



# SMART AGRICULTURE IN THE FOURTH INDUSTRY REVOLUTION

According to the United Nations Department of Economic and Social Affairs (Population Division, 2022), the world is anticipated to grow to about 8.5 billion in 2030 and add 1.18 billion in the next two decades, reaching 9.7 billion in 2050.

The way we produce, process, and distribute food will have to change dramatically if we are to provide the human population with adequate nutrition in the coming decades. It is not just the quantity of food that matters, but the way it is grown and reared.

As the world population increases and causes a rapid escalation of food demand, achieving a healthier diet is also a driver of human longevity and productivity, which is our most valuable asset.

**26%**

Food accounts for over a quarter (26%) of global **greenhouse gas emissions**

**50%**

of the world's habitable land (**land-use**) is used for agriculture.

**70%**

of global **freshwater withdrawals** are used for agriculture

**78%**

of **eutrophication** (the pollution of waterways with nutrient-rich pollutants) is caused by agriculture.

**94%**

94% of mammal biomass (excluding humans) is livestock (**Biodiversity**).

Addressing the challenges of feeding the planet better and more sustainably requires access to better dietary education. Moreover, it also means healthy food must become more available and affordable.

To achieve this, powerful lobbying groups must also be challenged due to the unhealthy diets and eating habits that are the root cause of the unspoken pandemic of our day and age, leading to various diseases that cause substantial human suffering and economic costs.

A sustainable global food system benefits human health as well as the global ecosystem. However, this is far from the reality at present, as almost 700 million people are undernourished, while at the same time, around 1.8 billion people globally are overweight or obese.

On a global average basis, fruit consumption needs to rise by 146%, whereas the intake of vegetables, nuts, and seeds needs to rise by 44% and 462%, respectively. Whole grain consumption needs to increase more than fivefold on average to provide sufficient energy and nutrients as part of a healthy diet.

## SMART AGRICULTURE OVER TRADITIONAL AGRICULTURE

Traditional agriculture with manual labour and low productivity is now being transformed into sustainable, intelligent, efficient, and eco-friendly agriculture with the use of innovation and technology.

New terminologies are emerging - smart farming, digital farming, precision farming, smart aeroponics, smart lights, smart nutrition, smart data, smart substrate, smart pest management, and smart scaling.

In smart agriculture (or smart farming) the focus is accessing data and applying those data to optimise a complex system towards increasing the quality standards and yield of the product along with reducing human labour.

Crops grown using precision agriculture produce a huge amount of data; a technology like Big Data is used to extract beneficial information from the bulk data obtained.

Additionally, technologies like GPS and GIS help farmers make better decisions based on the data collected and analysed. While IoT (Internet of Things) and AI (Artificial Intelligence) are powerful technologies individually, the amalgamation of IoT with AI, together known as Artificial Intelligence of Things (AIoT), can make huge impacts on numerous urban farming activities and processes.

IoT-based smart irrigation with the help of sensors used for monitoring reduces water wastage, while IoT and cloud increase agricultural efficiency. Coupled with the latest fifth-generation (5G) wireless technology and environment-friendly technology, the green 5G-AIoT can potentially deliver a reliable and energy-efficient massive network of interconnected smart devices that are capable of self-monitoring, self-correcting, and self-healing themselves, thereby redefining the future of agriculture industry and other industries, as well as transforming businesses across industries.

Moreover, traceability systems and blockchain technology can improve transparency and accountability in the food supply chain. Blockchain is a technology with promising applications in different fields which include peer-to-peer financial systems, Smart Agriculture, and many other industries. Blockchain-based applications can help farmers control the data access at granular levels and they can monetize the data on their own.

As real-time operation is critical in making decisions, the blockchain can help in developing an efficient real-time data-sharing model. The blockchain can help in this aspect by building transparent supply chains where the traceability and authenticity of the food can be easily verified. Blockchain improves the quality of food by reducing any chances of fraud.

Even though the blockchain has many potential applications in Smart Agriculture to enhance data security and integrity, there are still challenges which need to be addressed before the wide adoption of this technology into the agriculture space. Still, these are some of the methods used to help overcome the inefficiencies in farming and help meet the demands of today's competitive world.

## THE NEED FOR AEROPONICS

Food security production is limited by the environmental crises and by the negative impacts of open-field agricultural practices. For this reason, research on agriculture, food security, and the food supply chain has become more relevant.

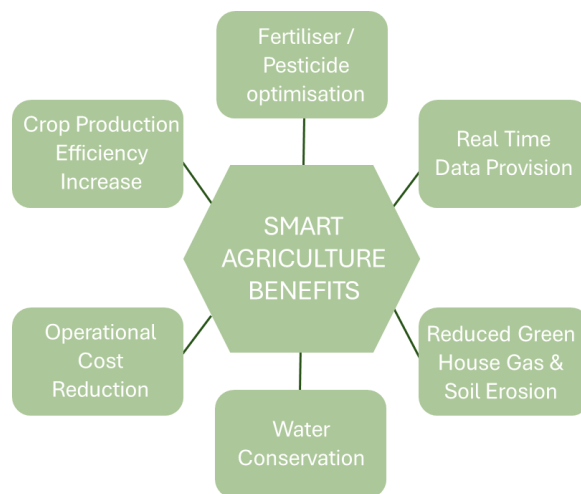
Innovative farming techniques, such as hydroponics, aquaponics, and aeroponics, can be exploited to optimise the use of resources, as they consume less water and space and have a high growth rate compared to traditional farming techniques.

Deciding whether to choose a hydroponic, aquaponic, or aeroponic system depends on what you intend to grow, the price of your produce and your chosen market. However, as aeroponics is a vertical farming technique that provides crops with much stronger and healthier root systems, it has a much higher potential performance than a standard hydroponic system.

The principles of aeroponics are based on cultivating vegetables whose roots are not inserted in the soil, hanging in a container filled with flowing plant nutrition. In these containers, roots can find the best condition for oxygenation and moisture. These conditions allow for better plant nutrition assimilation in a more balanced way, with consequential faster development of the cultivated plant.

Plant nutrition is supplied into a closed circuit. Consumption is consequently limited to only the quantities absorbed by the plants, allowing for water savings. For example: to produce a kilogram of tomatoes using traditional land cultivation requires 200 to 400 liters of water, hydroponics requires about 70 liters, and aeroponics utilises only about 20 liters.

Aeroponics is a method of growing plants without soil. Instead, roots are suspended in the air and irrigated with a nutrient-dense mist. The biggest advantage of aeroponics is that roots are exposed to air, thus there is never an issue of insufficient oxygen. This differs from hydroponics, where plant roots are submerged in a solution of water and nutrients.



## HISTORY

In 1942, W. Carter first researched air culture growing and described a method of growing plants in water vapor, but the first commercial aeroponics setup was the Genesis Rooting System, commonly called the Genesis Machine, by GTi in 1983.

## AEROPONICS TERM

The word "aeroponic" is derived from the Greek meanings of aero- (air) and ponos (labour). Aeroponics is a hydroponic system in which plant roots are suspended in air and misted with a nutrient water. Maximize oxygen available at the root zone, thus helping to maximize plant growth.

The growing in soil is no longer a sustainable way to grow food and in many instances its being replaced with aeroponics. This is advantageous for multiple reasons including but not limited to:

- Allows clean low maintenance and consistent production (increases crop yields by 45% to 75%).
- Aeroponics is conducted in the air combined with micro-droplets of water, almost any plant can grow to maturity in the air with a plentiful supply of carbon dioxide, water, and nutrients.
- Aeroponics appeared to be a highly feasible method to produce both aerial parts and roots as raw materials for the herbal dietary supplement and phytopharmaceutical industries.
- Aeroponics allows control of the environment, growth and variables that affect production while helping conserve water (reduce water usage by 95%), land, and nutrients, making cultivation of crops easier.
- Used indoors, aeroponics allows crops to grow without the use of pesticides (reduce the pesticide usage by 99%) and thus it will be disease-free.
- Provides an inexpensive option to grow year-round produce without depleting soil minerals.
- No weeding!

According to Research Reports World, the global Aeroponics market size was valued at USD 985.03 million in 2022 and is expected to expand at a Compound Annual Growth Rate (CAGR) of 15.89% during the forecast period, reaching USD 2386.01 million by 2028.

#### Regions leading the aeroponics market:

- North America
- Europe (Germany, UK, France, Italy, Spain, Russia, Poland)
- China
- Japan
- India
- South Asia (Malaysia, Singapore, Philippines, Indonesia, Thailand, Vietnam)
- Latin America (Brazil, Mexico, Colombia)
- Middle East and Africa (Saudi Arabia, United Arab Emirates, Turkey, Egypt, South Africa, Nigeria)
- Other regions

#### Largest global manufactures in the aeroponics market:

- Aerofarms
- AEssenceGrows
- Agrihouse Brands LTD.
- Alesca Life Technologies LTD.
- Altius Farms
- Combagroup SA
- CropTech
- General Hydroponics
- Good Life Growing
- Hanging Hydroponics
- Hydrogarden
- Lettus Grow
- Living Green Farm Inc.
- Neofarms
- Ponics Technologies
- Saveer Biotech LTD
- Swastik Agri Solutions Co.

#### BENEFITS OF AEROPONICS

- **Plant environment control:** unlike other plant growth systems, aeroponics allows better control over the root environment of the plant - as the roots are not always surrounded by the medium.
- **Improved nutrient feeding:** Aeroponics allows varieties of nutrients applied to the root without the need to wash off the solution, in which the roots were previously soaked. The intervals and durations of nutrient sprays can be fine-tuned to meet the needs of specific leafy green varieties.
- **Cost-effective:** While the one-off investments and maintenance costs are high, aeroponic systems are cheaper solutions due to the reduced throughput amount, less nutrients and water are needed in the system at one time compared to other nutrient delivery systems. There is no need for a substrate or moving parts.
- **Easy handling and user-friendly harvesting:** The design of the aeroponics solutions makes the plants easier to handle due to the plants' separation from each other and the fact that they are suspended in the air where their roots are not encased in an environment in which they develop. Harvesting individual plants is therefore straightforward.

Though the vulnerability to power outages can be solved with solar energy, the disadvantages of aeroponics are the high initial start-up/construction costs, recurring license fees, and the high level of technical knowledge required to successfully operate a full-scale commercial operation.

## COMPONENTS OF AEROPONICS

- A method by which to hold the plant in place with roots exposed
  - A water reservoir
  - Circulation/recuperation of water
  - Maintenance of water quality
  - A form of nutrient enrichment
  - A method of delivering water to the roots
  - Light exposure
  - Temperature regulation
- Some helpful considerations:
- Water exposed to much light can develop algae
  - Water exposed to open air can lose volume through evaporation
  - Space and desired crop volume will determine vertical or horizontal systems
  - Access to water and electrical will determine what type of pump and size of reservoir as aeroponics uses 95-98% less water than traditional agriculture making it an excellent option for areas where access to clean water is challenging.

I believe in the ancient saying, "Let food be thy medicine," and live by this mantra every day, but we still require collaboration with various stakeholders in the sector including governments, non-profit organisations, private companies and NGOs - and to encourage them to support mitigation strategies to curb the impact of horticulture biodiversity losses and improve the food crises.

Do you plan to plunge into aeroponics solutions to grow lettuce, strawberries or other leafy greens and vegetables indoors to ease the pressure on your agricultural land for a healthier and more sustainable future? We would love to hear who you've partnered with and what leafy greens work for you if so! Send me a message anytime!