

ENVIRONMENTAL BIOLOGY

INTENSIVE FOOD PRODUCTION

THE REQUIREMENT FOR INTENSIVE FOOD PRODUCTION



Monocultures in the Netherlands.



Intensive farming in the Sahara Desert – a mechanised rotary irrigation system in Libya.

Global food production has to keep pace with **human population increase** (the human population will exceed 7 billion by 2010). To meet this demand, farming has had to become **intensive**. Intensive farming uses **high inputs per unit area** to **maximise yield**.

Achieving high yields

Typically, intensive food production focuses on growing **high-yielding varieties**. In the cultivation of crops such as rice, wheat and maize, for example, varieties can be the products of careful artificial selection, including transgenic modifications (see p. 42).

To increase yield further, **optimal nutrients for rapid growth are provided**, such as in processed foodstuffs given to cattle. Growth promoters, such as bovine somatotrophin (BST), may be used (see p. 42). Intensive cultivation of plant crops uses synthetically produced macronutrients, such as ammonium fertiliser made using the Haber-Bosch process (see p. 52).

Greater efficiency of intensive farming can be achieved through the cultivation of crops as **monocultures** – single varieties or species crops grown together on a large scale. The uniformity of the crop in monocultures is often increased through the use of F₁ hybrids or micropropagation by tissue culture (see p. 10). Habitats are modified to create space for monocultures, such as in the removal of hedges to create larger fields.

Advances in **pest and competitor control** allow for regular applications of pesticides such as insecticides, fungicides, molluscides and herbicides. These ensure that yield is high by boosting crop productivity and limiting productivity of non-crop components of the ecosystem.

Intensive farming relies on fossil fuel-powered **mechanisation** of soil and crop management. Large-scale monoculture requires the simultaneous mechanical harvesting of large areas of crop.

ENVIRONMENTAL IMPACTS OF INTENSIVE FARMING

Loss of species diversity and ecosystem complexity

Intensive food production **reduces species diversity**. High crop productivity is achieved at the expense of native species – biodiversity that interferes with the crop tends to be eliminated. Large-scale monoculture creates a uniform habitat, and pest and competitor control restricts the non-crop ecosystem. This reduced species diversity results in a **loss of ecosystem complexity** – there are fewer species, so there are fewer niches and fewer links within the food web. This restricted ecosystem has **lower stability** than most natural ecosystem and this can lead to problems. For example, the genetic uniformity of the crop risks the rapid proliferation of any pest that does gain a foothold, and the lack of niches in the ecosystem makes it unlikely that a natural predator of this pest would exist within the crop.

Poorer soil condition

Intensive farming often damages one of the most precious natural resources for growing food – the soil. Single-species cropping combined with mechanisation results in a **poorer soil condition**. Large machinery causes compaction of the soil crumb structure, which can increase erosion and soil loss. Repeated cropping of the same species from the same area will exhaust the supply of certain nutrients in the soil and may also reduce the organic content of the soil.

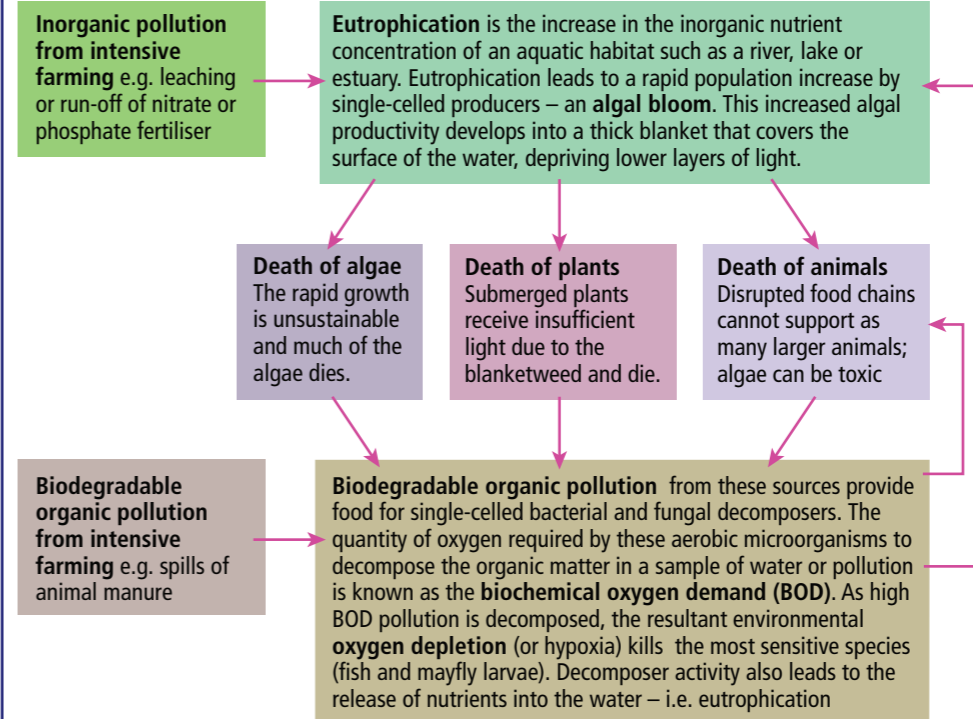


Comparison of complex natural habitat with intensive farming. A complex mosaic of natural habitat in South African savannah can support complex food webs including megafauna (such as martial eagle and white rhino shown here). Intensive cultivation of olives for oil in Europe involves the mechanical and chemical suppression of competition between trees creating a simple and potentially unstable ecosystem.

ENVIRONMENTAL IMPACTS OF INTENSIVE FARMING contd

Increased use of artificial fertilisers

The addition of chemical fertilisers containing inorganic nitrates (NO₃) and phosphates (PO₄) is common practice in intensive food production. If the application of fertiliser is not managed correctly, rainfall can lead to the loss of these nutrients either as **leaching** (dissolved nutrients washed through the soil) or **run-off** (dissolved nutrients washed away on surface). Inorganic nutrients washed into freshwater ecosystems can lead to **eutrophication** which in turn can cause environmental damage by **algal bloom** (see Figure).



Algal bloom in an upland lochan caused by eutrophication through animal waste contaminated run-off.

DON'T FORGET
Eutrophication is not another word for an algal bloom, but an increase in nutrient concentration that can lead to algal bloom.

Biodegradable organic pollution and BOD

Biodegradable organic pollution (such as animal manure or plant waste) can cause great damage to freshwater ecosystems. Any pollutant with a high **biochemical oxygen demand (BOD)** will stimulate the rapid growth of aquatic decomposer bacteria and lead to a low concentration of dissolved oxygen (see Figure). This oxygen depletion causes the death of aquatic animals. More **sensitive species** (such as the mayfly larvae) will die out rapidly in these circumstances. Other, more **resistant species** (such as sludgeworms) may thrive with a lack of competition. The relative abundances of these **indicator species** (the sensitive and resistant species) can be used to monitor the quality of the environment.

Increased use of pesticides

Intensive farming is associated with an increased use of pesticides. By their nature and intention pesticides are toxic to components of the ecosystem and their inappropriate use can have serious environmental consequences. For more details of the **bioaccumulation** and **biological magnification** of persistent pesticides see page 68.

DON'T FORGET
Many potential pollutants from intensive farming, such as silage run-off or pig slurry, would contain a wide mixture of both inorganic and organic pollution.

LET'S THINK ABOUT THIS

Intensive farming has been successful in raising food production to a level that can provide enough food for all. However, poverty and conflict mean that an estimated **13% of the world's population is undernourished** in terms of energy and/or protein. This undernourishment is the cause of more human deaths than any other single factor.

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