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Faculty of Management –The Leon Recanati Graduate School of Business Administration
The Eli Hurvitz Institute of Strategic Management

kaiima
SUSTAINABILITY MULTIPLIED

Kaiima – The Four--Dimensional Dilemma

"And there was a famine in the land; and Abram went down into Egypt to sojourn there; for the famine was sore in the land" Genesis 12:10

Introduction

A basic requirement for survival, food is a physiological need at the base of the hierarchy of human and animal needs. Famine and the need for food have indeed shaped mankind's biology as well as its history over many years, and even though many aspects of food production are now industrialized, it is still based on the land and is therefore still vulnerable to weather, land conditions, pests and other risks.

The prevalence of hunger in the modern world is closely connected to the cost of the most basic food commodities: cereal seeds such as rice, wheat, maize, sorghum and others, sometimes referred to as high-energy foods. It is these seeds that, if attainable, can allow for a cheap and basic diet rich enough in calories to sustain a human being. All of these cereal seeds are field crops that require substantial amount of land to yield an output large enough to meet demand.

Udi Aharoni from the Eli Hurvitz Institute for Strategic Management at the Faculty of Management, Tel Aviv University, prepared this case with the assistance of Orion Avidan, Erez Cohn , and Shira Lifshiz as the basis for a case competition. The case does not intend to illustrate effective or ineffective handling of business processes or decisions.

It was once thought that demand for crops was driven by the rate of population growth. This changed with the ascendancy of the Chinese, and to a lesser extent, the Indian economies. Increased prosperity in developing economies has increased the overall global demand for food. It is living standards, therefore, particularly in the developing world, which drive the demand for crops.

In the past decade grain prices have been influenced by several forces, including a growing demand for grains both for human consumption and more so for animal feed, a growing demand from the bio-fuel industry, increased transportation costs and the growing demand for land to support the growth of cities and industrialization. By 2008, these forces, combined with a decline in production due to weather conditions, led to speculation in the commodities markets and significant price increases in all high-energy foods. This led to food-related riots in Malaysia, Egypt, Bangladesh and elsewhere that resulted in death, damage, political unrest and tension. At the same time poverty and hunger were becoming more prevalent in the industrialized world as well.

It was during this difficult time that the core team at Kaiima, an Israeli startup founded in late 2006 to develop seeds and plants for the emerging bio-fuel market, decided to start development in the high-energy foods segment. Kaiima, from the Hebrew expression "Bar-Kaima", meaning sustainable, focuses on cultivating seeds and plants that will support global development, reducing unnecessary harm by adopting a holistic view of contribution to global welfare at present as well as in the future.

Based on earlier R&D done in joint ventures of its mother company, Morning Seeds, specializing in vegetables, fruits and herbs, Kaiima has developed a breeding technology that allows it to significantly improve yield, in some crops by over 100%, and control a wide variety of plant characteristics. Kaiima now has proof of concept for relevant seeds for high energy foods and is ready to go to market. It is time to define the strategy that will lead to success.

Background (Exhibits 1-6)

Following a global trend of escalating food prices the main high energy foods, wheat, rice, maize[1] and sorghum, have seen a slow and steady increase in prices over the last two decades. These prices peaked during 2007-2008. This is partly the result of a growing imbalance between long-term demand and supply. A major reason for this imbalance is the substantial slowdown in the yield growth rate of cereal grains in most countries over the past 10–15 years. This slowdown has been occurring in conjunction with an increase in demand growth rate for these cereal grains created by rising incomes in some developing countries and the shift in eating patterns from predominantly rice to more meat-based diets that this causes. As the demand for meat around the globe grows so does the need to feed

[1]In the case we used the term maize. Some international data use the term corn. Both refer to the same crop.

farm animals and cereal crops are diverted from human consumption to animal feed. On top of this there is the diversion of arable land to other uses, including, but not limited to, the production of government-subsidised bio-oil crops, industrialization and urbanization. Aggravating the situation in the 2007-2008 time frame were the bans and restrictions on exports of certain grains placed by some food-producing nations in order to ensure they can satisfy their own consumers.

Around 40% of the world's population depend on agriculture for their livelihoods. The world population was estimated at 6.7 bn in 2008 and is expected to exceed 8 bn by 2030, increasing the demand for food, feed and fiber by around 35%. In addition to this, in 2008 an estimated one third of the world's population had insufficient access to fresh drinking water and this phenomenon is expected to double by 2035. Irrigated agriculture accounts for around 70% of global water consumption. These are the driving forces for the agribusiness to create higher yield productivity through continuous innovation, resulting in more food and fiber produced from limited arable acres and limited water supply.

All cereal crops are cultivated in a similar manner. All are annual plants; consequently one planting yields one harvest. While wheat is a cool-season cereal, maize, rice and sorghum are warm-weather cereals. Cool-season cereals are hardy plants that grow well in moderate weather and cease to grow in hot weather; peak temperature is usually around 30°C but varies by species and variety. Warm-season cereals are more delicate and thrive in hot weather.

Warm-season cereals are grown year-round in tropical lowlands and during the frost-free season in temperate climates. Most cool-season cereals are either winter or spring types. Winter varieties are sown in the autumn and mature in late spring or early summer. In areas where the winter weather conditions do not allow growing winter wheat, farmers grow spring varieties. Spring cereals typically require more irrigation and yield less than winter cereals. Once the cereal plants have grown their seeds, they have completed their life cycle and dry out. As soon as the parent plants and their seed kernels are reasonably dry, harvest can begin. It is known that every year about 50% of the global yield of cereals is destroyed as a result of poor weather conditions that have led to failed crops.

Practices such as irrigation in drier climates and the additional use of herbicides, pesticides, and fertilizer can increase the likelihood of a larger yield.

There are major differences between the land farming practices in developed countries (such as the USA, the EU and others) and those in the least developed countries (LDC) of the world. In developed countries cereals are considered cash crops, grown en masse to be sold for profit, using highly mechanized work processes and a variety of chemical compounds to ensure high yields. In many

places the farmers work either for or in cooperation with big corporations. On the other hand, in LDCs cereals are grown to allow sustenance; for personal consumption and for sale, mostly local, to create a livable income. Land plots are small, a lot of the work is manual, and there is lower use of chemical compounds and of manipulated seeds that allow higher yields.

The Seed Industry (Exhibits 7-11)

While traditionally farmers would save some of the yield of their crops for planting in the following season, with the development of agricultural biotechnology it is becoming much more common for them to buy new seeds for each planting season. This is mostly the result of breeding techniques that make it undesirable to save seeds for planting or even make it illegal to do so. These practices have increased the size and power of the manufacturers in the seeds market, which includes seeds for field crops such as cereals and cotton as well as seeds for niche markets such as vegetables, fruits, herbs, flowers and more.

Industry structure

The world seed market is expected to reach about $42.2 billion in 2010, in consumer prices (the consumers being the farmers). Although there are some dedicated seed manufacturers, many of the leading companies in the industry are also involved in agrochemicals. While both seeds and agrochemicals go through the same marketing and distribution network, development and production activities are different, requiring different expertise and technology

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By 2009 the top 10 seed companies accounted for two-thirds (67%) of the global proprietary seed market, as more and more companies resorted to M&As to ensure growth and control risks. In addition there has been a growing tendency to create alliances and agreements to cross-license proprietary seed DNA and technologies, consolidate R&D efforts and terminate costly IP litigation. A major example of these alliances is the 2007 $1.5 billion R&D collaboration between Monsanto, the world's largest seed company, and BASF, the world's largest agrochemical corporation, to increase yields and drought tolerance in maize, cotton, canola and soybeans. This increasing consolidation led the US Department of Justice to announce, on August 2009, that it would investigate alleged anticompetitive conduct in the seed industry.

There has been growing consolidation between the seed developing industry and the agrochemical industry. The agrochemical industry supplies farmers with chemicals fertilizers and pesticides. The agrochemical market is very stable and many of the companies have expanded into the seed market as a growth mechanism. The industries are very complementary at the marketing level and companies that are active in both industries have managed to create good synergies through marketing practices such as bundling.

Marketing & Distribution channels

The seed business is product driven, with very low customer loyalty, as farmers easily change suppliers to obtain better seeds. To ensure economic value to the farmer, common convention is that seed cost can be up to 15% of the farmer's operating costs. Farmers are looking for seeds with added value in yield production and crop stability, that is, the ability to withstand heat, aridity or pests, traits which improve yield predictability.

Seed companies use distributors to sell their seeds. These distributers sell the seeds to local distributors who sell to the farmers. .Seed manufacturers usually retain about 80% gross profits. The end customers of the seeds, the farmers, pay a markup of about 50% as the primary distributors retain about 30% gross profit and the secondary distributors retain about 15% gross profit. As part of the industry's consolidation, major seed manufacturers have been merging their leading distributors into their value chain through M&As

Seed marketing is mostly done through demonstration. The marketer, be it the seed company or a distributer, must set up a field that shows how the seeds fare in the relevant growing conditions and the expected benefits. Penetration is relatively fast, and two to three growing seasons might be enough to achieve over 80% of the market, given a substantial enough benefit, as data and knowledge travel fast in the farming community.

Seeds

Seed manufacturers market three types of seeds: open-line seeds, which have no protection against seed saving, hybrid seeds, which are protected against seed saving by their genetic makeup, thus making seed saving undesirable, and genetically modified (GM) seeds, which are IP protected so that it is illegal to save seeds for re-planting. All seed producers practice the traditional breeding techniques such as cross-breeding, selective breeding and so on. Once a seed has been developed, manufacturing the stock needed for sale simply requires planting a field and growing enough new seeds. Additional handling is trivial.

Agricultural biotechnology (AgBio) involves the development and production of seeds with enhanced input and or output traits. Enhanced inputs help the farmer produce better yields more efficiently by increasing each plant's yield or by reducing yield lost to pests, weather conditions, disease and so on, while enhanced outputs offer consumers enhanced nutritional values. AgBio involves both traditional breeding and the utilization of hybrid seeds as well as genetic modification of plant traits.

Traditional breeding techniques are applied to the plant as a whole, through trial and error, and are based on centuries of accumulated experience. Breeders can introduce new traits into the plant through practices such as cross-breeding with other plant varieties. Developed in the field, by creating

a large variety and selecting the best results, traditional breeding requires a lot of experience combined with intuition developed over time. In order to increase the economical viability of traditional breeding, companies have reverted to producing hybrid seed varieties. These seeds are produced through a highly controlled process of breeding using male and female plants. Saved seeds from hybrid varieties do not reliably produce true copies, making seed saving undesirable. Traditional breeding techniques require up to four years, depending on the crop, as it usually requires four to eight generations to complete the breeding process, and development costs are a few million dollars per crop.

There is little legal IP protection of hybrid seeds as only the "father" and "mother" plants are really IP protected. This allows the use of saved seeds, whether to re-grow crops, at the farmer's own risk that yield and traits will vary greatly from those of the parent plant, and for reverse engineering in order to try and create similar seed offerings. Due to the genetic diversity of these seeds reverse engineering is expected to be a long process, during which the originating company can introduce other improvements to the seeds, rendering the reverse engineering efforts futile, as there will be no market for the resulting seeds.

GM techniques are applied to specific traits by manipulating the plant at the gene level. This gives breeders major levels of control and allows them to introduce new traits into the plant, some of which are not present in nature at all. Developed in the lab, GM R&D is time consuming and costly. The cost range of an average R&D process for a GM product is $50m-$100m, with the time-to-market ranging from 8 to 13 years, depending on regulatory issues. GM crops, on the other hand, are patent protected, making it illegal to save seeds for further planting.

GM crops have been commercially produced since 1995 and have achieved major market penetration since then, with GM maize leading the market. GM crops have only proved economically advantageous in four, large size row-crops: soybeans, maize, canola and cotton. The most prominent GM crops are Monsanto's *Roundup Ready crops*, which replace the need for a variety of herbicides with a single, non-selective herbicide (i.e. Glyphosate, the active ingredient in Monsanto's Roundup™ herbicide), which is both cheap and efficient. This demonstrates the growing synergy created between seed development activities and the agrochemical business.

GM crops are still banned in some regions, such as the EU, which are not expected to change their position in the near future. Fears of unpredictable and irreversible environmental impact, food safety concerns, and political interests, all fuel resistance to the introduction of GM crops in the EU.

Although to some extent distinct activities, traditional breeding and GM have become increasingly integrated. Many of the leading seed companies today are also heavily involved in the development and breeding of GM seeds (Monsanto, Syngenta).

Conventionally bred hybrid seeds and GM seeds offer economic advantages to the farmer and are sold at large premiums. Hybrid seeds can fetch five times the price of conventional seeds, while promising an even larger growth in yield. The premium is limited since there are no guarantees and the farmers still bear the risk. The average premium for GM seeds is around 40% of the price for conventional seeds, besides additional technology fees. With the introduction of new traits the premium rises, and major GM crops, such as maize, cotton and soybean have reached higher premiums, sometimes over 100%.

Seed development is a hyper segmented industry since seed breeding is done on a local geographical basis to account for the differences in weather, soil, demand, mechanization, cost of work and so on. Even so, the seed industry, which was once extremely fragmented, has gone through massive consolidation in recent decades. It is now led by a limited number of major corporations, which buy local seed developers and distributers to accommodate the need for localization as they grow.

Kaiiama

Kaiima is an AgBio company that was initially conceived in November 2006, as an energy-crop focused joint venture between Morning Seeds, a company with a strong core of breeding and related technologies, and a complementary group that provided financing and marketing expertise. Earlier, Morning Seeds had formed several joint venture companies to apply its expertise in specific seed markets, e.g., Top Seeds, which focused on vegetable seeds.

Kaiima focuses on dramatically increasing crop productivity by using its breakthrough Clean Genome Multiplication (CGM™) technology in conjunction with traditional and proprietary breeding techniques. In development since 2002, the CGM platform is based on the insight that conventional genome multiplication practices often fail because of unintended extensive damage they inflict on DNA and DNA-related structures. By minimizing such damage, CGM provides plant scientists with unprecedented scope and latitude in implementing cutting-edge breeding concepts. While Kaiima's CGM technology does manipulate the cells at the DNA level it does not manipulate the DNA itself and so is not a GM technology. Kaiima's CGM technology has been successfully tested in multiple plant varieties, in sister companies that specialize in specific fruits and vegetables.

Kaiima is led by an experienced management team, with most of the team's experience being in the seed industry. The company now has 23 employees and has created an extremely cooperative environment with good working procedures, especially in the R&D team.

In July 2008 Kaiima raised its first round at $8m, a significant sum at such a stage, which should last until the end of 2010. A second round is in progress, expected to finalize around September 2010 without any obstacles.

At the beginning of 2010 Kaiima merged with its sister company TOP, which specializes in vegetable and herb seeds. The two companies had been sharing R&D resources and the merger is intended to improve resource allocation. TOP is a profitable company with sales of a few million dollars in 2009 and is expected to double its sales in 2010.

Technology

Most plants are diploids - meaning that they have two sets of chromosomes in each cell nucleus. Some plants are polyploid - meaning that they have more than two sets of chromosomes in each cell nucleus. Naturally occurring polyploids exhibit several advantages over their diploid equivalents: they are larger, more robust and more climate tolerant. These advantages have long inspired scientists and breeders to try to induce polyploidy in economically important plant varieties by artificial methods. These methods damaged the original plant DNA, and the resultant polyploids exhibited deformities, instability, reduced fertility, and reduced rates of biomass accumulation.

CGM™ (Clean Genomic Multiplication) is a biotechnology platform in development since 2002 that induces clean polyploidy in plants. This allows the DNA to sustain only minimal damage - keeping the plant fertile and genetically stable. The resulting plants are bigger, have higher yield potential, supply greater biomass accumulation per time unit and water unit, have enhanced photosynthesis, have improved adaptability to extreme climates and improved resistance to stress factors such as dryness, salinity and extreme soil pH levels.

Kaiima's R&D team has accumulated unique experience with CMG based plant breeding while working on developments at Kaiima and its sister JVs. The team has a large variety of breeding techniques in use to allow extensive manipulation of plant characteristics. Kaiima's development processes are relatively fast, with a time to market of a new variety that can be less than half the time needed for a GM development.

The R&D team is working on creating new versions of the high-energy foods such as high-ploidy versions with significantly higher yield and robustness as well as versions that can thrive in sub-

optimal land, meaning that land currently considered marginal may become arable, and sub-optimal weather, meaning less irrigation is needed and yield risk levels are lowered.

Its Israeli origin is an asset to the company in several ways. First, development capabilities are enhanced by the ability to take advantage of Israel's large variety of soil and climate conditions, all prevalent in a small area. Second, it has connections to the world leaders in complementary industries such as irrigation, and last it has immediate access to a variety of leading research facilities that can support R&D efforts in various ways through collaborative research or state of the art facilities.

Kaiima's first development, hybrid castor seeds for the bio-polymer and bio-fuel industry, has already generated some orders, but while these industries have high growth potential, currently this market is small and unpredictable.

The Four-Dimensional Dilemma

With roots in the niche markets of vegetables and herbs, a small presence in oils for the bio-fuel market and proof of concept for high-energy foods Kaiima is at a crossroad. With limited resources and capabilities it must map out a clear strategic direction. While the company has a proven technological advantage, developing technologically advanced seeds alone will not lead to success; the technological advantage has to be transformed into a competitive advantage. The strategy must help the company define its pipeline, setting priorities for the seeds and traits that are to be developed. The team has to come up with a comprehensive plan of the markets it will serve with these products, the timeline for addressing these markets and the correct way to penetrate and serve these markets. It should also decide whether strategic partnerships are needed or not and if they are, with whom and how they **should** cooperate. Risk levels must also be accounted for.

Whatever the decision, it will impact Kaiima for many years to come, since completing all the necessary R&D will take at least a couple of years, maybe more. This time frame and industry structure considerations dictate that the strategy should lead to a real quantum leap in Kaiima's performance. Such a leap should give Kaiima a sustainable competitive advantage for the coming years and it will enable the company to develop from a niche player to a major player in a fierce hypercompetitive industry.

Appendixes

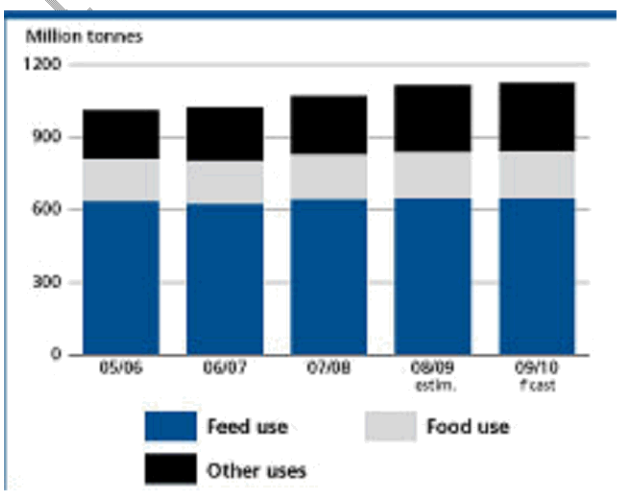
Exhibit 1 – World Grain Consumption

Commodity	Wheat			Rice			Coarse grains*		
Variable	2004	2009	2018 forecast	2004	2009	2018 forecast	2004	2009	2018 forecast
Production, kt	628,292	653,255	722,427	409,677	459,675	494,367	1,032,353	1,113,059	1,283,583
Imports, kt	112,064	119,933	133,876	30,120	33,494	38,692	102,979	117,836	127,960
Consumption, kt	611,229	648,288	718,912	419,271	454,842	494,835	978,989	1,119,512	1,276,004
Ending stocks, kt	185,555	195,444	217,722	85,011	101,815	107,909	256,207	252,925	292,891
Exports, kt	110,212	119,933	133,876	28,844	32,750	37,912	112,030	117,836	127,960
Trade balance, kt	-1,852	0	0	-1,277	-744	-779	9,051	0	0
Area harvested, 000 ha	218,379	223,464	224,773	150,844	159,300	159,223	306,009	318,807	328,251
Feed, kt	112,996	118,583	132,873	..	..	..	625,917	645,937	715,523
Food, kt	438,598	465,761	508,167	367,265	392,715	431,841	192,483	217,021	243,927
Other use, kt	59,001	59,239	63,729	..	..	..	93,241	107,789	121,723
Yield, Mt/Ha	2.88	2.92	3.21	2.72	2.89	3.10	3.37	3.49	3.91

* Coarse grains are cereal grains other than wheat and rice, and include maize, grain sorghum, barley, and oats

Source: OECD-FAO Agricultural Outlook 2009-2018

Exhibit 2 – Coarse Grain Utilization



Source: FAO - Global Market Analysis

Exhibit 3: Estimated Value* of the Seed Consumption in Selected Countries, Consumer Prices, June 2008, $ 1,000 **

Country	Value	Country	Value
USA	8,500	Morocco	140
China	4,000	Egypt	140
France	2,150	Bulgaria	120
Brazil	2,000	Chile	120
India	1,500	Serbia	120
Japan	1,500	Nigeria	120
Germany	1,500	Slovakia	110
Italy	1,000	New Zealand	100
Argentina	950	Switzerland	90
Canada	550	Paraguay	80
Russian Federation	500	Portugal	80
Spain	450	Ireland	80
Australia	400	Algeria	70
Korea	400	Uruguay	70
United Kingdom	400	Kenya	60
Mexico	350	Iran	55
Poland	350	Israel	50
Turkey	350	Tunisia	45
Taiwan	300	Colombia	40
South Africa	300	Bolivia	40
Hungary	300	Slovenia	40
Netherlands	300	Zimbabwe	30
Czech Republic	300	Peru	30
Denmark	250	Libya	25
Bangladesh	250	Saudi Arabia	20
Greece	240	Zambia	20
Sweden	240	Ecuador	15
Romania	220	Tanzania	15
Belgium	190	Malawi	10
Finland	160	Uganda	10
Austria	150	Dominican Republic	7
		Total	**32,002**

*Estimation, +/- 10%

**The commercial world seed market is assessed at approx. $36.5 bn

Source: International Seed Federation

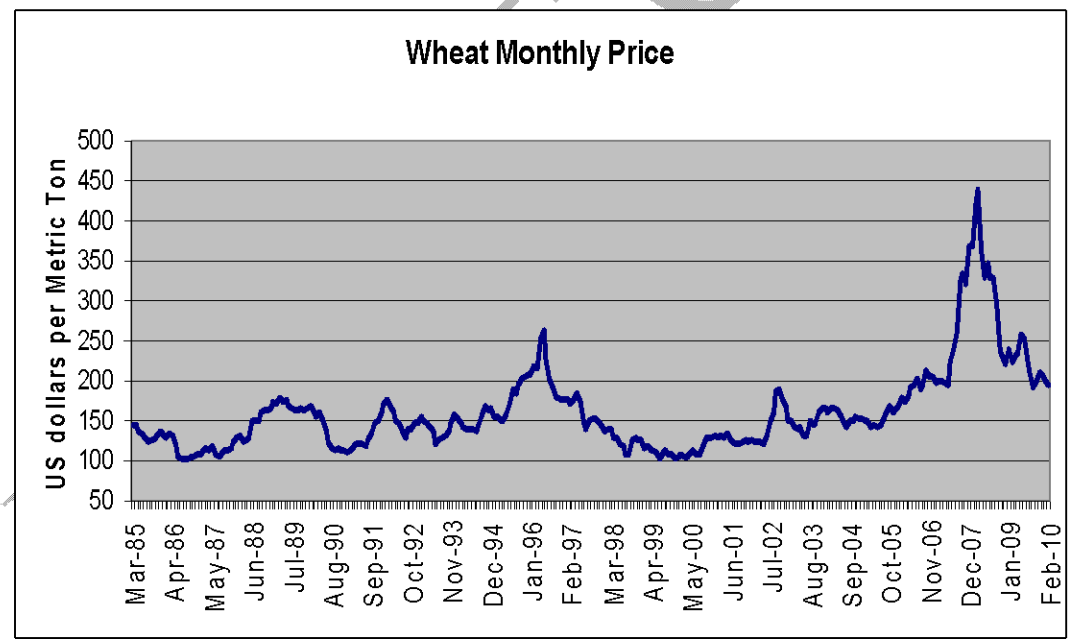
Exhibit 4: Seed Background & Prices

Wheat

Wheat is widely cultivated as a cash crop because it produces a good yield per unit area, grows well in a temperate climate even with a moderately short growing season, and yields a versatile, high-quality flour that is widely used in baking. The popularity of foods made from wheat flour creates a large demand for the grain, even in economies with significant food surpluses.

Of the major high energy foods, wheat presents the least favourable return on investment for seed breeding companies; having been cultivated for centuries, the wheat seeds available to farmers through open lines and seed saving are robust enough, in comparison to the other high energy foods. Therefore, most of the wheat grown today is from non IP protected seeds as there has not been much R&D directed to wheat and no major commercial break through with modern cultivation methods in wheat. In 2009 Monsanto announced that it will start an R&D effort in genetically-engineered wheat, with the first product planned to reach the market within seven to eight years.

In 2009 there were about 225 million hectares of wheat fields in the world, yielding 683 million metric tons of wheat. In 2009, the average wheat price was $225 per metric ton.



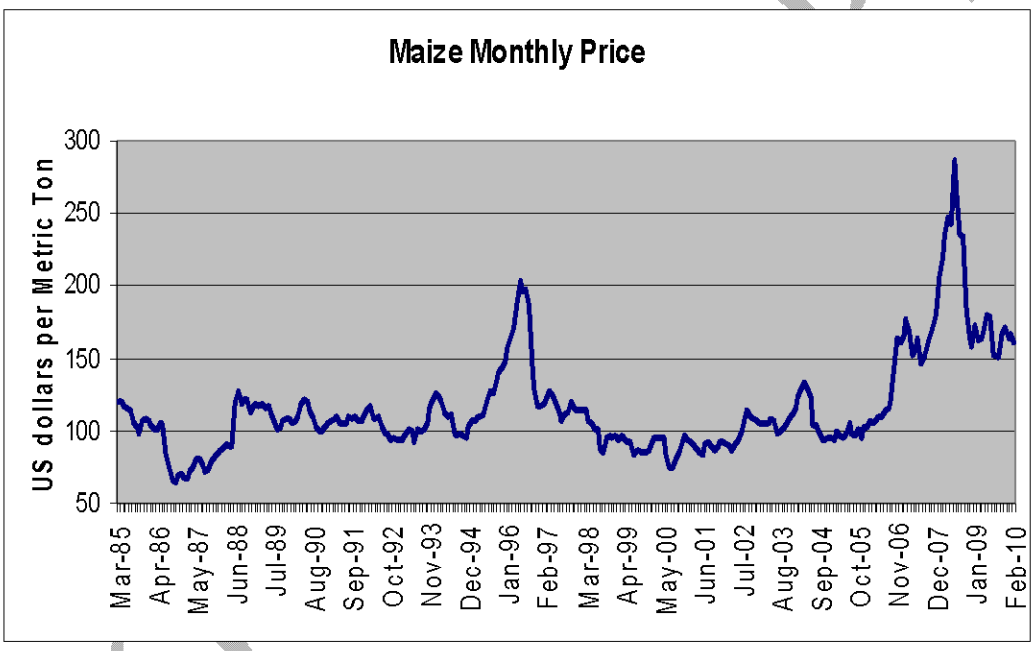
Source: International Monetary Fund

Maize

Maize is widely cultivated throughout the world as almost all of its parts have economic value; the green leaves, stalk, tassel and cob can be used to produce a large variety of food, animal feed and non-food products. The use of maize in biofuels is on the increase, especially in the USA, where ethanol's share of maize consumption in 2009 was above 35%.

Maize has been subject to major R&D efforts since the 1930s, when the first higher yielding hybrid varieties were introduced. By 2010, most of the maize crops in developed countries comes from manipulated seeds. Moreover, in the USA only 2% of the seeds used in 2009 were not genetically engineered. The world leading supplier is Monsanto, with over 80% of the maize planted in the US containing Monsanto's genetically engineered traits. One implication of this situation is that there is less commercial logic in using the seeds and DNA from open-pollinated seeds for further development as these are at a disadvantage compared to the manipulated seeds, which are IP protected and belong to a certain seed company.

In 2009 there were 157 million hectares of maize fields in the world, yielding 794 million metric tons of maize. In 2009, the average maize price was $180 per metric ton.



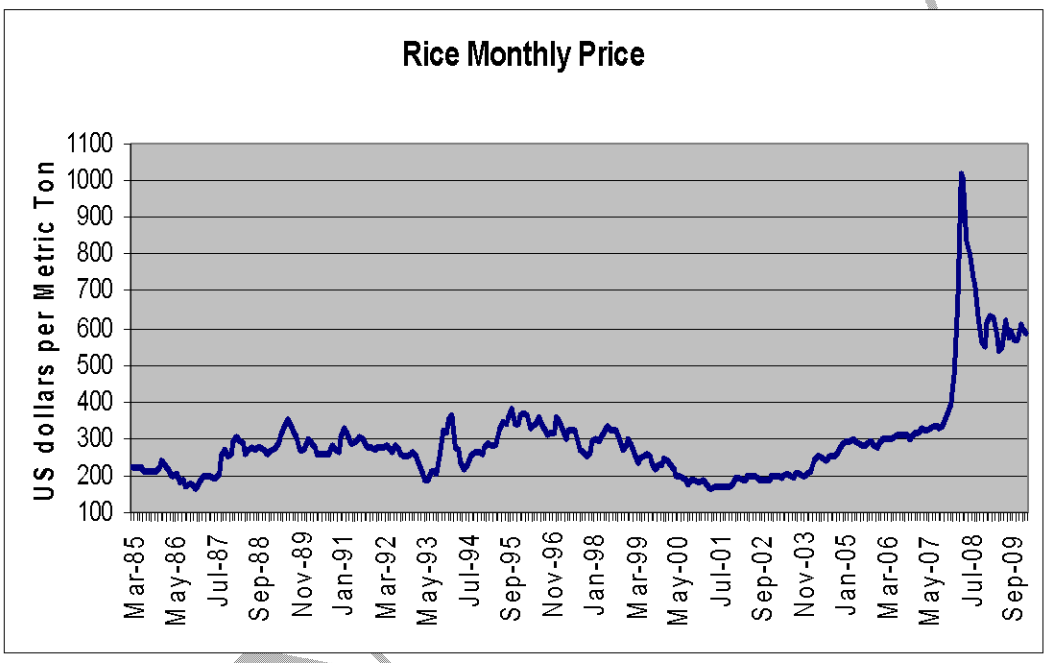
Source: International Monetary Fund

Rice

Rice is the seed of an annual plant, although in tropical areas it can survive as a perennial. The edible seed is a grain, and as a cereal grain, it is the most important staple food for a large part of the world's human population, especially in Asia, the Middle East and Latin America. Rice cultivation is well-suited for countries and regions with low labor costs and high rainfall, as it is very labor-intensive and requires plenty of water for cultivation - the traditional method for cultivating rice is flooding the fields while, or after, setting the young seedlings.

Rice has been subjected to some modern R&D and hybrid varieties are available, but most of the rice grown in 2009 was still from non IP protected seeds.

Although China and India are the two largest producers of rice in the world, both countries consume the majority of the rice produced domestically, leaving little to be traded internationally. Most rice is consumed within a close region of its production area. Very little rice is traded and for this reason its market price is very volatile. While only 5% of the world's rice production is traded between countries, 15% of the world's wheat and other coarse grains production is traded between countries.
In 2009 there were 158 million hectares of rice fields in the world, yielding 678 million metric tons of rice. In 2009, the average rice price was $600 per metric ton.



Source: International Monetary Fund

Sorghum

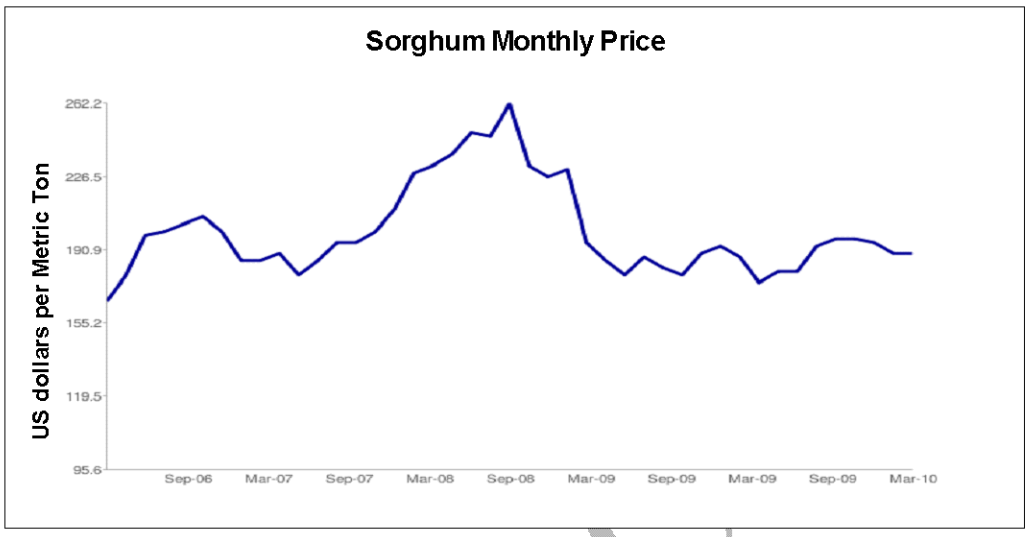
Sorghum is an annual grass, one of the five top cereal crops in the world. White sorghum is mostly used for food while yellow sorghum is mostly used for animal feed. It is extremely drought tolerant, making it an excellent high energy food for dry areas, as it has special adaptations to weather extremes and is, therefore, a very stable source of nutrition.

Sorghum's seeds, stalks, and leaves can all be fed to livestock or left in the field and used as a forage crop. Sorghum is almost exclusively traded for feed and international market prices are largely determined by the supply and demand situation in the United States. In the United States, sorghum starch is used in a variety of industrial applications such as adhesives and paper making. In much of the rest of the world sorghum is consumed by humans as well as animals.

A hybrid for sorghum was developed in the 1960s and is widely used in large parts of the world, as it improves productivity, uniformity and quality. There has been R&D work in sorghum since but dissemination is poor.

The United States is the world's largest producer of grain sorghum followed by India and Nigeria. It is a leading cereal grain produced in Africa and is an important food source in India.

In 2009 there were 42 million hectares of sorghum fields in the world, yielding 61 million metric tons of sorghum. In 2009, the average sorghum price was $180 per metric ton.



Source: mongabay.com using figures from World Bank Commodity Price Data

Exhibit 5: Various Seed Statistics, million ton

Wheat

	Production		Imports		Exports		Total Utilization	
	2008E	2009F	2008/09E	2009/10F	2008/09E	2009/10F	2008/09E	2009/10F
ASIA	**276.0**	**286.0**	**59.7**	**52.2**	**10.2**	**13.1**	**312.8**	**318.6**
Bangladesh	0.9	1.0	2.3	2.1	-	-	3.2	3.1
China	112.5	111.0	1.8	1.7	0.2	1.0	103.6	105.6
Taiwan	-	-	1.1	1.1	-	-	1.2	1.1
India	78.4	77.6	0.5	0.5	0.3	1.0	77.4	77.1
Indonesia	-	-	5.5	5.5	-	-	5.3	5.5
Iran	9.8	13.5	7.0	3.0	-	-	15.7	16.5
Iraq	1.5	2.0	3.8	3.8	-	-	5.8	5.8
Japan	0.9	0.8	5.4	5.5	0.4	0.4	5.9	5.9
Kazakhstan	12.5	14.0	-	-	5.0	6.0	7.0	8.0
Korea,	-	-	4.0	4.1	0.1	0.1	3.7	3.9
Pakistan	21.8	23.8	2.5	1.0	1.6	1.6	22.7	23.1
Philippines	-	-	2.5	2.7	-	-	2.5	2.6
Saudi Arabia	1.7	1.2	0.8	1.3	-	-	2.6	2.7

Thailand	-	-	1.1	1.2	0.1	-	1.1	1.1
Turkey	17.8	20.0	2.5	0.5	1.5	1.8	18.7	18.9
AFRICA	**21.2**	**23.8**	**32.1**	**30.0**	**0.8**	**0.8**	**54.0**	**54.6**
Algeria	1.6	2.9	5.7	4.8	-	-	7.7	7.8
Egypt	8.0	7.8	7.7	8.0	-	-	15.9	16.0
Ethiopia	3.2	3.2	0.5	0.5	-	-	3.9	3.7
Morocco	3.7	5.2	3.4	2.0	0.2	0.2	7.0	7.1
Nigeria	0.1	0.1	3.2	3.4	0.1	0.1	3.2	3.4
South Africa	2.1	1.8	1.3	1.2	0.2	0.2	3.0	3.1
Tunisia	0.9	1.2	1.8	1.5	0.1	0.1	2.7	3.0
CENTRAL AMERICA	**4.0**	**4.1**	**7.3**	**7.1**	**1.1**	**1.1**	**10.0**	**10.2**
Cuba	-	-	0.8	0.8	-	-	0.8	0.8
Mexico	4.0	4.1	3.6	3.4	1.0	1.0	6.4	6.5
SOUTH AMERICA	**17.8**	**18.6**	**12.2**	**12.6**	**6.2**	**5.1**	**24.9**	**25.3**
Argentina	8.3	9.6	-	-	5.0	4.0	5.0	5.1
Brazil	5.9	5.7	6.0	6.0	0.3	0.3	10.9	11.1
Chile	1.2	1.3	0.8	1.1	-	-	2.2	2.3
Colombia	-	-	1.3	1.3	-	-	1.3	1.3
Peru	0.2	0.2	1.5	1.6	-	-	1.7	1.8
Venezuela	-	-	1.6	1.7	-	-	1.7	1.7
NORTH AMERICA	**96.6**	**81.0**	**2.9**	**2.6**	**43.5**	**42.0**	**45.7**	**43.3**
Canada	28.6	25.9	-	-	17.0	17.5	11.7	8.7
U.S	68.0	55.1	2.9	2.6	26.5	24.5	34.0	34.6
EUROPE	**247.3**	**219.9**	**9.0**	**8.8**	**50.0**	**37.9**	**189.5**	**194.6**
European Union	150.0	138.6	6.8	6.5	21.0	16.0	126.3	130.6
Russian Federation	63.8	55.0	0.2	0.2	17.5	14.0	41.5	42.2
Ukraine	25.9	19.1	0.1	0.2	10.5	7.0	13.4	13.4
OCEANIA	**21.7**	**22.3**	**0.6**	**0.6**	**12.0**	**14.0**	**7.8**	**8.3**
Australia	21.4	22.0	-	-	12.0	14.0	6.8	7.4
WORLD	**684.6**	**655.8**	**123.8**	**114.0**	**123.8**	**114.0**	**644.7**	**655.0**
Developing countries	292.3	304.5	99.1	89.7	12.6	13.5	369.1	374.7
Developed countries	392.3	351.3	24.7	24.3	111.1	100.5	275.6	280.3
LIFDCs	250.7	254.9	51.6	48.5	3.0	4.7	289.4	293.1
LDCs	9.8	10.6	12.7	12.2	0.1	0.1	22.9	23.1

Source: FAO - Global Market Analysis

Maize

	Production		Imports		Exports		Total Utilization	
	2008E	2009F	2008/09E	2009/10F	2008/09E	2009/10F	2008/09E	2009/10F
ASIA	**232.8**	**230.3**	**42.4**	**43.5**	**2.7**	**3.9**	**259.5**	**267.0**
China	165.5	163.0	4.5	4.4	0.3	0.7	157.0	164.5
Taiwan	-	-	4.3	4.3	-	-	4.4	4.4
India	19.5	18.5	0.1	0.1	0.6	0.6	18.7	18.0
Indonesia	16.3	17.0	0.2	0.2	0.5	1.2	14.7	15.0
Iran	1.0	1.2	3.0	2.8	-	-	4.1	4.0
Japan	-	-	16.4	16.5	-	-	16.6	16.6
Korea, D.P.R.	1.4	2.0	0.5	0.5	-	-	2.0	2.5
Korea	0.1	0.1	6.9	7.5	-	-	8.0	7.7
Malaysia	0.1	0.1	2.6	2.6	-	-	2.7	2.7
Pakistan	3.2	3.2	-	-	-	-	3.2	3.2
Philippines	6.9	6.7	0.3	0.3	-	-	6.9	7.0
Thailand	4.2	4.3	0.5	0.4	0.7	0.8	3.9	3.9
Turkey	4.3	3.7	0.4	0.8	-	-	4.6	4.5
Viet Nam	3.7	3.7	0.7	0.7	-	-	4.4	4.4
AFRICA	**56.7**	**57.9**	**12.9**	**12.7**	**4.0**	**3.8**	**64.9**	**66.4**
Algeria	-	-	2.0	2.2	-	-	2.1	2.2
Egypt	6.7	7.0	4.1	4.2	-	-	11.2	11.2
Ethiopia	5.2	5.2	0.1	-	0.1	0.1	5.2	5.2
Kenya	2.3	3.0	0.8	0.7	-	-	3.4	3.6
Morocco	0.2	0.2	1.6	1.8	-	-	1.9	1.9
Nigeria	7.5	7.5	0.1	0.1	0.2	0.2	7.3	7.4
South Africa	13.2	11.7	0.1	0.2	2.3	2.0	9.4	9.9
Tanzania	3.6	3.5	0.1	0.1	0.2	0.2	3.4	3.5
CENTRAL AMERICA	**28.0**	**26.9**	**13.6**	**13.9**	**0.1**	**0.1**	**41.5**	**41.0**
Mexico	24.3	23.0	8.8	9.2	0.1	0.1	33.0	32.4
SOUTH AMERICA	**91.6**	**75.1**	**8.0**	**7.8**	**21.8**	**18.1**	**71.2**	**69.3**
Argentina	22.0	13.0	-	-	12.5	9.0	7.5	5.7
Brazil	59.0	51.3	0.5	0.5	8.0	8.0	46.6	46.3
Chile	1.4	1.3	1.8	1.7	-	-	3.2	3.1
Colombia	1.6	1.7	2.8	3.0	0.1	-	4.4	4.7
Peru	1.4	1.4	1.4	1.5	-	-	2.9	2.9
Venezuela	2.4	3.0	1.0	0.6	-	-	3.5	3.6
NORTH AMERICA	**318.0**	**317.5**	**2.4**	**2.7**	**44.3**	**51.4**	**276.5**	**282.4**

Canada	10.6	10.5	2.1	2.4	0.3	0.4	12.5	12.5
U.S	307.4	307.0	0.3	0.4	44.0	51.0	263.9	269.9
EUROPE	**92.1**	**83.5**	**4.0**	**4.3**	**8.5**	**7.6**	**80.6**	**80.9**
European Union	62.5	58.6	3.2	3.5	1.8	2.0	60.1	60.3
Russian Federation	6.7	5.5	0.2	0.2	1.0	1.0	5.1	5.2
Serbia	5.9	6.5	-	-	1.2	1.6	4.3	4.5
Ukraine	11.4	8.0	-	-	4.5	3.0	5.3	5.4
OCEANIA	**0.6**	**0.6**	**0.1**	**0.1**	-	-	**0.6**	**0.6**
WORLD	**819.8**	**791.8**	**83.3**	**85.0**	**81.5**	**85.0**	**794.7**	**807.6**
Developing countries	394.4	376.9	59.6	60.1	26.3	24.0	408.2	414.4
Developed countries	425.4	414.9	23.8	24.9	55.2	61.0	386.5	393.2
LIFDCs	263.7	264.1	13.5	13.0	3.0	4.3	260.2	269.2
LDCs	28.4	29.6	2.1	1.7	1.8	1.9	28.7	29.3

Source: FAO - Global Market Analysis

Sorghum

	Production		Imports		Exports		Total Utilization	
	2008E	**2009F**	**2008/09E**	**2009/10F**	**2008/09E**	**2009/10F**	**2008/09E**	**2009/10F**
ASIA	**10.3**	**10.3**	**1.6**	**1.5**	**0.1**	**0.1**	**11.8**	**12.1**
China	1.8	1.7	0.1	0.1	-	-	2.0	1.9
India	7.2	7.5	-	-	-	-	7.2	7.5
Japan	-	-	1.3	1.3	-	-	1.3	1.4
AFRICA	**26.3**	**26.3**	**0.9**	**0.7**	**0.8**	**0.7**	**26.7**	**26.4**
Burkina Faso	2.0	1.7	-	-	0.1	0.1	1.8	1.7
Ethiopia	2.6	2.6	0.1	0.1	-	-	2.9	2.8
Nigeria	9.3	9.3	-	-	0.1	0.1	9.3	9.3
Sudan	4.2	4.5	0.3	0.3	0.3	0.3	4.5	4.5
CENTRAL AMERICA	**7.1**	**6.7**	**2.0**	**1.8**	-	-	**8.7**	**8.9**
Mexico	6.6	6.2	2.0	1.8	-	-	8.2	8.4
SOUTH AMERICA	**5.9**	**5.2**	**0.4**	**0.5**	**0.8**	**0.7**	**5.2**	**4.8**
Argentina	2.9	2.3	-	-	0.8	0.5	1.9	1.6
Brazil	2.0	1.7	-	-	-	0.1	1.9	1.7
Venezuela	0.4	0.5	-	-	-	-	0.4	0.5
NORTH AMERICA	**12.0**	**9.7**	-	-	**3.4**	**3.5**	**8.3**	**6.4**
U.S	12.0	9.7	-	-	3.4	3.5	8.3	6.4
EUROPE	**0.6**	**0.6**	**0.6**	**0.8**	-	-	**1.3**	**1.4**

European Union	0.6	0.6	0.4	0.6	-	-	1.2	1.3
OCEANIA	**3.1**	**2.1**	**0.2**	**0.2**	**0.7**	**0.6**	**2.4**	**1.8**
Australia	3.1	2.1	-	-	0.7	0.6	2.2	1.6
WORLD	**65.2**	**60.9**	**5.6**	**5.5**	**5.7**	**5.5**	**64.4**	**61.7**
Developing countries	49.3	48.2	3.5	3.1	1.6	1.3	50.7	50.4
Developed countries	15.9	12.7	2.1	2.4	4.1	4.2	13.7	11.2
LIFDCs	36.1	36.0	1.0	0.7	0.8	0.7	36.5	36.4
LDCs	15.5	15.2	0.7	0.6	0.7	0.6	15.6	15.3

Source: FAO - Global Market Analysis

Rice

	Production		Imports		Exports		Total Utilization	
	2008E	**2009F**	**2008/09E**	**2009/10F**	**2008/09E**	**2009/10F**	**2008/09E**	**2009/10F**
ASIA	**416.3**	**418.1**	**14.2**	**14.4**	**24.2**	**24.5**	**386.4**	**396.2**
Bangladesh	32.3	31.5	1.7	0.4	-	-	29.8	31.6
China	133.3	133.4	0.8	0.9	1.0	1.2	126.3	127.2
Taiwan	1.1	1.1	0.1	0.1	-	-	1.2	1.2
India	98.9	99.5	0.1	0.1	3.7	4.0	89.1	92.6
Indonesia	38.0	38.4	0.3	0.2	-	0.1	37.0	37.7
Iran	1.6	1.8	1.0	1.2	-	-	3.0	2.9
Iraq	0.2	0.2	0.7	1.0	-	-	1.0	1.1
Japan	8.0	7.8	0.6	0.7	0.2	0.2	8.3	8.4
Korea, D.P.R.	1.1	1.2	0.7	0.9	-	-	2.0	2.0
Korea,	4.8	4.7	0.3	0.3	-	0.1	4.7	4.9
Malaysia	1.5	1.6	1.0	0.9	-	-	2.4	2.4
Myanmar	19.2	19.8	-	0.1	0.2	0.7	19.8	19.8
Pakistan	6.5	6.3	-	-	2.9	3.5	2.8	3.0
Philippines	11.1	11.3	2.3	2.4	-	-	12.7	13.5
Saudi Arabia	-	-	1.1	1.3	-	-	1.1	1.2
Sri Lanka	2.6	2.8	0.1	-	-	-	2.3	2.5
Thailand	20.8	20.6	0.2	0.2	10.0	8.3	11.8	12.0
Viet Nam	25.8	26.0	0.2	0.2	4.7	5.0	19.9	20.5
AFRICA	**17.2**	**18.4**	**9.5**	**9.5**	**0.5**	**1.0**	**23.7**	**25.3**
Cote d'Ívoire	0.4	0.4	0.9	0.9	-	-	1.3	1.3
Egypt	5.0	5.0	-	-	0.5	0.7	3.8	4.0
Madagascar	3.3	4.4	0.1	-	-	0.3	2.8	3.3
Nigeria	2.5	2.6	2.0	1.8	-	-	4.0	4.3
Senegal	0.3	0.2	0.9	0.9	-	-	1.1	1.1

South Africa	-	-	0.8	0.9	-	-	0.9	0.9
Tanzania,	0.9	0.9	0.1	0.2	-	-	1.0	1.0
CENTRAL AMERICA	**1.7**	**1.7**	**2.3**	**2.3**	**-**	**-**	**3.9**	**4.0**
Cuba	0.3	0.3	0.7	0.7	-	-	1.0	1.0
Mexico	0.2	0.2	0.5	0.5	-	-	0.7	0.7
SOUTH AMERICA	**16.1**	**16.6**	**1.0**	**1.1**	**2.0**	**2.1**	**14.8**	**14.9**
Argentina	0.8	0.8	-	-	0.3	0.5	0.3	0.5
Brazil	8.1	8.6	0.4	0.7	0.5	0.3	8.6	8.0
Peru	1.9	1.8	0.1	-	-	-	1.7	2.0
Uruguay	0.9	0.9	-	-	0.8	0.8	0.1	0.1
NORTH AMERICA	**6.5**	**7.2**	**1.0**	**1.0**	**3.3**	**3.1**	**4.3**	**4.6**
Canada	-	-	0.3	0.3	-	-	0.3	0.3
U.S	6.5	7.2	0.7	0.7	3.3	3.1	4.0	4.3
EUROPE	**2.4**	**2.5**	**1.8**	**2.0**	**0.1**	**0.2**	**4.2**	**4.3**
European Union	1.8	1.9	1.3	1.5	0.1	0.1	3.1	3.2
Russian Federation	0.5	0.5	0.3	0.3	-	-	0.7	0.7
OCEANIA	**-**	**0.1**	**0.4**	**0.5**	**0.1**	**0.1**	**0.5**	**0.5**
Australia	-	-	0.2	0.2	0.1	0.1	0.2	0.2
WORLD	**460.3**	**464.5**	**30.2**	**30.9**	**30.2**	**30.9**	**437.9**	**449.8**
Developing countries	442.9	446.5	25.6	25.7	26.5	27.4	419.2	430.8
Developed countries	17.4	18.0	4.6	5.2	3.7	3.5	18.7	19.1
LIFDCs	350.3	352.6	16.4	16.0	9.5	11.1	334.8	345.1
LDCs	70.5	71.8	7.3	6.3	1.7	2.3	71.4	74.5

Source: FAO - Global Market Analysis

Exhibit 6: Various Grains - Yield and Production 2007-2009

Country/Region	Sorghum				Wheat				Rice				Maize			
	Area		Yield		Area		Yield		Area		Yield		Area		Yield	
	Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare	
	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09
World	42.68	42.2	1.56	1.53	218.05	225	2.8	3.03	155.06	158	4.18	4.22	160.02	157	4.95	5.06
United States	2.75	2.94	4.6	4.08	20.64	22.5	2.7	3.02	1.11	1.2	8.09	7.68	35.01	31.8	9.46	9.66
Total Foreign	39.93	39.2	1.35	1.34	197.41	203	2.81	3.03	153.94	157	4.15	4.19	125	125	3.69	3.89
East Asia																
China	0.5	0.49	3.84	3.75	23.72	23.6	4.61	4.76	28.92	29	6.43	6.56	29.48	29.9	5.17	5.56
Japan									1.67	1.6	6.51	6.78				
Korea, South									0.95	0.9	6.28	6.99				
Korea, North									0.6	0.6	3.94	4.89				
South America																
Brazil	0.85	0.85	2.35	2.26					2.87	2.9	4.2	4.33	14.7	14.1	3.99	3.62
Argentina	0.62	0.45	4.74	3.69	6	4.55	3	1.98					3.41	2.5	6.45	6
Peru									0.38	0.4	7.36	6.92				
Mexico	1.78	1.78	3.49	3.54									7.33	7.32	3.22	3.31
EU-27	0.09	0.1	5.65	5.36	24.71	26.7	4.86	5.66	0.42	0.4	6.49	6.42	8.44	8.86	5.63	7.08
France	0.05	0.04	5.88	6.24	5.24	5.49	6.25	7.1					1.48	1.7	9.67	9.29
Italy	0.03	0.04	5.68	5.77	2.04	2.45	3.51	3.83	0.23	0.2	6.41	6.25	1.01	1.06	9.41	9.53
Hungary					1.11	1.13	3.59	5					1.12	1.19	3.6	7.47
Romania					1.85	2.17	1.62	3.48					2.55	2.45	1.54	3.21
Poland					2.11	2.28	3.94	4.08					0.26	0.32	6.57	5.82
Germany					2.99	3.21	6.96	8.09								
United Kingdom					1.83	2.08	7.22	8.28								
Spain					1.83	2.07	3.47	3.25	0.1	0.1	7.23	6.94				
Denmark					0.69	0.64	6.56	7.85								
Bulgaria					1.04	1.1	2.3	4.21								
South Asia																

India	7.93	7.7	1	0.95	28	28.2	2.71	2.79	43.77	45	3.31	3.28	8.26	8	2.3	2.41
Country/Region	Sorghum				Wheat				Rice				Maize			
	Area		Yield		Area		Yield		Area		Yield		Area		Yield	
	Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare	
	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09
Pakistan	0.25	0.24	0.6	0.6	8.4	8.2	2.77	2.62	2.55	2.9	3.35	3.45				
Afghanistan					2.2	1.6	1.52	0.94								
Bangladesh									11.1	12	3.89	4.01				
Canada					8.64	10	2.32	2.85					1.37	1.17	8.5	9.06
Australia	0.94	0.75	4.02	3.54	12.58	13.2	1.08	1.59								
Former Soviet																
Russia					24.4	26.7	2.02	2.39					1.3	1.65	3.04	4
Ukraine					5.95	7.05	2.34	3.67					1.9	2.4	3.89	4.75
Kazakhstan					12.9	13.5	1.28	0.93								
Uzbekistan					1.3	1.36	4.77	4.41								
Serbia													1.21	1.28	3.36	4.8
North Africa																
Egypt	0.16	0.16	5.63	5.63	1.29	1.23	6.43	6.43	0.67	0.7	10.07	10.04	0.72	0.73	8.58	8.52
Morocco					2.57	2.86	0.62	1.31								
Southeast Asia																
Philippines									4.35	4.5	3.83	3.77	2.74	2.66	2.66	2.58
Indonesia									11.9	12	4.82	4.88	3.21	3.22	2.65	2.7
Vietnam									7.41	7.3	4.98	5.05	1.15	1.14	4	3.97
Thailand									10.83	11	2.77	2.78	1	1.02	3.85	4.12
Burma									7.09	6.7	2.61	2.61				
Cambodia									2.57	2.6	2.62	2.75				
Laos									0.82	0.9	3.51	3.53				
Malaysia									0.65	0.7	3.49	3.58				
Sub-Saharan																
South Africa	0.09	0.09	2.93	3.26									3.3	2.9	3.99	4.34
Nigeria	7.4	7.4	1.35	1.49					2.2	2.3	2.27	2.32	4	4.7	1.63	1.68

Sudan	6.6	6.6	0.68	0.71												
Country/Region	Sorghum				Wheat				Rice				Maize			
	Area		Yield		Area		Yield		Area		Yield		Area		Yield	
	Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare		Million hectare		Metric tons/hectare	
	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09	07/08	08/09
Burkina	1.61	1.62	0.94	1.11												
Ethiopia	1.53	1.55	1.73	1.69									1.77	1.98	2.12	2.33
Tanzania	0.9	0.9	1	1												
Niger	1.5	1.5	0.62	0.67												
Uganda	0.31	0.31	1.58	1.58												
Mozambique	0.5	0.5	0.7	0.8												
Ghana	0.21	0.34	0.75	0.81												
Madagascar									1.35	1.4	2.67	3.01				
Zimbabwe													1.25	1.3	0.56	0.4
Middle East																
Turkey					8.6	8.6	1.8	1.95					0.45	0.52	6.44	7.98
Iran					6.9	5.85	2.17	1.71	0.63	0.6	4.45	3.95				
Syria					1.67	1.49	2.42	1.4								
Others	6.17	5.88	0.92	0.99	17.58	18	2.32	2.36	10.25	10	2.88	2.96	28.02	28.1	1.91	1.93

Source: United States Department of Agriculture: Foreign Agricultural Service

Exhibit 7 – Top 10 Global Seed and Top 10 Agrochemical Companies, Company Sale Price, US $m

2000			2007		
Company *	**Seed sales**	**Agrochemical sales**	**Company**	**Seed Sales**	**Agrochemical sales**
DuPont (Pioneer)	1,938	2,500	Monsanto	4,694	3,753
Pharmacia (Monsanto)	1,600	4,100	DuPont	3,300	2,400
Syngenta (Novartis)	958	6,100	Syngenta	2,018	7,285
Groupe Limagrain	622	n/a	Groupe Limagrain	1,226	n/a
Grupo Pulsar (Seminis)	474	n/a	Land O' Lakes	917	n/a
Advanta (AstraZeneca and Cosun)	373	n/a	KWS AG	702	n/a
Dow (Cargill North America)	350	2,100	Bayer CropScience	524	7,447
KWS AG	332		Sakata	396	n/a
Delta & Pine Land	301		DLF-Trifolium	391	n/a
Aventis	267	3,400	Takii	347	n/a
BASF (+Cyanmid)	n/a	3,400	Machteshim-Agan	n/a	1,879
Bayer	n/a	2,100	BASF	n/a	4,291
Machteshim-Agan	n/a	675	Dow AgroSciences (excluding seeds)	n/a	3,414
Sumitomo	n/a	625	Nufarm	n/a	1,819
FMC	n/a	575	Sumitomo Chemical	n/a	1,248
			Arysta	n/a	1,036

* Company's name prior to consolidation

Source: ETC Group, Agropages, company reports, PMcD analysis and company reports

Exhibit 8: Main Competitors in Seed Market

Syngenta

Based in Basel, Switzerland, with more than 26,000 employees in 90 countries, Syngenta was established in December 1999 as a merger of two divested agrochemical businesses of the pharmaceutical companies Astra Zeneca and Novartis. The merger and IPO were completed in late 2000. Since then Syngenta has expanded through further acquisitions. In 2000 Syngenta had to divest several products due to regulatory requirements. Today Syngenta has a broad portfolio, it is the world leader in cereal herbicides and fruit fungicides making it the 2nd biggest company in the crop protection industry.

The company's sales in 2009 were $10,992 million with $1,371 million profit. Its most important markets are North America (34%) and Western Europe (33%), followed by Latin America (19%) and East Asia (14%). The main product lines in 2009 were crop protection with $8,491 million in sales (compared to approximately $6,600 million in 2003) and seeds with $2,564 million in sales (compared to over $1,000 million in 2003). The seed business was the main growth engine in 2009 with a 5% growth, based on a 10% price growth, 3% volume growth and 8% decrease of income due to international currency changes.

In 2009 Syngenta invested about $960 million in R&D, $368m in seed-related areas. As part of cross agreements in the industry Syngenta has several agreements and joint ventures with its competitors, including a joint venture with DuPont called GreenLeaf Genetics holding a 3% share of the US market for hybrid maize, and an R&D initiative with Dow.

Monsanto

Monsanto, headquartered in Missouri, USA, is a multinational agricultural biotechnology corporation established in 1901, With 21,700 employees, offering a variety of herbicides, pesticides and crop seeds. It is the world's leading producer of the herbicide glyphosate, marketed as "Roundup" and 3rd ranked in the agrochemical industry. Monsanto is also the leading producer of genetically engineered (GE) seeds. Ranked 1st in the seed industry; the company estimated it sells approximately 90% of the world's GE seeds. Much of Monsanto's seed products are genetically modified, often to make them immune to Monsanto's Roundup herbicide. Monsanto was not heavily involved in the seed industry before the mid-1980s, when it shifted its strategic interest from agrochemicals to seeds

and their traits. Its strategy was based on life sciences, and most of its R&D is biotechnological, developing seeds based on advanced genomics. Monsanto has purchased several seed companies, but kept some of the original brand names for marketing reasons. The company's growth has been achieved through large R&D investments, the use of patented technologies and numerous M&As of seed companies, including the purchase of Seminis Inc. (2005) and De Ruiter Seeds (2008), making Monsanto the world's largest producer of seeds, both conventional and GM.

Monsanto 2009 sales amounted to $11,724 million, with $2,109 million profit. Seed and genomic segment sales were $7,297 million (vs. $1,900 million in 2003), dominated by maize seeds and traits (56%), soybean (20%), cotton (6%), vegetables (11%) and others (7%) Agricultural productivity segment sales were $4,427 million, of which $3,527 million were herbicides, including Roundup. Monsanto major cooperation is with BASF in research, development and marketing of biotechnology products.

DuPont

Operating in more than 70 countries, DuPont is an R&D company which offers a wide range of innovative products and services for diverse applications including agriculture, nutrition, electronics, communications, safety and protection, home and construction, transportation and apparel. In 1997 DuPont embarked on a strategy of fast growth, based on both its chemical and biological industrial capabilities. At the same time, it gave up its energy business.

DuPunt's 2008 revenues were $30.5 billion, with 60,000 employees worldwide. DuPont Agriculture & Nutrition division focuses on enhancing the quality, quantity, and safety of the global food supply. The division's 2008 $7.9 billion sales are divided to seeds 50% (of them 70% maize, 18% soybean), chemicals 33% and food ingredients 17%. Division activity is globally diversified - Europe (includes Europe, Middle East & Africa) 28%, North America 43%, Asia Pacific 9%, Latin America 20%.

DuPont has a strong R&D base in the GMO sector and is the owner of Pioneer, a company founded in Iowa in 1926 to produce maize seed, and today a world leading developer and supplier of advanced plant genetics to farmers worldwide. Pioneer produces hybrid and varietal proprietary, patented genetics seeds with a focus on biotech traits for insect protection and herbicide resistance. Its leading product is maize, but the company also markets and sells hybrids or improved varieties of sorghum, sunflower, soybean, alfalfa, canola, rice and wheat, as well as forage and grain additives

Bayer

Bayer AG is a German chemical and pharmaceutical company headquartered in Leverkusen, Germany, founded in 1863 is well-known for its original brand of Aspirin. In 2009 its sales were €31 billion sales, with 108,400 employees. The company devides its activities into three main fields: healthcare, material science and crop science.

Bayer CropScience is the world's leading research-based provider of agrochemicals. Formed from a merger of two large firms and based in Germany, Bayer CropScience focuses on crop protection chemicals, but is also involved in plant biotechnology and seeds (17%). CropScience sales in 2009 were €6.5 billion, of them €5.4 billion in crop protection and €1.1 billion in environmental science and bioscience. Europe is the leading regional market for the division sales (39%) followed by North America (23%), Latin America/Africa/Middle East (22%) and Asia/ Pacific (16%).

In 2002 Bayer purchased the crop protection business of Aventis (sales: $3,800 million in 2001), and although it was forced by the regulators to divest some of its products, it has established itself as the leading company in the industry. Prior to the acquisition, Bayer focused on R&D and new product lines. Now it has the advantage of a very broad portfolio for crop treatment worldwide. Bayer also enhanced its involvement in the seeds and genomics business, focusing primarily on the American market. The research in this area (through acquisitions of seed treatment companies) is aimed to develop both input and output traits for crops. But the investment in these fields is not nearly as heavy as that by Monsanto, Syngenta and DuPont. In addition this division holds a 15% stake in KWS SAAT, a German seed company that is also among the top 10 globally.

BioScience, is a part of Bayer CropScience, and is a global player in research, development and marketing of high quality seeds and innovative plant-based solutions derived from modern breeding and plant biotechnology. In synergy with Bayer CropScience, BioScience offers an integrated portfolio of high quality seeds, trait technologies and high performance crop protection products. Bayer BioScience hybrid seeds offer a wide product range covering hybrid rice, cotton, pearl millet, maize, grain sorghum as well as research varieties of mustard.

Dow

The Dow Chemical Company engages in the manufacture and sale of chemicals, plastic materials, agricultural products, and other products and services worldwide. The company was founded in 1897 and is based in Midland, Michigan. In 2009, Dow had annual sales of $45 billion and employed approximately 52,000 people worldwide.

Dow AgroSciences LLC, based in Indianapolis, Indiana, USA, is a top-tier agrochemical company providing innovative agrochemical and biotechnology solutions globally. The company, a wholly owned subsidiary of The Dow Chemical Company, had 2009 sales of $4.5 billion, of them 11% in seeds and traits, and is the most profitable subgroup. Sales are led by the North American market (36%), followed by Latin America and Europe (25% each).

Over the last few years Dow has gone into joint ventures and acquisitions, enhancing its production, distributing and marketing capabilities in Europe, Latin America, South Africa and Japan. It has also introduced a number of new products that contributed to a significant increase in sales.

In 2000 Dow reached an agreement with Monsanto, under which Dow contracted to supply intermediates to Monsanto, in return for access to registration packages for glyphosate. On another front, Dow cooperates with BASF in R&D aimed at improving input and output traits in canola.

Land O'Lakes

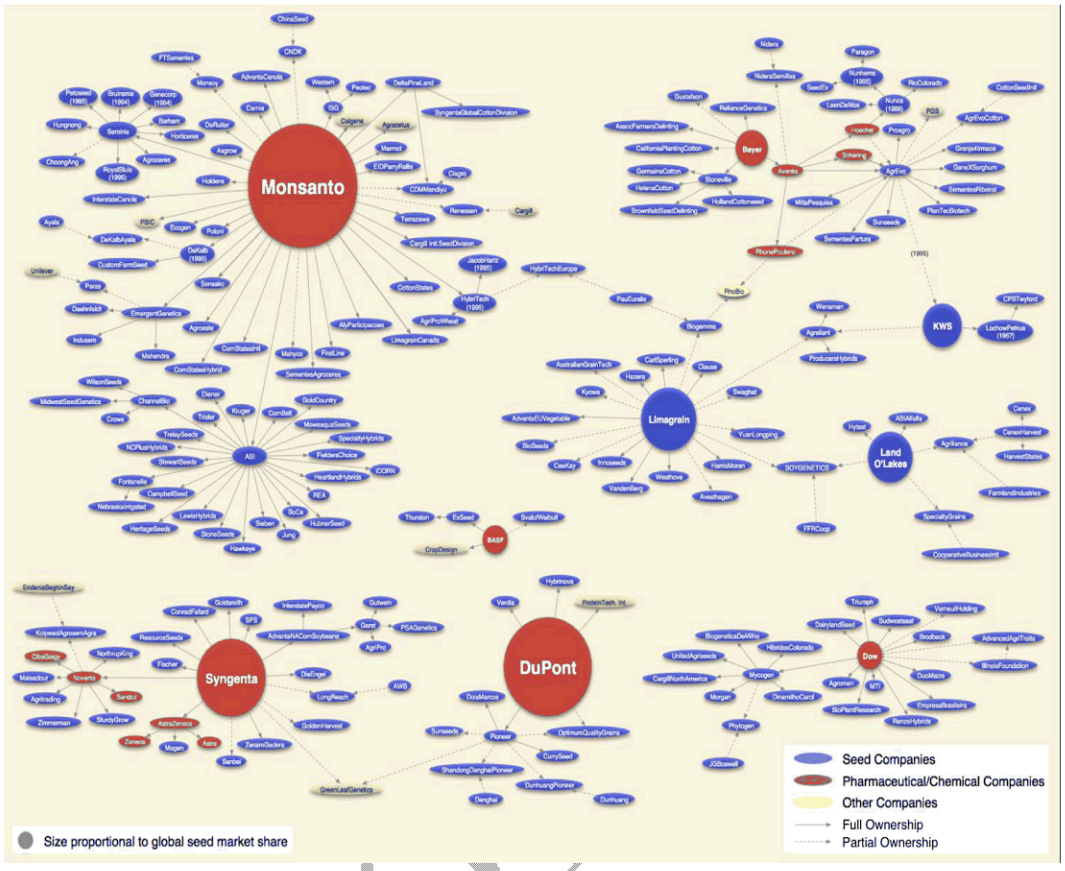
Land O'Lakes is a member-owned $12 billion cooperative based in the USA offering local cooperatives and agricultural producers an extensive line of agricultural supplies and production and business services. In addition Land O'Lakes is a leading marketer of dairy-based food products. The cooperative provides its members with wholesale fertilizer and crop protection products, seed and animal feed. Through its Croplan Genetics brand, Land O'Lakes currently sells both Syngenta and Monsanto seeds. Land O'Lakes and DuPont/Pioneer are the only major seed companies that provide agronomic services to farmers.

Limagrain

French-based Limagrain is a cooperative and the fourth largest seed company in the world, with numerous seed brands targeted at farmers and market gardeners and home gardeners (field crops, vegetables, fruit, flowers). Limagrain is rapidly expanding geographically, in part through acquisitions and joint ventures involving seed companies from the Netherlands, UK, Germany, USA, Canada, Japan, India and China. The annual sales for 2009 were €1, 233 million with a profit of €58 million. Most sales are to Europe (65%), followed by the Americas (20%).

The cooperative has joint ventures with Land O'Lakes and KWS, as well as indirect ties to Monsanto and Bayer through a majority stake in Biogemma, a company that focuses on transgenic traits.

Exhibit 9: Consolidation of the Seed Industry 1996-2008



Source: Philip H. Howard, Department of Community, Agriculture, Recreation and Resource Studies, Michigan State University.

Exhibit 10: Worldwide Seed Sales, Consumer Prices, US $b

Country	2005	2008	2010
World	34	36.5	42
U.S.	7.1	8.5	8.7

Source: The International Seed Federation (ISF)

Exhibit 11: U.S. Farm Seed Expenditures and Farm Seed Price Index, US $m

Year	Expenditure on seed	Total farm production expenditure	Share of total farm production expenditure	Producer Price Index 1991 = 1	Real expenditures on seed
1985	3,128	71,671	4.36%	0.87	3,595
1986	3,188	69,956	4.56%	0.85	3,751
1987	3,259	74,234	4.39%	0.87	3,746
1988	4,060	81,696	4.97%	0.92	4,413
1989	4,397	86,121	5.11%	0.97	4,533
1990	4,518	90,097	5.01%	0.99	4,564
1991	5,113	92,071	5.55%	1.00	5,113
1992	4,913	90,400	5.43%	1.01	4,864
1993	5,163	97,743	5.28%	1.02	5,062
1994	5,373	101,578	5.29%	1.05	5,117
1995	5,462	106,310	5.14%	1.09	5,011
1996	6,212	109,205	5.69%	1.14	5,449
1997	6,711	116,534	5.76%	1.18	5,687
1998	7,214	114,544	6.30%	1.14	6,328
1999	7,217	115,225	6.26%	1.13	6,387
2000	7,519	118,136	6.36%	1.18	6,372
2001	8,222	121,577	6.76%	1.21	6,795
2002	8,925	119,548	7.47%	1.21	7,376
2003	9,425	125,789	7.49%	1.25	7,540
2004	9,625	132,841	7.25%	1.33	7,237
2005	10,426	139,253	7.49%	1.42	7,342
2006	11,026	149,113	7.39%	1.51	7,302
2007	11,927	166,327	7.17%	1.62	7,362

Source: United States Department of Agriculture: National Agricultural Statistics Service, various years