



The Significance of Agriculture and its Requirements

TASK 1

Points to consider

a) First, consider what natural resources, products and equipment arable farming needs in order to produce enough food for the world's growing population.

The human population is growing, **the available farmland is not.**

Farmland is scarce **and the areas are unevenly distributed.**

Agriculture: Where are we headed?



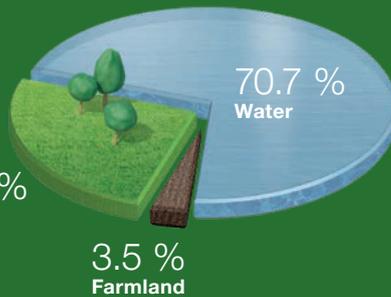
Predicted development of the world population up to 2050 (in billions)

Source: UN Department of Economic and Social Affairs, Population Division, 2015



Available farmland area per head of the world population (in square meters)

Source: FAO, 2012



Only 1.5 billion hectares of land worldwide is used for farming.

Source: FAOAGRAR-TRENDS

Mean farm sizes worldwide

Sources:	Mean farm size	Region
International Fund for Agricultural Development	1 ha	East Asia
Global Agriculture Report (2011), Farmers' Association	1-2 ha	Southeast Asia, Sub-Saharan Africa
	5 ha	West and North Africa
	11 ha	Central America
	32 ha	Europe
	60 ha	Germany
	112 ha	South America
	178 ha	USA



b) Once you have done so, use the following webpages to verify / refute your ideas and to add more information with explanations:



- // www.nature.com/articles/d41586-018-02792-7
- // <https://nifa.usda.gov/topic/agriculture-technology>
- // <https://ourworldindata.org/yields-and-land-use-in-agriculture>
- // www.risefoundation.eu/images/files/2014/2014_%20SI_RISE_FULL_EN.pdf

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Here you can choose between **alternative 1** and **alternative 2** with the corresponding tasks:

TASK

2.1

ALTERNATIVE 1:

A report on agriculture and climate change stated that “Faced with growing global demand and competition for resources, the EU’s food production and consumption need to be seen in a broader context, linking agriculture, energy, and food security.”

Data source:

www.eea.europa.eu/signals/signals-2015/articles/agriculture-and-climate-change

- a) Name reasons why agriculture is so important for our viability and quality of life.
- b) Evaluate the source of the quote and explain what effect it might have had on the outcomes mentioned in the report.

TASK

2.2

ALTERNATIVE 2:

- a) Look at the report below and analyze why “agriculture” is regarded as one of the main issues for climate change. Justify your answer.

Data source:

www.eea.europa.eu/signals/signals-2015/articles/agriculture-and-climate-change

- b) Evaluate the source of the report and explain what effect it might have had on the outcomes presented.

Various Forms of Agriculture



To get started and gain a better understanding of the subject, first watch the following video:

<https://www.youtube.com/watch?v=B8Vd1WWgFog>

Conventional farming, organic farming and future developments

As a result of technical advances, globalization and increasing competition, agriculture has changed and developed greatly over the years. In the meantime, many processes are highly-automated and use modern technology to guarantee and optimize yields. Other changes involve farm size, specialization in certain agricultural products and, more specifically, the development of monocultures. In a monoculture, a particular plant is usually grown over large areas for many years without any crop rotation. Ideally, for the farmer, specialization is associated with efficiency gain and, thus, with increased productivity. Therefore, the frequently stylized media depiction of life on the farm no longer fits the reality of farming practices today.

Conventional farming

The term “conventional farming” refers to traditional farming using standard agricultural practices. In Europe, most farmers practice conventional agriculture: in 2017, the organic farming area made up seven percent of total EU agricultural land¹. The term is often used to distinguish this type of farming from organic farming – the term “conventional” has only been in existence since the introduction of the organic (see below) form of agriculture. Thus, the term conventional farming refers to the currently prevailing methods of crop cultivation and animal husbandry, which need to be implemented in accordance with the general legal requirements that apply to farming, such as food safety or animal welfare laws.

In addition, there are numerous quality and certification programs and guidelines governing “good agricultural practice”, which many farmers involved in conventional agriculture follow voluntarily, in addition. Despite all this, conventional farming repeatedly comes under criticism nowadays. Many consumers want to see less use of crop protection products (CPPs), also known as pesticides, and fertilizers, more sustainable practices which take greater account of environmental effects and also better animal husbandry conditions.

¹ https://ec.europa.eu/eurostat/statistics-explained/index.php/Organic_farming_statistics

Various Forms of Agriculture

Organic farming

As agriculture intensified, organic farming developed as an alternative in the 20th century. Its methods are aimed particularly towards the maintenance of natural resources, biodiversity, soil fertility and water quality. One obligatory aspect of organic farming, for example, is a crop rotation cycle of several years, which reduces soil stress.

The use of synthetic chemical crop protection products (pesticides) and antibiotics in animals is highly restricted, while the use of genetically modified organisms (GMO) is prohibited. Natural pest control approaches, such as the use of beneficial species (the natural enemies of pests), are applied where significant pest infestation has occurred. Weeds are often removed mechanically. Natural fertilizers of composted livestock manure or organic material are used to fertilize crops. Additional fertilizers or soil improvers may be used only if they have been approved for use in organic production.

There are also certain CPPs permitted for use in organic farming, such as copper or sulfur. Crop species with the highest possible disease resistance and adapted to local growing conditions, are also selected. Furthermore, organic farming standards require the use of locally-available resources, e.g. livestock feed grown on the farm, and also the free-range, open-air rearing of livestock, which have to be fed with organic feeds.

However, because of its low productivity, organic farming requires a lot more agricultural land than conventional farming. Conventional production can achieve yields that are around 19 percent higher². Substantial expansion of the areas devoted to organic cultivation would mean transforming natural habitats into farmland – an effect that organic farming, as a system, actually aims to counteract.

The aim of organic production is to cause as little environmental impact as possible; due to the relatively high production requirements and the lower yield, organically-grown foods are, therefore, often (significantly) more expensive for the end consumer than foods grown using conventional farming techniques.

² Ponisio LC, M'Gonigle LK, Mace KC, Palomino J, de Valpine P, Kremen C. (2015)
"Diversification practices reduce organic to conventional yield gap". Proc. R. Soc. B 282: 20141396

Various Forms of Agriculture

Looking to the future: Sustainable agriculture and integrated farming

Since the land area available for cultivation is decreasing worldwide, while the world's population is rising, with a resultant increase in the amount of food required, "[Productivity growth] is seen as one prerequisite to meet the challenge of feeding more than nine billion people by 2050, by achieving more with less,' according to an EU market brief.³

"The sustainable intensification of agriculture is seen as a possible solution. This by producing more food from existing farmland in a way that the future production potential and livelihoods of rural communities are not undermined and the environment is not affected."^{3a} So, if it is to meet food requirements, farming not only needs to be as productive as possible, but it also has to be as environmentally-friendly and resource-efficient as possible. Therefore, sustainability plays an increasingly important role in agriculture. Innovative technologies can help optimize the use of resources.

One option for the future is to combine the advantages of each form of agriculture: The concept of integrated farming is heading in this direction. In this approach, the aim is to find the best possible pest control solution, based on all available methods. The treatment method that is chosen is the one that can achieve maximum yields with minimum environmental impact.

Sources:

// www.fao.org/organicag/oa-faq/oa-faq1/en/

// www.sare.org/Learning-Center/Bulletins/Transitioning-to-Organic-Production/Text-Version/What-is-Organic-Farming

// [www.europarl.europa.eu/RegData/etudes/BRIE/2015/557009/EPRS_BRI\(2015\)557009_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/557009/EPRS_BRI(2015)557009_EN.pdf)

// www.fao.org/organicag/oa-faq/oa-faq6/en/

// <https://geneticliteracyproject.org/2017/02/16/organic-farming-better-environment/>

// <https://geneticliteracyproject.org/2016/11/15/organics-v-conventional-v-gmos-debate-grows-farm-yields-sustainability/>

// <https://geneticliteracyproject.org/2019/01/24/when-it-comes-to-food-pesticides-and-drugs-does-natural-mean-safe/>

// <https://geneticliteracyproject.org/2018/12/20/>

[can-we-meet-a-growing-need-for-food-without-destroying-our-environment/?mc_cid=f5c31a77cb&mc_eid=58fe812bdb](https://royalsocietypublishing.org/doi/full/10.1098/rspb.2014.1396)

// <https://royalsocietypublishing.org/doi/full/10.1098/rspb.2014.1396>

³ https://ec.europa.eu/agriculture/sites/agriculture/files/markets-and-prices/market-briefs/pdf/10_en.pdf

^{3a} <http://theconversation.com/the-future-of-food-growing-more-with-the-same-land-35559>



Various Forms of Agriculture

TASK

1

Compare organic and conventional farming methods with regard to the aspects listed in the table. You can add other aspects into the empty cells of the table.

	Organic farming	Conventional farming
Farm size		
Land area needed for cultivation		
Effects on the environment (e.g. on the soil and on water quality)		
Yields		
Food prices		
Food production		

Various Forms of Agriculture

TASK

2

Record some new technical terms and their definitions in a glossary.

TASK

3

Research the standards for organic production of fruits and vegetables in the EU.

The legal basis is provided by Regulation (EC) no. 834/2007, Article 12.



// www.irishstatutebook.ie/eli/2016/si/683/made/en/print

// https://ec.europa.eu/agriculture/organic/organic-farming/what-is-organic-farming_en

// www.gov.uk/guidance/organic-farming-how-to-get-certification-and-apply-for-funding

// www.soilassociation.org/our-standards/what-are-organic-standards/

// https://ec.europa.eu/info/publications/legislation-organics-sector_en



TASK

4

Working together, note down the arguments for and against conventional and organic farming in the table next page. When you finish, formulate a personal statement as to which elements of these two types of farming might be sustainable for the future and justify your opinion.



Various Forms of Agriculture



	Organic farming	Conventional farming
Advantages		
Disadvantages		

Personal statement



Crop Protection and Agriculture

“Crop protection products” (CPPs), also known as “pesticides”, is an umbrella term for substances that are used to control weeds, i.e. unwanted plants (these substances are called herbicides), insect pests (insecticides) and fungi or fungal diseases (fungicides).

In addition to the synthetic chemical CPPs, there are also organic (biological) ways of controlling pests, e.g. with so-called beneficial species (or beneficials) – these are predators of the pests being controlled. CPPs are used in agriculture to help maximize crop yields, and prevent crop failures and to assure the quality of the harvest. However, some pesticides are also used outside farming, for instance in gardening, forestry or in communal areas e.g. parks.

TASK

1

Test your prior knowledge and answer the following questions (more than one answer may be correct):

1. CPPs (pesticides) are used:

- a) to scare off birds with the smell of the CPP and to stop them from eating seeds after they are sown.
- b) to protect the crop from pests / organisms that cause disease (pathogens) / competitor plants so that crop growth is unrestricted.
- c) to improve the color of the crop, so that it looks more attractive to pollinators such as honey bees and bumblebees.

2. A herbicide is used for the:

- a) control of fungi.
- b) control of insect pests.
- c) control of weeds and unwanted plants.



Crop Protection and Agriculture

3. The advantage of CPPs is that:

a) they make fruit and vegetable varieties particularly colorful, making them more attractive for the end consumer.

b) they can improve the quality and yields of the fruits of the treated plants by controlling insect pests.

c) they make trees grow bigger so that they can bear more fruit.

4. Before a CPP is authorized to be used,

a) a risk assessment needs to be carried out first.

b) the active substance to be used needs to be approved by the EU Commission and by relevant Consumer Protection and Food Safety authorities.

c) a registration by the country Environment Ministry is sufficient.

5. The risk assessment of active substances determines whether, if used as intended:

a) a potentially harmful effect on the health of humans and animals is to be anticipated – for example via drinking water, human food or animal feeds.

b) a negative effect on the quality of groundwater is to be expected.

c) unacceptable effects on non-target organisms, such as bees, are foreseen.

Crop Protection and Agriculture

TASK

2



Using the following websites, inform yourself about CPPs / pesticides (when you do this, ensure you are discriminating and critical in your approach to the sources).

// <https://geneticliteracyproject.org/2016/07/25/organic-vs-conventional-farming-lower-environmental-impact/>
 // www.efsa.europa.eu/en/topics/topic/pesticides
 // www.youtube.com/watch?v=aTm7i84mcMI
 // www.ecpa.eu/reports_infographics/pesticide-use-and-food-safety
 // <http://ec.europa.eu/assets/sante/food/plants/pesticides/lop/index.html>

Additional sources:

// https://ec.europa.eu/food/plant/pesticides_en
 // www.pcs.agriculture.gov.ie/aboutus/aboutpesticides/whydoweneedpesticides/
 // www.nfuonline.com/cross-sector/science-and-technology/crop-protection/crop-protection/pesticides-faqs-your-questions-answered/
 // www.pan-uk.org/site/wp-content/uploads/List-of-active-substances-approved-for-use-in-organic-agriculture.pdf
 // www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=9874504b6f1025eb0e6b67cadf9d3b40&rqn=div6&view=text&node=7:3.1.1.9.32.7&idno=7#sg7.3.205.g.sg0



You don't always need all the information on each page. Read through the task description carefully first, so that you know what you are looking for, and so that you can search specifically for this information. Skimming the text for keywords will also help you filter out the answers.

Once you have done this, work through the following tasks:

- a) Explain what CPPs (pesticides) are used for and why.
- b) Prepare an overview for yourself of how CPPs are tested, before permission is given for them to be sold and used.
- c) Comment on the statement: "Crop protection products – better than their reputation."
- d) List possible alternatives to chemical CPPs. Have a class discussion about this afterwards.

Finally, summarize the positive aspects of using CPPs in agriculture, along with the potential problems of doing so.

Regulation of Crop Protection Products

TASK

1

Look at the following videos and/or articles again, this time focusing on the regulation of CPPs in European legislation and answer the following questions using keywords:

- What is the process for registering a CPP? Who is involved?
- What is meant by “maximum residue levels”?
- Are there any other controls or standards for the use of CPPs?



- // www.youtube.com/watch?v=aTm7i84mcMI
- // www.efsa.europa.eu/en/topics/topic/pesticides
- // www.ecpa.eu/reports_infographics/pesticide-use-and-food-safety
- // https://ec.europa.eu/food/plant/pesticides/authorisation_of_ppp_en
- // www.hse.gov.uk/pesticides/topics/pesticide-approvals/pesticides-registration/general/faq-on-registration-of-pesticides.htm
- // www.nfuonline.com/cross-sector/science-and-technology/crop-protection/crop-protection/pesticides-faqs-your-questions-answered/
- // <https://english.ctgb.nl/about-ctgb>
- // www.hse.gov.uk/pesticides/topics/reducing-environmental-impact/maximum-residue-levels/mrls-basic-guidance.htm



TASK

2

The use of CPPs (pesticides) is often criticized by the public and NGOs. Based on the background knowledge you have gained so far, work with a partner and discuss your opinions about this.

What does the Future of Farming look like?

TASK
1

Give a brief verbal summary of the main features of conventional and organic farming, respectively.



TASK
2

Think about and discuss which type of farming is going to play an important role in the future, in view of the world's growing population. In this context, also discuss the meaning of the term "sustainable agriculture".



Here you can choose between **alternative 1** and **alternative 2**:

TASK
3.1

ALTERNATIVE 1:

Write a newspaper article or make up a role play or interview in which you explain both types of farming and present your vision for the farming of the future.

TASK
3.2

ALTERNATIVE 2:

Create a poster, in which you explain the farming of the future, incorporating the knowledge you have gained from your previous workstation exercises (worksheets 2A-C).



For those who are already finished, there is an extension task on the next page.

What does the Future of Farming look like?



EXTENSION TASK

Discuss the farming of the future:

Working in groups, first work out different standpoints about the future of farming, and assign one of these to each group member. Collect arguments for each point of view and also prepare yourselves for counter-arguments from the others point of view.

Stakeholders in the debate:

- // Farmer (small family farm)
- // Farmer (large farm)
- // Consumer (general public)
- // Environmentalist
- // Scientist

During the discussion, follow the usual rules for dialogue. The moderator begins, directs and ends the debate.

The aim of the debate is to find a joint proposal for the future of farming, in view of the growing world population.

You can find some more background information on the various standpoints here:



- // The Future of Farming and Agriculture video:
www.youtube.com/watch?v=Qmla9NLFbVU
- // <https://foodtank.com/news/2015/03/esther-farmer-story/>
- // www3.weforum.org/docs/WEF_Innovation_with_a_Purpose_VF-reduced.pdf
- // www.anthropocenemagazine.org/2018/09/sustainable-intensification-is-no-longer-an-oxymoron-it-could-be-the-future/
- // <https://businesswales.gov.wales/farmingconnect/posts/importance-biodiversity-and-wildlife-farmland>
- // www.cropsscience.bayer.com/en/stories/2017/high-tech-helpers-for-tomorrows-agriculture-precision-farming-is-the-future
- // www.weforum.org/agenda/2017/06/how-consumer-demand-and-new-technologies-will-drive-sustainable-agriculture/



General Background Information for Teachers

World population and food requirements

The human population is growing, **the available farmland is not.**

Agriculture: Where are we headed?



Predicted development of the world population up to 2050 (in billions)

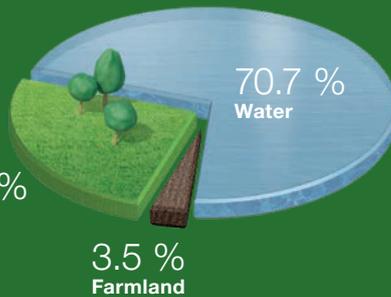
Source: UN Department of Economic and Social Affairs, Population Division, 2015



Available farmland area per head of the world population (in square meters)

Source: FAO, 2012

Farmland is scarce and the areas are unevenly distributed.



Only 1.5 billion hectares of land worldwide is used for farming.

Source: FAOAGRAR-TRENDS

Mean farm sizes worldwide

Sources:	Mean farm size (ha)	Region
International Fund for Agricultural Development	1 ha	East Asia
Global Agriculture Report (2011), Farmers' Association	1-2 ha	Southeast Asia, Sub-Saharan Africa
	5 ha	West and North Africa
	11 ha	Central America
	32 ha	Europe
	60 ha	Germany
	112 ha	South America
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General Background Information for Teachers

More people, less arable land

The agricultural sector is facing huge challenges. According to the United Nations Food and Agriculture Organization (FAO), agricultural productivity will need to increase by around 60 percent by the year 2050 relative to the year 2005 – without compromising sustainability.

By 2050, the world population will have grown to nearly ten billion people (UNO, 2017). This is around 30 percent more people than today. Feeding a world population that continues to grow is an immense political and societal challenge, involving issues such as the fair distribution of available food and new ideas to prevent food waste. However, it is also a major task for the agricultural sector, which is expected to produce sufficient, high-quality foods.

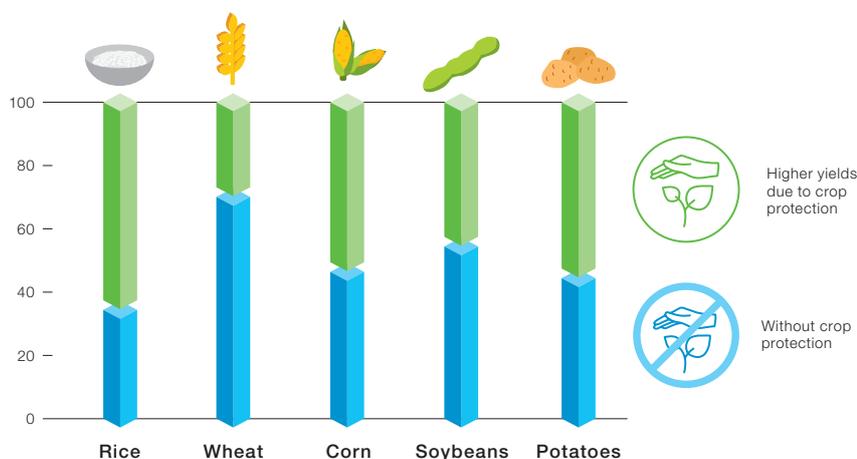
While the population is growing rapidly, the amount of arable land available is limited. According to FAO estimates, the area of arable land available per head in 1950 was still the size of four Olympic swimming pools; since then, it has already shrunk to less than two and this trend is set to continue. But this is not the only problem. Due to climate changes, harvest yields are set to decline by 17 percent through 2050 (FAO). Wheat, for example, is highly temperature-sensitive.

At the same time, the demand for higher-quality foods is growing rapidly, due to the significantly expanding middle class in developing and emerging countries. According to the FAO, 70 percent more meat is likely to be consumed in those countries by 2050. “Tank or plate” is another driver for the food shortage: there is a rising trend towards the production of biofuels from certain crops.

All this demonstrates that farming will need to become more productive but also more sustainable, in future, in order to meet the needs of a rising number of consumers. Modern agriculture will, thus, become a key sector over the next few decades.

Increasing yields by crop protection

Pathogens, pests and weeds are a threat to farmers’ yields around the world. Without crop protection, the yields of important field crops would be reduced by one-third.



Data source:
Oerke (2006). “Crop Losses to Pests.” In: Journal of Agricultural Science 144: 31-43.



The Significance of Agriculture and its Requirements

TASK

1

WORKSHEET 1 /// TASK 1

1a)

- // Combine harvester, tractor, reapers, milking systems, cooling systems, other machines
- // Storage silos
- // Water, irrigation plants
- // Fertilizers, crop protection products (pesticides), animal feed, seeds and propagation materials
- // Electricity, fuel

1b) Internet research



Here the students can choose between **alternative 1** and **alternative 2** with the corresponding tasks:

TASK

2.1

WORKSHEET 1 /// TASK 2 /// ALTERNATIVE 1

- // Agriculture assures a food supply by growing and selling crops and their products (and by rearing, breeding and selling animals).
- // It influences the structure of the landscape and thereby also has a huge effect on its appearance. Agriculture, or farm life, is part of European culture.
- // ...

TASK

2.2

WORKSHEET 1 /// TASK 2 /// ALTERNATIVE 2

Compare answers to Alternative 1, Task 1b.

Agriculture is essential for food production, at the same time it impacts the environment. Climate change is one of the current environmental challenges we face. As agriculture intensifies, to provide more food from the arable land that is available, greenhouse gas emissions may increase, such as methane and nitrous oxide, two powerful greenhouse gases. It will become even more important to ensure that measures are in place to protect the climate.

Before our food gets to us, it has to be produced, stored, processed, packaged, transported, prepared and served. At every stage, providing our food releases greenhouse gases into the atmosphere.

In general, in northern Europe agricultural productivity might increase in future due to a rise in temperature, leading to a longer growing season and an extension of the frost-free period. Warmer temperatures and longer growing seasons might also allow new crops to be cultivated.

It is clear that the world will need to produce more food and that key resources are limited. Agriculture has high impacts on the environment and the climate. Moreover, climate change affects – and will continue to affect – how much food can be produced and where.

Critical appraisal of the source:

The source comes from the European Environmental Agency, in whose interest it is to highlight the significant role of agriculture on climate change. This would oversimplify the complexity of the issue of climate change, which is impacted by multiple factors. The view taken in the article is not an objective one.



Various Forms of Agriculture

TASK

1

WORKSHEET 2A /// TASK 1

(Student can add other aspects into empty cells of the table.)

	Organic farming	Conventional farming
Farm size	Variable – from small to large	Variable – from small to large
Land area needed for cultivation	More land area needed for cultivation due to lower productivity	Less agricultural land area needed due to higher productivity
Effects on the environment (e.g. on the soil and on water quality)	<p>Particular focus on less environmental impact</p> <p>Additional information for the teacher: // E.g. by means of multi-year crop rotation and stringent restrictions on the use of chemical and synthetically produced crop protection products (pesticides) or fertilizers. // But: Also the mechanical removal of weeds and the application of organic fertilizers, as evaluated extensively, can put pressure on the soil and groundwater.</p>	<p>Stronger focus on optimal productivity</p> <p>Additional information for the teacher: // Intensive production, e.g. in monocultures, can impair soil fertility. // The use of fertilizers and chemical and synthetically produced crop protection products can lead to residues in soils and waters; their compatibility with the environment is evaluated extensively in the registration process. // Keep in mind: Many farmers voluntarily take action to minimize environmental impact.</p>
Yields	<p>Generally lower</p> <p>Additional information for the teacher: // Under comparable conditions, yields are, on average, 19 percent lower than in conventional farming. (Source: Ponisio LC et al. 2014. "Diversification practices reduce organic to conventional yield gap". Proc. R. Soc. B 282:1396).</p>	<p>Generally higher</p> <p>Additional information for the teacher: // Yield increases, e.g. by using innovative and highly specialized technologies.</p>
Food prices	<p>Generally higher (compare land use and yields)</p>	<p>Generally lower (compare land use and yields)</p>
Food production	<p>Lower</p> <p>// According to the German Federal Minister of Agriculture, the food requirements of the world's population cannot be assured with organic farming alone.</p>	<p>Higher</p> <p>// According to the German Federal Minister of Agriculture, the food requirements of the world's population can only be assured with conventional farming.</p>

Additional information for teachers:

There are virtually no differences between organically and conventionally grown foods with regard to vitamin and nutrient content, or from the a safety point of view: This was the conclusion of a review study from Stanford University, which analyzed more than 200 studies on the topic.

(Source: Smith-Spangler C et al. 2012. "Are Organic Foods Safer or Healthier Than Conventional Alternatives? A Systematic Review". Ann Intern Med. 157: 348-366).



Various Forms of Agriculture

TASK

2

WORKSHEET 2A /// TASK 2

Individual solutions

TASK

3

WORKSHEET 2A /// TASK 3

Production

Search for 'Council Regulation (EC) No. 834/2007'

Special regulations for organic crop production (a selection, not a complete list):

Article 12

Plant production rules

1. In addition to the general farm production rules laid down in Article 11, the following rules shall apply to organic plant production:
 - (a) organic plant production shall use tillage and cultivation practices that maintain or increase soil organic matter, enhance soil stability and soil biodiversity, and prevent soil compaction and soil erosion;
 - (b) the fertility and biological activity of the soil shall be maintained and increased by multiannual crop rotation including legumes and other green manure crops, and by the application of livestock manure or organic material, both preferably composted, from organic production;
 - (c) the use of biodynamic preparations is allowed;
 - (d) in addition, fertilizers and soil conditioners may only be used if they have been authorized for use in organic production under Article 16;
 - (e) mineral nitrogen fertilizers shall not be used;
 - (f) all plant production techniques used shall prevent or minimize any contribution to the contamination of the environment;
 - (g) the prevention of damage caused by pests, diseases and weeds shall rely primarily on the protection by natural enemies, the choice of species and varieties, crop rotation, cultivation techniques and thermal processes;
 - (h) in the case of an established threat to a crop, plant protection products may only be used if they have been authorized for use in organic production under Article 16;
 - (i) for the production of products other than seed and vegetative propagating material only organically produced seed and propagating material shall be used. To this end, the mother plant in the case of seeds and the parent plant in the case of vegetative propagating material shall have been produced in accordance with the rules laid down in this Regulation for at least one generation, or, in the case of perennial crops, two growing seasons;
 - (j) products for cleaning and disinfection in plant production shall be used only if they have been authorized for use in organic production under Article 16.



Various Forms of Agriculture



WORKSHEET 2A /// TASK 4

Organic farming

Advantages

- // More environmentally-friendly due to less environmental impact on soil and water
- // Use of biological pest control approaches and organic fertilizers
- // Keep in mind: the use of copper and sulfur is also disputed

Disadvantages

- // Highly labor-intensive
- // Land-intensive. According to the Federal Minister of Agriculture, too little land is available to feed the world's population
- // Higher prices for the end consumer

Key points:

Organic farming alone will not be enough to feed the world; there is pressure on conventional farming to focus more on sustainable practices. This can be achieved by integrating elements from organic farming, by better use of resources or via new technologies to increase productivity, or by integrating concepts that minimize adverse effects on the soil and on biodiversity. One possible approach is so-called integrated farming (see text of Worksheet 2a).

Last but not least, it is up to consumers to decide which foods they buy. The willingness and ability of consumers to pay more for sustainably-produced agricultural products also plays a significant role.

Conventional farming

Advantages

- // Uses less land compared to organic farming
- // Production of large quantities at lower prices. Guaranteed food supply, customer satisfaction due to wide variety and low prices

Disadvantages

- // Environmental impacts (e.g. on soil and water) under certain circumstances
- // Intensive production due to cost pressure, e.g. monocultures, may lead to less fertile soils



Crop Protection and Agriculture

TASK

1

WORKSHEET 2B /// TASK 1

1 a (though this is an exception) and b

2 c

3 b, possibly also a and c

4 a and b

5 a, b, c

TASK

2

WORKSHEET 2B /// TASK 2

a) Crop protection products (CPPs) are used to control insect pests, weeds or fungi, thus allowing crops to grow normally and ultimately increasing the quantity and quality of agricultural produce.

b) The risk assessment involves testing whether CPPs, when used correctly, have a harmful effect on human health and the environment. A possible negative impact on the groundwater quality is also investigated. This may include a complex multi-tier assessment scheme, starting with laboratory studies and, if required, also involving semi-field and field tests.

c) Individual answers

d) Alternatives:

Preventative measures instead of herbicides:

// Shallow soil tillage: hoeing, selective flaming.

However, mechanical treatment is not always soil-friendly.

Preventative measures instead of insecticides:

// Breeding and selection of robust crop varieties

// Diverse crop rotation

// If required: use of plant-based products (e.g. liquid nettle fertilizer), mineral powders (e.g. seaweed calcium) and also, to a limited extent, plant-based insecticides

Controlling fungal infestation without fungicides:

// Use of sulfur and copper salts

Main, natural approach of pest control:

// Use of the natural enemies of insect pests, known as beneficials: these include beetles, flies, mites, among others ...

Key points:

// Organic farming also has an effect on the soil and the environment.

// In addition, some organically-grown crops can rot more quickly and often look less "attractive".



Crop Protection and Agriculture

TASK

2

WORKSHEET 2B /// TASK 2

Summary for Task 2 (with supplementary information for the teacher):

Potential negative influences:

Crop protection products (CPPs) land up in the environment

- // Active substances which, when used to treat crops, get into the soil and leach or drift from the treated field into adjacent land, may come into contact with animals and plants which were not targeted with the treatment.
- // The accumulation of certain persistent substances in the soil (though these are now largely restricted as a result of regulatory restrictions on poorly-biodegradable substances).

Potential positive influences:

Increased yields through the control of pests / diseases / weeds. Rich harvests, increased quality. Low prices, meeting increased food requirements (a weighty argument!)

- // Up to 40 percent of global crop production is lost each year as a result of weeds, insects and plant disease. Without crop protection, these losses could be twice as high, with serious consequences for food availability and food supplies, and also for food prices (Source: CropLife International).

Limited natural resources, such as land suitable for cultivation, can be better utilized with the aid of CPPs.

- // Without high-yielding varieties, CPPs and the use of machines for cultivation, an additional 970 million hectares of arable land would be needed to feed today's world population – this is more than the land area of the USA (Source: CropLife International).

Plant protection does not stop with the harvest:

- // Harvests often need to be stored or packaged for prolonged periods and transported to other locations.

Up to the time of sale, this means that fungi, moths, flies or beetles can destroy a laboriously-harvested cereal crop. Fruits and vegetables are also at risk – fungal spores may settle on them, for example. Correct storage and the use of insecticides and fungicides can help prevent such losses and guarantee food safety and quality.



Regulation of Crop Protection Products

TASK

1

WORKSHEET 2C /// TASK 1

1a) Process for registering a CPP and who is involved

- // EU: Following preparation by individual Member States, the EFSA (European Food Safety Authority), assesses the available studies and data on the active substances which are to be used in CPPs. The European Commission, acting jointly with the EU's Member States, decides whether an active substance should be approved or not.
- // The risk assessment determines whether CPPs, if used correctly, have a harmful effect on human health and on the environment. A possible negative impact on the quality of surface water and groundwater is also investigated. A further aim is to estimate potential effects on non-target organisms. This may entail a complex, multi-tier assessment process, starting with laboratory studies and, if required, also involving semi-field and field tests.
- // The registration of an active substance does not automatically mean the registration of the CPP that contains this active substance, since the composition of the product can vary depending on the additives used. The different uses of the product must also be assessed and approved, which happens at the national level.
- // In Germany, for example, the assessment of CPPs is a task shared by several agencies: the Federal Institute for Risk Assessment (BfR) carries out the risk assessment in the area of human health; the Federal Environment Agency (UBA) is responsible for the environmental evaluation, while assessment of the efficacy of CPPs is carried out by the Julius Kühn-Institut (JKI, the Federal Research Centre for Cultivated Plants). The BVL (the Federal Office of Consumer Protection and Food Safety) has a coordinating role: If a final positive recommendation is given, this agency then registers the products on a national level.
- // In the EU, an active substance is generally, initially registered for up to ten years, after which the manufacturer has to submit a new application for re-registration, and additional testing of the active substance is conducted on the basis of current scientific knowledge and technology. Based on these new results, the approval may be extended or revoked. In general, this is also followed by renewed evaluation of all the CPPs that contain the active substance, since the registration period of CPPs is dependent on the registration period of the active substances they contain.



Regulation of Crop Protection Products

TASK

1

WORKSHEET 2C /// TASK 1

1b) Meaning of “maximum residue levels”

- // EU-wide maximum residue levels apply to all EU-registered active substances; adherence to these levels is necessary to allow the sale of cereals, fruit and vegetables that have been treated with these CPPs. The levels depend on the crop / foodstuff and they are calculated with the aid of extensive studies, based on average dietary consumption.
- // More than 80,000 food samples are tested for residues each year in the EU alone. The results speak for themselves: In 2015, 97.2 percent of the samples were below the legal maximum residue level, while more than half were below the limit of detection for the relevant active substances (Source: EFSA, The 2015 European Union Report on pesticide residues in food). However, since a variety of safety factors need to be taken into account when defining these limit values, the fact that a limit value has been exceeded slightly in no way means that consumption of the food in question is automatically harmful.
- // In Germany, for example, 97.9 percent of German fruit and vegetable samples were below the legal limit, in 2015. Out of all the food groups tested, 2.1 percent of the samples showed residues above the maximum level (Source: BVL, National Report “Plant protection product residues in foods”, results of monitoring in the year 2015). However, the fact that a limit value has been exceeded does not automatically mean there is a risk to the consumer.
- // These extensive controls ensure that the legal requirements are followed and that a high level of food safety is assured.

1c) Other controls or standards for the use of CPPs

Farmers

- // Need special training in order to use CPPs
- // Need certificates of competence
- // Need to update their knowledge every 3-6 years
- // Need to document their use of CPPs

Equipment used for the application of CPPs:

- // Needs to be technically inspected every 3-5 years

Additional information: Regulations

- // In the EU, CPPs are regulated mainly by the framework Regulation (EC) No. 1107/2009.
- // In the EU, legal limit values for pesticide residues in foods and animal feeds are regulated by Regulation (EC) No. 396/2005.



TASK

2

WORKSHEET 2C /// TASK 2

Individual answers



What does the Future of Farming look like?

WORKSHEET 3 /// ALL TASKS

Individual answers

Notes:
