GCE A level

1204/01

GEOGRAPHY G4
SUSTAINABILITY

A.M. TUESDAY, 19 June 2012

1 hour 45 minutes

ADDITIONAL MATERIALS

In addition to this question paper, you will need a 20 page answer book and the Resource Folder.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

Answer **all** questions.

Write your answers in the separate answer book provided, following the instructions on the front of the answer book.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answers.

You are reminded that this paper is synoptic and so will assess your ability to draw on your understanding of the connections between the different aspects of the subject represented in the geography specification.

Even where not specifically asked for, you should support your answer with examples and/or case studies.

SECTION A

Answer **all** *questions.*

In this section you may use information from the **Resource Folder** *and your own research.*

0 1 Compare levels of food and energy consumption in different parts of the world. [10]
(approximately 13 minutes)

0 2 Outline opportunities for increasing energy supplies in one or more countries. [10]
(approximately 13 minutes)

0 3 Explain why some countries experience shortages in food supply. [10]
(approximately 13 minutes)

0 4 'Future energy needs cannot be met without threatening the sustainability of food supplies.'
How far do you agree with this statement? [25]
(approximately 33 minutes)

SECTION B

In this section you may use information from any of your studies for AS and A2 Geography as well from the Resource Folder and your own research.

0 5 Describe some of the ways in which economic development influences the **demand** for water.
Discuss the impact of these ways on the sustainability of water **supplies**. [25]
(approximately 33 minutes)

GCE A level

1204/01-A

GEOGRAPHY - G4
SUSTAINABILITY

A.M. TUESDAY, 19 June 2012

Examination copy

To be given out at the start of the examination.

The pre-release copy must not be used.

1204
01A001

RESOURCE FOLDER

ADVICE TO CANDIDATES

In this synoptic exercise you will be assessed on your ability to **synthesise knowledge and understanding and skills** derived from your A level course.

You are reminded that assessment will take into account the quality of written communication used in your answers.

The information in this Resource Folder is related to the sustainability of food and energy supplies. In particular, food security and the potential for producing biofuels are examined. Possible conflicts between food supplies and energy needs are highlighted. The principal focus is on South Africa but information from other countries is introduced to give a variety of perspectives.

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Contents

WORLD FOOD AND ENERGY

Figure 1 World calorie intake

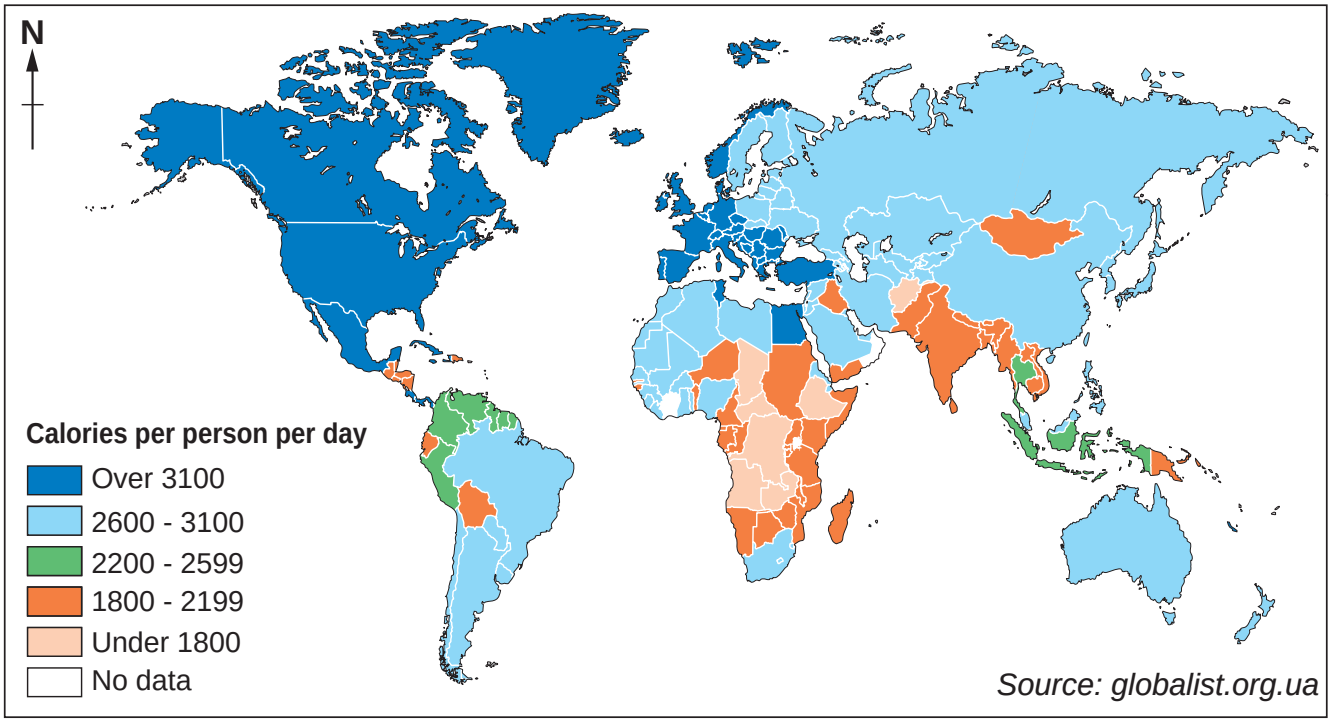


Figure 2 World energy consumption

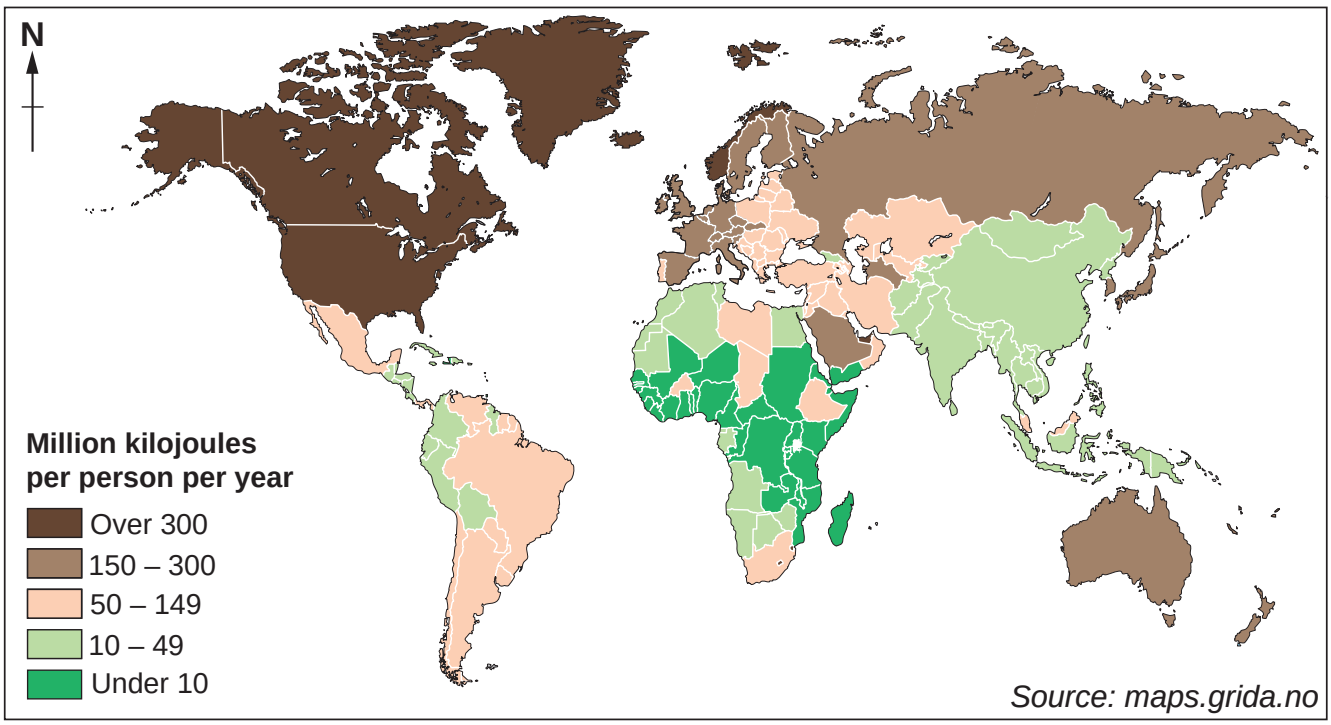


Figure 3 Indicators for food, energy and development for selected countries

	Brazil	Germany	Kenya	South Africa	Vietnam
Food intake calories/person/day	3 012	3 411	1 886	2 805	2 616
Calories/person/day from animal products	642	1 067	231	351	272
Per capita food production (tonnes)	293	569	94	257	219
Percentage of population undernourished	4	< 1	32	4	13
Percentage of food imported	18	9	21	6	5
Total energy consumption (Quadrillion Btu)*	10.1	14.2	0.2	5.4	1.3
Energy consumption per person (kgoe)*	1068	4203	481	2597	539
Percentage of population without electricity	4.3	< 1	32.8	12.0	9.5
Oil imports (barrels/day)	632 900	2 777 000	80 500	490 500	134 300
Percentage of commercial energy from renewable sources	85	15	10	< 1	3
GDP/capita (US$)	9 567	34 401	1 542	9 757	2 600
Gini index of wealth distribution (as percentages)	55.0	28.3	47.7	57.8	37.8
Literacy rate (percentage)	90.0	99.9	73.6	88.0	90.3
Life expectancy (years)	72.2	79.8	53.6	51.5	74.3
Happy planet index	61.0	48.1	27.8	29.7	66.5

Sources: earthtrends.wri.org, cia.gov and happyplanetindex.com

Information is the most up-to-date available in 2010

*Quadrillion = a thousand million million
Btu = British thermal unit
*kgoe = kilograms oil equivalent

Turn over.

SOUTH AFRICA FOOD AND ENERGY

Figure 4 Food supply for South Africa

South Africa has a dual agricultural economy, with both well-developed commercial farming and more subsistence-based production in the remote rural areas.

Agricultural activities range from intensive crop production and mixed farming to cattle ranching and sheep farming. Maize is most widely grown, followed by wheat, oats, sugar cane and sunflowers.

While 13% of South Africa's land can be used for crop production, only 22% of this is high-potential arable land. The most important limiting factor is the availability of water. Rainfall is distributed unevenly across the country, with some areas prone to drought. Almost 50% of South Africa's water is used for agriculture, with about 1.3 million hectares under irrigation.

Today, South Africa is not only self-sufficient in virtually all major agricultural products, but is also a net food exporter. Imports are mainly of foods that cannot be produced under South African climatic conditions.

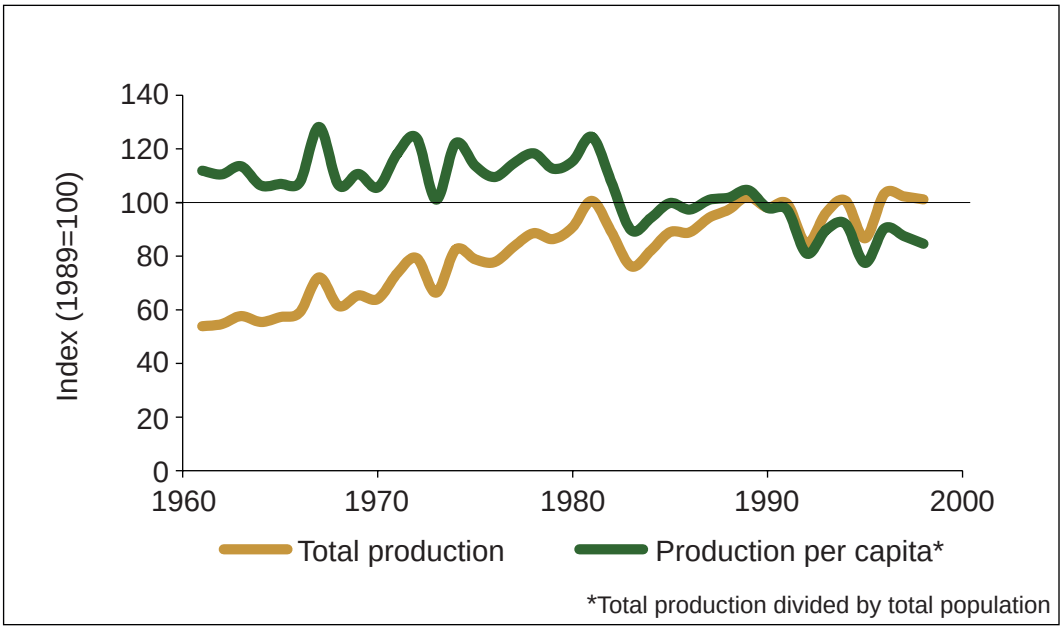
Farming contributes some 8% to the country's total exports. The largest export groups are wine, citrus, sugar, grapes, maize, fruit juice, wool, and fruit such as apples, pears, peaches and apricots.

Cattle farming for beef production

Ostrich farming – new, low fat meat source

Source: www.southafrica.info

Figure 5 Food production in South Africa, 1960 – 2000



Source: earthtrends.wri.org

Figure 6 Potential to increase food production in South Africa

The biggest problem for South African agriculture is that many farmers in remote rural areas need information, other related inputs and technology, which are critical for unlocking the potential of natural resources. People in rural areas need to understand what services the government offers about technical information on crops and products that can be grown in an area, crop diseases, crop-quality related information and advice on marketing. Farmer Support Centres are being opened to bring Internet access into rural areas.

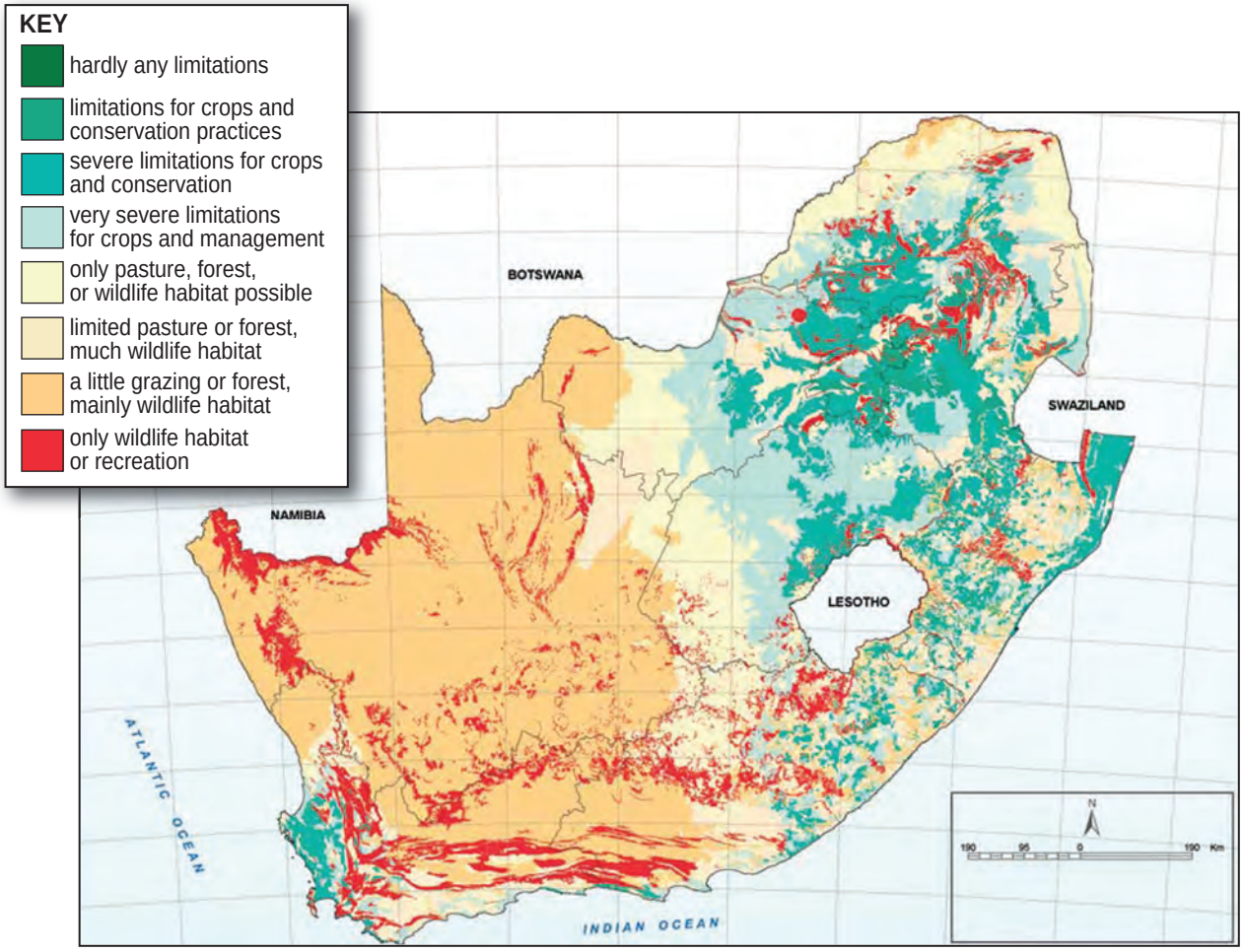
Biotechnology has a lot to offer South Africa but the current issue is whether to depend on increases of fertilizers and herbicides to increase yields, or whether to be innovative and make the quantum leap into biotechnology. The benefits of biotechnology from agricultural research are known to scientists, but the problem is that scientists are not very good at communicating this information to rural farmers. The government needs to bring in legislation on genetically modified organisms (GMOs) and develop a communications strategy for biotechnology.

The danger of a media-driven dialogue on genetically modified foods is that it does not deal fairly with the science behind progress. For example, sweet potato that has resistance to the mosaic virus, because of work done in Kenya, is portrayed as a food that has been meddled with. But all that has been done is to introduce resistance through a genetic modification. In the past, to overcome the virus, the crop would have needed spraying with chemicals. There is a need to avoid having a naïve discussion as if GMOs were some kind of monster suddenly appearing out of the gloom.

South African agriculture also needs to have an appropriate technology-transfer partnership with developed countries, to facilitate economic growth by raising yields and incomes and at the same time, satisfy food security at the household level.

Source: www.new-ag.info

Figure 7 Land potential in South Africa

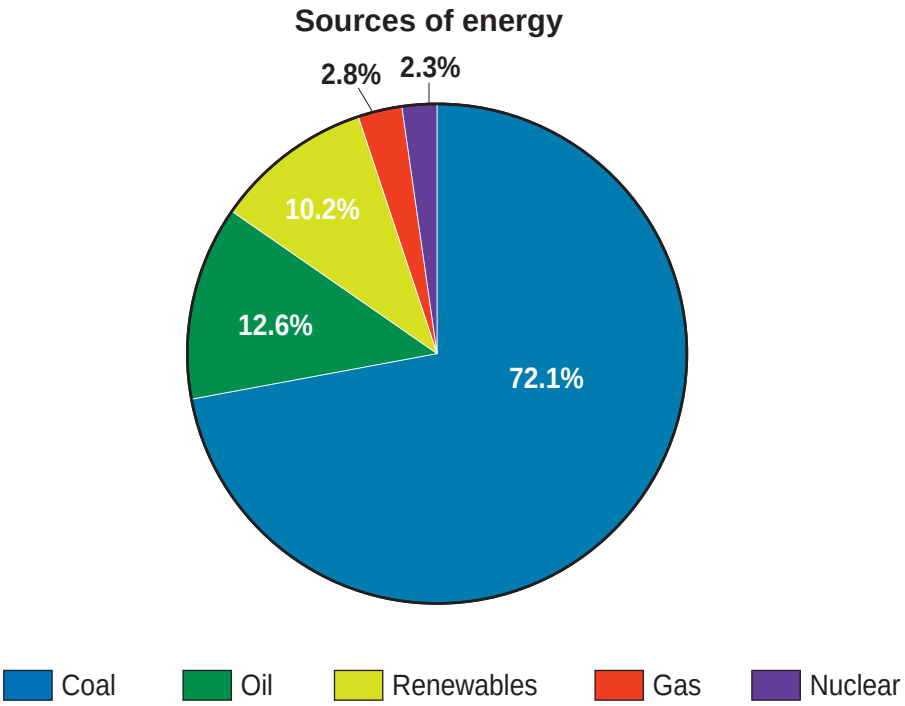


Source: www.esri.com

Turn over.

Figure 8 Sources of energy within South Africa

South Africa's energy sector is critical to the economy as the country relies heavily on its large-scale, energy-intensive mining industry. South Africa has only small deposits of oil and natural gas and uses its large coal deposits for most of its energy needs. As a result, carbon emissions are very high. The country also has a highly developed synthetic fuels industry, producing both gasoline and diesel fuels from coal.



- South Africa's energy sector contributes about 15% of the country's GDP.
- Coal deposits offer cheap electrical power – the cost of the coal is one of the cheapest in the world, but it is a major producer of CO_2. The government is aware, and is making genuine and effective efforts to reduce emissions.
- There are no significant oil or gas reserves, but synthetic oil and gas are made from coal. These burn to produce far less CO_2 than coal, and can be used just like naturally occurring oil and gas. South Africa is a world leader in this form of technology.
- Two companies dominate manufacturing the synthetic fuels and are the biggest of their type in the world. As well as converting coal to liquid and gas forms, they produce petrochemicals from coal for the chemical industry.
- Synthetic fuels are not renewable forms of energy, but South Africa is developing two renewable sources and is more advanced with these than any other countries.
- The two renewable sources are fuel cells and the Jatropha plant.

Source: www.southafrica.info

Figure 9 Fuel cell technology

South Africa is also becoming important for fuel cells, a clean, efficient technology. International companies are investing in cutting-edge fuel cell technology in rural areas. A fuel cell is similar to a battery but uses oxygen and hydrogen as fuel. Fuel cells are more stable and can be run for longer than batteries. They are more efficient than petrol and diesel engines. At present, fuel cells are used only for back-up if power from the national grid is interrupted. This is useful for clinics and hospitals, banks, telecommunications and other users of information technology infrastructure.

Source www.intelligent-energy.com

Figure 10 Renewable energy from Jatropha

Jatropha curcas has the potential to become one of the world's key energy crops. Crude vegetable oil, extracted from the seeds of the Jatropha plant, can be refined into high quality biodiesel. Seeds are crushed to produce crude Jatropha oil that can be used directly in generators and boilers or refined into biodiesel. The remaining material left after oil extraction is excellent organic fertiliser, or it can be burnt for power generation.

Many people believe that Jatropha may be 'the new crude oil'. Jatropha grows in tropical and subtropical regions in a band around the earth between latitudes 30 degrees north and south of the Equator. Jatropha is hardy and relatively drought resistant. Trees have a lifespan of up to 30 years. Jatropha grows on a wide range of land types, including non-arable, marginal and waste land, and need not compete with vital food crops for good agricultural land. South Africa has perfect conditions for growing Jatropha across most of the country, and has been talked of as 'the Saudi Arabia of the 21st century'.

Source: www.d1plc.com

Figure 11 Other biofuel crops in South Africa

The country can grow many of the biofuel crops that are currently being used throughout the world. There are areas ideal for growing maize and others for sugar cane. Both these plants can be used to produce ethanol which can be used much like petrol. The country can also grow soya beans and sunflowers, which can produce biodiesel.

The government has provided funding to start production from these plants during 2010. The joint production from these sources is expected to be around 1 billion litres of biofuels a year and would contribute to earnings of about 1.3% of South Africa's GDP. Local community farmers will be encouraged to supply crops as part of a community empowerment strategy. The scheme will provide up to 55 000 jobs in the agricultural sector, and it is expected to reduce carbon emissions significantly by replacing fossil fuels, especially low grade coal.

Source: www.indaloyethu.co.za

Maize Canola Oil palm Sugar cane

©Shutterstock

Turn over.

Figure 12 Future energy demands in South Africa

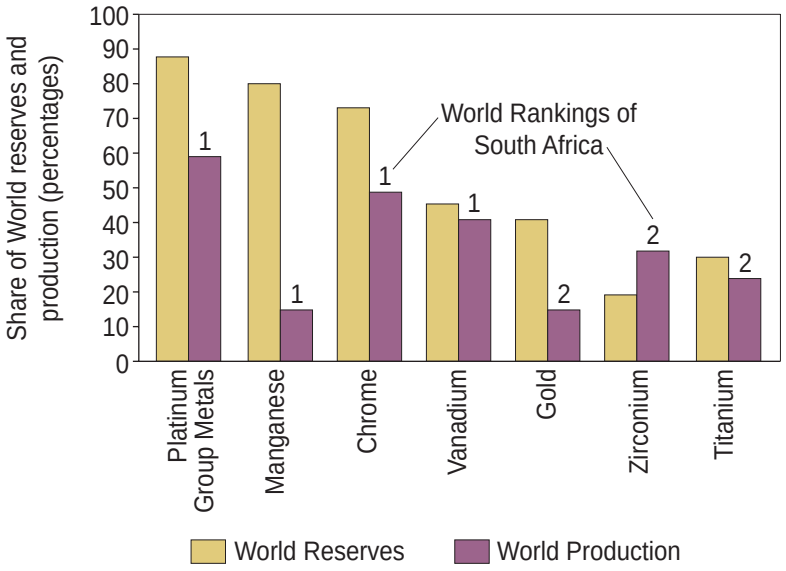
South Africa's economy has been growing since 1999 – the longest period of economic expansion in the country's recorded history. During this upswing, the country's annual economic growth rate has averaged over 4%. In the decade prior to 1994, economic growth averaged less than 1% a year. Global companies are increasingly outsourcing to South Africa.

The growing beneficiation industry – adding value to raw mineral materials – promises to unlock even more of the wealth underground. There are lucrative opportunities for the processing of iron, carbon steel, stainless steel, aluminium, platinum group metals and gold.

More energy is required to power growing industrialisation. Increasing affluence within some sections of South African society is also increasing the demand for more energy for consumer goods.

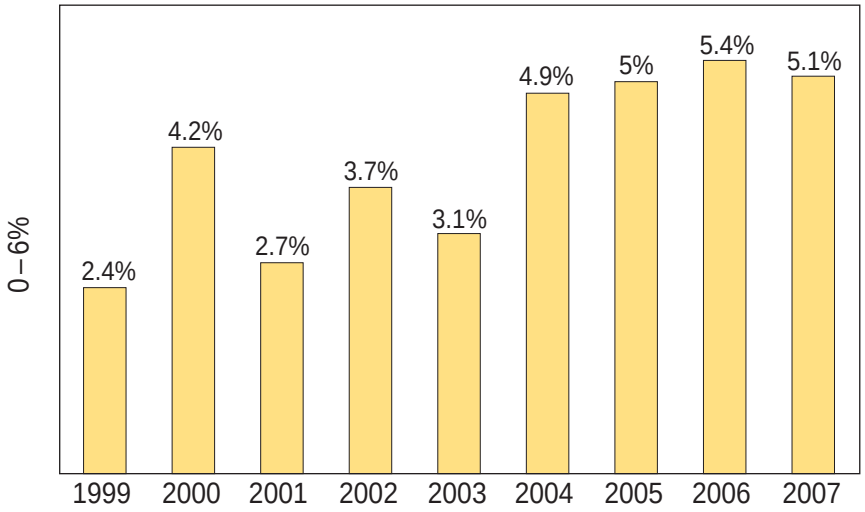
Source: www.eia.doe.gov

Figure 13 South Africa's share of World metal reserves and production



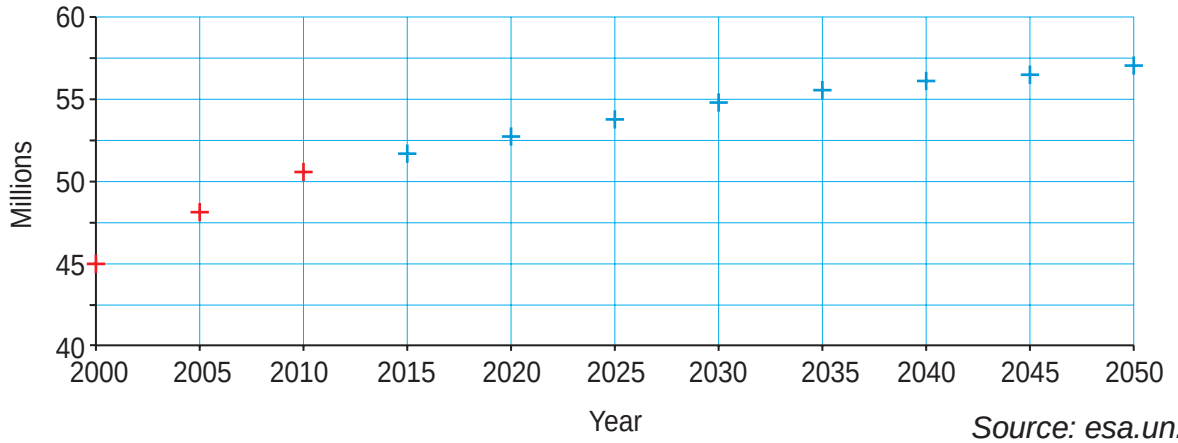
Source: www.southafrica.info

Figure 14 Annual growth of GDP in South Africa



Source: www.southafrica.info

Figure 15 Actual and projected population growth for South Africa



Source: esa.un.org

Figure 16 Biofuels versus food

Biofuel crops can provide secure energy with much reduced emissions of greenhouse gases, and help with rural development. Producing biofuels on a large scale can require huge tracts of land and that land is also needed for growing food crops. Many countries cannot afford to divert land away from food production, particularly where the population is growing, and there is a need for food security based on domestic supply.

The 'food versus fuel' controversy is complex. Food and biomass require the same resources for production – land, water and agrochemicals. Food and fuel need not necessarily compete, particularly when there is careful planning for ecological conservation and sustainable production methods. But the real situation is less clear cut.

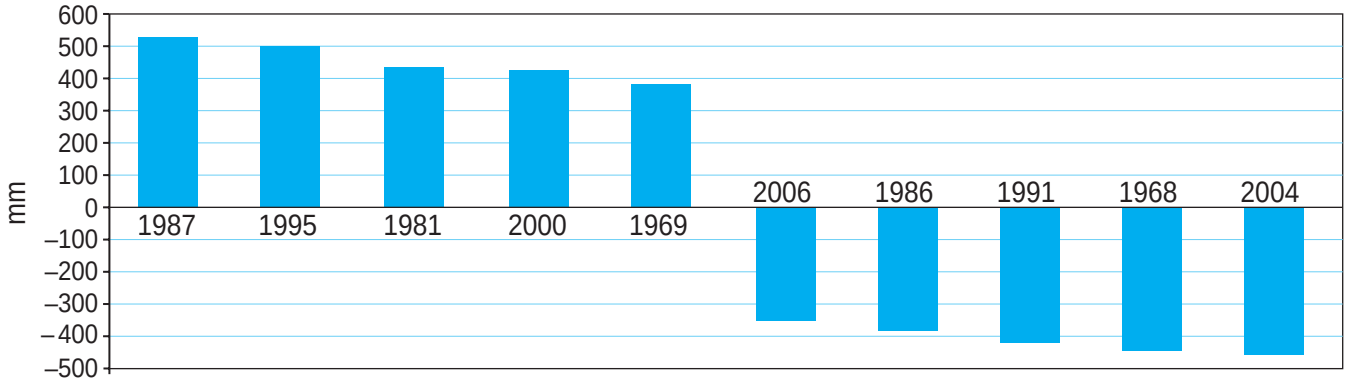
In South Africa, the biofuel debate is growing. Until Jatropha is widely established biofuels would most likely be made from maize. Maize is the staple crop feeding the bulk of southern Africa's people, and its price has already fluctuated when droughts, to which the region is prone, occur.

On average, South Africa yields around four tonnes per hectare from its dry-land maize. In comparison, the USA grows more than double this amount. US farmers obtain only the modest energy-to-output gain of 1:1·3. It is unlikely that South African maize, with its much lower yields, could produce any positive energy gain at all. This means that it would take more energy to grow and harvest the crop than the energy that could be obtained from its use as a fuel.

There is concern amongst southern African countries that if South Africa takes the biofuel route, it will not be able to sell them any excess maize during times of food shortage.

Source: www.scidev.net

Figure 17 Rainfall variability in South Africa



Five greatest deviations in rainfall above and below mean of 852 mm 1960–2010

Source: www.environment.gov.za

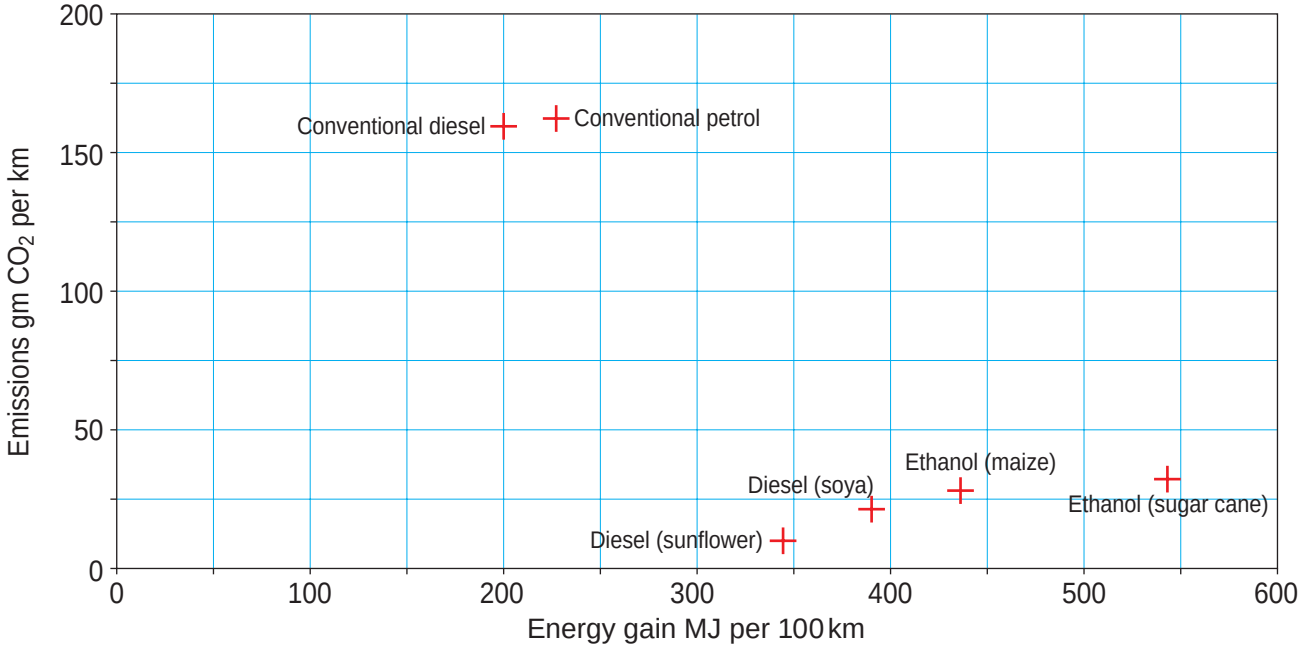
Turn over.

BENEFITS OF BIOFUELS

Figure 18 Biofuels compared to conventional fuels

There are two main advantages of biofuels. Firstly, they provide far more energy than they take to produce. This energy gain is usually measured in MJ (million joules) provided for an average car journey of 100 km. The second advantage is that biofuels produce much lower greenhouse gas emissions. They do emit CO_2 when burnt, but also absorb CO_2 from the atmosphere whilst growing. Machinery used in growing the crop and transporting it to where it will be used, also cause CO_2 emissions. The CO_2 emissions are usually slightly greater than the amounts absorbed. They are measured in CO_2 gms emitted by an average car travelling one kilometre. The comparison can be seen below.

Energy gain and CO_2 emissions for various fuels



Source: www.europabio.org

Figure 19 Biofuels around the world

World Region	Total primary energy demand	Total supplied by renewables	Total supplied by biomass	Biomass share of primary energy
Africa	21.5	10.8	10.5	49%
Latin America	18.8	5.3	3.3	18%
Asia excluding China	48.2	16.1	15.0	31%
China	48.4	10.0	9.0	19%
Middle East	16.3	0.1	0.0	0%
CIS* + Central Europe	43.7	1.7	0.6	1%
OECD*	223.3	12.7	6.8	3%
World	**420.3**	**56.7**	**45.2**	**11%**

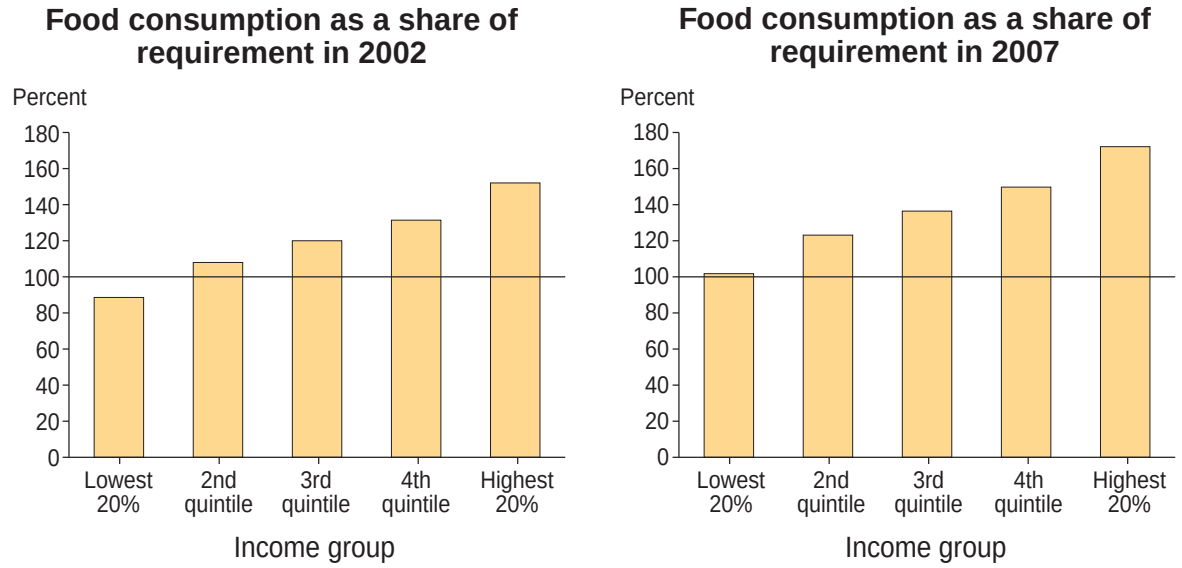
Source: oeko.de

Data in exajoules per year
1 Exajoule (EJ) = 10^{18} Joules
*CIS – Commonwealth of Independent States
*OECD – Organisation for Economic Cooperation and Development

FOOD AND FUEL IN OTHER COUNTRIES

Figure 20 Brazil food security

In 2002, President Lula launched the Zero Hunger Programme with the aim of ensuring all the population of Brazil had at least the minimum food requirement met.



Source: ers.usda.gov

Figure 21 The biofuels versus food debate in Brazil

In favour of biofuels.
Food shortages and price increases that Brazil suffered before 2002 were blamed on growing crops to produce ethanol, but this may not be so. Brazil, as one of the world's largest exporters of agricultural commodities and leaders in agricultural production, has kept ahead of population growth: in 1976 the production of cereals was 416 kg per capita, and in 1987 was 418 kg per capita. Of the 55 million hectares (ha) of land area devoted to primary food crops, only 4.1 million ha (7.5 per cent) was used for sugar cane, which represents only 0.3 per cent of Brazil's total land area. Of this, only 1.7 million ha was used for ethanol production, so competition between food and crops is not significant. Furthermore, crop rotation in sugar cane areas has led to an increase in certain food crops.

Food shortages and price increases in Brazil have resulted from a combination of policies which were biased towards commodity export crops and large acreage increases of such crops, hyper-inflation, currency devaluation and price control of domestic foodstuffs.

Against biofuels.
Ethanol was seen as an easy way to reduce greenhouse gas emissions, but the World Bank has estimated that maize prices rose by more than 60% between 2005 and 2007, and have continued to rise into 2010. The price rises have been greatest in the poorest countries of the world where food shortages already exist. Staple foods such as maize are the very crops being used for biofuel.

Numerous studies have demonstrated that the energy return on energy invested from most forms of maize and sugar-based ethanol is at best marginal, and at worst, a net loss. Bio-ethanol must be grown, collected, dried, fermented, and then burned. These steps require resources, infrastructure and transportation that often produce as much pollution and require as much energy as ethanol saves.

The degrading of farm land it produces, and the impact on small farmers and communities in Brazil, could be a problem.

Sources: www.journeytoforever.org and www.global-greenhouse-warming.com

Turn over.

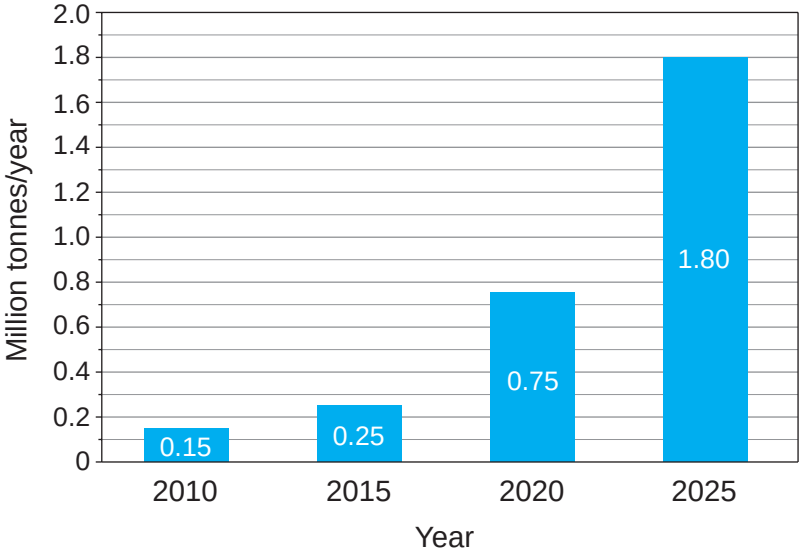
Figure 22 Food security in Vietnam

Vietnam experienced one of the fastest increases in food prices in early 2008. The retail price of rice increased by 65 percent. As a result, Vietnam has been classified as one of the hunger hot spots in Asia based on the Global Hunger Index classification, which is a composite measure of population undernourishment (13%), child malnutrition (20%), and child mortality (under 5 mortality rate 15/1000). The coastal regions in Vietnam are susceptible to typhoons and have been classified as vulnerable to food insecurity.

Food security is a concern because even though Vietnam is the second largest exporter of rice in the world, many rural households are net buyers of food. For example, approximately 53 percent of the population in the Mekong Delta and 55 percent in the Red River Delta are net purchasers of food. In response to the high prices, the government cut rice exports by approximately one million tonnes. The government also plans on setting up 100 000 tonnes of storage to keep the rice prices stable. This is in addition to 31 600 tonnes of food aid.

Source: www.foodsecurityportal.org

Figure 23 Projected biofuels in Vietnam



Marginal lands and forests have been cleared for biofuels production, making it even more difficult for forests and agricultural lands to act as sinks to absorb CO_2. In South-East Asia as a whole, 87% of all deforestation between 1985 and 2000 can be attributed to palm oil plantations, many of which are for the production of biofuels.

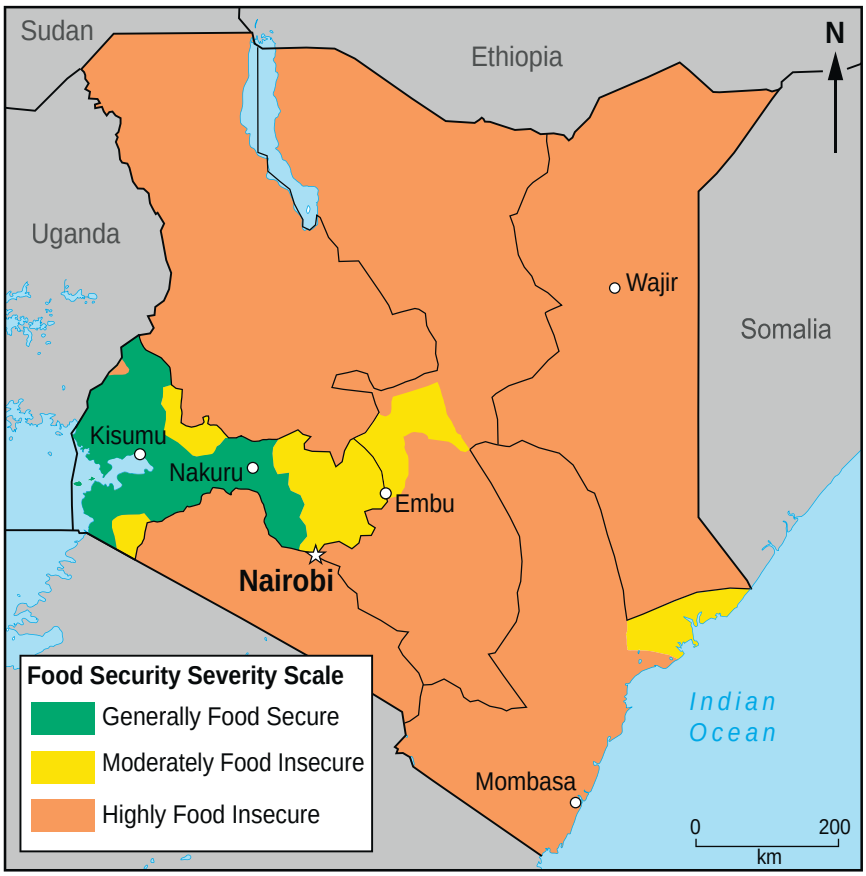
Vietnam plans to go ahead with producing biofuels to meet its increasing energy needs. Manufacturing industry is growing rapidly and the affluence of the population is increasing, both requiring more energy.

There may be some conflict between biofuels and food supply. Switching to biofuels is regarded as an important factor in fighting the greatest threat to Vietnam. If predictions about global warming are correct, then sea levels will rise and threaten the Mekong and Red River deltas. Switching to biofuels is seen as one way that Vietnam can do something practical to combat the threat of rising sea levels. These two deltas produce the majority of home-grown food in Vietnam, and if they were to be lost in the future, the country would face food shortages many times more severe than the minor shortages at present.

Rice straw and rice husks, currently just waste from rice production, could become vital contributors to biofuel production.

Source: www.pecj.or.jp

Figure 24 Food security in Kenya in 2010



- A long dry spell during most of 2009 has threatened food security in many parts of the country.
- Some rain has fallen in the early part of 2010, but 3.8 million people remain food insecure.
- Limited harvests have occurred, and many livestock have died.
- The food distribution chain has broken down.
- In some localised areas, floods have affected food security.

Source: www.kenyafoodsecurity.org

Figure 25 Biofuels in Kenya

In January 2010, people on part of Kenya's Indian Ocean coast were woken up by smoke and the sound of bulldozers that were beginning to clear nearby forest.

50 000 hectares of the land upon which they are dependent for their livelihoods had been handed over to an Italian company. It aims to produce the biofuel crop Jatropha, the so-called 'miracle-plant' supposed to provide high yields of oil to be converted into fuel.

According to the draft approved by the Kenyan national authorities (and not the local population), 30% of the oil produced in Kenya will be exported to Italy, and 70% will be used for national energy consumption (Jatropha is not edible). However, the company has recently declared to the Italian press that it would export to Italy as much as 80% of the oil produced, while only 20% of it will be used to satisfy the domestic demand in Kenya.

It has been predicted that 20 000 people are in danger of being displaced and that the ecological balance of the region will be severely threatened.

Source: www.hungerfreeplanet.org

Efforts to turn Kenya into Africa's principal producer of biofuels have made significant steps with the completion of a policy for cost-effective and safe production of biofuels. Aimed at reducing the country's dependence on fossil fuels, the proposed policy hopes to establish the principles that will enable Kenya to gain from rising demand for clean energy without social and economic shockwaves.

Many NGOs have introduced oil plants like Jatropha to farmers, saying it could be a major export product with the possibility of bringing wealth to Kenya quickly. Kenya is hoping for middle income economy status by 2030.

At the moment, Kenya is paying too heavy a price for electricity and cooking gas, forcing more than 80% of rural households to rely on wood fuel for their energy needs. Biofuels could significantly reduce the number of people suffering ill health caused by indoor pollution that is mainly caused by use of wood fuels.

Biofuels have the potential of boosting economic growth in the countryside through job creation and skills development.

Source: www.businessdailyafrica.com

Turn over.

Sources of information

Figure 1	globalist.org.ua/eng/14467-world-food-consumption-in-calories-per-day-the-map
Figure 2	maps.grida.no/go/graphic/energy_consumption_per_capita_2004
Figure 3	earthtrends.wri.org, cia.gov and happyplanetindex.com
Figure 4	www.southafrica.info/business/economy/sectors/agricultural-sector.htm
Figure 5	earthtrends.wri.org/pdf_library/country_profiles/agr_cou_710.pdf
Figure 6	www.new-ag.info/en/country/profile.php?a=885
Figure 7	www.esri.com/mapmuseum/mapbook_gallery/volume19/images/large/agr_3c.jpg
Figure 8	www.southafrica.info/business/economy/infrastructure/energy.htm
Figure 9	www.intelligent-energy.com/products_and_services/fuel_cells/power_systems
Figure 10	www.d1plc.com/agronomyEnergy.php
Figure 11	www.indaloyethu.co.za/index.php?option=com_content&task=view&id=181 ©Shutterstock
Figure 12	www.eia.doe.gov/cabs/South_Africa/pdf.pdf
Figure 13	www.southafrica.info/pls/procs/iac.page p_t1=2779&p_t2=0&p_t3=0&p_t4=0&p_dynamic=YP&p_ content_id=416221&p_site_id=38
Figure 14	www.southafrica.info/business/economy/econoverview.htm
Figure 15	esa.un.org/unup/p2k0data.asp
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Figure 22	www.foodsecurityportal.org/vietnam
Figure 23	www.pecj.or.jp/english/plaza/7th_asiasympo/2-9_Huynh-Hung-My.pdf
Figure 24	www.kenyafoodsecurity.org/index.php? option=com_content&view=article&id=19&Itemid=34
Figure 25	www.actionaid.org/kenya/(hungerfreeplanet.org) and biofuels.carboncapturereport.org/cgi-bin//profiler? key=businessdailyafrica_com&pt=4

GCE A level

1204/01-B

GEOGRAPHY - G4
SUSTAINABILITY

Pre-Release Material for examination on 19 June 2012.

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RESOURCE FOLDER

INSTRUCTIONS TO CANDIDATES

A new copy of this Folder will be given out in the examination. This copy must not be taken into the examination.

Work through this Folder to make sure you understand all the resources. You may seek help from your teachers or any other sources in this context. You have to apply your critical understanding to an unfamiliar situation.

ADVICE TO CANDIDATES

The information in this Resource Folder is related to the sustainability of food and energy supplies. In particular, food security and the potential for producing biofuels are examined. Possible conflicts between food supplies and energy needs are highlighted. The principal focus is on South Africa but information from other countries is introduced to give a variety of perspectives.

Guidelines for using the pre-release materials

The contents of the booklet should be studied carefully. The examples given will help in answering some of the questions on the question paper. To give a fuller answer, it is advisable to look at other material before the examination. This could be similar topics, related to information in other countries, or may be the same countries but in greater depth, or on closely related topics. It would be particularly useful to note if other case studies seem similar in nature, or if they show contrasting perspectives to those from the material in this Resource Folder.

Some of the resource materials come from Geography textbooks, but others come from companies, pressure groups, research organisations, governments and private individuals. In some cases they are using information to promote their own interests rather than to represent an impartial view. It is worth considering if they are trying to support a particular interest group and persuade readers to agree with them. In finding other materials, it is worth bearing in mind that they might not be presented in an impartial and objective way.

Material in the Resource Folder may often be related to other themes found in G4, and to other units in Geography AS and A2. These links should be noted, as there will be opportunities to refer to such connections with other work in some of your answers. Being able to link together different parts of your Geography studies is important and will be rewarded in answers. Such linkages are sometimes referred to as ‘synopticity’.

Textbooks, journals, good quality newspapers and television and radio programmes are good sources of information. Probably the most accessible source of geographical information is the Internet, but it is also the one which may be most susceptible to bias and lack of impartiality. Many of the resources are extracted or adapted from sources on the Internet. These sources have the web addresses provided. Many are only extracts or shortened versions of fuller documents. It is well worth following these links for greater depth of reading and for more recent updates of material.

Each candidate will be provided with a copy of the Resource Folder, for use in the examination, at the same time as the question paper is issued at the beginning of the examination on the day set for the paper.

Copies of the Resource Folder with added notes, or notes from research carried out in the previous six weeks, may not be taken into the examination.

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WORLD FOOD AND ENERGY

Figure 1 World calorie intake

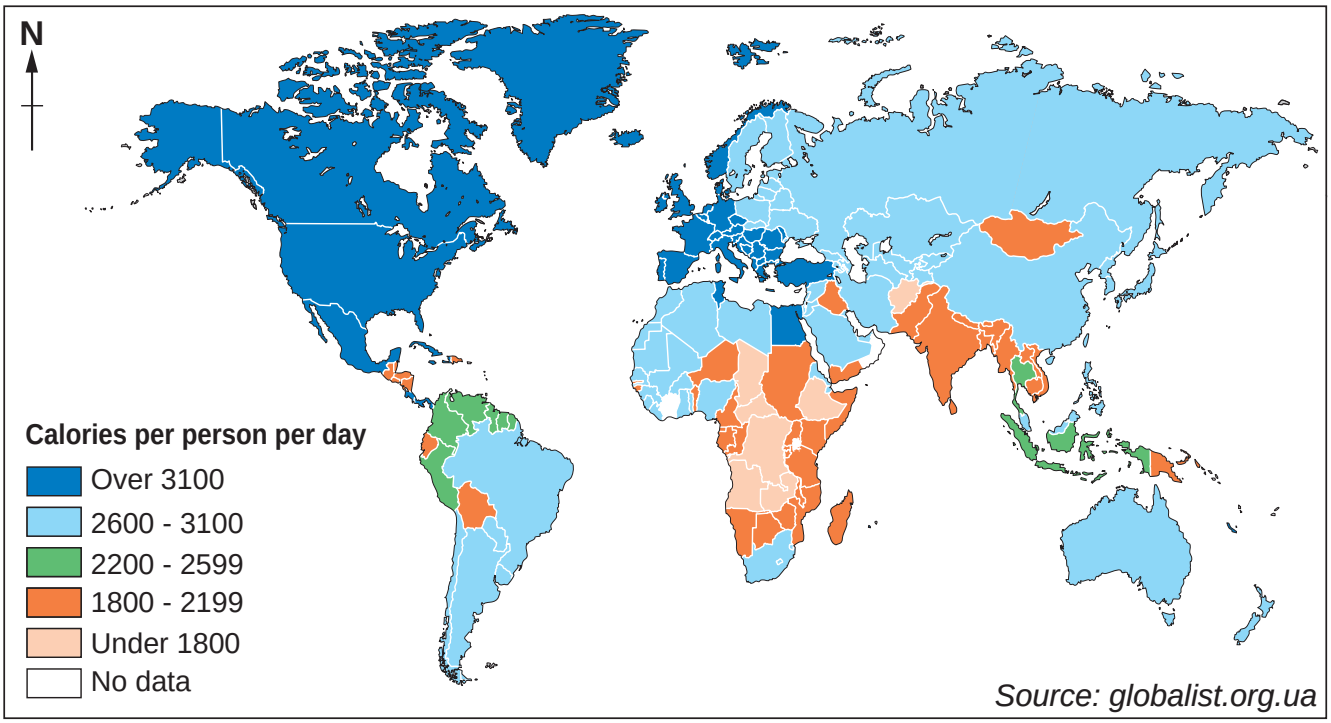

Figure 2 World energy consumption

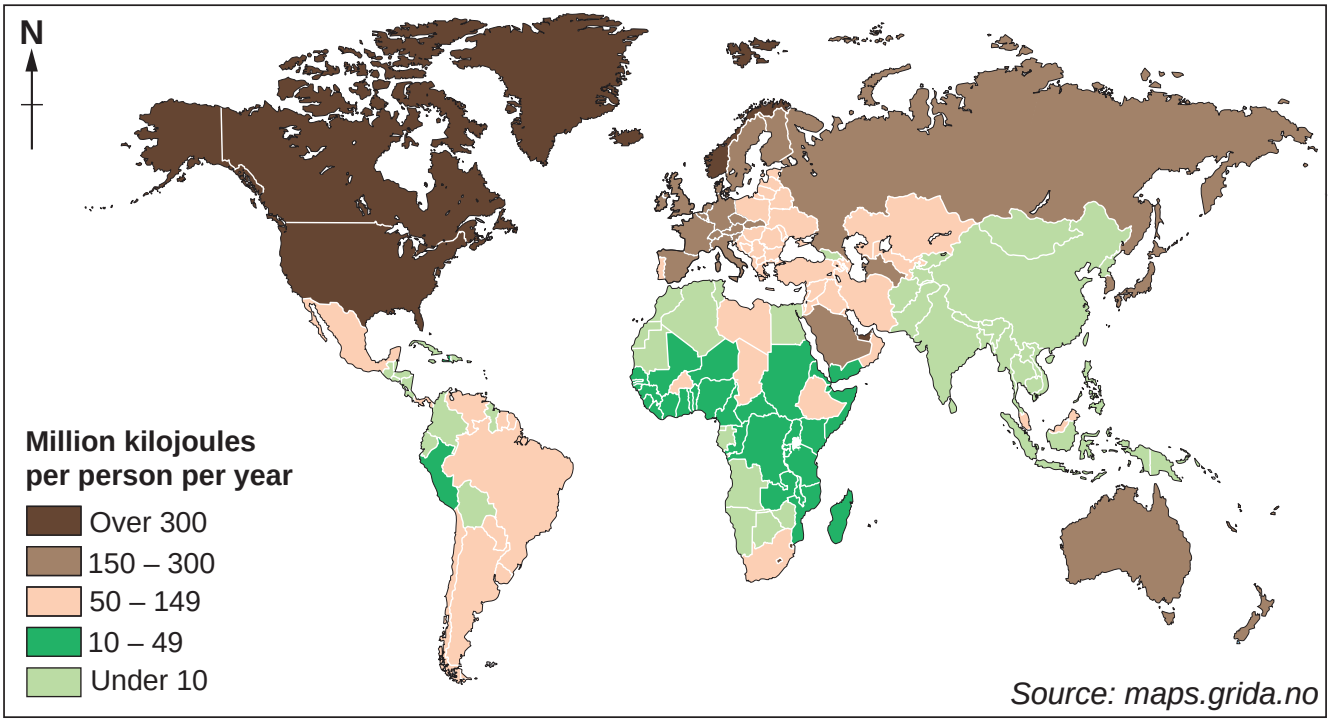

Figure 3 Indicators for food, energy and development for selected countries

	Brazil	Germany	Kenya	South Africa	Vietnam
Food intake calories/person/day	3 012	3 411	1 886	2 805	2 616
Calories/person/day from animal products	642	1 067	231	351	272
Per capita food production (tonnes)	293	569	94	257	219
Percentage of population undernourished	4	< 1	32	4	13
Percentage of food imported	18	9	21	6	5
Total energy consumption (Quadrillion Btu)*	10.1	14.2	0.2	5.4	1.3
Energy consumption per person (kgoe)*	1068	4203	481	2597	539
Percentage of population without electricity	4.3	< 1	32.8	12.0	9.5
Oil imports (billion barrels/day)	632 900	2 777 000	80 500	490 500	134 300
Percentage of commercial energy from renewable sources	85	15	10	< 1	3
GDP/capita (US$)	9 567	34 401	1 542	9 757	2 600
Gini index of wealth distribution (as percentages)	55.0	28.3	47.7	57.8	37.8
Literacy rate (percentage)	90.0	99.9	73.6	88.0	90.3
Life expectancy (years)	72.2	79.8	53.6	51.5	74.3
Happy planet index	61.0	48.1	27.8	29.7	66.5

Sources: earthtrends.wri.org, cia.gov and happyplanetindex.com

Information is the most up-to-date available in 2010

*Quadrillion = a thousand million million
Btu = British thermal unit
*kgoe = kilograms oil equivalent

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SOUTH AFRICA FOOD AND ENERGY

Figure 4 Food supply for South Africa

South Africa has a dual agricultural economy, with both well-developed commercial farming and more subsistence-based production in the remote rural areas.

Agricultural activities range from intensive crop production and mixed farming to cattle ranching and sheep farming. Maize is most widely grown, followed by wheat, oats, sugar cane and sunflowers.

While 13% of South Africa's land can be used for crop production, only 22% of this is high-potential arable land. The most important limiting factor is the availability of water. Rainfall is distributed unevenly across the country, with some areas prone to drought. Almost 50% of South Africa's water is used for agriculture, with about 1.3 million hectares under irrigation.

Today, South Africa is not only self-sufficient in virtually all major agricultural products, but is also a net food exporter. Imports are mainly of foods that cannot be produced under South African climatic conditions.

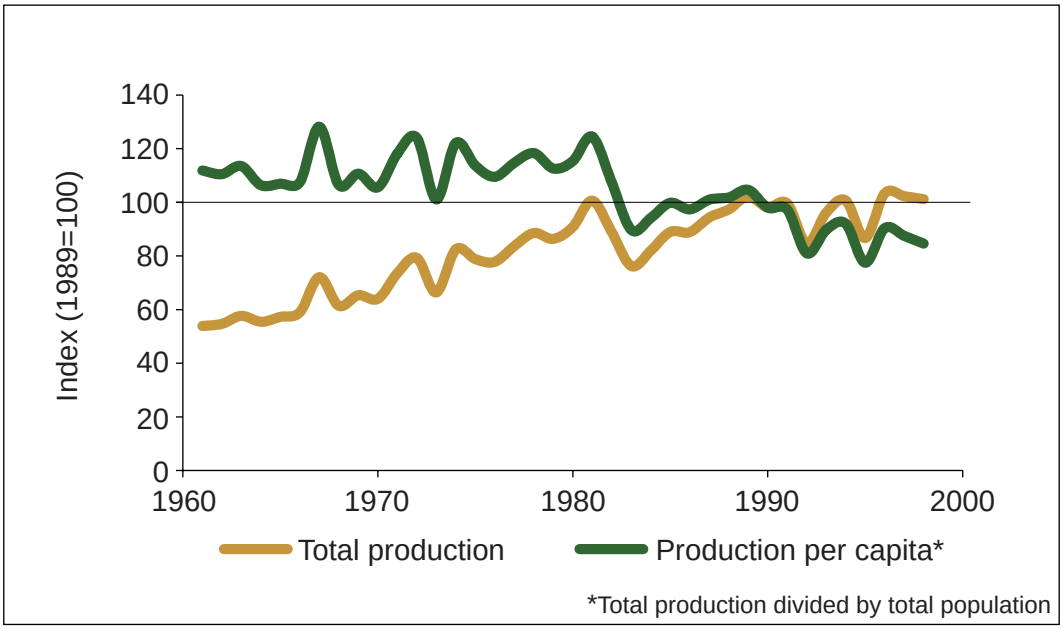
Farming contributes some 8% to the country's total exports. The largest export groups are wine, citrus, sugar, grapes, maize, fruit juice, wool, and fruit such as apples, pears, peaches and apricots.

Cattle farming for beef production

Ostrich farming – new, low fat meat source

Source: www.southafrica.info

Figure 5 Food production in South Africa, 1960 – 2000



Source: earthtrends.wri.org

Figure 6 Potential to increase food production in South Africa

The biggest problem for South African agriculture is that many farmers in remote rural areas need information, other related inputs and technology, which are critical for unlocking the potential of natural resources. People in rural areas need to understand what services the government offers about technical information on crops and products that can be grown in an area, crop diseases, crop-quality related information and advice on marketing. Farmer Support Centres are being opened to bring Internet access into rural areas.

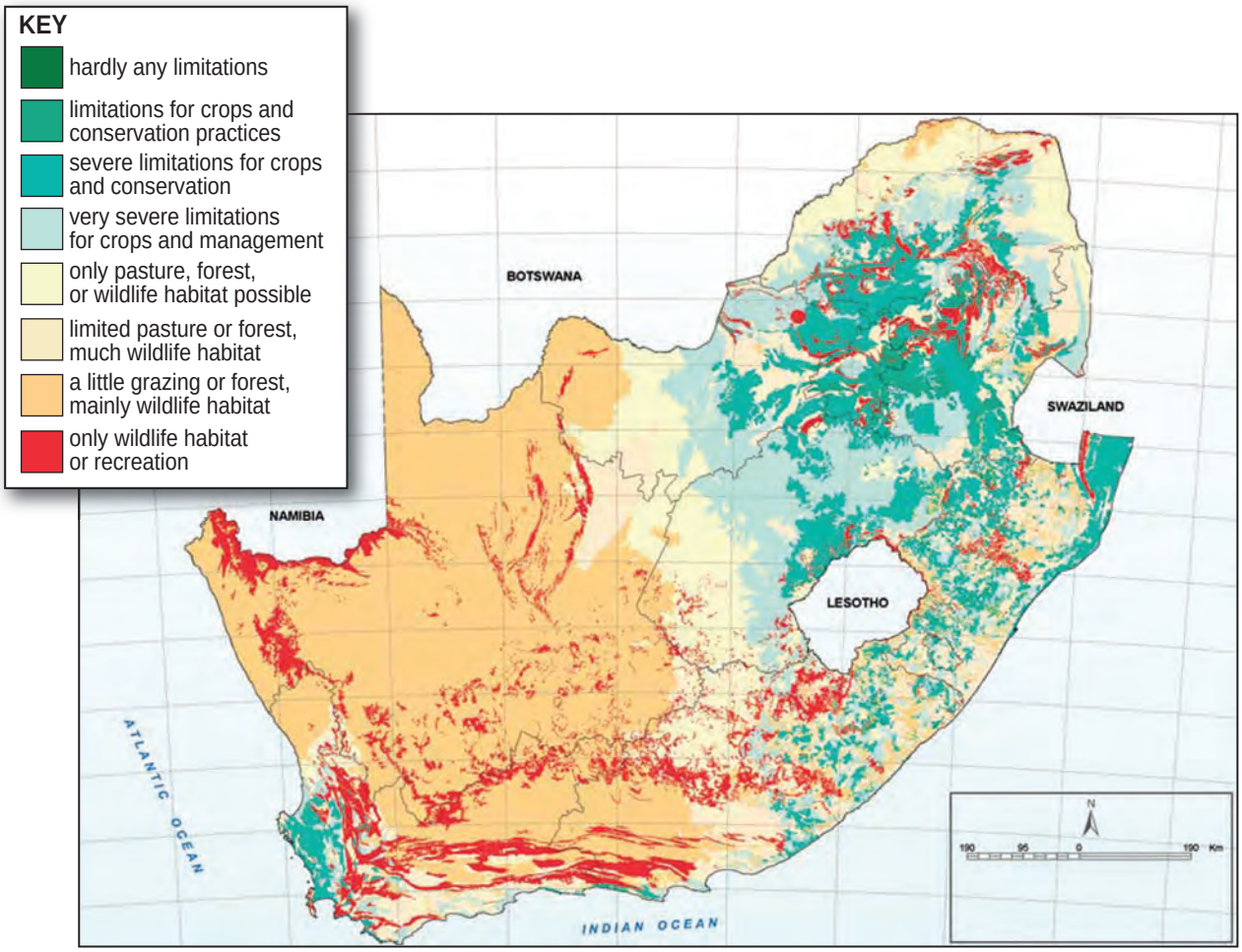
Biotechnology has a lot to offer South Africa but the current issue is whether to depend on increases of fertilizers and herbicides to increase yields, or whether to be innovative and make the quantum leap into biotechnology. The benefits of biotechnology from agricultural research are known to scientists, but the problem is that scientists are not very good at communicating this information to rural farmers. The government needs to bring in legislation on genetically modified organisms (GMOs) and develop a communications strategy for biotechnology.

The danger of a media-driven dialogue on genetically modified foods is that it does not deal fairly with the science behind progress. For example, sweet potato that has resistance to the mosaic virus, because of work done in Kenya, is portrayed as a food that has been meddled with. But all that has been done is to introduce resistance through a genetic modification. In the past, to overcome the virus, the crop would have needed spraying with chemicals. There is a need to avoid having a naïve discussion as if GMOs were some kind of monster suddenly appearing out of the gloom.

South African agriculture also needs to have an appropriate technology-transfer partnership with developed countries, to facilitate economic growth by raising yields and incomes and at the same time, satisfy food security at the household level.

Source: www.new-ag.info

Figure 7 Land potential in South Africa

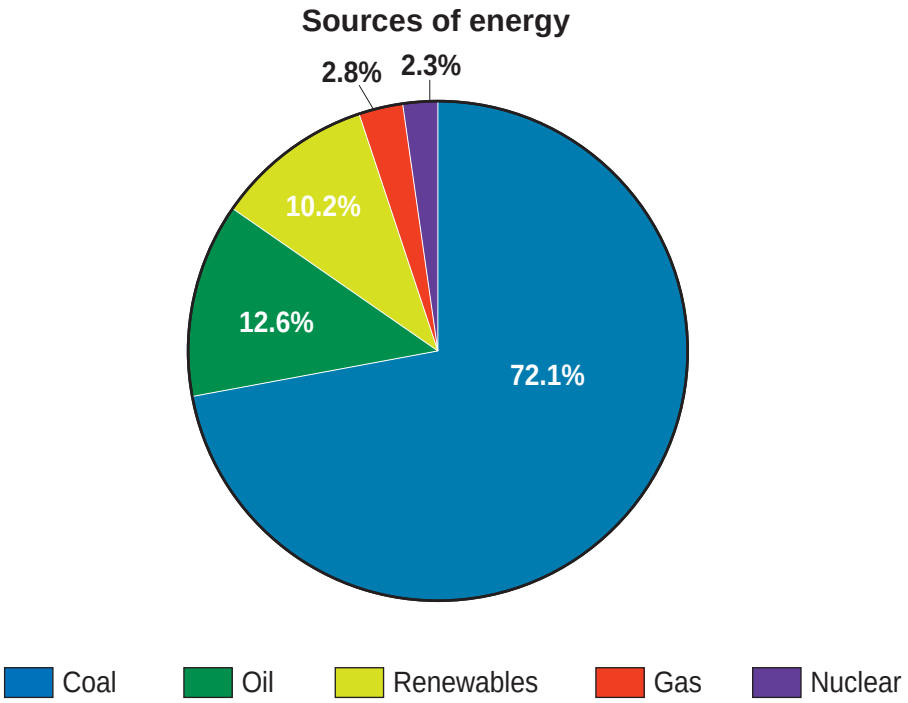


Source: www.esri.com

Turn over.

Figure 8 Sources of energy within South Africa

South Africa's energy sector is critical to the economy as the country relies heavily on its large-scale, energy-intensive mining industry. South Africa has only small deposits of oil and natural gas and uses its large coal deposits for most of its energy needs. As a result, carbon emissions are very high. The country also has a highly developed synthetic fuels industry, producing both gasoline and diesel fuels from coal.



- South Africa's energy sector contributes about 15% of the country's GDP.
- Coal deposits offer cheap electrical power – the cost of the coal is one of the cheapest in the world, but it is a major producer of CO_2. The government is aware, and is making genuine and effective efforts to reduce emissions.
- There are no significant oil or gas reserves, but synthetic oil and gas are made from coal. These burn to produce far less CO_2 than coal, and can be used just like naturally occurring oil and gas. South Africa is a world leader in this form of technology.
- Two companies dominate manufacturing the synthetic fuels and are the biggest of their type in the world. As well as converting coal to liquid and gas forms, they produce petrochemicals from coal for the chemical industry.
- Synthetic fuels are not renewable forms of energy, but South Africa is developing two renewable sources and is more advanced with these than any other countries.
- The two renewable sources are fuel cells and the Jatropha plant.

Source: www.southafrica.info

Figure 9 Fuel cell technology

South Africa is also becoming important for fuel cells, a clean, efficient technology. International companies are investing in cutting-edge fuel cell technology in rural areas. A fuel cell is similar to a battery but uses oxygen and hydrogen as fuel. Fuel cells are more stable and can be run for longer than batteries. They are more efficient than petrol and diesel engines. At present, fuel cells are used only for back-up if power from the national grid is interrupted. This is useful for clinics and hospitals, banks, telecommunications and other users of information technology infrastructure.

Source www.intelligent-energy.com

Figure 10 Renewable energy from Jatropha

Jatropha curcas has the potential to become one of the world's key energy crops. Crude vegetable oil, extracted from the seeds of the Jatropha plant, can be refined into high quality biodiesel. Seeds are crushed to produce crude Jatropha oil that can be used directly in generators and boilers or refined into biodiesel. The remaining material left after oil extraction is excellent organic fertiliser, or it can be burnt for power generation.

Many people believe that Jatropha may be 'the new crude oil'. Jatropha grows in tropical and subtropical regions in a band around the earth between latitudes 30 degrees north and south of the Equator. Jatropha is hardy and relatively drought resistant. Trees have a lifespan of up to 30 years. Jatropha grows on a wide range of land types, including non-arable, marginal and waste land, and need not compete with vital food crops for good agricultural land. South Africa has perfect conditions for growing Jatropha across most of the country, and has been talked of as 'the Saudi Arabia of the 21st century'.

Source: www.d1plc.com

Figure 11 Other biofuel crops in South Africa

The country can grow many of the biofuel crops that are currently being used throughout the world. There are areas ideal for growing maize and others for sugar cane. Both these plants can be used to produce ethanol which can be used much like petrol. The country can also grow soya beans and sunflowers, which can produce biodiesel.

The government has provided funding to start production from these plants during 2010. The joint production from these sources is expected to be around 1 billion litres of biofuels a year and would contribute to earnings of about 1.3% of South Africa's GDP. Local community farmers will be encouraged to supply crops as part of a community empowerment strategy. The scheme will provide up to 55 000 jobs in the agricultural sector, and it is expected to reduce carbon emissions significantly by replacing fossil fuels, especially low grade coal.

Source: www.indaloyethu.co.za

Maize Canola Oil palm Sugar cane

©Shutterstock

Turn over.

Figure 12 Future energy demands in South Africa

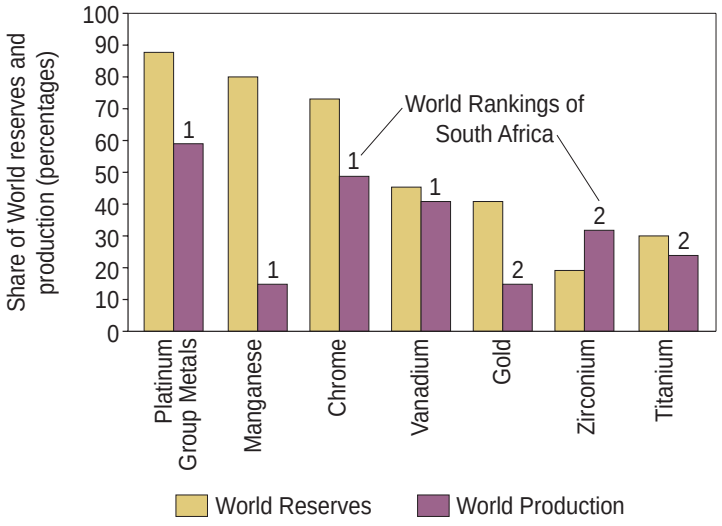
South Africa's economy has been growing since 1999 – the longest period of economic expansion in the country's recorded history. During this upswing, the country's annual economic growth rate has averaged over 4%. In the decade prior to 1994, economic growth averaged less than 1% a year. Global companies are increasingly outsourcing to South Africa.

The growing beneficiation industry – adding value to raw mineral materials – promises to unlock even more of the wealth underground. There are lucrative opportunities for the processing of iron, carbon steel, stainless steel, aluminium, platinum group metals and gold.

More energy is required to power growing industrialisation. Increasing affluence within some sections of South African society is also increasing the demand for more energy for consumer goods.

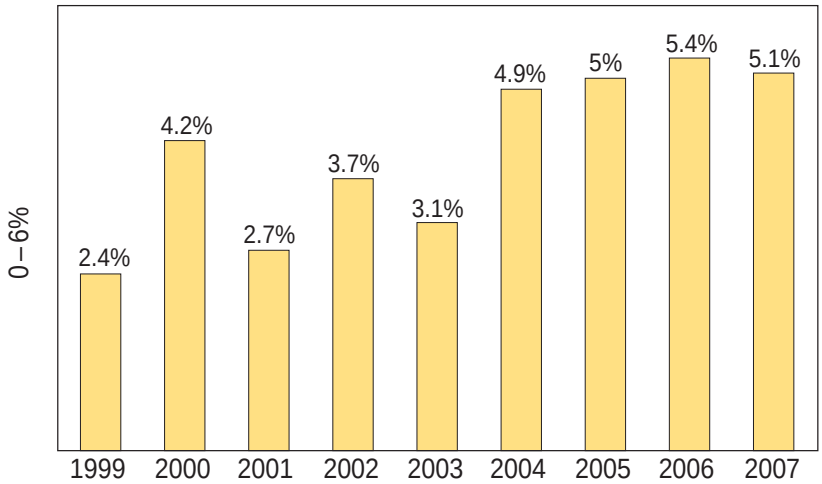
Source: www.eia.doe.gov

Figure 13 South Africa's share of World metal reserves and production



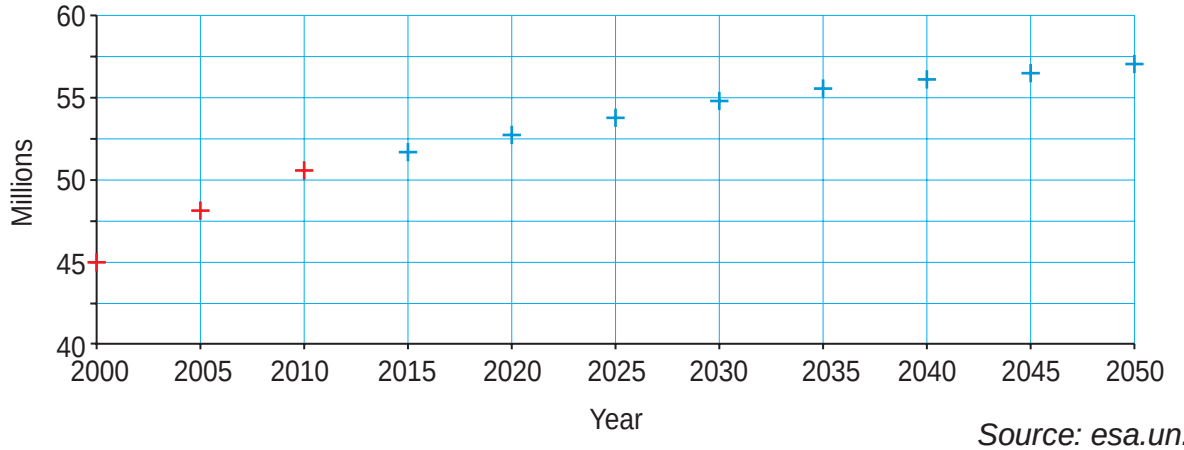
Source: www.southafrica.info

Figure 14 Annual growth of GDP in South Africa



Source: www.southafrica.info

Figure 15 Actual and projected population growth for South Africa



Source: esa.un.org

Figure 16 Biofuels versus food

Biofuel crops can provide secure energy with much reduced emissions of greenhouse gases, and help with rural development. Producing biofuels on a large scale can require huge tracts of land and that land is also needed for growing food crops. Many countries cannot afford to divert land away from food production, particularly where the population is growing, and there is a need for food security based on domestic supply.

The 'food versus fuel' controversy is complex. Food and biomass require the same resources for production – land, water and agrochemicals. Food and fuel need not necessarily compete, particularly when there is careful planning for ecological conservation and sustainable production methods. But the real situation is less clear cut.

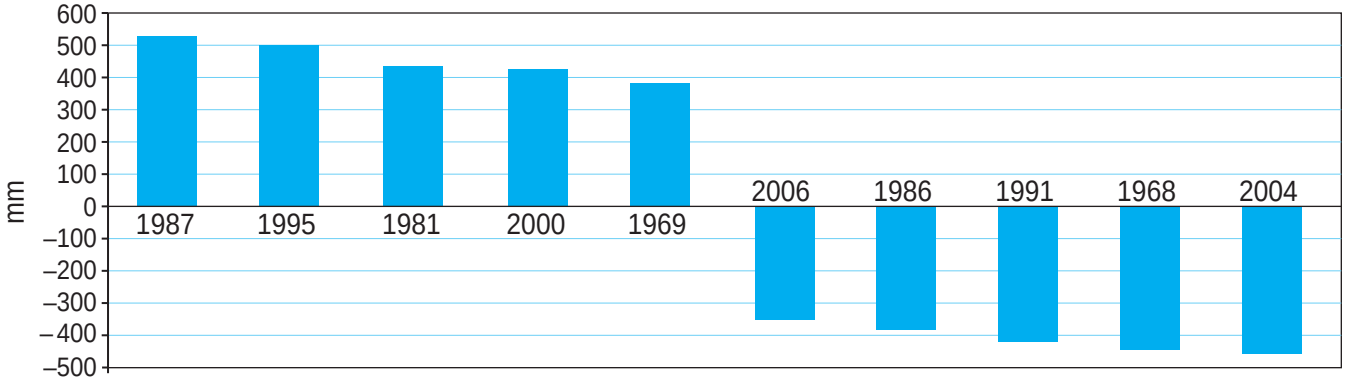
In South Africa, the biofuel debate is growing. Until Jatropha is widely established biofuels would most likely be made from maize. Maize is the staple crop feeding the bulk of southern Africa's people, and its price has already fluctuated when droughts, to which the region is prone, occur.

On average, South Africa yields around four tonnes per hectare from its dry-land maize. In comparison, the USA grows more than double this amount. US farmers obtain only the modest energy-to-output gain of 1:1·3. It is unlikely that South African maize, with its much lower yields, could produce any positive energy gain at all. This means that it would take more energy to grow and harvest the crop than the energy that could be obtained from its use as a fuel.

There is concern amongst southern African countries that if South Africa takes the biofuel route, it will not be able to sell them any excess maize during times of food shortage.

Source: www.scidev.net

Figure 17 Rainfall variability in South Africa



Five greatest deviations in rainfall above and below mean of 852 mm 1960–2010

Source: www.environment.gov.za

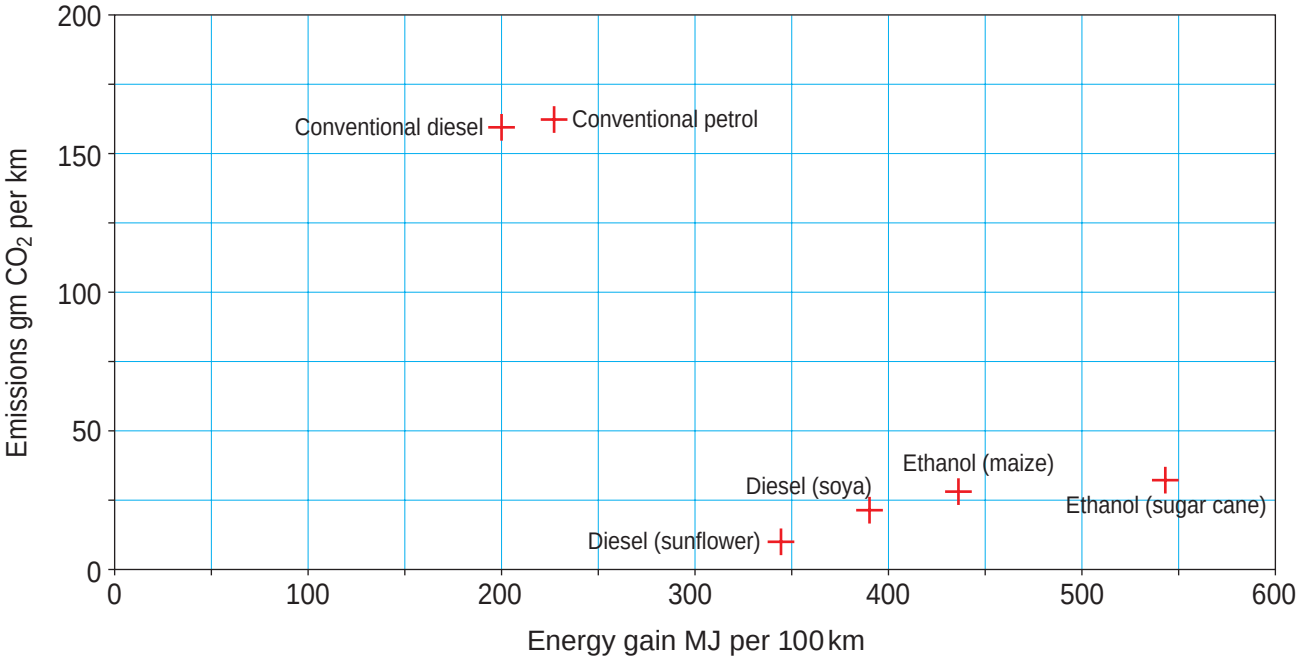
Turn over.

BENEFITS OF BIOFUELS

Figure 18 Biofuels compared to conventional fuels

There are two main advantages of biofuels. Firstly, they provide far more energy than they take to produce. This energy gain is usually measured in MJ (million joules) provided for an average car journey of 100 km. The second advantage is that biofuels produce much lower greenhouse gas emissions. They do emit CO_2 when burnt, but also absorb CO_2 from the atmosphere whilst growing. Machinery used in growing the crop and transporting it to where it will be used, also cause CO_2 emissions. The CO_2 emissions are usually slightly greater than the amounts absorbed. They are measured in CO_2 gms emitted by an average car travelling one kilometre. The comparison can be seen below.

Energy gain and CO_2 emissions for various fuels



Source: www.europabio.org

Figure 19 Biofuels around the world

World Region	Total primary energy demand	Total supplied by renewables	Total supplied by biomass	Biomass share of primary energy
Africa	21.5	10.8	10.5	49%
Latin America	18.8	5.3	3.3	18%
Asia excluding China	48.2	16.1	15.0	31%
China	48.4	10.0	9.0	19%
Middle East	16.3	0.1	0.0	0%
CIS* + Central Europe	43.7	1.7	0.6	1%
OECD*	223.3	12.7	6.8	3%
World	**420.3**	**56.7**	**45.2**	**11%**

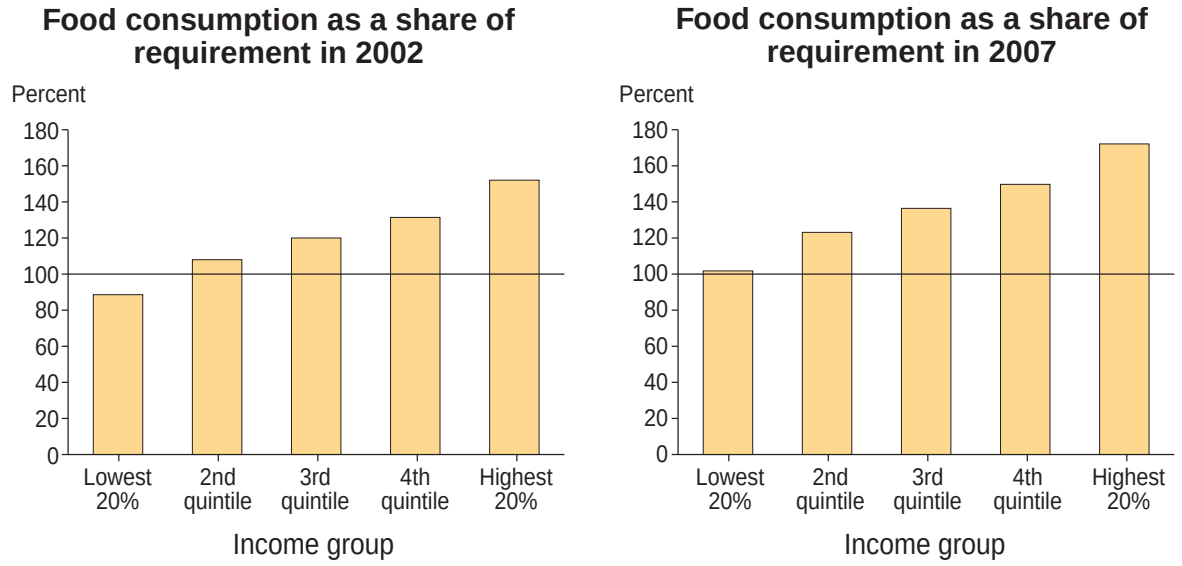
Source: oeko.de

Data in exajoules per year
1 Exajoule (EJ) = 10^{18} Joules
*CIS – Commonwealth of Independent States
*OECD – Organisation for Economic Cooperation and Development

FOOD AND FUEL IN OTHER COUNTRIES

Figure 20 Brazil food security

In 2002, President Lula launched the Zero Hunger Programme with the aim of ensuring all the population of Brazil had at least the minimum food requirement met.



Source: ers.usda.gov

Figure 21 The biofuels versus food debate in Brazil

In favour of biofuels.
Food shortages and price increases that Brazil suffered before 2002 were blamed on growing crops to produce ethanol, but this may not be so. Brazil, as one of the world's largest exporters of agricultural commodities and leaders in agricultural production, has kept ahead of population growth: in 1976 the production of cereals was 416 kg per capita, and in 1987 was 418 kg per capita. Of the 55 million hectares (ha) of land area devoted to primary food crops, only 4.1 million ha (7.5 per cent) was used for sugar cane, which represents only 0.3 per cent of Brazil's total land area. Of this, only 1.7 million ha was used for ethanol production, so competition between food and crops is not significant. Furthermore, crop rotation in sugar cane areas has led to an increase in certain food crops.

Food shortages and price increases in Brazil have resulted from a combination of policies which were biased towards commodity export crops and large acreage increases of such crops, hyper-inflation, currency devaluation and price control of domestic foodstuffs.

Against biofuels.
Ethanol was seen as an easy way to reduce greenhouse gas emissions, but the World Bank has estimated that maize prices rose by more than 60% between 2005 and 2007, and have continued to rise into 2010. The price rises have been greatest in the poorest countries of the world where food shortages already exist. Staple foods such as maize are the very crops being used for biofuel.

Numerous studies have demonstrated that the energy return on energy invested from most forms of maize and sugar-based ethanol is at best marginal, and at worst, a net loss. Bio-ethanol must be grown, collected, dried, fermented, and then burned. These steps require resources, infrastructure and transportation that often produce as much pollution and require as much energy as ethanol saves.

The degrading of farm land it produces, and the impact on small farmers and communities in Brazil, could be a problem.

Sources: www.journeytoforever.org and www.global-greenhouse-warming.com

Turn over.

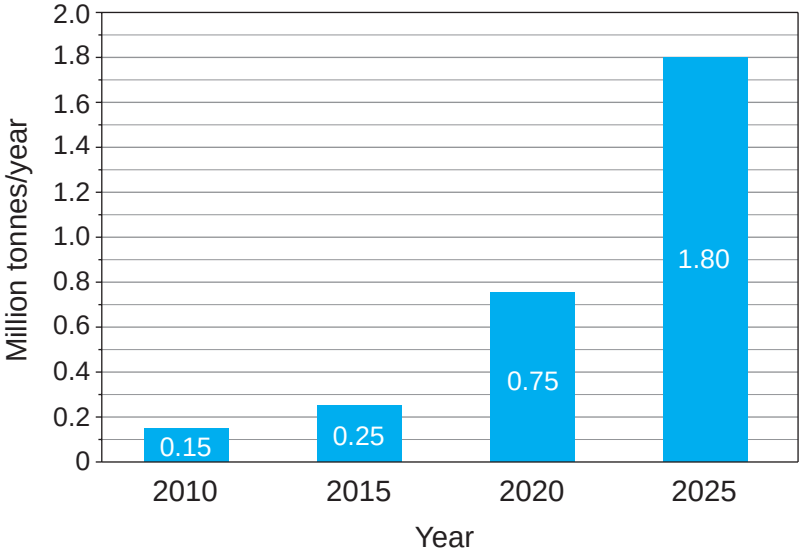
Figure 22 Food security in Vietnam

Vietnam experienced one of the fastest increases in food prices in early 2008. The retail price of rice increased by 65 percent. As a result, Vietnam has been classified as one of the hunger hot spots in Asia based on the Global Hunger Index classification, which is a composite measure of population undernourishment (13%), child malnutrition (20%), and child mortality (under 5 mortality rate 15/1000). The coastal regions in Vietnam are susceptible to typhoons and have been classified as vulnerable to food insecurity.

Food security is a concern because even though Vietnam is the second largest exporter of rice in the world, many rural households are net buyers of food. For example, approximately 53 percent of the population in the Mekong Delta and 55 percent in the Red River Delta are net purchasers of food. In response to the high prices, the government cut rice exports by approximately one million tonnes. The government also plans on setting up 100 000 tonnes of storage to keep the rice prices stable. This is in addition to 31 600 tonnes of food aid.

Source: www.foodsecurityportal.org

Figure 23 Projected biofuels in Vietnam



Marginal lands and forests have been cleared for biofuels production, making it even more difficult for forests and agricultural lands to act as sinks to absorb CO_2. In South-East Asia as a whole, 87% of all deforestation between 1985 and 2000 can be attributed to palm oil plantations, many of which are for the production of biofuels.

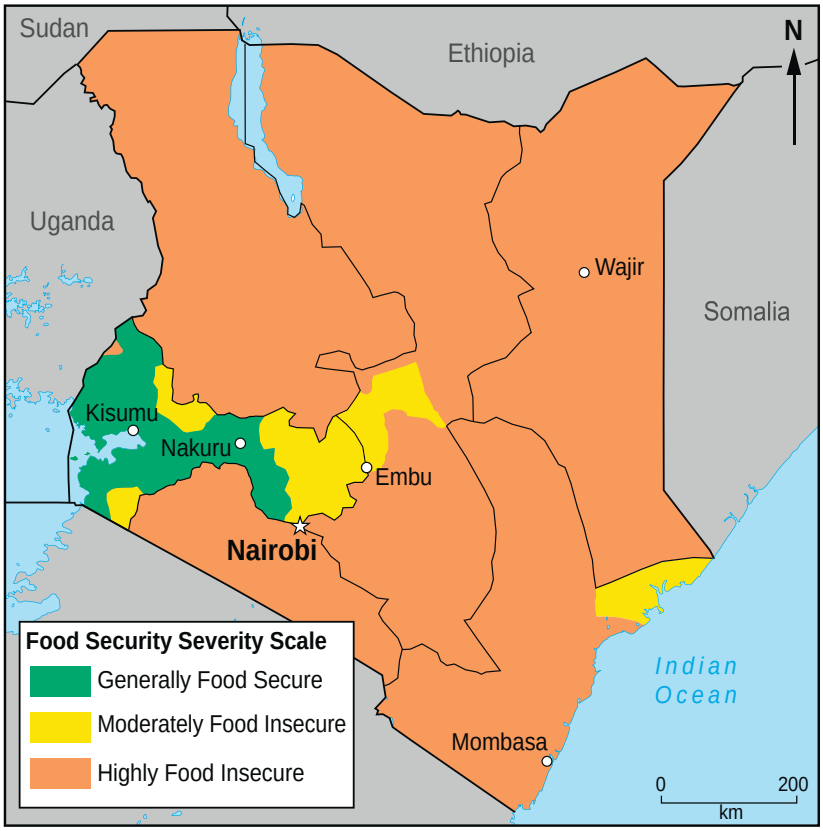
Vietnam plans to go ahead with producing biofuels to meet its increasing energy needs. Manufacturing industry is growing rapidly and the affluence of the population is increasing, both requiring more energy.

There may be some conflict between biofuels and food supply. Switching to biofuels is regarded as an important factor in fighting the greatest threat to Vietnam. If predictions about global warming are correct, then sea levels will rise and threaten the Mekong and Red River deltas. Switching to biofuels is seen as one way that Vietnam can do something practical to combat the threat of rising sea levels. These two deltas produce the majority of home-grown food in Vietnam, and if they were to be lost in the future, the country would face food shortages many times more severe than the minor shortages at present.

Rice straw and rice husks, currently just waste from rice production, could become vital contributors to biofuel production.

Source: www.pecj.or.jp

Figure 24 Food security in Kenya in 2010



- A long dry spell during most of 2009 has threatened food security in many parts of the country.
- Some rain has fallen in the early part of 2010, but 3.8 million people remain food insecure.
- Limited harvests have occurred, and many livestock have died.
- The food distribution chain has broken down.
- In some localised areas, floods have affected food security.

Source: www.kenyafoodsecurity.org

Figure 25 Biofuels in Kenya

In January 2010, people on part of Kenya's Indian Ocean coast were woken up by smoke and the sound of bulldozers that were beginning to clear nearby forest.

50 000 hectares of the land upon which they are dependent for their livelihoods had been handed over to an Italian company. It aims to produce the biofuel crop Jatropha, the so-called 'miracle-plant' supposed to provide high yields of oil to be converted into fuel.

According to the draft approved by the Kenyan national authorities (and not the local population), 30% of the oil produced in Kenya will be exported to Italy, and 70% will be used for national energy consumption (Jatropha is not edible). However, the company has recently declared to the Italian press that it would export to Italy as much as 80% of the oil produced, while only 20% of it will be used to satisfy the domestic demand in Kenya.

It has been predicted that 20 000 people are in danger of being displaced and that the ecological balance of the region will be severely threatened.

Source: www.hungerfreeplanet.org

Efforts to turn Kenya into Africa's principal producer of biofuels have made significant steps with the completion of a policy for cost-effective and safe production of biofuels. Aimed at reducing the country's dependence on fossil fuels, the proposed policy hopes to establish the principles that will enable Kenya to gain from rising demand for clean energy without social and economic shockwaves.

Many NGOs have introduced oil plants like Jatropha to farmers, saying it could be a major export product with the possibility of bringing wealth to Kenya quickly. Kenya is hoping for middle income economy status by 2030.

At the moment, Kenya is paying too heavy a price for electricity and cooking gas, forcing more than 80% of rural households to rely on wood fuel for their energy needs. Biofuels could significantly reduce the number of people suffering ill health caused by indoor pollution that is mainly caused by use of wood fuels.

Biofuels have the potential of boosting economic growth in the countryside through job creation and skills development.

Source: www.businessdailyafrica.com

Turn over.

Sources of information

Figure 1	globalist.org.ua/eng/14467-world-food-consumption-in-calories-per-day-the-map
Figure 2	maps.grida.no/go/graphic/energy_consumption_per_capita_2004
Figure 3	earthtrends.wri.org, cia.gov and happyplanetindex.com
Figure 4	www.southafrica.info/business/economy/sectors/agricultural-sector.htm
Figure 5	earthtrends.wri.org/pdf_library/country_profiles/agr_cou_710.pdf
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Figure 9	www.intelligent-energy.com/products_and_services/fuel_cells/power_systems
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Figure 14	www.southafrica.info/business/economy/econoverview.htm
Figure 15	esa.un.org/unup/p2k0data.asp
Figure 16	www.scidev.net/en/climate-change-and-energy/biofuels/
Figure 17	www.environment.gov.za/soer/nsoer/issues/climate/index.htm
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Figure 23	www.pecj.or.jp/english/plaza/7th_asiasympo/2-9_Huynh-Hung-My.pdf
Figure 24	www.kenyafoodsecurity.org/index.php? option=com_content&view=article&id=19&Itemid=34
Figure 25	www.actionaid.org/kenya/(hungerfreeplanet.org) and biofuels.carboncapturereport.org/cgi-bin//profiler? key=businessdailyafrica_com&pt=4

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RESOURCE FOLDER

INSTRUCTIONS TO CANDIDATES

A new copy of this Folder will be given out in the examination. This copy must not be taken into the examination.

Work through this Folder to make sure you understand all the resources. You may seek help from your teachers or any other sources in this context. You have to apply your critical understanding to an unfamiliar situation.

ADVICE TO CANDIDATES

The information in this Resource Folder is related to the sustainability of food and energy supplies. In particular, food security and the potential for producing biofuels are examined. Possible conflicts between food supplies and energy needs are highlighted. The principal focus is on South Africa but information from other countries is introduced to give a variety of perspectives.

Guidelines for using the pre-release materials

The contents of the booklet should be studied carefully. The examples given will help in answering some of the questions on the question paper. To give a fuller answer, it is advisable to look at other material before the examination. This could be similar topics, related to information in other countries, or may be the same countries but in greater depth, or on closely related topics. It would be particularly useful to note if other case studies seem similar in nature, or if they show contrasting perspectives to those from the material in this Resource Folder.

Some of the resource materials come from Geography textbooks, but others come from companies, pressure groups, research organisations, governments and private individuals. In some cases they are using information to promote their own interests rather than to represent an impartial view. It is worth considering if they are trying to support a particular interest group and persuade readers to agree with them. In finding other materials, it is worth bearing in mind that they might not be presented in an impartial and objective way.

Material in the Resource Folder may often be related to other themes found in G4, and to other units in Geography AS and A2. These links should be noted, as there will be opportunities to refer to such connections with other work in some of your answers. Being able to link together different parts of your Geography studies is important and will be rewarded in answers. Such linkages are sometimes referred to as ‘synopticity’.

Textbooks, journals, good quality newspapers and television and radio programmes are good sources of information. Probably the most accessible source of geographical information is the Internet, but it is also the one which may be most susceptible to bias and lack of impartiality. Many of the resources are extracted or adapted from sources on the Internet. These sources have the web addresses provided. Many are only extracts or shortened versions of fuller documents. It is well worth following these links for greater depth of reading and for more recent updates of material.

Each candidate will be provided with a copy of the Resource Folder, for use in the examination, at the same time as the question paper is issued at the beginning of the examination on the day set for the paper.

Copies of the Resource Folder with added notes, or notes from research carried out in the previous six weeks, may not be taken into the examination.

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WORLD FOOD AND ENERGY

Figure 1 World calorie intake

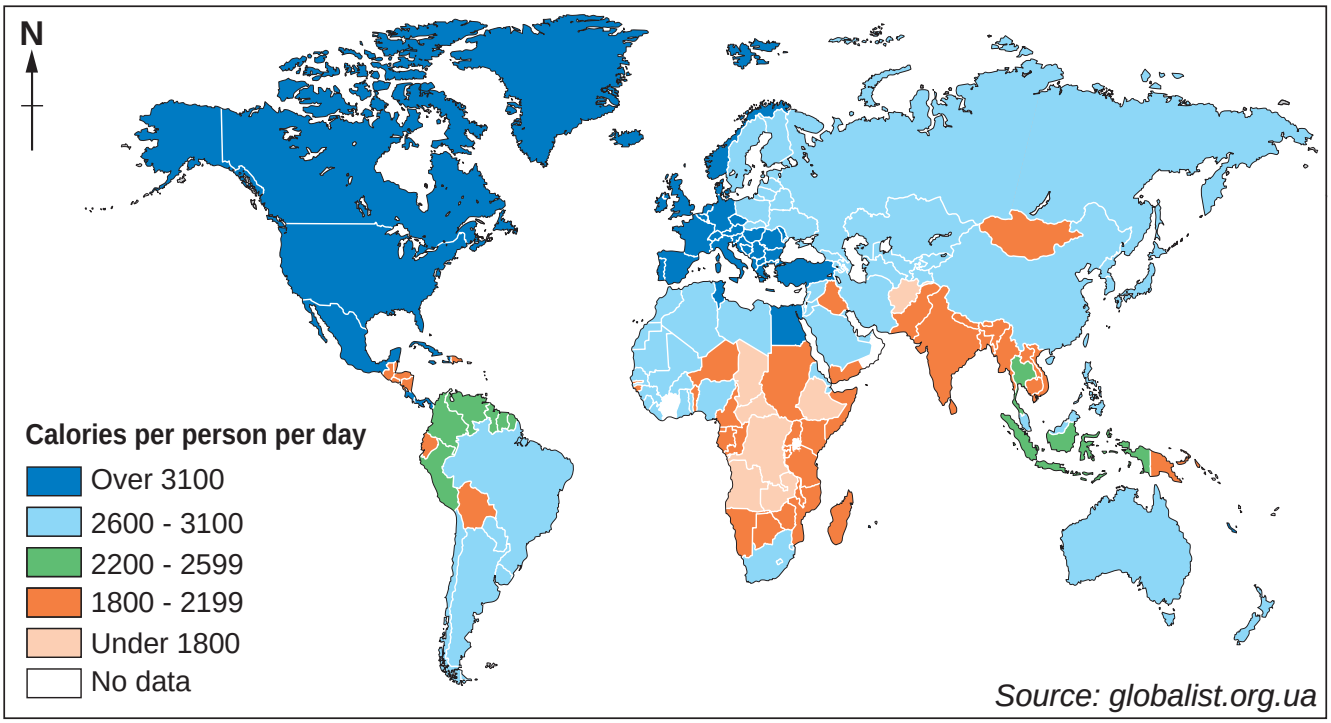

Figure 2 World energy consumption

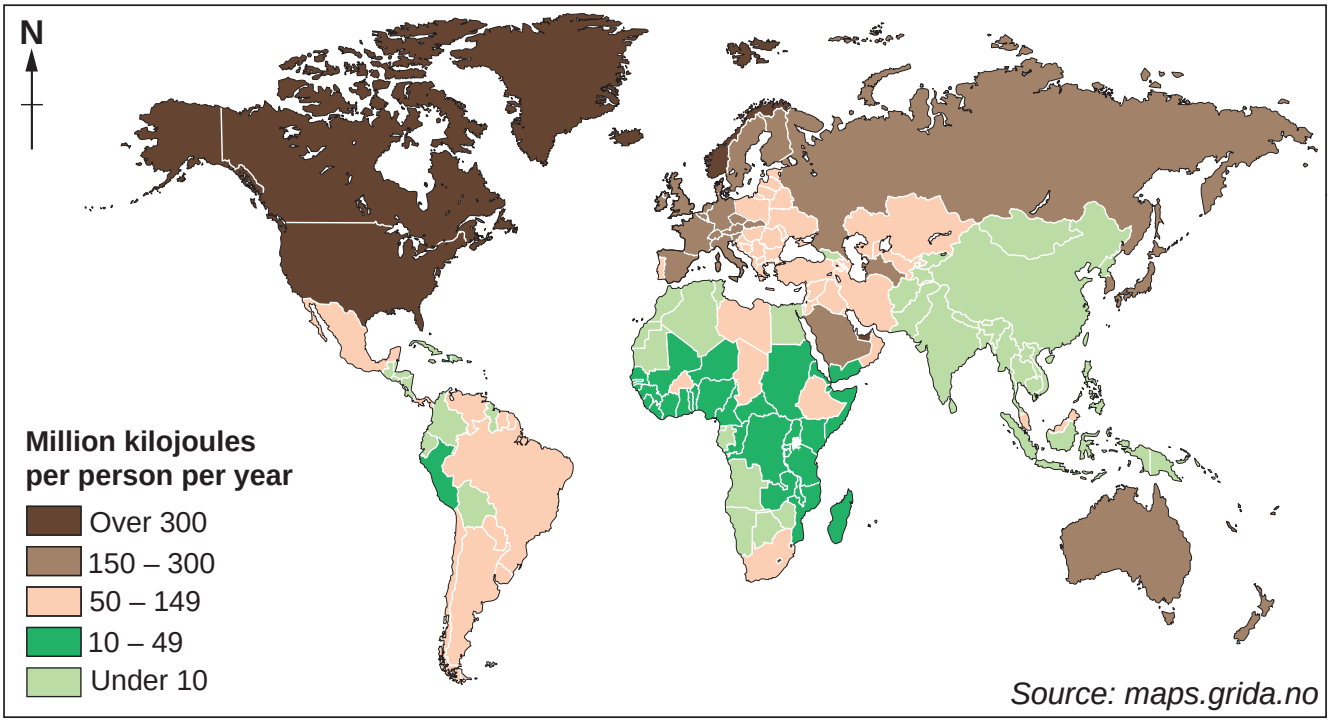

Figure 3 Indicators for food, energy and development for selected countries

	Brazil	Germany	Kenya	South Africa	Vietnam
Food intake calories/person/day	3 012	3 411	1 886	2 805	2 616
Calories/person/day from animal products	642	1 067	231	351	272
Per capita food production (tonnes)	293	569	94	257	219
Percentage of population undernourished	4	< 1	32	4	13
Percentage of food imported	18	9	21	6	5
Total energy consumption (Quadrillion Btu)*	10.1	14.2	0.2	5.4	1.3
Energy consumption per person (kgoe)*	1068	4203	481	2597	539
Percentage of population without electricity	4.3	< 1	32.8	12.0	9.5
Oil imports (billion barrels/day)	632 900	2 777 000	80 500	490 500	134 300
Percentage of commercial energy from renewable sources	85	15	10	< 1	3
GDP/capita (US$)	9 567	34 401	1 542	9 757	2 600
Gini index of wealth distribution (as percentages)	55.0	28.3	47.7	57.8	37.8
Literacy rate (percentage)	90.0	99.9	73.6	88.0	90.3
Life expectancy (years)	72.2	79.8	53.6	51.5	74.3
Happy planet index	61.0	48.1	27.8	29.7	66.5

Sources: earthtrends.wri.org, cia.gov and happyplanetindex.com

Information is the most up-to-date available in 2010

*Quadrillion = a thousand million million
Btu = British thermal unit
*kgoe = kilograms oil equivalent

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SOUTH AFRICA FOOD AND ENERGY

Figure 4 Food supply for South Africa

South Africa has a dual agricultural economy, with both well-developed commercial farming and more subsistence-based production in the remote rural areas.

Agricultural activities range from intensive crop production and mixed farming to cattle ranching and sheep farming. Maize is most widely grown, followed by wheat, oats, sugar cane and sunflowers.

While 13% of South Africa's land can be used for crop production, only 22% of this is high-potential arable land. The most important limiting factor is the availability of water. Rainfall is distributed unevenly across the country, with some areas prone to drought. Almost 50% of South Africa's water is used for agriculture, with about 1.3 million hectares under irrigation.

Today, South Africa is not only self-sufficient in virtually all major agricultural products, but is also a net food exporter. Imports are mainly of foods that cannot be produced under South African climatic conditions.

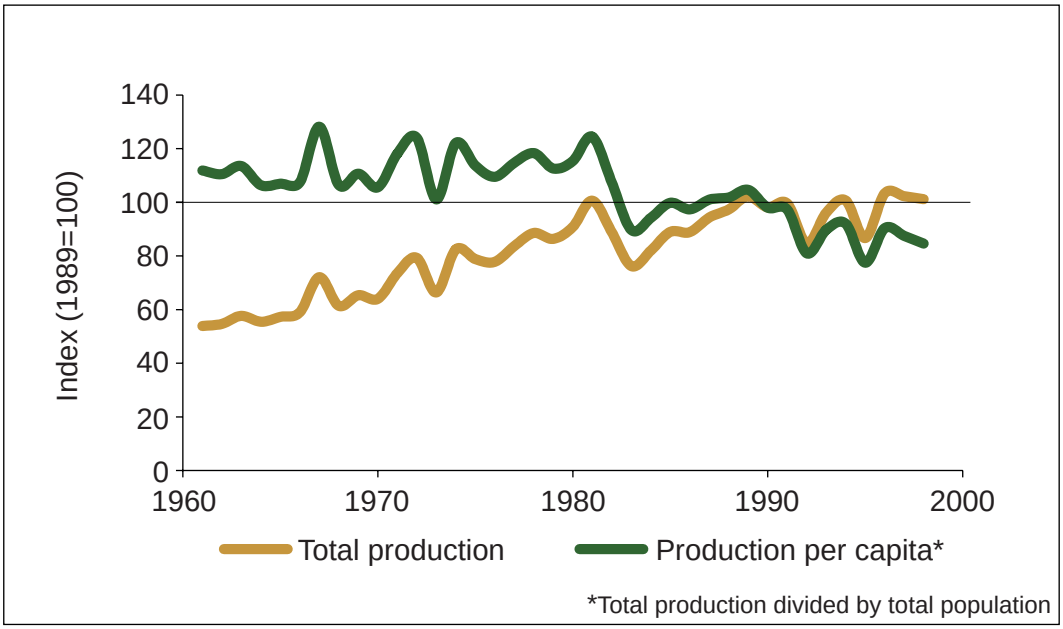
Farming contributes some 8% to the country's total exports. The largest export groups are wine, citrus, sugar, grapes, maize, fruit juice, wool, and fruit such as apples, pears, peaches and apricots.

Cattle farming for beef production

Ostrich farming – new, low fat meat source

Source: www.southafrica.info

Figure 5 Food production in South Africa, 1960 – 2000



Source: earthtrends.wri.org

Figure 6 Potential to increase food production in South Africa

The biggest problem for South African agriculture is that many farmers in remote rural areas need information, other related inputs and technology, which are critical for unlocking the potential of natural resources. People in rural areas need to understand what services the government offers about technical information on crops and products that can be grown in an area, crop diseases, crop-quality related information and advice on marketing. Farmer Support Centres are being opened to bring Internet access into rural areas.

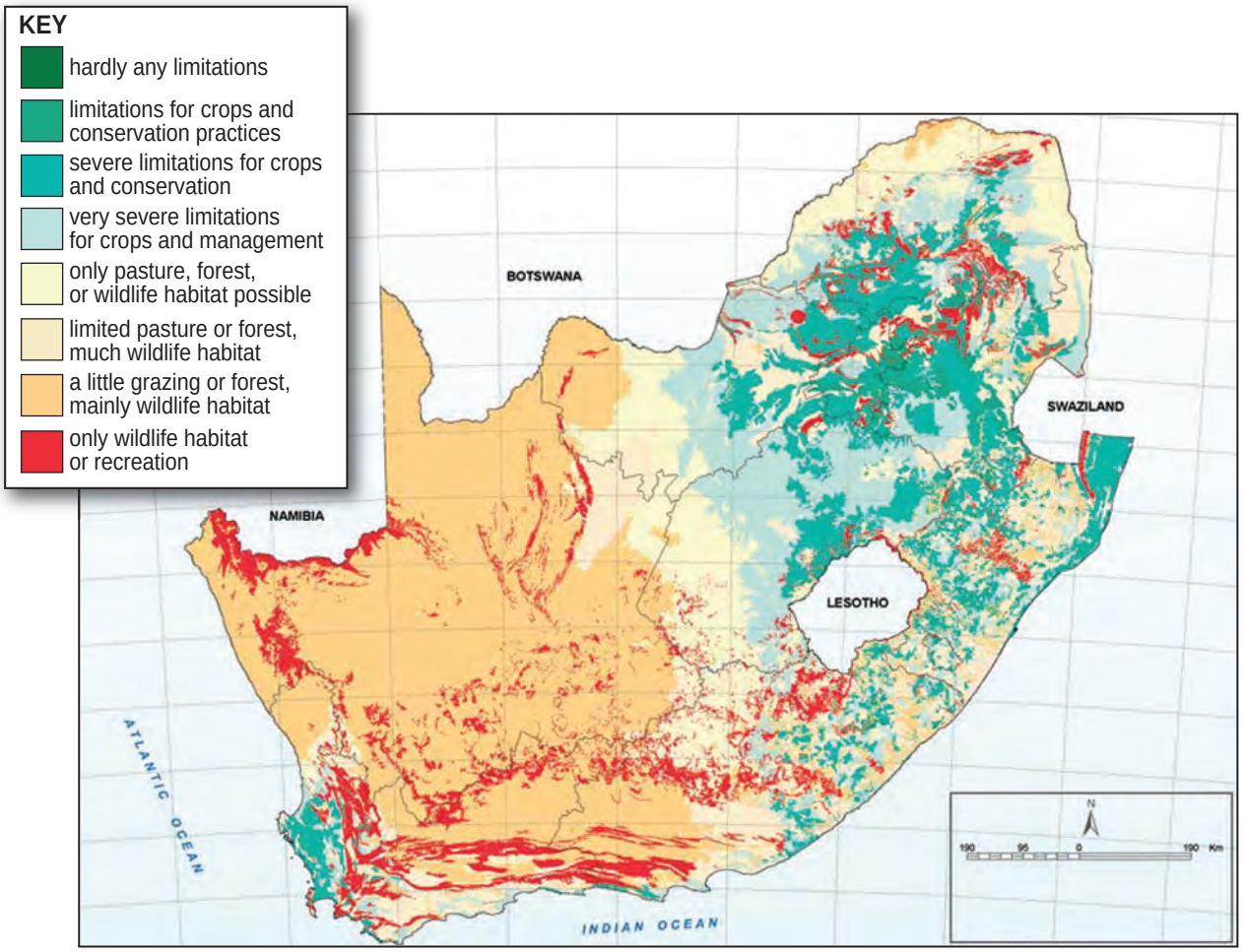
Biotechnology has a lot to offer South Africa but the current issue is whether to depend on increases of fertilizers and herbicides to increase yields, or whether to be innovative and make the quantum leap into biotechnology. The benefits of biotechnology from agricultural research are known to scientists, but the problem is that scientists are not very good at communicating this information to rural farmers. The government needs to bring in legislation on genetically modified organisms (GMOs) and develop a communications strategy for biotechnology.

The danger of a media-driven dialogue on genetically modified foods is that it does not deal fairly with the science behind progress. For example, sweet potato that has resistance to the mosaic virus, because of work done in Kenya, is portrayed as a food that has been meddled with. But all that has been done is to introduce resistance through a genetic modification. In the past, to overcome the virus, the crop would have needed spraying with chemicals. There is a need to avoid having a naïve discussion as if GMOs were some kind of monster suddenly appearing out of the gloom.

South African agriculture also needs to have an appropriate technology-transfer partnership with developed countries, to facilitate economic growth by raising yields and incomes and at the same time, satisfy food security at the household level.

Source: www.new-ag.info

Figure 7 Land potential in South Africa

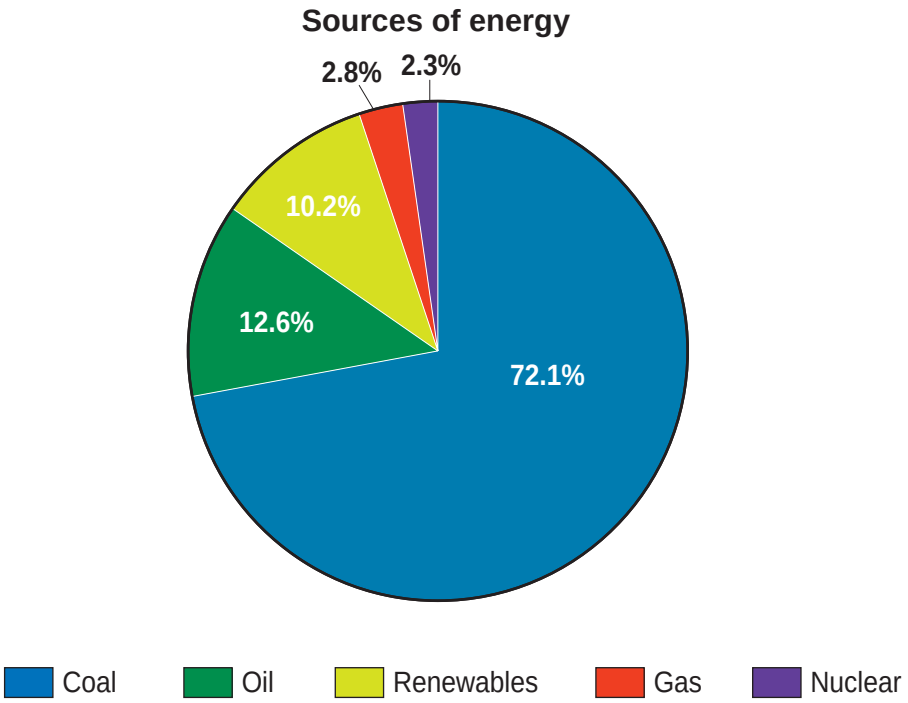


Source: www.esri.com

Turn over.

Figure 8 Sources of energy within South Africa

South Africa's energy sector is critical to the economy as the country relies heavily on its large-scale, energy-intensive mining industry. South Africa has only small deposits of oil and natural gas and uses its large coal deposits for most of its energy needs. As a result, carbon emissions are very high. The country also has a highly developed synthetic fuels industry, producing both gasoline and diesel fuels from coal.



- South Africa's energy sector contributes about 15% of the country's GDP.
- Coal deposits offer cheap electrical power – the cost of the coal is one of the cheapest in the world, but it is a major producer of CO_2. The government is aware, and is making genuine and effective efforts to reduce emissions.
- There are no significant oil or gas reserves, but synthetic oil and gas are made from coal. These burn to produce far less CO_2 than coal, and can be used just like naturally occurring oil and gas. South Africa is a world leader in this form of technology.
- Two companies dominate manufacturing the synthetic fuels and are the biggest of their type in the world. As well as converting coal to liquid and gas forms, they produce petrochemicals from coal for the chemical industry.
- Synthetic fuels are not renewable forms of energy, but South Africa is developing two renewable sources and is more advanced with these than any other countries.
- The two renewable sources are fuel cells and the Jatropha plant.

Source: www.southafrica.info

Figure 9 Fuel cell technology

South Africa is also becoming important for fuel cells, a clean, efficient technology. International companies are investing in cutting-edge fuel cell technology in rural areas. A fuel cell is similar to a battery but uses oxygen and hydrogen as fuel. Fuel cells are more stable and can be run for longer than batteries. They are more efficient than petrol and diesel engines. At present, fuel cells are used only for back-up if power from the national grid is interrupted. This is useful for clinics and hospitals, banks, telecommunications and other users of information technology infrastructure.

Source www.intelligent-energy.com

Figure 10 Renewable energy from Jatropha

Jatropha curcas has the potential to become one of the world's key energy crops. Crude vegetable oil, extracted from the seeds of the Jatropha plant, can be refined into high quality biodiesel. Seeds are crushed to produce crude Jatropha oil that can be used directly in generators and boilers or refined into biodiesel. The remaining material left after oil extraction is excellent organic fertiliser, or it can be burnt for power generation.

Many people believe that Jatropha may be 'the new crude oil'. Jatropha grows in tropical and subtropical regions in a band around the earth between latitudes 30 degrees north and south of the Equator. Jatropha is hardy and relatively drought resistant. Trees have a lifespan of up to 30 years. Jatropha grows on a wide range of land types, including non-arable, marginal and waste land, and need not compete with vital food crops for good agricultural land. South Africa has perfect conditions for growing Jatropha across most of the country, and has been talked of as 'the Saudi Arabia of the 21st century'.

Source: www.d1plc.com

Figure 11 Other biofuel crops in South Africa

The country can grow many of the biofuel crops that are currently being used throughout the world. There are areas ideal for growing maize and others for sugar cane. Both these plants can be used to produce ethanol which can be used much like petrol. The country can also grow soya beans and sunflowers, which can produce biodiesel.

The government has provided funding to start production from these plants during 2010. The joint production from these sources is expected to be around 1 billion litres of biofuels a year and would contribute to earnings of about 1.3% of South Africa's GDP. Local community farmers will be encouraged to supply crops as part of a community empowerment strategy. The scheme will provide up to 55 000 jobs in the agricultural sector, and it is expected to reduce carbon emissions significantly by replacing fossil fuels, especially low grade coal.

Source: www.indaloyethu.co.za

Maize Canola Oil palm Sugar cane

©Shutterstock

Turn over.

Figure 12 Future energy demands in South Africa

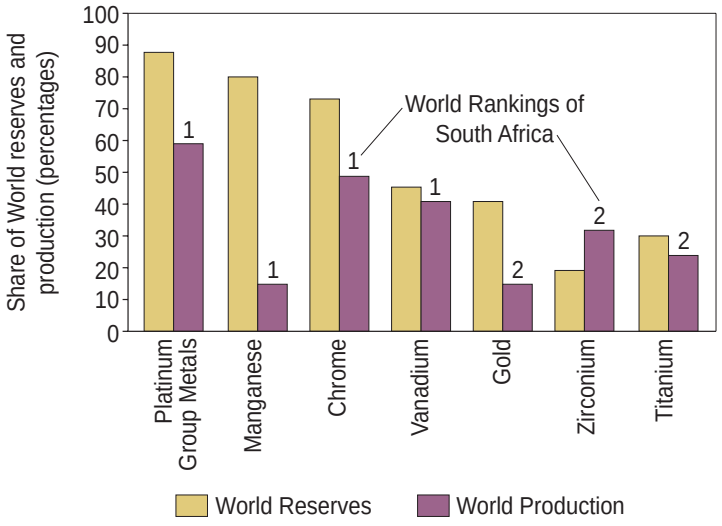
South Africa's economy has been growing since 1999 – the longest period of economic expansion in the country's recorded history. During this upswing, the country's annual economic growth rate has averaged over 4%. In the decade prior to 1994, economic growth averaged less than 1% a year. Global companies are increasingly outsourcing to South Africa.

The growing beneficiation industry – adding value to raw mineral materials – promises to unlock even more of the wealth underground. There are lucrative opportunities for the processing of iron, carbon steel, stainless steel, aluminium, platinum group metals and gold.

More energy is required to power growing industrialisation. Increasing affluence within some sections of South African society is also increasing the demand for more energy for consumer goods.

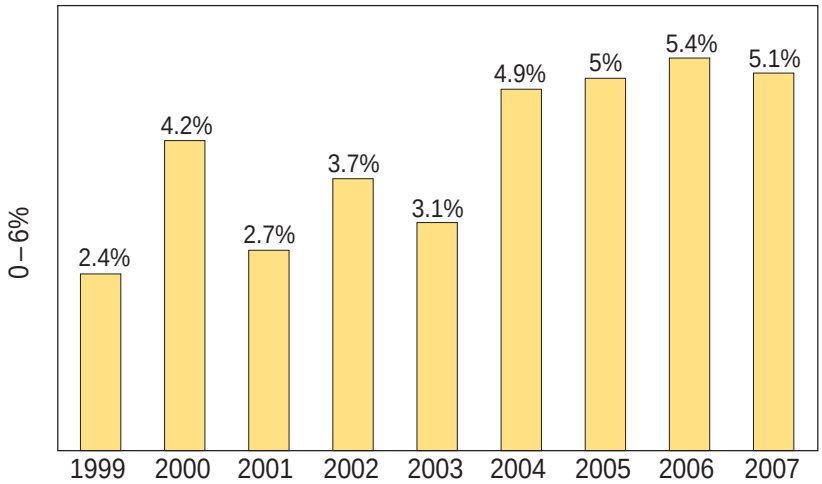
Source: www.eia.doe.gov

Figure 13 South Africa's share of World metal reserves and production



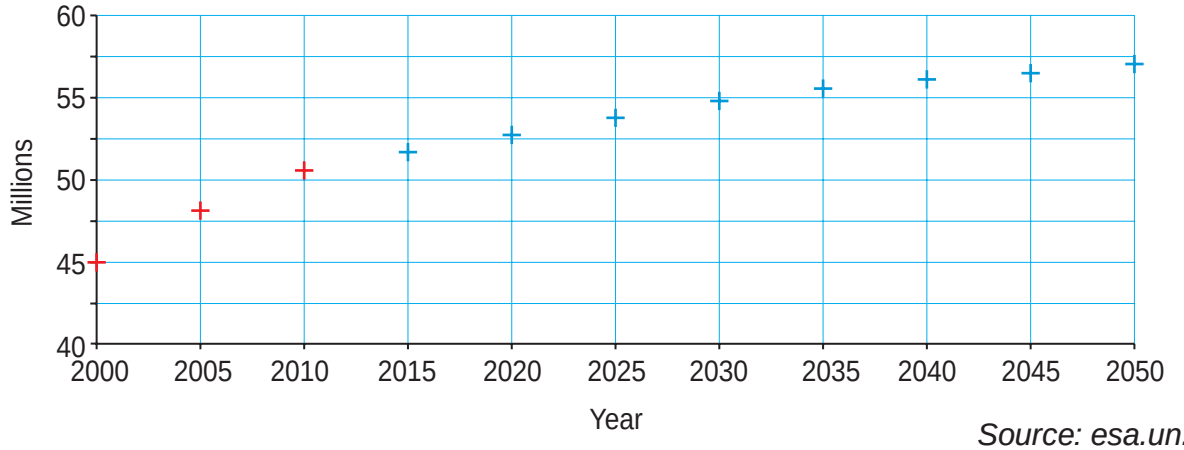
Source: www.southafrica.info

Figure 14 Annual growth of GDP in South Africa



Source: www.southafrica.info

Figure 15 Actual and projected population growth for South Africa



Source: esa.un.org

Figure 16 Biofuels versus food

Biofuel crops can provide secure energy with much reduced emissions of greenhouse gases, and help with rural development. Producing biofuels on a large scale can require huge tracts of land and that land is also needed for growing food crops. Many countries cannot afford to divert land away from food production, particularly where the population is growing, and there is a need for food security based on domestic supply.

The 'food versus fuel' controversy is complex. Food and biomass require the same resources for production – land, water and agrochemicals. Food and fuel need not necessarily compete, particularly when there is careful planning for ecological conservation and sustainable production methods. But the real situation is less clear cut.

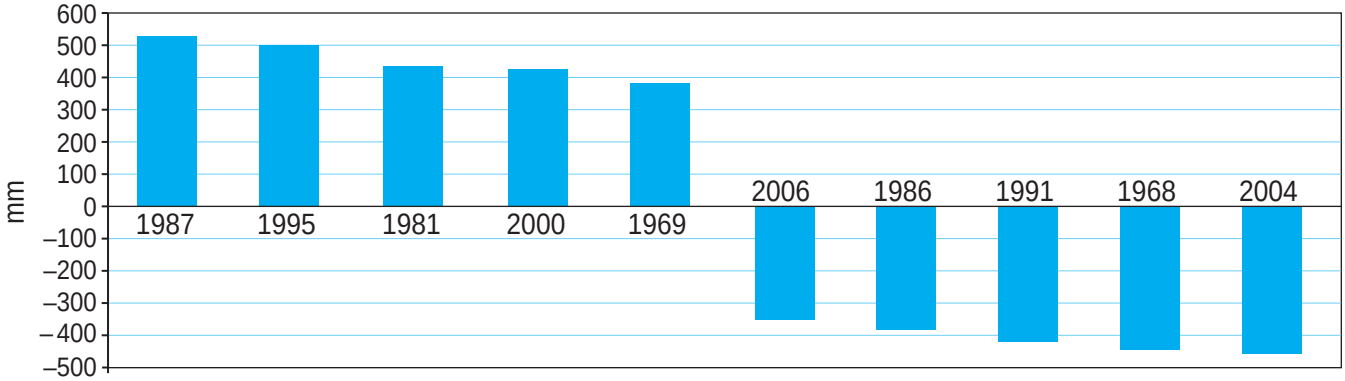
In South Africa, the biofuel debate is growing. Until Jatropha is widely established biofuels would most likely be made from maize. Maize is the staple crop feeding the bulk of southern Africa's people, and its price has already fluctuated when droughts, to which the region is prone, occur.

On average, South Africa yields around four tonnes per hectare from its dry-land maize. In comparison, the USA grows more than double this amount. US farmers obtain only the modest energy-to-output gain of 1:1·3. It is unlikely that South African maize, with its much lower yields, could produce any positive energy gain at all. This means that it would take more energy to grow and harvest the crop than the energy that could be obtained from its use as a fuel.

There is concern amongst southern African countries that if South Africa takes the biofuel route, it will not be able to sell them any excess maize during times of food shortage.

Source: www.scidev.net

Figure 17 Rainfall variability in South Africa



Five greatest deviations in rainfall above and below mean of 852 mm 1960–2010

Source: www.environment.gov.za

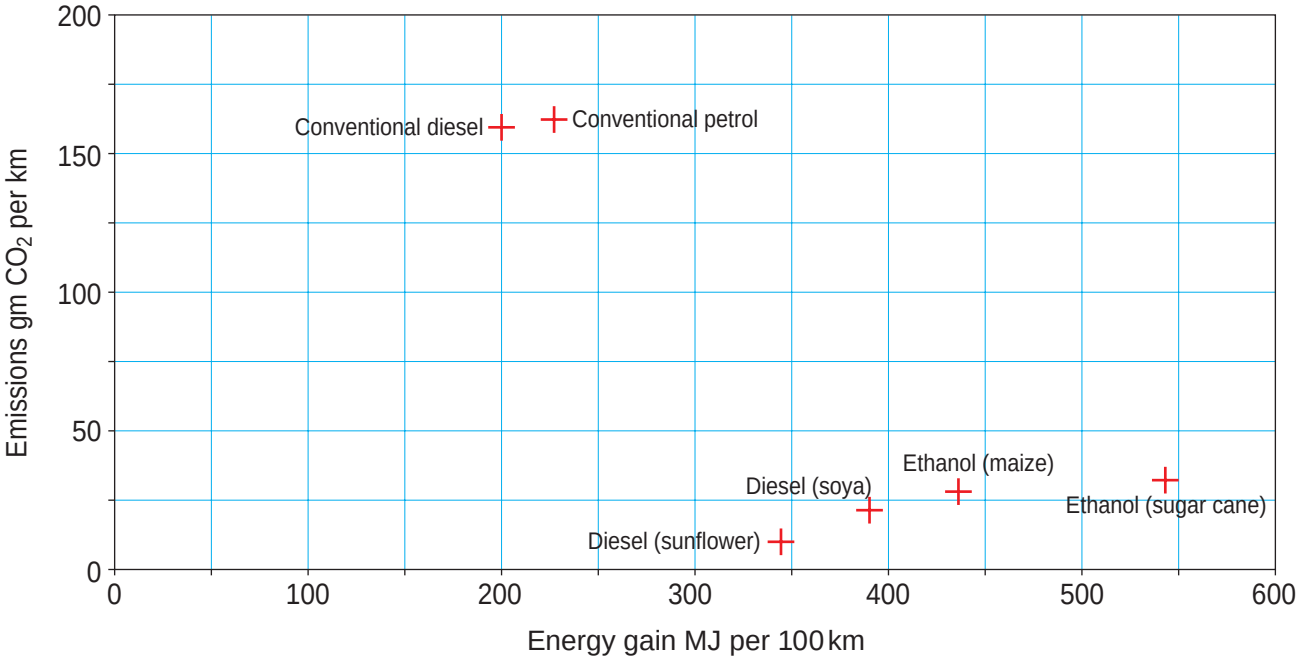
Turn over.

BENEFITS OF BIOFUELS

Figure 18 Biofuels compared to conventional fuels

There are two main advantages of biofuels. Firstly, they provide far more energy than they take to produce. This energy gain is usually measured in MJ (million joules) provided for an average car journey of 100 km. The second advantage is that biofuels produce much lower greenhouse gas emissions. They do emit CO_2 when burnt, but also absorb CO_2 from the atmosphere whilst growing. Machinery used in growing the crop and transporting it to where it will be used, also cause CO_2 emissions. The CO_2 emissions are usually slightly greater than the amounts absorbed. They are measured in CO_2 gms emitted by an average car travelling one kilometre. The comparison can be seen below.

Energy gain and CO_2 emissions for various fuels



Source: www.europabio.org

Figure 19 Biofuels around the world

World Region	Total primary energy demand	Total supplied by renewables	Total supplied by biomass	Biomass share of primary energy
Africa	21.5	10.8	10.5	49%
Latin America	18.8	5.3	3.3	18%
Asia excluding China	48.2	16.1	15.0	31%
China	48.4	10.0	9.0	19%
Middle East	16.3	0.1	0.0	0%
CIS* + Central Europe	43.7	1.7	0.6	1%
OECD*	223.3	12.7	6.8	3%
World	**420.3**	**56.7**	**45.2**	**11%**

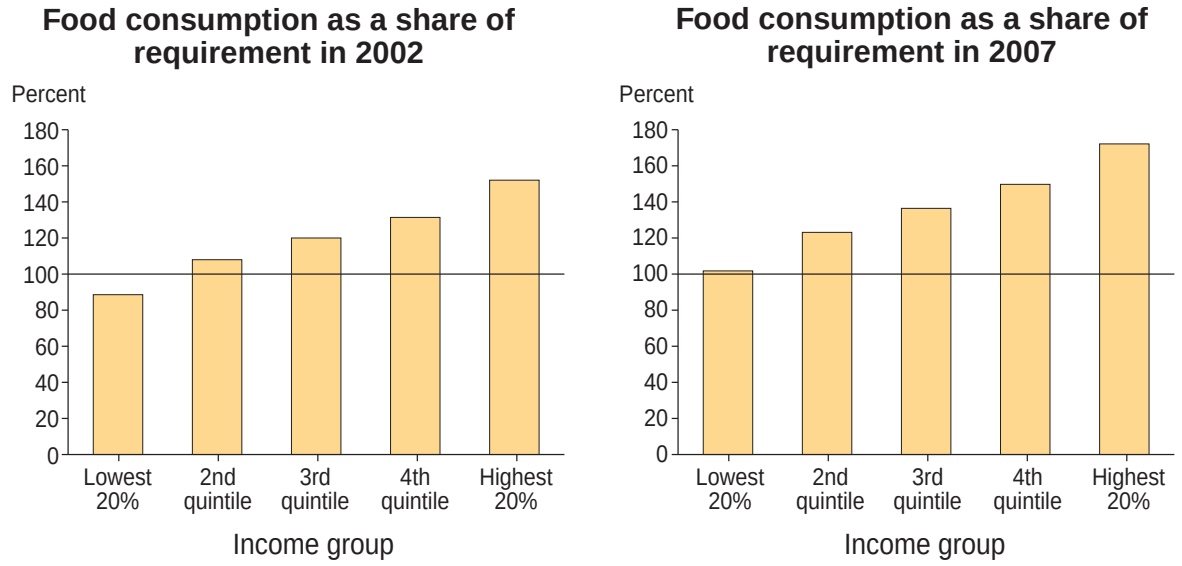
Source: oeko.de

Data in exajoules per year
1 Exajoule (EJ) = 10^{18} Joules
*CIS – Commonwealth of Independent States
*OECD – Organisation for Economic Cooperation and Development

FOOD AND FUEL IN OTHER COUNTRIES

Figure 20 Brazil food security

In 2002, President Lula launched the Zero Hunger Programme with the aim of ensuring all the population of Brazil had at least the minimum food requirement met.



Source: ers.usda.gov

Figure 21 The biofuels versus food debate in Brazil

In favour of biofuels.
Food shortages and price increases that Brazil suffered before 2002 were blamed on growing crops to produce ethanol, but this may not be so. Brazil, as one of the world's largest exporters of agricultural commodities and leaders in agricultural production, has kept ahead of population growth: in 1976 the production of cereals was 416 kg per capita, and in 1987 was 418 kg per capita. Of the 55 million hectares (ha) of land area devoted to primary food crops, only 4.1 million ha (7.5 per cent) was used for sugar cane, which represents only 0.3 per cent of Brazil's total land area. Of this, only 1.7 million ha was used for ethanol production, so competition between food and crops is not significant. Furthermore, crop rotation in sugar cane areas has led to an increase in certain food crops.

Food shortages and price increases in Brazil have resulted from a combination of policies which were biased towards commodity export crops and large acreage increases of such crops, hyper-inflation, currency devaluation and price control of domestic foodstuffs.

Against biofuels.
Ethanol was seen as an easy way to reduce greenhouse gas emissions, but the World Bank has estimated that maize prices rose by more than 60% between 2005 and 2007, and have continued to rise into 2010. The price rises have been greatest in the poorest countries of the world where food shortages already exist. Staple foods such as maize are the very crops being used for biofuel.

Numerous studies have demonstrated that the energy return on energy invested from most forms of maize and sugar-based ethanol is at best marginal, and at worst, a net loss. Bio-ethanol must be grown, collected, dried, fermented, and then burned. These steps require resources, infrastructure and transportation that often produce as much pollution and require as much energy as ethanol saves.

The degrading of farm land it produces, and the impact on small farmers and communities in Brazil, could be a problem.

Sources: www.journeytoforever.org and www.global-greenhouse-warming.com

Turn over.

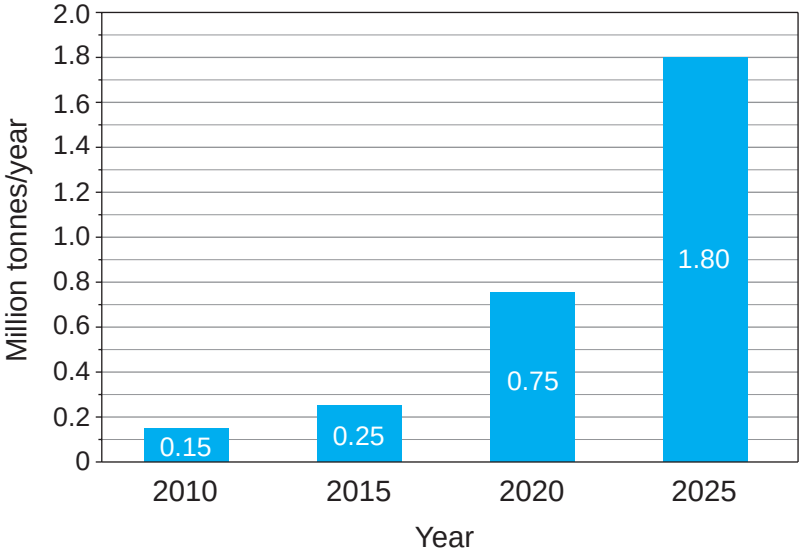
Figure 22 Food security in Vietnam

Vietnam experienced one of the fastest increases in food prices in early 2008. The retail price of rice increased by 65 percent. As a result, Vietnam has been classified as one of the hunger hot spots in Asia based on the Global Hunger Index classification, which is a composite measure of population undernourishment (13%), child malnutrition (20%), and child mortality (under 5 mortality rate 15/1000). The coastal regions in Vietnam are susceptible to typhoons and have been classified as vulnerable to food insecurity.

Food security is a concern because even though Vietnam is the second largest exporter of rice in the world, many rural households are net buyers of food. For example, approximately 53 percent of the population in the Mekong Delta and 55 percent in the Red River Delta are net purchasers of food. In response to the high prices, the government cut rice exports by approximately one million tonnes. The government also plans on setting up 100 000 tonnes of storage to keep the rice prices stable. This is in addition to 31 600 tonnes of food aid.

Source: www.foodsecurityportal.org

Figure 23 Projected biofuels in Vietnam



Marginal lands and forests have been cleared for biofuels production, making it even more difficult for forests and agricultural lands to act as sinks to absorb CO_2. In South-East Asia as a whole, 87% of all deforestation between 1985 and 2000 can be attributed to palm oil plantations, many of which are for the production of biofuels.

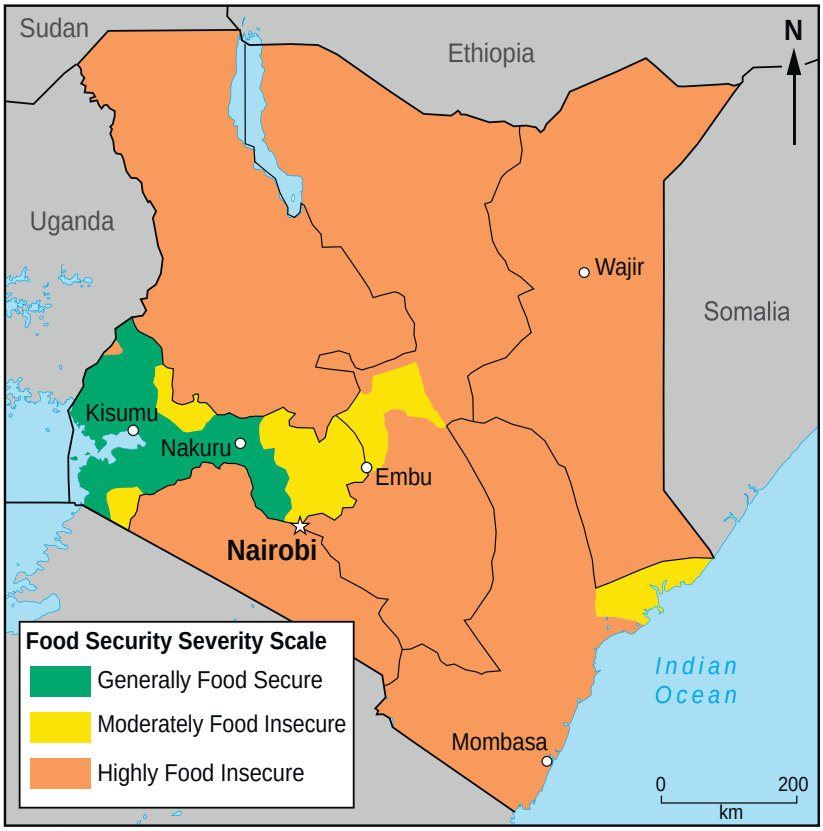
Vietnam plans to go ahead with producing biofuels to meet its increasing energy needs. Manufacturing industry is growing rapidly and the affluence of the population is increasing, both requiring more energy.

There may be some conflict between biofuels and food supply. Switching to biofuels is regarded as an important factor in fighting the greatest threat to Vietnam. If predictions about global warming are correct, then sea levels will rise and threaten the Mekong and Red River deltas. Switching to biofuels is seen as one way that Vietnam can do something practical to combat the threat of rising sea levels. These two deltas produce the majority of home-grown food in Vietnam, and if they were to be lost in the future, the country would face food shortages many times more severe than the minor shortages at present.

Rice straw and rice husks, currently just waste from rice production, could become vital contributors to biofuel production.

Source: www.pecj.or.jp

Figure 24 Food security in Kenya in 2010



- A long dry spell during most of 2009 has threatened food security in many parts of the country.
- Some rain has fallen in the early part of 2010, but 3.8 million people remain food insecure.
- Limited harvests have occurred, and many livestock have died.
- The food distribution chain has broken down.
- In some localised areas, floods have affected food security.

Source: www.kenyafoodsecurity.org

Figure 25 Biofuels in Kenya

In January 2010, people on part of Kenya's Indian Ocean coast were woken up by smoke and the sound of bulldozers that were beginning to clear nearby forest.

50 000 hectares of the land upon which they are dependent for their livelihoods had been handed over to an Italian company. It aims to produce the biofuel crop Jatropha, the so-called 'miracle-plant' supposed to provide high yields of oil to be converted into fuel.

According to the draft approved by the Kenyan national authorities (and not the local population), 30% of the oil produced in Kenya will be exported to Italy, and 70% will be used for national energy consumption (Jatropha is not edible). However, the company has recently declared to the Italian press that it would export to Italy as much as 80% of the oil produced, while only 20% of it will be used to satisfy the domestic demand in Kenya.

It has been predicted that 20 000 people are in danger of being displaced and that the ecological balance of the region will be severely threatened.

Source: www.hungerfreeplanet.org

Efforts to turn Kenya into Africa's principal producer of biofuels have made significant steps with the completion of a policy for cost-effective and safe production of biofuels. Aimed at reducing the country's dependence on fossil fuels, the proposed policy hopes to establish the principles that will enable Kenya to gain from rising demand for clean energy without social and economic shockwaves.

Many NGOs have introduced oil plants like Jatropha to farmers, saying it could be a major export product with the possibility of bringing wealth to Kenya quickly. Kenya is hoping for middle income economy status by 2030.

At the moment, Kenya is paying too heavy a price for electricity and cooking gas, forcing more than 80% of rural households to rely on wood fuel for their energy needs. Biofuels could significantly reduce the number of people suffering ill health caused by indoor pollution that is mainly caused by use of wood fuels.

Biofuels have the potential of boosting economic growth in the countryside through job creation and skills development.

Source: www.businessdailyafrica.com

Turn over.

Sources of information

Figure 1	globalist.org.ua/eng/14467-world-food-consumption-in-calories-per-day-the-map
Figure 2	maps.grida.no/go/graphic/energy_consumption_per_capita_2004
Figure 3	earthtrends.wri.org, cia.gov and happyplanetindex.com
Figure 4	www.southafrica.info/business/economy/sectors/agricultural-sector.htm
Figure 5	earthtrends.wri.org/pdf_library/country_profiles/agr_cou_710.pdf
Figure 6	www.new-ag.info/en/country/profile.php?a=885
Figure 7	www.esri.com/mapmuseum/mapbook_gallery/volume19/images/large/agr_3c.jpg
Figure 8	www.southafrica.info/business/economy/infrastructure/energy.htm
Figure 9	www.intelligent-energy.com/products_and_services/fuel_cells/power_systems
Figure 10	www.d1plc.com/agronomyEnergy.php
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Figure 14	www.southafrica.info/business/economy/econoverview.htm
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Figure 23	www.pecj.or.jp/english/plaza/7th_asiasympo/2-9_Huynh-Hung-My.pdf
Figure 24	www.kenyafoodsecurity.org/index.php? option=com_content&view=article&id=19&Itemid=34
Figure 25	www.actionaid.org/kenya/(hungerfreeplanet.org) and biofuels.carboncapturereport.org/cgi-bin//profiler? key=businessdailyafrica_com&pt=4