



SENSE N' SCIENCE

Agricultural Science

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Editor's Note

Agriculture came into existence about 12,000 years ago when people abandoned their hunter-gatherer lifestyles for a steady food supply, learning how to grow cereal and root crops. It led to the development of civilisations and communities, helping to increase global population levels, fostering economic growth and furthering the prosperity of the human species.

Agriculture is equal parts science and art, involving the creative and economical use of technologies based on scientific principles to maximise crop yields. Today, agriculture is one of the largest creators of livelihood, encompassing more than a quarter of national GDP in developing countries.

We are thrilled to bring to you the 10th edition of Sense 'N' Science and hope that it gives you a window into the vast scope of agricultural contributions to society. We thank all the teachers and students who contributed to this edition.

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*ECONOMICS AND
TECHNOLOGY IN
AGRICULTURE*

Food Safety and Security

By Sian Browne, 8D IGCSE

Food safety is about handling, storing and preparing food to prevent infection and help to make sure that our food keeps enough nutrients for us to have a healthy diet. Food security, as defined by the United Nations' Committee on world food security, means that all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their food preferences and dietary needs for an active and healthy life.

Unsafe food contains harmful bacteria, viruses, and parasites of chemical substances, causing more than 200 diseases ranging from diarrhoea to cancers. It also creates vicious cycles of diseases and malnutrition, particularly affecting infants, young children and the elderly. Factors which contribute to potential hazards in foods include improper agricultural practices, poor hygiene at all stages of the food chains, lack of preventive controls in food processing and preparation operation, misuse of chemicals, contaminated raw materials, ingredients and water, inadequate or improper storage.

Food safety is the need for people to have food that is free of contamination. Food security is the need for people to have access to food. Whether someone has access to safe, nutritious food depends a lot on where they live and how much money they make. The core messages to safer food are: keep clean, separate raw and cooked, cook thoroughly, keep food at safe temperatures and use safe water and raw materials. The three components of food security are having a sufficient quantity of appropriate food and having adequate dietary intake and the ability to absorb and use nutrients in the body.

Another factor affecting access to quality food is location. Food in polluted environments is unsafe and may lead to diseases, affecting everyone in the community. Poor agricultural practices such as an excessive usage of fertilisers and pesticides would also reduce food safety and security.

In India, some of the measures taken for achieving food security for growing population through higher food production include increased education and literacy, improved technology adoptions, integrated nutrients management, integrated water management, crop diversification, and so on. As for food safety, India is working on reducing the use of chemicals for agriculture.

Introduction to Agronomy

By Saamyaa Desai, IBDP 1

Agronomy is a branch of agricultural science that deals with soil management and field crop production. It is the science and technology of producing and using plants for food, fibre, chemicals, and land conservation.

Agronomy is a Greek word derived from *agros*, which means field, and *nomos* (management). It began in the 20th century, when people needed an improvement in their current crops. The foundation of the American Society of Agronomy in 1907 led to a vigorous development of the subject as a field science. Pietro de'Crescenzi is the father of agronomy. Peter Decresenzi (1230-1307) collected many literature pieces related to agronomy in his book 'Opus Ruralium Kamo Daram' for the first time.

The Indian father of agronomy is Mankombu Sambasivan Swaminathan. He is an agricultural scientist, plant geneticist, administrator and humanitarian, along with being notable leading icon in the green revolution. Agronomic crops are mass produced (often mechanised with the help of technological advancements) at a low cost. Examples include wheat, rice, corn, and soybean. Scientists working in this field find different ways to maximise crop production from a given area of land. They study how to get the best use out of land for human benefits.

The main goal of agronomy is to identify and provide favourable climates for crop production, for higher yields. Agronomic value is the monetary worth at which buyers and sellers agree to do business for agricultural products. Agronomy has numerous benefits. Some include: increased yields, lower production costs, improved soil fertility, and reduced use of water. Interestingly, agronomy is not just a science, but also a business and an art! As an art, agronomy allows the knowledge of the way to perform the operations of the farm in a skilful and proficient manner but does not necessarily have to include an understanding of the principles underlying farm practices. It will be accurate to say that agronomy is the future of agricultural science.

Agricultural Economics and Marketing

By Prisha Shah, 9B IGCSE

Agricultural economics is an applied area of economics that focuses on using economic theory to optimise the production and distribution of food and fibre products. When agricultural economics first emerged, it was a subfield of economics that focused on how land was used. Environmental, agricultural, and food policies are all influenced by agricultural economics.

Agricultural marketing and economics is useful in many ways for the future generation. One of the benefits include increasing farm income, which would lead to an efficient marketing system that ensures higher levels of income for the farmers by reducing the number of middlemen or by restricting the cost of marketing services and the malpractices in the marketing of farm products.

An additional benefit of agricultural marketing is that marketing activities add value to the product thereby increasing the nation's gross national product and net national product. This in turn leads to employment creation, with millions of people engaged in various activities, such as packaging, transportation, storage and processing.

However, agricultural marketing practices come with their share of disadvantages, including malpractices in unregulated markets, inadequate market information and improper warehouses. This poses a threat to farmers, who may be forced to sell their produce at low prices due to a lack of information.

Future markets will serve as a low-cost, highly efficient and transparent mechanism for discovering prices in the future by providing a forum for exchanging information about supply and demand conditions. The hedging and price discovery functions of future markets promote more efficient production, storage, marketing and agro-processing operations and help in improving overall agricultural marketing performance.

Revolutionising the Farming Industry - Modern Farming Techniques and Technology

By Pranika Pandya, 9C IGCSE

New farming techniques have replaced traditional labour intensive farming with systematic methods. These methods increase efficiency of production of crops and reduce the destruction of soil biodiversity. Most of them include reducing fertiliser use to the extent that yields remain largely unaffected. Modern farming techniques use modern technology which reduces the wastage of food grains by methodical storage practices. including various methods like vertical farming, micro farming, precision farming and regenerative farming.

Vertical farming, also referred to as hydroponics or aeroponics, is the most effective method to overcome soil-erosion and produce good yields in a small space. With the use of modern technology crops and plants are grown in a soil-free, layered and vertical environment where lighting, irrigation, fertigation and climate are controlled to maximise efficiency and output. This maximises space vertically, rather than occupying many hectares of land to produce crops.

Micro-farming is a method which produces a maximum yield in minimum area. This is possible by the use of cutting-edge technologies which include aquaponics which utilise Nitrogen-rich wastewater from a fishpond, automated irrigation which updates the requirement of the water, LED lighting like blue light which mimics natural light for photosynthesis, solar to regulate significant temperature control to keep greenhouses and indoor growing areas warm.

Precision farming involves a combination of technology with livestock and crop science to improve agricultural practice in large acres of land. It is a sustainable method that helps address and alleviate many environmental, economic and productivity pressures. This concept is based on observing and resulting upon inter- and intra-field variability in crops. Precision farming works on sensors which identify the requirements of each crop and AI that analyses the treatment. In addition, satellites and robotic drones provide farmers with real-time images of their crops.

Regenerative farming focuses on improving farmland and productivity by increasing biodiversity, enriching the soil and regenerating the land around you. it reduces input costs while maintaining production. The agriculture sector is one of the biggest emitters of CO₂, the greenhouse gas (GHG) most responsible for the changes we are seeing in our climate today. Regenerative farming pays golden attention to soil health, water management, and fertiliser use.

New age farming strategies and technology are not only beneficial to farmers and producers but also pays good attention to nature. The use of modern technology in farming not only provides economic benefits in the form of higher yields and better quality crops, but is a more environmentally friendly alternative to more aged farming practices.

The Benefits and Drawbacks of Genetically Modified Organisms in Agriculture

Tanisha Mehta, IBDP 1

One crucial area of agricultural science is the use of genetically modified organisms (GMOs) in farming. Genetically modified organisms are those whose genetic make-up has been altered in a way that does not result from natural reproduction or recombination. With the help of this technology, crops should be more resistant to pests and diseases, produce more, and have a higher nutritional value.

The use of GMOs is a hotly debated issue, even though they have the potential to significantly boost crop yields and decrease the use of harmful pesticides and herbicides. Critics claim that GMOs could result in the emergence of superweeds and superbugs that are resistant to common pesticides and herbicides and that the long-term effects of GMOs on human health and the environment are unknown. Ultimately, the decision to use or not use GMOs in agriculture must be made on a case-by-case basis, taking into account the potential benefits and drawbacks.

Despite these reservations, GMO use in agriculture has grown significantly in recent years. In fact, it's thought that more than 90% of the cotton, corn, and soybeans grown in the US are genetically modified.

The ability of GMOs to boost crop yields is one of their main advantages. This is especially crucial in resource-constrained areas where pests and diseases frequently affect crops. Farmers can use fewer harmful pesticides and herbicides while also increasing yields by introducing genes that confer resistance to diseases and pests. The ability of GMOs to increase the nutritional value of crops is another advantage. In developing nations where rice is a common food, for instance, scientists have created a genetically modified strain of rice with high levels of vitamin A that can help prevent blindness in children.

However, there are still worries about the long-term effects that GMOs may have, including the emergence of superweeds and superbugs that are resistant to common pesticides and herbicides, which could have detrimental effects on the environment and public health.

Overall, despite the intense debate surrounding the use of GMOs in agriculture, this technology undeniably has the potential to significantly raise crop yields, lower the use of harmful pesticides and herbicides, and enhance the nutritional value of crops. In the upcoming years, it is likely that the use of GMOs in agriculture will increase even further as the world population continues to rise and resources become more scarce.

Soil Health and Conservation

By Bhoomi Shah, 8C IGCSE

Soil health is the continual ability of soil to perform as a fundamental living system, within ecosystem and land-use boundaries, to preserve biological productivity, advance the quality of air and water environments, and uphold plant, animal, and human health. There are five principles of soil health:- 1) soil armour 2) minimising soil disturbance 3) plant diversity 4) continual live plant/root and 5) livestock integration.

1. **Soil Armour:** Wind or water are shielded from the soil's surface by armour. It keeps the soil in place, preserving precious soil nutrients and organic materials. Soil armour reduces the rate of evaporation which in turn makes moisture available for plant use. It also helps keep the soil at a moderate range of temperature.
2. **Minimising soil disturbance:** Rebuilding soil aggregates, pore spaces, soil glue, and soil organic matter can all be started by minimising soil disturbance. To maintain soil productivity over time, this procedure is crucial.
3. **Plant Diversity:** Plant diversity refers to the existence of a wide variety of plant species in their natural environments. Crop rotations with a variety of crops increase biodiversity, which is good for the soil food web. As a result, disease and pests are decreased, and rainfall infiltration and nutrient cycling are improved.
4. **Continual live plant/root:** Adaptable plants can flourish in both the hot summer months and the cool spring and fall climates. As a result, the soil food web can continuously receive carbon exudates from a live plant during the whole growing season. Cover crops can provide the missing live root exudate, which is the primary food source for the soil food web.
5. **Livestock integration:** Farmers can reverse the roles and let the livestock graze the material on-site instead of hauling feed to a feedlot, lowering the number of nutrients that are exported from our farmland and hayfields. The bulk of nutrients, minerals, vitamins, and carbon are recycled in this way.

Soil conservation is the prevention of soil loss from erosion or reduced fertility caused by over usage, acidification, salinisation or other chemical soil contamination. There are many ways to conserve soil. Below are some of the ways:-

- **Contour farming:** In slope areas, the soil conservation technique works well and advises planting species following the contour. The rows along the contour prevent soil erosion which helps to conserve soil and reduces its degradation processes.
- **Strip cropping:** To protect the crops from the wind, farmers blend fast-growing and slow-growing crops. An extra benefit is the organic matter material from the low crops.
- **Cover crops:** By using this method of soil conservation, farmers benefit from planting cover crops in between growing cash crops and preventing bare soils. This technique can be used for different reasons such as producing forage and grazing material for cattle or providing green manure.

There are many organisations which have come up to prevent soil erosion or to invent new techniques which can help to conserve soil such as The Soil Conservation Society of India or American Farmland Trust.

The background features soft, layered watercolor washes in various shades of green, from light mint to deep forest green. Scattered throughout are small, dark green ink splatters. At the bottom, several thin, brown stems rise, each bearing numerous small, round, brown seed pods or buds. The overall aesthetic is natural and organic.

AGRICULTURE AND SOCIETY

What Was the Indian Farm Law Crisis?

By Kavya Talsania, AS Levels

India's farm law crisis began in September 2020 when the Indian government passed three new agricultural laws aimed at liberalising and modernising the country's agricultural sector. These laws were met with widespread protests from farmers who saw them as a threat to their livelihoods and a potential windfall for large corporations.

The three laws are the Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, the Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, and the Essential Commodities (Amendment) Act. The first law allows farmers to sell their produce outside of government-regulated markets, giving them the freedom to negotiate prices with buyers. The second law allows farmers to enter into contracts with buyers and provides dispute resolution mechanisms. The third law removes certain commodities such as cereals, pulses, oilseeds, edible oils, onions and potatoes from the list of essential commodities, removing the government's power to regulate their production, supply, and distribution except under extraordinary circumstances.

Protesters argue that the laws will leave small farmers vulnerable to exploitation by large corporations and weaken the government-regulated markets, known as *mandis*, that have been the backbone of the Indian agricultural system for decades. They also fear that the laws could lead to the dismantling of the Minimum Support Price (MSP) system, which guarantees a certain price for crops to protect farmers from market fluctuations.

The protests started in Punjab and Haryana, two states that have a large agricultural sector, but soon spread to other parts of the country. Farmers staged sit-ins, marches, and road blockades, which were met with violence by the police and counter-protests by supporters of the laws. The government has tried to negotiate with the protesters, offering to suspend the laws for 18 months and form a committee to study their impact, but the protesters have refused to back down until the laws are repealed entirely.

The crisis has had significant economic and political implications for India. Agriculture employs nearly half of the country's workforce and is a crucial component of the Indian economy. The protests have disrupted transportation, led to crop losses, and caused food prices to rise. They have also sparked a larger conversation about the Indian government's handling of the agricultural sector and the influence of large corporations in the country's economy.

Gender Inequality in the Agricultural Industry

By Soumyaa Desai, IBDP 1

The agricultural industry is one of the biggest industries in India, comprising mainly cleaning, processing and packing the products obtained from agriculture. Besides this, there are firms that support agricultural activities by producing machinery required for agriculture, including fertilisers and seeds. The market in India is driven by the exponentially growing population. In 2022, the industry reached an approximate value of USD 435.9 billion. An important topic that isn't talked about enough is the gender inequality that exists in this industry.

There is a 20-30% gender gap between the participation of the two genders in the Agricultural sector in India, attributed by experts to the inequality of resources. The gender gap is extremely significant in South Asia. The female employment trends show that women are getting excluded to an increasing extent, because the ratio of men to women in poor households is 100 men to 109 women. Furthermore, the quality of employment for women working in the agricultural sector is very poor, with the ownership of agricultural land being very disproportionate in favour of men.

Lately, the situation has been changing but inequality still persists. Men are now moving on to sectors which require education and training. The Farm Bills that were going to be implemented by the parliament a few years ago caused women to fight for their identities as farmers. Jasbir Kaur, a 74 year old farmer from western Uttar Pradesh said, "We toil in the fields alongside the men. Who are we if not farmers?"

Women now form the backbone of this industry, but like in many other industries, their efforts go unnoticed. Research shows that while more than three-quarters of rural women are involved in agricultural work, only 12.8% of the total land holdings are owned by women. Women work day and night to make ends meet, but because the men own the land, they receive most of the benefits. That said, their voices are being heard, with hundreds of foundations rising overnight to express support for the women farmers of India.


Religion and Agriculture - What Does Jainism Say About Agriculture?

By Dvisha Shah, 9D IGCSE

Jainism is defined by the Britannica English Dictionary as an Indian religion teaching a path to spiritual purity and enlightenment through disciplined nonviolence (*ahimsa*, literally “non-injury”) to all living creatures. It has spread to different parts of North India, notably Gujarat, Tamil Nadu and Karnataka. Jainism expressly mentions the 15 types of sin (*karmadan*) one shouldn't commit. One of the major sins stated there is harming microorganisms and other living creatures. Jainism does not “prohibit” agriculture. The Lord Rishbhdev of the religion himself taught the skill of farming to those around him who couldn't fulfil their needs of food. The part that makes it difficult to opt for this activity for a Jain individual is the sin of killing living organisms. For keeping insects, animals and bacterias away from the crops grown, pesticides have to be used which could kill the organisms.

According to a site- mahavir-sanglikar.blogspot.com - "Jains who think that agriculture is a sin should immediately stop eating anything that is produced by farmers, as eating agricultural products also becomes a sin according to the Jain definitions of sins. They should stop trading food grains and other agricultural products. They should not invest a single Rupee in the industries based on agriculture. They should also try to pressurise their state Government and ban farming." However, it is important to note that a farmer works in the field to feed people. His activity cannot be called sinful according to the texts. What makes the practice sinful is the killing of microorganisms and other living creatures which can be minimised. The reason why most Jain individuals do not eat underground vegetables like carrots and radishes is because they involve the killing of a large number of microorganisms.

To conclude, agriculture is not prohibited in Jainism if only a bare minimum of the microorganisms are harmed. Whatever their beliefs, we need to be open-minded and respectful in order to progress as a society.



*THE FUTURE OF
AGRICULTURE*

What is the future of agricultural science?

By Ayaan Bhatt, IBDP 1

The future of agricultural science looks bright, with an increasing need for sustainable agriculture practices, higher crop yields, and improving food security. The advancement of technology and research in agricultural science is essential to meet these needs.

One of the significant areas of focus in agricultural science is precision agriculture. Precision agriculture refers to the use of technology to increase agricultural efficiency and productivity while minimizing environmental impact. This technique includes using remote sensing tools such as drones, satellites, and GPS to analyze crop growth and identify potential problem areas. The data collected helps farmers make informed decisions about how to manage their crops, such as adjusting irrigation or fertilizer application. Precision agriculture reduces costs and enhances the quality of crops.

Another critical area in agricultural science is genetic modification. Genetically modified crops have been developed to resist pests, tolerate drought, and improve yield. The application of biotechnology to agriculture allows scientists to modify plant DNA for specific traits, resulting in more sustainable crops. For example, drought-resistant crops can withstand extreme weather conditions and minimise crop failure due to insufficient water supply. Moreover, the use of genetically modified crops reduces the use of harmful pesticides, making food safer for consumption.

Vertical farming is another growing trend in agriculture. It involves cultivating crops indoors, with controlled environments that optimise growing conditions. Vertical farming technology utilises hydroponics, aeroponics, and aquaponics, which enable crops to grow without soil, using minimal water and energy. Vertical farming technology provides a solution to the increasing urbanisation and a lack of farmland, which is becoming a concern globally. This technique has proven to be efficient, producing higher yields per square meter than traditional farming methods.

The use of blockchain technology in agriculture is another area of potential growth. Blockchain technology can help improve transparency in the food supply chain. Consumers can track the origin of their food, from seed to table, by scanning QR codes. This technology ensures food safety and helps build consumer trust in the food supply chain. Additionally, blockchain technology enables farmers to access financing and other resources, enabling small farmers to participate in the global food market.

In conclusion, agricultural science is poised to make significant advancements in the future, with the use of precision agriculture, genetic modification, vertical farming, and blockchain technology. These innovations have the potential to increase crop yields, improve food security, and promote sustainable agriculture practices. As the world population continues to grow, the demand for food will increase, making it critical to explore and apply new technologies to agriculture. The future of agricultural science is essential to meet the challenges of feeding a growing population while minimising environmental impact.

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DID YOU KNOW?

Agriculture is the largest employer in the world

Farmers need to produce 70% more food than today to feed the world's growing population by 2050

Crayons are grown from soybeans

India holds the first position in organic farming

Mycorrhizal fungi help trees grow

Sourced from: [krishijagran.com](https://krishijagran.com/agripedia/top-20-agricultural-facts-that-will-amaze-you/). (n.d.). Top 20 Agricultural Facts That Will Amaze You.
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