

The future for global agriculture The adaptation of agriculture to climate change

Agriculture is especially vulnerable to the impacts of climate change. Changes in temperature and rainfall, shifting pests and diseases, and increasingly frequent extreme weather events will affect food production and food security globally. Currently, agriculture is responsible for 11% of global greenhouse gas emissions, so its adaptation to climate change should include reducing that figure.

What can be done so that agriculture can adapt to climatic changes?

1. Changing methods (all of which help to reduce agriculture's carbon footprint)

- Reduce the amount of tilling of the soil (ploughing, hoeing, raking etc) – disturb the soil less frequently and reduce the depth of disturbance; adopt the minimum amount of tilling necessary for crop production.
- Expand crop rotations – crop rotation involves planting different crops in sequence on the same plot of land to improve soil health, optimize nutrients in the soil, and combat pests and weeds. For example, say a farmer has planted a field of maize or wheat, when the harvest is finished, beans might be planted, since cereal crops needs a lot of nitrogen and beans return nitrogen to the soil.
- Plant cover crops – a cover crop is a non-cash crop grown mainly to protect or improve the soil between periods of regular crop production. Cover crops can manage soil erosion, soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife in an agricultural ecosystem. Cover crops may be off-season crops planted after harvesting the cash crop; they may grow over winter.
- Bringing back livestock into crop rotation systems – this has been shown to reduce agriculture's own carbon footprint and to be of benefit to the crops, animals and soil. The

animals fertilise the land so less artificial fertiliser is needed.

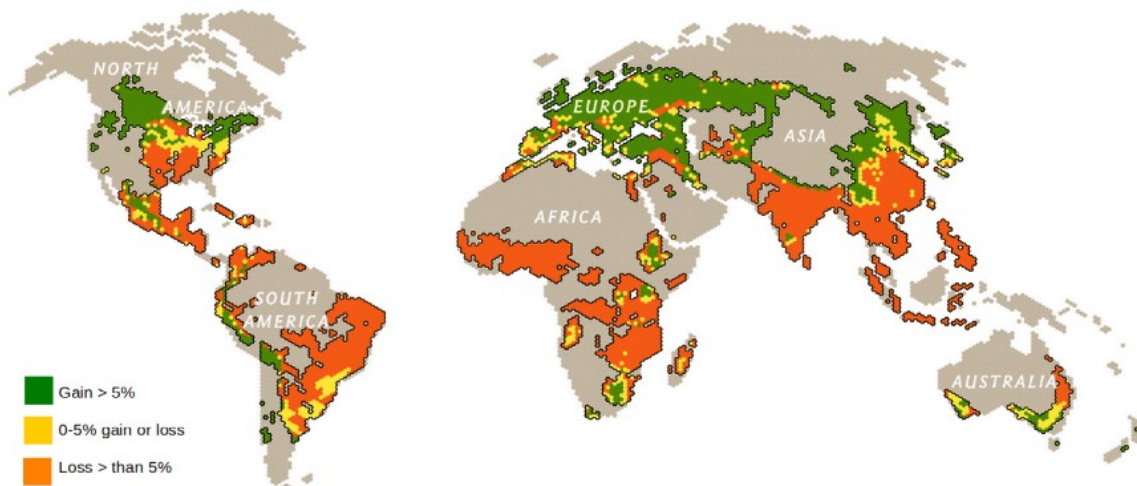
- If more and more people become vegetarian and vegan, demand for produce of different types will change dramatically, so affecting farming methods.

Adopting these practices seems to be an obvious choice, so why do the majority of farmers globally continue to use traditional agriculture practices?

- Farmers would have to make significant changes with no guarantee of immediate success.
- They would experience decreased yields during the transition process, as they gain the required experience to learn and perfect the changes.
- Decrease in production poses difficult financial problems, e.g. farmers in India, already have difficulty in competing with developed nations, where subsidies have artificially driven down the price of agricultural produce. Often import and export policies heavily favour consumers over producers by keeping prices artificially low.
- The whole infrastructure of agriculture would have to change – all agricultural suppliers, machinery, hauliers and so on would be involved.
- For the agriculture in some developing countries to adapt to climatic changes, foreign investment and expertise will be needed to avoid failure and mass migration of populations.

2. Changing crops

Climate change may benefit some crops by lengthening growing seasons and increasing atmospheric carbon dioxide. Yet other effects such as more pests, droughts, flooding, heat waves can be devastating.



Map shows areas that produced 75% of maize, potatoes, rice and wheat yields in 2015.

It shows the change in potential average yields in these crops in 2050.

Produced by the International Food Policy Research Institute, using the HadGEM2. climate model.

Predictions for the future from the HadGEM2 model:

North America – currently, no region grows more maize than the mid-western United States. According to the map, there would be a 20% drop in production but the region will probably remain a global supplier. However, farms will have to adapt to cope with more severe weather events, like droughts and floods.

South America – many crops will suffer in Brazil. The model suggests that maize farmers will see crops decline by nearly 16%. It is hoped that the rain forest will not continue to be felled at its current rate and rather than developing large meat-producing farms, farmers will diversify production.

Northern Europe – potato farmers will see longer growing seasons, so will be able to grow more. Fields farther south will become increasingly dry and new drought-resistant species will have to be developed.

West Africa – the rich soil and abundant water may support more rice. Parts of *East Africa* are believed to have great potential to expand production if irrigation schemes and modern farming practices can be developed.

Asia – with its large population and land area, changes will affect the most people. *India and China* will experience major losses of arable land and new crops and changing practices will need to be adopted.

Indonesia – rice production will be largely spared by climate change, but maize will decline by as much as 20%. Hopefully new more mixed farming practices will be introduced.

New parts of *Australia* will become arable, but droughts will require efficient farming with irrigation, if growing wheat is to continue. Parts of the country are affected by severe flooding at times.



Sunflowers may become a common crop in Northern Europe as temperatures increase.

The photo shows a sunflower field near Deeping St Nicholas, Lincolnshire where the flowers are grown for bird food.

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Desert locusts in Morocco
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Food security

The changing climate and the ever-increasing global population are having great impacts on agricultural production, which are likely to challenge food security in the future. Global food security relies on both enough food production and access to food, and is defined as a state when "all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life". The principal barrier to food security is currently food access. **Sufficient food is produced globally to feed the current world population, yet more than 10% are undernourished.**

In groups, **ask the pupils** to use the internet or reference books to describe a typical farm in one country in the world, e.g. wheat in Canada, rice in China, beef in Brazil, sheep in New Zealand, subsistence in Botswana. Be aware that climate change may mean that farming can no longer continue in the chosen area.

Ask them to:

- describe briefly how the farm operates now;
- describe how its methods might change to adapt to a changing climate;
- describe how the crops/animals might change to adapt to a changing climate;
- give a short presentation to the whole class about their results;
- summarise the findings.

Back up

Title: The future for global agriculture

Subtitle: The adaptation of agriculture to climate change

Topic: How global farming methods and crops may need to change in response to changes in the climate.

Age range of pupils: 14 years upwards

Time needed to complete activity: 30 to 60 minutes depending on the levels of discussion

Pupil learning outcomes: Pupils can:

- explain how agriculture is vulnerable to climate change;
- list how farming methods could change to adapt to climate change;
- explain how new methods will aim to reduce agriculture's greenhouse gas emissions;
- explain how crops will change as the planet warms;
- describe current farming practices in one country;
- explain how those practices and crops will have to change in the future;
- explain that without foreign intervention and investment, farms in some developing countries will fail, leading to mass migration of populations;
- explain the meaning of food security.

Context:

Global agriculture will have to adapt as the planet's climate continues to change. How farming methods and the introduction of new crops can change, to adapt to the new conditions and reduce agriculture's greenhouse gas emissions, are discussed.

2019 will go down in history as a most difficult planting season; in the USA, more than 4 million hectares of crops were not planted due to extreme weather conditions; farmers in the Punjab, in India, experienced rain showers almost every month; and more humid air in Africa led to greater pest infestations.

Following up the activity:

Search the internet for farming types other than the one investigated for this activity. How might these farms adapt to climate change? Investigate the synthetic meat and fish substitutes that are currently being developed.

Underlying principles:

- Agriculture will need to change as the climate changes.
- Some agricultural land will benefit from global warming while some will not.
- Climate alone does not dictate crop yields. There are other factors: politics, global demand, agricultural practices.
- New farming methods must include soil protection i.e. less tilling of the soil, crop rotation to even out nutrients, mixed farming to reduce the need for artificial fertilisers.
- Agriculture's current greenhouse gas emissions are 11% of the global total. New methods must reduce this figure.
- New crops will be introduced as climate changes.
- Without intervention, farming in some developing countries will fail, leading to mass population migration.

Thinking skill development:

A pattern develops as changing farming methods and changing crops in response to climate change are introduced. Discussion of how farms will change involves metacognition and many of the difficulties encountered will cause cognitive conflict. Applying all the necessary changes to real farm situations is bridging.

Resource list:

- normal school resources

Useful links:

Search 'net-zero' on the Earthlearningidea website to find other Earthlearningideas relating to climate change mitigation or adaptation. The full list may be seen on the last page.

Use a search engine like Google to explore the internet for more information about likely global impacts of 'net-zero' on global agriculture.

World Economic Forum -

<https://www.weforum.org>

National Geographic -

<https://www.nationalgeographic.com/climate-change/how-to-live-with-it/crops.html>

Source: Written by Elizabeth Devon of The Earthlearningidea Team

This information was as accurate as possible in Spring 2021

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The 'How will the 'net-zero' target affect your local area?' series of Earthlearningideas

Topic		Earthlearningidea title	
Introduction		How will the 'net-zero' target affect your local area?	
Possible mitigation measures	Use alternative energy sources	Solar	Harnessing the power of the Sun
		Wave	Harnessing the power of waves
		Wind	Farming the wind: through onshore and offshore windfarms
		Tidal	Tidal energy
		Nuclear	Nuclear power - harnessing the energy of the atom
		Nuclear waste	Nuclear waste disposal
		Biofuel	Liquid biofuels: keeping our wheels turning into the future
		'Blue' hydrogen	Blue hydrogen: the fuel of the future? Also: Hydrogen of many colours
		Geothermal – hot rocks	Deep geothermal power from 'hot dry rocks': an option in your area?
		Geothermal – flooded mines	A new use for old coal mines
		Hydro – small scale	Small-scale hydroelectric power schemes
		Heat pumps	Heat from the Earth
		Waste – incineration	Energy from burning waste
	Waste – methane	Energy from buried waste	
	Stop fuels releasing greenhouse gases	Carbon capture	Capturing carbon?
	Store energy from sources that give irregular energy supplies	Batteries	Nuclear batteries: the future?
		'Green' hydrogen	Green hydrogen used to even out renewable energy supplies? Also Hydrogen of many colours
		Hydro – storage	Matching supply and demand using stored water
	Provide raw materials for new technologies	Compressed gas	Storing gas underground: What can we store? How can we do it? How will it help?
		Electric vehicles	Electric vehicles: the way to go?
Remove carbon from the atmosphere	Insulation	How do I choose the best insulation?	
	Enhanced weathering	Speeding up nature to trap carbon dioxide	
Possible adaptation measures	Tree planting	Let's plant some trees	
	Coastal flooding	How will rising sea level affect our coastlines?	
	Inland flooding	Inland flooding: a Sheffield case study	
	Landslides	Landslide danger	
	Agriculture	The future for global agriculture	