A GLIMPSE ABOUT ARTIFICIAL INTELLIGENCE IN AGRICULTURE

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FOREWORD:

To start with, Agriculture and Artificial Intelligence are ironically contradicting topics particularly in tradition-based farming countries like India. At the same time, most of the recent start-ups are based on Precision Agriculture, fully automated vertical aero/ hydroponic farms and AI-based forecasting models. As humans are evolving with the advancement of technologies, the Human population also hikes exponentially hand in hand which simultaneously leads to adverse climatic changes and catastrophes. The population of the world is expected to be 8.6 billion, 9.8 billion in 2050 and the substantial demand for food is predicted to upsurge by 70%. To put this in an understandable perspective, we will have to produce more food in 35 to 40 years than the previous 10,000 years combined.

According to 'The state of the world's land and water resources for food and agriculture' report by FAO, in developing countries even if Agricultural production doubles by 2050, one person in twenty still risks being under-nourished equivalent to 370 million hungry people, most of whom will be in Asia and Africa. Above all, Agriculture and cultivation industry involve in generating $330 billion annually to boost the economy according to the Environmental Protection Agency (EPA) reports. The governments, International Organizations are tirelessly engaged in a call of action agreed by several countries to promote prosperity while protecting the planet known as the Sustainable Development Goals whose Goal to concentrates on achieving Zero Hunger by 2030. Here's where the question raises on land and resource availability. Taking all this into consideration, we are in the urge to produce significantly more food with significantly less land and resources through sustainable climate-smart agriculture with the aid of artificially intelligent technologies.

Artificial Intelligence and Agriculture as a Collective Term:

Artificial Intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. Jeff Bezos rightly said, "We're at beginning of a golden age of AI. Recent advancements have already led to an invention that previously lived in the realm of science fiction-and we have only scratched the surface of what's possible". Food producers are facing challenges to a great extent due to uncontrollable factors such as humidity, rainfall and temperature. The cultivation area is prone to disastrous events even at a smaller scale resulting in interrupting food security and affecting the socio-economic status of the farmer. One of the best solutions to increase production with fewer resources is to predict and control the Out-of-control factors. AI is being used in agriculture to yield robust crops, have pest and disease population at check, monitor soil health and growing conditions to provide all the necessary nutrients, organizing data for the entire production cycle so that farmers can keep track of all the events beginning from sowing to harvesting and sharing the workload.

Real-time examples and applications of cutting edge technologies at a glance

PREDICTION MODELLING:

Pest and disease forecasting models generally consist of one or more mathematical relationships which describe the progress of one or more aspects of pest or pathogen life cycles in terms of one or more environmental parameters. There are some relatively simple models, where a threshold is exceeded or which are based on accumulated temperature sums such as day degrees. However, many models are more complex, are the synthesis of years of research, rely heavily on computing power to input data, perform calculations, and provide a tailor-made output. Similarly, other parameters such as soil oxygen level, NPK and Micronutrients can be assessed and necessary measures can be undertaken accordingly.

Mostly all crops are susceptible to infection or infestation by various pests and pathogens. The pathogens may be fungi, bacteria, or viruses, while the majority of pests are invertebrates such as insects and mites. The process of infection or colonization is greatly influenced by environmental conditions, together with other attributes of the crop and cropping system, and the subsequent development of the pathogen or pest outbreak is also dependent on environmental conditions. Except for mammal and bird pests, all organisms infesting or infecting crops are ectotherms, which means

that their life cycles are highly dependent on the ambient temperature. A wide range of pests and particularly pathogens are also affected by humidity. This paves the way to attempt to predict the incidence and severity of pest and disease outbreaks using environmental data such as records of temperature, precipitation, and humidity through Machine Learning Technology (MLT) and regression analysis.

INDOOR VERTICAL FARMS:

Stuart Oda is an investment banker turned urban farmer passionate who co-founded Alesca Life, an agricultural technology company developing solutions to improve food security, food safety, supply chain transparency and farming efficiency. The company has converted decommissioned shipping containers into indoor vertical farms in Industrial parks of North America, Urban cities of Asia and even in the arid regions of the Middle East. He refers this method as controlled environmental agriculture or weather/climate-proof farming. These farms replace conventional elements with artificial elements. Sunlight is replaced with artificial full spectrum LEDs and soil is replaced with polyurethane sponges, biodegradable peat moss and inorganic materials like perlite and clay pellets. The precise nutrient formula is circulated and recycled throughout the facility, which is pumped directly into the root zone of the individual crops.

The complete structure is monitored through sophisticated monitoring and automation systems. Manual labours are greatly reduced and harvesting robots are used. Altogether, year-round production is ensured with predictable output. Resource use efficiency is high as it uses 90-99% less water, fertilizers and zero chemical usage. These 3D Vertical farms can yield 350 times more food than conventional farms. The major drawback here is the process of production is energy-intensive. Following that, research is going on to develop lasers optimized for plant growth using fibre optic cables to channel sunlight directly into the farm during the day reducing the need for artificial light. These futuristic farms can be installed in underutilized, unused spaces in urban areas and are perfectly capable of providing quality vegetables to even the most underprivileged communities.

Harvest croo robotics was found to tackle the labour shortage in crop cultivation especially in strawberries with their extraordinary set of technologies. They provide a harvesting service that automates the crop management, harvesting and packing of speciality crops. Their harvester reduces CO2 emissions by 96% than conventional manual harvesting according to Destination better Environmental and Sustainability consultants. In their AI-based machine learning vision system, each berry on a plant is scanned to determine if it's ripe, healthy, and ready to be picked. With 6 picking claws per robot, each harvester has 96 claws which can pick fruits without damaging them. These technologies play a vital role in making strawberries affordable to everyone and holding them from entering into entering the list of luxurious commodities in America.

ENERGID CITRUS PICKING SYSTEM:

Energid has been funded by the U.S. Department of Agriculture. Their system will combine the intelligence of robotics with the efficiency of bulk fruit removal to reduce harvesting costs to the citrus grower. It uses multiple low-cost picking mechanisms organized into a grid. They are simple with extending parts of picking mechanism have no actuators and no sensors, easy to manufacture and to replace.

ECOROBOTIX AG

This particular company specializes in Precision technology for weeding. One of their innovations, Avo- The fully autonomous robot is used for 100% ecological weeding. The other one is Ara- The mounted sprayer. It has top-notch spraying precision and speed allow a drastic reduction of the used chemicals products.

SELF-DRIVEN TRACTORS:

Taranis is one of the companies which have released autonomous tractors. These GPS-enabled tractors can plant, spray and harvest with a professional in the driver's seat. Another astonishing creation is the Auto-Trac which is the heart of the self-driving software. It uses a combination of GPS, laser range finders, thermal infrared sensors, colour cameras, and inertial navigation to safely steer machinery. To enhance the accuracy of GPS, John Deere developed its own RTK radio towers and linked its Starfire receivers to NASA's ground stations to achieve a stated accuracy of +/- 1 inch. The self-driving technology can be utilized to reduce fatigue, maximize field usage, and integrate the automatic distribution of fertilizers, seeds, water, and pesticides.

Other similar technologies include Agro-bot E-series, Blue river lettuce bot 2, Agribotix and Robo Plant. Besides these technologies, there are Planes, Drones and satellites used for aerial imaging which in turn helps in analysing the farm with the help of computer vision algorithms along with image annotation that aids farmers to figure out the problems and finding solutions.

FACING PROBLEMS WITH YOUR LAND? A SOLUTION IN YOUR HAND:

Peat is a Berlin AI-based start-up that has developed PLANTIX, which is a mobile advisory application for farmers. This crop doctor claims to diagnose infected crops and offers treatments for any pest, disease or nutrient deficiency problems with just a photo. The company claims its results are 95% accurate in detecting unique imaging patterns. It covers nearly 30 major crops, detects 400 plant damages and available in 18 languages.

The direct competition for this application is Crop diagnosis. It is a mobile application aiming to improve pest management decisions by making crop diagnosis accurate, selection of chemicals and application assisted by personalised instructions. It works by evaluating the crop's details (type, location, soil and history) and threat's characteristics (type, appearance and progress) as entered by a user through a smart questionnaire.

CHALLENGES IN THE WAY:

Farmers in most of the developing countries are not aware of complex technologies, and it is difficult for them to adapt within a short span of time. To tackle these situations, Governments and companies should put their hands together and introduce the technologies by explaining them step by step with multiple demonstrations. Most of the technologies even though reduce time, manage labour shortage and are sustainable, are not affordable by small and marginal farmers. Collective farmers and large farmers can be benefitted from this.