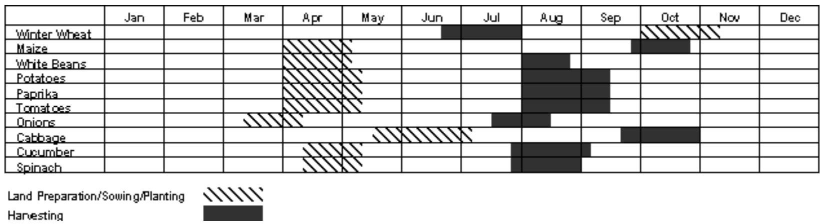
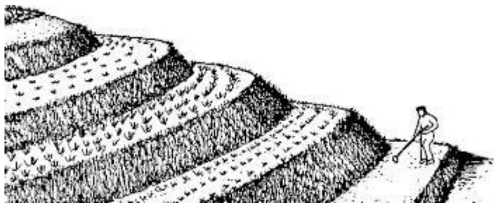
Chp 4 Gateway 2 – Trends and challenges in the production of food crops

***Factors* affecting intensity of food production**

<u>Physical</u>

<table>
<tr><th>Factor</th><th>Description</th><th>Example</th></tr>
<tr><td rowspan="4">1. Climate</td><td><u>Temperature</u>
affect rate of photosynthesis & seed germination
varies among crops</td><td rowspan="2">Temp & rainfall required for growth varies among crops<table><tr><th>Crop</th><th>Temp</th><th>Rainfall</th></tr><tr><td>broccoli</td><td>18 ~ 24</td><td></td></tr><tr><td>soya bean</td><td>25 ~ 28</td><td>450 ~ 700</td></tr><tr><td>rice</td><td></td><td>1500 ~ 2000</td></tr></table></td></tr>
<tr><td><u>Rainfall</u>
varies among crops</td></tr>
<tr><td>High temp + rainfall: usually conducive for crop growth (tropics)
long growing season → 2 or 3 harvests per year
22 ~ 32°C + 2000mm rainfall
Low temp + rainfall: unsuitable for crop growth (winter)
food production only occur during warmer seasons</td><td>Spain crop calendar

Land preparation + sowing: Apr to Aug
Harvesting: July to Oct
Winter season (snow): Dec to Apr</td></tr>
<tr><td>Greenhouse: create optimal conditions for crop growth
overcome short growing season → grow throughout year</td><td>Netherlands</td></tr>
<tr><td>2. Soil</td><td><u>Fertility</u></td><td><u>Mekong Delta</u> (Vietnam)</td></tr>
</table>

	• availability of air + water + nutrients (from minerals) in soil - varies among locations • fertile → rich in minerals (N, P, K) → **high crop yield** • distribution: river floodplain, delta, volcanic areas	• high rice production 1) highly fertile soil 2) flat terrain 3) large water supply
	Drainage • ability to retain / drain off water • proper soil drainage → root receive sufficient air + nutrients → growth of crop → **high crop yield**	Oats • sandy soil (drain water) Rice • clay soil (retain water)
3. **Relief**	Slope • steep slope → rain remove topsoil → reduce soil fertility → less suitable for crop production → **low crop yield** • **terracing**: cut steps into hillside to create flat land for cultivation → previously unsuitable slops can be used for farming → **high crop yield**	Terraces for farming • Longji Rice Terraces @ China • Sapa @ Vietnam • Banaue Rice Terraces @ Philippines 
	Altitude • higher altitude → lower temperature • cool temp of mountainous areas: suitable to grow certain crops e.g. strawberries	Cameron Highlands (Malaysia) • temp 18°C + elevation 1471m above sea level • strawberry, tea plantation Yunnan province (China) • temp 15°C + elevation 2000m above sea level • Pu’er tea plantation

<u>Economic</u>

<table>
<tr><th>Factor</th><th>Description</th><th>Example</th></tr>
<tr><td>1. Purpose of farming</td><td colspan="2">
<table>
<tr><th>Type</th><th>Subsistence farming</th><th>Commercial farming</th></tr>
<tr><td>1) Purpose</td><td>produce crops for self-consumption</td><td>produce crops for sale (cash crops)</td></tr>
<tr><td>2) Land</td><td>small</td><td>large</td></tr>
<tr><td>3) Labour</td><td>farmer + family members</td><td>hired labour</td></tr>
<tr><td>4) Capital</td><td>simple farming tools (animals)</td><td>machinery (<u>combine harvesters</u>, tractors)</td></tr>
<tr><td><u>Crop yield</u></td><td><u>low</u></td><td><u>high</u></td></tr>
<tr><td rowspan="2">Example</td><td>Distribution
● Sub-Saharan Africa</td><td>Distribution
● Europe
● N & S.America
• Australia
• Asia</td></tr>
<tr><td>Crops: staple food
● corn
• cassava</td><td>Crops
● wheat
● corn
● tea
• banana
• sugar cane
• coffee</td></tr>
</table>
</td></tr>
<tr><td>2. Demand and capital</td><td>Demand: willingness to obtain
● change according to taste + preference of consumers
● greater demand → <u>high crop yield</u> to meet demand

Capital: consumer’s amt of money, assets</td><td><u>Corn</u>
● <u>China</u>: larger + wealthier population [capital] → higher demand for meat [demand] → more corn needed to feed livestock
● <u>US</u>: increase local corn production [meet demand] → export to China → more livestock reared for meat</td></tr>
</table>

3. **Agribusiness**	● Business/industry involved in food production ○ large-scale farming + related business activities ○ commercial farming → processing → packaging → distributing → retailing ● Scientific research and development: invest in food production → produce crops with greater crop yield ● Greater financial ability to absorb losses: withstand impact of envt changes ○ e.g. crop damage caused by pests & flooding	Dole food company ● largest producer of fruit and vegetables ● over 300 products in 90 countries ○ e.g. bananas, pineapples

Political

Factor	Description	Example
1. **Government policy**	Agricultural policy ● policies pertaining to domestic agriculture ● govt decide how resources can be best used	Punjab Agriculture Department (India) ● need for greater productivity from farmland ● education programme for wheat farmers → taught about best available ○ seed varieties ○ pesticide treatment ○ irrigation methods
	Food policy ● govt decide how food is produced → processed → packaged → distributed → purchased 1) **stockpiling**: set aside food to ensure food security during emergency → food available to population during food shortage / price increase 2) **diversifying food supply**: import food from diff sources → avoid relying on a few countries → buffer against food shortage / price fluctuation	SG: buy vegetables ● past: mainly from Msia ● now: large proportion from China, US SG: govt encourage local companies to place contracts directly with farmers for agreed amt + price of food production ● NTUC Fairprice purchase vege thru contracts with Indonesian farmers
2. **International policy**	ASEAN Plus Three Emergency Rice Reserve (APTERR) ASEAN sign agreement with China, Japan, S.Korea ● commitment from big rice producers to supply rice for a reserve → provide rice during disaster ○ China: 300k tonnes ○ Thailand: 150k tonnes ○ SG: US$100k	Thailand started a programme (2012) ● work with neighbouring countries (Cambodia) → increase efficiency in rice production

Technological

Green revolution: rapid increase in productivity of agriculture thru science + tech

Factor	Description	Example
1. **High-yielding varieties (HYV)**	• improved strains of crops (e.g. wheat, rice) • developed thru cross-breeding of selected varieties that have favourable characteristics 1) increased resistance to pests & diseases → less crop damaged → **high crop yield** 2) shorter growing seasons → more harvests per year → **high crop yield**	Wonder Rice • shorter growing season: 100 days ⇔ 120 days IR36 • shorter maturation period: 105 days ⇔ 150 days IR8 • produce 2x grain than traditional varieties • saved India from famine in 1960s
2. **Chemicals**	Fertilisers • provide nutrients for healthy plant growth • continuous use of farmland → nutrients eventually depleted if not left to fallow → unhealthy plant growth → less crop growth → low crop yield • fertilisers → return nutrients to soil → healthy plant growth → more crop growth → **high crop yield**	
	Pesticides • fight high level of pest damage that frequently occurs when only a single crop covers a wide area • pesticides → kill pests (insects/animals) that destroy crops → crop protected → **high crop yield**	Malathion (California, USA) • solve fruit fly problem in fruit orchards
	Herbicides	

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<tr>
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herbicides → kill weed & undesirable plants that compete with crop for resources → crop protected → <u>high crop yield</u>

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<td></td>
</tr>
<tr>
<td>3. Improved irrigation</td>
<td>

supply water to land too dry for agriculture → more arable land for agriculture → more crops grown → <u>high crop yield</u>
types:

<table>
<tr><th>Flood irrigation</th><th>Centre-pivot irrigation</th></tr>
<tr>
<td>deliver water to whole surface via <u>pipes</u> e.g. rice fields</td>
<td>mount pipes on wheeled towers with <u>sprinklers</u> along its length
move pipes around central point, rotate in circular pattern - water large area with small amt of water</td>
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<td></td>
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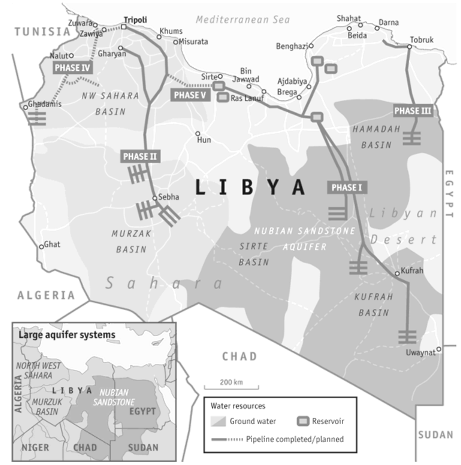
</table>
</td>
<td>
<u>Great Man-made River</u> (Libya)

network of underground pipes, canals, wells, reservoirs, tunnels: draw water from underground aquifers
channel water supply to coastal cities for agriculture → possible to grow crops in Sahara Desert



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<tr>
<td>4. Mechanisation</td>
<td>

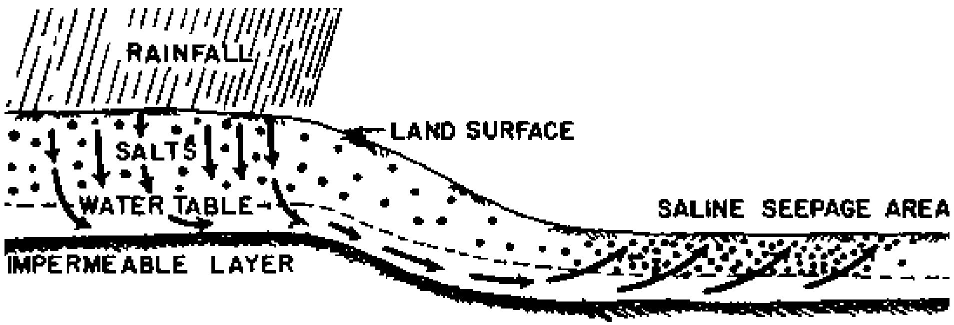
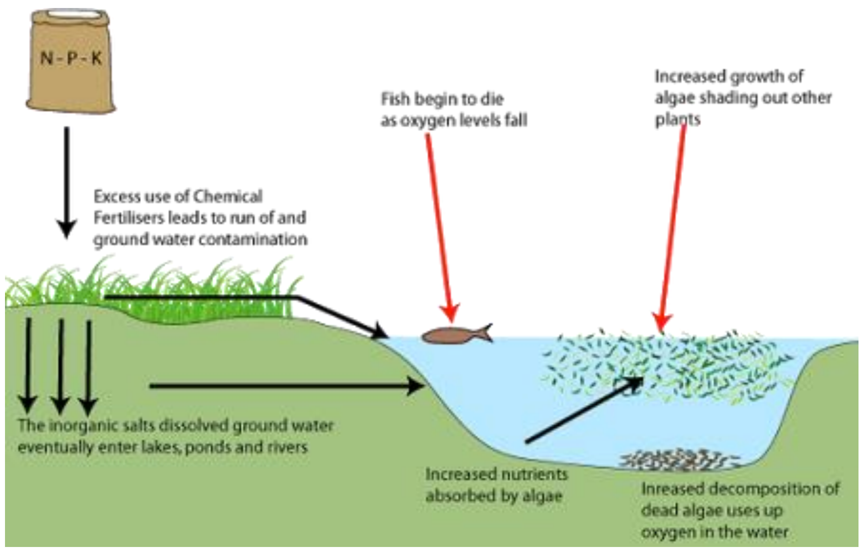
use advanced machinery to perform manual tasks → speed up processes (plough land, tend to crops, harvest) → more crops grown within same period of time → <u>high crop yield</u>

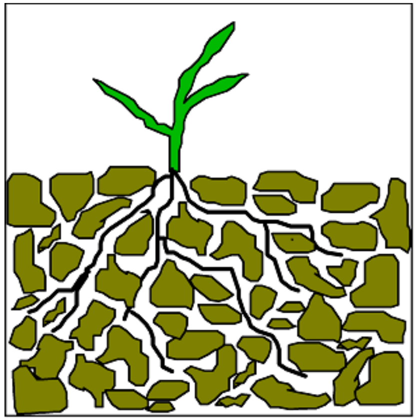
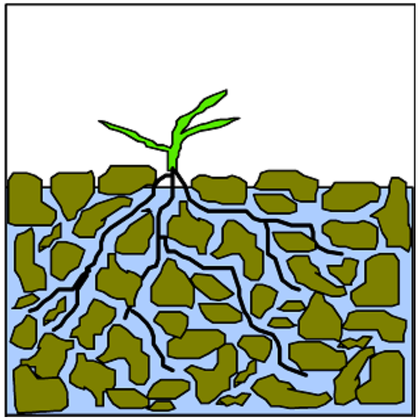
</td>
<td>
<u>Combined harvester</u>

machine used to harvest crops
reduce reliance on human labour → increase crop productivity

</td>
</tr>
</table>

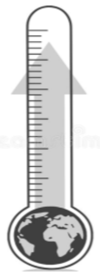
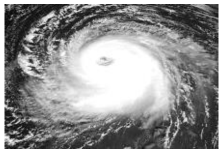
***Effects* of continuing intensification of food production**

Effect of **irrigation** on water & soil quality	Effect of **chemicals** on water & soil quality
Salinisation 1. No proper drainage of excess irrigation water 2. **Crop growth (soil):** raise water table → groundwater rise → bring dissolved mineral salts closer to surface at upper soil layers → water evaporate directly from moist soil → leave behind salts → saline soil → land degradation → reduce soil fertility for crop growth → salt conc too high for crops to grow well 3. **Irrigation (water):** raise water table → groundwater rise → more salts from groundwater enter river → poor water quality for irrigation  	**Eutrophication** 1. Excessive use of fertilisers + pesticides → chemicals concentrated in soil 2. Chemicals seep into groundwater → contaminate 3. Washed into streams & rivers by surface runoff → nutrients for algae to grow on water surface → algae bloom 4. Deplete O_2 in water + block sunlight from reaching aquatic plants 5. Aquatic plants & animals die → decompose → further deplete O_2 in water 

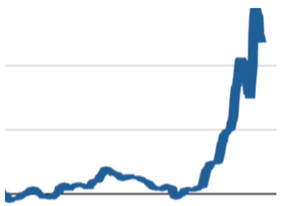
<u>Waterlogging</u> 1. Extensive irrigation → too much water seep into soil → soil become over-saturated 2. Roots deprived of air + nutrients that crops need → crops die  	Solutions 1. Control measures 2. Education to raise awareness
Egypt: waterlogging + salination → reduce agricultural productivity by 30%	US: eutrophication in freshwaters → annual economic loss of $2.2 bil

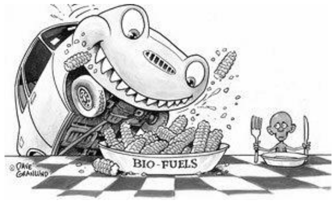
***Causes* of food shortage**

Physical

Cause	Description	Outcome	Example
1. **Climate change** 	Rise in global temp ● – : existing farmland unsuitable for farming ● + : lengthen growing season → farm crops in areas unsuitable for farming in past	Food production of staple food producers 1) decrease 50% → **food shortage** ● India ● Brazil 2) increase 35% ● China ● Canada	Shrinking of glaciers ● seasonal melting of glaciers in Himalayas: provide river basins of major rivers with water → irrigate crops during dry season ○ India (Ganges river) ○ China (Yellow river, Yangtze river) ● IPCC: glaciers melt entirely by 2035 → loss of water for irrigation during dry seasons → low crop production → **low food production**
2. **Extreme weather events more frequent** 	● drought: reduce water supply for irrigation ● tropical cyclone: flood farmland, destroy crops ● heat wave	Crop damaged + difficult to grow crops → low crop production → low food production → **food shortage**	Madagascar (2022) ● Tropical cyclone - Batsirai ● 90% rice crop destroyed
3. **Pests** 	● wild rabbits ● moles ● insects (caterpillars, locusts)	Damage food crops → low crop production → low food production → **food shortage**	Liberia (2009) ● armyworms devoured all crops ● 46 villages affected, crop damage posed major threat to the already serious food security situation

Economic

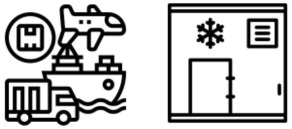
Cause	Description	Outcome	Example
1. **Rising demand for meat and dairy products from emerging economies** 	BRIC: fast developing LDCs that contribute significantly to global economy • **B**razil • **R**ussia • **I**ndia • **C**hina	Rising disposable incomes + rapidly growing urban middle class → increase in food demand (meat & dairy products) → deplete global food inventories → **food shortage** in poorer countries	
2. **Soaring cost of fertilisers and transport** 	Price increase in 1) fertilisers: higher cost of producing food → higher food price 2) energy: higher cost of transport, machine operation, fertilisers • modern agriculture rely heavily on burning fuel → power machinery + transport farm produce • 2011: world crude oil prices increase by 10.3%	Increase in food prices is transferred to consumers → the poor X afford higher food prices → **food shortage**	Kazakhstan (2011) • major wheat producer • rise in fuel cost → sell wheat to neighbouring countries e.g. Tajikistan at higher price
3. **Farmland converted to industrial crop**	• Biofuel: derive energy from biological carbons instead of fossil fuels	Less land to grow food crops for consumption → less food crops	US Department of Agriculture report (2009)

production to produce biofuel crops 	○ corn ○ sugar cane ○ palm oil ● Rising demand for biofuel + more profitable → convert farmland to grow crop for biofuel ● Amt of crops required to fill a car with ethanol = feed a person for a year	available for consumption → **<u>food shortage</u>**	● 25% crops grown for fuel ● amt enough to feed 300 mil people for a year <u>IFPRI</u> (2006) ● 30% increase in food price related to biofuel production

<u>Political</u>

Cause	Description	Outcome	Example
1. **Civil strife** 	Major internal conflicts due to: ● riots ● unrest ● civil war	Conflict b/w various stakeholders over control of resources impt for crop growth (e.g. land, water) → resources destroyed → desperation + frustration abt food shortage → **<u>vicious cycle of civil strife & food shortage</u>**	
2. **Poor governance** 	● corruption ● policy error ● inability to implement policies	Govt prioritise other developmental needs > food security → allocate less land area for agricultural activities → low crop production → **<u>low food production</u>**	<u>Madhya Pradesh</u> state @ India (2010) ● govt policy → develop mining, steel plant, port ● 40k villagers lose farmland → X carry out subsistence farming + too poor to afford food

Social

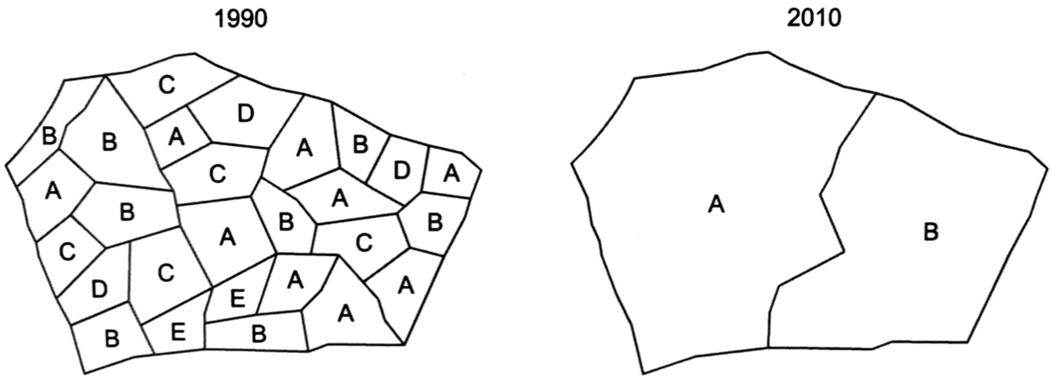
Cause	Description	Outcome	Example
1. **Lack of accessibility** 	● Transport facilities: impt to make food accessible to people who live far away from shops ● Food outlets: no. & location is impt ○ LDCs: few + far apart from each other	People X access food easily → **<u>food shortage</u>**	
2. **Inadequate logistics of food distribution & storage** 	● food distribution: food moved from farms to retail outlets ● transport network → affected by mountains & landslides ● esp when local production cannot meet local demand → import	X transport food to various locations → food not delivered to people → **<u>food shortage</u>**	<u>Timor Leste</u> ● food shortage in b/w harvests ● worsened by lack of storage facilities + difficult to access remote communities
3. **Rapid population growth** 	<u>FAO</u> ● world population will reach 10 bil by 2050	Growing demand for food → insufficient food supply to meet demand → **<u>food shortage</u>**	<u>Sub-Saharan Africa</u> ● small amt of land suitable for farming + decreasing due to rising temp ● high population growth in urban + rural areas → worsen food shortage problem ● 2025: 75% will have to rely on food aid

Typical questions

Structured questions

1 Study the figure below, which shows land ownership in an area of India in 1990 and 2010.

Map of land ownership in part of India in 1990 and 2010



land belonging to farmers A, B, C, D and E

land belonging to farmers A and B

(O-Level 2014)

(a) Describe the changes in land ownership between 1990 and 2010 shown in the figure. [3]

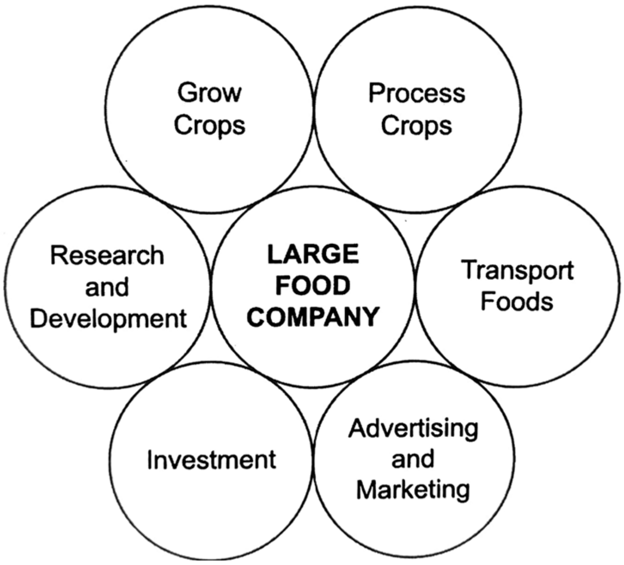
- In 1990, the land was owned by five different farmers. However, in 2010, the land was owned by only two. In 1990, the land was distributed unequally among the five farmers, but in 2010, there were only two farmers who owned land, but the land was distributed equally between them.
- Land ownership is more organised. While in 1990 the plots of land owned by each farmer was haphazard and disorganised. In 2010, the land owned by each farmer was arranged neatly.
- The size of the plots of land each farmer owns is different. In 1990, the plots of land each farmer owned was small, but in 2010, the plot of land each farmer owned was significantly larger.

(b) Explain why the changes in the figure above may have led to an increase in productivity in the area. [4]

- Larger plots of land would mean that it would be feasible to use machinery to aid in farming. This would therefore lead to an increase in productivity.
- With a larger plot of land, farmers are able to move beyond subsistence farming, and instead grow crops that are valuable. They sell these crops at a higher price than what they usually sell. By earning more money, they may be able to afford fertilisers and pesticides, thus improving productivity.

2 Study the figure below, which shows some of the activities of a large food company (an agri-business).

Some of the activities of a large food company (an agri-business)



Use information from the figure above to explain why large food companies are able to intensity food production. [5]

(O-Level 2014)

- Large food companies are a part of many different industries. Many of the industries that these food companies are part of being involved in food production, such as crop processing and growing of food. Furthermore, as large food companies, they have a wide range of resources to draw from. This would help to speed up and intensify food production.
- Since these food companies are also involved in research and development, they may be able to come up with crops that produce a larger yield, or crops that are pest-resistant. This would therefore help to increase food production.

3 Study the photograph below, which shows stockpiling of food taking place.

With the help of the photograph, describe how food stockpiling takes place and explain how it helps governments achieve food security. [5]

(O-Level 2014)

- Food stockpiling is done in order to make sure that a country has enough food. This is to make sure that the country has a stable supply of food for its citizens.
- Stockpiling is the collecting and storing of food to make sure that a country's citizens have access to food during emergencies. The photograph shows a man carrying sacks of rice,

an important staple food in many countries. This shows that countries would usually stockpile staple food such as rice and wheat.

- Governments would usually collect food either from imports overseas or from local farms. Food stockpiling gives a country food security, whereby it is able to provide food for its citizens even in emergencies.

4 Study the figures below. Fig 1 shows some of the leading countries of North America, Europe and Asia that produced GM crops in 2010. Fig 2 shows part of a questionnaire on GM crops used in the USA and UK.

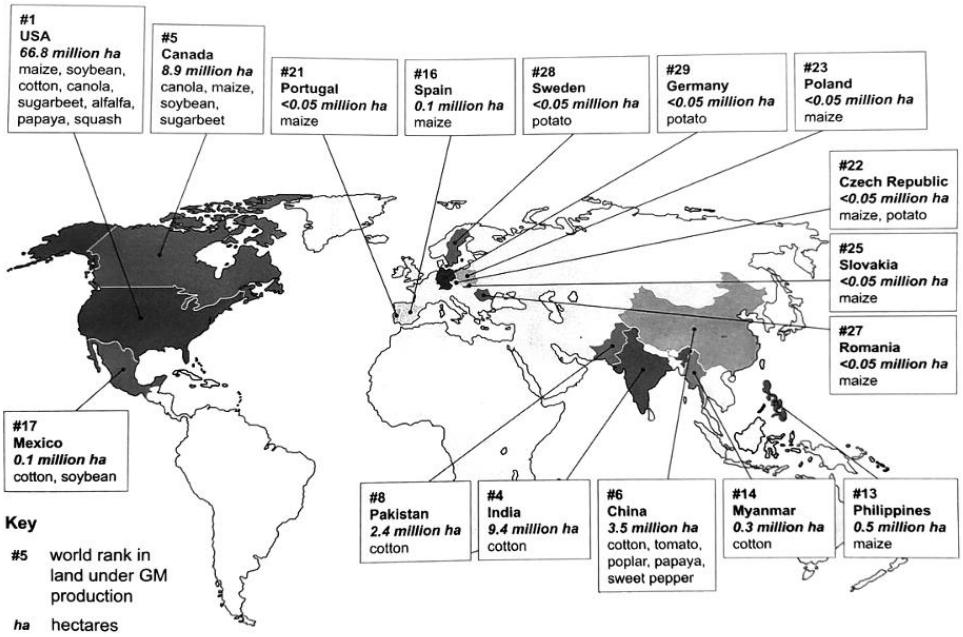


Fig 1

Part of a questionnaire on GM crops answered in the USA and UK

	UK			USA		
	Yes	No	Don't know	Yes	No	Don't know
Do you think GM crops are safe for you and your family to eat?	17	69	14	74	12	14
Do you think GM crops can harm the environment?	72	13	15	9	76	15
Do you think GM crops give too much power to multinational corporations?	81	5	14	52	32	16
Are there enough government regulations to control GM crops?	4	88	8	47	51	2
Do you think GM crops should be grown in areas where there is a risk of famine?	33	32	35	89	4	7

all figures in percentages

Fig 2

(O-Level 2013)

(a) Use Fig 1 to compare the production of GM crops in North America and Asia in 2010. [3]

North America:

More than 75 million hectares in North American countries (USA, Canada and Mexico) were used in GM crop production. A common GM crop was soybean.

Asia:

Only 16.1 million hectares in Asian countries (India, China, Pakistan, Myanmar, Philippines) were used in GM crop production. A common GM crop was cotton.

(b) Use Fig 2 to explain why the USA is featured on Fig 1 but the UK is not. [4]

- People in UK have doubts on effectiveness and safety of GM crops. The opposite is true for people in USA. For example, 69% of people in UK did not think GM crops were safe for consumption, whereas 74% in USA felt otherwise. 72% in UK believed that GM crops were harmful to the environment, whereas 76% in USA felt that they caused no harm.
- This affected the popularity of GM crops in UK and USA respectively, and also affected the laws in these countries which regulated or encouraged the production of GM crops, as well as whether or not agricultural firms were willing to invest in it.

5 Study the table, which shows the information on income and production costs of milk and wheat for farmers in Europe. Not all European countries are part of the European Union (EU).

The production and sale of milk and wheat in Europe in $US

	price paid to all farmers	extra EU subsidy to EU farmers	cost of production for all farmers
milk (per litre)	0.49	0.19	0.31
wheat (per kg)	0.45	0.31	0.37

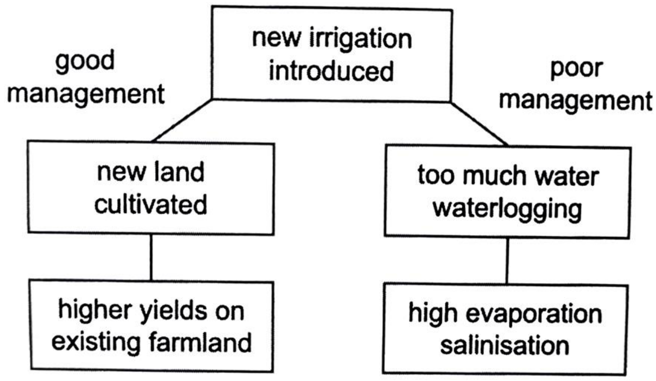
With the aid of information from the table, explain why the EU imports few milk products and little wheat. [6]

(O-Level 2013)

- The market of milk products and wheat in the EU is protected.
- Farmers producing milk and wheat generally earn more from their production than the cost incurred to produce them. Price of each litre of milk paid to all farmers is US$0.18 more than its cost of production. Farmers also receive an additional US$0.19 from EU subsidies for each litre of milk produced, raising their total profit for each litre of milk to US$0.37.

- While the price of each kilogramme of wheat is a mere US$0.08 more than its cost, the farmers' profits are boosted by the US$0.31 per kilogramme from EU subsidies, making the total profit per kilogramme of wheat to be US$0.39. With high profits, farmers in the EU have incentive to produce more milk products and wheat, hence there is no need to import these products.

6 Study the figure below, which shows some of the results of irrigation.

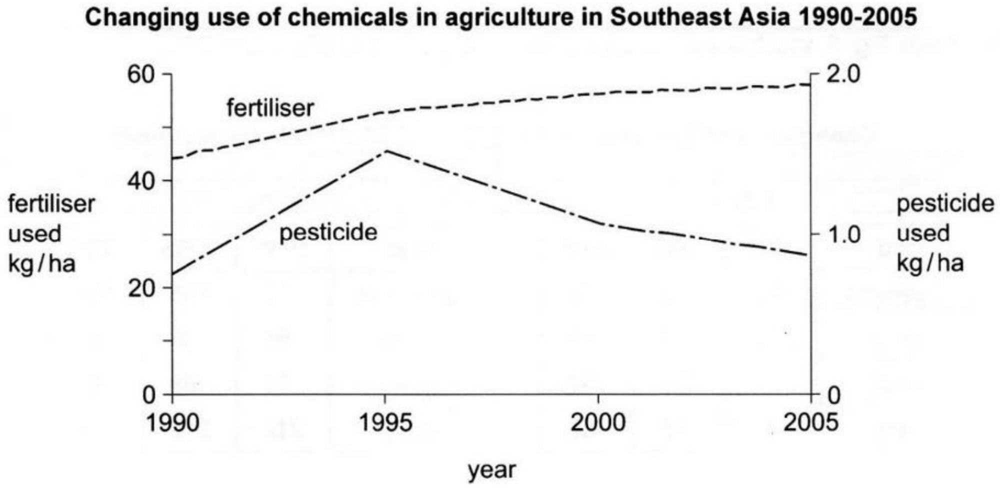


Explain one benefit and one problem resulting from irrigation. [6]

(O-Level 2012)

- One of the benefits of irrigation that is properly managed is that the existing farmland will have higher yields. This is because water can be channelled to the fields even in dry seasons from nearby water bodies such as rivers or lakes. It could also mean that previously non-arable land could be used for farming, and thus increases food production in general.
- However, when the irrigation system is poorly managed, too much water may flow through the irrigation channels, thus causing waterlogging. When roots are deprived of air and nutrients as a result of the excess water, they will rot and die. This kills the crops, thus affecting the amount of food produced.

7 Study the figure below, a graph of the changing use of chemicals in agriculture in Southeast Asia.

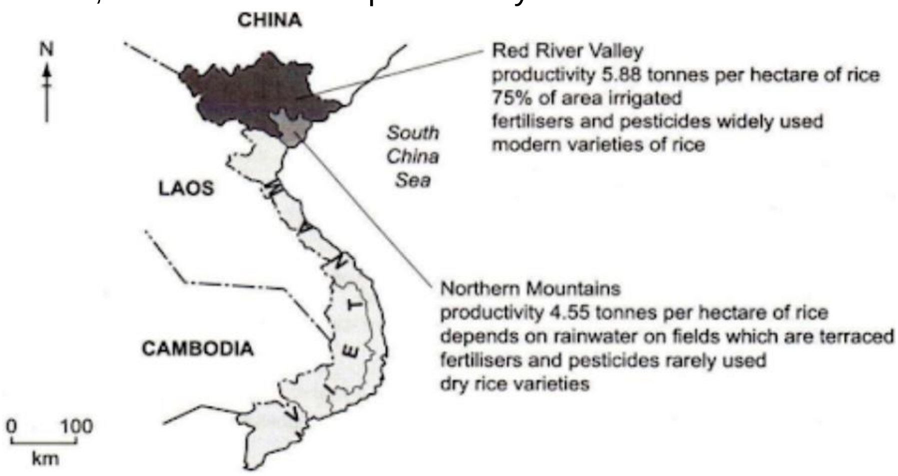


Describe and explain the changes in the use of chemicals in agriculture in Southeast Asia between 1990 and 2005 shown in the figure. [6]

(O-Level 2011)

Description [3]	**Explanation** [3]
Use of fertiliser increase steadily from 44 kg/ha in 1990 to 58 kg/ha in 2005	Use of fertiliser increase due to cultivation of high-yielding varieties of crops which require large amounts of fertilisers are grown. Some HYVs of rice were adapted to maximise growth with use of chemical fertilisers.
Use of pesticide first increase from 0.7 kg/ha in 1990 to 1.5 kg/ha in 1995,	Widespread cultivation of HYVs led to increase use of pesticide in early 1990s. This helped control problem of pests which increases productivity and crop yield.
then decrease from from 1.5 kg/ha in 1995 to 0.8 kg/ha in 2005 at faster rate	From late 1990s, farmers may have chosen to use lesser chemicals as there are negative effects e.g. eutrophication which leads to environmental and health problems.

8 Study the figure below, information about productivity of rice in two areas of Vietnam.



Explain how the methods used in the Red River Valley and the Northern Mountains account for the different levels of rice productivity between the two areas. [4]

(P Geog 2013 Q4)

Red River Valley	Northern Mountains
Higher level of rice productivity at 5.88 tonnes per hectare	Lower level of rice productivity at 4.55 tonnes per hectare
75% of area is irrigated, hence water is available throughout the year	Water supply is dependent on rainwater and may be irregular
Fertilisers and pesticides are widely used, hence higher yield	Fertilisers and pesticides are rarely used, hence lower yield
Modern rice varieties are used, hence higher yield as produce more grain and have shorter growing season	Dry rice varieties are used, hence lower yield as produce less grain and have longer growing season

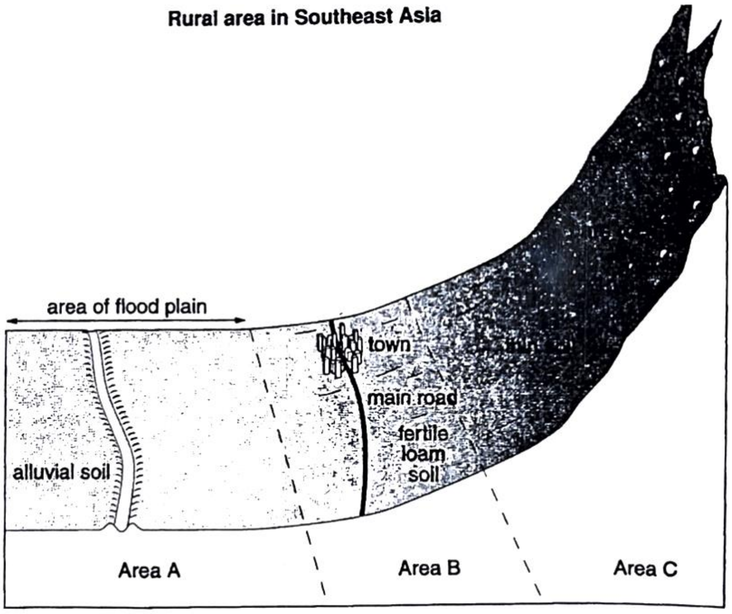
9 Study the photograph below.

Describe the farming landscape in the lowland area shown in the photograph. [4]

(P Geog 2013 Q4)

- Landscape is flat
- Area is large / extensive in size
- Segmented plots of land for farming
- River that supplies water for irrigation

10 Study the figure below.



Explain any advantages and disadvantages of each of the areas A, B and C for intensive farming and food production. [7]

(P Geog 2008 Q4)

	Advantage	Disadvantage
A	● Fertile alluvial soil provides nutrients essential for maximising amount of wet rice crops grown ● Flat land at flood plain allows rice to be submerged by freshwater from rivers during flooding season + facilitate use of machinery to increase productivity	● Not suitable to grow any other types of crops as seasonal flooding on plains will destroy any other crops
B	● Land provides well-drained soil + fertile loam soil provides nutrients essential for maximising crop output ● Main road linking farm to nearby town - farmers sell crops at town	● Possible landslides from area C which may bury farm at area B
C	● Grow crops that need cooler climate on slopes as temperature decreases with increasing altitude	● Soil is infertile as it consists of thin soil - hard to maximise crop output ● Bare rocks exposed may result in possible landslide - destroy crops ● Steep slopes make it difficult to use machinery + terrracing of steep slopes to create flat strips of land for cultivation involves very high cost

11 The figure below shows a response to a physical limitation in food production.

Explain how the strategy shown and other strategies can increase agricultural productivity despite physical limitations. [4]

(AHS 2017 Q3)

- Terracing: create flat land on steep slopes through cutting steps on slopes
  - maximise land space for farming to overcome steep relief conditions
  - overcome problem of erosion on steep slopes and loss of nutrients
- Greenhouses: allow people to regulate temperature and environmental conditions → mitigating unsuitable climatic conditions / increase growing season and allow certain types of crops to be grown throughout the year
- Farmming technology:
  - using chemical fertilisers replaces nutrients in soil → allows land to be used continuously / maximise areas with poor soil
  - irrigitation overcome water shortages and hot weather conditions
  - HYVs
    - increased resistance to pests and diseases → overcome problem of pests
    - ability to grow within a shorter growing season → overcome land constraints
- Biotechnology: some breeds of GM have high yield for small land area hence overcoming land constraints, some are drought resistant, some are pest-resistant
- Water and soil conservation: no-till farming overcome poor soil conditions
- Crop rotation: grow several crops on same land area in specific order, following changes in season
  - help farmer overcome soil erosion
  - prevent decrease in soil fertility
- Multiple cropping: grow 2 or more crops on a single piece of land at the same time
  - minimise problem of pests, crop such as garlic, pepper and onions planted next to tomatoes
  - leguminous crops such as groundnut and soya bean have roots that are able to replenish nitrogen in soil are planted next to non-leguminous crops to benefit from the nitrogen generated

12 Study the figure below, which shows the world's food security situation based on the global supply and demand conditions for grains.

Global Supply and Demand conditions for grains 2001 and 2012

	2001 (million tons)			2012 (million tons)		
	Output	Consumption	Net surplus / deficit	Output	Consumption	Net surplus / deficit
World	2060	2060	0	3025	3025	0
Developed countries	637	530	107	681	608	74
Less developed countries	1424	1530	-106	2344	2418	-74
● Middle-income countries	484	565	-81	1133	1194	-61
● Low-income countries	939	965	-26	1211	1223	-12

Describe how far the food security situation for grains has changed between 2001 and 2012. [5]

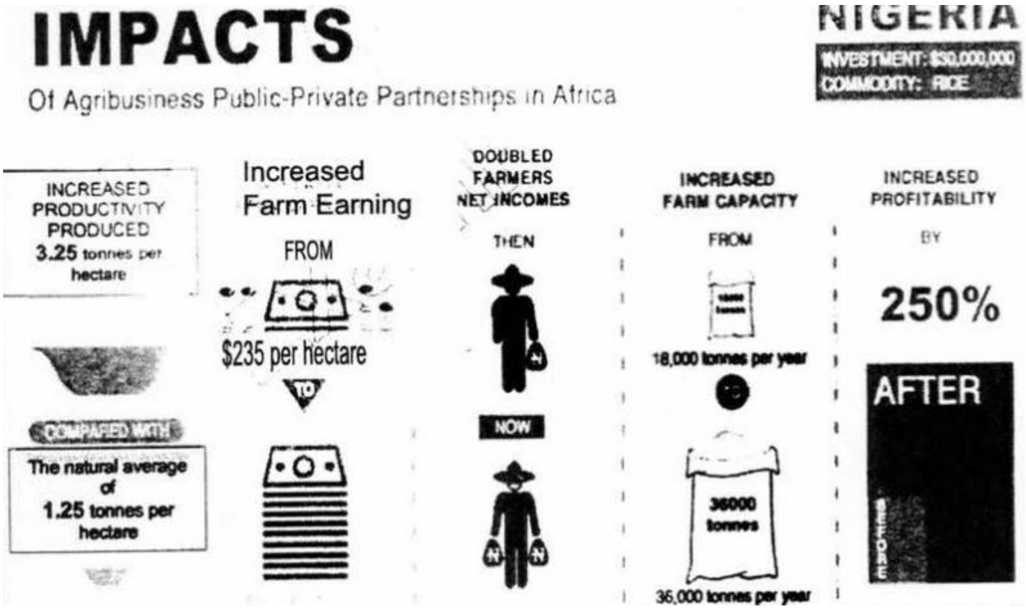
(AHS 2017 Q4)

- Overall for the world, there is no change in food security situation
- DCs: food security as supply / output exceeds demand / consumption for both years
  - both years had surpluses, 2001: 107 mil tons and 2012: 74 mil tons
  - however, less food security - net surplus for DCs decreased by 33 mil tons
- LDCs: less food security as demand / consumption exceeds supply / output
  - both years had deficits, 2001: deficit of 106 mil tons and 2012: deficit of 74 mil tons
  - food security situation has improved slightly, decreased in deficit of 32 mil tons
- Middle-income countries in LDCs: greatest shortage, 2001: 81 mil tons and 2012: 61 mil tons
  - however, food shortage decreased over the years from 16.7% to 5.4%
- Low-income countries in LDCs: overall supply increase faster than demand to meet consumption needs, supply increased by 64% and demand increased only by 58%

13 Explain how climate change could affect food production. [4] (ACSI 2017 Q5)

- Climate change causes existing farmland to become unsuitable for farming, decreasing crop yield; while in certain areas that were unsuitable for farming in the past become suitable for farming, increasing crop yield.
- Climate change brings about extreme weather events such as tropical cyclones which could flood farmland and destroy crops, decreasing crop yield.
- Climate change brings about extreme weather events such as droughts which would reduce water supply needed for crops to grow properly, decreasing crop yield.
- Climate change causes glaciers to melt, reducing or discontinuing fresh water supply of rivers which flood low-lying areas. Without sufficient water supply, farming productivity is reduced, decreasing crop yield.

14 Study the figure below, which shows the impacts of agribusiness in Nigeria in Africa.

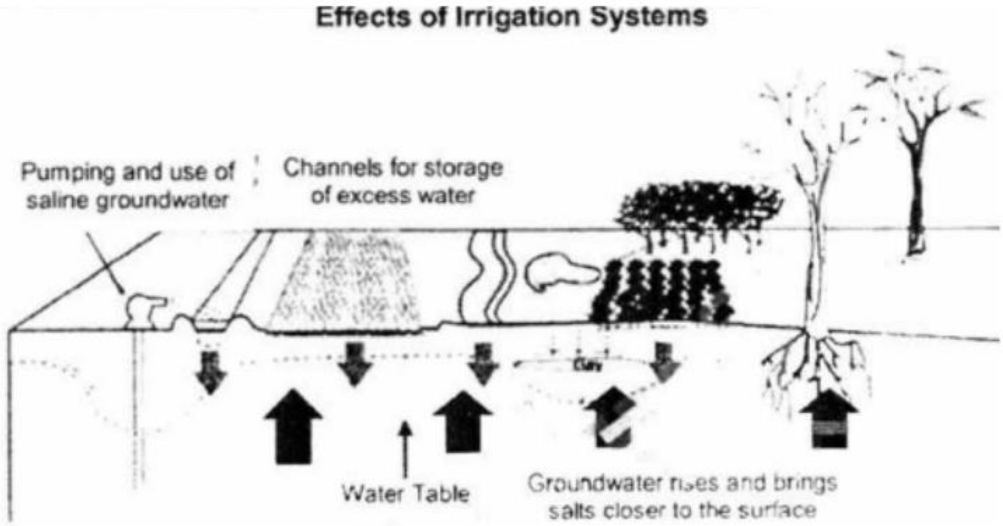


With reference to the figure above, explain how agribusiness contributes to the positive impacts of farming in Nigeria. [4]

(ACSI 2017 Q5)

- Increased productivity of 3.25 tonnes per hectare led to increased farm earnings from $235 per hectare to $1000 per hectare.
- This in turn doubled the farmers’ income.
- The farm capacity and productivity has increased from 18000 tonnes per year to 36000 tonnes per year.
- Thus the productivity rate of the farm has increased by 250% as compared to the past.

15 Study the figure below, which shows the effects of irrigation systems on soil and water quality.

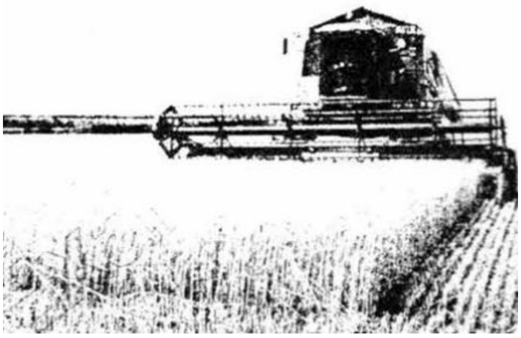


With reference to the figure above, discuss the effects of irrigation systems on the soil and water quality. [4]

(ACSI 2017 Q5)

- Irrigation systems can supply water to dry soil and allow for the intensive cultivation of crops. It can also bring abot negative impact on the soil and water quality.
- Salinisation can occur as the pumping of groundwater to the irrigation channels can result in raising of the water table, which brings mineral salts closer to the surface at the upper soil layers.
- As water evaporates from the soil, the salts are left behind which results in the soil becoming saline. This results in degradation of land as crops can no longer grow on the saline soil which has high concentration of salts.
- The salts from the groundwater also enters the river as the water table is being raised from the tapping of groundwater which results in poorer water quality.

16 Study the photograph below, which shows a method of harvesting used by some farmers.



With reference to the photograph above and other studies you have made, explain how technological advancements affect the intensity of food production. [4]

(ACSI 2017 Q6)

- Through the use of machinery such as combined harvester, farming is more efficient as the process of harvesting is sped up and there is also less reliance on human labour, resulting in **higher crop yield**.
- High-yielding varieties are cross-bred to develop improved strains of crops, for example shorter growing season which allows for more harvests a year, resulting in **higher crop yield**.
- Use of irrigation supplies water to agricultural land, for example through use of centre pivot irrigation, allowing crops to be cultivated on land that used to be too dry, making more arable land available, increasing amount of crops cultivated, hence resulting in **higher crop yield**.
- Use of irrigation supplies water to agricultural land, for example through use of centre pivot irrigation, allowing crops to be grown all year round even when there is less rainfall during dry season, resulting in **higher crop yield**.
- Use of fertilisers helps supply nutrients for healthy plant growth and replenish nutrients that have been used up which allows for shorter fallowing period for farmers to plant continuously, resulting in **higher crop yield**.

Open-ended questions

1 To avoid food shortages, there is a need to increase food production.
How far do you agree with the statement? Give evidence to support your answer. [8]
(O-Level 2021)

2 The benefits brought by the use of fertilisers, pesticides and irrigation outweigh the damage caused to water and soil quality.
How far do you agree? Give evidence to support your answer. [8]
(O-Level 2020)

3 Political factors such as poor governance and civil strife are the major causes of food shortages.
How far do you agree? Give evidence to support your answer. [8]
(O-Level 2019)

4 The growth of biofuel crops is the greatest threat to food security.
To what extent is this true? Use examples to support your answer. [8]
(O-Level 2017)

5 Physical factors are the most important in determining the intensity of food production and supply.
How far do you agree? Give evidence to support your answer. [8]
(O-Level 2016)

6 Intensification of food production cannot be achieved without harm to the environment.
To what extent is this true? Support your answer with evidence. [8]
(O-Level 2014)

7 For one or more areas, describe how the Green Revolution has increased food production.
In what ways has the Green Revolution caused problems and how far have they been overcome? [8]
(O-Level 2012)

8 The use of biotechnology has been effective in overcoming food shortages.
How far do you agree? Give evidence to support your answer. [8]
(CCHM 2017 Q3)

9 Evaluate the effectiveness of strategies introduced to address the problems of food shortage. [8]
(ACSI 2017 Q3)

10 Assess the success of technological factors to increase food supply. [8]
(ACSI 2017 Q4)

11 ‘Physical factors play a great role in determining the levels of food production in LDCs.’
How far do you agree with the statement? support your answer with evidence. [8]
(ACSI 2017 Q5)

12 ‘Food shortages are mainly the result of social factors.’

To what extent is the statement true? Support your answer with evidence. [8]

(ACSI 2017 Q6)