) "Upgrading Primary Production: A Global Commodity Chain Approach," *World Development* 29 (2): 345-363.
Gibbons, S. (2000) "Transgenic Sweet Potato Research Collaboration: A Case Study of ABSP Involvement in Kenya," *ABSP Linkages Newsletter* (4).
Gibson, R.W. (2002) "Promotion of and Technical Support for Methods of Controlling Whitefly-Borne Viruses in Sweet Potato in East Africa: Final Technical Report," Chatham: Natural Resources Institute.
Gibson, R.W., S.C. Jeremiah, V. Aritua, R.P. Msabaha, I. Mpembe, and J. Ndunguru (2000) "Sweet Potato Virus Disease in Sub-Saharan Africa: Evidence That Neglect of Seedlings in the Traditional Farming Systems Hinders the Development of Superior Resistant Landraces," *Phytopathology* 148: 441-447.
Gibson, R. W., R. O. M. Mwanga, S. Kasule, I. Mpembe, and E. E. Carey (1997) "Apparent Absence of Viruses in Most Symptomless Field Grown Sweet Potato in Uganda," *Annals of Applied Biology* 130: 481-490.
Gilbert, V.B. and T. Lee (2001) "Genetically Altered Cotton Transforms Farming in S. Africa," *St. Louis Post - Dispatch* 26 Nov.
Glover, D. (2003) "Biotechnology for Africa?," *Democratising Biotechnology Brief No. 10*, Brighton: IDS.
Government of Rwanda (2002) "Poverty Reduction Strategy Paper," online: www.worldbank.org.
Green, P. (1996) "Pockets Full of Land, but No One to Give It to," *Mail and Guardian* 1 Nov.
Greenpeace (2002) "USAID and GM Food Aid," *http://www.greenpeace.org.uk/MultimediaFiles/Live/FullReport/5243.pdf*, Londno: Greenpeace UK.
Gregory, P., T. Stewart, and S. Stavos (2002) "Adoption of Bt Cotton by Small-Scale Farmers in South Africa," *Pesticide Outlook* 13 (1): 31-34.
Gresser, C. and S. Tickell (2002) "Mugged: Poverty in Your Coffee Cup," Oxford: Oxfam.

Gubbels, P.A. (1993) "Peasant Farmer Organisation in Farmer First Agricultural Development in West Africa: New Opporutnities and Continuing Constraints," *AgRen Network Paper No. 40*, London: ODI.
Guofa, Z., W.A. Overholt, and M.B. Mochiah (2001) "Changes in the Distribution of Lepidopteran Maize Stemborers in Kenya From the 1950s to 1990s," *Insect Science and its Application* 21 (4): 395-402.
Guyer, J. (1997) *An African Niche Economy: Farming to Feed Ibadan, 1968-88*. London: Edinburgh University Press for the International African Institute.
Guyer, J.I. 1996. Diversity at Different Levels: Farm and Community in Western Nigeria. *Africa* 66(1): 71-90.
Guyer, J.I. (1997) "Diversity and Intensity in the Scholarship on African Agricultural Change," *Reviews in Anthropology* 26 (1): 13-32.
Habib, A. and V. Padayachee (2000) "Economic Policy and Power Relations in South Africa's Transition to Democracy," *World Development* 28 (2): 245-263.
Hagenimana, V., L. M. K'osambo, and E. E. Carey (1999a) "Potential of Sweetpotato in Reducing Vitamin A Deficiency in Africa." In, CIP*CIP Program Report, 1997-1998*. Lima, Peru: CIP, pp. 287-294.
Hagenimana, V., M.A. Oyunga, J. Low, S.M. Njoroge, S.T. Gichuki, and J. Kabira (1999b) "The Efffect of Women Farmer's Adoption of Orange-Fleshed Sweet Potatoes: Raising Vitamin A Intake in Kenya," *Research Report No. 3*, Washington, DC: International Center for Research on Women.
Hahn, S.K., E.R. Terry, and K. Leuschner (1981) "Resistance of Sweetpotato to Virus Complex," *HortScience* 16: 535-537.
Haile, A. and T. Hofsvang (2002) "Host Plant Preference of the Stem Borer Busseoloa Fusca (Fuller)(Lepidoptera: Noctuidae)," *Crop Protection* 21 (3): 227-233.
Hall, A., G. Bockett, and N. Silim (1998) "Sweetpotato Postharvest Systems in Uganda: Strategies, Constraints, and Potentials," *Working Paper No. 1998-7*, Lima: CIP.
Hall, A. and A.D. Devereau (2000) "Low-Cost Storage of Fresh Sweet Potatoes in Uganda: Lessons From Participatory and on-Station Approaches to Technology Choice and Adaptive Tetsting," *Outlook on Agriculture* 29 (4): 275-282.
Harrington, L. and R. Tripp (1984) "Recommendation Domains: A Framework for on-Farm Research," *Economics Working Paper No. 02/84*, Mexico: CIMMYT.
Hart, G. (2002) "Geography and Development: Development/s Beyond Neoliberalism? Power,Culture, Political Economy," *Progress in Human Geography* 26 (2): 812-822.
Hassan, R. and D. Karanja (1997) "Maize in Kenya." In, D. Byerlee and C.K. Eicher (eds.) *Africa's Emerging Maize Revolution*. Boulder: Lynne Reiner.
Hassan, R.M., M. Mekuria, and W. Mwangi (2001) "Maize Breeding Research in Eastern and Southern Africa: Current Status and Impacts of Past Investments Made by the Public and Private Sectors, 1966-1997," *A: CIMMYT*, Mexico, DF: CIMMYT.
Haugerud, A. and M. Collinson (1990) "Plants, Genes and People: Improving the Relevance of Plant Breeding in Africa," *Experimental Agriculture* 26: 341-362.
Heald, S. (1999) "Agricultural Intensification and the Decline of Pastoralism: A Case Study From Kenya," *Africa* 69 (2): 213-237.
Heeg, J. and C.M. Breen (1982) "Man and the Pongolo Floodplain," *South African Natoinal Scientific Programmes Report No. 56*, Pretoria: Council of Scientific and Industrial Research.
Hendrickson, D., J. Armon, and R. Mearns (1998) "The Changing Nature of Conflict and Famine Vulnerability: The Case of Livestock Raiding in Turkana, Kenya," *Disasters* 22 (3): 185-199.
Hilje, L., H. Costa, and P.A. Stansly (2001) "Cultural Practices for Managing *Bemisia Tabaci* and Associated Viral Diseases," *Crop Protection* 20 (9): 801-812.
Hinchee, M. (1998) "Development of virus-resistant sweetpotato." In, C.L.a.B.M.B. Ives (eds) *Agricultural Biotechnology in International Development*. New York: CABI Publishing, pp. 89-95.
Hofs, J.L. and J. Kirsten (2001) "Genetically Modified Cotton in South Africa: The Solution for Rural Development?," *Working Paper No. 2001-17*, Pretoria: Department of Agricultural Economics, Extennsion and Rural Development, University of Pretoria.
Horner, B. (2002) "'Green Revolution' Starts to Bear Fruit for KwaZulu-Natal's Poor," *Sunday Times* 14 April.
Horton, D. (1986) "Assessing the Impact of International Agricultural Research and Development Programs," *World Development* 14 (4): 453-468.
Howie, M. (2001) "'No Debate' That Africa Needs Biotechnology," *Feedstuffs* 73 (28).
IITA (1992) *Sustainable Food Production in Sub-Saharan Africa: IITA's Contribution*. Ibadan, Nigeria: IITA.
-------- (1997) "Centers Decalare Victory Over the Cassava Green Mite," *CGIAR Newsletter* 4 (4).
IPS (1999) "South Africa: Genetically Engineered Crops Ready," *IPS* 13 April.
ISAAA (2002a) "Bt Cotton in South Africa," Nairobi: ISAAA.
-------- (2002b) "Poverty and Technology: ISAAA's Strategic Plan 2001-2005," Nairobi: ISAAA.
Ismael, Y., R. Bennet, and S. Morse (2001a) "Biotechnology in Africa: The Adoption and Economic Impacts of

Bt Cotton in the Makhathini Flats, Republic of South Africa,"*AfricaBio Biotechnology Conference for Sub-Sahran Africa.*
-------- (2001b) "Farm Level Impact of Bt Cotton in South Africa," *Biotechnology and Development Monitor* 48: 15-19.
-------- (2002) "Benefits From Bt Cotton Use by Smallholder Farmers in South Africa," *AgBioForum* 5 (1): 1-5.
ISNAR (nd) "Private-Public Partnership Pays Off in Sweet Potato Potential," *Public Private Partnerships News* 10 (www.isnar.cgiar.org/ppp/news_10.htm).
ISNAR, O. Niangado, J.F. Scheuring, and M. Yudelman (1995) "Lessons Learned: A Private-Sector Foundation's Support to Developing Country Agricultural Research," *Briefing Paper 20*, The Hague: ISNAR.
ISPNews (2003) "Farmers Demand Compensation to Offset U.S. Cotton Subsidies," *ISPNews* 9 May: www.ipsnews.net/interna.asp?idnews=18091, accessed 15 May.
Jayne, T.S., J. Govereh, A. Mwanaumo, and J.K. Nyoro (2002) "False Promise or False Premise? The Experience of Food and Input Market Reform in Eastern and Southern Africa," *World Development* 30 (11): 1967-1985.
Jayne, T.S., T. Yamano, J. Nyoro, and T. Awuor (2001) "Do Farmers Really Benefit From High Food Prices? Balancing Rural Interests in Kenya's Maize Pricing and Marketing Policy," *Tegemeo Agricultural Monitoring and Policy Analysis Project Draft Working Paper No. 2B*, Ann Arbor: MSU.
Jeeves, A.H. and J. Crush (eds.) (1997) *White Farms, Black Labor: The State and Agrarian Change in Southern Africa, 1910-1950.* Portsmouth, Pietermaritzburg, Oxford: Heinemann, University of Natal Press, James Currey.
Jennings, B. H. (1997) "The Killing Fields: Science and Politics at Berkeley, California, USA," *Agriculture and Human Values* 14: 259-271.
Jiggins, J. (1997) "Breaking New Ground: Options for Agricultural Extension and Development in South Africa," *Policy Paper No. 34*, Johannesburg: LAnd and Agricultural Policy Centre.
Jones, S. and A. Lawson (2000) "Moving From Projects to Programmatic Aid," *OED Working Paper No. 5*, Washington, DC: World Bank.
Jordan, B. (2001) "SA to Create Biggest Coastal Park," *Sunday Times* 18 Nov.
Jubasi, M. (2002) "Beach Ban on 4x4 Vehicles 'Will Knock KZN Economy'," *Sunday Times (South Africa)* 13 Jan.
Kaimowitz, D. (1992) "Motive Forces: External Pressure and the Dynamics of Technology Systems," *Linkages Discussion Paper No. 11*, The Hague: ISNAR.
Kamau, M.W., D.W. Kilambya, and B.F. Mills (1997) "Commodity Program Priority Setting: The Experience of the Kenya Agricultural Research Institute," *Briefing Paper No. 34*, The Hague: ISNAR.
Karyeija, R.F., R.W. Gibson, and J.P.T. Valkonen (1998a) "Resistance to Sweet Potato Virus Disease (SPVD) in Wild East African Ipomoea," *Annals of Applied Biology* 133 (1): 39-44.
-------- (1998b) "The Significance of Sweet Potato Feathery Mottle Virus in Subsistence Sweet Potato Production in Africa," *Plant Disease* 82 (1): 4-15.
Karyeija, R.F., J.F. Kreuze, R.W. Gibson, and J.P.T. Valkonen (2001) "Variability of Sweetpotato Feathery Mottle Virus in Africa," *African Crop Science Journal* 9 (1): 293-299.
Keeley, J. and I. Scoones (2003a) "Seeds in a Globalised World: Agricultural Biotechnology in Zimbabwe," *Biotechnology Policy Paper No. 7*, Brighton: IDS.
Keeley, J. and I. Scoones (2003b) "Contexts for Regulation: GMOs in Zimbabwe," *Biotechnology Processes Paper*, Brighton: IDS.
Kennedy, E. and B. Cogill (1988) "The Commercialization of Agriculture and Household-Level Food Security: The Case of Southwestern Kenya," *World Development* 16 (9): 1075-1081.
Kepe, T., L. Ntsebeza, and L. Pithers (2001) "Agri-Tourism Spatial Development Initiatives in South Africa: Are They Enhancing Rural Livelihoods?," *Natural Resource Perspective No. 65*, London: ODI.
Kfir, R. (2001) "Prospects for Biological Control of *Chilo Partellus* in Grain Crops in South Africa," *Insect Science and its Application* 21 (4): 275-280.
-------- (2002) "Increase in Cereal Stem Borer Populations Through Partial Elimination of Natural Enemies," *Entomologia Experimentalis et Applicata* 104 (2-3): 299-306.
Khan, Z.R., J.A. Pickett, J. van den Berg, L.J. Wadhams, and C.M. Woodcock (2000) "Exploiting Chemical Ecology and Species Diversity: Stem Borer and Striga Control for Maize and Sorghum in Africa," *Pest Management Science* 56: 957-962.
Kidd, A.D. (2001) "Extension, Poverty and Vulnerability in Uganda: Country Study for the Neuchatel Iniative," *Working Paper No. 151*, London: ODI.
King, N. (2002a) "U.S. Ponders Next Course in EU Biotech-Food Fight," *Wall Street Journal* 02 Dec.
-------- (2002b) "US Courts Africa in Food Fight: U.S. Official Courts African Allies for Brewing Biotech-Food

Fight," *Wall Street Journal* 20 Feb.
Kirsten, J. and M. Gouse (2002) "Bt Cotton in South Africa: Adoption and Impact on Farm Incomes Amongst Small-and Large-Scale Farmers," *ISB News Report* October: 7-9.
Kirsten, J., R. Townsend, and C. Gibson (1998) "Determining the Contribution of Agricultural Production to Household Nutritional Status in KwaZulu-Natal, South Africa," *Development Southern Africa* 15 (4): 573-587.
Kithure, M. (2001) "GM Crops Are Safe," *The Nation (Nairobi)* 23 May.
Koch, E., G. de Beer, S. Elliffe and others (1998) "SDIs, Tourism-Led Growth, and the Empowerment of Local Communities in South Africa," *Development Southern Africa* 15 (5): 809-826.
Koch, M. (2003) "There's More to Biotechnology Than GM Foods," *Mail and Guardian* May.
Kreuze, J. F., R. F. Karyeija, R. W. Gibson, and J. P. T. Valkonen (2000) "Comparisons of Coat Protein Gene Sequences Show That East African Isolates of Sweet Potato Feathery Mottle Virus Form a Genetically Distinct Group," *Archives of Virology* 145 (3): 567-574.
Krige, D. (2003) "There Are Better Ways to Feed Africa Than With GM Crops," *Sunday Times* 2 March.
Krimsky, S. and D. Golding (eds.) (1992) *Social Theories of Risk*. Westport: Praeger.
Kruger, F.J., B.W. Vanwilgen, A.V. Weaver, and T. Greyling (1997) "Sustainable Development and the Environment - Lessons From the St. Lucia Environmental Impact Assessment," *South African Journal of Science* 93 (1): 23-33.
Kumar, H. (1997) "Resistance in Maize to *Chilo Partellus* (Swinhoe) (Lepidoptera: Pyralidae): An Overview," *Crop Protection* 16 (3): 243-250.
Kuyek, D. (2000) "ISAAA in Asai: Promoting Corporate Profits in the Name of the Poor," GRAIN.
-------- (2002) "Genetically Modified Crops in African Agriculture," GRAIN Publications.
Lahiff, E. (2003) "Land Reform in Southern Africa," *Sustainable Livelihoods in Southern Africa Research Paper No. 18*, Brighton: Institute of Development Studies.
Lash, S., B. Szerszynski, and B. Wynne (eds.) (1996) *Risk, Environment and Modernity: Towards a New Ecology*. London: Sage Publications.
Legg, J.P. (1999) "Emergence, Spread and Strategies for Controlling the Pandemic of Cassava Mosaic Virus Disease in East and Central AFrica," *Crop Protection* 18: 627-637.
Lewis, J. (1999) "Leveraging Partnerships Between the Public and Private Sector--Experience of USAID's Agricultural Biotechnology Program." In, G. J. Persley and M. M. Lantin (eds.) *Agricultural Biotechnology and the Poor*. Washington, D.C.: CGIAR TAC Secretariat, pp. 196-199.
Lipson, G. (2002) "Drop Tariffs and You May As Well Feed SA Sugar to the Rats," *Business Day* 10 Nov.
Lipton, M. (1996) "Successes in Anti-Poverty," *Issues in Development Discussion Paper No. 8*, Geneva: ILO, Development and Technical Cooperation Department.
Little, P.D. (1985) "Adding a Regional Perspective to Farming Systems Research: Concepts and Analysis," *Human Organization* 44 (4): 331-337.
Lorch, A. (2000) "Push and Pull: Biological Control of Stemborer and Striga," *Biotechnology and Development Monitor* 43: 22.
Loveridge, S., J.B. Nyarwaya, and E. Shiringiro (2003) "Decaffeinated? Situation, Trends and Prospects for Smallholder Coffee Production in Rwanda," *Food Security II Research Report*, Ann Arbor: Michigan State University, Agricultural Economics Department .
Low, J. W. (1997) "Prospects for Sustainaing Potato and Sweetpotato Cropping Systems in Southwest Uganda." In, CIP*CIP Program Report, 1995-1996.* Peru: CIP.
Lynne, M. and M. Darroch (2001) "Landredistribution in KwaZul-Natal, South Africa: Four Census Surveys of Farmland Transactions, 1997-2000," *BASIS Report*, Madison: University of Wisconsin-Madison.
M'Mbijewe, K. (2003) "Les OGM Transforment L'Agriculture Sud-Africaine," *L'Intelligent* 2196: 64.
Machethe, C.L. and N.M. Mollel (2000) "Extensio nand support services for smallholder agricultural development in South Africa: Who is the smallholder farmer:?" In, B. Cousins (ed.) *At the Crossroads: Land and Agrarian Reform in South Africa into the 21st Century.* Pretoria and Capetown: NLC and PLAAS, pp. 340-349.
MacIlwain (1998) "Berkeley Teams Up With Novartis in 50m-Dollar Plant Genomics Deal," *Nature* 396 (6706): 5.
Mahlati, V. (2000) "Integrated planning and implementation in rural areas: Experiences from agri-tourism Spatial Development Initiatives (SDIs)." In, B. Cousins (ed.) *At the Crossroads: Land and Agrarian Reform in South Africa into the 21st Century.* Pretoria and Capetown: NLC and PLAAS, pp. 248-254.
Makabila, S. and M. Namafu (2003) "Milk Prices Drop As Production Goes Up," *The East African Standard (Nairobi)* 17 January.
Masters, W.A. (2003) "Research Prizes: A Mechanism to Create Effective Demand for Agricultural Biotechnology in Africa,"*"Productivity, Public Goods and Public Policy: Agricultural Biotechnology*

Potential," The 7th International ICABR Conference.
Mather, C. (1998) "Populist Agrarian Visions and Rural Livelihoods in KwaZulu-Natal," *Canadian Journal of African Studies* 32 (1): 139-145.
Matiri, F.M. and J.M. Ndubi (2002) "Inventorising Indigenous Technical Knowledge (ITK) in Crop Protection, Soil and Water Conservation and Ethnoveterinary Medicine in Mbeere and Tharaka Districts," *Unpublished final report*, Embu: KARI.
Matthews, J. (2002) "The Fake Parade: Under the Banner of Populist Protest, Multinational Corporations Manufacture the Poor," *Freezerbox Magazine* 3 Dec: http://www.freezerbox.com/archive/article.asp?id=254 .
Mayer, S. (2002) "Genetically Modified Cotton: Implications for Small-Scale Farmers," London: Pesticide Action Network UK.
McAfee, K. (2003) "Genetically Modified Morals," *International Herald Tribune* 13 June.
McDonald, S. and J. Piesse (1999) "Rural Poverty and Income Distribution in South Africa,"*37th Annual Conference of the Agricultural Economics Association of South Africa, "Agricultural Economics, Farm Management and Agribusiness: Combining Strengths and Stretching the Frontiers".*
McGee, R., J. Levene, and A. Hughes (2002) "Assessing Participation in Poverty Reduction Strategy Papers: A Desk-Based Sysnthesis of Experience in Sub-Saharan Africa," *Research Report No. 52*, Brighton: IDS.
Mellon, M. and J. Rissler (eds.) (1998) *Now or Never: Serious New Plans to Save a Natural Pest Control*. Cambridge, MA: Union of Concerned Scientists.
Merrill-Sands, D. and M.-H. Collion (1994) "Making the Farmer's Voice Count in Agricultural Research," *Quarterly Journal of International Agricultural Research* 32 (3): 260-279.
Mills, J.J. (1986) "A Pilot Study to Assess Rural Water Supplies and Sanitation Conditions on the Pongolo Floodplain: A Social Anthropological Perspective," *Development Southern Africa* 3 (3): 479-499.
Miring'uh, E. (2003a) "Govt Ready to Apply Biotech," *The East African Standard* 24 March.
Miring'uh, E. (2003b) "Govt Urged to Stop Cheap Milk Imports," *The East African Standard* 7 Feb.
Mohyuddin, A.I. (1971) "Comparative Biology and Ecology of *Apanteles Flavipes* (Cam.) and *A. Sesamiae* Cam. As Parasites of Graminaceous Borers," *Bulletin of Entomological Research* 61: 33-39.
Monbiot, G. (2001) "Manipulated Facts: Genes Aren't the Only Things Being Engineered by the Biotech Companies," *The Guardian (UK)* April 5.
-------- (2002a) "Corporate Phantoms: New Findings Reveal a Web of Deceit Around GM Food, in Which the Prime Minister Has Now Been Caught," *The Guardian (UK)* May 29.
-------- (2002b) "The Covert Biotech War: The Battle to Put a Corporate GM Padlock on Our Foodchain Is Being Fought on the Net," *The Guardian* 19 Nov.
-------- (2002c) "The Fake Persuaders: Companies Are Creating False Citizens to Try to Change the Way We Think," *The Guardian (UK)* May 14.
Monsanto (2002) "Monsanto Providing Answers for South African Agricultural Challenges," *Online* 22 May: http://www.monsanto.com/monsanto/layout/media/02-03-22-02.asp, accessed 23 Dec., 2002.
Monsanto Company (2002) "2001 Annual Report," St. Luis: Monsanto.
Moock, J. L. (ed.) (1986) Boulder and London: Westview Press.
Moore, M. (2001) "Political Underdevelopment: What Causes Bad Governance?," *Public Management Review* 3 (3).
Moore, N. and N. Deane (2003) "Tensions Rise Over Land Rights Bill," *Mail and Guardian* 17-23 January.
Morss, E.R.G. (1984) "Institutional Destruction Resulting From Donor and Project Proliferation in Sub-Saharan African Countries," *World Development* 12 (4): 465-470.
Mose, L.O., J.M. Wanyama, H. De Groote, M. Mulaa, and W.K. Muge (2002) "Participatory Rural Appraisals on Maize Production in the Moist Transitional and High Tropics Zones," *IRMA Socio-Economic Working Paper No. 02-04*, Nairobi: KARI and CIMMYT.
Mthembu-Salter, G. (1999) "An Assessment of Sanctions Against Burundi," London: ActionAid.
Mtshali, S. M. (2002) Household Livelihood Security in Rural KwaZulu-Natal, South Africa. Wageningen: Wageningen University.
Mugo, S.N., D. Bergvinson, and D. Hoisington (2001) "Options in Developing Stemborer-Resistant Maize: CIMMYT's Approaches and Experiences," *Insect Science and its Application* 21 (4).
Mungai, N. (2000) "Transgenic Sweet Potato Could End Kenyan Famine," *Environmental News Service* September 15 (http://ens.lycos.com/ens/sep2000/2000L-09-15-07.html): Accessed 21 May 2000.
Mutinda, C.J.M. and S.O. Ajala (1998) "Advances in Breeding for Resistance to *Chilo Partellus* Swinhoe in Maize in Kenya,"*The First ARPPIS Symposium.*
Mwanga, R.O.M., C.G.C. Yencho, and J.W. Moyer (2002) "Diallel Analysis of Sweetpotatoes for Resistance to Sweetpotato Virus Disease," *Euphtica* 128 (2): 237-248.
Mwangi, M. (2001) "It's Do or Die for KCC Today," *The Nation (Nairobi)* 24 March.

Mwangi, P.N. and A. Ely (2001) "Assessing Risks and Benefits: Bt Maize in Kenya," *Biotechnology and Development Monitor* 48: 6-9.
Mwangi, V. (1999) "Moi Son Link in KCC Fraud Case," *The Nation (Nairobi)* 30 July.
NAMPA-AFP (2002) "S. Africa Harvests First GM Maize for Humans in Run-Up to Earth Summit," *NAMPA-AFP* 19 Aug.
Naranjo, S.E. (2001) "Conservation and Evaluation of Natural Enemies in IPM Systems for *Bemisia Tabaci*," *Crop Protection* 20 (9): 835-852.
Ndemah, R., S. Gounou, and F. Schulthess (2002) "The Role of Wild Grasses in the Management of Lepidopterous Stem-Borers on Maize in the Humid Tropics of Western Africa," *Bulletin of Entomological Research* 92 (6): 507-519.
Ndemah, R., F. Schulthess, S. Korie, C. Borgemeister, and K.F. Cardwell (2001) "Distribution, Relative Importance and Effect of Lepidopterous Borers on Maize Yields in the Forest Zone and Mid-Altituted of Cameroon," *Journal of Economic Entomology* 94 (6): 1434-1444.
Ndiritu, C. G. (1999) "Kenya: Biotechnology in Africa: Why the Controversey?" In, G. J. Persley and M. M. Lantin (eds.) *Agricultural Biotechnology and the Poor*. Washington, D.C.: CGIAR TAC Secretariat, pp. 109-114.
Nel, G.P., C.A.J. Botha, and J.A. Groenewald (1998) "Managerial Ability and Farming Success: An Analysis of Small Farmers at the Makatini Scheme," *South African Journal of Agricultural Extension* 27: 45-60.
Ng, F. and A. Yeats (1996) "Open Economies Work Better! Did Africa's Protectionist Policies Cause Its Marginalization in World Trade?," *Policy Research Working Paper No. 1636*, Washington, DC: World Bank.
Ngi-Song, A.J., W.A. Overholt, and J.A. Ayertey (1995) "Suitability of African Graminaceous Stem Borers for Development of *Cotesia Flavipes* and *C. Sesamiae* (Hymenoptera: Braconidae)," *Environmental Entomology* 24: 978-984.
Nicola, J. (2002) "Bitter Battle Unfolds Over Sugar Price in SA," *Business Day* 14 Nov.
Njuguna, M. (2002a) "Co-Ops Wind Up As Market Share Shrinks," *The Nation (Nairobi)* 9 Aug.
-------- (2002b) "Imports Hit Dairy Industry," *The Nation* 12 March.
Norman, D. W., C. A. Francis, and G. M. Heinrich (1994) "Providing Relevant Education and Training for Sub-Saharan African Agricultural Scientists: Foundation for a Sustainable Future," *Journal of Sustainable Agriculture* 4 (3).
Norman, D.W. (1980) "The Farming Systems Approach: Relevancy for the Small Farmer," *MSU Rural Development Paper No. 5*, East Lansing, Mich.: Dept. of Agricultural Economics, Michigan State University.
Nsami, E., B. Pallangyo, V. Mgoo, and C.O. Omwega (2001) "Distribution and Species Composition of Cereal Stemborers in the Eastern Zone of Tanzania," *Insect Science and its Application* 21 (4): 347-351.
Ntsebeza, L. (1999) "Land Tenure Reform, Traditional Authorities and Rural Loal Government in Post-Apartheid South Africa," *Research Report No. 3*, Cape Town: Programme for Land and Agrarian Studies, University of the Western Cape.
Nyong'o, P.A. (1981) "The Development of a Middle Peasantry in Nyanza," *Review of African Political Economy* (20): 108-120.
Nyoro, J.K., M.W. Kiiru, and T.S. Jayne (1999) "Evolution of Kenya's Maize Marketing Systems in the Post-Liberalization Era,"*Workshop on Agricultural Transformation.* web.
Odame, H., P. Kameri-Bote, and D. Wafula (2003) "Globalisation and the International Governance of Modern Biotechnology: Implications for Food Security in Kenya," *Biotechnology Policy Process Paper*, Brighton: Institute for Development Studies.
Odame, H., P. Kameri-Mbote, and D. Wafula (2002) "Innovation and Policy Process: Case of Transgenic Sweet Potato in Kenya," *Economic and Political Weekly* 6 July.
Odendo, M., H. De Groote, O. Odongo, and P. Oucho (2002) "Participatory Rural Appraisal of Farmers' Maize Selection Critieria and Production Constraints in the Moist Mid-Altitude Zone of Kenya," *IRMA Socio-Economic Working Paper No. 02-01*, Nairobi: KARI and CIMMYT.
Odhiambo, B. (nd) "Current Issues in Biotechnology Research and Training,"*ICIPE Workshop.* mimeo: http://www.icipe.org/bionet/Workshop_2.doc/ws2_p4.doc, accessed 1 Apr. 2003..
Oettle, N., S. Fakir, W. Wentzel, S. Giddings, and M. Whiteside (1998) "Encouraging Sustainable Smallholder Agriculture in South Africa," *Agricultural Services Reform in Southern Africa Paper*, Hillside, UK: Environment and Development Consultancy Ltd.
Ogodo, O. (2002) "KCC: The Long, Sad Story," *The East African Standard* 8 July.
Ogol, C.K.P.O., J.R. Spence, and A. Keddie (1999) "Maize Stem Borer Colonization, Establishment and Crop Damage Levels in a Maize-Leucaena Agroforestry System in Kenya," *Agriculture, Ecosystems & Environment* 76 (1): 1-15.

Okali, C., J. Sumberg, and J. Farrington (1994) *Farmer Participatory Research: Rhetoric and Reality*. London: Intermediate Technology Publications on Behalf of the Overseas Development Institute.
Okidi, J.A. and G.K. Mugambe (2002) "An Overview of Chronic Poverty and Development Policy in Uganda," *Working Paper No. 11*, Manchester: University of Manchester, Chronic Poverty Research Centre.
Okuro, O.J., H. De Groote, and M. Gethi (2002) "Participatory Rural Appraisal of Farmers' Perceptions of Maize Varieties and Production Constraints in the Moist Transitional Zone in Eastern Kenya," *IRMA Socio-Economic Working Paper No. 02-02*, Nairobi: KARI and CIMMYT.
Oldham, G., G. Creemers, and T. Rebeck (2000) "An Economic Evaluation of Tourism: A Case Study of Accomodiation Facilities in Southern Maputaland," *Development Southern Africa* 17 (2): 175-188.
Omamo, S.W. (1998) "Transport Costs and Smallholder Cropping Choices: An Application to Siaya District, Kenya," *American Journal of Agricultural Economics* 80 (1): 116-123.
Omolo, E.O. (1983) "Screening of Local and Exotic Maize Lines for Stem-Borer Resistance With Special Reference to *Chilo Partellus*," *Insect Science and its Application* 4: 105-108.
Opala, K. (2001) "Moi Sons Fight Back Over Corruption Claims," *The Nation (Nairobi)* 24 July.
Orvis, S. (1993) "The Kenyan Agrarian Debate: A Reappraisal," *African Studies Review* 36 (3): 23-48.
-------- (1997) "The Agrarian Question in Kenya," Gainsville: University Press of Florida.
PanAfrican News Agency (2000) "Kenya Launches Genetically Modified Potato," *PanAfrican News Agency* 23 Aug.
Pardey, P.G., J. Roseboom, and J.R. Anderson (1995) "African Agricultural Research: Three Decades of Development," *Briefing Paper No. 19*, The Hague: ISNAR.
Patel, R. (2002) "The Profits of Famine: Southern Africa's Long Decade of Hunger," *Background Vol. 8 No. 4* , Oakland: Food First.
Payne, W. A., J. H. Williams, K. A. Mai, and R. D. Stern (1998) "Crop Diversification in the Sahel Through Use of Enivronmental Changes Near Faidherbia Albida," *Crop Science* 38 (6): 1585.
Pearce, F. (2002) "Farmers Clash With Environmentalists: World Hunger Discussion Banished to Fringes of World Summit," *The Scientist* 4 Sep.
Philips, B. (2003a) "ANC Moves to Avert Political Crisis," *BBC News* 8 Jan.: http://news.bbc.co.uk/1/hi/world/africa/2639241.stm.
-------- (2003b) "Mbeki Tries to Defuse Provincial Crisis," *BBC News* 6 Jan: http://news.bbc.co.uk/1/hi/world/africa/2632949.stm.
Pimbert, M. and T. Wakeford (2002) "Prajateerpu - A Citizens' Jury/Scenario Workshop on Food and Farming Futures in Andhra Pradesh, India," London: IIED.
Pimbert, M., T. Wakeford, and P.V. Satheesh (2001) "Citizens' Juries on GMOs and Farming Futures in India," *LEISA Magazine* December: 27-30.
Pingali, P.L., M. Hossain, and R.V. Gerpacio (1997) *Asian Rice Bowls: The Returning Crisis*. Wallingford, UK: CAB International.
Poats, S.V., M. Schming, and A. Spring (eds.) (1988) *Gender Issues in Farming Systems Research and Extension*. Boulder: Westview Press.
Poultney, C. (2001) "Case Study Mbangweni Corridor - Ndumu Game Park and Tembe Elephant Park Maputaland - N.E. Kwa Zulu Natal," *Unpublished Report*,
Poultney, C. and A. Spenceley (2001) "Practical Strategies for Pro-Poor Tourism, Wilderness Safaris South Africa: Rocktail Bay and Ndumu Lodge," *PPT Study No. 1*, London: Overseas Development Institute.
Prakash, C. S. (1994) "Sweet Potato Biotechnology: Progress and Potential," *Biotechnology and Development Monitor* 18: 18-22.
-------- (2000a) "Can Genetically Engineered Crops Feed a Hungry World," *IPA Review* July: http://www.ipa.org.au/Units/Biotech/Prakashbiotech.html.
-------- (2000b) "Cradle of Scientific Discovery Is Rocked by Green Activists Who Exploit Consumers' Worries to Promote Anti-Capitalist Agenda," *BridgeNews* 7 June.
Prakash, C.S. and U. Varadarajan (1992) "Genetic Transformation of Sweet Potato by Particle Bombardment," *Plant Cell Replication* 11: 53-57.
Pray, C., J. Huang, and F. Qiao (2001) "Impact of Bt Cotton in China," *World Development* 29 (5): 813-825.
Pray, C.E., J. Huang, R. Hu, and S. Rozelle (2002) "Five Years of Bt Cotton in China - the Benefits Continue," *The Plant Journal* 31 (4): 323-430.
Purcell, D.L. and J.R. Anderson (1997) "Agricultural Extension and Research: Achievements and Problems in National Systems," *Operations Evaluation Study, Report No. 16851*, Washington, DC: World Bank.
Qaim, M. (1999) "The Economic Effects of Genetically Modified Orphan Commodities: Projections for Sweetpotato in Kenya," *Brief No. 13*, Ithaca and Bonn: ISAAA and ZEF.
Rafie, A., J. Diaz, and P. McLeod (1999) "Effects of Forage Groundnut in Reducing the Sweetpotato Whitefly and Associated Gemini in Virus Disease in Bell Pepper in Honduras," *Tropical Agriculture* 76 (3):

208-211.
Raghavan, S. (2003) "For African Nations, Biotech Corn Carries Seeds of Hope, Fear," *Mercury News Africa Bureau* 14 Jan.
Raworth, K. (2002) "The Great EU Sugar Scam: How Europe's Sugar Regime Is Devastating Livelihoods in the Developing World," *Briefing Paper No. 27*, Oxford: Oxfam.
Reardon, T. (1998) "African Agriculture: Productivity and Sustainability Issues." In, C. K. Eicher and J. M. Statz (eds.) *International Agricultural Development.* Baltimore: The Johns Hopkins University Press, pp. 444-457.
Reinkika, R. and P. Collier (eds.) (2001) *Uganda's Recovery: The Role of Farms, Firms, and Government.* Washington, DC: World Bank.
Republic of South Africa (2001) "A National Biotechnology Strategy for South Africa," Pretoria:
Reuters (1999) "Africa Produces First Gene-Modified Maize," *Reuters* 8 March.
-------- (2002a) "US Farm Group Seeks Immediate WTO Case on EU Biotech," *Reuters* 19 Dec.
-------- (2002b) "US Senators Urge WTO Case Against EU on Biotech," *Reuters* 23 Dec.
Reynolds, T. (2002) "South Africa Ploughs Lonely Furrow for GM Crops," *DAWN Internet Edition* 16 October.
-------- (2003) "GM Cotton Gives More for Less S. Africa Farmers," *Reuters* 6 May.
Ribot, J.C. (2002) "Democratic Decentralization of Natural Resources: Institutionalizing Popular Participation," Washington, DC: World Resources Institute.
Richards, P. (1985) *Indigenous Agricultural Revolution*. Boulder, CO: Westview Press.
-------- (1989) "Agriculture as a performance." In, R. Chambers, A. Pacey, and L.A. Thrupp (eds.) *Farmer First: Farmer Innovation and Agricultural Research.* London: Intermediate Technology Publications, pp. 39-42.
-------- (1993) "Cultivation: Knowledge or Performance?" In, M. Hobart (ed.) *An Anthropological Critique of Development: The Growth of Ignorance.* London: Routledge, pp. 61-79.
-------- (1997) "Toward an African Green Revolution: An Anthropology of Rice Research in Sierra Leone." In, A. E. Nyerges (ed.) *The Ecology of Practice: Studies in Food Crop Production in Sub-Saharan West Africa.* India: Gordon and Breach Publishers, pp. 201-252.
Roberts, B. (2000) "Chronic and Transitory Poverty in Post-Apartheid South Africa: Evidence From KwaZulu-Natal," *Working Paper No. 28*, Durban: Centre for Social and Development Studies, University of Natal.
Romdhane, M.B. and S. Moyo (eds.) (2001) *Peasant Organisations and the Domcratisation Process in Africa*. Dakar: CODESRIA.
Rondot, P. and M.-H. Collion (2000) "Investing in Producer Organizations for Sustainable Rural Development,"*IFAP Mediterranean Committee Meeting, 6th Session.*
Ross, K. (2002) "KZN Can Become SA's Breadbasket," *Sunday Tribune* 28 April.
Rowell, A. (2003) "The Alliance of Science: 'Independent' Groups Share Pro-GM Common Ground," *The Guardian* 26 March.
Ruttan, V.W. and H.P. Binswanger (1978) "Induced innovation and the green revolution." In, H. Binswanger and V.W. Ruttan (eds.) *Induced Innovation: Technology, Institutions and Development.* Baltimore: Johns Hopkins University Press, pp. 358-408.
Salgado, I. (1999) "4 000 Jobs at St Lucia Park," *Sunday Times* 19 Sep.
Schevitz, T. (2002) "Funding Drying Up in UC-Biotech Partnership," *San Francisco Chronicle* 19 Dec.
Schneider, H. (1988) *Small Farmers' Associations and Agricultural Productivity: Cases From Africa*. Paris: OECD.
Schroeder, J. (2000) "Closing,"*Strategic Alliance for Biotechnology Research in African Development (SABRAD) Workshop on Biotechnology.* http://www.usinfo.state.gov/topical/global/biotech/00111302.htm.
Schulthess, F. and S.O. Ajala (1999) "Recent Advances at IITA in the Control of Stemborers in West and Central Africa,"*Proceedings of a Regional Maize Workshop on Strategy for Sustainable Maize Production in West and Central Africa.*
Scoones, I. (ed.) (2001) *Dynamics and Diversity: Soil Fertility and Farming Livelihood in Africa*. London: Earthscan.
Scoones, I. and J. Thompson (eds.) (1994) *Beyond Farmer First: Rural People's Knowledge, Agricultural Research and Extension Practice*. London: Intermediate Technology Publications.
Scott, J. (2002) "Biotech Could Boost Africa's Agriculture," *Engineering News* 16 Aug: 9.
Serageldin, I. (1999) "Biotechnology and Food Security in the 21st Century," *Science* 285 (16): 387-389.
Seria, N. (2002) "Cotton Production Plummets, Taking Jobs," *Business Day (Johannesburg)* 7 Oct.
Shaner, W.W. (1984) "Stratification: An Approach to Cost-Effectiveness for Farming Systems Research and Development," *Agricultural Systems* 15: 101-123.

Shapiro, R. B. (1998) *Speech Before the Tidewater Development Conference, June 29, 1998, Washington, D.C.* http://www.monsanto.com/monsanto/mediacenter/speeches/98june29_Shapiro.html.
Sharma, D. (2003) "US Seeks to Force-Feed Scientific Apartheid to Third World," *Business Report (South Africa)* 21 May.
Sims, H. and D. Leonard (1989) "The Political Economy of the Development and Transfer of Agricultural Technologies," *Linkages Theme Paper No. 3*, The Hague: ISNAR.
Smit, N.E.J.M. (1997) "Integrated Pest Management of Sweetpotato in Eastern Africa," Wageningen: Grafisch Service Centrum Van Gils.
Smith, L.D. (2001) "Reform and Decentralization of Agricultural Services: A Policy Framework," *Agricultural Policy and Economic Development Report No. 7*, Rome: FAO.
Smith, S. (2002) "Letter to the Editor," *The Guardian (UK)* 20 Nov.
Sohati, P.H., E.M. Musonda, and M. Mukanga (2001) "Distribution of Cereal Stemborers in Zambia and Release of *Cotesia Flavipes* Cameron, an Exotic Natural Enemy of *Chilo Patellus* Swinhoe," *Insect Science and its Application* 21 (4).
Somerville, K. (2002) "Africa: Globalisation or Marginalisation?," *BBC News Online* 14 Dec.: http://news.bbc.co.uk/2/low/africa/2538665.stm.
Songa, J.M., W.A. Overholt, J.M. Mueke, and R.O. Okello (2002) "Regional Distribution of Lepidopteran Stem Borers and Their Parasitoids Among Wild Grasses in the Semi-Arid Areas of Eastern Kenya," *African Crop Science Journal* 10 (2): 183-194.
Spenceley, A. (2003) "Tourism, Local Livelihoods and the Private Sector in South Africa: Case Studies on the Growing Role of the Private Sector in Natural Resources Management," *Sustainable Livelihoods in Southern Africa Research Paper No. 8*, Brighton: Institute of Development Studies.
SPP (1983) "Forced Removals in South Africa," *Volume 4: Natal*, Cape Town and Pietermaritzburg: Surplus Peoples Project and Association for Rural Advancement.
Sserunkuuma, D. (1999) "Agricultural Technology Economic Viability and Poverty Alleviation in Uganda," Kampala: ASARECA.
Steeves, J.S. (2002) "Ethnic clashes in Kenya and the politics of the 'Ethnic Enclave': the ruling party, the opposition, and the post-Moi succession." In, P. Ahluwalia and A. Zegeye (eds.) *African Identities: Contemporary Political and Social Challenges.* Aldtershot: Ashgate, pp. 103-131.
Stoop, W.A. (2002) "A Study and Comprehenisve Analysis of the Causes for Low Adoption Rates of Agricultural Research Results in West and Central Africa: Possible Solutions Leading to Greater Future Impacts," Rome: FAO and CGIAR Interim Science Council.
Sumberg, J., C. Okali, and D. Reece (2003) "Agricultural Research in the Face of Diversity, Local Knowledge and the Participation Imperative: Theoretical Considerations," *Agricultural Systems* 76: 739-753.
Sunday Tribute (1989) "Reassurances for Local People in New Maputland Conservation Area," *Sunday Tribute* 17 Dec.
Swaziland Government (1999) "Agriculture Ministry to Help Farmers With Credit to Purchase Implments," *Swaziland Today* 3 (35): http://www.swazi.com/government/newsletter/1999/nl35-17-09.html.
Tabor, S. R. (ed.) (1995) *Agricultural Research in an Era of Adjustment: Policies, Institutions, and Progress.* Washington, D.C.: World Bank.
TAC (1978) *Farming Systems Research at the International Agricultural Research Centers*. Rome: TAC Secretariat.
-------- (1988) *Sustainable Agricultural Production: Implications for International Agricultural Research*. Rome, Italy: FAO.
Tait, J. and A. Bruce (2001) "Globalisation and Transboundary Risk Regulation: Pesticides and Genetically Modified Crops," *Health Risk and Society* 3 (1): 99-112.
Taitz, L. (1999) "Summertime ... and the Modified Cotton Is High," *Sunday Times (South Africa)* 28 Nov.: http://www.suntimes.co.za/1999-11/28/news/news08.htm (accessed 23 Dec, 2002).
Taylor, D. (1988) "Agricultural Practices in Eastern Maputaland," *Development Southern Africa* 5 (4): 465-481.
Taylor, N. and R. Cairns (2001) "May Farming Make a Contribution to Poverty Alleviation in a "Deep Rural" Area in South Africa,"*Paper Presented at the SARPN Conference on Land Reform and Poverty Alleviation in Southern Africa.*
Tayton, A. (2000) "Genetic Engineering: Don't Play With Your Food," *Dispatch Online (South Africa)* 22 August: http://www.dispatch.co.za/2000-08/22/features/LP.HTM.
The Mercury (2000) "KZN Faces a Revolution on the Land," *The Mercury* May: http://www.highroad.co.za/may00/pg3.htm.
The Nation (2000) "Informal Milk Market Booms, Manager Claims," *The Nation* 13 April.
-------- (2001a) "Collapse of Textile Firms Deplorable," *The Nation* 21 Feb.
-------- (2001b) "Kibaki Alleges Plot Over KCC," *The Nation (Nairobi)* 11 March.

-------- (2002) "Scientist's Work Wins Recognition," *The Nation (Nairobi)* 1 Oct.
The Nation (2003) "Firms Face Cane Farmers' Wrath," *The Nation* 17 Jan.
The Western Mail (2003) "Bias Towards GM Alleged," *The Western Mail* 2 June.
Thirtle, C., L. Beyers, Y. Ismael, and J. Piesse (2003) "Can GM-Technologies Help the Poor? The Impact of Bt Cotton in Makhathini Flats, KwaZulu-Natal," *World Development* 31 (4): 717-732.
Throup, D.W. (1987) "The construction and the destruction of the Kenyatta state." In, M.G. Schatzberg (ed.) *The Political Economy of Kenya*. New York: Praeger, pp. 33-74.
Todes, A. and D. Posel (1994) "What Has Happened to Gender in Regional Development Analysis? Examples From KwaZulu/Natal," *Transformation* 25: 58-79.
Ton, P. (2002) "Organic Cotton Production in Sub-Saharan Africa: The Need for Scaling Up," London: Pesticide Action Netork UK.
-------- (2003) "The International Market for Organic Cotton and Eco-Textiles," London: Pesticide Action Netork UK.
Traoré, D. and D. Sanfo (2001) "Limits on the Use of Genetically Modified Cotton in Africa: The Case of Burkina Faso," ICAC: Washington, DC.
Tripp, R., P. Anandajayasekeram, D. Byerlee, and L. Harrington (1990) "Farming Systems Research Revisited." In, C.K. Eicher and J.M. Staatz (eds.) *Agricultural Development in the Third World*. Baltimore: Johns Hopkins University Press, pp. 384-399.
UNECA (2002) "Harnessing Technologies for Sustainable Development," Addis Ababa: United Nations Economic Commission for Africa.
Urban-Econ and Zakhe (2002) "Towards and Agricultural Development Plan for the Makhathini Flats," Kloof: Urban-Econ and Zakhe for the KwaZulu-Natal Department of Agriculture and Environmental Affairs.
US Trade Representative (2003) "Fact Sheets: USTR Details Urgency of Ending EU Ban on Biotech Food," *online* 13 May.
USAID (nd) "Alliance Examples,"http:///www.usaid.gov/gda/gda_samples.html.
USDA (1996) "Biological Control of Sweetpotato Whitefly," Washington, DC: United States Department of Agriculture.
Uthungulu District (nd) "Uthungulu Regional Development Plan," *Part 1: Status Quo*,
Uvin, P. (1998) *Aiding Violence: The Development Enterprise in Rwanda*. Connecticut: Kumarian Press.
van der Ploeg, J.D., J. van den Hoogen, and F. Moors-Dekker (1994) "Report From an Orientation Visit to the Republic of South Africa," Wageningen: Wageningen Agricultural University.
van der Walt, W.J. (nd) "Biotechnology in South Africa - A Concise Overview," *www.sansor.co.za* accessed March, 2003.
van Rensburg, J. (1999) "Evaluation of Bt-Transgenic Maize for Resistance to the Stem Borers Busseola Fusca (Fuller) and Chilo Partellus (Swinhoe) in South Africa," *South Africa Journal of Plant and Soil* 16 (1): 38-43.
-------- (2001) "Larval Mortality and Injury Patterns of the African Stalk Borer, Busseola Fusca (Fuller) on Various Parts of Bt-Transgenic Maize.," *South Africa Journal of Plant and Soil* 18 (2): 62-68.
Vara (1989) "Ubombo-Ingwavuma Structure Plan," *A Report Prepared for the South African and KwaZulu Governments*,
Wafula, J. "Building Partnerships for Biotechnology Development and Networking in Africa,".
-------- (2000) "KARI Final Project Report," *Report submitted to USAID-MSU ABSP, June*, Nairobi: KARI.
Wainaina, S. (2000) "Shut Up and Eat Your GM Soup, Africans Are Told," *The East African* 7 Sep.
Wales, C. and G. Mythen (2002) "Risky Discourses: The Politics of GM Foods," *Environmental Politics* 11 (2): 121-144.
Walker, P.A. (1999) "Democracy and Environment: Congruencies and Contradictions in Southern Africa," *Political Geography* 18: 257-284.
Wambugu, F. (1991) *In Vitro* and Epidemilogical Studies of Sweetpotato (*Ipomoea Batatas* (L.) Lam.) Virus Diseases in Kenya. Bath: University of Bath.
-------- (1999) "Why Africa Needs Agricultural Biotech: There Is an Urgent Need for the Development and Use of Agricultural Biotechnology in Africa to Help Counter Famine, Environmental Degradation and Poverty," *Nature* 400 (6739): 15-17.
-------- (2001) *Modifying Africa: How Biotechnology Can Alleviate Poverty and Hunger*. Devon, United Kingdom: Green Ink.
Wanyama, C. (2003) "The World Is Beginning to Embrace Agri-Biotech," *The East African Standard* 28 April.
Watkins, K. and J. Sul (2002) "Cultivating Poverty: The Impact of US Cotton Subsidies on Africa," *Briefing Paper No. 30*, London: Oxfam.
Weeks, J. (1999) "Stuck in Low GEAR? Macroeconomic Policy in South Africa, 1996-1998," *Cambridge Journal of Economics* 23 (6): 795-811.

Wekesa, E., H. De Groote, J. Ndungu, W. Chivatsi, P. Mbutha, L. Hadullo, J. Odhiambo, and G. Ambajo (2003) "Participatoryu Rural Appraisals for Insect Resistant Varieties in the Coastal Lowlands, Kenya," *Socio-Economic Working Paper No. 03-01*, Nairobi: IRMA.
Wellmann, G. (2000) "B.t. Cotton on the Makhatini Floodplains," *Report prepared for Biowatch SA*, mimeo:
Wheeler, M.W. and G.F. Ortmann (1990) "The Role of Dryland Cotton As a Source of Household Income in Two Magisterial Districts of KwaZulu Natal," *Development Southern Africa* 7 (2).
Williamson, S. (2003) "The Dependencey Syndrome: Pesticide Use by African Smallholders," London: Pesticide Action Netork UK.
Wolfenbarger, L.L. and P.R. Phifer (2000) "The Ecological Risks and Benefits of Genetically Engineered Plants," *Science* 290 (5499): 2088-2093.
World Bank (1995) "Kenya Poverty Assessment," *Report No. 13152-KE*, Washington, DC: World Bank.
-------- (1996) "Staff Appraisal Report, Republic of Kenya National Agricultural Research Project - Phase II," *Report No. 14535-KE*, Washington, DC: World Bank.
-------- (1998a) "Project Information Document: Uganda-Second Agricultural Research and Training Project," *Report No. PID8041*, Washington, DC: World Bank.
-------- (1998b) "The World Bank and the Agricultural Sector in Kenya: An OED Review," *Report No. 18088*, Washington, DC: World Bank.
-------- (1999a) "Agricultural Extension: The Kenya Experience," *Operations Evaluation Department Precis No. 198*, World Bank: Washington, DC.
-------- (1999b) "Project Information Document: Rwanda-Agricultural and Market Development Project," *PID7861*, World Bank: Washington, DC.
-------- (1999c) *World Bank Agricultural Extension Projects in Kenya: An Impact Evaluation*. Washington, DC: World Bank.
-------- (2000a) *Can Africa Claim the 21st Century?* Washington, DC: World Bank.
-------- (2000b) "Project Information Document: Uganda-National Agricultural Advisory Services Program," *Report No. PID8313*, Washington, DC: World Bank.
-------- (2001) "Project Information Document: Rwanda-Rural Sector Support Project," *PID9531*, Washington, DC: World Bank.
-------- (2002a) "Program Document for a Proposed Economic Rehabilitation Credit in the Amount of SDR 40.8 Million ($US 54 Million Equivalent) to the Republic of Burundi," *Report No. 24611-BU*, Washington, DC: World Bank.
-------- (2002b) "Reaching the Rural Poor," Washington, DC: World Bank.
Wulfsohn, T. (1991) "Challenging the Conventional Approach to Natural Resource Management/Environmental Planning in Rural Development: A Regional Political Ecology Analysis of Maputaland," *Development Southern Africa* 8 (4): 405-508.
Zimbabwe Independent (1998) "Kangai Blocks Cottco's American Seed Deal," *Zimbabwe Independent* 22 May.
-------- (1999) "Monsanto Bid to Set Up $150m Venture Scuttled," *Zimbabwe Independent* 23 April.
Zingel, J. (1984) "Ingwavuma: Problems in Paradise," *Indicator* 2 (4): 6-10.