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How long will the 'faithful' *hoe* feed Africa's expanding population?

INSIDE THIS ISSUE:

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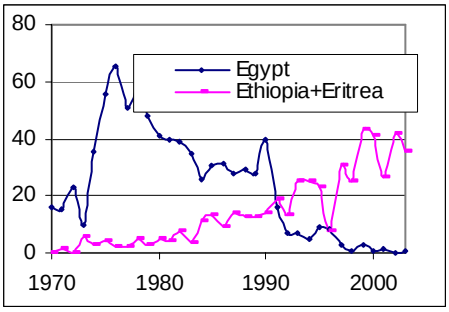
Front photo by Sheba Okwenje



Food aid shipments (as % receipts)

THE CHALLENGE OF KICKING HUNGER OUT OF AFRICA: THE CASE OF BURKINA FASO

Victor Konde, ATDF

Abstract

There are several international declarations that recognize the right to food and freedom from hunger. And yet millions of people continue to go without food even when the world has technology and means to end hunger. Africa, especially sub-Saharan Africa (SSA), continues to suffer from hunger and food production per capita continues to drop. This presents a major challenge as to whether Africa can feed itself.

For this reason, Burkina Faso, a country with literacy rate and GDP per capita less than that of SSA, presents an interesting case as it has increased maize, millet and sorghum production substantially within a decade. The government's effort to promote modernization of agriculture, strengthen extension services and promote research and development has played a vital role in increasing food supply.

Introduction

In 1974, leaders declared "[e]very man, woman and child has the inalienable right to be free from hunger and malnutrition [..] Society today already possesses sufficient resources, organizational ability and technology and hence the competence to achieve this objective". Since then, several declarations have been made except for one thing: hunger still persists in several parts of the world despite increased global wealth and technological advancement. For some countries in the sub-Saharan Africa (SSA), the proportion of people hungry today is probably higher than it was in 1977.

Agriculture is estimated to employ over 60% of the labour force, account for 17% of the GDP and 18% of merchandize exports of Africa. This is expected since Africa is a rural continent. However, this situation raises many questions. How can 60% of the labour force contribute only 17% to the GDP, 18% to exports and fail to feed themselves and support the remaining 40%?

Agricultural productivity

One key challenge is to substantially increase agricultural productivity in terms of yields per hectare or labour-hours. For instance, in 2003, total cereal and total tubers and roots yields were 10 metric tones per hectare (MT/Ha) and 80MT/HA in sub-Saharan Africa (SSA), respectively. By contrast, the total cereal yields for Asia and Latin America and Caribbean (LAC) are about 30MT/Ha (see table 1). Therefore, from the same farm-size, Africa gets less food or harvest than Asia and LAC.

Table 1. General comparison of yields (in MT/Ha)

	Africa	Asia	LAC
Total cereal	***12***	33	30
Total tubers and roots	***82***	172	112.5

Source: FAOSTAT.

However, that does not capture all the costs of food production in Africa. For instance, each year millions of labour-hours and millions of dollars spent on seed, fertilizer and other inputs are lost due to drought alone. Simple irrigation facilities could reduce the risk and cost of farming in Africa.

Harnessing technology

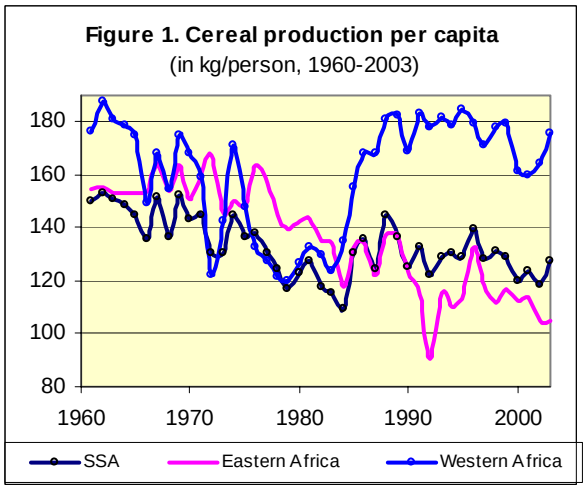
Technology helps individuals, firms and nations improve the efficiency of production, processing, marketing and delivery of products and services. Africa's agricultural production tools remain the ***'hoe***' and '***axe***' while the common transportation method is 'the ***human head*** or ***shoulder*** on ***two legs'***. The use of simple production technologies such as fertilizers, pesticides, tractors and irrigation is very low.

Emerging technologies, as such as biotechnology, could improve yields, and provide alternative inputs, diagnostic tools and vaccines that could improve agricultural productivity and help stem the currently declining food production per capita in SSA. (See figure 1). Further, technological capacity to design, develop and market a range of consumer products from local produce could provide a market for producers. For instance, in the 1990s, some Nigeria's breweries substituted imported barley with locally produced sorghum and maize.

Agricultural trade performance

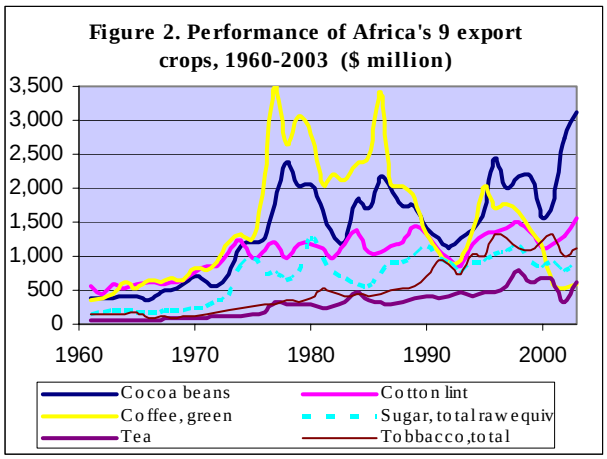
Africa's agricultural trade with the rest of the world has moved from a handsome surplus in the 1960s and 1970s to a burgeoning deficit since the 1980s (see African agriculture in figures, ATDF Newsletter 2004) due to fall in prices and, as consequence, fall in output of some of Africa's major agricultural export commodities. For instance, between 1980 and 2000, the price of sugar, cocoa, coffee and cotton fell by about 70%, 71%, 64% and 47%, respectively

(UNCTAD, 2004). Take coffee - in 1977, Africa earned $3.5 billion but exports have since fallen to about $601 million in 2003 (see figure 2).



Source: ATDF based on FAO

Note: Eastern and Western Africa FAO groupings not political classification.



Source: FAOSTAT

With increasing globalization, agricultural products of African countries will have to compete on the domestic and international market. In 2003, Africa imported 6.3 million MT of raw sugar at a cost of $1.3 billion while it exported 2.6 million MT at $0.9 billion. The phasing out of export quotas that guaranteed a higher price to qualifying countries entail that African products, such as sugar, will have to compete on the global market to compete on the domestic or regional markets.

Africa's share of global agricultural exports and imports were 3.4% and 4.1% in 2003, respectively. Although, heavily subsidized products present a major obstacle to export growth, some African countries also lacks the productive capacity to compete with other developing countries such as Brazil, China and India.

Table 2. Africa, Brazil and China; Their share of global production of selected products in 2004 .

As percentage	Africa	Brazil	China
Sugar cane	6.3	31.2	7.1
Cotton	7.6	5.4	26.7
Coffee, green	12.3	31.8	0.3
Cocoa beans	62.8	5.3	0.0

Source: ATDF based on FAO.

Creating alliances for production and marketing growth

The various agricultural sub-sectors have to perform efficiently to improve production. For instance, a new technology that could increase productivity and/or marketing may fail to perform if the linkages among the various players, such as technology developers, extension services, distributors and farmers, are poor. Bringing together professional and producer associations, distributors and marketers could facilitate development and diffusion of innovations.

Such alliances may also be vital in helping Africa learn to move up the value chain through agricultural processing. For instance, Chilean Salmon Industry introduced the salmon fillet packaging that proved very popular and enabled them to penetrate the US market. Other than value addition, processing may reduce storage and transportation costs and, in some cases, help meet some of the stringent sanitary requirements.

The case of Burkina Faso

Burkina Faso has a population of about 12 million of which 32% are literate (See Human Development Index 2002, UNDP). In the late 1980s, the agricultural output of the major food crops increased substantially after nearly 2 decades of stagnation. Maize production shot up by almost 7 times, millets up 6 times and sorghum up nearly 3 times between 1984 and 2003. Consequently, Burkina Faso's caloric supply (in kilocalories/person) also increased from 1750 kilocalories in the 1970s and early 1980s to about 2400 kilocalories over the same period.

This growth was achieved through concerted efforts to empower farmers and promote input use. For instance, fertilizer consumption increased from about 10,000 MT in the early 1980s to over 20,000 MT in the late 1990s. In addition, the number of agricultural tractors in use increased from 120 in the early and mid 1980s to over 800 by early 1990s and 2,000 by 2002.

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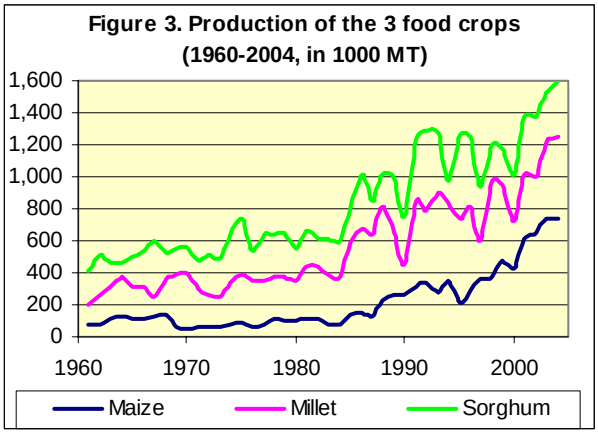

Source: FAOSTAT

1990s. In addition, the number of agricultural tractors in use increased from 120 in the early and mid 1980s to over 800 by early 1990s and 2,000 by 2002.

The government invested in public research and development institutions, and strengthened the agricultural extension service. One of the key components of the agricultural policy was modernization of agricultural production and practices. Several stakeholders formed professional and producer groups to promote the interests of their members.

Like many African countries, Burkina Faso relies on only one major export product-cotton which accounts for nearly half the total exports of Burkina Faso. The fall in the price of cotton over the last two decades may have limited the potential impact of increased cotton production. In other words, it is a loss in expected export earnings that may have hurt the producers and reduces government revenue needed to provide basic services.

Agricultural policy objectives of Burkina Faso

Some of the objectives of Burkina Faso include development of markets in rural areas, modernization of agricultural and livestock practices, improved soil management practices, encouraging the emergence of professional organizations and training of farmers and empowering the agricultural extension services. To achieve some of these objectives, the government promoted agricultural research, extension and advisory services and agricultural training and development of rural infrastructure.

Specifically, the following programs were implemented with great success:

Irrigation: *The implementation of the 'cloud seeding' program called SAAGA to extend the rain season and mitigate drought spells with 'artificial' rain, and the development of several irrigation systems (water wells, reservoirs and ponds and wetland irrigation systems).*

Extension service: *The introduction of the 'Training and Visit' system has facilitated the uptake of new technologies, and the training of 117 technicians and 50,000 farmers.*

Empowering producer associations*: The purchase by local cotton producer organizations of 30% of the shares of SOFITEX - the national cotton ginning and seed producer- in 1999. SOFITEX assures cotton farmers a stable price irrespective of the world market price.*

Soil fertility management*: Over 90,000 manure pits were constructed under the Integrated Soil Fertility Plan (PAGIS), contour ridges and trees were replanted to reclaim degraded land.*

Others: *Several livestock fattening centre were implemented and 'volunteer vaccinators' were trained. Further, credit and fertilizer support was extended to the poor.*

The experiences of Burkina Faso point to the following lessons:

Diversification of food base. Like most West African countries, Burkina Faso has a diversified food base. Sorghum, Millet and Maize production in 2004 were estimated at about 1.6 million MT, 1.2 million MT and 750,000 MT, respectively. In contrast, maize alone accounted for about 89% of cereal production in Malawi and 62% of cereals production in Kenya, and cassava accounts for 53% of the caloric intake in Congo D.R. Country that depend on a single food crop are to face frequent famines.

Modernization of agricultural production. Between 1980 and 2002, fertilizer consumption and use of tractors increased only by about 20% and 30%, respectively, in SSA. About 58% of Africa countries own less than 2000 agricultural tractors. For instance, Egypt and South Africa account for about 52% of Africa's fertilizer consumption annually although the two countries account for only 24% of cereal production. The low fertilizer use may be accelerating soil nutrient depletion.

Despite the existence large rivers, including man-made lakes, irrigation remains a subject addressed largely during droughts. Simple canals and waterholes could enable farmers to grow different food and cash crops all year round.

Enhancing domestic marketing and distribution. A functional domestic distribution and marketing system is important for achieving high output efficiently and promoting trade. They help link farmers to markets, suppliers of inputs and technology developers to users at home and abroad.

Diversifying into dynamic export products- The case of Burkina Faso is not unique. While its cotton production

went up more than 8 times between 1980 and 2003, its earnings from cotton exports increased only 3 times. Indeed, Africa's participation in the trade in dynamic products (products with increasing global market share) is low. Of these, only undergarments export is important to Africa. Africa's share is 1.7% of the world trade in undergarments. Above all, Mauritius and Swaziland account for about 85% of Africa's undergarment exports. It may be advisable to diversify into dynamic products.

Conclusion

Some Africa countries, Botswana, Mauritius, Tunisia and Equatorial Guinea, have graduated from the food aid list by increasing their per capita income. The average annual exports of Botswana, Mauritius and Tunisia grew by more than 20% in 1970s while that of Equatorial Guinea grew by about 20% in 1980s and 41% in 1990s (UNCTAD 2004). Consequently, their GDP per capita increased spectacularly.

Countries that cannot marshal such growth in exports may have to focus on food self-sufficiency. There are some aspects that countries could undertake even without donor support, such as promoting emergence of private distribution and marketing chains, empowering farmer's cooperatives and associations, and encourage closer collaboration between farmers and researchers. Indeed, countries could replace car loans to parliamentarians with tractor loans. In addition, local municipalities could also be encouraged to own tractors for hire, and schools could be used as training centres for farmers. Governments could also encourage the formation of cooperatives of farmers willing to share the cost of running and maintaining agricultural machinery, irrigation systems and input sales outlets.

Government targets also need to be clear, quantifiable and measurable. While targets such as '***3 meals a day for all***' are politically right, it suggests the goal-setter will supply enough food. Quantifiable targets such as ***production targets*** (number of metric tones, veterinary officers, warehouses, tractors and irrigation schemes, etc, to be produced) facilitate the estimation of needs (financial, institutional, organizational, etc). Such goals also enable other stakeholders determine not only the best way to contribute towards attaining the set targets but also to measure if the goals are being achieved or not.

Endnotes

1. Universal declaration on the eradication of hunger and malnutrition, 1974
2. Wangwe, S. M. (1995) Exporting Africa: technology, trade and industrialization in Sub-Saharan Africa, Chapter 9, UNU Press.
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SELECTED INTERNATIONAL PLEDGES ON HUNGER AND RIGHT TO FOOD

The New York Declaration on the action against hunger and poverty (2004)

"The greatest scandal is not that hunger exists, but that it persists even when we have the means to eliminate it. It is time to take action."

United Nations millennium declaration (2000)

"Men and women have the right to live their lives and raise their children in dignity, free from hunger"

Rome declaration on world food security (1996, World Food Summit)

"We, the Heads of State and Government, or our representatives, ...reaffirm the right of everyone to have access to safe and nutritious food. We pledge our political will and ...national commitment...to reducing the number of undernourished people to half their present level no later than 2015"

Universal declaration on the eradication of hunger and malnutrition, 1974

Every man, woman and child has the inalienable right to be free from hunger and malnutrition in order to develop fully and maintain their physical and mental faculties. Society today already possesses sufficient resources, organizational ability and technology and hence the competence to achieve this objective.

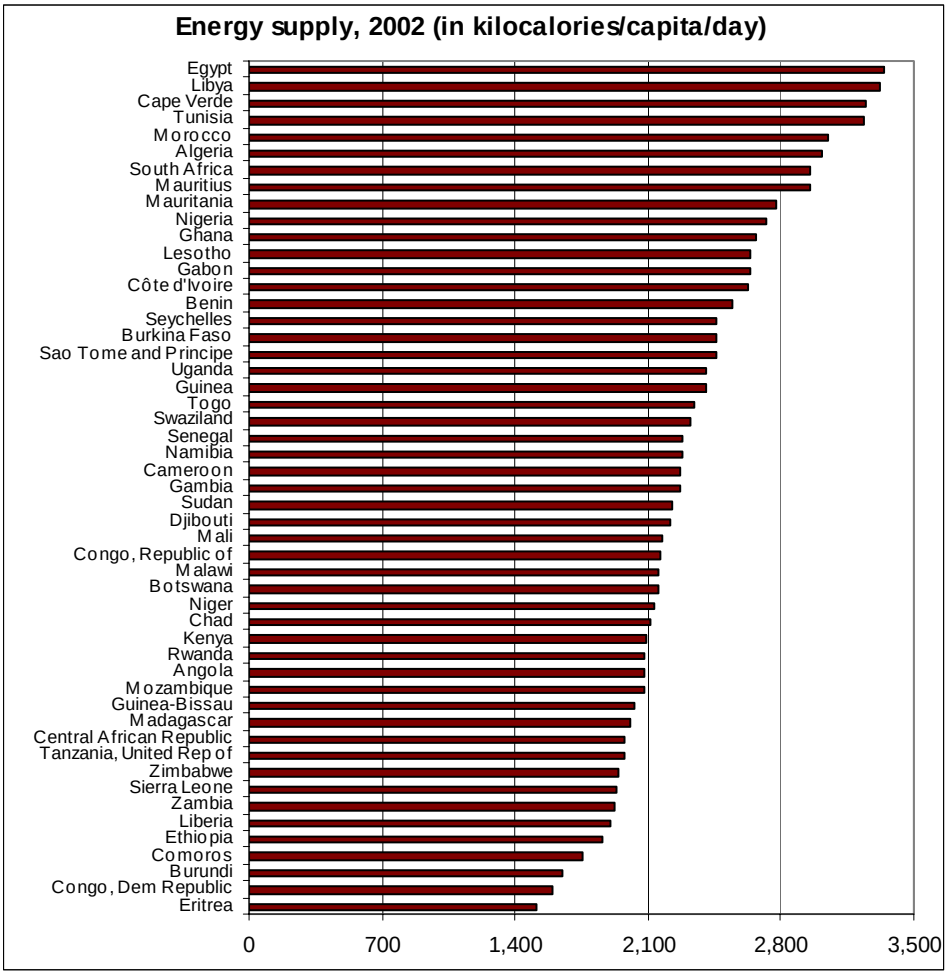
International covenant of economic, social, and cultural rights (1966), Article 11.

"The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food.... ...To improve methods of production, conservation and distribution of food .. to ensure an equitable distribution of world food supplies in relation to need."

Universal declaration of human rights (1948), Article 25.

"Everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food."

Africa's food supply, emergiencies and their causes



African countries requiring emergency food aid and the causes (as of March, 2005)

Angola*	Returnees
Burundi*	Civil strife, IDPs and returnees
Chad	Refugees
Central Afr. Rep.	Civil strife
Congo, D.Rep.*	Civil strife, IDPs and refugees
Congo Rep. of	Civil strife, IDPs
Côte d'Ivoire	Civil strife, IDPs
Eritrea*	Drought,IDPs, returnees
Ethiopia*	Drought in parts, IDPs
Guinea*	IDPs and refugees
Kenya*	Drought in parts
Lesotho*	Drought
Liberia*	Civil strife, IDPs
Madagascar*	Drought in southern parts, cyclones
Mauritania*	Drought, locusts
Malawi*	Drought in parts
Sierra Leone*	Returnees
Somalia*	Civil strife, drought in parts
Sudan*	Civil strife, drought in parts
Swaziland*	Drought in parts
Tanzania, U.R.	Drought in parts, refugees
Uganda*	Civil strife, IDPs
Zimbabwe*	Adverse weather, economic crisis

Source: GIEWS. IDPs = Internally displaced persons

Conference Announcement

For details see
Http://www.atdforum.org

Traditional Healing & HIV/AIDS
Dakar, Senegal
11 - 13 April 2005

Fifth International Triple Helix Conference
Turin, Italy
18 - 21 May 2005

Improving Quality of Care: Malaria Update Short Course
Kampala, Uganda
30 May - 10 June 2005

12th International Product Development Management Conference
Copenhagen, Denmark, June 12-14, 2005

World Congress on Conservation Agriculture
Nairobi, Kenya
3 - 7 October 2005

New strategies against an ancient scourge
Yaoundé, Cameroon
13 November 2005

The World Summit on the Information Society
Tunis, Tunisia
16 - 18 November 2005

ATTITUDES IN THE PUBLIC DEBATES ON AGRICULTURAL BIOTECHNOLOGY IN DEVELOPING COUNTRIES

Philipp Aerni, ETH-Zurich

Abstract

Three stakeholder perception surveys conducted in the Philippines, Mexico and South Africa indicate that the overall attitude toward the risks and benefits of agricultural biotechnology in developing countries is predominantly pragmatic. Yet, the polarizing forces in favor of or against agricultural biotechnology in these national debates are largely fueled by stakeholders from Europe and the United States. The author argues that these foreign stakeholders may have a strategic interest to intervene in public debates in developing countries with the expectation of gaining public trust back home. National academia, which still enjoys most public trust in developing countries, should counteract this trend in this particular area by reassuming political and scientific leadership in their respective countries.

The battle for the moral highground in the GMO debate in industrialized countries

Public debates on agricultural biotechnology in industrialized countries have a highly moralist component that relates to the potential of this technology to improve the conditions of poor farmers in developing countries. All agree that poor people cannot be left behind and that urgent help is needed to improve their livelihoods; but they strongly disagree about the right approach in assisting these countries. The discussion often ends in mutual reproaches of being only driven by self-interest and not caring much for the poor. In order to emphasize the accuracy and relevance of their own position, proponents and opponents in the biotechnology debate often pick representatives from developing countries with similar attitudes to speak on behalf of all the stakeholders in the developing world as a whole. This frequently leads to tremendous simplifications of what people want and need in developing countries.

Risk as a social and cultural construction

Risk is primarily a social and cultural construction (Johnson & Covello 1987), and its meaning may differ significantly among societies with different political and economic circumstances. Everyday, many people in developing countries face a wide range of risks that have to a large extent been eliminated in developed countries. Ironically, these risks were reduced in affluent societies through the use of modern technology. The unintended side effects caused by new technologies may still be a serious matter of concern. However, the knowledge of how to deal effectively with these unintended side effects has increased significantly through the process of learning over the last century. These potential side effects of technology must be weighed against the potential gains from the appropriate use of technology to reduce existing risks to human health and the environment.

This is one reason why it is important to conduct surveys on public debates towards agricultural biotechnology not just in developed but also in developing countries where the potential benefits from a new technology, in case of fair access, may outweigh the potential risks to a much greater extent than in industrialized countries (UNDP 2001).

Three stakeholder surveys in the Philippines, Mexico and South Africa

Surveys on the views on agricultural biotechnology expressed by the political stakeholders were conducted in three developing countries, the Philippines (1997), Mexico (2000) and South Africa (2000).

The stakeholders that participated in the surveys were equally spread across the political spectrum including representatives from government, academia, business, NGOs, churches, consumer organizations, producer organizations, the mass media, legislature and international organizations. They were asked to complete a semi-standardized questionnaire where they had to assess statements and pre-structured answers to certain questions on a scale from 1-5 (e.g. 1=not important at all, 5=very important). The exact answers and statements are listed in the annex. The results of the surveys revealed that, on average, the respondents in the Philippines, Mexico and South Africa believe that agricultural biotechnology has the potential to solve important problems in agriculture such as drought (*Drought*), pest infestation (*Pests*), plant disease (*Disease*) and high use of pesticides *(Pesticides)* (see Figure 1).

In assessing positively and negatively worded statements on a scale from 1-5 (1=don't agree at all, 5=completely agree), respondents generally disagreed with the statement that genetically modified crops would pose a significant risk to consumer health *(health risk)* and agreed that genetic engineering is just a new tool that helps solving problems than cannot be solved with conventional breeding methods *(just a new tool +)* (see Figure 2). They also approved of the statement that genetically engineered crops may eventually contribute to future food security *(food security +)*. In turn, there are significant concerns regarding the potential negative impacts of such crops on the natural environment *(environment -)* and the difficulty to implement strict regulation *(implementation -)*.

Figure 1: The importance of the problems in agriculture and the potential of genetic engineering for solving them

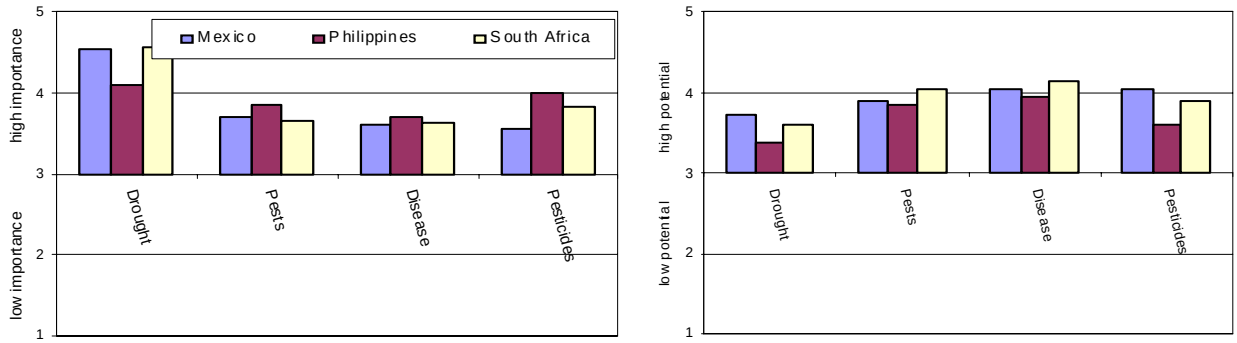
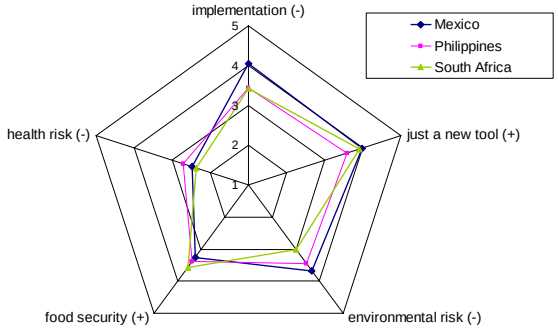


Figure 2: Average Assessment of the Positive and Negative Assessments of Genetic Engineering in Agriculture



This indicates that a majority of the respondents in these countries tend to have a rather pragmatic view. They recognize the potential of biotechnology to address certain problems in agriculture but also emphasize the importance of improving access to markets, rural infrastructure and biosafety capacity in order to make this technology also profitable for farmers in marginal areas and ensure its safe and responsible use.

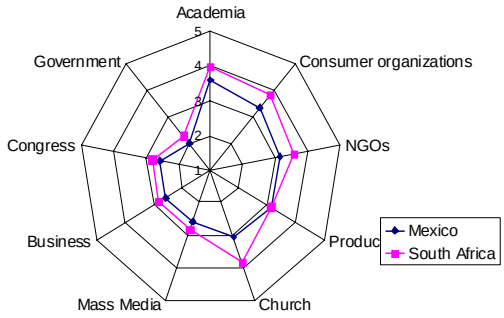
A common denominator is the insight that agricultural biotechnology needs to be perceived as a home-grown technology in order to be accepted and to become really useful. This again would require much more attention to the role of local universities in technology transfer and capacity building efforts.

Pragmatic views prevail but extreme views are better funded

This pragmatic view differs sharply from the stronger 'genophobic' view of large NGO networks in Europe that look at biotechnology as a plot devised by big business to exploit poor farmers and endanger the health of consumers, and the 'genophile' view of American business that tends to advocate 'one size fits all' solutions. A common observation in all three countries is that local stakeholders that are either affiliated with international agribusiness or the global anti-biotech movement turn out to have the most uncompromising attitudes towards agricultural biotechnology. Even though these stakeholders may have local roots they are increasingly dependent on foreign donors (international business, international NGOs and Western donor agencies). In the Philippines, it was the interception of transgenic material from Switzerland, organized and funded by Greenpeace Switzerland in

1995, that had a decisive influence on the public debate on agricultural biotechnology in the 1990s (Aerni 1999). In South Africa, 5 out of 6 sponsors of Biowatch SA, the leading local anti-biotech NGO, are foreign players (http://www.biowatch.org.za), and in Mexico, the most important activist group against GMOs is Greenpeace Mexico. Judging from the recent strategic decision of Greenpeace Switzerland to shift more resources from domestic activities to campaigns in developing countries with new offices in China, India and possibly Africa (Schuler 2004), this trend of foreign NGO involvement in local debates in developing countries is likely to become stronger in future.

Figure 3: Public Trust in Institutions (1=no public trust, 5=lots of public trust)



Personal communication with a local representative of Greenpeace Mexico revealed a growing dissatisfaction with the prevailing franchising system of the organization in which the basic strategy of protest and the selection of protest topics are determined in the headquarters of Europe while the local representatives are

just asked to execute the strategy without paying attention to local circumstances. This paternalist attitude is also reflected in the punitive actions of Greenpeace International against local Greenpeace offices that are reluctant to participate in international campaigns that they believe are not in accordance with domestic public environmental concerns or the real environmental problems in their respective country (Knauer 2004).

As a result, many of these NGOs tend to adopt the political agenda of their foreign donors and often abandon their initial struggles for particular local concerns. This indicates that interest groups from richer countries may be contributing to political polarization in this particular policy area in poorer countries.

Academia in developing countries must act as an intermediator

National academia in all three countries may become the key players in counteracting the polarizing forces. When asked how much trust different institutional groups were having in public (in a scale from 1-5), respondents of the surveys still considered academia to be the most trustworthy stakeholder in the public debate on agricultural biotechnology (ahead of churches, NGOs, consumer organizations etc.) (see Figure 3 on South Africa and Mexico).

Concluding Remarks

The results of the surveys conducted in the Philippines, Mexico and South Africa indicate that stakeholder perceptions toward the risks and benefits of agricultural biotechnology are generally pragmatic. A majority of the respondents is interested in using the new tools of agricultural biotechnology to solve important problems in agriculture and generally do not share the extreme views in favor or against this technology featured predominantly in the mass media in Europe and the United States. Nevertheless, the global debate on agricultural biotechnology continues to be primarily a transatlantic debate and its main representatives are trying to persuade developing countries to endorse their moral claims either about the promise or the curse of genetic engineering in agriculture.

These vested interests that try to influence public perceptions are usually associated with transnational agribusiness companies who aggressively pushed for permissive GMO legislation in the 1990s. Yet, their lobbying and PR efforts seemed to have been largely ineffective in view of their controversial public image and the relatively low number of countries that have embraced transgenic crops in commercial agriculture. This stands in strong contrast to the success of mainly European-based NGOs and government agencies in shaping a negative public opinion on GMOs through well-staged media-campaigns. With such actions, they have largely succeeded in consolidating their image as defenders of the public interest and in persuading many governments to generally oppose the use of GMOs. As presumed 'defenders of the public interest' they have gained the valuable political resource of public trust which they continue to manage successfully in the public sphere. Public trust has probably become the most important source of public legitimacy in a global debate on GMOs, which ceased to be about the real risks and benefits of this new technology but is about values and worldviews. Those stakeholders who have gained public trust are increasingly unwilling to regard it as a public but as private good that helps them to gain more freedom of action in politics (through more public legitimacy) at the cost of those whom the public distrusts. In other words, they may be benefiting from political polarization and are interested in exporting it to developing countries.

The three surveys indicated that the national academia continues to be the most trustworthy actor in the public debates on agricultural biotechnology in developing countries. Academia should therefore use this political currency to build bridges between business and anti-biotech NGOs and support the governments in their efforts to make responsible use of agricultural biotechnology. They may also persuade stakeholders in industrialized countries to abandon their single-minded pursue against or in favor of agricultural biotechnology and turn moral rhetoric into effective and pragmatic action in developing countries.

Center for Comparative and International Studies
Institute of Agricultural Economics
Swiss Federal Institute of Technology (ETH) Zurich
ETH-Zentrum, SEI F6
8092 Zürich
Tel: 01 632 44 58
E-mail: philipp.aerni@iaw.agrl.ethz.ch

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GMOs: A NEW DILEMMA FOR AFRICA

Simonetta Zarrilli, UNCTAD Geveva

Introduction

Biotechnology is a revolutionary technology. It offers humanity the power to change the characteristics of living organisms by transferring the genetic information from one organism, across species boundaries, into another organism. These solutions continue the tradition of selection and improvement of cultivated crops and livestock developed over the centuries. However, biotechnology identifies desirable traits more quickly and accurately than conventional plant and livestock breeding and allows gene transfers impossible with traditional breeding. The use of biotechnology in sectors such as agriculture and medicine has produced a growing number of genetically modified organisms (GMOs) and products derived from them. A GMO can be defined as "an organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination".

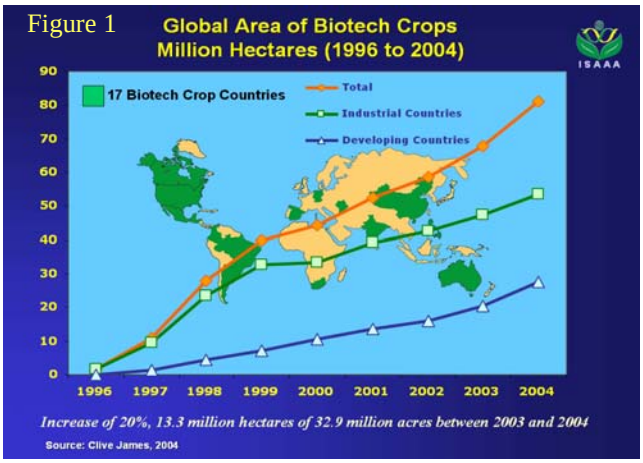
Bio-technological improvements present significant opportunities for agriculture and farmers. At present, the perceived benefits of genetically modified crops are better weed and insect control, higher productivity and more flexible crop management. These "first generation" GM crops are mainly benefiting the producers who can obtain higher yields and/or lower costs. The broader and long-term benefits, however, would be more sustainable agriculture and better food security that would benefit everybody, and especially the developing countries. For instance, breeding for drought tolerance could greatly benefit tropical crops, which are often grown in harsh environments and in poor soils. Increasing the amount of food produced per hectare could be a way to feed the world's growing population, without diverting land from other purposes such as forestry, animal grazing or conservation. There are a number of examples of food products that are being developed to act as edible vaccines and have raised hopes of solving many of the problems associated with the delivery of safe, effective vaccines in developing countries. A shift is, therefore, occurring from the current generation of "agronomic" traits to the next generation of "quality" traits, from which consumers, more than producers, would to able to benefit.

While GM crops may offer great benefits to agriculture and farmers and, potentially, to consumers, in particular to poor people in developing countries, biotechnology does not come without risks and uncertainty. There are many fears linked to perceived threats of biotechnology to human, animal and plant life and health, to the conservation of biodiversity and to the environment at large. Although there is not yet any definite scientific evidence of harm to humans, animals or the environment, it is submitted by many that adverse effects may be revealed in the future by more extensive research. The fear is that GMOs may change the toxicity and allergenicity of food, thus fostering allergic reactions or altering antibiotic resistance. A major environmental concern relates to potential consequences of gene flow from GM to non-GM individuals of the same species and to the possibility of unpredictable crosses with other species. Some claim that crops modified to be tolerant to herbicides could foster the development of "super weeds". Another related concern is that GMOs could threaten the world's biological diversity and lead to excessive dependence on few crop varieties, thereby increasing the vulnerability of crops to diseases. Economic preoccupations have also been voiced. They relate to the fact that a large number of patents have been issued in the sector. If the results of plant research continue to be patented, there is a risk that they may become too expensive for poor farmers, especially in developing countries. Moreover, the private sector invests in areas where there are hopes of a financial return; as a consequence, private science may focus on crops and innovations that are of interest to rich markets and put less emphasis on those of interest to poor countries. It is also argued that biotechnology may change the nature, structure and ownership of food production systems by consolidating control in the hands of a few large firms. This could aggravate food security problems that are allegedly caused not so much by food shortages as by inequity, poverty and concentration of food production. Finally, modern biotechnology techniques may raise ethical and religious concerns.

Trends

According to figures from the International Service for the Acquisition of Agri-biotech Applications (ISAAA), the global area of GM crop plantation has grown 47-fold since 1996, and the estimated global GM crop area in 2004 was 81 million hectares, cultivated by approximately 8.25 million farmers in 17 countries. Herbicide-tolerant soybean was the dominant transgenic crop, followed by Bt maize, Bt cotton, and herbicide-tolerant canola. 14 countries grew 50,000 hectares or more of biotech crops; the eight leading biotech crop countries being the United States, representing 59 per cent of global transgenic crop area; Argentina, 20%; Canada and Brazil, 6% each; China, 5%; Paraguay, 2%; and India and South Africa, 1% each. Plantings were also found in Uruguay, Australia, Romania, Mexico, Spain, the Philippines, Honduras, Colombia, and Germany. More than one-third of the global transgenic crop area in 2004 was grown in developing countries (see figure 1).

Figure 1



Although continuously expanding, GM crop plantings are still confined to a rather small number of countries. Apart from suspected health or environmental hazards, the reason for the restricted global uptake of GM crops may find its rationale in fear of export loss due to the political and regulatory environment in many countries outside the Americas that oppose GMOs.

Countries' positions on agro-biotechnology

Countries' positions on agro-biotechnology depend on many factors, such as their policy awareness, the level of risk they are willing to accept, their capacity to carry out risk assessments in the sector and implement adequate legislation, their perception of the benefits they could gain from biotechnology, their dependence on agricultural exports and the consequent need to satisfy the rules and expectations in the export markets; their reliance on food aid, and the investments they have already made in the sector. Countries' positions can be classified into three main categories:

(i) the position of those countries that have adopted the equivalence principle, have authorized most GM products for production and consumption, and strive for easy and reliable access to foreign markets for their biotechnology exports;

(ii) the position of those countries that have mainly adopted the precautionary approach and are imposing strict rules on approval and marketing of GMOs and GM products; and finally

(iii) the position of those countries that are still in the first phase of evaluating the risks and benefits that agricultural biotechnology may imply for them, that are striving to develop comprehensive regulatory systems on the issue, and whose main trade-related preoccupation at present is to preventing GM-related regulations and concerns having negative repercussions on their agriculture exports, including exports of conventional products. Many developing countries fall into the third category.

GMO regulations are based on scientific assessment of the actual or potential risks that those products may bring about. Such assessment can be a "conventional" risk assessment or a risk assessment based on the precautionary approach. The former is about relevant scientific evidence, which means that there is sufficient scientific evidence for the perceived risks underlying the measure. The large GM producers, such as the United States, Canada and Argentina, rely on this approach. Conversely, the "precautionary approach" to risk assessment is concerned with scientific uncertainty, where there is no "adequate theoretical or empirical basis for assigning possibilities to a possible set of outcomes". Three basic conditions may thus trigger application of protective measures: uncertainty, risk, and lack of proof of direct causal link.The EU legislation is based on this approach.

Many developing and least developed countries, especially in Africa, still lack, or are in the process of developing, comprehensive regulatory systems to deal with the challenges of agricultural biotechnology. Developing a regulatory framework concerning GMOs may be a costly and lengthy process. Areas for regulation include: (a) research and development (R&D), for example conditions under which laboratory experiments take place and conditions for testing in contained facilities or in the field; (b) approval processes for commercial release, including prior scientific assessment of risks to human and animal health and the environment, the minimum distance from organic agriculture or non-GM fields, labelling, post-commercialization monitoring, and liability; and (c) import regulations.

In setting up domestic legislation, developing countries seem to be paying increasing attention to international trade concerns. On the other hand, developed countries are increasingly getting involved in how the issue of biotechnology is going to be settled in developing countries.

The EU, for instance, has stressed that GMOs are not the panacea likely to solve famine in Africa, since the real causes for hunger and famine in Africa have to do with ethnic feuds and regional wars that displace populations. Moreover, the EU has noticed that most of present GMOs are herbicide-resistant or pest-resistant, however most African producers do not use herbicides or pesticides in their crops. The kinds of GMOs that would benefit African producers, such as GMOs that are drought and soil-acidity resistant, are however still confined to laboratories. GMO crops, to be efficient, need extensive farming land and involve fewer farmers. The reality in Africa is the opposite: small fields and many farmers. Moreover, if Africa were to adopt biotechnology, it would become completely dependent on Western companies that hold the patents.

On its side, the United States has claimed that the delay on accepting shipment of US maize might jeopardize the life of millions people in African countries which refuse food aid which may contain GMOs. The United States insists that only by using GM crops will Africa be able to feed its burgeoning population. US companies are exercising pressure on some African countries to adopt GM crops.

Assessments of the risks and benefits related to agro-biotechnology vary substantially between countries and regions, and so do the regulatory approaches (rules on GM approval, marketing, import, labelling, documentation). When GM products are commercialized internationally, as has been the case since the second half of the 1990s, the diverging domestic requirements may hamper international trade in agro-biotechnology products and further complicate an already difficult regulatory trade system in the agricultural sector.

From an international trade perspective, the major preoccupation of GM producing and exporting countries is to have easy and reliable access to foreign markets for the GMOs and GM products that they have already developed or may develop in the future. For countries, like the EU, that have adopted a "no-risk" approach, the main preoccupation is to establish strict production and import measures that would guarantee that the chosen high level of health and environmental protection is indeed achieved.

Developing country preoccupations have several facets. While some developing countries produce GMOs for domestic consumption, very few export them. However, many developing countries are exporters of conventional agricultural products. Those countries find themselves in a particularly difficult situation: in order to preserve their export opportunities, especially towards markets that are sceptical about bio-engineered products, they may need to be "GM-free" countries. This means not only that they should not be exporters of GMOs, but also that they should not be producers of GMOs for domestic consumption and not even importers of GMOs. Losing "GM-free" status is perceived by some countries as having negative repercussions for their export opportunities for all agricultural products. This is due to the perception that consumers, especially in Europe, may react negatively towards products that could be linked even remotely to genetic modification. Some trade-diverting effects are apparently already taking place because companies substitute some inputs with others (which do not bear the risk of being genetically modified) or use inputs coming from alternative countries, which are supposed to be "GM-free", to avoid cumbersome documentation and traceability requirements, as well as to meet consumers expectations, especially in Europe.

While South Africa is striding ahead with the cultivation of GM maize and cotton, many other African countries prefer to keep away from biotechnology fearful of environmental damage and reduced exports to Europe. A handful of other African countries, including Kenya, Nigeria and Tanzania, are looking at creating new laws to allow planting of GM crops. Kenya and Nigeria are looking at making their own GMO variants, while cotton-producing countries in West Africa may move into GMO production (see Table 1).

The perception of possible reduced exports to the EU has been among the reasons why some African countries have refused food aid that includes genetically modified commodities. In 2002, Zambia declined a US offer of maize, some of which contained GM products. Main Zambian concerns related to uncertainty regarding the safety of GM maize for human consumption, as well as the possible contamination of local varieties which could allegedly imply a rejection by EC countries of Zambian food exports. In July 2002, the Zimbabwean Government agreed to allow into the country food aid that contained genetically modified maize, provided it was milled immediately upon arrival to avoid any possible contamination of local varieties. Previously, Zimbabwe had rejected GM food aid due to concerns that it might supposedly threaten beef exports to the EU and local maize varieties. Uganda recently announced that GM crops could be imported into the country, but that they should be used strictly for consumption and not for cultivation. At the same time, a draft law that would regulate both research into GM crops and the release of GM organisms into the environment is under consideration.

At the beginning of May 2004, more than 60 groups representing farmer, consumer and environmental organizations from 15 African countries sent a letter of protest to the World Food Programme (WFP). These groups are protesting against the alleged pressure exerted by the WFP and USAID on Sudan and Angola over their respective decisions to impose restrictions on GM food aid. Sudan has requested that GM food aid be certified "GM-free" (though the Sudanese Government has put in place an interim waiver on GM food restrictions until January 2005), and Angola will accept GM food aid only on condition that all GM grain is first milled. According to the organizers of this initiative, non-GM alternatives exist at national, regional and international levels, and donors should make these available to Sudan and Angola. According to the WFP, on the other hand, the requirement imposed by the Government of Angola would imply substantial extra costs and cause shipment delays of up to two months. This decision is going to further aggravate an already serious funding situation where the WFP has received only 24% of the funds it asked for under its current operation in the country. As a consequence, WFP is to halve the food rations given to the majority of the 1.9 million people it assists in Angola.

In August 2003, the Southern African Development Community (SADC) approved a set of recommendations formulated by the SADC Advisory Committee on Biotechnology and Biosafety as interim measures aimed at guiding the region on those issues. The recommendations are divided into four main sections: Handling Food Aid; Policy and Regulations; Capacity Building; and Public Awareness and Participation. Under "Handling Food Aid", donors providing GM food aid should comply with the Prior Informed Consent principle and with the notification requirements in accordance with Article 8 of the Biosafety Protocol. Food aid consignments containing GM grain should be milled or sterilized prior to distribution to beneficiary populations. The sourcing of food aid should be within the region, and the region should develop and adopt a harmonized transit information and management system for GM food aid designed to facilitate transboundary movement in a safe and expeditious manner. GM food aid in transit should be clearly identified and labelled in accordance with national legislation. In the absence of it, it is recommended that countries make use of the requirements under the African Union model law on biosafety. The recommendations encourage SADC countries to develop national biotechnology policies and strategies to exploit the benefits of biotechnology, to establish national biosafety regulatory systems, and to sign and ratify the Biosafety Protocol and the Convention on Biological Diversity.

Following those recommendations, in May 2004, at the summit on agriculture and food security, SADC approved guidelines on handling GM food aid. The guidelines fully endorse the recommendations of the SADC Advisory Committee on Biotechnology and Biosafety.

Another specific area of concern in Africa is cotton. Cotton is grown principally for the fiber, although a small quantity of the seed is used as a source of food, feed and oil for humans and animals. Globally, 28% of the 32 million hectares of cotton were biotech crops in 2004, up from 21% in 2003.

Although Africa is not the largest cotton exporter (10-15% of world exports), cotton is of critical importance in West and Central Africa (WCA). For several WCA countries, cotton is the largest source of export receipts. The cotton sector is also key to rural poverty reduction, with cotton-related activities accounting for a large share of rural employment (about 6 million people are involved in the cotton industry in WCA).

In WCA, plans are being finalised to convert some cotton crops into transgenic cotton varieties over the next years. In Mali, for example, the government signed in 2004 a research agreement with USAID, Monsanto, Syngenta and Dow Agrosciences to develop and commercialise transgenic cotton by 2009, starting with field-testing in 2004. Field-testing of Bt cotton started in Burkina Faso in 2003. The trials aim to assess the viability of Bt cotton and to develop varieties resistant to the caterpillars (which affects approximately half of the country annual cotton output). A question is therefore whether GM cotton will be able fulfilling its promises of increased profits for farmers. The major problem that Western African cotton producers face seems to be international low prices, which are mainly due to inequitable trading practices, more than low productivity due to pests. Therefore, according to many, those trade practices should be targeted and dismantled to redress the situation of cotton producers in Western Africa. Some concerns have also been voiced about the economic soundness of breaking the traditional scheme of seeds supply and switching to a system where seeds have to be bought every crop year from multinational companies.

At present, international trade in GMOs and products thereof has to take place according to the rules contained in the WTO Agreements, in particular those spelt out in the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), the Agreement on Technical Barriers to Trade (TBT Agreement) and the General Agreement on Tariffs and Trade (GATT) 1994. Disciplines regarding transboundary movement of GMOs, however, have been developed in a specific multilateral agreement being negotiated outside the purely trade context, the Cartagena Protocol on Biosafety. The rules included in different legal instruments may not be fully consistent with each other. In developing national schemes to deal with agro-biotechnology, countries have to make sure that those schemes do not infringe the multilateral trade obligations they have subscribed.

CONCLUSIONS

While developed countries have established their national frameworks to deal with agro-biotechnology and biosafety focusing primarily on domestic priorities and strategies, most developing countries are doing so under less flexible circumstances. Instead of enjoying the freedom to assess risks and benefits that agro-biotechnology may bring about and act accordingly, developing countries increasingly seem to be expected to set up their national regulatory schemes based on the requests and expectations of the developed countries and their companies. Political, economic and trade-related pressures exercised on developing countries may compromise their ability to find balanced and development-oriented solutions that would fit their environmental and food needs.

As a general rule, domestic regulations should be scrutinized in the light of multilaterally agreed trade rules, if they are likely to have an impact on international trade. The two main legal frameworks applying to trade in agro-biotechnology products are the WTO framework – which is not specific to biotechnology and was actually developed at a time when biotechnology was not an issue – and the Biosafety Protocol which, on the contrary, is a more recent multilateral instrument specifically targeted at GMOs and GM commodities. Considering that the rules included in the WTO Agreements and in the Biosafety Protocol may not be fully consistent to each other, developing countries in general and African countries in particular have to be particularly careful in putting in place their nations regimes for agro-biotechnology in order to avoid infringing their multilateral trade obligations.

Agro-biotechnology is a particularly challenging issue for developing countries. Their main concern seems to be to find the appropriate balance between pursuing their development objectives and at the same time complying with their multilaterally agreed obligations. The preoccupations that many developing countries may have as exporters of agricultural and food products must be balanced against their role as producers and their responsibility for improving the quantity and quality of agricultural and food products made available to the population, as well as with commitment to environmental preservation. Making these goals mutually supportive is not an easy task, especially for countries in Africa that still face major difficulties in dealing with the scientific aspects of biotechnology.

The decision of the big and highly populated developing countries, such as India, Brazil and China, to embark on agro-biotechnology may have an impact on African countries. Different options are possible. Some African countries may take the option of keeping their "GM-free" status, differentiate themselves from other providers that have become GM-producers, and target markets that prefer to stay away from agro-biotechnology. Conversely, African countries could take advantage of the biotechnology advances of other developing countries and try to get from those countries technology and support.

Some additional capacity-building efforts on agro-biotechnology and biosafety seem to be required, including efforts to strengthen developing country ability to deal with the international trade dimension of the issue. Efforts may also be needed at the international level to set up a global strategy to deal with new phenomena in a more coherent and systemic manner and avoid *ad hoc* solutions. Bio-engeneering is a recent phenomenon, but the rapid evolution of science and technology will inevitably lead to new scenarios that may be challenging for all countries, but particularly for developing countries.

Table 1.Current status on use and imports of GM products in some SSA and Biosafety Protocol's Membership

Country	Legal regime	Additional information	Membership Bio-safety Protocol
Angola	Import ban introduced in April 2004 on all GM products, except for food aid providing it has already been milled.	According to the WFP, the additional cost of milling has put off some food donors.	No
Benin	A five-year moratorium was introduced in March 2002 on the importation, commercialisation and use of GM products to give the country time to effectively debate, develop and implement national biosafety legislation.	The country is under constant pressure from agro-biotechnology companies to introduce Bt cotton.	Yes
Burkina Faso	Field trials of GM-cotton started in 2003. The tests are expected to last several years before any decision on whether to go ahead with large-scale planting may be taken.	Concerns about potential harm to the environment.	Yes
Ethiopia	Import ban on GM products, because they would allegedly undermine farmers who have developed traditional practices for fighting pests and weeds.	Debate continues over whether GM crops could help fighting serious food shortages that the country has been experiencing for several years.	Yes§
Kenya	Import ban on GM products, but government in the final stage of drafting pro-industry legislation on agro-biotechnology.	Research is going-on to develop GMOs variants of cotton, maize and tuber. Field trials of GM sweet potato.	Yes
Lesotho	Import ban on GM products unless already processed or milled.	Concerns about potential harm to the environment.	Yes
Madagascar	Import ban on GM products.	Concerns about potential harm to human health and to the environment.	Yes
Malawi	Import ban introduced in 2002 on GM products unless already processed or milled.	Concerns about potential harm to the environment.	No
Mali	Field trials of GM cotton started in 2004.	Concerns about potential harm to human health and to the environment, as well as about dependence on foreign producers of GM seeds. Research agreement between the National Agricultural Research Institute and USAID, Monsanto, Syngenta and Dow Agro-sciences to develop transgenic cotton.	Yes
Nigeria	Draft law authorizing the planting of GM crops under consideration. GM imports allowed.	Research is going-on to develop GMOs variants.	Yes
Rwanda	The government is awaiting conclusions from a government biotechnology committee before adopting a national policy.		Yes
South Africa	Cultivation of GM crops widespread, especially for maize, soybean and cotton. South Africa is among the eight world leading biotech crop countries, with 1% of global transgenic crop area.	The environmental group Biowatch won in March 2005 a court case forcing the government to disclose data about all GMOs and GM products imported, exported or manufactured in the country.	Yes
Sudan	Import ban introduced in May 2003 on GM products. A series of temporary waivers were issued enabling food aid shipments to the country to continue while alternatives were found.		No§
Swaziland	Imports of GM products allowed.		No
Uganda	The government began in 2004 hearings over whether or not to authorize the planting of GM crops. GM crops can be imported, but they should be used strictly for consumption and not for cultivation.	Ugandan scientists are working on the development of GM bananas.	Yes
Tanzania	Draft law authorizing the planting of GM crops under consideration. Field trials of GM-cotton will start by October 2005.		Yes
Zambia	Import ban on GM products.	Concerns about potential harm to human health and to the environment, as well as about losing export markets.	Yes
Zimbabwe	Import ban on all GM products, except for food aid providing it has already been milled.	Concerns about potential harm to human health and to the environment, as well as about losing export markets.	Yes

Endnote:

1.The Convention on Biological Diversity defines biotechnology as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use".

2.See Directive 2001/18/EC of 12 March 2001 of the EC on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC, OJ L 106, 17.04.2001, Article 2(2).

3.MacKenzie, D.J. and M.A. McLean (2004) "Agricultural Biotechnology: A Primer for Policymakers", in *Agriculture and the WTO – Creating a Trading System for Development*, World Bank, pp.237-253.

4.Bt plants produce their own pesticide through a gene borrowed from the bacterium *Bacillus thuringiensis*.

5.Christoforou, Th., "The Precautionary principle in European Community Law and Science", in J.A. Tickner (ed.), *Precaution, Environmental Science, and Preventive Public Policy* (Washington, DC: Island Press, 2003), pp. 241-257, at 246.

6.*Ibid.*, at 243.

7.ISNAR and FAO, in consultation with UNEP/GEF, have developed a web-based "Decision Support Toolbox for Biosafety Implementation" (http://www.isnar.cgiar.org/ibs/biosafety/regulatory.cfm), while the UNEP-GEF Projects on National Biosafety Frameworks (NBF) are implementing the GEF Initial Strategy in Biosafety to assist: (i) 123 countries in developing their NBFs, (ii) 8 countries in setting up a fully operational NBF and (iii) Parties to the Biosafety Protocol building capacity for effective participation in the Biosafety Clearing House (BCH). For details see www.unep.ch/biosafety.

8.European Union in the US, EU Newsweb, Commentary, *The case of Africa and GM crops: The European View*, 13 June 2003, found at: http://www.eurunion.org/newsweb/commentary/GMOCommentary.htm

9.PlanetArk, *Starving Africa should accept GMO food, US say*, 29 July 2002, found at: http://www.planetark.com/avantgo/dailynewsstory.cfm?newsid=17051.

10.L'Express, *South Africa leads on GMO crops*, 1 March 2005, found at: http://www.lexpress.mu/display_article_sup.php?news_id=36906.

11.See *Bridges Trade Biores*, 11 July 2002, available at http://www.ictsd.org/biores/02-07-11/inbrief.htm

12."Uganda gives cautious approval to GM food", *Science and Development Network*, 2 March 2004, available at: http://www.scidev.net/News/index.cfm?fuseaction=readNews&itemid=1257&language=1

13.*African countries 'forced' to accept GM food aid*, Mail&Guardianonline, 5 May 2004.

14.*Food Rations to Be Halved in Angola Amid Funding Crisis and GM Ban*, 2 April 2004, World Food Programme, In Brief, available at: www.wfp.org/newsroom/in_brief/Africa/angola/angola-040402.html

15.The information on GM utilization and import is based on: PlanetArtk, FACTBOX – Genetically Modified Crops in Africa, 1 March 2005, found at: http://www.planetark.com/avantgo/dailynewsstory.cfm?newsid=29767. Biosafety Protocol's membership as of 10 March 2005.

16.§ Ethiopia is not a Member country of the WTO.

17.§ Sudan is not a Member country of the WTO.

18.The Recommendations are available in the SADC web site: http://www.sadc.int/fanr.php?lang=english&path=fanr/agrres&page=sadc_biotechnology_gmo.

19."SADC Sets Guidelines for Gm Food", *Zambezi Times Online*, 14 May 2004.

20.Cotton accounted for about one third of Benin's exports, 40% of Burkina Faso's exports and 35% of Mali's exports and cotton is also critical to livelihood. Cotton employs about 45% of rural households in Burkina Faso and 40% of rural households in Mali.

21.GRAIN, *Bt Cotton on Mali's doorstep*, April 2004, found at: http://www.grain.org/seedling_files/seed-04-04-4.pdf.

22.The Cartagena Protocol on Biosafety was adopted on 29 January 2000 and entered into force on 11 September 2003. As of 10 March 2005, 117 countries, including the EC, had ratified or acceded to it. The Protocol provides rules for the safe transfer, handling and use of "living modified organisms" (LMOs). Its aim is to address the threats posed by LMOs to biological diversity, also taking into account risks to human health. The Protocol does not cover consumer products derived from LMOs, such as corn flakes, flour, starch, seed-oil, tomato paste or ketchup.

Conference Announcement

IAMOT 14th International Conference on Management of Technology in Vienna, in collaboration with UNIDO

May 22-26, 2005

International Conference on Agricultural Research for Development

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27–29 April 2005,

International workshop on community level adaptation to climate change

Dhaka, Bangladesh

16 - 18 January 2005

Technologies and Applications of Genomics, Proteomics and Bioinformatics

Dubai, United Arab Emirates

25 - 29 January 2005

Science: Practitioners Dialogue on Science and Technology for Sustainable Development

Washington DC, United States

18 February 2005

The burden of diseases in poor resource countries: meeting the challenges of combating HIV/AIDS, tuberculosis and malaria

Arusha, Tanzania

21 - 24 February 2005

The role of biotechnology for characterisation and conservation of crop, forestry, animal and fishery genetic resources

Turin, Italy

5 - 7 March 2005

VIEWPOINT:

IS BIOLOGICAL CONTROL A VIABLE OPTION F O R AFRICAN FARMERS?

Agboka Komi, IITA, Benin

An increasing number of farmers in Africa cannot afford the high costs of pesticide. Replacing chemical-intensive pest control methods with alternative agricultural approaches could be . Moreover, the demand for environmentally friendly-farmed products is increasing. Consequently programs of biological control are growing dramatically. This trend will continue and probably increase in future for a number of reasons: firstly, biological control (BC) is growing in popularity due to a number of recent successes in both developed and developing countries.

Africa offers some examples of biological control and provides an opportunity to understand why they work and how things break down. The BC of cassava mealybug with the Encyrtid wasp, *Anagyrus lopezi,* provides an outstanding example of the impact of introducing an effective parasitoid to control a devastating pest in 27 African countries. Similarly, the wasp *Gyranusoidea tebigy* was imported into Benin to control mango mealybug. It is now considered as the first line of defense against the pests (Waage, 1999). Secondly with recent liberalization of the world trade, there will be a growing rate of introduction of alien pest species. The long list of successes, involving more than 370 bio-control agents world wide, is evidence of BC potential and safety, notwithstanding a few isolated cases of failures.

Since BC is economically viable and self-sustaining strategy, African farmers can rely on it for pest control and avoid dependence on costly pesticides. However, biological controls are not always satisfactory because the natural enemies are either insufficient or are somehow prevented from developing their full potential. In such case an Integrated Pest Management (IPM) strategy, a situation where several intervention have to be combined, have to be employed.

There are several obstacles that have prevented the prospect of BC being a profitable business enterprise in the past. Classical biological control in the past needed most interactions with government and inter-governmental agencies and collaborations institutions for coordinating foreign exploration, quarantine, and to overcome the considerable transport problems that have already affected the earliest practitioners. This process of BC is economical expensive. The involvement of farmers and extension services were less associated and not trained. Some of these key constraints should be tackled before farmers can fully benefit from the BC. Biological control should take the demand from farmers and government policy. The resurgence of pests despite the presence of effective parasitoids shows that presence of natural enemies is no guarantee for effective pest management. Farmer education is essential for classical or natural BC to work effectively.

For instance, the use of *Anagyrus* to control *Planococcus Kenyae* was not successful because of the use of persistent chlorinated hydrocarbon insecticides to control other coffee pests. To be successful, BC programs need to be explained and demonstrated to farmers, the public and government agencies or officials responsible for formulating agricultural and environmental policies (van Driesche, 1989). Practical, proven and effective control pest technologies may exist but effectiveness may depend on good and adequate dissemination and effective delivery system.

Research must therefore include a focus on producing operational recommendations. It can be also recognized that results are not relevant if they cannot be implemented by farmer under local conditions. African governments should be much more aware of BC and Biological agents being more thoroughly tested and evaluated before importation and release. Greater awareness should also provide a spur to the environment to the development of IPM system minimizing the use of broad spectrum chemicals and making greater use of the potential of BC agents and bio-pesticides.

In many, if not most cases, BC by itself does not provide economically acceptable suppression of pests in agricultural cropping system. Therefore BC must be developed and implemented as a component of IPM, which is feasible for and relevant to African agriculture. There is a great opportunity to promote IPM more effectively in Africa. International donors can promote development and implementation of the IPM in African countries most effectively by helping to establish the necessary scientific, technical and logistical capacity and helping to impress upon government leaders the benefits and the needs to establish supportive policies. The success of these initiatives will ultimately rely on the extent to which authorities and policy-makers become educated about and come to accept, and adopt the principles of BC.

But some time we (practitioners and to some extends, farmers) are skeptical about the likelihood success of BC. African farmers face great uncertainty on outcomes as nothing is guaranteed in farming- it is a risk way to make a living. If farmers have some knowledge of the chances of possible outcomes (from the path they take) and the factors that affect the outcomes, then they will be in better position to make decisions that include their attitudes toward risk. The more African farmers are willing to gamble for better prospect the more they are likely to accept the use of BC. Those farmers who cannot afford to lose much (monetarily) usually do not want to risk using BC. They rather pay the price of “prevention” insecticide treatments than take a chance on BC just in case it does not work for them.

Although BC is viable approach to agricultural pest management, it takes many years to realize its impact and benefit. Commercializing the antagonists proved to be also difficult due to the limitation in local registration guidelines, which in some African countries do not exist or limited. Thus many agriculturalist find BC irrelevant and inapplicable to Africa. This claim is sometimes based on perception that the BC represents a low productivity strategy, which is incompatible with the agricultural intensification needed to reverse declining per capita agricultural production in Africa. In many respects, the challenge is to development biological approaches to manage some of the most destructive pests. The application of multi-

A SUMMARY:

AFRICA'S FOOD AND NUTRITION SECURITY : WHERE ARE WE AND HOW DID WE GET HERE?

Todd Benson, IFPRI, Washington

Food and nutrition security remain Africa's most fundamental challenges for human welfare and economic growth. Far too many people on the continent are unable to acquire and effectively utilize at all times the food they need for a healthy life. Because of low food availability and profound poverty, an estimated 200 million people on the continent are undernourished, and their numbers have increased by almost 20% since the early 1990s. The result is that more than a third of African children are stunted in their growth and must face a range of physical and cognitive challenges not faced by their better-fed peers. Undernutrition is the major risk factor underlying over 28% of all deaths in Africa (some 2.9 million deaths annually). The continuing human costs of inadequate food and nutrition are enormous, and the aggregate costs of food and nutrition insecurity at the national level impose a heavy burden on efforts to foster sustained economic growth and improved general welfare.

To be successful, new and innovative initiatives against poverty in Africa must sharply reduce hunger and malnutrition. The logic is as follows: Broad-based economic growth is necessary to increase incomes and consumption to reduce poverty. Economic growth can be achieved primarily through enhanced economic productivity, which in turn comes about through broad improvements in the intellectual and technical capacity of the population. The potential intellectual and technical capacity of the population is dependent on improved nutrition, particularly for young children and women in their childbearing years. Similarly, the effective utilization of such capacity is dependent on a properly nourished population, in which individuals are living healthy and active lives and are able to contribute creatively to their own and the nation's economic well-being. It is only when Africans have secured their basic food and nutritional needs that they will begin to experience sustained improvements in their broader welfare.

A household is *food secure* if it can reliably gain access to food in sufficient quantity and quality for all household members to enjoy a healthy and active life. It is possible, however, for individuals in food-secure households to have deficient or unbalanced diets. *Nutrition security* is achieved when secure access to food is coupled with a sanitary environment, adequate health services, and knowledgeable care to ensure a healthy and active life for all household members. The ability of an individual to fully reach his or her personal and economic potential, however defined, must depend to a large degree on his or her level of nutrition security. Moreover, the availability of nutrition resources and the degree to which an individual has access to such resources are a function of how society is organized in terms of economic structure, political and ideological expectations, and its institutions. Consequently, nutrition security must be a subject for political debate and an issue of immediate concern to any national development strategies.

nutritional status of children varies directly with the educational level of their parents, and in particular their mothers.

What then is the level of access to the components of food and nutrition security that most Africans enjoy? For all Africans, such security is closely tied to agricultural productivity. Higher production from one's own farm or herds enhances household food security. For food purchasers, higher production generally means lower food prices and access to a greater quantity of food in the market for a given income level. Many countries, however, particularly in Eastern and Central Africa, possess a combination of a moribund food crop sector and very low purchasing power. Stable access to food through the market requires that the food marketing system is effective in supplying food while also providing benefit to those who have food to sell. In most parts of Africa, the marketing system is not effective in this regard. People living on less than one dollar per day are unable to pay the prices they would need to pay to import all of the staple food they require.

In consequence, undernutrition in its various forms is primarily a chronic condition in Africa. Food crises emerge when broad negative shocks--drought, floods, economic downturns, conflict--affect chronically food-insecure populations. However, while not to discount the severity of acute hunger crises facing 30 to 40 million Africans annually, there are 160 million persons in Africa who are undernourished. Although they may not necessarily be facing an acute crisis in access to food, their access is not secure. If any of the 160 million were to be affected by one of these broad shocks or a range of other more individual shocks--death in the household, loss of an income source, chronic illness--most would face an acute hunger crisis relatively quickly. Because of this vulnerability, food aid and social safety net institutions remain an important component of the food security for many Africans.

Moreover, nutrition security requires several factors that are complementary to food security. Among these are a hygienic environment and access to health services. In these areas, the challenges are great, and important advances in nutrition security remain to be achieved through continued and increasing investment in these areas. There is also considerable evidence that the nutritional status of children varies directly with the educational level of their parents, and in particular their mothers. Mothers with more education are more knowledgeable about the care they need to provide their children. Although it is not an obvious element of strategies to enhance nutrition security, ensuring that girls are able to attain their full educational potential is a critical and currently deficient component of such efforts in Africa.

In a survey of the continent, the countries of North Africa are clearly among the most secure nutritionally. These countries are among the wealthiest in Africa, a fact that has implications for access to food through the market and for the basic requirements of good nutritional status. In contrast, those countries that are least nutritionally secure are not surprising. Those nations in Africa that have experienced conflict and the absence of an effective central government in recent years do not

have in place the conditions that might assure broad nutrition security. Conflict exacerbates poverty and poor governance. These governments are unable to provide basic public goods, which results in a consequent lack of access to food, care, health services, and a healthy environment.

The more interesting and challenging cases are the broad range of countries that exhibit poor to fair progress in assuring the nutrition security of their citizens--countries where the majority of Africans live. Assessing what such nations might do differently to significantly improve nutrition security can only be done on a case-by-case basis. Where food availability is poor, food production must be enhanced at the same time as trade policies are reexamined to allow a more reliable supply of food from the global market. Other countries may be food secure but still have crippling rates of malnutrition. In these, attention should be directed to issues of household access to food and to the context within which the food is utilized--sanitation, health services, level of knowledgeable care, and a broad range of related issues. Moreover, the quality of policy-making and the effective and responsible implementation of those policies are important basic determinants of the degree to which food and nutrition security can be assured in any country in Africa.

Responsibility for assuring that individuals are able to attain food security ultimately lies with national governments. They have a duty to establish the conditions and institutions necessary to enable citizens to access the basic requirements of nutrition security--sufficient quantities of food necessary for a balanced diet; the means to acquire this food, whether through cash incomes or access to productive resources; education in order to provide proper nutritional care to one's dependents and oneself; clean water and adequate sanitation; and effective health services. It should not be expected that one detailed policy and action prescription will enable national governments to effectively address malnutrition in all countries. Because of historical factors, agroecological conditions, economic comparative advantage, or institutional structures, the basic determinants of food and nutrition security in any one African country will never be exactly the same as those of another. That said, there really are no exceptions--all African countries can attain nutrition security. What is needed is commitment to this goal; dedicated efforts to marshal the human, institutional, and material resources necessary for the task; followed by the application of the political will to undertake the actions necessary to achieve it.

National governments must lead several aspects of the effort to attain nutrition security, highlighted here:

- Sustained and broad-based economic growth is necessary. To end hunger in Sub-Saharan Africa by 2050, it is estimated that the region must attain a 3.5% annual average growth rate in per capita gross domestic product (GDP). In the past decade, however, only half a dozen countries had growth rates above 2.5%. The challenge is immense.

- Efforts must be made to open national markets to international trade, both within Africa and globally. National food availability should not necessarily or even primarily be dependent upon national food production alone. The nutrition security of the population of a country is enhanced to the degree that the nation invests in building the necessary institutional and legal frameworks and physical infrastructure to facilitate open, reciprocal trade, both with neighboring countries and with the globe as a whole.

- Agriculture cannot be ignored. The effectiveness of farmers in producing food is a critical factor in the level of access to food enjoyed by the farmers themselves and the much broader population with whom they are linked through the market. Growth in food supplies has the dual effect of increasing the income of the farming household and reducing the prices households must pay to acquire food in the marketplace, both of which enhance nutrition security. Moreover, increased production of food and non-food crops provides an important input into the broader economy, both in rural areas and in urban manufacturing centers.

- Education is a critical input to good nutritional status, particularly for girls.

Direct nutrition interventions are a necessary component of any effort to build the quality of human capital for economic growth and improved standards of living.

A close link exists between successful improvements in child nutrition and increasing women's social access to resources they can use to improve care and increase the diversity and quantity of food provided the children under their care. Consequently, improving the level of equity between men and women is good for nutrition security.

Locally conceived and implemented action has been shown to be the most effective way to improve food and nutrition security. Central government's role should consist of giving broad direction to local efforts and facilitating those efforts through resource allocation, provision of needed expertise, and institutional support.

Budgetary allocations by central governments should reflect the central importance that food and nutrition security has for the welfare of all people and the immense economic benefits it provides for relatively little cost. In this regard, donor funding should be viewed as a secondary resource to complement government's own.

Without dedicated advocacy to inform policy makers at all levels of the critical role improved nutrition plays in development and poverty alleviation, it is unlikely that emerging democratic, decentralized, bottom-up political systems across Africa will allow the voices of the malnourished to be any better heard in planning and resource allocation decisions. The issue must be communicated effectively and understood widely, its significance for the welfare of all members of society recognized, and action catalyzed around proposed solutions. Ultimately, advocacy seeks to ensure that the political will is established so that the necessary resources are provided to aid individuals and households in attaining food and nutrition security.

Responsibility for assuring food and nutrition security must ultimately lie with national governments. Consequently, the master development plans of government should reflect the importance of such security to the welfare of its citizens. Thus it is critical that the poverty reduction strategy papers (PRSPs) that many African nations have developed in the past five years and that serve as master development plans for many are explicit on the importance of investing in food and nutrition security to reduce poverty and generate sustained economic growth. Similarly, sectoral plans and strategies, most notably agricultural sector strategies, should be oriented toward food and nutrition security objectives, along with their other longstanding objectives. Advocates for full food

and nutrition security must engage in the higher-level policy processes guiding the revisions of the PRSPs and sectoral strategy documents. The key message should be that the arrow of cause and effect between nutrition security and income and broader economic growth runs both ways. Just as income growth enhances nutrition security, healthy, active, well-nourished citizens are an important precondition for sustained growth in income. Nutrition and food security concerns must be among the primary components of such strategies.

It is at the local government level, however, that direct actions must be taken to facilitate improved access to nutrition security for individuals and households. Global and national policies are meaningless if they do not cascade into action at the local level that improves the nutrition security of individuals resident there in real, measurable ways. Policy processes, capacity, and resource allocations at the local level all pose important challenges that must be successfully addressed to enable local residents to attain food and nutrition security.

The costs of attaining food and nutrition security in Africa are high. The benefits of such security, however, can easily be shown to outweigh these costs. Moreover, there is a moral obligation to address hunger and nutrition insecurity. This being the case, it is important to recognize the power of political will and effective leadership to overcome such constraints. Where development issues such as food and nutrition security arise through broad, participatory policy processes, political will is built. When effective leadership is brought to bear on such issues, any resource voids that hamper action can be quickly filled.

Food and nutrition insecurity is a critical constraint to economic growth in Africa and an immediate cause of widespread suffering. Millions of Africans seek enhanced food and nutrition security. National governments and their development partners can do a great deal on many different scales to facilitate and ensure their citizens' access to the tools that will allow them to meet their food and nutrition requirements. The solutions are known. Now we must build the broad political will to address this issue and to foster the leadership necessary to effectively implement the solutions.

Financing and joint venture opportunities: SWEDFUND International AB

SWEDFUND International offers risk capital and know-how to Swedish companies investing in Africa, Latin America, Asia, and Eastern Europe. Risk capital is invested in companies with well-defined business concepts and with a strong growth potential. The returns from these investments are then reinvested in new profitable companies. With the exception of the LDCs, a Swedish interest is required as a strategic partner, normally a Swedish company.

SWEDFUND invests in any developing country, with a focus on countries with a per capita GNP of less than $3,000 per year. Investments may be made in most industries with the exception of companies that manufacture or distribute weapons, tobacco and alcohol. It may provide up to 30% of the total capital required but not seed capital and the Swedish partner should have at least a 3-year track record and international business experience.

SWEDFUND provides venture capital, generally in the form of equity, to local companies in one or several countries or together with other international or local financial institutions and companies. Its financial solutions comprise ordinary and preference shares, leasing, loan guarantees, and participating, subordinated or secured loans. When the venture has achieved a sustainable and profitable operation with views to the long term, SWEDFUND will sell its shares to the other investors or any willing buyer.

In Africa, SWEDFUND has direct investments in Benin, Egypt, Mozambique, South Africa, Tanzania, Uganda, Zambia and Zimbabwe. For instance, Swedfund has invested telephone operators MTN (Uganda) and MTC (Namibia), and in Maputo Port (Mozambique). As of 2003, SWEDFUND had an investment portfolio of SEK 302.2 million in Africa

For business interest contact:

Swedfund International AB, http://www.swedfund.se/ email: info@swedfund.se

P.O. Box 3286, SE-103 65 Stockholm, Sweden. Phone: +46 8 725 94 00,

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VIEWPOINT:

IDENTIFYING AND PROTECTING SPECIAL PRODUCTS IN WTO AGRICULTURE NEGOTIATIONS

C. Obura Bartel, ATDF

Agriculture is the backbone of many African economies. It provides employment and livelihood as it accounts for over 60 per cent of the labour force, and for some, agricultural products constitute more than 70 per cent of exports. For this reason, policy makers are fearful that liberalization in the agriculture sector could in some instances drive local farmers into a state of mass poverty. A central issue of the agriculture negotiations is the ability of countries to freely determine tariffs that are appropriate to national needs. The tariff levels, according to some member states, should be determined by the need to protect certain vulnerable groups of the population or some important staple foods.

In order to support agrarian reform as the means to increase welfare and fulfil the rights of farmers to a better livelihood, a range of national and multilateral mechanisms to protect agriculture products and local farmers has been conceived. At the multilateral level, WTO Members agreed on a framework for agriculture, which will constitute the basis for the negotiations of full modalities in the next phase of the negotiations. Included in the framework agreement is the recognition that "developing countries will have the flexibility to designate an appropriate number of products as Special Products (SP), based on the criteria of food security, livelihood security and rural development needs". In addition, a Special Safeguard Mechanism (SSM) will be established for use by developing countries. Generally, WTO

Members agree that SP and SSM could provide developing countries with much needed flexibility to address their development concerns, particularly because the majority of them would have no recourse to measures apart from border measures or tariffs to support their farmers. This means that African countries may have the flexibility to designate an appropriate number of products as SP. The idea of special products was put forward by an alliance of 16 developing countries including Kenya, Mauritius, Nigeria, Uganda and Zimbabwe from Africa.

The alliance also supports the new SSM to address situations of import surges and price swings. Additional duties and quantitative restrictions could provide relief from import surges and declining prices. Some countries, including the European Union, the United States and New Zealand propose restricting SPs to crops that are important for food security or for subsistence farmers. Others widen the definition to include any product important to a country's overall farm income, export income or food security. This would affect countries such as India where approximately 35 crops individually are depended upon by around five million people, and more than 25 crops cover an area of over one million hectares each. The European Union and the United States would rather see negotiated criteria to limit the number of products to staple food products only, or products necessary for food security, that are produced in the country concerned.

"Special Products" are those products that are "exempted" from the general reduction commitments.

Now that countries may designate SPs, the process of deciding what farm products should be eligible and determining what level of protection or duty cuts has begun.

The main question is what should be the norm to determine or identify the set of SPs in each country that best meets its development needs. There is a need to identify and agree on indicators that allow countries to choose special products and to provide analysis of the implications of alternative choices. A number of possible selection criteria include 1) the share of the product in total agricultural production (rural development) 2) the share of the product in total apparent agricultural consumption (food security) 3) the share of domestic consumption of domestically produced products (food security) 4) the contribution of the product in the total agricultural labour force or agriculture employment (livelihood security).

For example, if the livelihood of a majority of the population depends on cassava and yam, they could be designated as SPs and the country would be allowed to keep a higher protection level on both crops. However, there may also be cases where a crop alone, for example wheat, accounts for over 15 per cent of protein and energy supply but is largely imported.

Although African countries would like to have the freedom or space to designate their SPs, the negotiations may lay down specific conditions to define them and

perhaps limit the number of products that can be designated as SPs. These products are eligible for lower tariff reduction and would be exempt from minimum access quota provisions which could support African countries to increase rural production, employment and farm gate incomes. Least-Developed Countries are not required to undertake reduction commitments, however, it is expected that developed and developing country Members should provide them with duty-free and quota-free market access for their products.

Issues to clarify

Issues to be clarified include whether SPs would also have access to SSM and the circumstances under which such a mechanism could be activated or triggered. Supporters of SPs want SSM to be made available to protect all SP products as well, whereas the Cairns Group and the United States have conditioned the access to SSM for those SP which have undergone deeper tariff-cuts. It is not yet certain if a SP is entitled to a SSM.

How these safeguards are to be activated, and how many are to be allowed is a matter of negotiations. However, trigger mechanisms should be simple to determine and to use. The proposals on when the SSM should be triggered are 'price' and 'volume' triggers or a combination of both. The price trigger is when prices drop beyond a reference price and the volume trigger when import volumes increased beyond a reference level.

Many in the developing world see the designation of SP and SSM as positive steps in addressing the concerns of developing countries, particularly food security. The next task lies in translating these ideas into concrete instruments and criteria for SP and elaborate terms and conditions for SSM, which would not negate the potential effectiveness of these concepts. They also agree that any rules for SP and SSM for developing countries to pursue national development objectives and structural adjustment programs must allow flexibility within the bounds of trade rules and disciplines.

Table 1. Indicators of Special Products for selected African Countries

Indicators of "special product" for selected African countries and commodities		Percentage share of product in total agriculture production	Percentage share of product in total agricultural consumption	Ratio of domestic production and consumption	Percentage share in total employment in agriculture
Ethiopia	Maize	20.0	20.0	0.9	4.5
	Sorghum	9.0	11.0	0.8	2.7
	Wheat	9.0	13.0	0.6	2.5
	Barley	7.0	7.0	0.9	1.5
	Potatoes	3.0	3.0	1.0	0.1
	Millet	2.0	2.0	1.0	0.6
Nigeria	Cassava	26.5	25.6	1.0	17.4
	Yams	20.9	20.2	1.0	16.8
	Sorghum	6.2	6.0	1.0	16.2
	Millet	4.9	4.7	1.0	17.9
	Maize	4.0	3.9	1.0	11.4
	Rice	2.7	3.5	0.7	8.8
	Groundnuts	2.3	2.2	1.0	7.6
	Sweet Potatoes	1.8	1.7	1.0	0.6
	Plantains	1.5	1.5	1.0	7.8
Cameroon	Plantains & Bananas	22.5	20.0	1.1	2.7
	Cassava	22.3	21.8	1.0	3.9
	Maize	9.0	8.2	1.1	4.4
	Sorghum	4.6	4.5	1.0	0.2
	Tomatoes	3.0	3.0	1.0	0.2
Zambia	Cassava	29.8	24.2	1.0	1.5
	Maize	26.8	39.6	0.5	7.6
	Wheat	2.4	3.7	0.5	0.2
	Millet	2.0	1.7	1.0	2.3
	Groundnuts	1.8	1.5	1.0	2.8

Source: FAO

SPECIAL FEATURE:

CREATING SMART BUSINESSES; THE INNOVATION HUB

Amie Hunter, TIH, Pretoria

The Innovation Hub is one of 11 Blue IQ initiatives in South Africa, that are aimed at generating sustainable economic growth in line with global economic developments, including 'smart' industries. It is financed by the Gauteng Provincial Government and will be Gauteng's first high-tech cluster to support the growth of knowledge-intensive industries through a combination of custom-designed real estate and value-added services that support the needs of high-tech enterprises. In fact, it will be become the first internationally benchmarked Science Park in Africa.

The Innovation Hub is located on a 60 ha site between the University of Pretoria and the CSIR in the Eastern suburbs of Pretoria. The site has been strategically chosen to benefit from the UP/CSIR knowledge axis and other research and development activities in Gauteng. Major freeways link The Innovation Hub to other South African provinces and to neighbouring Mozambique through the Maputo Corridor Industrial Developmental Zone.

Programme and Objective

The main objective of the Innovation hub is to attract a variety of high-tech tenants active in ICT, electronics, life sciences, defence, aerospace and advanced materials. It shall create a unique environment for innovation and technology development and transfer.

The Innovation Hub's **maxum** Business Incubator is to develop an incubation programme for early stage and start-up companies. In addition, its **CoachLab™** Leadership Development Programme will offer a pre-incubation programme for entrepreneurs from previously disadvantaged backgrounds, and a leadership and skills training programme for post-graduate students. The latter is implemented by means of a partnership with business and tertiary education institutions.

Value and Scope

Blue IQ's investment in land, infrastructure and buildings is R318 million. It is estimated that, at full development, the project will have acquired private infrastructural investment of over R1-billion. In terms of the Development Facilitation Act record, 30 ha of the site is earmarked for development, comprising 121 000 m^2 of gross floor area.

Latest developments

The first phase of the construction of The Innovation Hub has been completed and the Science Park is now open for business at its new premises. The Innovation Hub Management Company (Pty) Ltd, mandated to manage activities at the Science Park, moved to the Innovation Centre at the new site in December 2004.

The **maxum** Business Incubator also has moved to the new site – sharing occupation of the Innovation Centre with the Management Company and with three start-up companies as incubation participants. The multi-tenant Enterprise Building already houses four tenants, namely the Naledi3d Factory, the Expertron Group, Ultimate Sports Nutrition (USN), Giftwrap, BioPAD and Agile Works. A further three tenants will be moving in shortly, with significant interest from numerous other high-tech companies, both in rental space and site accommodation, currently being pursued.

The Innovation Centre

Contact details for project information

The Innovation Hub, tel (012) 844 0000 or visit their website at www.theinnovationhub.com

SOY PROTEIN AND WOMEN'S HEALTH

James W. Anderson and Kathryn M. Patterson

Introduction

There are many popular approaches to the application of alternative and complementary medicine interventions for women's health problems. Increased soy consumption appears to be one avenue for safe and effective augmentation of mainstream medical therapy. Future research in personalized nutrition and expanded investigations in nutrigenomics may reveal additional health benefits of soy consumption.

In the age of medicinal drugs and quick fixes for every health condition, safe, efficacious, natural alternatives to hormone replacement therapy (HRT) such as dietary interventions are often overlooked. Women's health is one area where small dietary changes may be an adjunct to prevention and treatment of various problems. The inclusion of soy foods in the diet may constitute an example of an alternative or complementary approach to promote women's health.

Coronary Heart Disease. Pre-menopausal women have a lower risk of CHD than men of the same age. However, following menopause, a woman's risk is comparable to a man's risk. One of the factors contributing to this delay in CHD in women relates to the production of estrogen, an endogenous cardioprotectant.

Observational studies and clinical evidence support the use of soy in preventing heart disease in all persons, specifically post-menopausal women. Setchell (2001) suggested that soy isoflavones resemble selective estrogen receptor modulators (SERMs) in adults and thus appear to protect women from CHD through mechanisms similar to that of estrogen. In addition, soy protein may reflect its impact on several types of lipoproteins, improvement in vascular health and reactivity, protection from oxidative damage, reduction of inflammation, and lowering of blood pressure; yet safety and efficacy of soy protein as a cardioprotectant remain to be sufficiently demonstrated in large, at-risk populations (Park et al., 2005).

Menopause. Support for the use of soy foods to treat menopause symptoms has also been found. It is especially attractive for women who cannot or will not use HRT. Since the safety of HRT is questionable, especially for women who have a history of breast cancer, dietary soy may provide an alternative. The phytoestrogens found in soy have been shown to have estrogenic effects, which may act to substitute for the declining estrogen levels in women after menopause (Albertazzi and Purdie, 2002). However, earlier clinical data seem to support the inclusion of two to three servings of soy foods per day with naturally occurring isoflavones rather than using soy isoflavone supplements (Mackey and Eden, 1998).

Breast cancer. One of the most provocative areas of soy research lies in the realm of neoplastic disease. Interest is spurred by findings that populations with high consumption of soy foods seem to have lower rates of breast, uterine, and colon cancers than societies with low soy food intakes. Despite many limitations in the epidemiologic and animal data, there remains intriguing support for the hypothesis that food components, particularly soy food and vegetable intake, are associated with a reduced risk of breast cancer (Greenwald, 2004). Genistein and other soy isoflavones are hypothesized to account for most of the cancer-protection properties of soy foods by inhibiting estrogen receptor–sensitive cell growth. Although the evidence for soy consumption in cancer reduction is inconclusive and divided, some research is suggestive of various chemoprotective properties of soy.

Diabetes. Among the leading diseasecaused fatalities in the United States, diabetes is ranked fifth, and diabetics are at a greater risk for multiple and concurrent health problems than non-diabetics. Unfortunately for diabetic women, there is a greater frequency of complications than are seen in diabetic men. The risk for cardiovascular disease (CVD), which is already higher among diabetics, is even higher for diabetic women than for men. Because of these additional complications, it may be important for diabetic women to take advantage of dietary adjustments, such as consuming soy foods, toward reducing some of their health risks.

For example, dietary soy may lower postprandial glucose levels, contribute to improved insulin levels and insulin sensitivity, reduce hyperglycemia, and possibly promote reduction in the reliance on medications to control and stabilize blood glucose levels, as well as modulate plasma lipid profile and concomitantly reduce a woman's risk of CVD (Friedman and Brandon, 2001).

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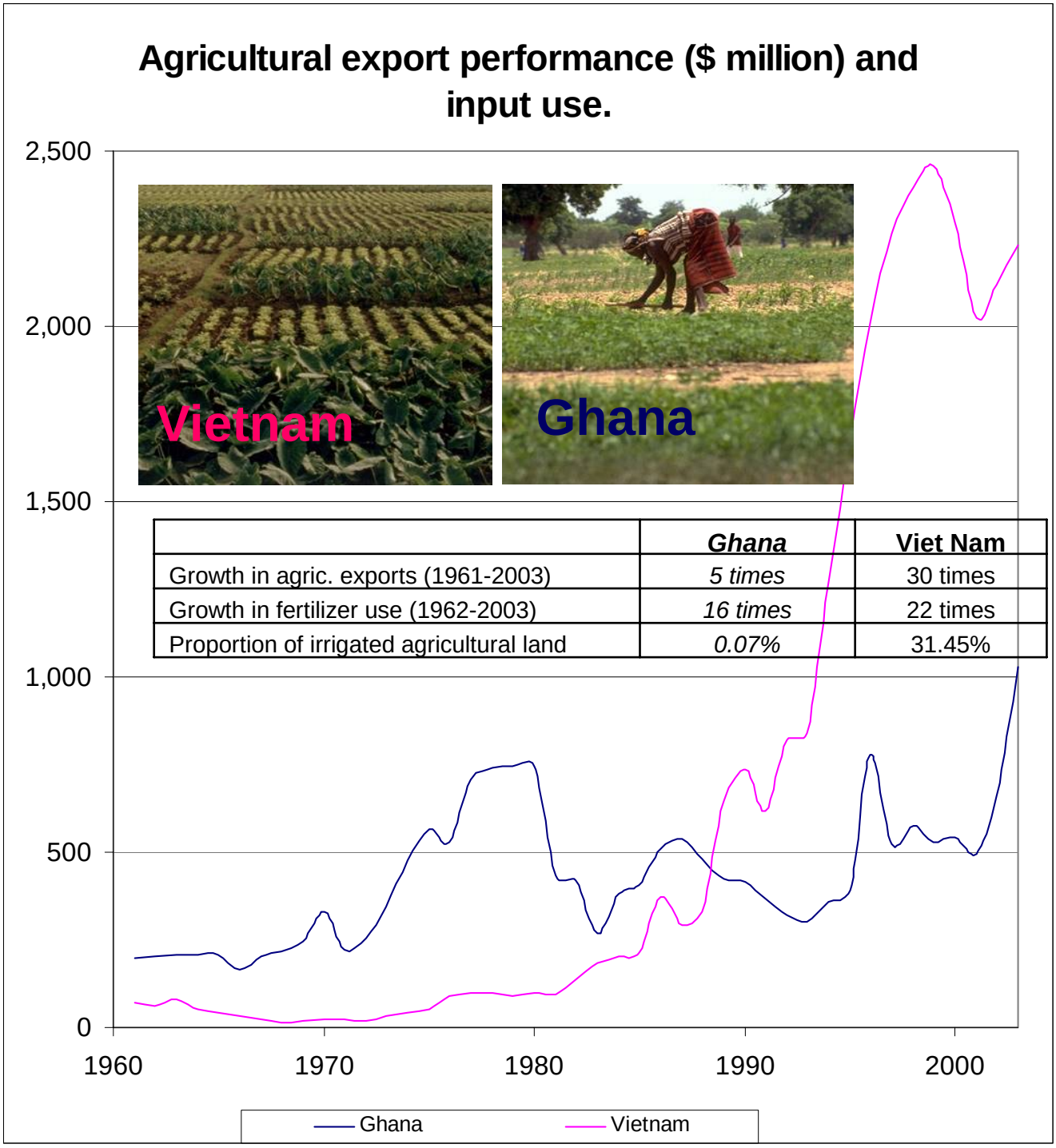
In Figures: A comparison of Ghana and Vietnam



	Ghana	Viet Nam
Growth in agric. exports (1961-2003)	*5 times*	30 times
Growth in fertilizer use (1962-2003)	*16 times*	22 times
Proportion of irrigated agricultural land	*0.07%*	31.45%

Ghana's agricultural exports were about 7 times more than those of Viet Nam in the late 1970s. By 2000, Viet Nam's agricultural exports are nearly 4 times more than those of Ghana. What happened?

Viet Nam has diversified it exports since then. For instance, rubber was the top agriculture export of Viet Nam in the 1970s but has since dropped to third position. For Ghana, cocoa remains its main export crop, accounting for nearly a third. While the prices of both rubber and cocoa have dropped, diversification has cushioned the effect on Viet Nam.

NEGOTIATING GLOBAL TRADE IN AGRICULTURE

Marita Wiggerthale, Freelance Consultant Berlin.

Negotiations on agriculture continue to take a central place in the current round of WTO negotiations, launched at the WTO ministerial Conference in Doha, November 2001, owing in part to the millions of people in Africa for whom farming is an essential source of income. On average, 56 per cent1 of the labour force in developing countries is engaged in farming, however, this figure is over 90 per cent2 in Burkina Faso, Rwanda and Burundi. Paradoxically, 80 per cent of those suffering from hunger live in rural areas where food is produced. 50 per cent of small farmer families represent the largest group of those affected by hunger. A further 28 per cent are landless or directly dependent on natural resources. The latest FAO estimates are alarming in that they point to a further increase in the number of undernourished persons. Between 1995 and 2001 the number of undernourished persons increased by 18 million. These estimates highlight the question concerning connections between agricultural trade liberalisation and food security.9

The need for the protection of food security is mentioned in both the Preamble and Annex II of the WTO Agreement on Agriculture (AoA) and while it is formally recognised by the WTO as a valid concern, failure to introduce relevant rules means that it has remained an empty promise. Moreover, it is generally accepted that the rules of the AoA are unbalanced, at the expense of the developing countries, thereby cementing North-South asymmetries.

Apart from the essential issue of food security, or the establishment of the right to food in the context of the WTO agriculture negotiations, the agricultural sector is one of the most sensitive sectors on account of its direct relationship with abiotic resources (soil, water, air), biotic resources (species diversity in flora and fauna, habitats), and aesthetic resources (landscape, cultural aspects). For example, 70 per cent of those suffering from hunger have no access, or inadequate access, to land.1 Soil protection is as central to food security as access to water, which in turn is an essential component of the right to food.

> Food aid must be disciplined in such a way that its sole use for the purpose of disaster relief can be ensured and that it is provided in the form of grants.

The issue of external protection is by far the most controversial, yet it is essential for maintaining national scope in terms of food security and sustainable development of rural areas both in the North and South. It is absolutely essential to assess the impact of liberalization on vulnerable groups such as small farmers, women and children who are directly dependent on natural resources, and not to base evaluations solely on macro-economic analyses. Staple foods are of particular significance in terms of domestic market access. The production of staple foods is essential for food security and for the realisation of the basic human right to food. Food sovereignty requires that farmers have a ready market for their locally produced staple foods. These crops are mostly grown by women and constitute 90 per cent of the food supply for those suffering from poverty and hunger.

The basis of agriculture negotiations

The Doha mandate establishes that 'special and differential treatment' for developing countries shall be an integral part of all elements of the negotiations. It states that developing countries are granted 'less than full reciprocity' in reduction commitments. Also the Article 20 AoA establishes that the ongoing negotiations should take into account ‘non-trade concerns’ such as food security or environmental protection. The same is true for the experience gained in the implementation of the reform process to date. It shows that markets in the developing countries are swamped with cheap imports, resulting in small producers becoming displaced and losing their means of income generation. Many developing countries have become highly dependent on imports as a result of the liberalisation of their markets.

Market protection and food security

A central issue in the negotiations on agriculture is the extent to which the developing countries will be given the ability to freely determine tariffs that are appropriate to their national needs. Tariff levels should be determined by the need to protect certain vulnerable groups or certain staple foods, by the competitiveness of certain agricultural produce sectors and by the need to import certain foods, provided these cannot be produced in the country itself.

Developing countries should have the right to protect the domestic production of small farmers and of staple food for food security reasons. Hence they should be given the flexibility for the introduction of quantitative restrictions, variable levies, raising low tariff bindings especially for staple foods, exemption of staple foods from reduction commitments ('special products'), a special safeguard mechanism for developing countries, and additional tariffs on imports which are subsidised in the country of origin. The establishment of effective safeguard measures is especially important since at present there is not a single protection instrument in the WTO

which allows all developing countries to effectively protect their agricultural sectors and their small farmers.

Additionaly the so called Marrakesh Decision has to be implemented. It provides for compensation for adverse impacts of trade liberalisation on LDCs and net food importing developing countries (NFIDCs). It's implementation is overdue since 1995.

Improved Market Access in developed countries

With regard to agricultural products, the question of market access and tariff reduction cannot be addressed in isolation. Apart from the fact that tariffs are the only means of protection for developing countries, tariffs are also an important source of government revenue. Reducing tariffs therefore means to restrict states possibility to support the social, environmental and economic development of their country.

Tariff levels should be determined by the need to protect certain vulnerable groups or certain staple foods,

In terms of improved market access for developing countries there are two important development issues to be tackled: tariff escalationa and preferential trade agreements. Tariff escalation continues to hamper diversification into higher–value added production in the developing countries. Therefore the unilateral reduction of tariff escalation on the part of the developed countries is particularly important in order to provide an impetus to development processes in the developing countries.

Preferential trade agreements, or the danger of 'preference erosion', also play an important role in the WTO tariff negotiations, in view of the looming general liberalisation. The G-90 in particular—a group comprising African, Caribbean, Pacific (ACP) countries, LDCs, and the African Union—calls for the consideration of their interests in this regard. The general advantage of preferential trade agreements is that those countries which are economically least developed and most affected by hunger and poverty, in particular, can be given preferential market access. Their possible continuation for development reasons should be inscribed in the WTO.

Enhance food security support possibilities

By now there is only one provision in the AoA, that is linked to food security, Art. 6.2. It provides for the support of "low income and resource poor farmers" and represents an exemption from the AMS. There have been calls to enhance the provisions under Art. 6.2. and to introduce a new category "poverty alleviation, food security, rural development etc." in the Green Box. These calls have been neglected so far, despite the fact that they do not "cost" the developed countries anything. Apart from the weak provisions on longer implementation periods and lower reduction coefficients, with which the EU and the USA think they have already largely fulfilled their obligations in terms of SND, the only other aspect mentioned up to now is the continued access to the provisions under Article 6.2.

Agriculture prices

Between 1997 and 2001 the price for coffee fell by 66 per cent, rice by 43 per cent, cotton by 39 per cent, cocoa by 30 per cent, sugar by 24 per cent, and wheat by 20 per cent.15 The fall in farm prices on the world market in conjunction with agricultural trade liberalisation threatens the incomes of small farmers for several reasons. First, cheaper imports threaten to substitute food that is produced by local farmers. Second, the domestic retail prices for their produce are pushed downwards. Low prices do not only effect small farmer incomes but they also have a negative impact on future food production, since the necessary incentives for the maintenance of production levels are no longer available.. A fundamental reason for the price collapse is the oversupply on the world market. Kenya, Uganda and Tanzania issued a non-paper into the WTO negotiations on 19 May 2003 on the commidity issue. It needs to be given due attention.

Export competition

In the 'export competition' section the AoA deals with 'export subsidies'. Despite the fact that export subsidies are recognised as being trade-distorting and are generally not permitted in the WTO, the WTO Agreement on Subsidies exempts the agricultural sector. Therefore, agricultural export subsidies are permitted unless the WTO AoA rules otherwise. 25 WTO member countries are currently allowed to continue to provide export subsidies for those agricultural products for which they have also entered into reduction commitments for agricultural export subsidies; other countries are not allowed to provide export subsidies. Amongst the 25 members are a mere 8 developing countries.

Issues at stake in export competition Currently the EU accounts for about 90 per cent of export subsidies granted by OECD countries.31 The EU is therefore the most significant user of export subsidies. With the 'temporary' permission for their continued use contained in the AoA the WTO allows for dumping rather than prohibiting. Export subsidies allow trading companies to place products from the developed countries on the developing country markets at prices that are below the production cost in the country of origin, to undercut prices for local agricultural products and thus to destroy domestic markets for small farmers. The existence of export subsidies is a scandal, in development policy terms, and their abolition is long overdue. They should expire within 3 years. The use of the food aid instrument for the purposes of eliminating domestic surplus production, as practiced by the US in particular, is no less harmful for the markets in the South. It must be disciplined in such a way that its sole use for the purpose of disaster relief can be ensured and that it is provided in the

form of grants. The provision of government-subsidised export credits is equally controversial. These provisions have a market-distorting effect when the terms for government or state-subsidised export credits are more favourable than those available on the market, making the product effectively cheaper for the importing country than a purchase financed under normal market terms. The effect is comparable to an export subsidy. The subsidy element must be eliminated and there must be appropriate disciplines to avoid the misuse of export credits.

Finally, in addition to food aid and subsidised export credits, state trading enterprisesunder the 'export competition' heading are also being discussed in the ongoing agriculture negotiations. Although state trading enterprises are generally in a position to take advantage of their monopoly and to circumvent WTO commitments, their importance in terms of guaranteeing marketing structures and stable prices, especially in the developing countries, must be adequately considered. However, the very existence of state trading enterprises in the North is not necessarily problematic. But it would be helpful to have more transparency so as to identify and tackle possible misuse.

Subsidizing Agriculture Production

In WTO terminology, subsidies in general are identified by 'boxes' which are given the colours of traffic lights: green (permitted), amber (slow down—i.e. be reduced), red (forbidden). In agriculture, things are more complicated. The AoA has no red box but there is a blue box for subsidies that are tied to programmes that limit production. The green box subsidies must not distort trade, or at most cause minimal distortion. They have to be government-funded and must not involve price support.

The discussions on the use of the blue box and the green box on the part of the developed countries and the resulting dumping and trade-distortion are politically much more controversial. The key element in the domestic support discussions is the blue box. At present it appears that the blue box will be preserved, opinions vary however, especially with regard to reductions in blue box payments starting from the established ceiling.

There are also discussions on further criteria to help distinguish the blue box from the amber box and to invalidate the argument on 'box-shifting'. It would be more useful, however, if the amber and blue boxes were combined under the category of 'trade distorting support' with the green box being maintained under the category of 'nontrade-distorting support' as was proposed by the developing countries. Moreover, the *de minimis* provision for developed countries should be abolished. The addition of measures to the green box to include subsidies paid with a view to meeting animal welfare requirements, as called for by the EU, is currently getting little attention. These discussions may be revoked in the post-framework phase.

Concluding observations

Agriculture is a question of livelihoods (North and South), of food security, and also of rural cultures, landscape management, the colourful diversity of regional foods and the sustainability of production. The outcome of the WTO Agriculture Negotiations will have a major impact on

> The fall in farm prices on the world market in conjunction with agricultural trade liberalisation threatens the incomes of small farmers

the future direction of developments in these areas.

In the agricultural arena the “Development Round” must mean more than the mere establishment of SP and SSM. The Agreement on Agriculture must ensure that developing countries will generally be given the opportunity to protect their small farmers for reasons of food security. This requires additional safeguard measures such as quantitative restrictions, retrospective tariff increases etc. Also the scope for the financing of food security and rural development programmes should be enhanced in the AoA.

Tariff reductions do not only threaten food security in developing countries and the livelihood of small farmers but they also limit governments’ ability to act as these loose the very important revenue from tariffs from their national budgets. Necessary investments into education, health, infrastructure, advisory services etc. are increasingly threatened by cut-backs. Furthermore, the already visible increase in net food imports will lead to balance of payments problems which harbour a further risk of indebtedness.

Marita Wiggerthale is working as a consultant in the field of agriculture trade and food security. For further information see her homepage www.marita-wiggerthale.de.

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Agricultural Biotechnology and the Millennium Development Goals: Revisiting the Role of Intellectual Property

Marion Motari, UNU *Maastricht*

Abstract

In September 2000, the member states of the United Nations unanimously adopted the Millennium Declaration. The Millennium Development Goals (MDGs) are recognized as part of the ways through the Millennium Declaration can be implemented. The first goal among the MDGs is to eradicate poverty and hunger and aims at halving the proportion of the people who suffer from hunger within the period of 1990-2015. Agricultural biotechnology could potentially play a vital role in eradicating hunger by increasing agricultural productivity, improving nutrition, increasing farm yields, facilitating conservation farming by providing soil management tools and the preservation of ecosystems. Biotechnology in this paper is perceived to include a wide range of diverse techniques such as gene modification and gene transfer, use of molecular markers and the use of *in vitro* vegetative propagation in plants.

Most research tools and processes used in agricultural biotechnology tend to be proprietary and held as intellectual property (IP) by big corporations, such as Monsanto and Aventis among others, usually based in developed countries, who seek this protection a result of their massive investments in biotechnology R&D. Developing countries, notably those in Sub-Saharan Africa (SSA), rely on public research institutions and nonprofit organizations for biotechnological innovations in crops essential for food security. Due to the proprietary nature of biotechnology tools, research institutions in developing countries may increasingly find it difficult to access this rapidly evolving technology. As a result, it remains a challenge for SSA countries to find ways and means through which biotechnology innovations can be accessed and transferred to farmers. This paper is particularly concerned with analyzing the role of intellectual property rights (IPRs) in facilitating or hindering access to biotechnology tools in SSA countries.

Introduction

IPRs have gained prominence in the post industrial age, where the manufacture and manipulation of goods has given way to the production of knowledge and the application of this knowledge in the production of goods and services (innovation). In the knowledge economy IPRs have assumed various roles. At their inception, IPRs were created with the purpose of acting as incentives for innovative behavior and at the same time help diffuse knowledge an assertion that remains debatable (Gold *et. al* 2004; David, P. 1993). Increasingly intellectual property protection is also sought by firms as a source of competitive edge in the marketplace (Mansfield, 1990), as a mechanism for market protection (Davis, 2004) and as a bargaining currency by firms to prevent being locked-out from using technology that is owned and held by competitors (Kingston, 2001).

IPRs are also used as a tool for ensuring equitable and fair utilization of genetic resources and also as a tool for the promotion of the conservation of biological diversity and the sustainable use of their components. The impetus towards an increased need for IP protection particularly in agriculture has been driven by 3 main synergistic forces, namely:

- The globalization of agriculture
- The changing nature of "innovation" which has seen an increase in the level of investment in R&D and in capacity building for optimal exploitation of biotechnology and the developments in the technology which have increased the potential value of genetic resources and the ability to extract those values.

The effects on international frameworks such as the Agreement on Trade Related Aspects of Intellectual Property (TRIPS) and the Convention on Biological Diversity (CBD) which become imperatives for national implementation.

Intellectual property (IP) is intricately related to trade, competition, industrial growth and economic development. The creation of the World Trade Organization (WTO) in 1995 and the consequent adoption of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) have generated new challenges for Sub-Saharan African (SSA) countries, particularly as far as IP is concerned. Developing countries are now faced with the task of formulating policies and laws relating to IPR, which includes considerations of pertinent issues such as the patentability of living organisms/material.

The TRIPS agreement is the most over-arching international instrument on the regulation and protection of all types of intellectual property. The agreement sets minimum standards which all countries signatory to the WTO must comply. This therefore means that SSA countries are faced with the obligation of complying with the agreement and formulating their laws and policies in line with the provisions of the Agreement. Developing countries may however benefit from the transition period before TRIPS comes into full effect. For example, with the exception of the national treatment requirement and the most favored nation (MFN) requirement, all TRIPS disciplines come into effect in January 2006 and the requirement for patent protection for pharmaceutical and agri-

cultural chemical products will come into effect in January 2016.

The IP debate has assumed an increasingly significant role in the global arena. This has been occasioned by the emergence of new technologies that are referred to as cross-cutting technologies such as the information and communication technologies (ICT) and biotechnology. The introduction and use of these technologies has revolutionized the application of knowledge, which in most cases is proprietary in fields affecting basic human needs such as health and agriculture. It has been argued that property rights extended to these technologies will increase the costs of accessing these technologies and consequently increase the technological divide between developed and developing countries.

Conceptualizing Intellectual Property Rights for Agricultural Biotechnology

Generally, IPRs are established to perform two functions namely to create incentives for innovative behavior and to help diffuse knowledge. It is presupposed that the monopoly power created by competition, which in turn improves the appropriability of knowledge through IPRs is what acts as incentive to invent and innovate. The trade off between the incentive to innovate and monopoly power lies in the non-rival nature of knowledge (Romer, 1990) as an economic asset and the cheap transmission costs of information (Arrow, 1962).

Article 7 of the TRIPS Agreement states that the objective of IPR is to,

> "...contribute to the promotion of technological and to the transfer and dissemination of technological knowledge in a manner conducive to social and economic welfare, and a balance of rights and obligations."

IPRs make it possible for innovative firms to appropriate the benefits of their innovative activity and are thus commonly viewed as stimuli for invention and innovation. However they are not the only appropriation method available to firms, other methods such as lead-time advantages and technological complexity can be used. It therefore becomes a policy question to ensure that an innovation system adopts an optimal IPR regime. An optimal IPR regime would be one that achieves both goals of encouraging innovative activity and at the same facilitate knowledge diffusion without breeding an unhealthy monopoly that interferes with the diffusion of new knowledge and innovations.

With respect to agriculture there exist two main IPR mechanisms, namely patents and plant variety protection through plant breeders' rights (PBRs). Both patents and PBRs provide the owners with certain exclusive rights as discussed herein.

A patent is generally considered the most powerful tool in the IP system, providing patent holders a monopoly of limited duration (usually 20 years) and excludes all others from making, using, selling, or offering to sell the invention in the country that granted the patent right, or importing into its market. To be patentable, the subject matter must satisfy the criteria of novelty, must constitute a non-obvious improvement to previous inventions, and must have an industrial application. In exchange for their exclusive market rights, patent holders are required to fully disclose their inventions in a manner sufficiently clear and complete for the invention to be reproduced by another person skilled in the art. Patent laws may provide a research exemption clause which allows others to study the protected subject matter without reproducing it for profit.

The international legal framework governing the protection of plant breeders' rights (plant variety protection) is the International Union for the Protection of New Variety of Plants (UPOV) Convention. PBRs are a form of intellectual property protection granted by governments to plant breeders to exclude others from producing or commercializing material of a specific plant variety for a specified period (normally 20 years.) While countries differ in how they implement PBRs, the law usually grants protection to varieties that are novel, distinct, uniform and stable. The holder of a plant breeder's right has a legal monopoly over commercialization of that variety over a prescribed length of time. Under UPOV (1991), the use of material of a protected variety for creating new varieties, and the commercial exploitation of these new varieties is to an extent free. This is under the breeders' exemption clause, which is the core principle of the PBR system. However, under UPOV (1991) this is not automatic as it must be provided for explicitly in national legislation and must be qualified. Of the two IP institutions, patents provide stronger exclusive rights.

As the biotechnological revolution unfolds, copyrights are becoming important in agriculture biotechnology because of the databases that hold information about plant genes can often be copyrighted, provided they contain a creative element. Trademarks are used for the protection of brand names such as Monsanto's Roundup Ready™ technology, or Aventis's Liberty® and LibertyLink® technologies. Trademarks though only protect the names and symbols denoting products or technologies, not the technologies themselves. Other forms of "indirect" legal protection may be through contractual provisions used to extend or establish IPRs to 3rd parties. These include material transfer agreements between technology developers and 3rd parties, bag label contracts between the manufacturer and the buyer of seed, technology use agreements and licenses. Another channel through which innovators impose technical limits on farmers is by using genetic restriction technologies (terminator technologies), which confer sterility on replanted seeds. It is noteworthy to mention that terminator technology is not an IPR mechanism as such but is in effect a technical circumvention of the IPR system in that it dos away with the rights and ability of states to regulate it. The section

below discusses in detail the effects of these types of IPR on agricultural development in SSA countries.

The Patent and Agricultural Biotechnology Debate

Over the past few decades IP protection has gained prominence since they are viewed as tools through which countries can attain industrial and technological development. There has also been a shift in the locus of research activities globally from lone inventors to organized in-house R&D facilities (Freeman, 1982). The shift to organized in house R&D has led to a change in the nature and costs of innovations in firms and consequently has brought into focus the reasons as to why IPRs are sought by innovative firms.

IPRs have now become a means through which biotechnology firms can safeguard returns on R&D investments. There exists paucity of literature on the effects of IPR and their relationship to welfare and development. Indeed it has been argued that the knowledge of the scope, standards and effectiveness of IPR in developing countries is seriously inadequate (Gold et al. 2004; Fink & Maskus, 2005) and that patent protection may not necessarily work in the same way it does in developed countries (assuming that IPRs still function as incentive to invent and innovate). This is because developing countries might not afford the cost of absorbing this knowledge e.g. investing in developing the necessary human capital (UNCTAD-ICTSD, 2003). In addition, developing countries experience IPRs as a development cost and barrier to global markets (Correa, 2000) because patents are increasingly used as a means for consolidating restrictive trade monopolies, a restrictive function, which extends far beyond the exploitation of the patented inventions (Drahos with Braithwaite, 2002).

It is within this backdrop that SSA countries should conceptualize the role of IP and particularly patents in biotechnology innovations and understand that patent protection does not necessarily serve the role of encouraging inventive and innovative behavior in developing countries. It is argued that patent protection of biotechnological innovations may have the adverse effect on SSA countries of hindering biotechnological research, affecting agricultural trade and disenfranchising poor small scale farmers who depend on agriculture as a source of livelihood by restricting easy and cheap access to biotechnology products.

Following the landmark case of Diamond v. Chakrabarty in 1980 where it was held that the patent on genetically engineered bacteria capable of cleaning oil spills was valid, patenting for biological inventions, particularly those for genetically engineered plants and animals as well as for individual genes with specific utilities, has increased. Most enabling technologies (research tools) used in the production of agricultural biotechnology end-products such as promoter gene techniques and marker gene techniques are under patent protection. As such it has been argued that intellectual property protection affects the free use of biotechnology research tools. However the golden rice case is exemplary in showing that most times research may not necessarily be hindered as much as development and commercialization of products. The development of this rice variety was slowed down by a complex tangle of close to 70 patents owned by some 32 companies. Because of the complexity of license agreements the inventors ceded their rights to Greenovation, a biotechnology university spin-off company, which struck a deal with AstraZeneca. AstraZeneca waived technological fees to enable the development of the rice for humanitarian purposes. Monsanto followed suit in waiving its technological fees. The deal gives AstraZeneca "…full commercial rights to the invention worldwide and "non-commercial" rights to the inventors for license free use by national and international research institutions and resource poor farmers in developing countries."

There is an emerging consensus that innovations are characterized by a cumulative nature. This means therefore that while some innovations are radical, others are incremental. Incremental innovations build upon previous innovations, thus in the case of agricultural biotechnology this means that most modern methods used to develop new crop varieties depend on a wide range of component innovations, the rights of which might be held by many competing parties (IP owners or others such as licensees). The number of separate rights needed to produce a new innovation will only escalate as biotechnology patents become more prevalent. It becomes even more complicated if the ownership of these rights is diffuse and uncertain, it can be difficult or impossible for potential users to successfully negotiate with all the relevant parties (Heller & Eisenberg, 1998).

Patent protection affects agricultural trade if crop breeders produce crop varieties that cannot then be legally exported to countries where the tools and processes used in developing the crop varieties fall under IP protection (Pardey *et al*. 2000). This essentially locks out developing countries from accessing global markets and thus seriously impacting their agricultural industries. This is of particular concern to those countries whose economies are heavily dependent on agriculture and horticultural produce.

UPOV, Plant Breeders' Rights and Appropriate Frameworks for Protecting Agricultural Innovations

The UPOV Convention came into effect in 1961 but has since undergone various amendments in 1971, 1978 and 1991, which amendments have progressively strengthened the protection afforded to plant breeders. Under the TRIPS Agreement the adoption of UPOV by WTO member countries is not compulsory. TRIPS only requires members to protect new plant varieties by either of 3 means: patents, an effective *sui generis* system or a combination thereof. A *sui generis* system means "of its own kind." Therefore countries can design and implement plant variety protection laws by themselves according to their national interests and local realities, which in practical terms means protecting both the breeders' and farmers' rights. However the word effective is ambiguous. Developed countries tend to refer to UPOV as the only effective *sui generis* model for PVP.

There are some developmental problems embedded within the provisions of UPOV that need to be discussed in the view of developing country goals. UPOV convention restricts the very form of livelihoods of farmers in developing countries by restricting the saving, exchanging, reusing and reselling seeds. UPOV revisions have progressively strengthened the protection afforded to plant breeders. For example under the 1978 UPOV provisions under the *farmers privilege* clause farmers were not allowed to sell seeds obtained from protected varieties however, there was no bar on them to store these seeds for cultivation, replant them and develop new plants from them.

This provision changed under UPOV 1991. The 1991 Convention provides the highest possible level of protection to breeders severely diluting farmers' privileges and restricting the farmers' right to save, reuse and exchange and sell seeds. Under Article 15.2 of the 1991 UPOV Convention farmers are only allowed to reuse protected material only if the "legitimate interests of the breeders are taken care of". This limits the ambit within which farmers can operate and requires as of necessity that farmers pay royalties to breeders before they can use the protected material. Under UPOV 1991 farmers are permitted the use of the protected varieties only with respect to acts done, privately and for non-commercial purposes; for experimental purposes and for the purposes of breeding varieties other than those which are "essentially derived varieties". *Vide* Article 15.2 of UPOV 1991 this includes saving of seeds and the re-use of seeds by farmers on their own holdings. This exemption is only optional under UPOV 1991 and must be specifically be provided for in the national legislation, unlike under UPOV 1978 where it was mandatory.

Developing countries do not have big seed companies therefore the application of UPOV provisions do not work in a beneficial way as they would work in a developed country. In developing countries almost all of agricultural research and plant breeding activities are financed by taxpayer's money. Public institutions play a big role and as such the knowledge produced here has public good characteristics. Logically then laws in developing countries should be tailored towards protecting farmers more than breeders.

In developing countries farmers play a significant role as breeders of new varieties of plants. They often are the custodians of tacit knowledge on how to breed successful varieties by crossing and selection from their fields. These varieties are then in most cases taken up by agricultural research stations as breeding materials for producing other varieties. Such farmers/breeders would not be able to participate in an expensive system like UPOV. The UPOV system works well in rich economies where farmers do not also play the role of breeding plant varieties. In developed countries this is mainly done by big multinational companies. Developing countries therefore need to develop appropriate frameworks under the *sui generis* provision for adequately protecting both farmers' and breeders' rights and as such should invest in training lawyers who can develop effective *sui generis* systems. For example the Namibian government has introduced a *sui generis* legislation.

The Namibian legislation was based on the Organization for African Unity (OAU now AU) African Model Law for the Protection of the Rights and Local Communities, Farmers and Breeders, and for the Regulation of Access to Biological Resources. The Access to Biological Resources and Associated Traditional Knowledge (ABTRACK) Act provides for the grant of farmers' rights and plant breeders' rights while recognizing the rights of the local communities over their biological resources and associated knowledge, innovations and practices.

Proposal for Way Forward

Developing countries have traditionally relied on public sector institutions and their collaboration with the international agricultural research system, notably the Consultative Group on International Agricultural Research (CGIAR), to provide inputs necessary for agricultural growth. As such, agricultural innovation is viewed as a public good. With the enforcing of stronger IPRs as promulgated by the TRIPS Agreement, SSA countries need to identify other policy mechanisms through which learning and national capabilities to engage in advanced agricultural research can be achieved. This paper proposes that following ways in which SSA countries can work to overcome the challenges confronting them as a result of strengthened IPRs,

- Through the creation of agricultural innovation systems.
- Through the formation of effective partnerships between the public and private sectors in agricultural research
- Developing negotiation strategies for exemption for the poor and grant of access.
- Increased investment in R&D and in developing scientific skills

1. The Creation of Agricultural Innovation Systems

The innovation system concept enables us to understand the evolutionary and systemic way through which learning and innovation can take place through the creation of ca-

The table below summarizes the main differences between the patent protection under TRIPS and the UPOV Conventions (1978 & 1991).

Provisions	UPOV 1978	UPOV 1991	Patents under TRIPS
Subject matter	Plant varieties of nationally defined species	Plant varieties of all genera and species	Inventions
Requirements	Distinctions Uniformity Stability	Novelty Distinctness Uniformity Stability	Novelty Non-obviousness Utility
Length	Minimum 15 years	Minimum 20 years	Up to 20 years.
Scope	Commercial use of reproductive material of the variety	Commercial use of all the material of the variety	Commercial use of the protected subject matter
Breeders' exemption	Yes	Not for essentially derived varieties	No
Farmers' Privilege	Yes	Have to be articulated by national PVP laws	No

pacities and capabilities of actors in an innovation system. This approach provides a much broader way than that provided by a focus on IPRs since it helps us identify the types of actors in biotechnology research and the types of interactions (by nature and intensity) needed for knowledge transfer between producers and users. This concept also enables us identify and design the institutions and policies which create and shape the patterns of interactions and linkages required for innovation.

An agricultural policy that embraces the innovation systems framework (Freeman, 1987; Lundvall 1992; Lundvall *et. al*. 2002, Hall *et. al.* 2004) moves beyond the traditional view of agricultural systems and brings to the fore the realization that innovation is becoming central to the ability of farmers, agro-enterprises and countries to cope, exploit and compete in rapid evolving technical and economic conditions. In the agricultural sector there has been a long tradition of development assistance investments in public research systems. Yet there is growing recognition that while public agricultural research is necessary, on its own it is not sufficient to create a dynamic innovation capacity. Fresh direction, however, is coming from recent insights that recognize that the innovation process involves not only research but also a wide range of other activities, actors and relationships associated with the creation and transmission of knowledge and its productive use (Mytelka, 2000).

As a framework for applying these insights the concept of an innovation system is emerging as a potentially valuable tool to help rethink the role of IPRs in agricultural biotechnology and at the same time the role of biotechnology in agricultural systems. The reason for rethinking the role of biotechnology in agricultural systems follows from the argument that biotechnology in itself is not necessarily the panacea to the challenge of eradicating hunger and poverty in SSA. Strengthening or optimizing existing practices or technologies could in some cases achieve the desired results.

2. Formation of effective partnerships between the public and private sectors

Sub-Saharan African countries need to put in place institutional arrangements that facilitate effective partnerships between the public and private sectors in agricultural research. These types of partnerships can enable the sharing of expertise through linking various knowledge stocks in the different sectors, along with allowing knowledge flows which necessitate product and process innovation in agriculture. The CGIAR is a leading example in striving to enforce partnerships with multinational firms and with national research centres in developing countries.

Strategic partnerships may be formed with either competitors or with complementing partners. It is proposed that in the case of such partnerships IP management should be dealt with both at the institutional level and then at the partnership level (Krattiger, 2002). These dual levels of IP management provide a channel through which IP ownership is clearly negotiated by the partners and ensures that all actors from different sectors (private and public) reach their respective goals. Such IP management office often also known as technology transfer office facilitates the joint development of agricultural innovations through R&D and capacity transfer by building on the comparative advantage residing with the partners. This may be in the form of collaborative research agreements, material exchange agreements and license agreements.

3. Developing Negotiation Strategies for Exemption for the Poor and Market Segments

Another approach through which SSA countries can circumvent the IP quagmire would be through working with the holders of IP to allow for the exploitation of their inventions in areas it does not pose a challenge to their markets. A good example where such a strategy has been applied is the transgenic sweet potato (Wambugu, 1996). This virus-resistant sweet potato was developed by Monsanto, who came into agreement with the Kenya Agricultural Research Institute (KARI) to allow unrestricted use by small scale farmers in Central Kenya.

4. Increased Investment in R&D and in Developing Scientific Skills

SSA countries need to take proactive steps towards strengthening national public R&D and scientific capacity. Developing scientific capacity implies the human capacity to assess, regulate, absorb and modify the technology. Scientific capacity in developing countries is necessary to enable them tap into the available knowledge and consequently product development. This can be done if facilitated through government policies. Governments can develop coherent national biotechnology policies, which specify various funding opportunities and at the same provide incentives for R&D (mostly tax incentives).

Endnotes

See Generally Penrose, E. T. (1951) "The Economics of the International Patent System" The John Hopkins Press.

TRIPS Agreement constitutes Annex 2C to the Marrakech Agreement establishing the World Trade Organization (The WTO Agreement)

The CBD was adopted at the 1992 Rio Earth Summit as a framework for promoting sustainable development. The Convention establishes 3 main goals namely; the conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits from the use of genetic resources.

National treatment under GATT Article 3 requires that members of the WTO must not accord discriminatory treatment between imports and like domestic products with the exception of the imposition of tariffs.

The most-favored-nation-treatment (MFN) requires contracting parties to accord the most favorable tariff and regulatory treatment given to the product of any one contracting party at the time of import or export to "like products" of all other contracting parties, is one of the bedrock principles of the WTO. If a country gives most-favored-nation treatment to one country regarding a particular issue, it must handle all other countries equally regarding the same issue.

This presumption is based on the neo-Schumpeterian economics of innovation

According to Article 27.3(b) of the TRIPS Agreement, WTO members can exclude plants and animals from patentability but "...shall provide for the protection of plant varieties by either patent or by an effective *sui generis* system or any combination thereof." (the protection of plant varieties under UPOV is an example of a *sui-generis* method) or through a combination of both systems.

Other forms of intellectual property rights include trademarks, trade secrets, utility models, designs, geographical indications , copyrights among others

447 U.S. 303 (1980): In this case it was decided that the creation of a bacterium that is not found anywhere in nature constitutes a patentable "manufacture" or "composition of matter." Moreover it was argued that the bacterium's ability to break down crude oil makes it "very useful".

Promoter genes control or modify the action of other genes

Marker genes when discovered in an organism facilitate the identification of an associated trait that is otherwise not detectable

The brief facts about Golden Rice are as follows: It was invented in 1999 by Dr. Ingo Potrykus and Dr. Peter Beyer. This rice contains beta-carotene which is a precursor for vitamin A produced by introducing 2 genes from daffodil and one gene from bacterium into a japonica rice variety (Taipei 309).

UPOV 1991 defines an "essentially derived variety" as a variety predominantly derived from another (initial) variety which retains the expression of the essential characteristics from the genotype or combination of genotypes of the initial variety.

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In focus: Selected biotechnology alternatives

Using conventional breeding to meet consumer needs: The Case of Syngenta's Fruits and Vegetables.

Tailoring products to meet consumer needs is the business of the food industry. Take watermelon as an example; purchase of a large watermelon by a small family presents major challenges. It's too heavy, cannot be eaten at one sitting and the remainder has to be stored in the fridge or trashed into the bin (more like trashing your money). Navigating around seeds during breakfast is not really interesting and the thick tasteless white back is not edible either.

Syngenta, a major agribusiness company, has produced a variety of fruits and vegetables produced using conventional breeding to develop designer products. It has produced a miniature seedless watermelon that is consistently sweet, uniquely small, about the size of a cantaloupe, and has a very thin rind. Other crops, such as tomatoes, have also been bred and selected based on outstanding shape, colour, taste and size. And consumers are spending slightly more to buy these products.

It is reasonable to argue that, as new technologies come along, some of the older technologies become more efficient and useful than before. African countries invested significant resources in breeding institutions and programs. The advance in fields such as genomics and informatics open up new avenues to develop products that meet their consumer needs. Tools such as genome maps and genetic markers could be very useful in accelerating breeding programs.

Such efforts could also be useful in building up capacity to move up the technological value chain and create familiarity with biotechnology development and management. If Africa is concerned about protecting its market and opening up new ones, it has to adopt new technologies to provide domestic and international markets with the products they need. Currently, Africa accounts for only 3% of the global agricultural exports even if the continent is largely rural and depends on agriculture.

African experiences with biofertilizers and biopesticides.

Nitrogen supply is a key limiting ingredient in crop production in many African countries. Biological nitrogen fixation (BNF) by microbes could be harnessed to improve soil fertility. Biofertilizers also include microorganisms that solubilize phosphorous and make it available to plants. Nitrogen fixing microorganisms include *Azospirillum, Azotobacter, Rhizobium, Sesbania*, Algae and *Mycorrhizae* while phosphorous solubilizing organisms include *P. striata*, and *B. megaterium* and *Aspergillus* among others.

Biofertilisers have been used in Kenya, Tanzania, Zambia and Zimbabwe, among others. The technology needed to produce biofertilizers is not complex. In some countries, the demand has often outstripped production of the pilot plants and yields increased. Expansion of these pilot plants could help improve food productivity in Africa.

The use of biopesticides in the control of pests is well established in Africa. For example, sterile tsetse flies (the vector of sleeping sickness) were used to control and eliminate the tsetse fly population on the Island of Zanzibar. Similarly, the cassava mealybug, *Phenacoccus manihoti*, was effectively controlled using a wasp, *Apoanagyrus lopezi*, from Latin America. Nematodes, bacteria, fungi and viruses may be used to control industrial, home and farm pests. The market is driven by consumer, retail and government demands for reduction in use of chemical fertilizers and pesticides. The limiting factors include lack of spectrum (few targets), slow killing rate, batch variations, high sensitivity (to soil types, chemicals, temperature and moisture content) and low stability (short shelf-life and high storage needs).