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# Economic Aspects of GM Beet and Cane

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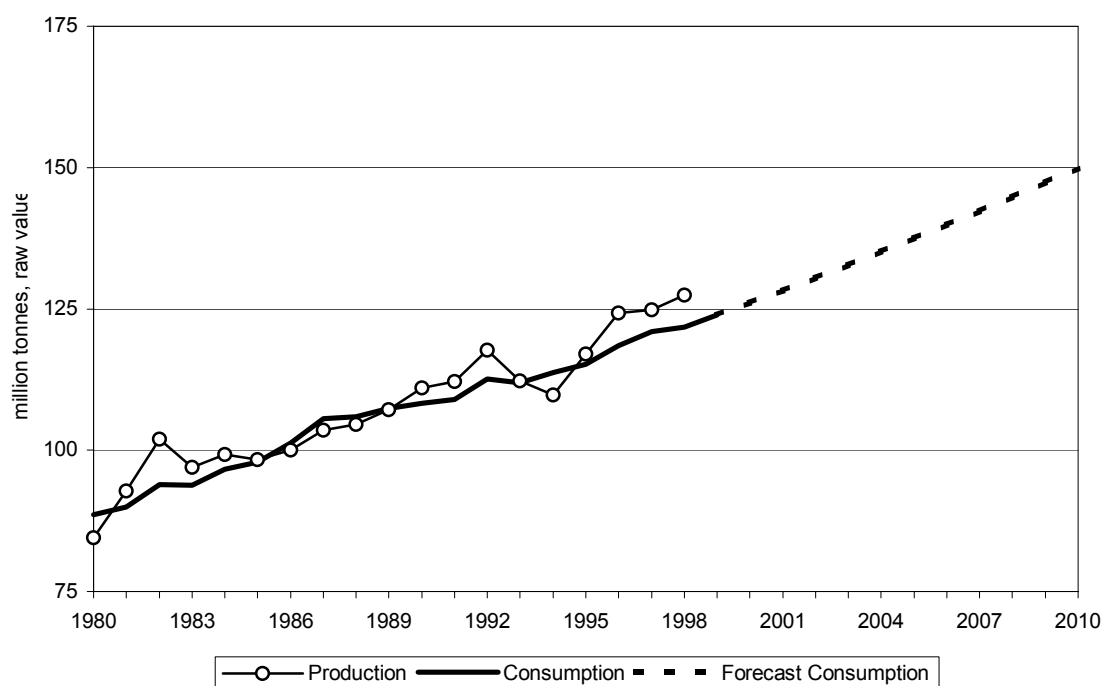
## THE GLOBAL CONTEXT

Biotechnology has been hailed as a means to create a second Green Revolution in agriculture. In the case of sugar, I would like to begin by examining the challenges that the future holds for the world's cane and beet sugar industries, to assess the extent to which such a revolution is required.

At present, cane sugar accounts for around 70% of global sugar production, with beet sugar accounting for 30% of global output. On average, global sugar production and consumption have risen at an annual rate of 1.7% since 1980.

If we project this rate of growth into the future, the implication is that by 2010, a mere 11 years away, global consumption will have risen from its present level of around 124 million tonnes, raw value, to around 150 million tonnes, raw value (Diagram 1).

Diagram 1: Trend in World Production and Consumption



Where is this extra 25 million tonnes of sugar, equivalent to an increase of 20% in global output from today's level, going to come from?

If we examine the way in which the world's beet and cane sectors have expanded output since 1980, a stark difference emerges: the driving force behind the expansion of world cane sugar production since 1980 has been increases in cane area. By

contrast, the key influence on the more modest expansion of world beet sugar production over the same period has been sugar yield.

Table 1 indicates that, on average, world beet sugar production has risen by around 0.7% since 1980. However, this has only been achieved because while world beet area has declined over this period (largely as a result of the contraction of the beet sector in the Former Soviet Union) by around 0.8% a year, average beet sugar yields have risen at a rate of almost 1.5% a year.

In contrast, the 2.7% annual increase in cane sugar production has been the result of strong expansion of cane area, at around 2.0% a year, coupled with a relatively minor increase in cane sugar yields per hectare of around 0.7%

**Table 1: Influences on the Growth of World Sugar Production since 1980**

	Average Annual Growth in Sugar Production (%)	← Influences →		Dominant Influence
		Area (%)	Sugar Yields (%)	
Beet Sugar	0.69	(0.79)	1.48	Sugar Yields
Cane Sugar	2.71	2.00	0.71	Area

Given that cane currently accounts for 70% of global sugar output, the burden of satisfying increasing demand for sugar in the future will fall mostly on the cane sector. Unless the cane sector succeeds in raising cane yields at a greater rate than it has done so to date, the area of land under cane will have to continue to grow at a rapid pace in the future.

Similar projections can be made for a host of other food commodities. This implies that as the supply of available agricultural land dwindles, and more marginal land is put under the plough, there will be an increasing need to focus on raising crop yields. Many scientists believe that biotechnology will be a key factor in addressing this issue, through the development of plants with enhanced production traits and the creation of new plant varieties designed to thrive under specific agroclimatic conditions.

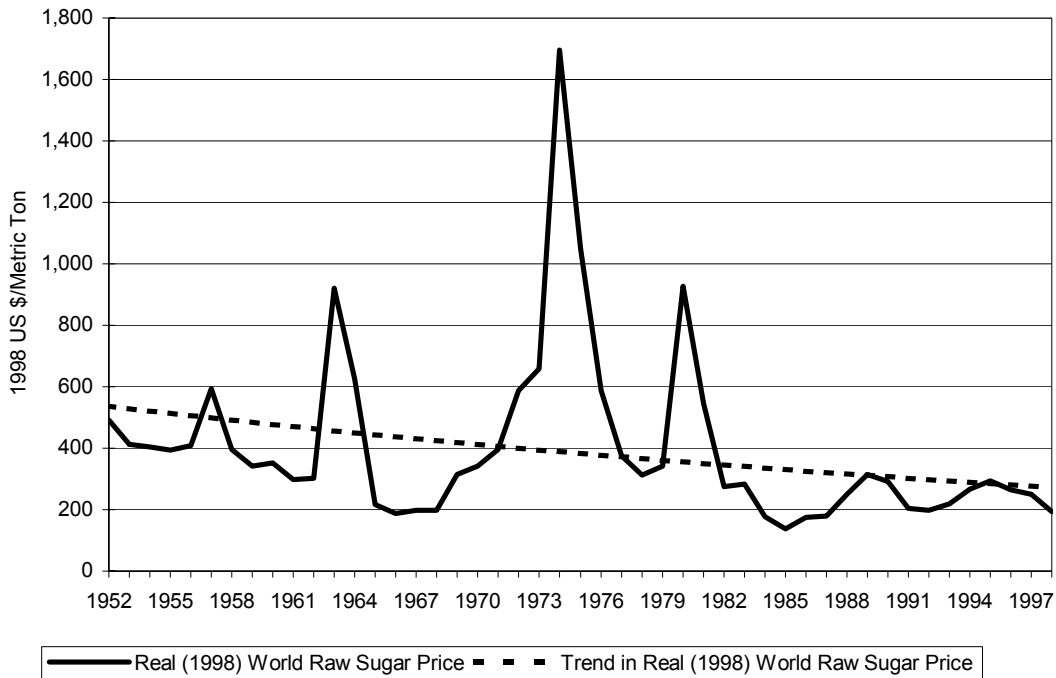
Along with this technical argument, there is a powerful economic rationale for the global sugar industry to take the potential of GM beet and cane seriously.

The slow but steady progress towards greater liberalisation of global trade in agricultural products suggests that any economic benefits to sugar producers arising from biotechnology will be seen as a means of enhancing competitiveness in the future. Diagram 2 indicates that over the last 40 years or so, real (i.e., adjusted for inflation) world sugar prices have fallen, on average, by between 1.5% and 2.0% per year. So far, global average sugar production costs have more or less managed to keep pace with this decline. However, what this implies is that producers are faced with a continual challenge of having to lower their costs if they are to maintain, let alone improve, their competitive position in the international arena.

The constant pressure on producers to reduce costs creates a powerful economic incentive to exploit any cost savings that can be achieved through the use of GM crops.

Biotechnology is expected to make a significant contribution towards meeting the technical and economic challenges outlined here. What progress have the world's beet and cane industries made to date in developing GM crops?

**Diagram 2: Trend in Real World Sugar Prices and Actual Real World Sugar Prices, 1952-1998**



### THE DEVELOPMENT OF GM BEET AND CANE

There is a fundamental difference in the breeding of beet and cane which has significant implications for the commercial development of GM beet and cane varieties.

Beet is an annual crop that must be grown every year from seed. Owing to the widespread use of hybrid seed, farmers cannot grow a crop of beet from seed collected from a previous crop; instead they must buy their seed from seed companies. As a result, a large and lucrative beet seed industry, with considerable resources to spend on research and development, has evolved to meet this need.

In contrast, cane is a perennial crop which farmers can propagate themselves without having to buy seed cane. So, not only do cane farmers replant their cane fields only once every few years, they also do not have to buy seed cane from cane breeders. The ability of farmers to propagate their own cane means that it has proved virtually impossible for any breeder to restrict the use of a newly developed variety to those farmers that buy seed cane directly from them. Not surprisingly, therefore, cane breeding programmes are generally government or industry financed, and tend not to have access to research and development facilities on the scale available to beet breeders.

In the context of development of GM beet and cane, the nature of the plant breeding industries within each sector has meant that companies investing in the development of GM beet can see a ready mechanism for generating returns on their investment through annual purchases of seed by farmers.

However, the difficulty of monitoring the use of a GM variety of cane following its initial release (and hence the difficulty of collecting breeders' royalties or fees) represents a significant impediment to the commercial development of GM cane containing genetic material that is the intellectual property of a private company. Legislation in a number of countries is evolving to cope with intellectual property rights in the context of plant breeding, although not without controversy.

The majority of commercial GM crops are currently produced in North America. The spread of GM crops across the rest of the world is likely to be spearheaded by the adoption of the technology in large commercial operations producing commodity crops. This is because this type of industrial structure provides the best opportunity for recovery of breeders' fees. This in turn suggests that, where intellectual property rights are an issue, cane sugar industries in which ownership of cane is concentrated on estates or on large commercial farms are likely to be among the first to exploit GM cane. Among such industries are Australia, Brazil, Colombia and South Africa, all major exporters of sugar.

As a result of the nature of cane breeding and the problems it raises regarding intellectual property rights, it is generally agreed that the commercial use of GM cane remains two to three years away. In contrast, commercial uptake of GM beet is likely to take place within the next year in the US. What will the introduction of GM beet offer to growers, processors and consumers?

## **GM BEET IN THE US**

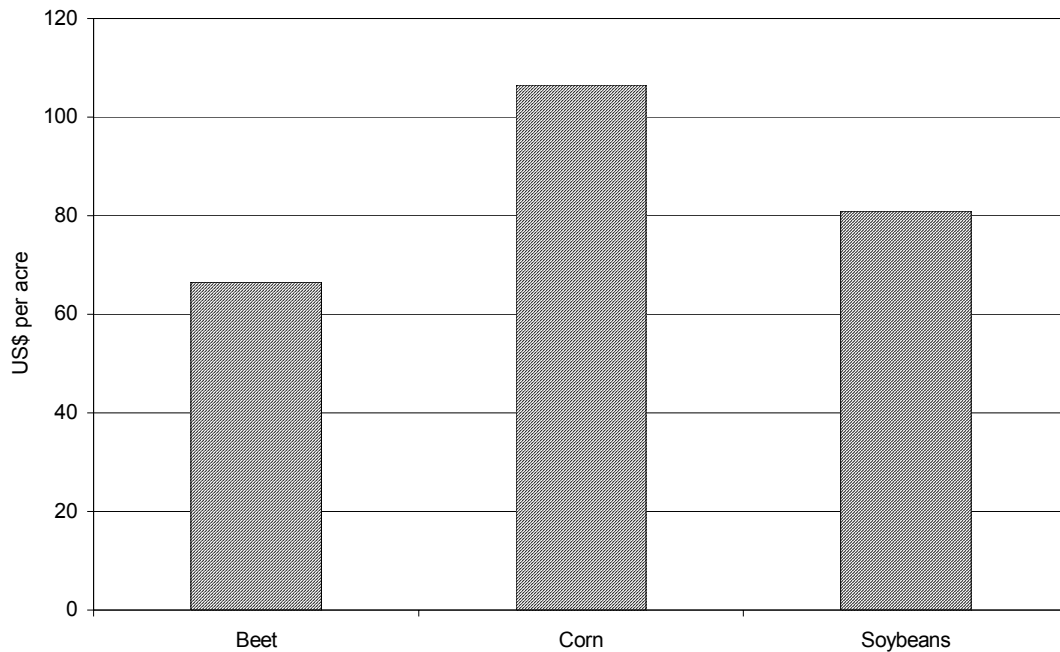
Beet is an annual crop grown in rotation along with a number of other crops. Along with rotational constraints and the spreading of risk, the relative profitability of the range of crops available to a farmer is a key factor influencing the area of land a grower is willing to dedicate to beet.

The relative profitability of sugar crops compared to alternative crops therefore has a key influence on raw material supplies for sugar processors. This means that processors themselves maintain a keen interest in the relative profitability of sugar crops, since their own costs are intimately linked with the level of factory capacity utilisation. In the case of co-operatives, of course, beet growers and processors are one and the same.

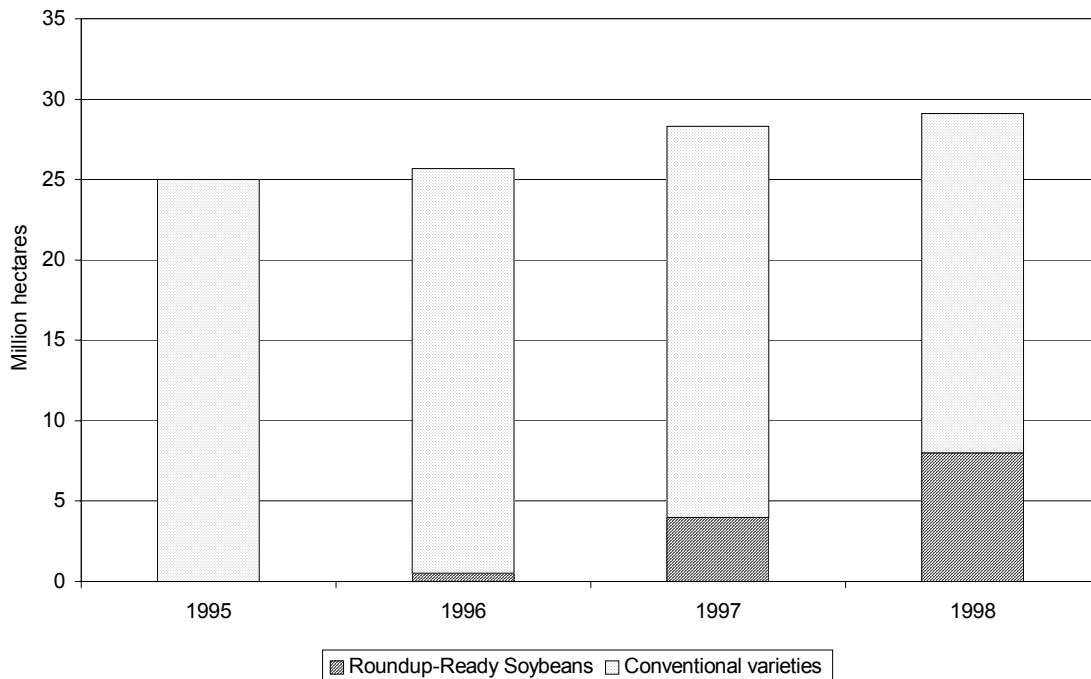
In certain sectors of the US sugar industry, pressure on raw material supplies has been brought about by the competitiveness of alternative crops, notably in California and the Great Lakes region. In the Great Lakes, the profitability of soybeans and corn have often been higher than beet over the past decade, as Diagram 3 indicates.

With the advent of GM soybeans and GM corn into mainstream US agriculture, this competitive pressure is likely to intensify. Despite the additional cost of acquiring seeds, farmers using commercially available GM soybean and corn varieties have enjoyed significant economic benefits, and the uptake of these varieties has been rapid (Diagram 4).

**Diagram 3: Average Gross Margins (excluding Land Rent), Great Lakes Region, 1992/93-1996/97 (US\$ per acre)**



**Diagram 4: Area Under Soybeans in the US, 1995 to 1998**



It is likely that where such competitive pressures exist, the interest in GM beet will be greatest. Trials of herbicide-tolerant beet varieties in the US (and in Europe) have indicated that such varieties have the potential to reduce costs and to increase ease of management while matching or exceeding current average beet yields.

Under these circumstances, the herbicide-tolerant beet varieties that are likely to come onto the US market within the next 12 months are sure to be of interest to at least part of the US beet industry.

For growers, the economic benefits of GM beets are certainly compelling. But consumers' attitudes to the sugar produced from such crops is also crucial in determining the extent to which sugar processors and food industries will countenance the use of GM sugar crops, and this is the next issue I would like to address.

## **GM SUGAR IN THE US AND EUROPE**

In the US, the FDA has officially approved the consumption of sugar and sugar by-products derived from GM beet. Because, in the US, the authorities have said that they see no evidence to suggest that, as a class, GM foods are inherently less safe than foods derived from conventionally bred crops, no special labelling is required for such sugar or for products containing such sugar.

To date there appears to have been little consumer resistance to this policy. Unlike their European counterparts, US consumers have been exposed to the GM debate for much of the 1990s, with the introduction of the Flavr-Savr tomato in 1992 and the approval of bovine somatotrophin in 1994. Furthermore, and this is a crucial point, US consumers have confidence in the FDA's judgement.

This stands in stark contrast to the situation in Europe, where the general public's confidence in the ability of scientists, regulators and politicians to monitor and assess potential threats to food safety has been undermined by a spate of recent food safety problems, most notably the BSE (Bovine Spongiform Encephalopathy) crisis.

This has meant that in Europe, consumers have yet to be fully convinced of the benefits of GM food crops. Given that the current 'first generation' of GM crops is geared towards enhancement of crop production, consumers can see no benefit for themselves in the introduction of such crops. Environmental concerns and worries about food safety have emerged as major issues affecting consumer attitudes to GM crops.

To date, only very small areas of GM crops have been produced in the EU, although considerable research into GM food crops has been carried out, as Table 2 indicates. The distribution of trials among EU countries broadly reflects national consumer attitudes to GM technology.

In the food processing and retail sectors, attitudes to GM crops are coloured by consumer opinion. For this reason, European sugar producers have for the most part adopted a position of neutrality towards GM beet.

However, it is possible that new labelling laws in the EU may encourage sugar processors to express greater interest in GM beet. Under these laws, all foods containing GM crops or their derivatives are required to be labelled, *except* when neither protein nor DNA resulting from the genetic modification is present.

For the EU sugar industry, this suggests that if GM beet were to be approved for use in the EU at some point in the future, the sugar produced from such beets would *not* have to be labelled as a GM food. The extraction and purification processes used in sugar production should ensure the purity of the final product.

**Table 2: Notifications of Releases of Genetically Modified Crop Plants in the EU to July 1998**

Country	← Crop →						Total
	Maize	Oilseed rape	Sunflower	Wheat	Sugarbeet	Others	
Austria	1					2	3
Belgium	14	38		1	8	29	90
Denmark		2			17	13	32
Finland		2			4	10	16
France	155	70	5		49	103	382
Germany	18	13			18	42	91
Greece	3					9	12
Ireland					4		4
Italy	77				19	105	201
Netherlands	13	9	2		16	60	100
Portugal	3					7	10
Spain	33	3	3	2	9	57	107
Sweden		14			4	18	36
UK	6	71		1	21	64	163
<b>Total</b>	<b>323</b>	<b>222</b>	<b>10</b>	<b>4</b>	<b>169</b>	<b>519</b>	<b>1,247</b>

Source: EU Commission.

Ultimately, however, the consumer is king. In Europe, environmental concerns about the commercial release of GM crops, coupled with an apparent desire on the part of the consumer for 'the right to choose' between the consumption of foods produced by conventional crops and by GM crops continue to dominate the public debate on the issue.

Indeed, the last two weeks have seen the GM debate plastered over the front pages of national newspapers in the UK. In the current rather frenzied atmosphere surrounding the issue, there is a real danger that a deluge of sensational headlines will deny the general public any significant exposure to reasoned arguments for and against the new technology.

## GM SUGAR AND INTERNATIONAL TRADE

Of the 37 million tonnes or so of beet sugar produced every year around the world, only around 7 million tonnes enter international trade, and the vast bulk of this originates from the EU. The majority of beet sugar production is destined for domestic consumption, and thus the acceptability of sugar produced from GM beet is largely a domestic issue, as it is in the US.

The world's cane sector produces around 85 million tonnes of sugar a year, of which close to 30 million tonnes is exported. For those countries exporting to the EU (The African, Caribbean and Pacific group of sugar producers), the persistence of negative attitudes to sugar derived from GM crops might impede the uptake of such crops in these industries. However, by the time these industries are in a position to export such sugar, attitudes in the EU may well have changed.

As mentioned earlier, the cane sugar industries having a structure most conducive to the commercial introduction of GM cane are those where cane production is concentrated on large mill-owned estates or private farms. Many of these industries are



also significant exporters of sugar, such as Australia, Brazil, Colombia and South Africa. Given approval of GM cane in these countries, this could help to enhance their competitiveness relative to other exporters who may find adoption and regulation of the new technology more problematic.

**Table 3: World Sugar Production and Trade** ('000 tonnes, raw value)

	← Average 1995/96 - 1997/98 →	
	Production	Exports
<b>Beet Sugar</b>	<b>37,130</b>	<b>7,030</b>
EU	17,770	5,250
US	3,730	-
<b>Cane Sugar</b>	<b>86,220</b>	<b>27,470</b>
US	3,260	-
Australia	5,550	4,490
Brazil	14,960	6,720
Cuba	4,010	3,130
Mexico	5,030	740
China	6,130	-
India	15,200	490
Thailand	5,580	3,780
<b>World Sugar</b>	<b>123,350</b>	<b>34,500</b>

## CONCLUSIONS

It is clear that the technical and economic challenges facing sugar producers in the future provide a compelling argument for the adoption of GM technology for sugar crops.

Experience with commercial production of GM crops in the US suggests that the 'first generation' of such crops have considerable appeal to farmers. Particularly in those regions of the US where the margin of competitiveness of beet compared to alternative crops is narrow, there is likely to be considerable interest in herbicide tolerant beet.

While US authorities and consumers appear to be satisfied that their regulatory procedures adequately address environmental and food safety concerns, the introduction of GM crops and foods into the EU continues to be controversial. There is a real danger that current scare stories in the media could further damage EU consumers' perceptions of GM crops, which, at the very least, would be likely to result in significant delays in their commercial introduction.

As a substantial importer of cane sugar, the EU's stance towards sugar produced from GM crops could have a significant effect not only on the uptake of GM sugar crops within the EU (which represents a massive potential market for biotechnology companies), but also on their use in countries supplying the EU with cane sugar.