

Artificial Intelligence in Agriculture

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Artificial Intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines. This is in contrast to the natural intelligence displayed by humans. The field is defined as the study of "intelligent agents", any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals. Artificial intelligence is used to network machines and systems. This improves productivity and creates more transparent processes. The use of artificial intelligence creates the basis for efficient predictive analytics models.

'AI' is a word that has interest of all globally. Be it ChatGPT, or Bard, AI is changing the way we do things.

AI can inform us

- Descriptive: What happened?
- Diagnostic: Why did it happen?
- Predictive: What will happen?
- Prescriptive: What is the optimal business decision?

AI uses data analytics. Data analytics enables organizations to analyse all their data (real-time, historical, unstructured, structured, and qualitative) to identify patterns and generate insights to inform and, in some cases, automate decisions, connecting intelligence and action. Data is collected either manually or by use of digital methods like sensors etc. Thus, farmers gain insight into every aspect of their operations, enabling informed decision-making and resource optimisation. A sensor works by detecting physical or chemical changes in the surrounding environment, which it converts into an electrical signal. This signal is then used for information gathering. Some sensors could be mentioned as follows:

- **Soil moisture sensors:** Water is vital for nourishing crops and sustaining ecosystems. Dielectric soil moisture sensors use the principle of dielectric permittivity, measure the ability of soil to hold an electrical charge, affected by the amount of water present.
- **Biosensors:** Biosensors offer farmers information of the physiological status of their crops and the surrounding environment.
- **Location sensors:** For efficiency in agriculture, location data is vital. Location sensors use GPS to triangulate a position, giving farmers very precise dynamic data of their fields and assets.

- **Optical sensors:** Optical sensors give information about the physiological status of a crop by using light waves to assess key indicators of plant health.
- **Electrochemical sensors:** These sensors function by converting chemical reactions into measurable electrical signals, allowing farmers to assess soil quality, detect environmental pollutants and monitor nutrient levels.
- **Sugar Industry:** The Indian sugar industry can try to implement AI in its day-to-day activities. Moreover, with the government's ethanol blending policy only AI can help to make fast the entire ethanol production process. AI can certainly help the sugar industry to make it competitive by reducing costs and improving quality.

Some areas of such help are:

Increase the yield of sugarcane

AI and machine learning can help increase sugarcane yield. AI will help to identify the right time to sow the seeds and give advice to farmers about the right time to plant sugarcane. This technology considers the nature of the soil and climate, and what is ideal for a good crop. This helps to predict the estimated crop yield in an area of agricultural land. It runs various simulations, and then determines the ideal time to sow, water, and harvest the crop. AI can give information if the soil receives correct inputs such as water and fertilisers, for good yield. It also advises about usage and maintenance of farm equipment, protection of the crop from weeds and on soil management.

Precision agriculture

This is a farming management AI technique. This uses drones to check crop growth, detect problematic areas, determine the health of the crops, spray water and pesticides evenly.

Smart harvesting

With AI, prediction of the right time to harvest a crop is very easy. It uses the data of conditions of climate and crop to predict the accurate time for harvesting sugarcane. This assists farmers to plan their harvest and reduces the risk of crop damage. If economics is thought of considering agricultural land size, AI robots can be used instead of humans, to harvest a crop at a faster pace and higher volume. This also reduces the cost of harvesting. Sugarcane harvesting is a labour-intensive task. Any delay in harvesting may damage the quality of sugar. Robots can ensure to maintain

the quality of sugar and also timely supply of harvested crops to sugar factories.

Reducing processing costs

In processing sugar, AI can be used at each stage, right from extracting the juice from sugarcane to packaging it. The production consists of series of repetitive tasks, right from preparing the cane, extracting the juice, storage, and molasses and centrifuges. Automating these will eliminate manual operations and bring down the cost of production. It will also result in lower raw material usage and higher sugar yield.

AI for the better

Sugar production results in carbon dioxide emissions. The production uses a lot of water, which results in discharging ample wastewater. Also, the factories use a large amount of electricity. If the the production process is digitalised, then it is easier to collect data on energy usage and carbon emissions. This will help the companies identify problem areas, savings possible and act on them accordingly.

Supply chain

A sugar company's supply chain begins from sourcing sugarcane from the farmers to producing crystalised sugar and its distribution through a logistics network. All these major processes have many sub-processes which need to be streamlined for a seamless operation. AI can be used to reduce lead times, increase the coordination between suppliers and manufacturers, and develop an improved logistics network.

AI is also helpful in managing inventory and forecasting demand to avoid sudden shortages or overstocking.

Integration of AI and Successful Implementation

So, steps are:

Collect and access appropriate data.

- Check the type of data that you have so far – disciplined or undisciplined.

- Important is to focus on collecting and accessing those data details that can help to solve business priorities and issues.

Make a scheme.

- Try to correlate your accumulated data with your business goals and challenges.
- Think how it will help to achieve them
- Organize the given data in a manageable way
- Understand the data, what is ethically allowed to stock up and use

Narrow all things down

- This is the time to focus on what matters to your business. Now with the knowledge of what data is important and what will help to achieve business goals, keep focussed on it.
- Concentrate on the data that matters

Test your data.

- It is the time to create a prototype and test the datasets.
- Program the algorithms to get answer to the questions by using relevant data
- For better results, have a partner who can bring fresh insights and experience
- Make the prototype work

Make it work

- Integrate the prototype into business process
- Operationalize and standardize the data insights to share with the entire organization.

Future of AI in the Indian sugar industry

India is one of the largest producers and exporters of sugar in the world. But the sugar industry is fighting on so many challenges. The yield of sugarcane in India is still very low. The production cost of sugar is also very high. However, AI can solve most of these problems one at a time. Surely, AI can make the Indian sugar industry more competitive.

About the Author

Vishwas Kale is Managing Director, Vijayesh Instruments Pvt Ltd, Pune and has more than thirty years' experience in instrumentation. He was twice President, International Society of Automation (ISA, USA) in India, now its Honorary Senior Life Member, Advisory Member of Industrial Process Measurement and Control Committee of Bureau of Indian Standards (BIS), Member of Experts Panel of NCTSI-Indian Institute of Foundrymen among many positions he holds with various organizations. He has received awards for innovative products.

Author of two books:

- Instrumentation and Process Control Techniques in Foundries
- Management for Success