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# DRUM COMMODITIES LIMITED (DCL) - REPORT ON CEREALS

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## 1. INTRODUCTION

- 1.1 Overview
  - 1.1.1 A cereal is a grass producing edible seed, called grain, which is grown as an agricultural crop. The fact the grain grow from a grass distinguishes them from pulses (beans and lentils), where the grain is grown from a legume.
  - 1.1.2 There are around 15 different genera of wheat and many types within them. Additionally, buckwheat and quinoa are examples of the ten or so pseudocereals that are not grasses but which produce seeds that can be ground into flours.
  - 1.1.3 Cereals are still the most important global food source due to both direct human consumption as well as an input into livestock production. Rice, maize and wheat alone provide 50% of global calorie consumption
  - 1.1.4 Current information suggests that total global cereal production will be 2,479 million tonnes in 2013, more than has ever been produced before. This continues the upward trend of recent years, as would be expected, with supply expanding to meet the demand of an ever growing world population.
  - 1.1.5 Cereals are known as grain commodities rather than soft commodities (which are cash crops such as cotton and cocoa). They are most actively traded during the spring and summer.
  - 1.1.6 In 2012 to 2013, 307 million tonnes of the cereals produced were traded internationally. This is a 2% increase from the year before. Most of this increase has come from higher maize imports caused by falling prices.
  - 1.1.7 The largest exporters of cereals are USA, China, India, Australia and the EU; whilst the largest importers of cereal are Japan, Northern Africa and the Middle East.



World Grain Exporters and Importers



## 1.2 Cereal Nutritional Values:

CEREAL	WHEAT	RICE	MAIZE	SORGHUM	BARLEY	MILLET
Energy (kJ)	1,369	1,528	1,528	1,419	1,474	1,582
Protein (g)	12.6	7.1	9.4	11.3	9.9	11
Fat (g)	1.54	0.66	4.74	3.3	1.2	4.2
Carbs (g)	71	80	74	75	78	73
Fibre (g)	12.2	1.3	7.3	6.3	15.6	8.5
Calcium (mg)	29	28	7	28	29	8
Iron (mg)	3.19	0.8	2.71	4.4	2.5	3

## 2. AIMS OF THE REPORT

- 2.1 The aim of this report is to provide an elementary analysis of cereal commodities with particular reference to those dealt with by DCL.
- 2.2 The focus will be on four major global cereal crops (rice, maize, wheat, and sorghum) and the countries in which DCL has a subsidiary company dealing in these commodities.
- 2.3 There will be a brief synopsis on how the cereals are cultivated but the main emphasis will be on the logistical side of trading in them.

## 3. SCOPE

- 3.1 Only four major cereal crops are covered by this report; they are grown on a much larger scale globally than smaller crops such as oats, rye and buckwheat, which makes them relatively more important.
- 3.2 Much of the data used in this report is slightly dated reflecting the paucity of up-to-date information; it will be referenced in the bibliography.

## <u>RICE</u>

## 4. OVERVIEW

- 4.1 Rice (*Oryza Sativa*) is a type of grass widely cultivated as a source of food, especially in Asia. It is a swamp grass, meaning it needs a plentiful supply of moisture to grow, which is why it is grown in paddy fields.
- 4.2 In 2009, over 700 million tonnes of rice was produced globally over an area of approximately 158 million hectares. This makes it the second most highly produced grain in the world after maize. However since maize is often not used for direct human consumption, rice is therefore the most important grain with respect to this. It provides more than a fifth of the calories consumed by humankind.
- 4.3 90% of rice is produced in Asia (640 million tonnes in 2009) with most of the remainder coming from Latin America (25 million tonnes) and Sub-Saharan Africa (19 million tonnes).
- 4.4 Almost all of the world's rice is produced on farms of between 0.5 and 3 hectares. The yield can range from less than 1 tonne per hectare in simple rain fed conditions to over 10 tonnes per hectare in intensive irrigated commercial farms<sup>1</sup>.
- 4.5 In the last 50 years, global per capita consumption of rice has increased by 40%, largely fuelled by the economic growth of many Asian countries where rice is the main foodstuff. China and India together consume over 50% of the world's rice; in 2009 they consumed nearly 280 million tonnes.

<sup>&</sup>lt;sup>1</sup> <u>http://irri.org/index.php?option=com\_k2&view=item&layout=item&id=9151&lang=en</u>



4.6 Only 5 to 6% of the world's rice is traded internationally. This trade mostly involves developing countries that account for 83% of exports and 85% of imports. The largest three exporters are India, Thailand and Vietnam, which account for 70% of total world rice exports. The three largest importers of rice are China, Nigeria and Indonesia<sup>2</sup>.



Global rice exports in 2008



Global rice imports in 2008

# 5. RICE CULTIVATION

5.1 Initially, the match of seed to the rice growing environment is important. A good seed type can increase yields by 5-20%.

<sup>&</sup>lt;sup>2</sup> <u>http://en.wikipedia.org/wiki/Rice</u>



- 5.2 The land is then tilled and levelled either manually or with the aid of an animal. Tillage is the process of breaking up the soil in order to allow the plants' roots to anchor deeply. How much tilling is required depends significantly on whether the rice is being grown in lowlands or uplands. Levelling of the soil then helps to maintain an even coverage of surface water, reducing water wastage.
- 5.3 There are two methods of establishing the rice plants. The first is transplanting, which involves germinating the seeds in a separate nursery before transferring them to the wet field. This requires fewer seeds and reduces weeds but increases labour. The second method is simply direct seeding by hand or machine straight into the wet field.
- 5.4 Once the rice is established, it is vital to keep the paddies flooded. There are various methods of doing this without using excess water, such as having saturated soil culture and raised beds. This also helps keep the nutrients in the soil.



Rice being grown in a paddy

- 5.5 As the rice grows, farmers attempt to keep weeds and pests to a minimum. This is done through either hand weeding or herbicides and by allowing the pests natural predators to thrive.
- 5.6 The rice is harvested after between 115 and 120 days, depending on conditions and type. Harvesting is usually manual, but may also be done mechanically. It takes on average 40 to 80 man hours to harvest a hectare. After the rice is harvested, it must be threshed and cleaned. Threshing is the process of removing the rice grain from the plant either manually through beating the rice plant against a hard surface or with a threshing machine. Cleaning is simply the removal of all unwanted materials from the rice, such as weeds or stones.





5.7 The rice is then dried, either simply in the sun or through a hot air dryer. At harvest, rice generally has a moisture content of between 20 to 28%. To facilitate good storage the moisture content must be reduced to below 14%, ideally 13 to 14%. If this process is delayed and the rice is not dried to below 20% within 48 hours, the high moisture content may cause mould, discolouration or attract insects. When the rice has been dried but has not been processed any further, it is known as paddy rice.



Rice drying in the sun on a roadside in the Philippines

- 5.8 The paddy rice grain is then milled, first to remove the hard outer husk, producing brown rice. If white rice is required, the bran is also milled off the brown rice and the grain may also be polished.
- 5.9 The average milling recovery rate is 65%, with 69 to 70% generally the maximum possible. The recovery rate is defined as the weight percentage of milled rice, including grains broken from the milling process known as "brokens", obtained from a sample of paddy rice.

## 6. RICE STORAGE

- 6.1 Rice can be stored either coarsely in bulk, in bags or in a silo. If the rice is stored in paddy form rather than after it has been milled, this will help protect against insects and will prevent quality deterioration. If rice is stored as brown rice rather than in paddy style it will require 20% less storage space, however under tropical conditions the brown rice will only last for around 2 weeks.
- 6.2 Rice storage needs to prevent insects, rodents and birds from getting access, be efficient and manageable, and prevent moisture from re-entering the grain after drying. The favourable temperature to store rice is between 5° and 20°C. 20 to 30°C is the optimum temperature for the developments of moulds. Average temperatures in many African countries fall within this range, making rice difficult to store.
- 6.3 If moisture is allowed to affect the rice, eventually the rice moisture content will become equal to that of the surrounding air because rice is hygroscopic, meaning it tends to absorb water from the air.
- 6.4 During storage, the final moisture content of the grain will be determined by the temperature and relative humidity of the air surrounding the rice. This table shows the EMC<sup>3</sup> of rice under various storage conditions:

<sup>&</sup>lt;sup>3</sup> (EMC) Equilibrium Moisture Content: During storage, the final moisture content of a grain will be determined by the temperature and Relative Humidity (RH) of the air that surrounds the grain. If the grain is not protected



	30%	50%	70%	90%
40°F	10.4	12.3	14.6	18.5
50°F	9.9	11.9	14.2	18.1
60°F	9.4	11.5	13.8	18.0
70°F	9.1	11.1	13.5	17.5
80°F	9.7	10.8	13.1	

## 7. TYPES AND QUALITIES OF RICE

- 7.1 Rice can be broken down into three main classifications:
  - 7.1.1 Short grain has the softest, stickiest texture and is commonly used in risotto or for puddings, e.g. Arborio rice.
  - 7.1.2 Medium grain is less soft but is good at absorbing flavours and moisture, e.g. Bomba rice used in paella.
  - 7.1.3 Long grain rice is the firmer, more typical rice, e.g. Basmati or Fragrant rice.
- 7.2 There are no universally accepted standards for grading milled or paddy rice. But generally the rice is given a grade and then a percentage for how many grains are broken. The table below shows an example of how milled rice might be graded; this is the Philippines' system.

Grade Specifica- tions	Premium	Grade 1	Grade 2	Grade 3
Defectives:				
-Damaged grains, max %	0	0.25	0.50	2.00
-Discoloured grains, max %	0.50	2.00	4.00	8.00
-Immature grains, max %	2.00	5.00	10.00	15.00
-Red grains, max%	0	0.25	0.50	2.00
-Red streaked grains, max %	1.00	3.00	5.00	10.00
Foreign matter (max %)	0	0.10	0.20	0.50
Paddy (max no./kg)	1	8	10	15
Moisture content (max %)	14.00	14.00	14.00	14.00

- 7.3 Few countries export their paddy rice, although the USA notably does. If paddy rice is exported it is normally given a guaranteed milling yield. For instance if its milling yield was 58-70, that would mean out of 100 kg of paddy, the miller would get 58 kg of white rice and 12 kg of broken grains.
- 7.4 The most widely traded white milled rice are:
  - 7.4.1 US milled 2/4 Long Grain (grade 2/4% brokens), generally to EU, Middle East and Latin America.
  - 7.4.2 US milled 5/20 LG(grade 5/20% brokens), generally US food aids.
  - 7.4.3 Thai White Rice 100%B (4,5% brokens). Generally to Middle East and Malaysia.
  - 7.4.4 Thai White Rice 5/10/15/25/35% brokens.
  - 7.4.5 Broken 100%, generally for animal feed.

against the humidity in the air, particularly when the RH is high, the grain moisture content will rise and this will lead to deterioration in both grain and seed quality.





Thai White Rice

#### MAIZE

## 8. OVERVIEW

- 8.1 Maize (*Zea Mays*) is a tall annual grass cultivated for its edible grains. Maize is grown widely across the world due its ability to grow in a diverse range of climates.
- 8.2 In 2012-13, 950 million tonnes of maize is expected to be produced globally over around 165 million hectares. It is currently the most cultivated crop in the world.
- 8.3 The USA is the world's leading grower, producing 40% of the world's harvest (313 million hectares in 2012 to 2013). It had an estimated 35 million hectares of maize planted in 2010. China is the second largest with Brazil, Mexico and Indonesia amongst the other top producers.



Map of Global Maize Production

8.4 Unlike rice which is almost always cultivated on farms smaller than three hectares, maize is grown on a wide range of scales, generally much larger. In the USA, some corporate farms are hundreds of thousands of hectares.



- 8.5 The major usage of maize in the world is as livestock feed (especially in developed countries). Global maize consumption has constantly increased over the last 10 years due to strong economic growth in the Middle and Far East. Additionally there has been a strong increase in the production of ethanol from maize, especially in the USA. World maize consumption in 2011 to 2012 was estimated to be 869 million tonnes; the USA and China were also the largest consumers.
- 8.6 In 2012 to 2013, 97 million tonnes of maize are expected to be traded internationally. The USA, Argentina and the Ukraine are the major exporters and Japan, Mexico and South Korea the largest importers.

#### 9. MAIZE CULTIVATION

- 9.1 Prior to planting, the area for cultivation must be ploughed to break-up the soil and give it some ability to raise water from below. Any previous stubble, rocks etc. should also be removed from the land.
- 9.2 Maize is planted in the spring time as it is cold-intolerant. For the crop to be a success, the soil temperature must be greater than 12°C when the seed is planted. On average, the maize seeds should be planted in rows 30 cm apart with around 75 cm between rows so the growth of one row does not affect another. Generally the seeds are planted at a depth of 5 cm.
- 9.3 After planting, maize needs a good supply of nutrients to ensure healthy growth. So fertilizer must be added to the soil regularly. In periods of drought and during pollination of the seeds, irrigation may also be needed.
- 9.4 The following numbers of days are approximate as they depend on the variety of maize and the weather conditions but the general growth cycle of maize is:
  - 9.4.1 60 days after the seedling emerges, the plant reaches its full height and pollination begins; this is called the tasseling stage. From this stage until maturity, a good supply of moisture is vital.
  - 9.4.2 3 days after the tasseling stage silking occurs. Silk like growths emerge from the plant which capture falling pollen grains and enable fertilization. This in turn causes the kernels to start growing.
  - 9.4.3 55 days after silking the plants reach maturity and all kernels should have attained their maximum dry weight.



Stages of maize growth where VT = tasseling stage, R1 = silking stage R5 = maturity

9.5 At maturity, as soon as the corn is dry, harvesting commences. In many developing countries this is still done manually by scythe, but generally in commercial operations this is done with a combine harvester.





Mature maize

- 9.6 Maize has a wide range of uses, each of which are harvested at different times. Sweet corn produced for human consumption is harvested before maturity so the kernels retain moisture. As the kernels dry and close to maturity, they are harvested for various other uses including grinding up the grains for cornmeal and the production of ethanol.
- 9.7 After being harvested, the maize is dried either naturally in the sun or in a drying machine. It then goes through a process of husking where a machine removes the inner layers leaving only the cob of maize. Finally the maize is shelled, where the grains are removed from the cob, either manually or again in a machine.

## 10. MAIZE STORAGE

10.1 Maize, like rice, has a critical moisture value of around 13 to 14%, meaning that for correct storage each grain should contain about that amount of moisture. It is generally stored in bulk, in silos or in more basic holdings, rather than in bags. Dried grain can last up to 12 months when stored correctly.



Grain silo

10.2 Again maize is best kept under 20°C as mould starts to form between 20 and 30°C and the germination might start to occur early. However, maize may be transported at temperatures up to 30°C if it is only for a brief period. Maize releases water vapour constantly and so it is preferable to have a good air supply where the grain is being stored to prevent moisture layers accumulating.



- 10.3 Grain weevils and grain borers are two insects particularly hazardous to maize. The best method to protect against them is by storing the grain in a sealed metal container. Freezing the grain before storage will kill any insects or larvae that the maize may have picked up in transit. If the maize is stored sealed, this will also help prevent rodent or fungal damage.
- 10.4 This table shows the EMC of maize under various storage conditions:

	30%	50%	70%	90%
40°F	10.6	13.1	16.0	20.8
50°F	9.9	12.5	15.4	20.2
60°F	9.3	11.9	14.8	19.7
70°F	8.7	11.4	14.3	19.3
80°F	8.2	10.9	13.9	18.9

## 11. TYPES AND QUALITIES OF MAIZE

11.1 Maize is sometimes categorised through colour. For instance, yellow and white maize are two of the most prevalent. This is simply describing the pigmentation of the corn as there is very little appreciable difference between the types.



Grade 1 Maize

- 11.2 Maize is sold in different forms, ranging from sweet corn to maize used as animal feed, for producing flour or for producing ethanol etc. The grains that are used to produce ethanol are often called tropical maize as they are generally grown in equatorial regions.
- 11.3 There are no internationally governed standards for the quality of maize but the table below shows the Indian Agmark standards of maize:

Grade	Moisure (%)	Organic Foreign Matter	Inorganic Foreign Matter	Other Edible Grains	Different Va- rieties	Damaged Grains	Immature Grains	Weeviled Grains
	12	0.10	0	0.5	5	1	2	2
II	12	0.25	0.10	1.0	10	2	4	4
III	14	0.50	0.25	2.0	15	3	6	6
IV	14	0.75	0.25	3.0	15	4	6	8

Maximum Limit of Tolerance (% by Weight) of Maize



#### <u>WHEAT</u>

## 12. OVERVIEW

- 12.1 Wheat (*Triticum*) originated from the Near East but is now grown globally in temperate climates.
- 12.2 It is the third most-produced cereal in the world and in 2011, 704 million tonnes were produced worldwide.
- 12.3 In 2011, the EU and China were the two largest global producers of wheat. They account for over a third of global production. Wheat production within the EU over the last ten years has remained stable, whereas in China and India, it has risen by over 20%, highlighting the growing demand in developing countries.
- 12.4 Wheat is grown on more land area than any other commercial food. As this suggests, most wheat cultivation is done on a large scale in big commercial farms, however there are also smaller scale subsistence farms particularly in developing countries. The average world farm yield for wheat is 3.1 tonnes per hectare with Holland's wheat farms the most productive, yielding on average 8.9 tonnes per hectare.
- 12.5 Wheat is the leading contributor of global vegetable protein in human food. Consumption is growing rapidly as more Asian consumers change their diets to those of the western world. In the last 4 years alone consumption has risen by over 7%. Most of this consumption is in the form of wheat flour used in breads, pastas, beer fermentation etc. Wheat is also used in the production of biofuels.
- 12.6 The international trade in wheat is huge; it surpasses all other crops combined. The world's leading exporter of wheat is the USA, which exports nearly double the amount of any other country (30 million tonnes). Australia, Russia and Canada are the next largest exporters, all around the 16 million tonnes mark. Egypt is the biggest importer (around 9 million tonnes) with China, Brazil and Indonesia following closely.

# 13. WHEAT CULTIVATION

- 13.1 Wheat is broadly split into two types; winter wheat and spring wheat. Winter wheat is planted in the autumn and then grown through the winter until it is harvested in the summer. Spring wheat is planted in early spring, grown through the summer and harvested in autumn.
- 13.2 Initially the soil must be ploughed, levelled and then spread with fertiliser to ensure the wheat has enough nutrients to grow. Seeds are then spread evenly around 15 cm apart. For winter wheat, the seeds need to be planted about 6 cm deep; for spring wheat, this only needs to be around 4 cm.
- 13.3 The growing process is then split into three main parts: foundation, construction and production. For winter wheat these stages are as follows:
  - 13.3.1 The foundation stage takes around 6 months and is the initial stage of growth. It covers the seedling appearing, leaf emergence on the main shoot, and then leaf production. After about two months tillering will start. Here lateral branches grow off the main stem and this is where the grains will eventually be formed.
  - 13.3.2 The construction phase takes two months during spring. The increasing sunlight and warmth means this is the stage when the most rapid growth occurs. The wheat's "ears" emerge a month into this stage. These appear on the branches from tillering and, after pollination, contain the actual wheat grains.
  - 13.3.3 The final stage, production, begins when the wheat starts flowering. The grains then start filling as they accumulate moisture and grow. Finally ripening occurs around mid-summer when the grains have sufficiently dried out and are ready to be harvested.



- 13.4 Spring wheat follows a very similar process albeit at a faster rate. Its growth cycle takes around 6 to 8 months compared to 8 to 10 months for winter wheat.
- 13.5 Wheat, like maize, is then mostly harvested using a combine harvester. However, in many rural areas of developing countries, it is harvested manually using a scythe.



Wheat being harvested

13.6 After harvesting, wheat is threshed and dried out prior to storage. It is then usually milled to produce flour.

#### 14. WHEAT STORAGE

14.1 Wheat, like other cereals, is best stored in sealed metal silos. But it may also be stored in more basic ways in poorer areas. A godown, for example, is a collection of bags of wheat stacked together often stored undercover.



A wheat godown

- 14.2 If the grains contain between 10 to 13% moisture, they will last well but may be susceptible to insects and rodents during storage. If this moisture is reduced down between 8 to 10% the grain will be sufficiently hard to be resistant to insect attack.
- 14.3 If wheat is stored correctly, it can in theory last for ever. There has been wheat found in the pyramids which is still able to grow.
- 14.4 This table shows the EMC of wheat under various storage conditions:

	30%	50%	70%	90%
40°F	10.5	13.0	15.7	20.4
50°F	10.1	12.6	15.3	19.9



60°F	9.7	12.2	15.0	19.7
70°F	9.3	11.8	14.7	19.4
80°F	9.0	11.5	14.3	19.1

#### 15. TYPES AND QUALITIES OF WHEAT

- 15.1 There are three main types of wheat; soft, hard and durum. They have the following characteristics:
  - 15.1.1 Soft wheat is high yielding but has relatively low protein. It is used in bakery to make flat breads, cakes, biscuits etc.
  - 15.1.2 Hard wheat has high levels of protein and is the most produced type of wheat. It is used to produce bread, rolls, tortillas etc.
  - 15.1.3 Durum wheat is the hardest type of wheat but the least exported. It is mainly used to produce semolina for making pasta.



Soft Wheat Grains

15.1.4 There is no international grading specification for wheat also. This is USA's official grading standards:

Grade	Hard Wheat (Ibs)	All Other Classes (lbs)	Heat Damaged	Other Damaged	Foreign Material	Shrunken Broken	Contracting Classes	Other Wheat Classes
1	58	60	0.2	1.8	0.4	3	1	3
2	57	58	0.2	3.8	0.7	5	2	3
3	55	56	0.5	6.5	1.3	8	3	10
4	53	54	1.0	9.0	3.0	12	10	10
5	50	51	3.0	12.0	5.0	20	10	10

Maximum limit of tolerance (% by weight unless stated) of 100lbs of wheat

## **SORGHUM**

#### 16. OVERVIEW

16.1 Sorghum (*Sorghum*) is a genus of grasses grown in warmer climates worldwide. It is native to Africa and Asia.



- 16.2 59 million tonnes of sorghum was produced globally in 2010 over 42 million hectares, making it the world's fifth major cereal in terms of production. Production has marginally dropped in the last 30 years.
- 16.3 The world's five biggest producers of sorghum are, in order: USA (8.8 million tonnes), India (7.0), Nigeria (6.9), Mexico (6.9), and Argentina (3.6). In many developing countries, such as India, the area planted to sorghum in the last 40 years has fallen considerably; but countering this, yields have risen by up to 40%.
- 16.4 The global average yield is around 1.4 tonnes per hectare although this varies hugely as expected. For instance in India, the average yield is less than 1 tonne per hectare.
- 16.5 Globally, approximately 500 million people consume sorghum. Although a lot of the sorghum produced is used for livestock feed and increasingly to produce ethanol, in arid regions, it is an important food crop especially for subsistence farmers. In these areas it is used as couscous, porridge and flour amongst other things. It is also becoming increasingly popular in home bread making due to being free of gluten<sup>4</sup>.
- 16.6 Most sorghum produced is consumed internally within the country of production. Consequently, world trade in the cereal is relatively low and only comprises 10% of global production. The US account for 80% of global exports, most of which are destined for Mexico and Japan who together account for 70% of global imports.

#### 17. SORGHUM CULTIVATION

- 17.1 Sorghum needs a warm climate to achieve maximum yields. Average temperatures need to be around 25°C and the soil needs to be at least 17°C before planting. If night time temperatures fall below 13°C, the plants potential grain production can be severely affected.
- 17.2 The seeds need to be planted at a depth of between 2 and 5 cm depending on the soil density (the sandier the soil the deeper the seeds need to be). Preferably the seeds should be planted around 10cm apart in rows 25cm apart. There is an average emergence rate of 75% so between 50,000 to 300,000 plants should grow per hectare.
- 17.3 The growth habits of sorghum are very similar to maize. However, sorghum needs more nitrogen and has fewer problems with weeds as it produces sorgoleone that kills surrounding weeds. It also grows more side shoots and a more complex root system than maize.
- 17.4 During the early stages of cultivation, the plants require between 70 and 100 mm of moisture every 10 days. As the seed heads begin to fill, only 50 mm of moisture becomes necessary. The plant is hardy enough to withstand short periods of drought because the seed heads are developed over a relatively long period of time. This relatively small water usage makes them easier to grow than maize and wheat in arid areas.
- 17.5 Sorghum is ready to harvest after 90 to 120 days, depending on the climate and hybrid.

<sup>&</sup>lt;sup>4</sup> Gluten (from Latin gluten, "glue") is a protein composite.





Mature Sorghum

17.6 Unlike wheat and maize, sorghum does not dry well while still in the field. So after it is harvested, either manually or by combine, it is artificially dried. Like other grains, sorghum is best stored when its moisture levels have been reduced to around 13.5%.

## 18. SORGHUM STORAGE

- 18.1 Sorghum, like all grains, is best kept in a cool, clean and dry environment. The critical humidity level for it is 65%; at anything above that the sorghum may start to develop moulds and attract insects.
- 18.2 Ideally the storage area should be aerated with a fan to maintain a flow of clean air and keep the temperature low. It should be checked at least every week to see that it is not beginning to spoil.
- 18.3 In developed countries a lot of sorghum is stored in small storage structures as there is very little need for bulk storage. In developing countries, such as Uganda or Sudan, sorghum is stored in gunny sacks or underground in storage pits.



Gunny Sack used to store Sorghum

18.4 This table shows the EMC of sorghum under various storage conditions:



	30%	50%	70%	90%
40°F	9.6	11.9	14.5	18.4
50°F	9.4	11.7	14.3	18.2
60°F	9.2	11.5	14.1	18.0
70°F	9.0	11.4	13.9	17.8
80°F	8.9	11.2	13.7	17.6

## 19. TYPES AND QUALITIES OF SORGHUM

- 19.1 There are a number of different types of sorghum including:
  - 19.1.1 Grain sorghum, the most cultivated type of sorghum used to make sorghum flour.
  - 19.1.2 Grass sorghums, used to make pasture and hay for livestock.
  - 19.1.3 Sweet sorghums, used to make sorghum syrup which in turn can make molasses.
  - 19.1.4 Broomcorn, the stalks of which are sometimes used to make brooms.
- 19.2 The kernels of sorghum grain can vary greatly from white to reddish brown. White and yellow sorghums are sweeter and used as a grain crop. Reddy brown sorghum, used in beer production, is less tasty to eat but also less susceptible to pests both during growth and in storage.



Grade 1 Red Sorghum

19.3 The USA's official grading standards of sorghum are as follows:

Grade	Min. Test Weight / Bushel (Ibs)	Max. Damaged Ker- nels (%)	Max. Broken & For- eign Materials (%)	Max. Count Limit of Other Material
1	57	2	3	10
2	55	5	6	10
3	53	10	8	10
4	51	15	10	10

(Other material includes any combination of animal filth, beans, seeds, glass, stones or other foreign substances)

## **COUNTRY OVERVIEWS**

## 20. BENIN

- 20.1 Overview. Benin is one of Africa's most stable democracies. However, economically it is still greatly underdeveloped and suffers from wide spread corruption. On average 22% of the country's infrastructure spending is lost to "inefficiencies".
- 20.2 Cereal Production.



- 20.2.1 Maize is the major cereal crop grown in Benin. It is grown all over the country wherever the land is most favourable for agricultural production.
- 20.2.2 Sorghum is grown mainly in the North in the less fertile areas.
- 20.2.3 Very little rice is grown as it is seen as a luxury good. Most of the rice that is consumed is imported. This is mainly because efficient production techniques as well as the equipment needed after harvest is not available.
- 20.2.4 In 2011, Benin produced 1.2 million tonnes of maize, 96,000 tonnes of rice, 175 tonnes of sorghum and there was no significant wheat production.
- 20.2.5 All three of these cereals' production levels peaked between 2006 and 2008 before falling sharply. Since then they have started to rise again.
- 20.3 Cereal Imports.
  - 20.3.1 In 2010 Benin imported the following cereals:

Wheat	\$1,439,000
Maize	\$370,000
Rice	\$78,567,000
Sorghum	\$670

20.3.2 The amount of rice imported fell by nearly 25% over the previous five years. In contrast, wheat imports had almost quadrupled and maize imports had tripled.



## 21. CAMEROON

- 21.1 Overview. Cameroon has had an authoritarian president since 1982. This has meant relatively high political and social stability. As a result, it enjoys comparatively good infrastructure investment for Africa. However, corruption within government officials is a major problem.
- 21.2 Cereal Production.
  - 21.2.1 Agriculture is the main industry in Cameroon, employing 70% of the workforce and providing 42% of GDP.
  - 21.2.2 In 2004, an estimated 750,000 tonnes of maize, 550,000 tonnes of sorghum and 62,000 tonnes of rice was produced. Wheat is not commonly grown in Cameroon.
  - 21.2.3 The level of food production has not grown in line with population growth and so recently the Ministry for Agriculture has set a target to train 30,000 extra farmers a year to reduce the country's dependence on imports of food.
- 21.3 Cereal Imports.



21.3.1 In 2010, Cameroon imported the following cereals:

Wheat	\$123,863,000
Maize	\$5,370,000
Rice	\$195,991,000
Sorghum	\$0

21.3.2 From 2005 to 2010, the level of rice imports rose by around 45%. Wheat imports also rose about 70% and maize imports nearly doubled. In the previous year, 2009, \$74,000 worth of sorghum was imported but the figures seem to suggest this was a one off.



## 22. EGYPT

- 22.1 Overview. Egypt has one of the largest economies in Africa and it has significant political clout in Africa and the Middle East. It has relatively good infrastructure and, prior to the revolution in 2011, it was a stable country to invest in. While the revolution appears no closer to a peaceful resolution, a lot of foreign investment is flooding out of the country.
- 22.2 Cereal Production.
  - 22.2.1 Almost all agriculture in Egypt is focused down the fertile banks of the Nile. However its agricultural industry as a whole has been in decline in recent years; urbanization means urban areas are encroaching rapidly on traditional arable land.
  - 22.2.2 Egypt is a substantial producer of cereals. In 2010 it produced 8.4 million tonnes of wheat, 5.5 million tonnes of maize, 4.2 million tonnes of rice and 900,000 tonnes of sorghum.
  - 22.2.3 Due to its large population, even though it is a major producer, Egypt imports a lot of cereal to complement its domestic production.
  - 22.2.4 There are no reliable figures available yet but all reports suggest that the current conflict is causing a great deal of economic uncertainty that will probably cause a substantial drop in Egypt's cereal production.
- 22.3 Cereal Imports.
  - 22.3.1 In 2010, Egypt imported the following cereals:

Wheat	\$2,181,907,000
Maize	\$1,270,650,000
Rice	\$9,111,000
Sorghum	\$986,000



# 22.3.2 Since 2005, the levels of wheat and maize imports had both doubled. Rice imports had quadrupled from the level in 2005. Sorghum has only been imported since 2008.



#### 23. GHANA

- 23.1 Overview. Since 2001 Ghana has had a period of political and social stability as well as sustained economic growth. It now has one of the largest GDP per capita in Africa.
- 23.2 Cereal Production.
  - 23.2.1 Ghana's main crops are cocoa, cotton and tobacco; together with other crops they produce 22.7% of Ghana's GDP.
  - 23.2.2 In 2011 Ghana produced 350,000 tonnes of sorghum, 276,000 tonnes of rice and 1.5 million tonnes of maize. Wheat is not widely grown in Ghana.
  - 23.2.3 The government has been trying to encourage farmers away from cash crops to more food staple crops in an attempt to curb the reliance on imported crops.
- 23.3 Cereal Imports.
  - 23.3.1 In 2010, Ghana imported the following cereals:

Wheat	\$117,204,000
Maize	\$662,000
Rice	\$201,420,000
Sorghum	\$398,000

23.3.2 Rice imports had increased by around 50% from the five years previously. Wheat imports had also risen but only by around 22%. Maize imports in 2010 were only 5% of what they were in 2005, however, in the intermittent years between, the figures fluctuated wildly, clearly demonstrating the linkage to domestic maize production. Ghana has only recently started importing sorghum.





## 24. IVORY COAST

- 24.1 Overview. In the last fifteen years the lvory Coast has experience a coup and two civil wars that have caused serious economic and political instability. However, lvory Coast has an important economic role in transit trade for the landlocked countries that neighbour it.
- 24.2 Cereal Production.
  - 24.2.1 In 2011 the lvory Coast produced 620,000 tonnes of maize, 456,000 tonnes of rice, 48,000 tonnes of sorghum and a small quantity of wheat.
  - 24.2.2 Even with the civil unrest, over the last 10 years the production of all three of lvory Coast's cereal crops has seen noticeable growth.
- 24.3 Cereal Imports.
  - 24.3.1 In 2010 the lvory Coast imported the following cereals:

Wheat	\$147,500,000
Maize	\$5,893,000
Rice	\$460,190,000
Sorghum	\$1,507

24.3.2 The level of rice imports has nearly doubled and wheat imports almost trebled since 2005. Maize imports were down 20% over the five years and sorghum imports only started in 2009.



Ivory Coast - Total Cereal Imports



#### 25. KENYA

- 25.1 Overview. Kenya is the largest economy in East and Central Africa, however there are large wealth disparities between a select rich urban minority and the rest of the country. 38% of Kenyans live in absolute poverty. The recent elections went well and the new constitution and democratic apparatus is proving popular. Tensions resulting in a blip in economic growth experienced in 2007 were not repeated in 2013.
- 25.2 Cereal Production.
  - 25.2.1 Agriculture is a major part of the Kenyan economy and 75% of working Kenyans work in farming.
  - 25.2.2 In 2011, 3.1 million tonnes of maize was produced in Kenya, 268,000 tonnes of wheat, 46,000 tonnes of rice and 200,000 of sorghum.
  - 25.2.3 Maize, wheat and rice production have seen steady growth over the last 20 years, barring a dip in 2008/09. In contrast, sorghum production had been falling until 2009, since then there has been a resurgence in production levels.
- 25.3 Cereal Imports.
  - 25.3.1 In 2010 Kenya imported the following cereals:

Wheat	\$219,687,000
Maize	\$68,968,000
Rice	\$100,321,000
Sorghum	\$2,928,000

25.3.2 From 2005 to 2010, Kenya's wheat and rice imports both doubled. The level of maize imports was five times what it was in 2005. The amount of sorghum imports in 2010 was very similar to 2005 however, within the intervening years, the levels fluctuated greatly (up to \$24 million in 2009).



## 26. LIBERIA

#### 26.1 Overview.

26.1.1 Liberia was Africa's first ever republic after being set up by the Americans in the nineteenth Century as a country to resettle freed slaves. Initially it was seen as a success



and saw strong economic growth post Second World War on the back of strong American foreign investment. However, a brutal civil war from 1980 up to 2003 eliminated most of this progress.

- 26.1.2 It now holds the distinction of being one of the most underdeveloped countries in the world. Much of the capital, Monrovia, is still without mains electricity or running water.
- 26.2 Cereal Production.
  - 26.2.1 80% of Liberia's workforce is in agriculture, mostly subsistence farms growing rice and cassava<sup>5</sup>. The civil war seriously depleted the nation's cereal crop. Internal production only accounted for 40% of Liberia's demand for rice.
  - 26.2.2 In 2007, Liberia produced 113,000 tonnes of rice and 20,000 tonnes of maize.
  - 26.2.3 From 2004, after the civil war, both cereals have seen a strong rise in production levels undoubtedly due to peace.
  - 26.2.4 There is no data on the level of wheat or sorghum produced in Liberia although the tropical humid climate wouldn't be particularly conducive to growing these two cereals.
- 26.3 Cereal Imports.
  - 26.3.1 In 2007 Liberia imported the following cereals:

Wheat	23,000 tonnes
Maize	50,000 tonnes
Rice	170,000 tonnes
Sorghum	0 tonnes

26.3.2 The data for both imports and production levels is difficult to obtain and is not available from reliable sources.

## 27. MALAWI

- 27.1 Overview. In 2009 Malawi was reported as the fastest urbanising country in Africa. It entered into a food crisis in 2012 with 1.9 million people estimated as food insecure by that December. 4 in 5 people depend on agriculture for income and there is a strong reliance on tobacco as an export crop.
- 27.2 Cereal Production.
  - 27.2.1 Maize is the staple crop for millions of Malawian diets. However, since it requires a lot of water, the erratic weather of 2012 severely affected production.
  - 27.2.2 As a result of government subsidies to farms, Malawi saw a grain surplus of 0.5 million tonnes in 2005 and was viewed as Africa's agricultural success story. However, with corruption in government and the programme, it soon became clear that this production outlook was not sustainable.
  - 27.2.3 In 2011 Malawi produced 3.9 million tonnes of maize. With respect to this, the production quantities of rice, sorghum and wheat are minimal.
  - 27.2.4 Malawi experienced a steady increase in cereal production until 1992 when there was a sudden drop in production levels from 1.68 million tonnes in 1991 to 688,786 tonnes in 1992. Since then, production had been growing at a much steeper but also more variable rate until the crisis of 2012.

<sup>&</sup>lt;sup>5</sup> A plant from the spurge family grown in the tropics for their edible tuberous roots which yield a nutritious starch.



#### 27.3 Cereal imports.

27.3.1 In 2010 Malawi imported the following quantities of cereals:

Wheat	\$81,055,034
Maize	\$6,885,123
Rice	\$435,512
Sorghum	-

27.3.2 The 2010 wheat imports represent a value more than double that of 2005 having seen a sharp increase in 2008. Between 2005 and 2007 maize imports dropped from \$21.5 million to \$3 million; having recovered by 2009, the 2010 value represents a declining trend again. Rice also followed a similar pattern. After dropping from \$3 million to \$1000 between 2005 and 2007, the imports of sorghum have not seen a recovery.



Malawi - Total Cereal Imports

## 28. MOZAMBIQUE

- 28.1 Overview. After independence, Mozambique experienced 15 years of continual civil war that severely damaged the economy. Since then the country has enjoyed a remarkable recovery; between 1996 and 2011 economic growth has averaged between 6 to 8%.
- 28.2 Cereal Production.
  - 28.2.1 80% of the country's workforce is in the agricultural sector. However, Mozambique is operating well below its potential in agriculture due to poor levels of infrastructure and investment. In 2012, more than 90% of Mozambique's arable land was not being cultivated.
  - 28.2.2 In 2011 Mozambique produced 2.2 million tonnes of maize, 410,000 tonnes of sorghum, 176,000 tonnes of rice and 3,000 tonnes of wheat.
  - 28.2.3 Maize, sorghum and rice have all seen a steady rise in production level since around 1993. Wheat, however, has seen a fall in production levels over the last 20 years.
- 28.3 Cereal Imports.
  - 28.3.1 In 2010 Mozambique imported the following cereals:

Wheat	\$64,227,000
Maize	\$10,596,000
Rice	\$74,104,000
Sorghum	\$234,000







#### 29. NIGERIA

- 29.1 Overview. Nigeria is known as "the Giant of Africa". It has the largest population in Africa and the 7<sup>th</sup> largest in the world. It is seen as one of the most promising economies in the world due to its mineral wealth, especially oil. However it is also internationally known for its mismanagement and corruption.
- 29.2 Cereal Production.
  - 29.2.1 Ever since the oil and mineral boom in the south of the country, agriculture has been in decline in Nigeria. 60% of the workforce is still employed in farming but it is no longer the country's largest export.
  - 29.2.2 In 2011 Nigeria produced 9.25 million tonnes of maize, 6.9 million tonnes of sorghum, 2.9 million tonnes of rice and 100,000 tonnes of wheat.
  - 29.2.3 Cereal production levels grew strongly until 2009 to 2011 when they started to fall due to the credit crunch as well as a transfer of labour to the oil industry.

#### 29.3 Cereal imports.

29.3.1 In 2010 Nigeria imported the following quantities of cereals:

Wheat	\$839,731,000
Maize	\$2,189,000
Rice	\$494,844,000
Sorghum	\$21,000

29.3.2 In the five years preceding 2010 wheat imports fell by 50%. Rice imports increased by 16%. There was strong growth in maize imports which have grown from \$28,000 in 2006 to over \$2 million. The level of sorghum imports has varied widely from \$4.6 million in 2008 to none in 2009.





#### 30. SENEGAL

- 30.1 Overview.
  - 30.1.1 Senegal undertook radical economic reform in 1993 in an attempt to kick start the economy. This proved successful and for the next ten years or so the economy grew by an average of 5% annually.
  - 30.1.2 However, urban unemployment and socioeconomic disparity are major problems. It continues to receive a large amount of international development assistance especially from the USA, Japan, France and China.
- 30.2 Cereal Production.
  - 30.2.1 Rice, millet and sorghum are the main subsistence crops in Senegal. In years of good rainfall Senegal nears self-sufficiency in maize and sorghum.
  - 30.2.2 However on average the total production of cereals only reaches 60% of demand. For rice this level is much lower and, on average, internal production only produces 20% of consumption needs.
  - 30.2.3 In 2011, Senegal produced 276,000 tonnes of rice, 120,000 tonnes of maize, 120,000 tonnes of sorghum and no significant quantity of wheat.
- 30.3 Cereal imports.
  - 30.3.1 The main cereal import to Senegal is rice. It is one of Africa's largest importers after Nigeria and the lvory Coast. The level of rice imports continues to grow as the per capita rice consumption rises. The preference in Senegal is for 100% broken rice from Asia.
  - 30.3.2 Two flourmills, Grands Moulins de Dakar and Sentenac, control most of the wheat industry. They import 90% of their wheat from France. Demand for wheat is also increasing.
  - 30.3.3 In 2010 Senegal imported the following cereals:

Wheat	\$127,263,000
Maize	\$25,013,000
Rice	\$289,492,000
Sorghum	\$318,000







#### 31. SIERRA LEONE

- 31.1 Overview.
  - 31.1.1 After gaining independence, Sierra Leone went through a number of coups and authoritarian governments. Even so, economic progress was relatively good until the civil war from 1991 to 2002.
  - 31.1.2 Since the civil war ended, the country's economy is slowly starting to grow again. The abundance of mineral wealth, especially diamonds, has been the major factor in this growth.
- 31.2 Cereal Production.
  - 31.2.1 Even though two-thirds of the population in Sierra Leone are involved in subsistence agriculture, the country is still a net importer of food.
  - 31.2.2 Rice is the most important crop in Sierra Leone with 85% of farmers growing it in the wet season.
  - 31.2.3 In 2011 Sierra Leone produced 746,000 tonnes of rice, 59,000 tonnes of maize, 30,000 tonnes of sorghum and no wheat.
- 31.3 Cereal Imports.
  - 31.3.1 Since the end of the civil war Sierra Leone domestic rice production has been recovering. Demand for rice is also rising so that, although in absolute terms rice imports are remaining stable, as a percentage of the total amount of rice consumed they are falling.
  - 31.3.2 In 2010 Sierra Leone imported the following cereals:

Wheat	38,000 tonnes
Maize	0 tonnes
Rice	115,000 tonnes
Sorghum	0 tonnes



31.3.3 The figures for both production levels and imports are much harder to find than other African countries as Sierra Leone continues its recovery from civil war and the accuracy of those available may be questionable.

#### 32. SOUTH AFRICA

- 32.1 Overview. South Africa has the most developed economy on the continent. However, an electricity crisis in 2007 caused the economy to slow and currently almost 25% of the workforce is unemployed. As a result of legislation during Apartheid, South African agriculture today is very much commercial and 95% of locally-produced food comes from around 36,000 farmers with around 2.3 million small-scale farmers unable to make a living.
- 32.2 Cereal Production.
  - 32.2.1 South Africa is one of the larger cereal producers in the world.
  - 32.2.2 Agriculture contributes a relatively low percentage of employment in South Africa compared to the rest of the continent. With arid lands, only 13.5% of the land can be used for crop production. Cereal is the most important crop and, although the area has since been falling, in 1990 60% of land under cultivation was used for cereals.
  - 32.2.3 In 2011 South Africa produced 12.76 million tonnes of maize, 2 million tonnes of wheat, 137,000 tonnes of sorghum and a minimal amount of rice.
  - 32.2.4 Cereal production levels have shown wide variation in South Africa over time. As of 2011 they were at 13 million tonnes, but have experienced such highs as 18 million tonnes in 1981, and such lows as 5 million tonnes in the 1992 drought of southern Africa.
- 32.3 Cereal imports.
  - 32.3.1 In 2010 South Africa imported the following quantities of cereals:

Wheat	\$276,154,811
Maize	\$11,498,841
Rice	\$414,468,318
Sorghum	\$9,752

32.3.2 In 2010 wheat imports had increased 52% since 2005, however, between 2010 and 2011, imports increased 116%. Maize imports in 2010 were similar to those in 2005 but had seen a dramatic peak in 2007 with \$200 million's worth of imports. Rice imports increased quite steadily by 121% from 2005 while sorghum imports have sustained a fairly low value but jumped to \$11 million in 2011.





#### 33. TANZANIA

Overview. Tanzania's population experienced a recent escalation, increasing 30% between 2002 and 2012. However, in terms of per capita income, Tanzania is one of the poorest economies. The country was selected as a test case for a G8 initiative for food security to promote agricultural growth through the private sector and lift 50 million people out of poverty by 2022.

- 33.1 Cereal Production.
  - 33.1.1 Agriculture accounts for about half of Tanzania's national income and employs around 80% of the citizens. Cereals are the predominant staples.
  - 33.1.2 In 2011 Tanzania produced 4.34 million tonnes of maize, 964,000 tonnes of rice, 807,000 tonnes of sorghum, and 95,000 tonnes of wheat.
  - 33.1.3 Cereal production in Tanzania has seen a fairly steady growth over time. Over the past 50 years production has reached a level 8.5 times its original value. This trend has experienced very little interruption, other than in the years 2003 and 2009, where the drop in levels here did not affect the pattern's increase the following year.
- 33.2 Cereal imports.
  - 33.2.1 In 2010 Tanzania imported the following quantities of cereals:

Wheat	\$291,942,938
Maize	\$15,675,994
Rice	\$475,081
Sorghum	\$444,266

33.2.2 Wheat imports between 2005 and 2010 increased fairly steadily by 238%. Maize imports have grown but saw a large anomalous peak in 2006 with \$51 million. Sorghum imports also saw a large peak in this year. Rice imports to Tanzania since 2005 have experienced a large amount of variation. The 2010 value was the lowest of the preceding 5 years but by 2011 had increased to \$15.7 million again.



## 34. TOGO

34.1 Overview. Following years of political unrest and criticism for human rights, Togo is now being rewelcomed into the international community. A ten year effort supported by the World Bank and IMF for economic reform and encouraging foreign investment has been slow moving. Togo is the world's largest phosphate producer and is looking to develop these reserves.



- 34.2 Cereal Production.
  - 34.2.1 Subsistence agriculture is the main economic activity and most of the labour force is employed in food and cash crop production. Cash crops are more significant than cereals in this respect.
  - 34.2.2 In 2011 Togo produced 638,000 tonnes of maize, 243,000 tonnes of sorghum, and 73,000 tonnes of rice. Wheat is rarely produced in Togo.
  - 34.2.3 While in relation to other countries Togo is not a huge producer of cereals, it has seen an incredibly steady increase in its own production levels. The 2011 total of 1.05 million tonnes represented a growth of 508% over the preceding 50 years.
- 34.3 Cereal imports.
  - 34.3.1 In 2010 Togo imported the following quantities of cereals:

Wheat	\$14,420,319
Maize	\$787,359
Rice	\$10,734,728
Sorghum	-

34.3.2 There is a fair amount of missing data concerning Togo cereal imports and not all subcategories are included. The shape of the graph below is very similar to that of wheat imports. The 2010 maize value is an 850% increase on 2007 but imports did drop again in 2011. Rice imports increased 86% over the preceding 5 years but were showing a steeper incline into 2011. A value of \$550 for sorghum in 2007 is the only data shown for this grain.





#### 35. UGANDA

- 35.1 Overview. Throughout the 70s and early 80s Uganda was under dictatorial regimes responsible for at least 400,000 deaths and many human rights abuses. Yoweri Museveni's rule from 1986 brought with it comparative stability and allowed for economic growth. With plenty of rain and fertile soils, Uganda has favourable agricultural conditions and this is the most important section of the economy.
- 35.2 Cereal Production.
  - 35.2.1 With 86% of the population living in rural areas, subsistence agriculture is relied on and 82% of people work in agriculture. Small holders produce almost all of the food crops.



- 35.2.2 In 2011 Uganda produced 1.3 million tonnes of maize, 500,000 tonnes of sorghum and 142,000 tonnes of rice. Wheat production was small in comparison but on the rise.
- 35.2.3 Uganda experienced a large increase in cereal production levels in 2009, taking the 2.7 million tonne value of 2008 to 3.8 million tonnes. The upward trend looked set to continue increasing, albeit at a slightly less dramatic rate.
- 35.3 Cereal imports.
  - 35.3.1 In 2010 Uganda imported the following quantities of cereals:

Wheat	\$129,085,803
Maize	\$1,051,857
Rice	\$29,898,258
Sorghum	\$398,012

35.3.2 From 2006 to 2008 wheat imports stayed fairly consistent; 2010 imports were an increase of about \$18 million from this. Maize imports saw a large decline into 2007, falling from \$6.68 million in 2005 to \$112,000. Rice imports have grown consistently since 2006; a slightly larger rise in 2008 countered by a small decline into 2010. The value for sorghum is a large fall from the \$14 million in 2006.



#### 36. ZAMBIA

- 36.1 Overview. Recently Zambia has seen substantial economic growth. Its economy is largely determined by the copper industry and was damaged in the 80s and 90s when copper prices fell. The industry was rescued by privatisation of mines in the 1990s and Zambia's economy was able to grow. However, due to high birth rates, HIV and certain agricultural policies, the economic growth has not been able to reduce a high poverty rate.
- 36.2 Cereal Production.
  - 36.2.1 Maize is both the staple food and the main cash crop produced in Zambia.
  - 36.2.2 Wheat is becoming an increasingly important cereal crop and research is being conducted into how it can become both a more productive and economic option.
  - 36.2.3 In 2011 Zambia produced 3.02 million tonnes of maize, 237,000 tonnes of wheat, 32,000 tonnes of rice and 25,000 tonnes of sorghum.



- 36.2.4 Zambia's cereal production has seen a very variable history. Despite having experienced large fluctuations, the value for 2002 was pretty much the same as in 1961. Recently, this variable trend has moved in an upwards direction with an increase of 1.7 million tonnes between 2008 and 2009.
- 36.3 Cereal imports.
  - 36.3.1 In 2010 Zambia imported the following quantities of cereals:

Wheat	\$1,479
Maize	\$2,487,706
Rice	\$5,538,028
Sorghum	\$45,481

36.3.2 The wheat imports shown had fallen from \$23 million in 2005. Maize experienced a drop from \$36 million to \$1 million between 2006 and 2007 but saw a slight recovery in 2009. Rice imports had been declining slightly over the preceding 5 years although saw an anomalous \$11 million in 2008. Since falling from \$6.5 million in 2006, sorghum imports have remained consistently low.



## 37. ZIMBABWE

- 37.1 Overview. Since its independence in 1980, Zimbabwe has had well documented troubles caused in the most part by the ruling Zanu PF party. In the last 10 years the economy has gone into free fall. Hyperinflation has caused serious problems and in particular the agricultural sector has been hit hard. There have however been slight signs of recovery in the past year or so.
- 37.2 Cereal Production.
  - 37.2.1 In the past, Zimbabwe has been one of the most agriculturally productive countries in Africa but, as a result of Mugabe's land reforms, the yields have fallen dramatically. Wheat and sorghum production levels in particular have dropped. The country has gone from being practically self-sufficient to needing to import a significant proportion of its food. There have also been reports that around 10% of the population now live in starvation.
  - 37.2.2 In 2011, Zimbabwe produced 1.45 million tonnes of maize, 95,000 tonnes of sorghum, 23,000 tonnes of wheat and little to no rice, although the government is trying to implement rice growing to reduce the reliance on imports.
- 37.3 Cereal imports.



37.3.1 In 2010 Zimbabwe imported the following cereals:

Wheat	\$168,596,000
Maize	\$57,208,000
Rice	\$57,082,000
Sorghum	\$9,665,000

37.3.2 As might be expected given the political situation in the country, Zimbabwe's cereal imports have grown substantially recently. This is due to continual decline of the internal agricultural sector. Wheat import levels in 2010 were 28 times greater than in 2005, maize imports had grown by 56%, rice imports were nearly 6 times larger than 2005 and sorghum imports were nearly 9 times greater.



## CONCLUSION

- 1. Cereals have been the most important global source of foodstuff for 12,000 years.
- 2. The global trend in the last few years had been a strong growth in cereal trade up to 2008 to 2009. The global recession, combined with a sharp rise in world cereal prices, caused a universal slump in cereal import levels. The last couple of years have seen a recovery and import levels are starting to hit previous highs.
- 3. Many of the countries that DCL operates within have experienced similar patterns in their levels of cereal imports. Zimbabwe was the least influenced by the 2008 credit crunch due to the various trade embargoes that leave it less affected by world events.
- 4. Cereal production within Africa is continuing to grow. It is particularly increasing in countries where crippling states of civil war have been resolved. The crops that had been left untended are being cultivated again and the farmers, who had previously been fighting, are now back to farming, boosting cereal production.
- 5. However, cereal imports will continue to rise as the population of Africa continues to grow. This is a result of many farmers operating only at the subsistence level rather than selling their crops within the country. Without significant investment, the levels of infrastructure in most African countries cannot support the growth of food production in line with the growth of the population.
- 6. As the countries DCL operates in become more prosperous, wheat imports are likely to increase. When a country becomes more developed, the trend has been for the diet of the inhabitants to become more Western. This means some demand for traditional African food, using cassava and sorghum, may be replaced by more wheat based products.



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