

Background paper for the
**Competitive Commercial Agriculture in Sub-Saharan
Africa (CCAA) Study**

Maize
International Market Profile

Abdolreza Abbassian
Trade and Markets Division
Food and Agriculture Organization of the United Nations

Disclaimer:

This background report is being made available to communicate the results of Bank-funded work to the development community with the least possible delay. The manuscript therefore has not been prepared in accordance with the procedures appropriate to formally edited texts. Some sources cited in this report may be informal documents that are not readily available.

The findings and interpretations expressed in this report are those of the author(s) and do not necessarily reflect the views of the Board of Executive Directors of the World Bank or the governments they represent, or those of the Food and Agriculture Organization of the United Nations (FAO).

The World Bank and FAO do not guarantee the accuracy of the data included in this work. The designations employed and the presentation of the material in this work, including the boundaries, colors, denominations, and other information shown on any map do not imply any judgment on the part of the World Bank or FAO concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Maize: International Market Profile¹

1 Introduction

Maize is the third largest planted crop after wheat and rice. It is mostly used and traded as a leading feed crop but is also an important food staple. In addition to food and feed, maize has wide range of industrial applications as well; from food processing to manufacturing of ethanol. This report discusses the significance of maize in the global context. It begins by providing an overview of the different origins/types of maize as well as describing its planting characteristics. Next it discusses the international maize economy and describes some of the main factors which have contributed to developments in production, consumption, and trade of maize over the past two decades. In the final analysis, the FAO's assessments of the current state of the world supply and demand balance for maize as well as its medium term outlook are presented. Statistical tables providing 10 years of data on production, total utilization, feed use, trade flows, stocks, freight rates, food aid shipments, co-products and prices are provided in Annex I. A descriptive list of selected on-line resources that provide market information on maize is included in Annex II.

Origins and Varieties

Maize is one of the oldest human-domesticated plants. Its origins are believed to date back to at least 7000 years ago when it was grown in the form of a wild grass called *teosinte* in Central Mexico. Recognizing its early potential as a major food crop, over time the *Mesoamerican* natives managed to improve the crop, by systematically selecting certain varieties for their desired traits. This process led to the gradual transformation of *teosinte* to its present day form known as maize, a name which is a likely derivative of "*mahis*", meaning "source of life" for *Tanío* people, the natives known to have mastered its cultivation. Maize is also known as *corn*, which is the name that has come into common usage primarily because it is used in the United States, the world's largest producer, consumer and exporter of maize. This reference to corn, rather than maize, in the United States can be traced to the arrival of the early European settlers in the New World when maize was referred to as "*Indian corn*". Indian corn is a type of maize known for its colourful kernel (or seed) which is scientifically known as *Zea mays*. The term corn most likely originates from the Germanic '**korn**' which referred to any edible grass. The importance of corn in North American heritage could not be more evident than in the history of the annual Thanksgiving celebration, the origin of which dates back to the first celebrations by the Pilgrims and the Native Americans who gave thanks for the "corn harvest".

Maize is an annual plant with high productivity which also enjoys exceptional geographic adaptability, an important property which has helped its cultivation to spread throughout the world. Its gradual expansion in the Americas by the Natives was rapidly propagated in the 16th century following the return of Columbus to Europe. Colonial conquests and trade played a central role in the spread of maize cultivation well beyond the European continent, to Africa and Far East Asia. There exist several hybrids of maize, each with their own specific properties and kernel characteristics; the most common ones include: **dent** (or field maize, used for livestock feeding and can be yellow or white), **flint** (or Indian maize, grown mostly

¹ Generous collaboration and inputs were provided by John Heine and Claudio Cerquiglini.

in Central and South America), and **sweet** (or green maize). Depending on their colour and taste, maize grown around the world is generally categorized into two broad groups: yellow and white. **Yellow maize** constitutes the bulk of total world maize production and international trade. It is grown in most northern hemisphere countries where it is traditionally used for animal feed. **White maize**, which requires more favourable climatic conditions for growing, is produced in only a handful of countries, the United States, Mexico and in southern Africa. White maize is generally considered a food crop. Market prices are usually higher for white maize compared to the yellow type but the premium can vary depending on local supply and demand conditions.

Grades and Production Cycles

As with other cereals, for commercial and marketing purposes, maize is also assigned different types of grades and classes depending on a set of physical descriptions or qualities such as the minimum test-weight, feeding values, and maximum limits of damaged kernels and foreign material. In the United States, for example, maize classes are determined on the basis of colour (divided into yellow, white and mixed) and are graded from 1 to 5 (Table 1). The No. 2 grade of maize is widely considered as the traditional representative price for maize produced in the United States; it is also accepted as the world's most representative price for maize and other coarse grains.

Table 1 - Grade Requirements for Maize in the United States (percent)

Grade	Minimum	Maximum Limits of			
	Test Weight Per Bushel (Pounds)	Moisture	Broken Corn and Foreign Material	Damaged Kernels	
				Total	Heat-Damaged Kernels
U.S. No. 1	56	14.0	2	3	0.1
U.S. No. 2	54	15.5	3	5	0.2
U.S. No. 3	52	17.5	4	7	0.5
U.S. No. 4	49	20.0	5	10	1.0
U.S. No. 5	46	23.0	7	15	3.0

SOURCE: Agricultural Marketing Service, USDA.

1 bushel = 0.0254 metric tonne and 1 tonne= 2204.6 pounds

Planting size and growing conditions are critical elements in determining price developments. For this reason, much effort is often spent on monitoring crop conditions during the production cycle (Table 2). One important advantage of agricultural crops is that they are renewable and take fairly short time to produce. Some crops such as maize are also produced in both the northern and southern hemispheres and this can be regarded as an additional stabilization bonus as the world harvests staggered throughout the year. Of course, any sudden turn in the weather and/or spill price effects arising from supply and demand developments in other markets can still influence maize spot and near-term prices during any given season but those conditions are usually sporadic as market behaviour is mostly driven by its own supply and demand fundamentals.

Table 2 – Maize Crop Cycles and Importance of Weather on Prices

Month	Northern Hemisphere		Southern Hemisphere	
	Crop Stage	Weather	Crop Stage	Weather
January			Silking	C
February			Filling	C
March			Maturing	C
April	Planting	M	Harvesting	M
May	Planting	M	Harvesting	M
June	Dormant	M		
July	Silking	C		
August	Maturing	C		
September	Harvesting	C	Planting	M
October	Harvesting	M	Planting	M
November	Harvesting	M	Planting	M
December			Dormant	M

SOURCES: FAO/USDA/ Dean Witter

M= Time of year weather can be a Major price determining factor.

C= Time of year weather can be a Most Critical price determining factor.

One factor which causes serious problems for maize production from time to time is the occurrence of **El Niño**, a weather phenomenon which is associated with significant abnormal warming of sea-surface temperatures in the Pacific Ocean. The maize crops that are most affected by the El Niño (mostly in the form of prolonged dry conditions) are largely concentrated in the southern hemisphere, in particular in southern Africa. During El Niño events of the 1980s and 1990s, for example, maize production in the Republic of South Africa fell by as much as 40 to 60 percent. Brazil is another significant southern hemisphere maize producer which has suffered from floods and drought driven by El Niño situations in the past. Adverse weather conditions caused by the last major El Niño event in 1997/98 were located mostly in Far East Asia and were responsible for sharp declines in yields in the affected countries (such as Thailand); in a way this contributed to an already difficult economic situation in the midst of the Asian financial crisis. However, on occasion El Niño events can also produce favourable growing conditions, thus boosting yields and production such as when its timing coincides with the critical tasseling stage of crops². Such positive outcomes are less frequent but not uncommon and were experienced in the past in both Argentina and the United States, the two leading maize producers.

2 Market Structure

International maize economy has undergone major changes over the past two decades in terms of production, utilization, trade as well as marketing structure. These changes were driven by a host of factors ranging from rapid advancements in seed and production technologies, changes in national policies and international trade, nearly uninterrupted expansion of feed usage across the globe and more recently the sudden surge in demand for ethanol.

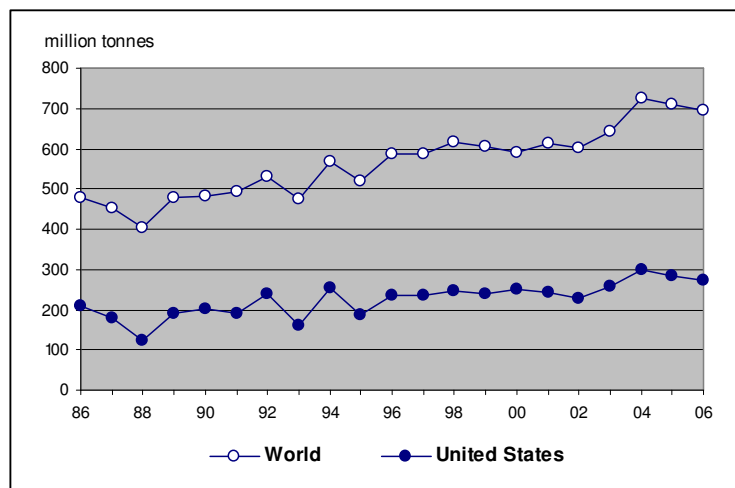
2.1 Production

From “Green Revolution” To “Biotechnology Revolution”

² Tasseling refers to a development stage in the maize growth cycle when the tassel-like male flowers emerge.

At around 700 million tonnes, world maize production represents over one-third of world cereal output. Over the past two decades, global maize production has increased by nearly 50 percent, or 1.8 percent annual compound growth rate (Figure 1). Most of the increase in world maize production during the past decade can be attributed to a rapid expansion in Asia. Asian maize production grew by nearly 35 percent during the past decade, accounting for almost 30 percent of the global increase. Both area and yield increases contributed to this high level of growth, with China making the most significant advance by contributing to as much as 60 percent of the total gains in Asian maize production over the past decade.

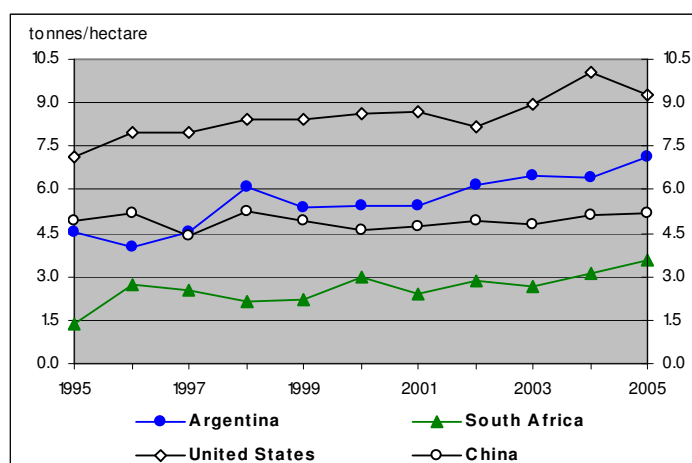
Figure 1- **Maize Production**



In spite of the advances attributed to the *Green Revolution* and the introduction of high yield maize varieties³, the possibilities for maize yield improvements in many countries has remained large as the degree of production efficiency, especially in the developing countries, still falls below major commercial producers. Average maize yields among the developing countries, as an aggregate, are

about one-third of those of the major maize producers. Among some of the largest maize producing countries (Figure 2), yield in China is around 5 tonnes/ha⁴ while in the Republic of South Africa it stands at around 3 tonnes/ha. This compare to 9 tonnes/ha in the United States, the highest world producer.

Figure 2 - **Maize Yields in Selected Countries**



Notwithstanding the large yield gap between the maize producing countries, a relatively more recent development with important implications for production as well as trade and marketing, has been the “biotechnology revolution”; a development which resulted in the spread of the **Genetically Modified (GM)** maize seeds or **Bt maize**. According to the United States Department of Agriculture (USDA), farmers in the United

³ The term *Green Revolution* refers to the transformation of agriculture which resulted in significant gains in cereal production between the 1940s and 1960s in the developing countries. The novel technological development of the Green Revolution was the production of high yielding varieties of maize, wheat, and rice.

⁴ A hectare (symbol ha) is a unit of area, equal to 10000 square metres.

States readily adopted the new technology in maize for two basic reasons: “increase yields through improved pest control” and “to decrease pesticide costs”⁵. In fact, the GM seeds were first introduced on a commercial scale in 1996 in the United States, followed by Canada in 1997 and Argentina in 1998. Since then it has been adapted on a smaller and/or experimental scale in several countries around the world, including some European countries, the Republic of South Africa, and China. The area under Bt maize has continued to grow significantly since 1996, from nil to almost 15 percent of the total world planted area of maize. According to the latest information compiled by the *International Service for the Acquisition of Agri-Biotech Applications* (ISAAA)⁶, the area devoted to Bt maize grew by roughly 25 percent per year between 2002 and 2004 and then expanded by about 10 percent in 2005. Most of the more recent increases occurred in the United States with modest growth registered also in Canada and the Philippines⁷. In addition, three new countries grew Bt maize in 2005: Portugal, France and the Czech Republic, all member states of the EU. According to ISAAA, Bt varieties of maize accounted for the second and third most dominant Biotech crop in 2005⁸. Bt maize was the second most dominant crop in 2005 with 11.3 million hectares (13 percent of the world total biotech crop area) which were grown commercially in the United States, Argentina, Canada, the Republic of South Africa, the Philippines, Spain, Uruguay, Honduras, Portugal, Germany, France, and the Czech Republic. The third most dominant crop was also maize, the Bt/Herbicide maize. This variety was grown over 6.5 million hectares in the United States and Canada (equivalent to 7 percent of the global biotech area).

Marketing of GM Maize

Continuing consumer and legislative pressure to regulate the marketing and trade of GM crops are the main challenges facing the producers of GM maize. In the present market environment, the growing emphasis is on final products and consumer concerns have been putting pressure on the industry to separate non-GM crops from their GM alternative (i.e. segregation). As a result, one of the greatest challenges facing the international trade of bulk commodities such as grains has become the development of multiple niche markets for GM grains in order to meet importer and consumer preferences⁹. Maize has been on the forefront of this new challenge and the reason behind the rise in market segregation practices.

⁵ The control of damage caused by insects has been the most popular among maize farmers in the United States, Argentina and a few other countries. The bulk of the GM maize crop in these countries is planted with seed modified to combat pest infestation – in the United States the major maize pest the so-called European “corn” borer. The insect resistant gene, commonly known as Bt (*Bacillus thuringiensis*, a bacterial disease of insects), is expected to reduce crop losses and, subsequently, increase yields. Production costs are also assumed to be reduced by the use of Bt maize (after accounting for the higher cost of GM seeds) because the use of chemical pesticides is reduced and/or eliminated altogether. Less common are herbicide tolerant maize plants (mostly used in soybean production) and “stacked”, or multiple-trait, GM maize. The USDA study notes that farmers also adopted GM seeds to facilitate crop rotation, to reduce mechanical tillage operations and to use environmentally friendly practices (USDA/ERS, 2000).

⁶ Global Status of Commercialized Biotech/GM Crops: 2005, ISAAA Briefs, No. 34 – 2005.

⁷ Marginal decreases in 2005 were reported in Argentina, The Republic of South Africa, and Spain but those were mainly due to total plantings of maize being lower because of uncertainty regarding weather, trade conditions and prices.

⁸ Herbicide tolerant soybean was the first, with 54.4 million hectare and representing 60 percent of the global biotech crop area of 90.0 million hectares for all crops.

⁹ For further reading see *Biotechnology developments and their potential impact on trade in cereals*, a paper presented to the joint meeting of the FAO Intergovernmental Group on Grains and the Intergovernmental Group on Rice in September 1999.

Segregation in maize markets is not a new development as it already exists for white maize (food quality) and high oil maize (feed quality). This requires the separation of marketing functions to preserve the “purity” of these speciality/niche crops. However, segregation of GM maize has proven a more formidable task.¹⁰ There are a number of important economic issues which have distinct implications for trade. Segregating markets requires physical separation of the non-GM maize from those which are GM “contaminated” starting at the farm level. Segregation along the supply chain from farm to end-user implies extra costs and the cost could increase dramatically as the tolerance level for the presence of GM material is lowered. At the same time, low tolerance levels are also proving less practical (or economic) to achieve under current conditions given the problem of cross-pollination in the field and the cost of thoroughly cleaning equipment to avoid “contamination”.

This problem of “contamination” received considerable international attention following the so-called *StarLink* controversy. StarLink is a trademark for a variety of bio-engineered maize, which similar to Bt maize was developed to resist certain insects. The commercial production of StarLink by Aventis, the company which produced it, was approved in 1998 by the authorities in the United States but only for animal feed and non-food purposes. However, in September 2000, the first traces of genetic material from StarLink maize were found in maize taco shells in the United States and in October it was also detected in snack food in Japan. This development had a damaging impact on consumer confidence, leading to a decline in demand in the domestic market, lowered exports and consequently depressed maize prices. While a more immediate response by some countries (such as Japan and the Republic of Korea, the two largest importers of maize from the United States) was a shift in purchases from the United States to non-GM maize producers in South America, the controversy over StarLink demonstrated the difficulty of segregating genetically engineered crops, heightened public awareness across the world and paved the way for radical changes in the regulatory process.

Legislators (e.g. the EU and Japan) have passed laws restricting the importation of certain GM crops and products from un-approved varieties. Consumer concerns in some countries (such as Australia, the EU and Japan) called for **labelling** foods containing a specified amount of genetically modified ingredients in the final product. The international scope of the issue was first incorporated into the *Protocol on Biodiversity* (Montreal, January 29, 2000) where 130 countries agreed to require the identification of GM material in exports - countries exporting GM products would be required to obtain importing country approval prior to shipment. As a result of these and other regulations, the market has begun to segregate non-GM crops to support *identity preservation (IP)* from producer to final consumer, although in the case of maize it still represents a relatively small percentage of the total market (5% by some estimates).

The situation for international trade in GM maize is further complicated by the trade regulations under the auspices of the *World Trade Organization (WTO)*, namely, the application of *Sanitary and Phytosanitary Measures (SPS)* and *Technical Barriers to Trade (TBT)*. In general, the SPS Agreement would allow importing countries to limit trade based on scientific evidence of potential human, plant and animal health risks and/or environmental degradation. In the case of maize (and all grains in general), there has been concern expressed about the introduction of Bt into maize seeds and the possible implications for human health

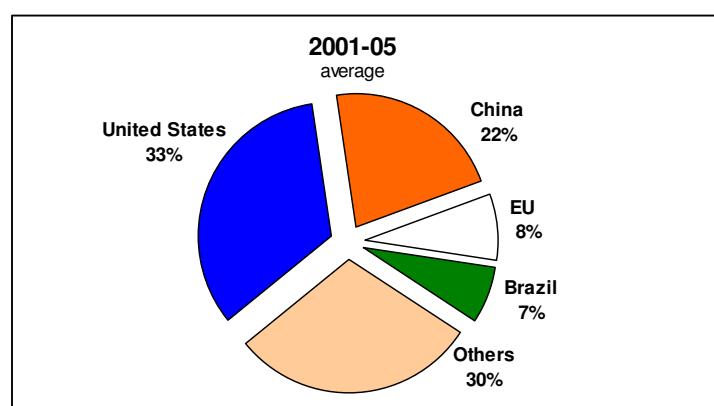
¹⁰ Both types of maize are currently produced through conventional breeding techniques. Other food and industrial use niche markets exist for waxy corn, hard endosperm corn and nutritional dense corn. Together, these speciality crops accounted for about 5 percent of the planted maize area in the United States in the 1990s.

and the environment. The issue has been raised with regard to the labelling of maize products which may have been produced from seeds containing the Bt gene. Such requirements for GM labelling have grown to become a multilateral or bilateral trade negotiating issue. These and other related safety and health issues are expected to continue to influence future trade in maize derived from biotechnology.

2.2 Consumption: Utilization and Co-products

Globally, around 460 million tonnes, or 65 percent, of total world maize production is used for feed purposes while around 15 percent is used for food and the remaining mainly destined for various types of industrial uses. The diversity in usage of maize stems from its multiple nutritional characteristics. Maize (yellow) is typically composed of roughly 61 percent starch, 3.8 percent oil, 8 percent protein, 11.2 percent fiber and 16 percent moisture.

Figure 3 – Maize for Animal Feed



Maize is an essential ingredient in animal feed because it is rich in energy. The leading users of maize for animal feeding are the United States, China, EU and Brazil; together they account for almost 70 percent of the global use of maize for animal feed (Figure 3). Nearly all regions in the world have registered strong growth in feed usage of maize in recent years. Economic growth,

urbanization and rising incomes have given rise to the fastest expansion taking place in the developing countries, especially in Africa and Central America where the compound growth between 2001 and 2006 exceeded 4 percent (Table 3).

Table 3 – Feed Use of Maize by Region

	2001/02	2002/03	2003/04	2004/05	2005/06 estimate	Growth Rate
	<i>million tonnes</i>					<i>%</i>
ASIA	142.9	145.4	149.4	152.2	155.5	2.1
AFRICA	15.4	15.6	16.5	16.7	18.3	4.3
CENTRAL AMERICA	11.5	11.7	13.0	13.8	13.9	4.8
SOUTH AMERICA	39.1	39.0	41.2	43.3	43.2	2.5
NORTH AMERICA	158.5	151.4	156.1	164.4	164.6	1.0
EUROPE	59.4	59.0	59.1	71.2	66.1	2.7
OCEANIA	0.4	0.5	0.4	0.5	0.4	-0.4
WORLD	427.2	422.7	435.7	462.1	462.0	2.0
Developing countries	191.5	193.5	200.6	207.2	211.3	2.5
Developed countries	235.7	229.2	235.1	254.9	250.7	1.5

SOURCE: FAO

Maize in the United States

Given the importance of the United States, not only as the world's largest producer and exporter of maize but, equally significant, as the largest and most advanced consumer of maize, it is useful to provide an overview of how maize is used in that country. Tables 4 and 5 illustrate the amount of products that can potentially be derived from one 1 tonne of maize.

Table 4 - **What Can One Tonne Of Maize Produce?**¹¹

29 Kg of Corn Oil	AND	571 Kg of Starch
AND		OR
241 Kg of 21% Protein Gluten Feed		589 Kg of Sweetener
AND		OR
46 Kg of 60% Gluten Meal		402 Litters of Ethanol / Alcohol

SOURCE: Iowa Corn

Table 5 – **How Much Meat Can One Tonne Of Maize Produce?**

Maize Input	Potential Production of Meat
1 tonne of Maize	100 kg Beef
	250 kg Pork
	333 kg Chicken
	500 kg Catfish

SOURCE: The USA National Corn Growers Association

In recent years, around 155 million tonnes, or 55 percent, of domestic maize production in the United States has gone to feed livestock (hogs, beef cattle, poultry and also dairy cattle) while around 18 percent was exported. After feed and exports, the third use of maize in the United States has become ethanol, production of which has quadrupled since the start of the decade. In 2005/06, over 40 million tonnes, or 14 percent, of domestic maize production was fermented into fuel alcohol or **ethanol**¹². Increase in oil prices coupled with rising demand for "green" fuel from renewable resources following the phasing out of **Methyl Tertiary Butyl Ether (MTBE)**, a rival additive, have boosted maize-based ethanol production and has turned the United States to the world's leading maize-based ethanol producer.

Around 5 percent of total maize production in the United States is used in the manufacturing of **High Fructose Corn Syrup (HFCS)**, which is a popular substitute for sucrose (found in sugar) and used in soft drinks and other processed foods. Also, roughly 4 percent of maize is processed into starch for food and industrial use (such as in paper, textiles, adhesives, plastics, baked goods, condiments, candies, soups and mixes) and around 1 percent is fermented into beverage alcohol¹³.

*Maize Feed Ingredients*¹⁴

¹¹ For more information, see Iowa Corn at http://www.iowacorn.org/cornuse/cornuse_3.html

¹² Put into perspective, the current usage of maize by the United States for ethanol is fast approaching its annual maize exports or exceeds total maize used for animal feed in the EU 25. It is also worth noting that an important coproduct of dry-grind ethanol production is distillers grains, which are also used/added to feed rations as a source of energy and/or protein in feed rations.

¹³ Given that making sweetener, starch and alcohol does not utilize the entire maize kernel, some 600 000 tonnes of co-products make their way to animal feed and another 1.5 million tonnes for production of maize oil.

¹⁴ For typical nutrient composition of maize grain and selected by-product feeds, see the Annex I, Table 15.

Maize products as feed ingredients have also gained more importance over the past two decades mainly in response to rising demand from the livestock sector, which itself has undergone major structural changes; gaining efficiency through vertical integration with feeding becoming increasingly concentrated and feedlots largely controlled by the commercial sector rather than the farm. Improvements and innovations in maize milling process have helped to keep up with the industry's increasing demand for more nutritious feed ingredients.

The most striking new development has been the rapid expansion in the ethanol industry which has also brought about a sudden increase in the supply of **Distillers Grains (DG)**. Under the dry-milling process, when maize is fermented to alcohol, around one-third of the **Dry Matter (DM)** is recovered in "co-products" which, in turn, are further processed into a variety of feed ingredient products¹⁵. The conversion from DM to DG involves starch fermentation which eventually produces two feed co-products: **Corn Condensed Distillers Solubles (CDS)** and **Corn Distillers Dried Grains with Solubles (DDGS)**, which are rich in essential nutrients such as protein, fat, minerals¹⁶. In 2004, ethanol plants produced approximately 7.3 million tonnes of DG, of which nearly 6.5 million tonnes were used in feeding in the United States while nearly 787 000 tonnes were exported. Since then, dry grind plants are estimated to have increased their production of DG to 10 million tonnes and based on the industry projections, this amount could expand to 16 million tonnes by 2012 thus increasing the role of DG in feed rations in the years to come¹⁷.

Aside from Distillers Grains, which result from the dry milling process, there are several other maize co-products used in feed rations, mostly derived from the more traditional wet milling process. The most common ones are:

Maize Gluten Meal: Dried high protein (almost 60 percent) feed source. It is a residue from maize after the removal of the larger part of the starch and germ, the separation of the bran by the process employed in the wet-milling manufacture of maize starch or syrup. It is commonly used by the poultry industry, farm animal feed in fish and pet food. It is also used in cattle feed.

Maize Gluten Feed: Is that part of the commercial shelled maize that remains after the extraction of the larger portion of the starch, gluten, and germ by the processes employed in the wet milling manufacture of maize starch or syrup. It is used in complete feeds for dairy and beef cattle, poultry, swine and pet foods.

¹⁵ Because of their increasing market value as feed ingredients, they are considered as "co-products" rather than "by-products".

¹⁶ According to a recent study by North Dakota State University, "all the nutrients are increased three-fold because most grains contain approximately two-thirds starch. For example, if corn used in the dry milling operation is 4% oil, distillers wet grains (DWG) or DDG will contain approximately 12% oil". For further information see: <http://www.ag.ndsu.edu/pubs/ansci/dairy/as1241w.htm>. Also, according to a study by Klopfenstein and Grant, "in general, there are two nutritional philosophies regarding their use in feedlot finishing diets. The DG can be fed at 6 to 15% of the diet dry matter (DM), serving primarily as a source of supplemental protein. When fed at higher levels (greater than 15% of the diet DM), the by-product's primary role is as a source of energy replacing corn grain. Other than DM content (wet DG, 35-45%; dried DG, 90-95%), the chemical composition of the two products is similar. Dried DG is routinely fed as a supplemental protein source; however, the drying process appears to reduce the energy value of the DG". On-line access to this study is available at <http://www.ddgs.umn.edu/articles-dairy/2001-Klopfenstein-%20MNC%20beef-dairy.pdf>

¹⁷ The National Corn Growers Association (NCGA). For more information see: <http://www.ncga.com/ethanol/DistillersGrains/index.asp>

Maize Seed Cake: With over 17 percent protein, it is considered ideal feed for breeding chickens, ducks, geese, pigs, fish, and other livestock.

Maize Germ Meal: Typically contains more than 20 percent protein and 9.5 percent fiber. It has an amino acid balance that makes it valuable in poultry and swine rations. It is also used as a carrier of liquid feed nutrients.

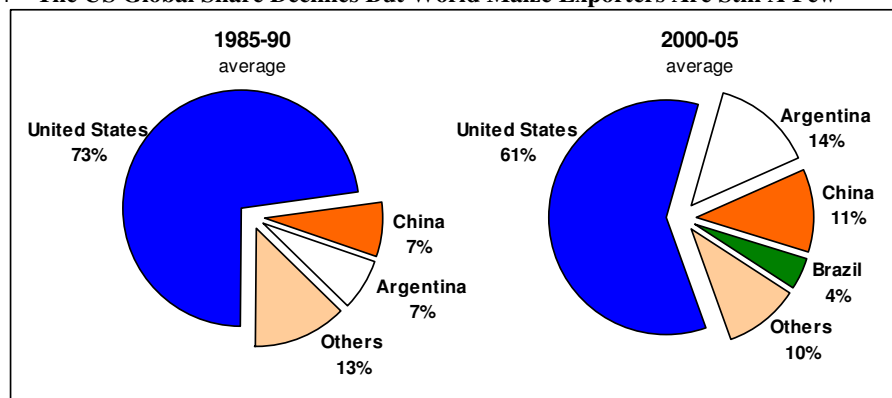
Liquid Feed Syrup: It is a highly concentrated feed syrup; high in protein and energy. This product is typically added to enhance an animal feed ration.

The international market for maize co-products used for animal feeding purposes has been gaining ground in recent years; mainly in response to growing demand for feed supplements. In terms of volume, roughly 2 million tonnes of these products are traded internationally as shown in Tables 12-14 in Annex I.

2.3 International Trade

While international trade accounts for only 12 percent of world maize production, it represents over one-third of total cereal trade. Global trade in maize has increased significantly over the past two decades, from 55 million tonnes to around 80 million tonnes, with the fastest expansion taking place in more recent years. The structure of the world maize market can be characterized as one with a high level of concentration in terms of exports but very low concentration on the import side. The main reason for this development is the fact that those countries which usually have significant maize surpluses for exports are relatively few in number, while those relying on international markets to meet their needs for domestic animal feeding purposes by importing maize (as a primary feed ingredient) are many. The United States is the world's largest maize exporter which accounts for roughly 60 percent of the global share, down from over 70 percent a decade ago (Figure 4), followed by Argentina and China. Brazil, the Republic of South Africa and Ukraine are among a few other countries which often have surpluses for exports.

Figure 4 – The US Global Share Declines But World Maize Exporters Are Still A Few



The dismantling of the USSR has had fundamental impacts on patterns of trade. The immediate contraction in feed use in the newly independent states not only resulted in a sharp

decline in their maize imports from world markets but was followed by the emergence of large surpluses of feed wheat as well as maize from the Black Sea region. Over the past decade several exporting countries increased their market share while new comers also entered the world market at a rapid pace. Argentina saw its export volumes to double since the early 1980s. Brazil, traditionally a major maize importing nation, emerged as an important supplier of maize to world markets in more recent years. China became a major competitor to the United States in other Asian markets and around the world. In fact, changes in China's agricultural policies have had a profound impact on the world grain economy. The fact that China has emerged as a major player in the world maize market stems from a substantial policy shift which aimed at downsizing the country's large stocks in the later years prior to its accession to the WTO as well as since 2001 when it finally joined the WTO after 15 years of negotiation.

In the EU, the Common Agricultural Policy (CAP) which provided high protection and boosted cereal production drove up supplies of feed grains in the EU. This, together with increased imports of non-grain feed ingredients, greatly lowered the EU's appetite for large maize imports; in fact, maize imports fell from over 15 million tonnes in the early 1980s to under 3 million tonnes in recent years. The gradual enlargement of the EU, to the current 25 member states, also played an important role in subsequent reductions of imports from outside the Union. The joining of Spain and Portugal in 1986 came about with an agreement to maintain certain amounts of maize imports (similar to what the two countries traditionally purchased from the United States).¹⁸ On the other hand, the joining of Austria, Finland and Sweden carried more weight on oats and rye markets than for maize although its indirect impact in terms of augmenting internal feed supplies within the EU also influenced maize demand. However, it is the latest enlargement of the EU to 25 countries in 2004 that has had more direct implications for the global maize market as it raised supplies of maize and all other feed grains in the EU, the former mostly because of Hungary, the largest non-EU European maize exporting country now belonging to the EU. It is expected that when Romania and Bulgaria join the EU in January 2007, this will also give way to larger feed grain supplies within the EU. Both countries are important producers of maize with a combined export of nearly one million tonnes.

Contrary to the situation with exports, the list of countries importing wheat is extensive, covering most countries in every corner of the world (Annex I, Table 11). In terms of volume, aggregate imports by countries in Asia make up over one-half of total world maize imports. In fact, most countries in Asia are net-maize importers. Japan is the world's leading importer with an annual intake of around 20 percent of the world total. The Republic of Korea is the world's second largest importer with almost 10 percent of the global share. Other major importers in Asia include Indonesia, Islamic Republic of Iran, Malaysia and Saudi Arabia. The strong growth in the livestock industry (poultry in particular) fuelled by rising incomes are the driving forces behind the fast growth in Asian imports.

Countries in Africa are also among the major importers of maize. Gradual liberalization of markets in Africa (seen also in Asia and Latin America), initiated in the 1980s and accelerated further in the 1990s, generally gave rise to higher imports with many countries relaxing their trade barriers by lowering tariffs. This development exposed high cost producers to lower world prices and resulted in imports by many countries in Africa to follow a rising trend over the past decade. With only few exceptions, most countries in Africa import maize and while

¹⁸ The EU policy of opening periodic tenders for import tariff cuts for maize is primarily to compensate farmers in the United States for lost markets caused by the entry of Spain and Portugal to the EU.

in some cases their imports may seem small from the global perspective, with respect to their own supplies, they can be significant. In terms of size, Egypt is Africa's top importer in spite of being also the third largest producer after the Republic of South Africa and Nigeria. Other major importers in Africa include Algeria and Tunisia, neither of which actually produces any maize of their own, as well as Morocco and Kenya.

Central America ranks third among the regions with highest imports. However, at around 6 million tonnes, annual imports by Mexico alone accounts for more than one-half of the total imports. Over the past decade, maize production in Mexico remained generally stable in spite of rising imports. While white maize remains a dominant crop in Mexico, the country has become one of the world's leading importers of yellow maize primarily because of its growing demand for cattle feeding. In fact, among the numerous regional and bilateral agreements that have come into existence over the past two decades, the agreement involving Mexico has had the most striking impact on world maize trade. In 1994, Canada, the United States and Mexico launched the **North American Free Trade Agreement (NAFTA)** which formed the world's largest free trade area. Although at the time of its launch it was difficult to foresee what influences NAFTA would bring to the regional maize market, it soon became evident that it provided a boost to maize exports from the United States to Mexico. Recognizing maize's importance as a staple crop, NAFTA allowed Mexico to apply a gradual Tariff-Rate Quota (TRQ) on maize imports.¹⁹ However, in practice, yellow maize imports became subject to only a minor TRQ (1 percent for yellow maize and 3 percent for white maize) and that several years (2001) after the start of NAFTA²⁰. From the onset, Mexico was confronted with rising inflation and this made imports of cheaper maize from the United States an attractive option. As a result, the country opted for almost non-application of TRQ on imports of yellow maize which consequently resulted in its exports from the United States to increase drastically, from around 1.5 million tonnes before NAFTA to nearly 6 million tonnes in recent years.

Food Aid in Maize

As mentioned before, while maize is a major feed grain, it is also considered as a vital food grain in many parts of the world; particularly in Africa but also in Asia and Central and Southern America. For this reason, maize is included among the leading commodities that make up the bulk of international food aid. In terms of the overall food aid volume, maize food aid ranks third after wheat and rice; ranging from 1 to 1.5 million tonnes, depending on the year. While maize as food aid represents between 20 to 30 percent of the total annual food aid shipments, it accounts for no more than two percent of total world trade in maize.

The United States is the largest food aid donor of maize; followed by the EU, China, and the Republic of Korea. On the recipient side, many countries in Africa normally occupy the top ten positions although consecutive droughts in recent years resulted in the Democratic Republic of Korea to join the world's leading recipients. In Africa, several countries, including Angola, Ethiopia, Kenya, Malawi, Mozambique, United Republic of Tanzania,

¹⁹ With an initial quota set at 2.5 million tonnes, increasing by 3 percent per annum until 2008.

²⁰ As a way to minimize the impacts of maize imports on farmers, Mexico also introduced compensatory income transfer (given on a per-hectare basis and decoupled from the actual land use) under a programme named *PROCAMPO*. In fact, the surge in Mexican imports from the United States was mostly for yellow maize while white maize imports started to fall sharply since 2000 as its domestic production rose in response to government incentives and Mexico also increased tariffs on over-quota purchases of white maize to more than 70 percent before being rolled back somewhat in 2005 to 54 percent.

Uganda, Zambia, and Zimbabwe, often received large amount of maize as food aid in recent years. Table 15 in Annex I provides a list of major donors with their recent shipments of maize (as food aid) to the largest recipients.

Major Players in World Markets

The break-down of the former USSR sent trade in maize tumbling and resulted in a rapid consolidation all around, especially in the form of mergers and acquisitions by grain firms. This gave way to greater volumes being controlled by lesser numbers of companies with storage and transportation operations across the supply chain as well as strong financial positions to manage returns and growth through business cycles. Excess capacity and low profit margins (from exports) were the reasons for global competitors combining their merchandising industries. This greatly enhanced their dominance and resulted in the creation of some new and more powerful players with a worldwide presence and extensive transportation network. In fact, only a handful of the world's largest grain trading companies in the early 1980s belong to the present leading firms. A relatively recent (2003) joint study by FAO and UNCTAD provided a list of the leading international food companies. Most important ones active in global maize markets are listed below:²¹

- **Cargill** (United States) is a privately-owned agricultural trading and processing firm headquartered in the United States, playing a major role in world markets for grain and oilseeds processing and trading, for livestock and poultry, for cotton, and active in a range of other commodities. The company is the world's largest food trader, with a volume of over 50 million tonnes of cereals and oilseeds/oils traded. It is, among other things, the world's largest maize trader, accounts for 20 percent share of United States wheat exports, and a quarter of Argentina's exports of wheat, maize and soybeans. In the late 1990s, Cargill took over Continental Grains, the world's second largest firm.
- **Archer Daniels Midland Company** (United States) is a major agricultural processing and trading firm. It is the largest biofuels producer and the world's second biggest grain trader after Cargill. In 2002, Archer Daniels Midland, known as ADM, became 80 percent holder of the German-based (and leading European) firm Alfred C. Toepfer International. Toepfer alone trades over 40 million tonnes of grains, oilseeds and oils a year. ADM is the largest crusher of soybeans in the United States, with a 31 percent market share (about one sixth of world production), and a 30-40 percent market share in Europe (another 4-5 percent of world production).
- **Bunge Group** (Argentina) formerly known as Bunge y Born, annually trades some 30 million tonnes of soybeans, wheat, maize and other grains. It is responsible for about a fifth of world trade in oilseeds and oils, and is a major grains and soybean exporter from Argentina and Brazil. The group operates one of the world's largest flour milling operations. Bunge is the largest soybean processor in the western hemisphere with substantial business in Brazil and Argentina (through an alliance with Aceitera General Deheza S.A.).
- **Louis Dreyfus** (France) is a family firm specialized in agricultural trade. It accounts for some 15 percent of world market trade in grains and oilseeds.

²¹ Financing Normal Levels of Commercial Imports of Basic Foodstuffs, FAO, Rome 2003.

- **Nidera** (The Netherlands) is a family firm with its headquarters in the Netherlands. It has its major trading operations in Latin America and annually trades some 18 million tonnes of soybeans, wheat, maize, rice and other grains.
- **Noble** (Hong-Kong based) is a large, diversified commodity trading company, with, among other commodities, operations in a range of grains and oilseeds.
- **ZenNoh** (Japan) the National Federation of Agricultural Cooperative Associations, is the third largest exporter of maize from the United States and the third largest soybean and oil exporter. The federation represents over 1 000 cooperatives bringing together most of Japan's 4.7 million farming households. ZenNoh also procures soybeans and oil from Canada and Australia, and is active in the rice and livestock markets in Japan.

2.4 International prices

While the price of yellow US maize is regarded as the world's most representative price, the maize futures traded at the **Chicago Board of Trade (CBOT)** are also widely considered as the world most important price discovery mechanism. There are numerous futures exchanges spread throughout the world and the most relevant ones are listed in Annex II. However, in most cases and nearly at all times, all maize futures tend to move in the same direction as those in Chicago. Periodically, some exceptions may occur as local/regional conditions could influence prices more than the developments in CBOT. For example, price movements in the **South African Futures Exchange (SAFEX)**, where both yellow and white maize are traded, may be subject to diverging fundamentals than those in Chicago depending on the prevailing supply and demand conditions in the region and most importantly in the Republic of South Africa itself which is the region's main surplus producer and exporter of maize. Other important commodity exchanges include **Rosario Futures Exchange** in Argentina; **EURONEXT**, which is Europe's leading cross-border exchange; China's **Dalian Commodity Exchange (DCE)**, the largest agricultural futures in that country; and the **Tokyo Grain Exchange**²².

As with most agricultural crops, the geography of maize production is widely spread around the world. Even inside the producing countries, the main growing areas may not always be near to one another. For this reason, maize distribution and trade hinges on different routes and transportation systems as well as on the location of ports and terminal facilities. These factors play important roles in maize economy and are critical in the competition for markets within the national boundaries as well as outside. In addition, for the many countries which import maize but are landlocked, the regional transport systems are also critical. For example, in eastern Africa, **Mombasa** is the largest port which not only serves Kenya but also the landlocked countries of Uganda, Rwanda, Burundi, the Democratic Republic of Congo, and Southern Sudan. Similarly, **Dar Es Salaam** which is the second largest port in East Africa (after Mombasa) provides alternative and more competitive rail/lake route to Uganda while also serving the landlocked countries of the Democratic Republic of Congo, Burundi, and Rwanda (by road) as well as Zambia, Zimbabwe, and Botswana (by rail)²³.

²² See Annex II for more details about the commodity exchanges mentioned.

²³ *East Africa Sub region: Enhancing Transportation Management To Foster U.S. Agricultural Trade Opportunities*, USDA, March 2001.

For local farmers, domestic transportation cost is one important determining factor in prices they collect. Similarly, at the international level, the cost of transportation between countries can be a determining factor for exporters and importers alike. As with all field crops, maize is transported via trucks, rail and on barge (local waterways river transport) inside countries while as much as 70 percent of its international trade is bulk-handled by mid and large size shipping vessels²⁴. A recent study by the USDA demonstrated that of all grains produced in the United States, maize “has the highest transportation requirements due to volume” and between 2000 and 2004, maize movements increased 5 percent, from 230 million tonnes to 242 million tonnes²⁵. The report also points out that while export movements fluctuated during this time, domestic movements of maize “reached record levels in 3 of the 5 years”. Also, barge is the dominant transport mode for moving maize to export facilities in the United States, “primarily because of the proximity of the Corn Belt to the Upper Mississippi River system. From 2000 to 2004, barge moved about 68 percent of total inland movements of corn to coastal export locations. Railroads handled about 30 percent of the export corn, and trucks moved the remaining 2 percent.” On the domestic front, however, “movements of corn are dominated by trucks, accounting for roughly 67 percent of the traffic from 2000 to 2004. Railroads move about 31 percent of corn within the United States. Barges handle only small amounts of domestic corn.”

On average, ocean freights costs (or shipping costs excluding insurance and port handling) for maize represent between 25 to 40 percent of the landed cost (paid by importers). Not surprisingly, therefore, recent price swings in world ocean shipping rates were unsettling for the grain market. China’s growing appetite for coal and raw materials have continued to fuel demand for more vessels, providing support to freight rates across the board. The steep rise and fall of freight rates are cause for concern for grain exporters and importers since they have little influence in the management of the shipping sector. In fact, the size of world grain shipment represents no more than 5 percent of total bulk shipments and for maize this share is even smaller. The fact that the shipping industry traditionally adjusts slowly to rising demand has contributed to a continuing supply uncertainty and more volatile rates. For example, in 2004 in spite of high and rising rates, old fleets were increasingly destined for supplying scrapping in response to even more attractive steel prices at the time. Ocean freight rates soared to record levels in 2004/05 and then started to recede to the current levels; which are still regarded as high. Tables 9 and 10 in Annex I provide information on freight costs associated with maize and maize meal transport for humanitarian aid from major donor ports to several destinations in Africa. Table 8 in Annex I provides data on maize ocean freight rates from the main loading ports in maize exporting countries to the world leading delivery ports²⁶.

²⁴ At the same time and as discussed earlier, the structure of the global maize market has become increasingly concentrated with a handful of firms responsible for most of its marketing and distribution. For example, in the United States, barge operations are largely owned by only four leading grain firms: ADM, ConAgra, Cargill, and Bunge. For more detailed analysis of domestic transportation system in the United States see *Grain Transportation and Marketing Channels*, FAPRI-UMC Briefing Paper N. 4, June 2004.

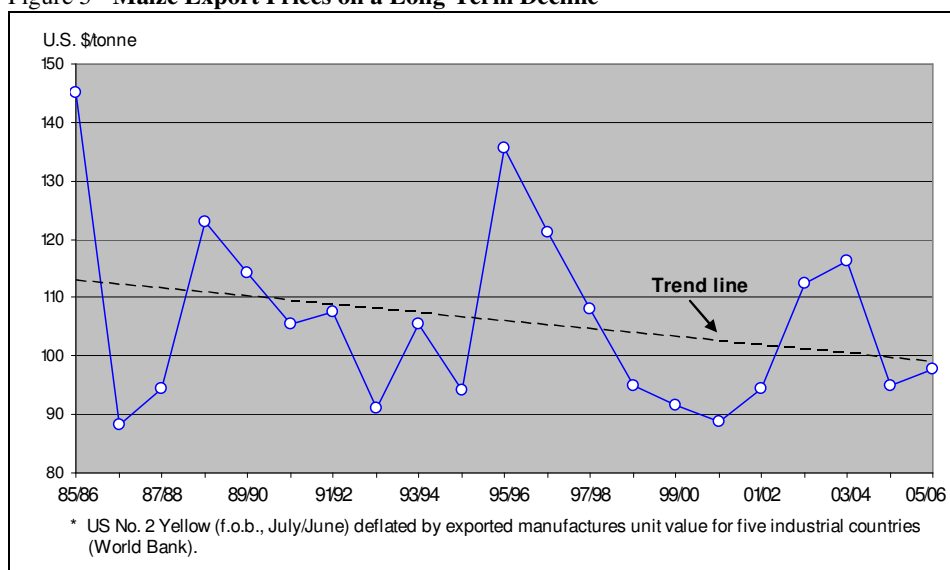
²⁵ *Transportation of U.S. Grains A Modal Share Analysis, 1978-2004*. USDA, October 2006

²⁶ A Detailed information on transport and ocean shipping rates are supplied regularly by the USDA in its Weekly Grain Transportation Report; available on-line at: <http://www.ams.usda.gov/tmdtsb/grain/>

3 Situation and Outlook: From 2006/7 to 2016/17 ²⁷

The gradual changes in market structure and the expansion in world maize trade have been fundamental in influencing the direction of international maize prices. For the most part of the last two decades, the increases in exportable supplies, stimulated by government support measures in some of the major producing countries²⁸, exceeded demand for maize and overtime this resulted in a large build-up of maize stocks and the consequent downward pressure on prices (Figure 5).

Figure 5 - Maize Export Prices on a Long-Term Decline*



As with other cereals, international maize prices continued on a declining trend in real terms (corrected for inflation); apart from occasional price swings often caused by such factors as unfavourable weather (i.e. El Niño induced) curtailing output and causing prices to rise, to developments in other related markets, especially in the livestock sector which in recent years confronted repeated outbreaks of disease, each time causing massive reductions in animal numbers, leading to a fall in demand for maize and hence lower prices.

²⁷ The analysis and data presented in this section are based on information as of November 2006. FAO reports up-to-date information and analysis on regular basis in *Crop Prospects and Food Situation* (bi-monthly publication) and *Food Outlook* (bi-annual publication). Both Reports can be accessed at: <http://www.fao.org/giews/english/index.htm>.

²⁸ Such as the marketing loan and countercyclical payments in the United States, the world's largest maize producer.

Table 6 – Maize Supply and Demand at a Glance

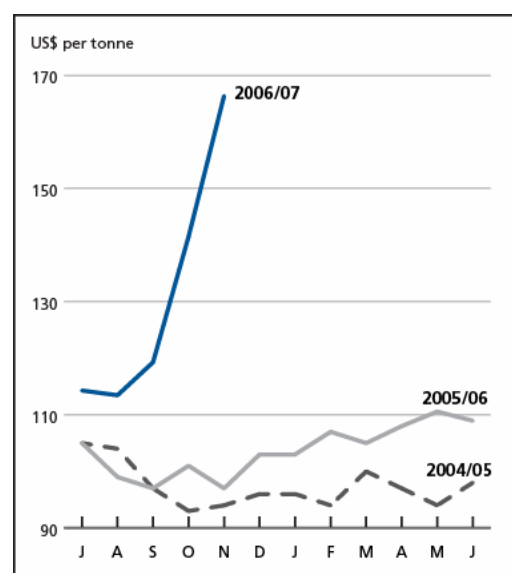
	2004/05	2005/06 estimate	2006/07 forecast	Change: 2006/07 over 2005/06
	<i>million tonnes</i>			<i>%</i>
WORLD BALANCE				
Production	725.0	710.0	694.2	-2.2
Trade (exports)	77.8	79.5	80.0	0.7
Total utilization	689.7	706.6	720.1	1.9
Food	101.2	103.4	105.3	1.9
Feed	462.1	462.0	458.4	-0.8
Other uses	126.4	141.2	156.4	10.8
Ending stocks	139.5	137.4	109.8	-20.1
SUPPLY AND DEMAND INDICATORS				
Per caput food consumption:				
World (Kg/year)	15.9	16.0	16.1	0.7
World stock-to-use ratio %	19.7	19.1	15.1	-20.7
Major exporters' stock-to-disappearance ratio %	17.8	16.4	8.7	-46.5

SOURCE: FAO/Food Outlook (as of November 2006)

International prices surge in 2006/07

In the current marketing season (2006/07) world markets for maize are experiencing an exceptionally volatile period as a result of a sharp decline in world production and a tightening of supplies in the United States. This season's decline in production coincides with a more rapid expansion in demand for industrial use, ethanol in particular. Against this background, global stocks by the end of the 2007 seasons are likely to be drawn down significantly, fuelling price volatility and increases across the board. Looking ahead, the current strong prices are likely to encourage higher plantings and result in larger production in 2007 compared with 2006. However, if industrial use continues to grow at the current pace, it may take more than one good crop season for prices to retreat significantly from their current highs.

Figures 6- US Maize Export Prices



The recent upward movements in **international prices** of maize have been mainly set off by the prevailing supply and demand fundamentals in the United States. The sharp cut in the 2006 maize production in the United States, just as its own demands for feed, industrial use and exports are all increasing, has resulted in a much tighter domestic balance and driven up prices. In addition, the trade situation this season is marked by much smaller maize exportable supplies in several exporting countries. Argentina recently suspended export permits due to concerns about the domestic supply situation in the light of large shipments already this season. Exports from China are expected to decline; based on the latest news, domestic prices are beginning to rise more rapidly throughout the country, which is a sign of

increased tightening that may eventually result in smaller exports than currently expected. In November, the United States maize export price (US No.2 Yellow) averaged US\$164 per tonne, up US\$67 per tonne, or 70 percent, from 2005. The Argentine export prices have also registered sharp increases in recent months, to almost US\$170 per tonne, up US\$78 per tonne from 2005.

Figure 7 - March CBOT Maize Futures



Similarly in the **futures market**, maize quotations have moved up sharply in recent months. In fact the supply tightness is such that the seasonal harvest pressure which normally would have put downward pressure on prices around late October 2006 has not appeared to have taken place this season. Instead, in early November, the nearby maize futures at the CBOT surged to a ten-year high on the expectation of an even more significant tightening in the United States than markets had anticipated earlier. Large speculative buying by investment funds also pushed up prices; so much so that the November maize trading volumes in the CBOT (futures and options) reached one of the highest in its history. By late November 2006, the March 2007 maize contracts stood at around US\$152 per tonne, up US\$72 per tonne, or 90 percent, from the

corresponding period in 2005. This confirms the view that high prices are not going to fade away any time soon, especially the United States export prices, given the recent fall in the value of the United States Dollar. However, strong maize prices would increase the likelihood of a substantial increase in maize planted area in the United States for the 2007/08 marketing season and this would most likely to occur at the expense of reduced plantings of soybeans, the second largest crop grown in the United States.

Figure 8 - Recent trends in the nearby soybean/maize future rates

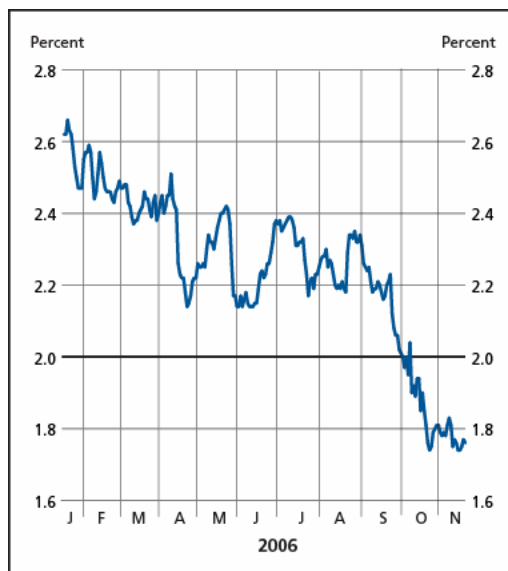


Figure 8 shows the trend in nearby soybean/maize price ratio since January 2006. From a historical perspective, whenever the ratio approaches two, the general bias favours maize over soybeans, resulting in a shift of planting area from soybeans to maize. With the recent ratios well under two, a significant increase in maize plantings in spring is most likely. Increases in plantings would be a positive development, which will improve the supply outlook for next season. However, demand for maize also continues to increase: demand for ethanol is likely to remain as thriving as this season even if crude oil prices were to decline further, and demand for feed is likely to increase faster as the livestock sector returns to its trend growth rate. Against this background, a massive increase in

production would be needed in order to prevent stocks from eroding further and to thwart price escalations.

Production falls in 2006 but a recovery is projected for 2007

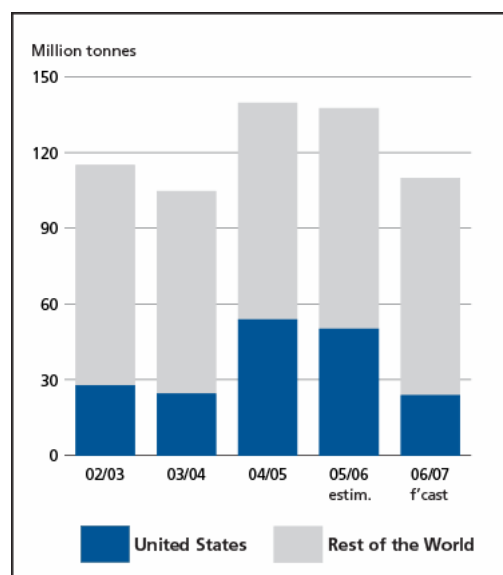
The bulk of the decline reflects smaller crops harvested earlier in the year in Argentina and South Africa and a reduced harvest, now almost completed, in the United States. The main factor for the smaller crops in all cases has been reduced incentive to plant maize because of too high production costs relative to expected returns, but adverse hot and dry weather also had an impact on yields in some parts. In contrast, aggregate (main and secondary season) maize output increased in Brazil, reflecting a larger area planted to the main season crop harvested earlier in 2006. A larger crop has also been gathered in Central America, with output in Mexico recovering from a below-average level in 2005. Also in Asia, maize output is estimated up in China, the Philippines and Thailand.

The first of the 2007 maize crops are now being sown in the southern hemisphere. In South America, after a slow start to the season due to limited soil moisture in some growing areas, planting is now well underway and early indications point to a slight increase in the aggregate area. In South Africa, conditions are favourable and a survey of farmers' planting intentions point to a sharp increase in the area sown.

Trade peaks and stocks decline

In spite of its high prices, world trade in maize is expected to enjoy another strong year, approaching 80 million tonnes in 2006/07. This would be slightly above the previous season's record. Canada, Egypt and Kenya are forecast to import more maize this season in view of their reduced domestic production. In contrast, good crops in most countries in Asia and southern Africa are expected to limit imports there. In China, given the prospect for a record maize crop, exports are likely to remain large but smaller than in the previous season because of strong domestic demand. Among major exporters, shipments from the United States are forecast to increase, largely offsetting anticipated declines from Argentina and the Republic of South Africa.

Figure 9– World Maize Stocks Decline



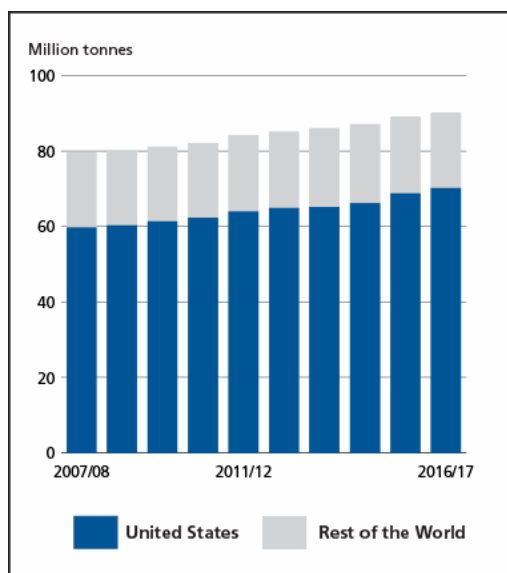
Large exports from the United States were also seen to result in a sharp reduction in its ending stocks which in turn would also weigh heavily on the size of world inventories. Global maize stocks by the end of seasons in 2007 are forecast to reach 110 million tonnes, down 20 percent from the previous season and smallest in 3 years.

Longer-term outlook points to stronger demand, higher trade and prices

If the main trend in the global maize market over the past two decades could be characterized as a rising curve in terms of supply, demand and trade, an even sharper rise is expected to prevail for the next 10 years; i.e. between 2006/07 and 2016/17. Maize **production** is projected to grow at a faster pace during the projection period than in the past 10 years, supported by stronger demand and more favourable price prospects. A combination of area expansion and increases in average yields are expected to contribute to the anticipated rise in world maize production. Most of the projected maize area expansion is expected to come from the major producing countries, most notably from China and the United States. Productivity gains through improved seed varieties (more drought resistant), inputs and adaptation of current technologies are likely to compensate for land-increase constraints, driven by water scarcity and urbanization, confronting most countries in developing world, especially in Africa and Asia.

World **demand** for maize in the next 10 years is projected to increase more rapidly than in the recent past: higher demand for animal feed and industrial use are the main drivers whereas the overall per caput growth in food consumption of maize is unlikely to change significantly, even in Africa where white maize is an integral part of local diets in several countries. Large parts of the global maize supply continue to be used in the livestock sectors and favourable prospects for economic growth will provide a further boost to shifts in dietary preferences toward protein-based food and result in even greater demand for all feed grains, including maize. However, it is the brisk demand for industrial use of maize, namely ethanol, which represents the most emerging source of additional demand for maize in the coming decade. In total, maize use, other than for feed and food purposes, is expected to grow by over 30% over the projection period, thus representing by far the most dynamic element in its utilization.

Figure 10– **Projected World Maize trade**



Maize **trade** is also projected to increase significantly, from roughly 80 million tonnes at the present to 90 million tonnes in 2016/17, a growth of 12 percent. Demand for maize in world markets continue to rise in response to the projected strong increase in livestock production. However, it is Asia that most of the increase is expected to occur. Asia will remain a leading destination for maize with its imports totalling at least 52 million tonnes by 2016/17, up 13 percent from the current levels, representing 57 percent of world import share (Annex 1 Table 17). On the export side, the United States will increase its dominant position as the world leading maize supplier to international markets. The United States' share in world exports is projected to increase from 75 percent to 78 percent. The

projected rise in sales by the United States are expected to compensate for the reduction in export supplies in China, which is in fact expected to turn into a small net maize importer (Annex 1, Table 18). The other major maize exporting country is Argentina but exports from

Argentina may not increase significantly from the current levels as a result of strong domestic demand and constraints in lifting production.

Continued strong growth in demand is expected to keep world maize **stock** levels at relatively low levels throughout the projection period. In spite of the anticipated expansion in their production, the two largest maize stock holders, China and the United States, are likely to hold less in their reserves than in recent years. While the eventual size of world stocks has always been a major area of uncertainty, maize stocks held by the world's largest exporter, the United States, are considered as an important market stabilizer factor, acting as the main buffer against any unexpected rise in world demand. However, in view of its rising industrial use and exports as well as strong domestic feed demand, the size of this buffer will be even more dependent on the level of domestic production.

The prospect for international market prices over the longer term is uncertain. Recent large price increases were not anticipated one year ago. Increased supplies in response to these prices will take time to come on stream, and will depend on many factors, especially world energy prices and the rate of growth of the ethanol sector in the United States. Moreover, any further stocks contractions beyond the current low levels will certainly contribute to more volatility in markets and higher world **prices**. The tighter supply prospects, especially during the first half of the projected period may not only induce further price gains in real terms but lead to a reversal in its secular decline.

ANNEX I : STATISTICAL TABLES

Table 1 - MAIZE PRODUCTION (million tonnes)

	1997	1998	1999	2000	2001	2002	2003	2004	2005 estimate	2006 forecast
ASIA	143.4	174.8	170.1	149.0	158.9	165.4	167.2	183.6	195.8	198.6
China	104.6	133.2	128.3	106.2	114.3	121.4	115.9	130.3	139.4	142.0
India	10.8	10.7	11.5	12.0	13.2	11.2	15.0	14.2	14.9	14.5
Indonesia	8.8	10.2	9.2	9.7	9.3	9.6	10.9	11.2	12.5	12.1
Iran, Islamic Rep. of	0.9	0.9	1.2	1.1	1.1	1.4	1.7	1.5	1.5	1.7
Korea, D.P.R.	1.0	1.8	1.2	1.0	1.5	1.7	1.7	1.7	2.1	1.9
Kyrgyzstan	0.2	0.2	0.3	0.2	0.4	0.4	0.4	0.5	0.4	0.4
Myanmar	0.3	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Nepal	1.3	1.4	1.3	1.4	1.5	1.5	1.6	1.6	1.6	1.6
Pakistan	1.5	1.7	1.7	1.6	1.7	1.7	1.9	2.8	3.3	3.3
Philippines	4.3	3.8	4.6	4.5	4.5	4.3	4.6	5.4	5.3	6.1
Thailand	3.8	4.6	4.3	4.5	4.5	4.2	4.2	4.2	3.4	3.7
Turkey	2.1	2.3	2.3	2.3	2.2	2.1	2.8	3.0	3.7	3.2
Viet Nam	1.7	1.6	1.8	2.0	2.2	2.5	3.1	3.4	3.8	3.8
AFRICA	41.3	41.0	42.1	44.8	41.0	42.4	45.0	45.0	49.0	46.1
Egypt	5.8	6.3	6.1	6.5	6.8	6.4	6.5	6.7	7.7	6.8
Ethiopia	2.3	2.8	2.7	3.3	2.8	2.8	2.7	2.4	2.9	3.0
Kenya	2.2	2.4	2.3	2.2	2.8	2.4	2.7	2.6	2.8	2.9
Malawi	1.5	1.8	2.5	2.5	1.6	1.6	2.0	1.7	1.3	2.6
Mozambique	1.0	1.1	1.2	1.0	1.1	1.2	1.2	1.4	1.4	1.5
Nigeria	5.3	5.9	5.5	4.1	4.6	4.9	5.2	5.6	6.0	6.4
South Africa	10.1	7.7	8.0	11.4	7.8	10.1	9.7	9.7	11.7	6.6
Tanzania	1.9	2.8	2.5	2.0	2.6	2.7	2.9	3.0	3.3	3.4
CENTRAL AMERICA	20.4	21.3	20.8	20.8	23.4	22.6	24.2	25.0	23.3	25.5
Mexico	17.7	18.5	17.7	17.6	20.1	19.3	20.7	21.7	19.8	22.0
SOUTH AMERICA	58.2	55.1	51.4	55.8	64.9	57.7	71.6	65.6	64.4	65.3
Argentina	15.5	19.4	13.5	16.8	15.4	14.7	15.0	15.0	20.5	14.5
Brazil	36.2	30.2	32.0	32.3	42.0	35.9	48.3	41.8	35.1	42.1
Chile	0.9	0.9	0.6	0.7	0.8	0.9	1.2	1.3	1.5	1.4
Colombia	1.0	0.8	1.0	1.2	1.2	1.2	1.2	1.4	1.4	1.3
Peru	0.8	0.9	1.1	1.2	1.3	1.3	1.4	1.2	1.2	1.2
Venezuela	1.2	1.0	1.1	1.7	1.8	1.4	1.8	2.2	2.1	2.1
NORTH AMERICA	241.0	256.8	248.7	258.7	249.9	236.8	265.9	308.7	291.7	281.2
Canada	7.2	9.0	9.2	6.8	8.4	9.0	9.6	8.8	9.5	8.8
United States of America	233.9	247.9	239.5	251.9	241.5	227.8	256.3	299.9	282.3	272.4
EUROPE	81.3	66.5	72.6	62.8	76.1	75.5	69.5	96.4	85.1	77.0
European Union 1/	39.4	36.4	37.1	38.3	41.0	40.5	33.7	54.9	50.9	46.4
Romania	12.7	8.6	10.9	4.9	9.1	8.4	9.6	14.7	9.9	8.7
Russian Federation	2.7	0.9	1.1	1.5	0.8	1.6	2.1	3.5	3.2	3.3
Ukraine	5.3	2.3	1.7	3.8	3.5	3.1	6.9	8.9	7.2	6.0
Yugoslavia Fed. Rep.	6.9	5.2	6.1	2.9	5.9	5.6	3.8	6.6	7.1	5.7
OCEANIA	0.6	0.5	0.5	0.6	0.5	0.6	0.5	0.6	0.6	0.6
WORLD	586.3	616.0	606.3	592.5	614.7	601.0	643.9	725.0	710.0	694.2
Developing countries	252.2	283.4	275.1	257.9	279.1	276.5	296.7	307.7	319.3	327.1
Developed countries	334.2	332.5	331.2	334.5	335.6	324.5	347.2	417.2	390.7	367.1
LIFDCs 2/	168.0	200.4	196.7	174.1	183.9	189.0	192.6	208.7	222.8	227.3
LDCs 3/	15.4	17.2	18.5	18.5	18.1	18.3	20.7	20.2	21.5	23.3
NFIDCs 3/	13.4	13.9	13.9	15.0	16.0	14.9	16.0	17.3	18.8	18.1

SOURCE: FAO

Note: Information as of November 2006.

1/ Up to 2003 15 member countries, from 2004 25 member countries.

2/ Low Income Food Deficit Countries (LIFDC) refer to food deficit countries with per caput income below the level used by the World Bank to determine eligibility for IDA assistance (i.e. US\$1 415 in 2002).

3/ The Least Developed Countries (LDC) and Net Food Importing Developing Countries (NFIDC) groups include a list of countries agreed by the World Trade Organization (WTO) to qualify as beneficiaries under the Marrakech Decision on the Possible Negative Effects of the Reform Programme on LDC and NFIDC.

Table 2 - MAIZE IMPORTS (million tonnes)

	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06 estimate	2006/07 forecast
ASIA	38.8	37.2	42.3	42.5	42.3	43.6	44.3	42.1	42.0	42.5
China	4.8	4.5	5.4	4.6	5.1	4.8	4.8	4.5	5.0	5.6
Taiwan Province	4.7	4.3	5.3	4.6	5.1	4.8	4.8	4.5	4.8	5.0
Indonesia	0.9	0.1	0.9	1.5	1.1	1.7	1.4	1.0	0.5	1.0
Iran, Islamic Rep. of	1.2	1.0	1.2	1.2	1.3	1.6	1.5	2.4	2.2	2.0
Israel	0.5	0.7	0.6	0.9	1.0	0.8	1.4	1.0	1.0	1.0
Japan	16.2	16.3	16.3	16.3	16.2	16.8	17.0	16.5	16.6	16.4
Jordan	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Korea, Rep. of	7.8	7.1	8.5	8.6	8.4	8.9	9.4	8.3	9.1	9.0
Malaysia	2.3	2.4	2.4	2.7	2.4	2.4	2.4	2.5	2.4	2.4
Saudi Arabia	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.4	1.5	1.5
Syria	0.5	0.4	0.7	0.8	0.9	1.0	1.2	1.6	1.2	1.2
Turkey	0.5	0.8	1.3	0.8	1.2	1.1	1.0	0.4	0.1	0.1
AFRICA	8.4	9.3	10.0	11.4	12.2	13.1	12.2	12.9	13.2	12.7
Algeria	0.9	1.1	1.1	1.5	1.6	1.2	1.9	2.1	2.0	2.1
Egypt	3.1	3.6	3.8	4.9	5.4	5.3	4.1	4.9	4.4	5.0
Ethiopia	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.0
Kenya	1.1	0.4	0.7	1.1	0.5	0.3	0.6	1.0	0.4	0.7
Morocco	0.6	0.8	0.7	0.9	0.9	0.9	1.0	1.3	1.4	1.3
South Africa	0.2	0.1	0.5	0.4	0.6	0.8	0.5	0.1	0.6	0.6
Tunisia	0.4	0.5	0.6	0.6	0.8	0.6	0.8	0.6	0.7	0.7
Zimbabwe	0.0	0.4	0.2	0.0	0.3	0.8	0.8	0.6	1.2	0.3
CENTRAL AMERICA	6.2	8.9	8.3	9.3	9.7	8.5	9.4	10.1	10.5	10.7
Costa Rica	0.0	0.3	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6
Dominican Rep.	0.6	0.8	0.9	1.0	1.0	1.0	0.9	0.9	1.1	1.1
Guatemala	0.6	0.4	0.4	0.5	0.6	0.5	0.5	0.7	0.7	0.7
Mexico	3.8	6.0	4.8	5.8	6.0	4.9	5.4	5.7	5.9	6.2
SOUTH AMERICA	5.2	7.1	7.2	6.7	5.0	5.3	5.6	5.3	6.6	6.7
Brazil	1.0	1.6	1.5	1.2	0.2	0.4	0.8	0.4	0.5	0.5
Chile	0.8	0.8	1.3	1.2	1.1	0.9	0.9	0.8	1.3	1.2
Colombia	1.4	1.8	1.9	1.9	1.8	2.1	2.0	1.9	2.8	3.0
Ecuador	0.1	0.4	0.2	0.2	0.2	0.3	0.4	0.5	0.4	0.4
Peru	0.9	1.2	0.9	0.8	1.0	0.9	0.9	1.2	1.4	1.3
Venezuela	1.0	1.4	1.3	1.1	0.7	0.6	0.6	0.4	0.2	0.3
NORTH AMERICA	1.5	1.3	1.4	2.7	3.8	4.6	2.8	2.8	2.0	3.4
Canada	1.3	0.8	1.0	2.6	3.5	4.2	2.4	2.6	1.7	3.2
United States of America	0.2	0.5	0.4	0.2	0.3	0.4	0.3	0.3	0.3	0.2
EUROPE	3.3	4.2	4.2	4.8	4.2	4.1	8.0	3.0	4.0	3.9
Belarus	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.3	0.3	0.3
European Union 1/	1.9	2.9	1.8	2.3	2.3	2.9	5.6	2.0	2.9	2.8
Russian Federation	0.2	0.3	1.2	0.2	0.5	0.1	0.5	0.3	0.3	0.3
OCEANIA	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
WORLD	63.5	68.1	73.4	77.4	77.2	79.3	82.4	76.3	78.3	80.0
Developing countries	41.7	45.4	50.3	52.3	51.3	52.1	52.7	52.7	54.0	54.5
Developed countries	21.8	22.7	23.1	25.2	25.9	27.2	29.7	23.6	24.3	25.5
LIFDCs 2/	14.5	13.9	16.8	17.9	18.4	19.4	18.2	19.5	18.5	18.9
LDCs 3/	1.7	1.9	2.2	1.7	2.0	2.9	2.3	2.1	2.1	1.8
NFIDCs 3/	9.2	10.3	10.6	12.2	11.9	11.3	11.0	12.5	11.8	12.5

SOURCE: FAO

Note: Information as of November 2006. Data are compiled on a July/June basis.

1/ Up to 2003/04 15 member countries, from 2004/05 25 member countries.

2/ Low Income Food Deficit Countries (LIFDC) refer to food deficit countries with per caput income below the level used by the World Bank to determine eligibility for IDA assistance (i.e. US\$1 415 in 2002).

3/ The Least Developed Countries (LDC) and Net Food Importing Developing Countries (NFIDC) groups include a list of countries agreed by the World Trade Organization (WTO) to qualify as beneficiaries under the Marrakech Decision on the Possible Negative Effects of the Reform Programme on LDC and NFIDC.

Table 3 - MAIZE EXPORTS (million tonnes)

	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06 estimate	2006/07 forecast
ASIA	7.7	4.1	7.9	10.9	7.2	15.9	13.3	6.9	7.2	4.3
China	7.0	3.3	7.2	9.8	6.3	14.9	11.3	5.6	5.9	3.0
India	0.0	0.0	0.0	0.0	0.0	0.1	0.8	0.3	0.3	0.3
Myanmar	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.3
Thailand	0.0	0.1	0.0	0.5	0.3	0.1	0.7	0.4	0.2	0.2
AFRICA	1.8	1.9	1.2	2.7	2.0	2.0	2.4	2.9	3.5	2.7
Mozambique	0.0	0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.2	0.2
South Africa	1.2	1.2	0.2	1.8	1.3	1.0	1.0	1.1	1.9	0.9
Tanzania	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.3	0.4	0.4
Uganda	0.1	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.4
CENTRAL AMERICA	0.2	0.4	0.1	0.1	0.1	0.3	0.2	0.1	0.1	0.1
SOUTH AMERICA	12.2	10.4	8.3	14.6	14.5	14.5	16.3	15.8	13.0	13.1
Argentina	11.8	10.0	7.9	11.8	9.2	11.7	9.9	12.4	11.3	10.0
Brazil	0.0	0.0	0.0	2.2	5.0	2.4	5.8	2.7	1.2	2.6
Paraguay	0.3	0.3	0.3	0.5	0.2	0.4	0.6	0.6	0.4	0.5
NORTH AMERICA	36.7	48.3	50.4	47.6	50.1	42.6	47.3	47.2	51.5	56.2
Canada	0.0	0.5	0.3	0.1	0.2	0.3	0.3	0.2	0.3	0.2
United States of America	36.7	47.7	50.1	47.5	49.9	42.3	47.0	47.0	51.2	56.0
EUROPE	3.8	3.4	3.1	1.4	3.7	3.4	2.5	5.0	4.1	3.6
Bulgaria	0.1	0.1	0.3	0.1	0.0	0.2	0.1	0.6	0.2	0.3
European Union 1/	0.4	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2
Romania	0.4	0.2	0.2	0.0	0.1	0.1	0.1	1.5	0.5	0.6
Ukraine	0.4	0.4	0.1	0.4	0.3	0.8	1.1	2.2	2.6	1.8
Yugoslavia Fed. Rep.	0.2	0.4	0.3	0.0	0.3	0.2	0.2	0.2	0.3	0.3
OCEANIA	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
WORLD	62.5	68.4	71.0	77.4	77.7	78.8	81.9	77.8	79.5	80.0
Developing countries	20.7	15.5	17.2	26.5	22.5	31.7	31.1	24.6	22.0	19.3
Developed countries	41.8	53.0	53.8	50.9	55.2	47.1	50.8	53.2	57.5	60.7
LIFDCs 2/	8.1	4.4	8.6	10.9	7.2	16.1	13.6	8.0	8.1	5.4
LDCs 3/	0.4	0.5	1.1	0.9	0.7	1.0	1.2	1.8	1.6	1.9
NFIDCs 3/	0.3	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

SOURCE: FAO

Note: Information as of November 2006. Data are compiled on a July/June basis.

1/ Up to 2003/04 15 member countries, from 2004/05 25 member countries.

2/ Low Income Food Deficit Countries (LIFDC) refer to food deficit countries with per caput income below the level used by the World Bank to determine eligibility for IDA assistance (i.e. US\$1 415 in 2002).

3/ The Least Developed Countries (LDC) and Net Food Importing Developing Countries (NFIDC) groups include a list of countries agreed by the World Trade Organization (WTO) to qualify as beneficiaries under the Marrakech Decision on the Possible Negative Effects of the Reform Programme on LDC and NFIDC.