

**Forum:** STI

**Issue:** Science in food production

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## ***Introduction***

Food production is a science in itself. Science is involved in growing plants and animals as food sources, as well as in the further processing necessary to produce food fit for human consumption.

Science can be used in all the stages of food production: for increased yields in agriculture and aquaculture (such as crop rotation, irrigation, pesticides, fertilisers, GMOs, ...), and for more effective and hygienic processing (e.g. use of preservatives, irradiation, mechanisation).

## ***Definition of Key Terms***

**Environment** means surroundings, including water, air, soil and their interrelationship as well as all relationships between them and any living organisms. (FAO)

**Fertiliser** means a synthetic or natural product used to render land fertile, fruitful or productive (based on FAO definition of fertilizer application)

**GMO** (abbr.: **genetically modified organism**): An organism that has been transformed by the insertion of one or more transgenes. (FAO)

**Pesticide** means any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport. (FAO)

**Poison** means a substance that can cause disturbance of structure or function, leading to injury or death when absorbed in relatively small amounts by human beings, plants or animals. (FAO)

**Poisoning** means occurrence of damage or disturbance caused by a poison, and includes intoxication. (FAO)

## ***Background Information***

Food production has been a part of human development ever since the transition from hunter-gatherer societies to agricultural societies: whereas food was previously obtained by gathering edible parts of wild-growing plants and hunting wild animals, humans started producing food themselves by cultivating these. Since, there has been an evolution spanning several millennia: with the development of techniques such as milling cereals for flour to produce bread, and the domestication of animals, humans have become able to subsist relying entirely on food produced by themselves.

Growing food is the first stage of food production, and science has allowed great improvements in agriculture, both in agronomy and in the keeping of livestock. In agronomy, techniques such as crop rotation, selective breeding and moderate application of fertilisers have been in use for several centuries, and have proved effective while displaying few noticeable negative effects on the environment or consumers. With the rapid development in technology beginning in the late 19th century and gaining speed ever since, new techniques have been developed that may further increase yields. Some of them have drawbacks though, and research conducted on them is far from exhaustive.

These technologies include various pesticides. Pesticides are useful for preventing the destruction of crops, or their contamination by pests resulting in poisoning of humans and livestock. Pesticides can have adverse effects on both local biodiversity and on the health of animals and humans consuming the crops; the exact consequences depend on the products used and research on them is incomplete. Fertilisers have been used throughout the history of agriculture. They allow the more rapid and high-yielding growth of crops. Traditionally, manure was used, but since advances in chemistry starting in the 19th century, mined and synthetic fertilisers have become common, being available in higher concentration and therefore more effectively usable.

While they provide great benefits, all fertilisers can have negative effects on the environment; when used in excess, they can wash into bodies of water and cause rapid growth of algae, which deplete oxygen within the water and unbalance the aquatic ecosystem as well as poisoning animals that drink the polluted water. Their use should therefore be moderated, but this is not always the case on current farms. In livestock keeping, science has allowed a variety of procedures allowing strong increases in yield and improvements in animal health.

For the increase of yield, hormones can be used to allow animals to grow faster and larger, producing more meat per animal. This raises concerns about animal welfare. Another procedure for increasing yield from animals is artificial insemination. It has numerous advantages, notably requiring the keeping of fewer male animals, which lowers maintenance costs.

Routine use of antibiotics has become a common method of reducing the spread of disease among livestock as well as its transmission to humans eating meat. The primary risk involved with this - especially the indiscriminate and regular use of

antibiotics - is the development of resistant strains of pathogenic bacteria, making the antibiotics less effective or even ineffective against these. However, the selective use of antibiotics is tedious and costly, and increases the amount of bacteria that can be found in the meat produced.

A major technology that has both diverse applications and major doubts in safety is that of genetically modifying organisms that act as a food source. GMOs can be more resistant against disease and pests and have higher yields. However, their use has a definite effect on the ecosystem: genetically modified, artificial genetic traits are introduced into nature and the GMOs can spread invasively. As well as this, the effect of consuming GM products has not been researched extensively, and may have side effects that are currently still unknown.

As well as being critical to efficient growing of plants and livestock, science also plays a major role in the further processing of the raw products. In ancient history, meat would be cooked over an open fire. Since then, the basic techniques have been refined and many new techniques introduced: more advanced cooking procedures, and various techniques to improve the food or its production in different ways.

One notable development is mechanisation. While milling has been powered by machines for over 2000 years, many other parts of food processing remained entirely within manual labour until the industrialisation process which began in the 19th century. Since, much processing has become mechanised.

Along with mechanisation, processes that increase the lifetime of foods have been invented. The use of pasteurisation, irradiation, canning and chemical preservatives has allowed the keeping of food over long periods of time by protecting it from microbes that would otherwise cause it to decompose and become inedible. While pasteurisation, irradiation and canning of food pose few concerns, some chemical preservatives can cause problems such as hyperactivity in children as well as causing allergies in some people.

### ***Major Countries and Organisations Involved***

**FAO** (Food and Agriculture Organisation) – UN body specialising in food, necessarily involved with the use of science in food production

**Netherlands** – major users of yield-increasing agricultural techniques, resulting in the highest crop yield by far in the world; also one of the largest exporters of food in terms of value

**China** – country with the largest population to feed and also one of those with the largest surface dedicated to growing crops and total production of crops

**India** – like China, has a large amount of land used for agriculture and large population to feed

**Brazil, United States** – Along with India and China, countries with great production of crops

**Germany** – Along with the US and Netherlands, one of the countries with the greatest agricultural export values in agriculture

### ***Timeline of Events***

**1866** – Mendel sets a basis for modern genetics with his studies of inheritance

**1871** – Louis Pasteur invents pasteurisation

**late 1800s-early 1900s** – Refrigeration becomes practical and commonplace for preservation of food

**1940s-70s** - “Green Revolutions” that involved use of higher-yielding varieties of cereal grains, synthetic fertilisers, pesticides and irrigation, resulting in greatly increased production

**1943** – FAO founded

**1952** – IPPC, International Plant Protection Convention, founded: “an international plant health agreement, established in 1952, that aims to protect cultivated and wild plants by preventing the introduction and spread of pests.”

**1960** – launch of Freedom from Hunger campaign

**1974** – First hybrid rice grown in China

**1981** – introduction of World Food Day

**1996** – World Food Summit

### ***Relevant UN Treaties and Events***

A/RES/63/187 The right to food: Declaring the necessity of the right to food being universal and indiscriminate

A/RES/525(VI) Food and famine: Measures to reduce severity of famines, including in the production of food

A/RES/628(VII) Increase in Food Production: Generic request to increase food production

A/RES/2301(XXII) Food Production: Request to increase food production, particularly of staples with the example of rice given

A/RES/37/247 Food problems: various problems and appreciations regarding food and its production

A/RES/63/235 Agriculture development and food security: reiteration of the importance of developing agriculture to ensure food security

### ***Previous Attempts to Solve the Issue***

The UN treaties and events mentioned above constitute the international attempts to improve food production through science.

### ***Possible Solutions***

- Regulations restricting use of fertilisers to a maximum amount to prevent algal bloom
- Recommendations for research into various pesticides and their effects on target organisms as well as other organisms (crops, livestock, consumers of produced food)
- Regulations on use of chemical preservatives and recommendation of life-extending procedures with no potential harm
- Limits or encouragements on routine use of antibiotics on livestock: consider health/hygiene advantages as well as the risk of developing resistances
- Use of hormones: restrictions for the sake of animal welfare, encouragement for higher yields
- GMOs: encourage, discourage, fund further research into potential risks

## ***Bibliography***

All internet resources were retrieved in February 2013 and the links may become invalid as the websites are restructured.

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FAO – Pesticides

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<http://greenliving.nationalgeographic.com/fertilizers-pollutants-2898.html>

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