



Sugar Beet  
White Sugar

This handbook is part of a series of agribusiness manuals prepared by the FAO Investment Centre Division, in collaboration with FAO's Rural Infrastructure and Agro-Industries Division. It was prepared for the EBRD Agribusiness team, under the FAO/EBRD programme of cooperation. The production of the manuals was financed by FAO and by the EBRD multidonor Early Transition Countries Fund and the Western Balkans Fund. The purpose of this handbook is to help agribusiness bankers and potential investors in the Early Transition countries (ETCs) and the Western Balkan countries (WBCs) to acquire basic knowledge about the sugar sector and to become acquainted with recent economic trends in the sector around the world, with a special focus on the ETCs and the WBCs. This volume was prepared by Inna Punda, FAO Agribusiness Expert, and reviewed by Dmitry Prikhodko, Economist, FAO Investment Centre Division, as well as by members of the EBRD Agribusiness team. Electronic copies can be downloaded from [www.eastagri.org](http://www.eastagri.org), where a database of agribusiness companies, including sugar refineries that operate in the ETCs and the WBCs, is also available. Please send comments and suggestions for a future edition of the manual to [TCI-Eastagri@fao.org](mailto:TCI-Eastagri@fao.org).

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## INTRODUCTION

Sugar cane, a large tropical grass, retained the monopoly on the provision of sweetness for nearly three thousand years, until the arrival in the nineteenth century of its rival, the sugar beet. By 1880, sugar beet had replaced sugar cane as the main source of sugar in continental Europe.

Sugar cane is known to have been cultivated in New Guinea and its neighbouring islands before 1000 BC. From there, it set out on a long journey that would take it first to India and then to China.

The Indians devised the first techniques for extracting sugar from cane and called it “sarkara”, a Sanskrit term from which the words for sugar in many European languages originate (sucre, zucker, zuccheto, azúcar, etc.).

It was in India, between the sixth and fourth centuries BC, that the Persians, followed by the Greeks, discovered the famous “reeds that produce honey without bees” and brought sugar cane to the West. A few merchants began to trade in sugar but the cultivation of sugar cane was confined to India.

A natural nutrient, sugar, also known as sucrose, is a vital ingredient in our daily diet. To meet the body’s energy requirements, carbohydrates should account for between 50% and 55% of a balanced diet. Sugar, whatever its form, is a source of the carbohydrates essential to our health and well-being.

Sugar displays a whole range of characteristics and tastes that affect the way it behaves when used. It is a sweetening, colouring and bulking agent and a preservative. It can alter boiling and freezing points, affect the flavour and smell of foods, and add bulk to foods.

Twenty percent of the world's supply of sugar is derived nowadays from sugar beet, mainly cultivated in industrialized countries, while the remaining 80% of the world’s sugar supply is derived from sugar cane, mainly cultivated in tropical climates in developing countries.

Because sugar beet is the main product of the Western Balkan countries (WBCs) and Early Transition countries (ETCs), the focus of this manual is on sugar beet as opposed to cane sugar.



## I. PHYSICAL AND TECHNICAL DATA

### I.1 Sugar beet and its physical characteristics

#### I.1.1 About sugar beet

Beets belong to the *Beta vulgaris* species, as do the three cultivated forms of beet:

- red table beet
- fodder beet, used mainly as animal feed
- sugar beet (white flesh beet)

Sugar beet has a conical, white, fleshy root and a flat crown. Sugar is formed through a process of photosynthesis in the sugar beet's rosette of leaves, the size of which differs according to the sugar beet variety. The root serves as a reservoir for the sugar, which can represent between 15% and 21% of the sugar beet's total weight.



Physical characteristics of sugar beet. The root of the beet (taproot) contains 75% water and 25% dry matter. The dry matter comprises about 5% pulp. Pulp, insoluble in water and mainly composed of cellulose, hemicellulose, lignin and pectin, is used in animal feed. Sugar represents 75% of the root's dry matter.

The sugar content in sugar beet can vary from 12% to 20%. It is the sugar that gives value to the sugar beet crop. The by-products of the sugar beet, such as pulp and molasses, give an added value of up to 10% of the value of the sugar.

The sugar extraction rate depends on the sugar content of the sugar beet at the moment of its arrival in the processing plant. European norms define the sugar beet as marketable if it contains 14% sugar or more (in Ukraine, for instance, the average sugar content is only 11.2%). The standard sugar beet should have a sugar content of 16%, which would yield 130 kg of sugar per 1 ton of standard sugar beet processed at a sugar plant (ideal efficiency is 82.5%).

#### I.1.2 Specific conditions for sugar beet cultivation

Unlike sugar cane, sugar beet does not thrive in tropical conditions. It prefers a temperate, humid climate, with dry, sunny periods just before the harvest.

Producers often reserve their best land, fertile and deep, for the sugar beet because of its delicate, fragile nature in the initial stages of life.

The sugar beet produces sugar during the first year of life and stores it in the root, which is almost completely buried in the soil and which measures from 15 cm to 35 cm in length. It is harvested after the first year. If the growing cycle were allowed to continue, it would enter into a reproductive phase and in the following year would use all of its sugar to produce seeds. For this reason, it is sown in spring and harvested in the autumn/early winter (a relatively long growing season).

Sugar beet plays an important part in the crop rotation cycle.

### **1.1.3 Harvesting**

In developed countries, sugar beet is lifted mechanically<sup>1</sup>. A single machine performs several tasks and has a “topper” or “defoliator” at the front and a “lifter” at the rear. A soil removal machine cleans the sugar beets before they are transported to the processing plant.

Transporting the crop is no mean feat. It must be completed very quickly because the sugar content of sugar beets drops rapidly once the sugar beets are lifted. Sugar processing plants work day and night during the two to three months following the harvest. The sugar beet harvest lasts about three months, while the sugar cane harvest lasts up to six months.

For each ton of sugar beet there is from 20% to 30% of waste, while for each ton of sugar cane there is less than 5% of waste.

### **1.1.4 Yields**

While the harvesting date has a certain impact on the crop yield (see Figure 1), other factors have a critical impact on the harvest yields and include the crop variety, the spacing between rows and the number of seeds within the rows, harvesting conditions and storage conditions.

However, depending on the quality of the seeds, the climatic conditions and the cultivation methods, individual yields can vary from as much as 30 to 70 tons/ha of sugar beet roots.

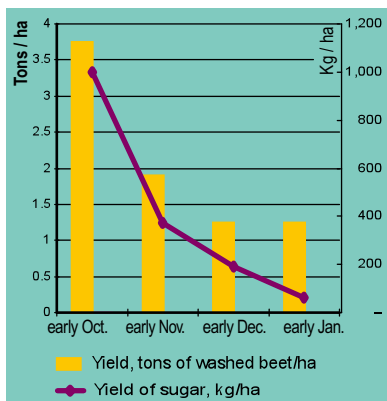
In 2007, the average global sugar beet yield was 39.5 tons/ha (83 tons/ha in France, placing this country among the world’s leading producers).

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<sup>1</sup> *Sugar beet is harvested manually in Turkey, Morocco and Egypt.*



**Figure 1: Effect of the harvesting date on the yield of sugar beet and the yield of sugar**



Changes that occur in the crop as the growing season progresses under the average climatic conditions of Western Europe

	Early Sept. to early Oct.	Early Oct. to early Nov.	Early Nov. to early Dec.	Early Dec. to early Jan.
Yield of washed beet tons/ha	up 3.75	up 1.9	up 1.25	up 1.25
Sugar content	up 1%	up 0.25%	down 0.25%	down 0.75%
Yield of sugar kg/ha	up 1,000	up 375	up 190	down 60

Source: John Nix. September 2007. *Farm Management Pocketbook*

### 1.1.5 New varieties and biotechnology

Genetic research, seed selection, the fight against diseases and parasites, and the mechanization of the various growing and harvesting phases resulted in significant improvements in sugar beet yields. In 1960 and 1980, sugar beet yields were 48 and 51 tons/ha, respectively.

Recent biotechnology studies have resulted in an herbicide-tolerant beet<sup>2</sup> that offers a radical solution to the problem of weeds. The pros of the genetically engineered seeds are weed control and, consequently, higher yields. The cons are higher seed costs and higher technical fees.

Sugar is a refined product that contains no deoxyribonucleic acid (DNA) or proteins but just the chemical sucrose. While the genetically modified (GM) sugar beet is genetically different from a standard beet, the sugar in both beets is the same.

## 1.2 Comparison of sugar beet and sugar cane

### 1.2.1 Cultivation conditions

Sugar beet is cultivated in countries with temperate climates, mainly in Western, Central and Eastern Europe, the United States, China and Japan but also in Chili, Morocco and Egypt. Sugar cane, by contrast, is cultivated in tropical and subtropical countries, mainly in Brazil, Cuba, Mexico, India and Australia.

<sup>2</sup> A. Pollack. 27 November 2007. *Round 2 for Biotech Beets*. *New York Times*.

Both sugar beet and sugar cane can be cultivated as an intensive crop or as an extensive crop.

### **1.2.2 Sugar content**

A standard sugar beet has a sugar content of 16% compared with 12 to 13% in sugar cane.

### **1.2.3 Extraction rate**

The extraction rate of sugar from sugar beet varies from 40 to 80% (sugar content 16%), while the extraction rate of from sugar cane can vary from 30 to 100% (sugar content 12%).

### **1.2.4 By-products**

The by-products of sugar cane can be divided into three categories: sugar/solids, molasses/juice and crop residues. A variety of products are feasible and marketable within each category.

The sugar beet, however, has neither the biomass content nor the solar conversion efficiency of the sugar-cane plant.

## **1.3 Processing of sugar beet into white sugar<sup>3</sup>**

The modern sugar industry has evolved into a rather complex agro-industrial activity, with three distinct phases:

- harvesting of the sugar beet crop
- conversion of sugar beet into small crystals of raw sugar
- refinement of raw sugar

Often beets are converted to raw sugar in a factory at one location and the raw sugar is refined at a different factory in another location. However, it is also possible to refine raw sugar into white sugar directly in the factory where sugar beets are converted to raw sugar by using sulfur dioxide as the bleaching agent. Many sugar refinery operators in industrialized countries demand raw sugar for processing at their own refineries.

A typical sugar factory produces brown granulated sugar known as raw sugar with a sucrose content (or purity) ranging between 94 and 99%. Factories configured to produce a final product for sale to the end-user tend to produce sugar in the upper purity range, while factories configured primarily for export to a refinery produce sugar in the lower purity range. From a health

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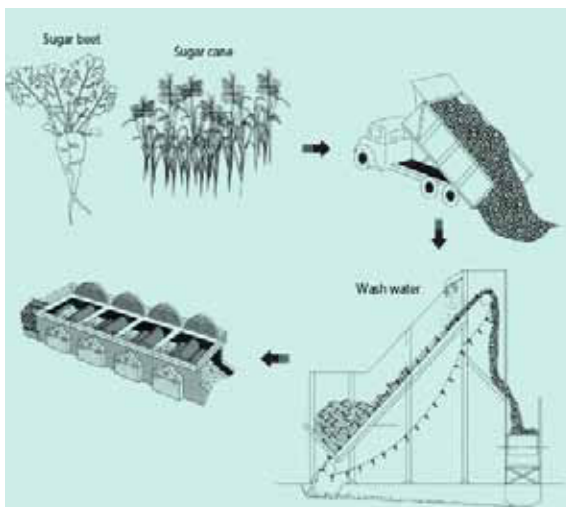
<sup>3</sup> For a more detailed description of the process, please refer to [www.madehow.com](http://www.madehow.com).

and environmental perspective, it is interesting to note that the purification or refining of sugar reduces its nutritive value and alters its natural taste.

White beet sugar is made from beets in a single process, rather than the two-stage process involved with cane sugar (namely, extraction of the cane juice/reduction to syrup and boiling of syrup for crystal formation). The single process for making white beet sugar involves the following ten steps:

**1. Delivery.** The sugar beet is delivered to the factory by growers located within a 30-km radius. Storage time is kept to a minimum in order to preserve the sugar content<sup>4</sup>.

*NB: Sugar beets are shipped to the sugar factory by truck or rail. The sucrose content in cut beets decreases rapidly, so the time between harvesting and processing at the factory must be minimized to maximize sugar yield. Therefore, most sugar factories are near beet fields.*



**2. Washing.** The sugar beet is moved to washers fitted with agitator blades to remove soil, weeds and stones.

**3. Slicing.** The washed sugar beet is then put through slicing machines that cut it into thin slices called "strips".

**4. Extraction.** The sugar juice is extracted from the strips by diffusion in a long cylinder in which hot water circulates in the opposite direction to the strips. In a process rather like brewing tea in a pot, the sugar from the strips gradually passes into the water.

**5. Purification.** The juice extracted contains all the sugar from the sugar beet as well as impurities (mineral salts), which are removed by adding milk of lime and carbon dioxide and then filtering.

**6. Evaporation.** The filtered juice contains around 13% sugar and 87% water. It is heated to boiling point and then passed through a series of evaporator pans to convert it to syrup containing 65–70% sucrose.

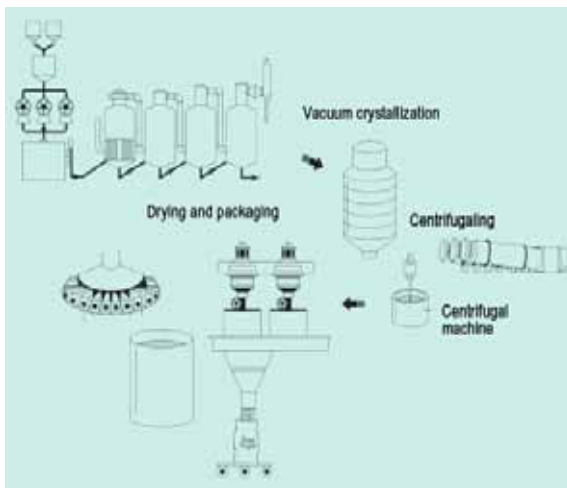
<sup>4</sup> Cedus Le Sucre. Statistics Memo 2006–2007.

**7. Crystallization.** Tiny sugar crystals are added to the pans to start crystal formation. The mixture of crystals and syrup (or “mother liquor”) is known as “massecuite”.

**8. Centrifugal treatment.**

The massecuite is spun in centrifuges to separate the sugar from the syrup. The sugar settles on the sides of the centrifuge and is then washed with clean hot water to produce white sugar crystals.

**9. Drying.** Still hot and moist, the crystallized white sugar is transferred to hot-air dryers and then cooled. It is then ready for consumption.



Source: <http://www.madehow.com/Volume-1/Sugar.html>

**10. Packaging.** After sifting, sorting and weighing, the sugar is stored in bulk in huge silos, then bagged or sent for specialized packaging, e.g. as cube, caster or icing sugar, before shipping.

### 1.3.1 By-products

The beet tops and extracted strips as well the molasses are used as feed for cattle. The beet strips are also treated chemically to facilitate the extraction of commercial pectin. The end product derived from sugar refining is blackstrap molasses. It is used in cattle feed as well as in the production of industrial alcohol, yeast, organic chemicals and rum.

One ton of sugar beet yields<sup>5</sup>:

- 160 kg of sugar
- 500 kg of wet pulp
- 38 kg of molasses

Pulp. The exhausted beet strips, which remain after being diffused with hot water to draw the sugar from the beets, are called pulp. They are pressed and/or dried for animal feed.

<sup>5</sup> *Cedus Le Sucre. Statistics Memo 2006–2007.*

Molasses. Molasses is the high viscous and coloured runoff syrup from the crystallization step. It is used as a substrate for biochemical transformation (alcohol fermentation carrier, production of baker’s yeast and of micronutrients).

**1.3.2 Quality control**

Mill sanitation is an important factor in quality control measures. Bacteriologists have shown that a small amount of sour bagasse can infect the whole stream of warm sugar juice flowing over it. In addition, strict measures are needed for insect and pest control.

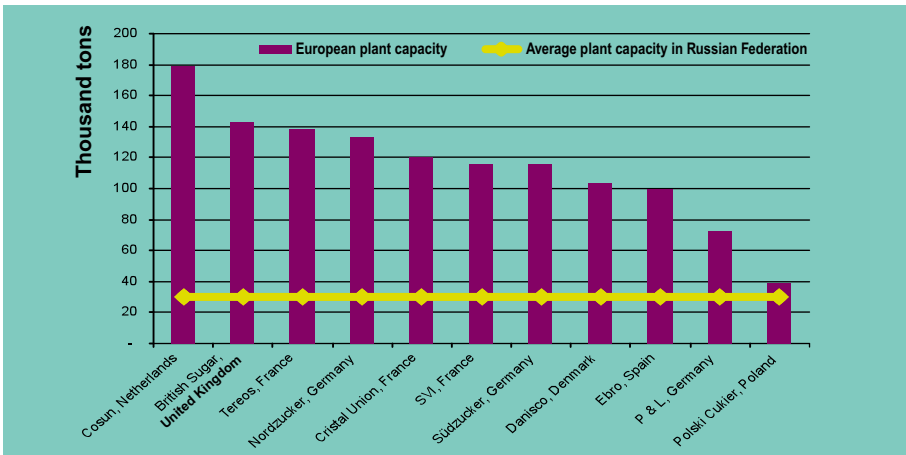
**1.3.3 Conversion of raw material to sugar**

One ton of sugar beet yields from 130 to 160 kg of white sugar. The non-crystallized sugar remains with the molasses, which contain 50% sugar.

Average sugar content in sugar beet	Sugar recovered by the extraction process
14%–16% i.e. 1 ton of sugar beets = 0.16 ton of sugar	80% i.e. 0.112–0.128 ton of sugar

With sugar beet yields ranging between 55 and 65 tons/ha, the anticipated sugar yield would be 6.6 to 7.8 tons/ha under ideal conditions. In Western Europe and the Russian Federation, the capacity in 2005/2006 to process raw material into sugar is shown in Figure 2.

**Figure 2: A comparison of the annual plant capacities in Western Europe and the Russian Federation, 2005/2006 (thousand tons per plant per year)**



Source: The data provided by the companies mentioned in the above figure

The sugar yields of the Russian Federation are more than 45% lower than the European average (6.85 tons/ha, average for 2006/2007–2008/2009) and about three times lower than yields in the most advanced sugar producing countries in Western Europe. This is mainly due to the lower availability of sugar beet, inadequate agricultural technology (cultivars, crop management, machinery) and constrained access to investments. If these factors were to improve, sugar output in the Russian Federation, given its current beet acreage and slicing capacity, would significantly increase (to more than 5.5 million tons against the 3.1 million tons estimated for 2008/2009). Plant capacity will inevitably grow with further industry consolidation.

## **I.4 World sugar production**

### **I.4.1 Recent developments and the current situation**

Worldwide, 123 countries are producing sugar, 80% of which is made from sugar cane and 20% from sugar beet.

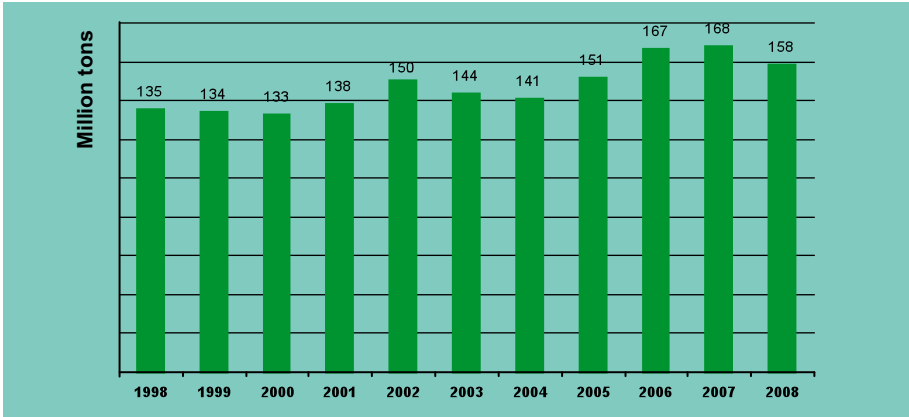
- both sugar cane and sugar beet are grown in 9 countries
- only sugar beet is grown in 43 countries
- only sugar cane is grown in 71 countries

In 2008<sup>6</sup>, world production dropped by a massive 9.1 million tons (–5.4%) to 158 million tons (see Figure 3), mainly because of a decrease in production in India, where sugar output is now estimated to have fallen by a drastic 45%. The drop reflects a decline in cultivated area, as many beet growers allocated land to alternative, more remunerative crops, such as maize and soybeans. Sugar production also contracted in Australia, the European Union (EU) (mainly policy driven), Pakistan and the United States, and relatively small decreases in production are foreseen in Thailand. However, in the Latin America and Caribbean region, sugar production in Brazil was expected to rise to 39.6 million tons in 2008, about 29% more than in 2007, despite heavy rains at harvest time that reduced yields.

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<sup>6</sup> On an October–September basis, i.e. 2008, should read 2008/2009.

**Figure 3: World sugar production (raw equivalent), 1998–2008**

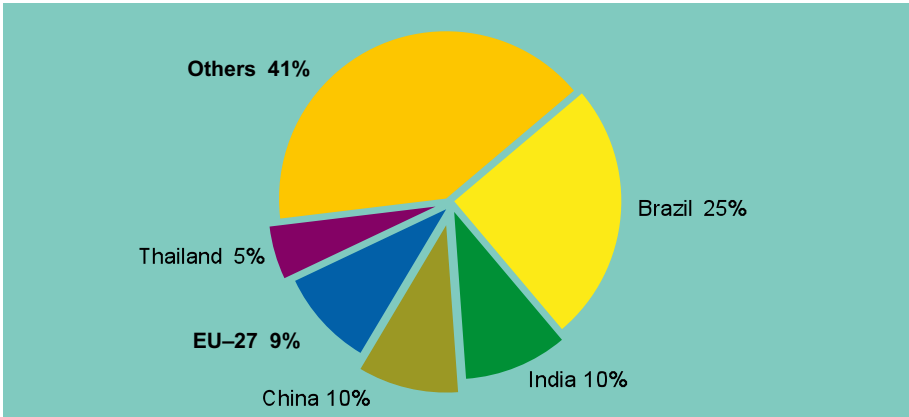


Source: *FAO internal follow-up*

The three largest sugar producing countries are Brazil (25%), India (10%) and China (10%), which together represent almost half of the world's production (see Figure 4). However, these sugar producing countries differ greatly in their level of national sugar consumption, so their profiles as top exporters/importers differ in the world market.

In terms of beet sugar, the largest producing countries are the 27 European countries (almost half of global production), followed far behind by the United States, the Russian Federation, Turkey and Ukraine.

**Figure 4: The world's top five sugar producers, 2008**

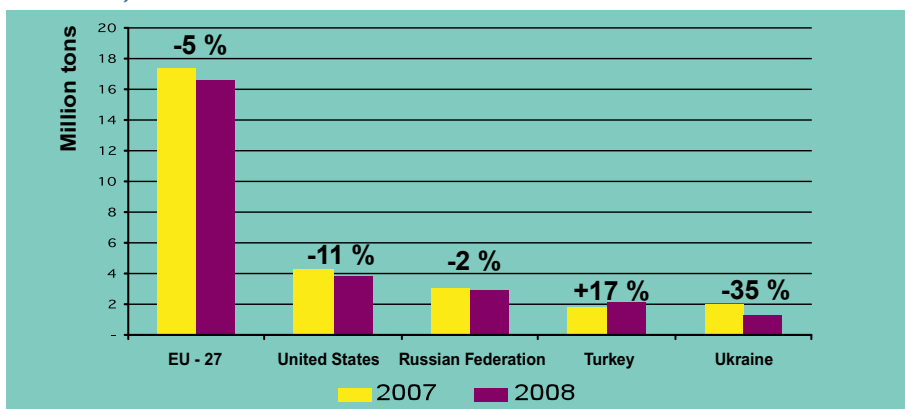


Source: *FAO*

The share of world production by each of the main producing countries has been evolving over the last years, with a particularly positive production dynamic in the Asian region (mainly Thailand and China). After a period of stagnation, European production is slowing down and this trend will continue.

As for beet sugar production, sugar output in the EU-27 was down to 16.6 million tons in 2008<sup>7</sup>, after reaching 17.4 million tons in 2007 (see Figure 5). Under the reform of its sugar regime (also see section 3.3.1), which began in 2006, the EU-27 aims to cut sugar production by 6 million tons over the four years of the restructuring programme.

**Figure 5: Trends in beet sugar production in the main producing countries, 2007–2008**



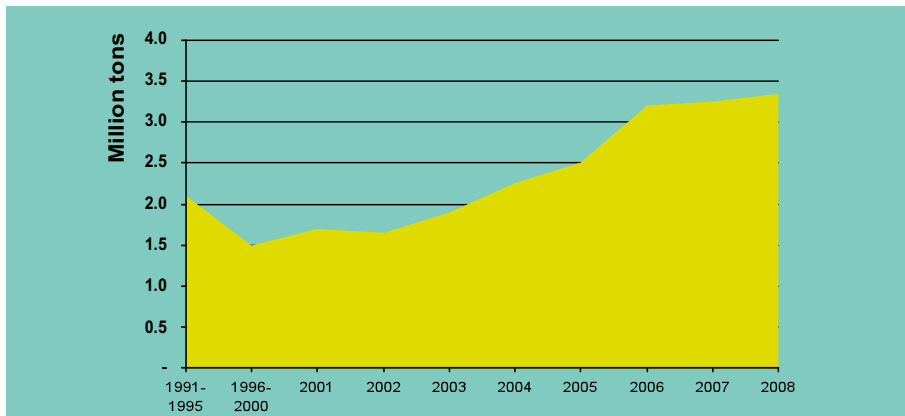
Source: Foreign Agricultural Service, Official United States Department of Agriculture (USDA) Estimates

Another important player in beet sugar production is the Russian Federation, which after a decade of declining sugar production, halted the long-term trend when sugar production from domestically cultivated sugar beet began to increase at the beginning of the current decade. It has now stabilized at a level of 3.2–3.3 million tons, white value (see Figure 6).

<sup>7</sup> On an October–September basis, i.e. 2008, should read 2008/2009.



**Figure 6: Beet sugar production in the Russian Federation (white value)**



Source: N. Chernyshova. *Russian Sugar Market in 2008/09*.  
A presentation to the International Sugar Council, November 2008.

Seventy-eight beet sugar factories and one sugar refinery were in operation in 2007 compared with 96 beet sugar factories and 2 refineries in operation in 1990. The industry processed 24.5 million tons of sugar beet into 3.2 million tons of white sugar. It refined imported raw sugar into 2.45 million tons of white sugar. The recent seasons have been characterized by a considerable improvement in beet and sugar yields (17.7 tons/ha in the period 1996–2000 compared with 29.1 tons/ha in 2007 and 35.8 tons/ha forecast by the International Sugar Organization (ISO) for 2008.

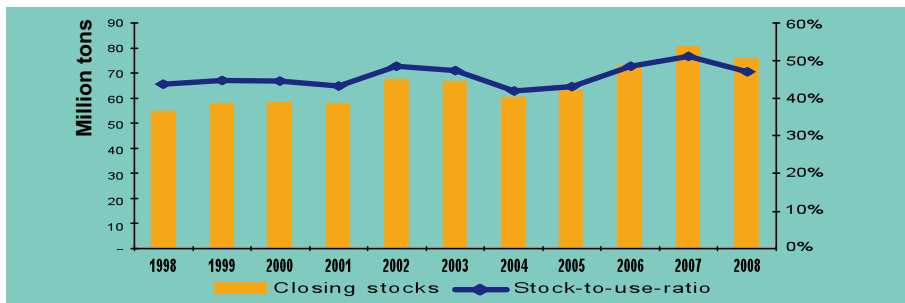
Sugar production has drastically fallen in Ukraine, where farmers reduced the area sown to sugar beet in response to a strong demand for grains and oilseeds.

Currently, production from sugar cane in the main exporting countries is significantly more competitive than production from sugar beet in the EU. The reasons often have nothing to do with technical efficiency or local production conditions but rather with favourable economic and political frameworks in terms of lower salaries and ground costs, and less demanding government regulations. The development potential of the major sugar producers indicates that liberalization of the world sugar market will serve to increase the pressure of competition on European sugar beet growers and sugar companies.

## 1.5 Sugar consumption

Despite slightly increasing global sugar production, the sugar stocks have not changed significantly during the last few years. However, world sugar stocks decreased in 2008 with the drop in production in Asia (see Figure 7).

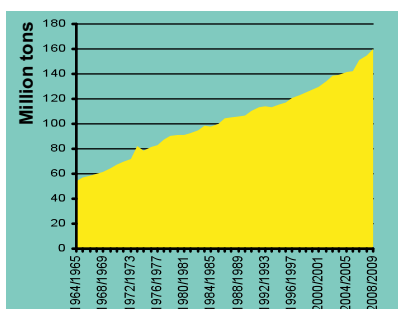
**Figure 7: The global sugar stocks and stock-to-use ratio, 1998–2008**



Source: FAO

In 2008–2009, world sugar consumption grew by a healthy 3.2% to 160 million tons in response to rapid increases in incomes and faster population growth mainly in the developing countries (see Figures 8 and 9). World sugar consumption is expected to continue to expand at a solid 1.5% per year, with faster growth in developing countries averaging over 1.9% per year<sup>8</sup>.

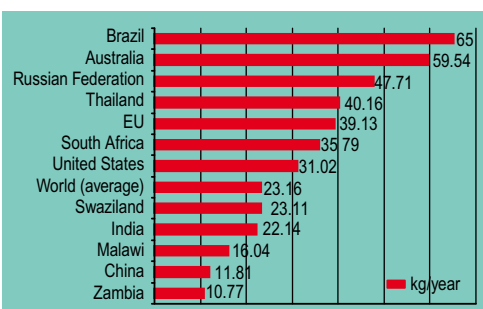
**Figure 8: The global trend in human domestic consumption, 1964–2008 (centrifugal sugar)**



Note: Estimates.

Source: Foreign Agricultural Service, Official USDA

**Figure 9: Per capita sugar consumption in selected countries, 2008/2009 (kg/year)**



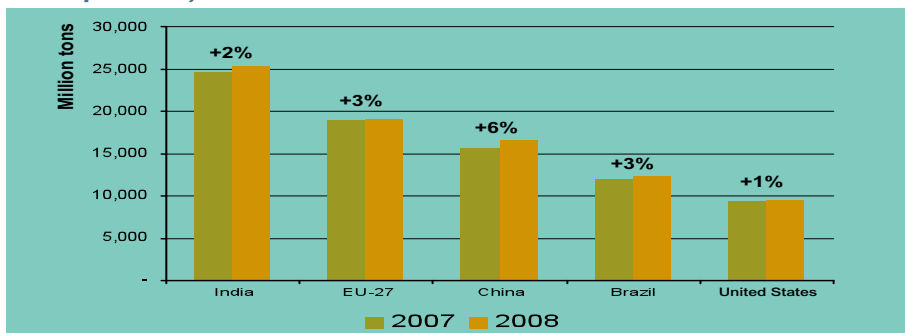
Source: FAO

<sup>8</sup> OECD-FAO Agricultural Outlook 2008–2017.

World per capita utilization in 2009 also grew to 23.8 kg compared with 23.6 kg in 2008<sup>9</sup>.

The top five consumers of sugar use 51% of the world's sugar, equivalent to 82.8 million tons. They include India, the EU-27, China, Brazil and the United States (see Figure 10).

**Figure 10: The five top sugar users, 2007–2008 (domestic consumption, raw equivalent)**



Source: FAO

Industrial demand accounts for 68% of total utilization in the EU, 60% of total utilization in India and the United States, and 48% of total utilization in Brazil.

## 1.6 Various types of sugar

The world of sugar consists of many varieties: white or brown sugar, granulated or caster sugar, lump or cube sugar, icing sugar, candy sugar, demerara (or cassonade) soft brown vergeoise and preserving sugar. Each variety has its own taste quality and specific uses.

The first type of sugar to emerge from the various stages of the industrial process is granulated sugar, which is white or brown, depending on whether it comes from sugar beet or sugar cane. It is also the source for the other kinds of sugar.

White granulated sugar is used to produce:

- caster sugar obtained by grinding and sifting
- icing sugar obtained by grinding
- preserving sugar obtained by adding pectin and citric acid

<sup>9</sup> *The World Sugar Economy in 2007 (International Sugar Organization).*

White or brown granulated sugar is used to produce:

- sugar lumps obtained by moistening, compressing and molding
- sugar cubes obtained by moistening, molding, drying and breaking

Three other sugars are obtained using special processes:

- demerara (or cassonade) obtained through direct extraction and crystallization of sugar cane juice
- soft brown vergeoise extracted from beet sugar syrup
- candy sugar obtained from very slow crystallization of highly purified sugar syrup

So-called raw sugars are yellow to brown sugars made by clarifying the source syrup by boiling and drying it with heat until it becomes a crystalline solid, with a minimal of chemical processing. They are an intermediate product in the white sugar production process.

White refined sugar has become the most common form of sugar in North America as well as in Europe. Refined sugar can be made by dissolving raw sugar and purifying it by bleaching the colourants with phosphoric acid (or by removing the colourants with colour-precipitating reagents in a similar process known as "blanco directo") or with calcium hydroxide and carbon dioxide in a carbonization process, or by removing the colourants with various filters. It is then further purified by filtration through a bed of activated carbon or bone char, depending on where the processing takes place. Beet sugar refineries produce refined white sugar directly without an intermediate raw sugar stage. White refined sugar is typically sold as granulated sugar, which has been dried to prevent clumping.

Granulated sugar comes in various crystal sizes – for home and industrial use – depending on the application:

- coarse-grained sugar, such as sanding sugar (also called "pearl sugar", "decorating sugar", nibbed sugar or sugar nibs), adds "sparkle" and flavour when decorating baked goods, candies, cookies/biscuits and other desserts;
- normal granulated sugar for table use: typically it has a grain diameter of about 0.5 mm;
- finer grade sugars, which result from selectively sieving granulated sugar. These sugars include caster (or castor) sugar (0.35 mm diameter), commonly used in baking, and superfine sugar, also called baker's sugar, berry sugar, or bar sugar – favoured for sweetening drinks or for preparing meringue; and

- finest grade sugars, including powdered sugar, 10X sugar, confectioner's sugar (0.060 mm diameter) or icing sugar (0.024 mm diameter) produced by grinding sugar to a fine powder. The manufacturer may add a small amount of anti-caking agent to prevent clumping – either cornstarch (1 to 3%) or tri-calcium phosphate.

Retailers also sell sugar cubes or lumps for the convenient consumption of a standardized amount. Producers/suppliers of sugar cubes make them by mixing sugar crystals with sugar syrup.

Brown sugars come from the late stages of sugar refining, when sugar forms fine crystals with significant molasses content, or from coating white refined sugar with a cane molasses syrup. Their colour and taste become stronger with increasing molasses content, as do their moisture-retaining properties. Brown sugars also tend to harden if exposed to the atmosphere, although proper handling can reverse this.

Natural sugars comprise all completely unrefined sugars and effectively include all sugars not defined as free sugars. Natural sugars are found in fruit, grains and vegetables in their natural or cooked forms.

## **1.7 Sugar substitutes**

A sugar substitute is a food additive that duplicates the taste of sugar but usually has less food energy. Some sugar substitutes are natural and some are synthetic. The substitutes that are not natural are, in general, referred to as artificial sweeteners.

The three primary compounds used as sugar substitutes in the United States are saccharin (e.g. Sweet'N Low), aspartame (e.g. Equal, NutraSweet) and sucralose (e.g. Splenda, Altern). In many other countries, xylitol, cyclamate and the herbal sweetener stevia are used extensively.

The food and beverage industry is increasingly replacing sugar or corn syrup with artificial sweeteners in a range of products that traditionally contained sugar. Artificial sweeteners cost significantly less to the food industry than natural sweeteners in spite of the extremely high markups on prices of artificial sweeteners by manufacturers. No wonder that the food industry is heavily promoting its “diet” or “light” products, thus moving the customers over to buying its even more profitable artificially-sweetened products.

Currently, aspartame is one of the most popular sweeteners in the food industry, as its price has dropped significantly since the Monsanto patent expired in 1992. Sucralose may soon be replaced as a leading sugar substitute, as

alternative processes to the sucralose process covered by the Tate & Lyle patent seem to be emerging (the price of sucralose may drop by as much as 30%). Aspartame is 180–200 times sweeter<sup>10</sup> than natural sucrose and sucralose is three-hundred times sweeter than natural sucrose. Thus, one would need 1/200<sup>th</sup> (or 1/300<sup>th</sup>) the amount per serving of these sweeteners to achieve a given level of sweetness. Currently, aspartame costs around £10/kg (USD 17.80)<sup>11</sup>. If the sugar price is around USD 0.30/kg, the use of aspartame is many times less expensive than natural sucrose.

## 1.8 Sugar and alcohol production

Ethyl alcohol (ethanol), commonly known as alcohol, is obtained either by chemical synthesis or by fermentation and distillation of sugar substrate (of beet, cane and cereals, and from the wine-making process). In the sugar industry, ethyl alcohol is prepared either by fermentation of sugar contained in raw beet and cane juices, by fermentation of sugar contained in concentrated refinery syrups after crystallization or from molasses.

Coproduction of both sugar and ethanol is often accomplished by locating (annexing) a distillery next to or near a sugar factory. The decision for or against coproduction of both sugar and ethanol (a decision which is more political than technical), is based on the relative economic value of sugar compared with ethanol, as well as the size of the two product markets. When ethanol is highly valued and a sufficiently high volume market appears likely, then an autonomous distillery is favoured. When sugar is highly valued and the market for ethanol is somewhat uncertain, then a distillery near a sugar factory is favoured.

Ethyl alcohol is used for consumption (potable spirit), for industrial purposes (solvents) and in perfumery and pharmacy. Moreover, its use as a fuel, commonly called either fuel ethanol or bioethanol, is on the rise. In Europe, bioethanol can be used in a pure or blended form, which is named ethyltertiobutylether (ETBE) and comprises 50% bioethanol and 50% of a by-product of petroleum, i.e. isobutylene.

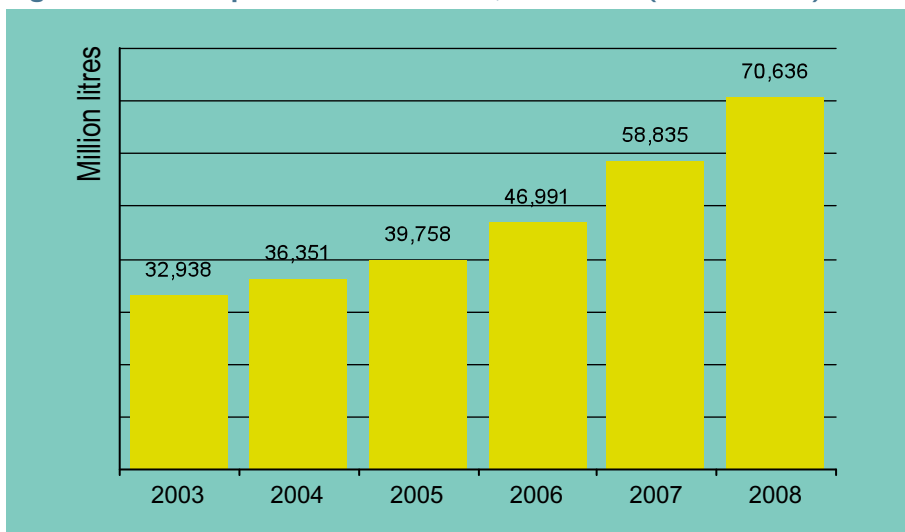
Figure 11 shows global production of alcohol. The two largest ethanol producing countries are the United States and Brazil. A number of other sugar producing countries base their renewable energy programmes on the use of molasses<sup>12</sup> or starch sources from grain and cassava.

<sup>10</sup> There are 35 g of sugar in a 12 ounce soda. It would take 175 mg of aspartame to equal that sweetness.

<sup>11</sup> According to Richard Stead, managing director of SinoSweet, United Kingdom.

<sup>12</sup> In some regions, such as the EU, specific sugar crops (beets for industrial use) are being designated and developed for non-food uses such as bioethanol production.

**Figure 1 I: Global production of alcohol, 2003–2008 (million litres)**



Source: FAO/OECD

The use of alcohol is on the rise in the EU, with total volume of almost 40 million hl consumed in 2006 (see Table 1). This increase in consumption is related to the expansion of bioethanol production.

**Table 1: Uses of alcohol in the EU**

Uses in the EU	2005 (thousand hl)	2006 (thousand hl)
Industrial alcohol	12,030	13,460
Potable spirit	7,352	8,398
Fuel	9,864	16,811
Other uses	1,978	1,241
<b>Total</b>	<b>31,224</b>	<b>39,910</b>

Source: The European Commission

Production of biomass-derived alcohol is on the rise, essentially due to the established mandates that underpin the growth of ethanol production. In Europe, alcohol is derived from cereals (53%), from beets and molasses (32%) and from wine-making and other processes (15%).





## **2. ECONOMIC DATA**

### **2.1 Key costs of producing sugar beet**

The price of sugar beet is a contractual price agreed between a sugar beet processor and a sugar beet farmer. Sugar beet prices depend on sugar prices. The price of sugar is fixed by the sugar producer according to market conditions and governmental agreements.

The price is also seriously affected by many technical factors that include beet yield, the sugar content of the beets and the sugar yield. Table 2 contains detailed information on production costs of both beet sugar and cane sugar in a range of selected countries.

In Europe, the production cost of beet sugar (16% sugar content) is around EUR 20–30 per ton in competitive countries and EUR 30–40 per ton in non-competitive countries.

### **2.2 Key costs of processing sugar**

Sugar manufacture is a heavy industry requiring a substantial investment, while the international market price of sugar is rather low. It is of utmost importance to have access to a raw material that incurs low transportation costs, and high and regular sugar yield as well as sufficient technical means to ensure continuous functioning of a large facility, the immobilization of which is rather costly.

**Table 2: Production profits and costs of beet sugar compared with cane sugar**

	Sugar beet					Sugar cane				
	Poland	Ukraine	United States	Germany <sup>1</sup>	Brazil <sup>2</sup>	Australia	Thailand	S. Africa <sup>3</sup>	India	United States
Yield of beet/cane (ton/ha)	39.5	19.5	46.1	60.3	68.5	97.7	42.5	53.6	73.8	74.4
Sugar content (%)	13.9	11.2	14.6	16.6	11.5	14.0	10.0	11.5	9.9	11.7
Sugar yield (ton/ha)	5.5	2.2	6.7	10.0	7.9	13.7	4.3	6.2	7.3	8.7
<b>Profit (EUR/ha)</b>	<b>1,011</b>	<b>355</b>	<b>2,082</b>	<b>3,253</b>	<b>548</b>	<b>1,686</b>	<b>6,36</b>	<b>1,072</b>	<b>1,454</b>	<b>2,176</b>
(EUR/100 kg beet/cane)	2.56	1.82	4.51	5.39	0.80	1.725	1.50	2.00	1.97	2.92
<b>Costs (EUR/100 kg sugar)</b>	<b>18.38</b>	<b>16.13</b>	<b>31.06</b>	<b>32.55</b>	<b>6.99</b>	<b>12.30</b>	<b>14.83</b>	<b>17.30</b>	<b>19.91</b>	<b>25.00</b>
(EUR/100 kg beet/cane)	945	262.5	1,887.5	2,542	762.5	1,564.5	665.5	951.5	860	2,501.5
	3.29	1.35	4.1	4.22	1.12	1.60	1.55	1.77	1.16	3.36
<b>Labour costs (EUR/100 kg sugar)</b>	<b>17.18</b>	<b>11.93</b>	<b>28.17</b>	<b>25.4</b>	<b>9.65</b>	<b>11.42</b>	<b>15.3</b>	<b>15.35</b>	<b>11.78</b>	<b>28.75</b>
Labour required (hour/ha)	4.40	2.80	5.42	4.49	2.35	2.55	5.10	4.20	5.98	8.68
Cost of labour (EUR/ha)	180	150	30	24	200	35	400–500	400–500	-	50
Cost of machinery (EUR/100 kg sugar)	1.35	0.31	12.50	18.70	1.05	10.70	0.50	0.60	0.23	15.00
Cost of land (EUR/100 kg sugar)	6.23	3.35	5.99	7.50	17.50	3.67	1.07	2.85	0.83	6.85
Cost of lease (EUR/ha)	0.635	0	4.96	5.32	1.65	1.83	2.33	2.01	0	4.85
	35	0	332.5	425	100	250	100	125	0	355.5

Note: 1) Database operated by the Association of South German Sugar Beet Growers, 1996 (particularly successful farms, above the national average).

2) Centre/south region; strong devaluation of the Brazilian currency.

3) Per ha of cultivated land (per ha of harvested land: raw yield 71.4 ton/ha; sugar yield 8.2 ton/ha).

Source: Association of South German Sugar Beet Growers, USDA, own data, 1999.

As can be seen from Table 2, the production cost of beet sugar is more than twice as high as the production cost of cane sugar.

The production cost of beet sugar is significantly offset by the revenue from the sale of the by-products, i.e. molasses, pulp, beet particulate matter and carbonation lime. Factory profitability often relies on the efficient utilization of molasses and animal feed by-products. The importance of the feed products to factory profitability is such that uniform, high quality products must be produced at all times. Factory efficiency and in turn profitability, also heavily depend on the use of multiple-effect evaporation. This procedure is of utmost importance to sugar beet factory operations because a sugar beet factory has no surplus fiber to provide fuel for power generation.

### **2.3 The growing and processing of sugar cane versus sugar beet**

The sugars from beets and cane are generally used interchangeably for candies, cereals, cakes and numerous other products, although some food manufacturers have switched to using high-fructose corn syrup, which is cheaper.

Little perceptible difference exists between sugar produced from sugar beet and sugar produced from cane. However, chemical tests can distinguish the two sugars.

One considerable disadvantage facing most sugar beet-growing countries is the very short growing season. Given the relatively short period of time during which sugar beets are harvested and available for processing, a beet sugar factory operates on average only 90 days a year (2,100 hours). A cane sugar factory operates over a longer period because raw sugar production lasts approximately five months and sugar refining takes place for some months afterwards.

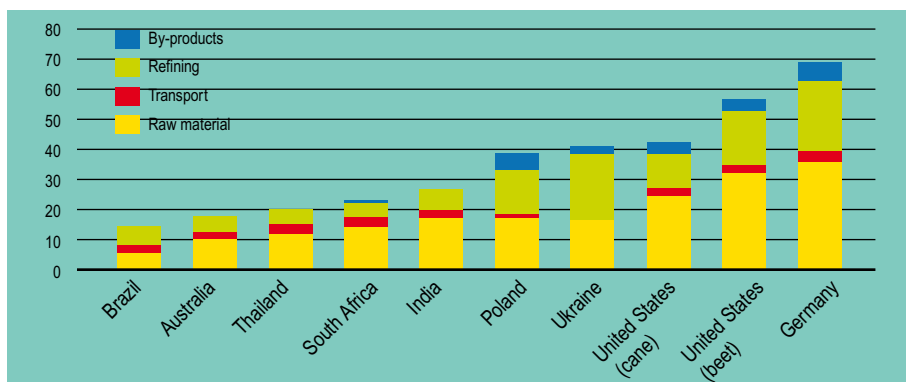
One advantage is that sugar beet cultivation requires approximately four times less water than sugar cane cultivation. For this reason, some countries such as Egypt, which traditionally cultivated sugar cane, now cultivate sugar beet, even though sugar beet tolerates hot climates less than sugar cane, and have built new beet sugar factories recently to process sugar beets. Some sugar factories process both sugar cane and sugar beet and extend their processing period in that way.

Factory operation time	
Beet sugar factory	Cane sugar factory
France: 85–100 days Northern Europe: 110–120 days England: 130–150 days United States and Turkey: 6 months	5–8 months on average up to 10 months in Colombia

A beet factory does not have a suitable by-product to use as fuel for the boilers and has to burn a fossil fuel such as coal, oil or gas, while the sugar cane factory burns the fiber resulting from the crushing of cane. So the source of energy to run the factories is one of the major differences between beet sugar factory and cane sugar factory operations. Both kinds of factories need steam and electricity to operate and both have cogeneration stations where high pressure steam is used to drive turbines that produce the electricity and create the low pressure steam needed by the production process.

A comparison of the costs of producing sugar in selected countries reveals clear cost advantages for sugar cane cultivation in Brazil, Thailand and Australia over sugar beet cultivation in Poland, the United States and Germany, as well as over sugar cane cultivation in the United States (Table 2 above and Figure 12). The sugar cane-producing countries benefit from a comparatively long growing season (up to nine months) and low salaries and worker-related costs. These factors more than compensate, in terms of production costs, for the often very low level of efficiency.

**Figure 12: The cost of producing sugar in selected countries (EUR/100 kg)**



Source: USDA, own data, 1999

The most important factors contributing to the low international competitiveness of American sugar production are the unfavourable climatic conditions, (shortage of water – or conversely, flooded soils; frost; soil crustation) and high labour and land costs. In Germany, any competitive advantage that is gained through advanced technology and generally high efficiency is offset by high labour costs and high land costs, as well as by demanding environmental and social regulations. In Poland and Ukraine, low efficiency is the main factor contributing to the high cost of sugar production<sup>13</sup>.

Various factors – natural, economic and political – influence the relative competitiveness of sugar production in each country and region and determine the ability of local production to compete on the world market.

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<sup>13</sup> *AgroConcept, Bonn.*



### 3. FINANCIAL AND STRUCTURAL DATA

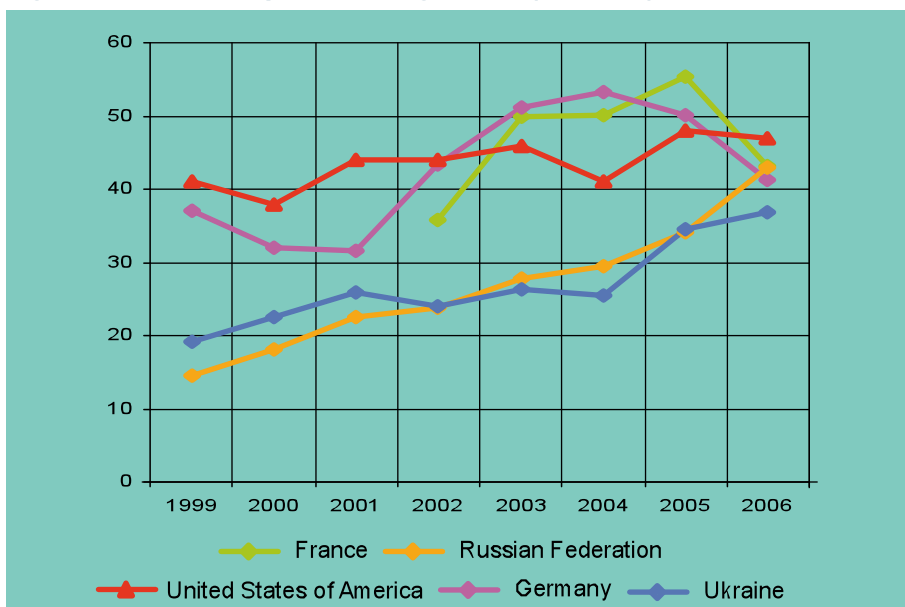
#### 3.1 Sugar beet prices

Sugar beet prices depend on sugar prices. Some producer prices for sugar beet are shown in Figure 13 and Table 3.

Sixty percent<sup>14</sup> of the revenues from the sale of sugar goes to the sugar beet farmer and 40% goes to the sugar producer. Pulp remains the property of the grower and beet transportation costs are partly covered by the producer.

The prices that European farmers receive for their beets are largely subsidized. The Producers Support Estimate (PSE) for refined sugar in the EU-27 is 25% (2007, estimates for 2008) and in the United States is only 10% (2007) and even as low as 7% (estimates for 2008) (Producer and Consumer Support Estimates, OECD Database 1986–2003).

Figure 13: Producer prices for sugar beet (USD/ton)



Source: FAOSTAT. © FAO Statistics Division 2009

<sup>14</sup> In the Russian Federation, 70% of the revenues from the sale of sugar goes to the beet growers.

**Table 3: Producer prices for sugar beet in the Western Balkan countries (WBCs) and Early Transition countries (ETCs) (USD/ton)**

Country	2004	2005	2006
<b>WBCs:</b>			
Albania	45.75	36.22	46.13
Bosnia and Herzegovina	46.09	39.36	41.73
FYR Macedonia	50.32	50.77	
Serbia	32.38	28.61	35.79
<b>WBC neighbouring countries:</b>			
Slovakia	53.53	56.35	48.80
Slovenia	54.89	48.67	40.82
<b>ETCs:</b>			
Armenia	52.34	44.87	53.50
Azerbaijan	29.73	34.04	45.81
Kyrgyzstan	36.90	39.74	41.84
Republic of Moldova	23.62	28.36	26.77
<b>ETC neighbouring countries:</b>			
Belarus	33.57	33.75	36.25
Kazakhstan	22.59	24.96	36.21

Source: FAOSTAT. © FAO Statistics Division, 2009

## 3.2 World sugar market prices

### 3.2.1 World sugar prices underpinned by strong global demand

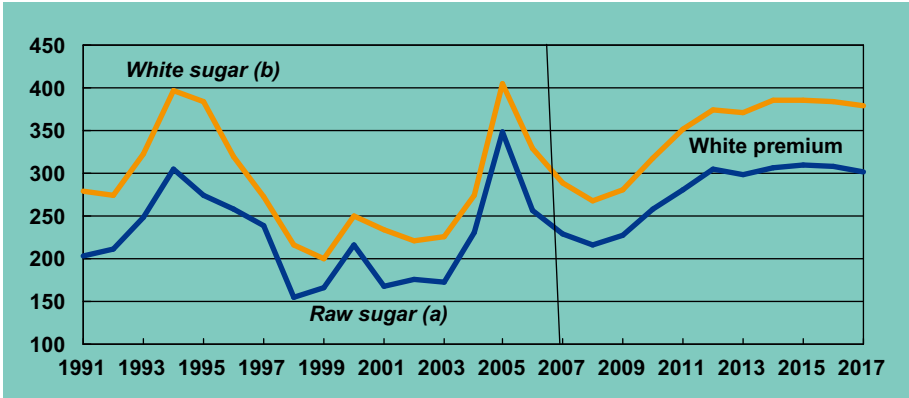
World sugar prices<sup>15</sup> in the period 1991–2007 and the price outlook for the period 2007–2017 are shown in Figure 14. International sugar prices<sup>16</sup> have followed a steady upward trend, moving from USD 266.80 per ton or USD 12.10 per lb. in November 2008 to USD 300.90 per ton or USD 13.65 per lb. in April 2009, reaching a three-year high of USD 354.10 per ton or USD 16.06 per lb. in May 2009 (see Figure 15). This price pattern mainly reflects a reduction in sugar availability for global export, following a sharp decline in India's sugar output in 2008. Prices could have moved higher had it not been for the world economic downturn, which curtailed demand, and the weakening of national currencies relative to the United States dollar, which sustained exports from countries such as Brazil, the world's largest sugar exporting country. Sugar prices may well display increased volatility given the uncertainty related to the extent to which India will require sugar from the world market to make up for the deficit in its production.

<sup>15</sup> FAO Food Outlook. June 2009. Global Market Analysis.

<sup>16</sup> International sugar prices are based on the International Sugar Agreement (ISA) of the International Sugar Organization (ISO), and computed as a simple average of the close quotes for the first three future positions of the Intercontinental Exchange Sugar Contract No. 11.



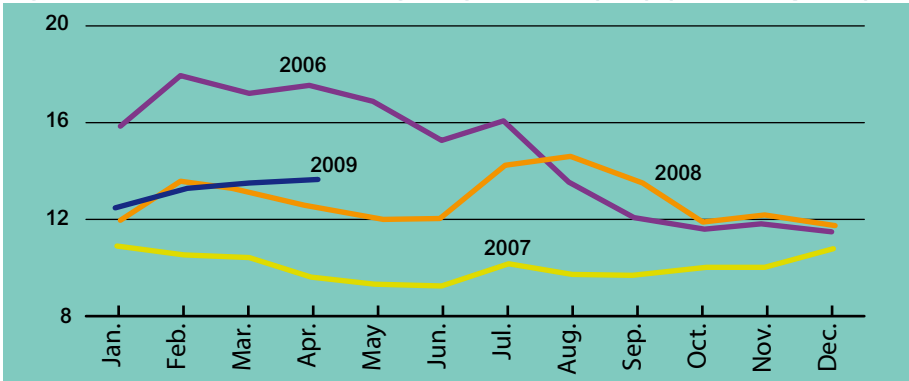
**Figure 14: World sugar prices, 1991–2007, and the price outlook, 2007–2017 (USD/ton)**



Note: (a) Raw sugar world price, ICE Inc. No 11, f.o.b., bulk spot price, October/September.  
 (b) Refined white sugar price, London No 5, f.o.b. Europe, spot price, October/September.

Source: OECD-FAO Agricultural Outlook 2008–2017. © OECD/FAO 2008/ OECD and FAO Secretariats

**Figure 15: The International Sugar Agreement (ISA) (US cents per lb)**



Note: The annual averages of sugar prices can be found on the International Commodities Prices page of the Food and Agriculture Organization (FAO) web site at <http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en>

Source: FAO Food Outlook. June 2009. Global Market Analysis

The apparent delinking of international sugar prices and market fundamentals illustrates the influence of factors exogenous to the sugar market itself, including high energy prices, the weakness of the United States dollar and the potential influence of investment funds on the sugar futures markets.

### **3.2.2 The impact of the economic downturn on sugar prices**

The global economic downturn stemming from the financial crisis and changes in the wider economy could be felt on the world sugar market in at least three ways<sup>17</sup>.

- 1** Import demand by industrial users of sugar, the market segment that is sensitive to changes in household incomes, has declined. Household consumption, however, is expected to be affected only moderately because sugar consumption is relatively inelastic to changes in prices and incomes. Because the industrial use of sugar accounts for the largest share of demand, and if the contraction in the world economy is more severe than expected, demand for sugar could be lower than the levels currently forecasted.
- 2** The export competitiveness of some countries has increased as currencies depreciate against the United States dollar. Already over the last few months, major sugar exporters such as Brazil, Thailand and Australia have seen their currencies weaken, which should boost their sugar exports.
- 3** If the downward trend in crude oil prices continues, demand for ethanol may fall, encouraging millers to process more sugar cane into sugar and less into ethanol. This shift would boost overall availability of sugar for export, especially in Brazil, the world's largest ethanol and sugar exporter. Therefore, a decrease in the demand for sugar by sugar importing countries combined with an increase in the availability of sugar for export would lead to a substantial decline in international sugar prices.

Only 40 years ago, 80% of the sugar on the European market was purchased by households and 20% was purchased by food industry players such as Coca Cola, Nestlé and Danone. Today the situation is just the opposite.

#### **Food and beverage producers**

- Sugar is an important raw material for candy manufacturers. Therefore, rising sugar prices increase the cost of the goods sold by these companies. Large candy manufacturers in the United States include Hershey Foods, Tootsie Roll Industries and the Wm. Wrigley Jr. Company.
- Sugar is also an ingredient for a variety of bakery products, syrups and food preservatives. The impact of sugar prices extends to a diverse range of food companies, such as Kraft Foods (i.e. mayonnaise production) and Nestlé (i.e. chocolate powder production).

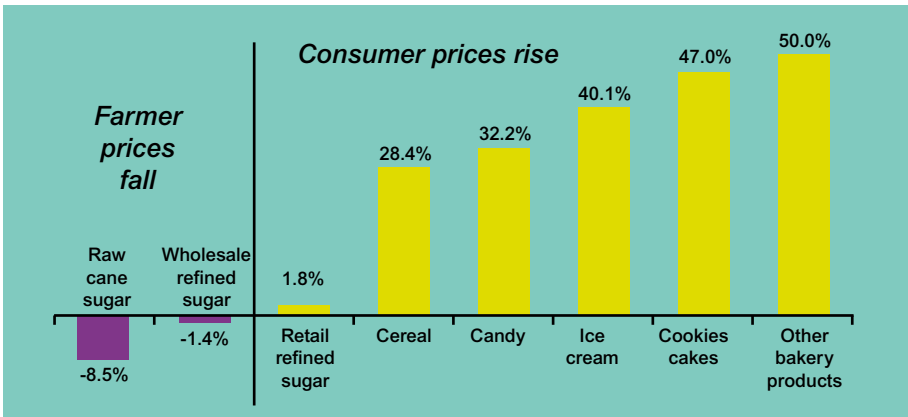
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<sup>17</sup> *FAO Food Outlook. November 2008. Global Market Analysis.*

- A substantial amount of sugar is used in the manufacture of breakfast cereals. Breakfast cereal manufacturers include General Mills and the Kellogg Company.
- Beverage providers use sugar extensively in their products. These companies include the Coca Cola Company and PepsiCo.

Many of the abovementioned companies buy sugar through long-term (5–6 year) contracts that dampen the effect of price hikes, and sometimes pass on price increases to consumers (see Figure 16).

**Figure 16: Farmer prices for sugar and consumer prices for sugar and products<sup>18</sup> (United States market)**



Source: Foreign Agricultural Service, Official USDA Estimates

Rising sugar prices also impact ethanol producers (see above). However, most ethanol producers that use sugar cane as a raw material are based in countries such as Brazil. In the United States, less than 3% of total ethanol production comes from sugar.

### Growers of sugar beet

Increases in sugar prices primarily help farmers who grow sugar beet. Sugar refiners also benefit from higher prices, which increase their margins. Companies that are involved in the production and sale of high-fructose corn syrup, a substitute for sugar, benefit from rising sugar prices as well.

### 3.2.3 The drivers of sugar prices

The primary driver of sugar prices is government support through production restrictions, import control and export refund, which are discussed in Section 3.3 below.

<sup>18</sup> Change in prices from 1990 to December 2005. Raw cane: duty-free paid, New York. Wholesale refined beet sugar: Midwest markets. Retail prices: Bureau of Labor Statistics consumer price indices.

Other drivers of sugar prices include:

- Government policies that artificially inflate sugar prices. Around the world, sugar is one of the most heavily-subsidized commodities. Eighty percent of foreign sugar market prices are subsidized by their respective governments to match the price of sugar in the United States, a value that is lower than production costs for sugar in those foreign sugar markets. This practice called dumping enables foreign manufacturers to eliminate sugar surpluses and gain market share.
- The ethanol industry. The ethanol industry when it increases the demand for sugar causes sugar prices to rise. More than 50% of the world's ethanol production stems from sugar cane (the share of production from sugar beet is insignificant). Producing ethanol from sugar is more efficient than producing ethanol from corn (the sugar-ethanol ratio of required energy input is one to two). Brazil is the leader in the production of ethanol from sugar, designating 60% of its sugar cane harvest for ethanol production. By contrast, less than 3% of the ethanol produced in the United States comes from sugar. Commercialization of the sugar-ethanol production process raises the demand for sugar, leading to increases in sugar prices. Whether this commercialization occurs depends on oil prices. When oil prices rise, then biofuels become more attractive, elevating the demand for ethanol. For example, in the first half of 2008, sugar prices increased 22% in response to rising oil prices<sup>19</sup>.

### **3.3 Governmental control of the sugar market**

The governments of almost all countries intervene in the sugar market to some extent. The various state interventions lead to marked differences among countries in the price of sugar, which as a result of the intervention is usually significantly higher than long-term<sup>20</sup> average prices on the world market (USD 50.80/ton margin between the prices of raw sugar and white sugar).

#### **3.3.1 The quota system in the EU**

Price support is at its highest level in the EU, with intervention prices of EUR 75/100 kg of refined sugar.

In 2006/2007, the EU-27 introduced a major programme to reform its domestic sugar market. The reform called for a reduction in sugar production quotas of 6 million tons, white value, and a cumulative cut in the intervention

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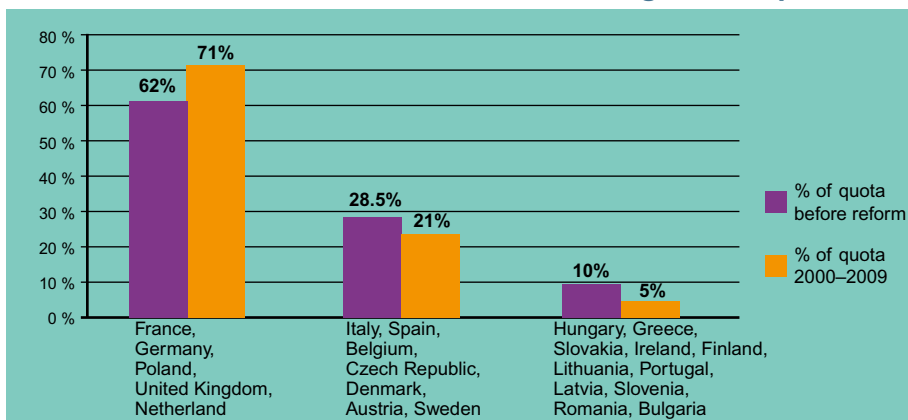
<sup>19</sup> Dave Goodboy. *Sugar: A Sweet Market on the Move*. See [www.tradingmarkets.com/](http://www.tradingmarkets.com/)

<sup>20</sup> 1998–2007.

sugar price by 36%. The purpose behind the reform was to achieve market balance in anticipation of rising sugar imports, stagnant sugar consumption and fixed quantities of sugar exports as per limits established by the World Trade Organization (WTO). To date, the voluntary quota reduction scheme, funded by a restructuring levy on production, has resulted in the renunciation of sugar production quota entitlements of about 5.8 million tons, white value. As a result, the area sown to sugar beet for sugar declined to 1.64 million ha in 2008/2009, which is about 60 percent less area than a decade ago. EU-27 sugar production is expected to decline to around 14 million tons by the end of the reform period. Figure 17 shows the share of the EU sugar quota of groups of EU member states before and after the EU sugar industry reform.

A large part of the EU sugar import requirements will be sourced under preferential import arrangements with the African, Caribbean and Pacific (ACP) countries as part of the Economic Partnership Agreements (EPAs) and from the least developed countries (LDC) under the Everything But Arms Initiative (EBA). However, the level of these preferential imports remains uncertain. Supply constraints, including lack of sugar storage capacity, continue to hinder the ability of LDC, non-LDC and ACP countries to expand exports. Aside from the existing gaps in physical infrastructure in these countries, the convergence of the EU internal sugar price and the world sugar price in recent years has substantially reduced the attractiveness to them of the EU market. This may lead beneficiaries of preferential market access to redirect some or all of their EU destined sugar to other regional and/or international markets.

**Figure 17: The share of the EU sugar production quota by groups of selected member states before and after the EU sugar industry reform**



Source: *International Confederation of Sugar Beet Growers, November 2008*

Beet sugar producing countries outside the EU have established systems more or less similar to the European one.

### 3.3.2 The system and regulation of imports in the United States

The price of sugar in the United States is only slightly lower than the world market sugar price. In the United States, the domestic market is protected by import levies because of the national sugar deficit. In Poland, South Africa and Thailand too, domestic sugar prices are subsidized heavily, whereas sugar exports must compete at world market prices.

### 3.3.3 The system in Brazil

The fully decentralized and “liberalized”<sup>21</sup> sugar marketing system in Brazil is run by individual sugar producers. Sugar export prices orient themselves around the world market sugar price. The only protection for domestic sugar prices exists in the form of a 2% import duty. Because about half of the sugar produced is used to make alcohol, the alcohol market plays a significant role in determining sugar prices.

## 3.4 Highlights about the main players in the beet sugar industry

### 3.4.2 The sugar beet growers

The agricultural community of sugar beet growers is very diverse, ranging from the small-scale Turkish planters with 0.5 ha per farm to industry giants such as the Russian companies with several tens of thousands of ha (see Table 4).

**Table 4: Area under sugar beet cultivation, sugar beet yields and sugar beet production in the world and by main producing countries, 2005–2007**

Country		2005	2006	2007
World	Area harvested (M ha)	5.4	5.4	5.3
	Yield (ton/ha average)	39.6	39.7	39.5
	Production quantity (M tons)	251.7	253.2	247.9
France (No. 1)	Area harvested (M ha)	0.4	0.4	0.4
World share: 13%	Yield (ton/ha)	82.3	78.8	82.3
	Production quantity (M tons)	31.1	29.9	32.3
United States (No. 2)	Area harvested (M ha)	0.5	0.5	0.5
World share: 13%	Yield (ton/ha)	49.5	58.0	63.2

<sup>21</sup> Brazil transforms 55% of its sugar cane into alcohol and 45% of its sugar cane into sugar. Depending on market prices, it adjusts (shifts) the cane-for-sugar percentage or the cane-for-alcohol percentage. On the one hand, it is a fight against subventions that misbalances the price, and on the other hand, it is significant aids such as tax exemptions that benefit biofuel producers.

Country		2005	2006	2007
	Production quantity (M tons)	24.9	30.6	31.9
Russian Federation (No. 3)	Area harvested (M ha)	0.8	0.9	1.0
World share: 12%	Yield (ton/ha)	28.2	32.5	29.0
	Production quantity (M tons)	21.4	30.9	29.0
Germany (No. 4)	Area harvested (M ha)	0.4	0.4	0.4
World share: 11%	Yield (ton/ha)	60.4	57.7	64.3
	Production quantity (M tons)	25.4	20.6	26.1
Ukraine (No. 5)	Area harvested (M ha)	0.6	0.8	0.6
World share: 7%	Yield (ton/ha)	24.8	28.5	26.7
	Production quantity (M tons)	15.5	22.4	17.0

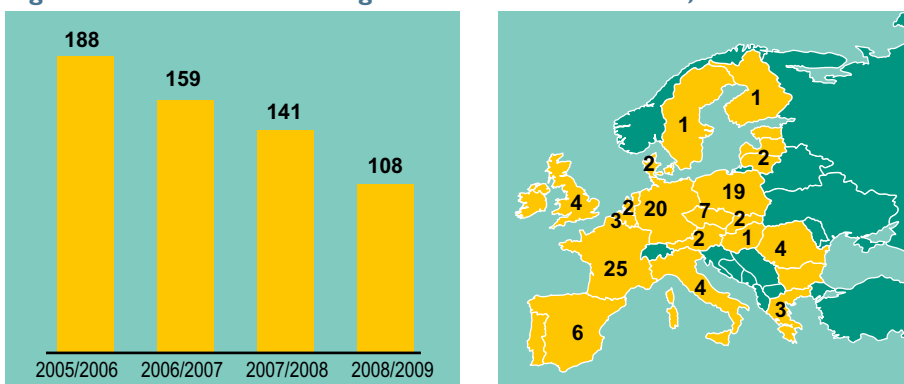
Source: FAOSTAT Database. © FAO 2009

### 3.4.3 The sugar extraction and refining companies

Worldwide, there is a large number of sugar extraction and refining companies, though there is a strong trend towards market consolidation (see Figure 18). Concentration of the sugar refining industry in the EU-27 is shown in Figure 18. The shares of the EU-25 sugar production quota by selected member states is shown in Table 5.

- The ten leading sugar companies hold over 84% of the EU-27 quota (see listing below).
- The sugar cooperatives hold 60% of the EU-27 quota.
- Around 40% of the European beet growers' cooperatives in the EU-27 deliver to sugar refining cooperatives in the EU-27.

**Figure 18: The number of sugar refineries in the EU-27, 2005–2009**



Source: International Confederation of European Beet Growers, November 2008.

**Table 5: The shares of the EU-25 sugar production quota by selected member states**

Country	Sugar production allowed after quota cut tons	Share of EU-25 quota %
Germany	2,859,942	19
France	2,760,245	18
Italy	1,342,672	9
United Kingdom	1,005,863	7
Spain	896,567	6
Netherlands	732,715	5
France (DOM)	423,912	3
Denmark	353,216	2
<b>Total</b>	<b>10,375,132</b>	<b>69</b>
Total EU-25 quota	15,047,113	100

Source: *The European Commission, 2006*

The top ten European sugar companies and the countries in which they operate are:

1. Südzucker – Germany	6. Pfeifer Langen – Germany
2. Nordzucker – Germany	7. Ebro Puleva – Spain
3. Tereos – France	8. Eridania Sadam – Italy
4. British Sugar – United Kingdom	9. Italia Zuccheri – Italy
5. Danisco – Denmark	10. Cosun – Netherlands

They represent 69% of the EU-25 quota.

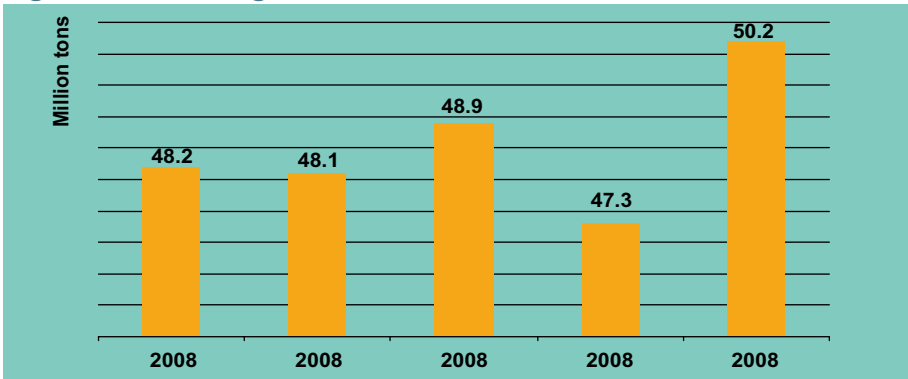
### 3.5 Sugar trade

World sugar trade is forecast to reach 50.2 million tons<sup>22</sup> (see Figure 19) in 2008/2009 (October/September), 6% more than the 2007/2008 estimate, driven by a strong import demand by countries that are likely to face a production shortfall, in particular the EU, India and Pakistan.

<sup>22</sup> FAO Food Outlook. June 2009. Global Market Analysis.



**Figure 19: World sugar trade<sup>23</sup>**



Source: FAO

### **3.5.1 The world's largest importers of sugar**

The EU is the most important element in the sugar trade outlook. It is turning into a net sugar importer as its production declines in line with the reform of its domestic sugar industry. Official imports are now set at 4.9 million tons, 53.6% or 1.7 million tons more than last season, much of which will be sourced from countries having preferential access to the EU.

India's sugar imports hover around 3 million tons, following the recent decision by the government to allow duty-free imports of white sugar. It imported no sugar in 2007/2008.

The Russian Federation and Ukraine have long been important players in the world sugar market. The Russian Federation is the world's third largest sugar importer, having switched most of its imports from white to raw sugar for domestic off-season refining in the 1990s<sup>24</sup>. However, Russia's import requirements continue to fall steadily. Rapid growth in domestic sugar beet cultivation, stimulated by higher beet prices with tariff protection and increasing investment, has been a feature of the sugar industry in the Russian Federation in recent years. This trend is expected to continue over the medium term against a backdrop of stagnant demand and to result in further domestic substitution of imports. Sugar production was projected to increase to 4 million tons, and with only slow growth in sugar consumption, raw sugar imports were forecast to decline by 14% to 2.8 million tons in 2008 (see Table 6). Ukraine has returned to self-sufficiency in sugar. Higher sugar beet yields are expected to lift sugar production in Ukraine.

<sup>23</sup> Figure includes adjustment for unrecorded trade.

<sup>24</sup> OECD/FAO Agricultural Outlook 2008.

**Table 6: The world's largest importers of sugar, 2004–2008 (million tons)**

Country/region	2004	2005	2006	2007	2008*
EU	3.3	3.2	3.3	3.3	4.4
India	2.1	0.0	0.0	0.0	3.0
Russian Federation	3.8	3.4	3.2	3.3	2.8
United States	1.8	3.2	1.9	1.9	2.7
United Arab Emirates	1.8	1.8	1.9	1.9	2.0
Malaysia	1.5	1.4	1.8	1.4	1.5
Japan	1.3	1.4	1.6	1.5	1.5
Republic of Korea	1.6	1.6	1.5	1.6	1.5
Nigeria	1.4	1.4	1.3	1.4	1.5

*\*Estimated figures*

*Source: FAO*

### **3.5.2 The world's largest exporters of sugar**

The production shortages in 2008/2009, mainly in India, have induced a closer supply/demand situation in the world market. Nonetheless, relatively comfortable stock availability in Thailand and good crops in Brazil and Guatemala help to sustain a 6.2% expansion in world sugar exports. Brazil, the world's largest exporter, could be among those countries to benefit most from rising international sugar quotations. Indeed, the country boosted its shipments by 28% to 24.12 million tons, following a contraction in 2007/2008, especially because falling freight costs may enable the country to regain market share, particularly in Asia (see Table 7). Driven by high international sugar prices, shipments from Thailand increased by 41% to 5.02 million tons in 2008, mostly routed to neighbouring importing countries.

**Table 7: The world's largest exporters of sugar, 2004–2008 (million tons)**

Country/region	2004	2005	2006	2007	2008
Brazil	19.15	16.87	21.53	18.85	24.12
Thailand	3.39	2.13	4.56	3.55	5.02
Australia	4.30	3.87	3.60	3.26	3.34
United Arab Emirates	1.64	1.68	1.75	1.82	1.97
Guatemala	1.10	1.55	1.36	1.30	1.54
South Africa	1.05	1.14	0.73	0.93	0.82
Cuba	0.77	0.73	0.84	0.90	0.74
Swaziland	0.70	0.63	0.62	0.62	0.64
Mexico	0.28	0.87	0.17	0.53	0.64
EU	6.04	8.07	1.59	1.10	0.30

Source: FAO

Production shortfalls are expected to lead to a decrease in the amount of sugar available for export on the one hand and higher import demand on the other hand. Most of the production shortfalls in exporting countries are expected to be covered by sugar stocks accumulated during the two previous surplus seasons.



## 4. SUGAR BEET CULTIVATION AND WHITE SUGAR PRODUCTION IN THE THE WESTERN BALKAN COUNTRIES (WBCs) AND THE EARLY TRANSITION COUNTRIES (ETCs)

### 4.1 An overview of the sugar sector in the regions of the WBCs and the ETCs

The only countries where sugar beet is being grown are Serbia in the WBC region followed far behind by the Republic of Moldova, Kyrgyzstan and Azerbaijan in the ETC region. Azerbaijan is showing impressive growth in its newly established sugar industry. Sugar production and refinement of imported raw sugar (mainly from Brazil) in other ETCs/WBCs, namely Albania, Armenia and the former Yugoslav Republic of Macedonia, are insignificant. Some countries like Montenegro, Georgia, Tajikistan, Uzbekistan and Mongolia do not produce sugar.

More information on sugar beet processing companies that operate in the ETCs and the WBCs can be downloaded from <http://www.eastagri.org/agribusinesses/>.

Table 8 provides an overview of sugar beet cultivation in the WBCs and the ETCs as well as in the countries neighbouring these two regions.

**Table 8: Sugar beet cultivation in the regions of the WBCs and the ETCs, and neighbouring countries, 2005–2007**

Country	Yield in ton/ha			Area harvested in ha			Total cultivation in M tons*		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
<b>WBCs:</b>									
Albania	30.8	20.0	20.0	1,300	2,000	2,000	40	40	40
Bosnia and Herzegovina	n/a	17.5	n/a	n/a	2	n/a	n/a	0.04	n/a
FYR Macedonia	36.4	25.0	29.5	1,591	1,000	200	58	25	6
Serbia	48.2	44.5	40.6	64,326	71,581	79,016	3,101	3,189	3,206
<b>WBC neighbouring countries:</b>									
Hungary	57.0	52.4	50.0	61,643	46,828	40,000	3,516	2,454	2,000
Slovakia	52.2	49.5	45.3	33,216	27,719	18,869	1,733	1,371	855
Slovenia	51.4	39.2	38.2	5,057	6,684	6,800	260	262	260
<b>ETCs:</b>									
Armenia	18.8	20.0	18.7	80	80	75	2	2	1
Azerbaijan	13.1	21.2	21.5	2,799	7,889	6,178	37	167	133
Georgia	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Country	Yield in ton/ha			Area harvested in ha			Total cultivation in M tons*		
Kyrgyzstan	20.0	16.8	18.1	14,454	13,484	8,600	289	226	155
Republic of Moldova	29.0	27.8	6.7	34,165	42,387	91,300	991	1,177	612
Uzbekistan	8.9	7.8	7.8	1,800	1,800	1,800	16	14	14
<b>ETC neighbouring countries:</b>									
Kazakhstan	21.6	24.6	25.0	14,400	13,800	12,400	311	339	309
Russian Federation	28.2	32.5	29.0	758,720	948,520	1,000,000	21,420	30,861	29,000
Ukraine	24.8	28.5	26.7	623,300	787,600	635,000	15,468	22,421	16,978

\* Slight difference in total cultivation data is due to the rounded yield figures.

Source: FAOSTAT. © FAO Statistics Division, 2009

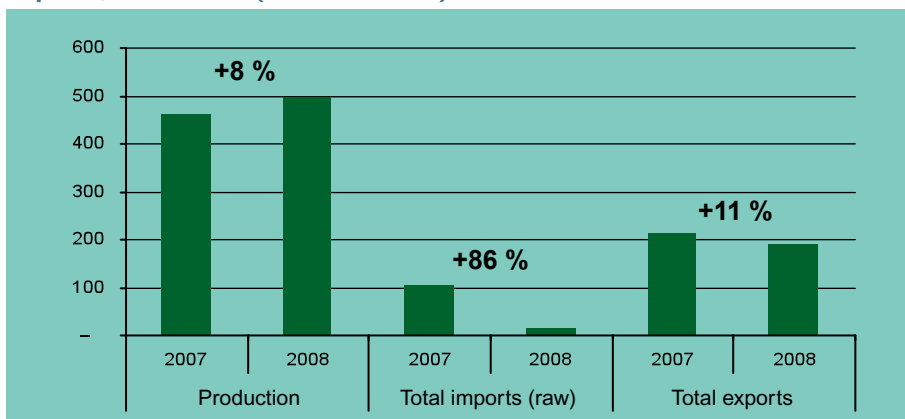
The main area in Serbia for sugar beet cultivation is the northern province of Vojvodina, where the soil and climate conditions are the most suitable. There, on the soils called chernozems, potential sugar beet yields could range from 40 to 53 tons/ha, with beet sucrose content of up to 16%. All Serbian sugar factories are located in Vojvodina and have a capacity to produce a total of 660,000 tons of beet sugar.

In 2007, Serbian beet growers cultivated 3.2 million tons<sup>25</sup> of sugar beet on about 80,000 ha. The production of sugar reached 454,000 tons in 2007/2008. In 2008, beet growers cultivated 2.5 million tons of sugar beet on 49,000 ha and produced 372,000 tons of beet sugar (82,000 tons less than in the previous year or -18%). Total sugar supply (domestic production plus opening stocks plus imports) is enough to meet domestic needs (250,000 tons per year on average) and fulfils the export quota for the EU market amounting to 180,000 tons (see Figure 20).

Some sugar beet was exported to Croatia, whose sugar refineries offered higher prices to the Serbian producers.

<sup>25</sup> Agricultural Inspection Service, Serbia.

**Figure 20: The Serbian sugar supply, including production, imports and exports, 2007–2008 (thousand tons)**



Source: FAO

In Serbia, eight sugar factories are in operation (all owned by EU companies). Four factories are owned by the company SUNOKO (Nordcuker of Germany and the domestic MK Group with minor ownership), two factories are owned by the Italian company SFIR and two factories are owned by Hellenic Sugar of Greece.

Serbia's sugar beet processing facilities are now primarily in private hands. Šećerana Crvenka (Hellenic Sugar) is the leading processing plant, followed by Te-To AD Senta (SFIR, Italy) and Donji Srem Pećinci (SUNOKO), the second and third largest processing plants, respectively.

Investment in the sugar processing sector since privatization (2000) is as follows:

- EUR 45,600,000 by SUNOKO
- EUR 20,600,000 by Hellenic Sugar
- EUR 13,800,000 by SFIR

The Republic of Moldova became the first and to date the only republic of the former Soviet Union (FSU) to receive large-scale western investment in its sugar sector. In 1997, Südzucker AG (Germany), the leading West European sugar producer with 150 years of history, acquired control of half of the factories in the Republic of Moldova. The other half of the factories were bought by a Russian agro-industrial company.

As a result of the financial, technological and managerial support provided by foreign investors, sugar production in the Republic of Moldova increased from 102,000 tons in 2002 to 161,000 tons in 2006. In 2007, the rise in production was checked by the most severe drought in 60 years, which affected 84% of the arable land. According to industry experts, damage was inflicted by the 2007 climatic calamities on 50% of the beet harvest. As a result, sugar production in 2007/2008 was halved compared with the previous season's production. With the return of normal weather in 2008, output rebounded to 140,000–150,000 tons from 965,200 tons of beet, with an average yield of 42.1 tons/ha.

Presently, the sugar industry in the Republic of Moldova is represented by two companies, Südzucker Moldova and the MarrSugar Moldova. Südzucker Moldova, a Moldovan-German joint venture with Südzucker AG the main shareholder, was established in 2001 as the result of a merger between the sugar refineries in Drochia, Falesti and Dondiuseni and was joined three years later by the refinery in Alexandreni. The four sugar refineries in Drochia, Falesti, Alexandreni and Donduseni, which are now owned by Südzucker Moldova, process more than 500,000 tons of beet per year and produce more than 70,000 tons of sugar.

One of the most important tasks of Südzucker Moldova is to strengthen and develop partnerships with agro-economies. Company experts provide support throughout the entire agricultural cycle, from preparation of the ground for crops to harvesting the crops.

Since 2002, MarrSugar, a Moldovan-Russian enterprise, owns the Cupcini-Cristal and Glodeni-Zahar sugar refineries.

In 2008, a record-breaking sugar beet harvest in the Republic of Moldova yielded a total of more than 965,200 tons or 42.1 tons/ha. About 132,500 tons of sugar were produced – almost twice as much as Moldova's annual domestic demand.

Of the sugar producing countries in the ETC region, Azerbaijan has been the most dynamic. After the completion of the construction of the first sugar factory in the country, an initial 60,000 tons of sugar from domestically grown sugar beet were produced in 2006. In 2008, the country was expected to produce about 140,000 tons of sugar.

Beet sugar is also manufactured in Kyrgyzstan, but the levels of production are extremely unstable, varying from 29,000 to 88,000 tons per year.



## 4.2 Issues and challenges specific to the regions of the WBCs and the ETCs

Large state or privatized organizations are not suitable production units for the cultivation of sugar beet, which is an intensive crop requiring advanced agricultural technology and strict discipline.

The existing sugar factories consume huge amounts of energy, five times more energy per ton of sugar beet processed than a modern competitive factory. Moreover, they are usually located far from sugar beet farms. For example:

France	Russian Federation
<ul style="list-style-type: none"><li>■ average distance farm to factory: 25–30 km</li><li>■ plant capacity: 12,000 tons/day of sugar beet</li><li>■ sugar content: 17.5%</li></ul>	<ul style="list-style-type: none"><li>■ average distance farm to factory: 60–80 km</li><li>■ plant capacity: 3,500 tons/day of sugar beet</li><li>■ sugar content: 15.5%</li></ul>

Source: *Industry sources*

Lack of Integrity in operations is as much an issue as market protection of beet sugar prices. Unethical practices are particularly typical of the majority of the Caucasus countries. The form that fraud takes varies but typically consists of false custom's declarations.

Custom's declarations may be true but sometimes practices such as mixing sugar with cacao or powdered milk in order to incur a lower custom duty are followed (later the product is treated in a special way to extract the sugar). Although this practice is not fraudulent, it does demonstrate a good knowledge about custom duties (sugar products are classified under categories that are subject to lower custom duties than sugar products 1701 or 1702).

**Table 9: White sugar production, imports and exports in the WBCs and ETCs regions (million tons)**

Country	Production		Raw imports		White imports		Total imports		Country partners		Total exports		Country partners	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
<b>WBCs:</b>														
Albania	4	4	93	98	n/a	n/a	93	98	Brazil, India, Thailand	4	3	Serbia		
Bosnia & Herzegovina	n/a	n/a	155	155	n/a	n/a	155	155	Brazil, India	1	1	Croatia, United States		
FYR Macedonia	9	9	49	46	31	29	80	75	Brazil	n/a	n/a	Greece, Serbia, Poland		
Serbia	463	500	105	15	n/a	n/a	105	15	Republic of Moldova, Brazil, India	213	190	Italy, Greece, Austria		
<b>ETCs:</b>														
Armenia	1	1	7	9	98	87	105	96	Georgia, Brazil	n/a	n/a	Russian Federation, Georgia, Turkmenistan, Iran		
Azerbaijan	72	82	249	236	28	26	277	262	Brazil, Russian Federation	115	120			
Georgia	n/a	n/a	346	338	38	38	384	376	Brazil, Azerbaijan, France, Belarus	160	155	Armenia, Azerbaijan, Kazakhstan		
Kyrgyzstan	20	25	130	126	14	1	145	128	Kazakhstan, Belarus, Brazil	28	25	Tajikistan		
Mongolia	0	0	0	0	30*	30*	30*	30*	n/a	0	0			
Republic of Moldova	91	141	115	85	13	10	128	95	Hungary, Romania	26	35	Russian Federation, Romania, Serbia		
Tajikistan	n/a	n/a	148	135	16	15	165	150	n/a	n/a	n/a			
Uzbekistan	n/a	n/a	526	521	58	58	584	579	no data	17	17	No data		
<b>Neighbouring countries:</b>														
Kazakhstan	26	28	420	326	77	164	498	490	Brazil, Russian Federation, Guatemala	22	29	Kyrgyzstan, Ukraine, Russian Federation, Uzbekistan		
Russian Federation	3,334	3,800	3,020	2,714	234	73	3,254	2,787	Brazil, Cuba, Argentina, Thailand	130	50	Kazakhstan, Tajikistan, Afghanistan, Azerbaijan, Uzbekistan		
Ukraine	1,981	1,710	4	320	72	88	76	408	n/a	1	6	n/a		

Source: FAO. \* Estimate.

### 4.3 Investment projects

Select EBRD investments in sugar projects in the WBC and ETC regions include:

Year	Name	Country	Investment type	Project (M EUR)	EBRD (M EUR)
1993	Dobrovice Sugar Factory	Czech Republic	Equity	33	4
2000	SFIR	Serbia	Debt	37	30
2005	SFIR	Serbia	Debt	28	7
2008	Astarta	Ukraine	Debt	13	13
2008	Viro Tvornica Secera	Croatia	Debt	40	20

The EBRD loaned EUR 13 million to Astarta, Ukraine's leading agribusiness operator and sugar producer. The loan enabled Astarta to purchase sugar processing equipment to achieve higher efficiency in its sugar factory operations as well as its sugar beet farming operations. To address energy saving project opportunities, the EBRD commissioned an energy audit conducted within the Energy Audit Programme funded by the Central European Initiative.

The EBRD loaned EUR 40 million to Viro Tvornica Secera, Croatia's leading sugar producer for the modernization of its production facilities, including a comprehensive energy efficiency programme, the installation of new sugar processing equipment and the privatization of the state-owned sugar refinery Sladovana.



## 5. FURTHER READING

- OECD-FAO Agricultural Outlook 2008–2017. 2008.
- FAO Food Outlook, published twice a year in June and November.
- Serbia and Montenegro: Review of the Sugar Sector. 2004. Report Series No. 6. FAO/EBRD.  
(Available at <ftp://ftp.fao.org/docrep/fao/008/af099e/af099e00.pdf>)



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