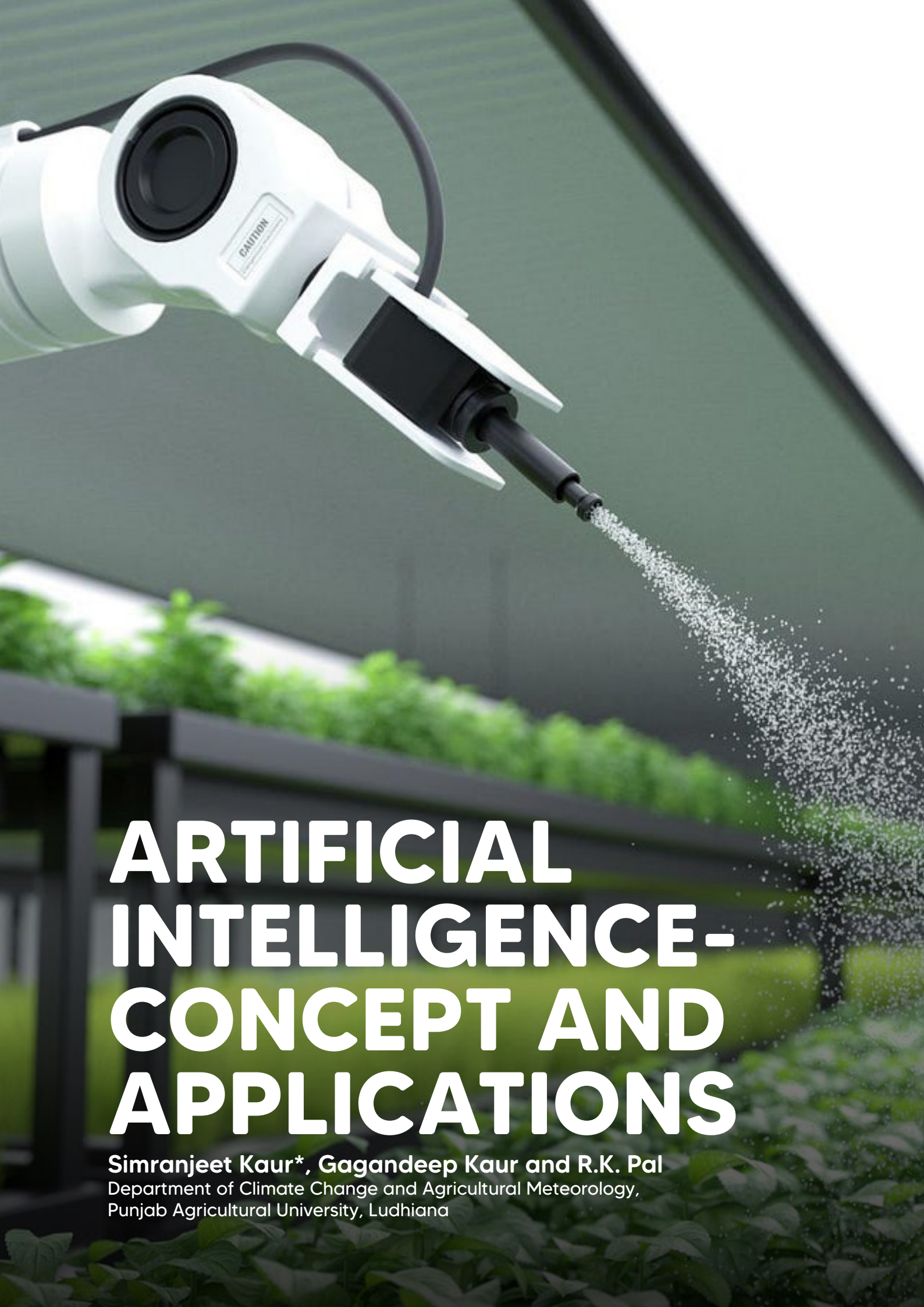

ARTIFICIAL INTELLIGENCE-CONCEPT AND APPLICATIONS

Simranjeet Kaur*, Gagandeep Kaur and R.K. Pal
Department of Climate Change and Agricultural Meteorology,
Punjab Agricultural University, Ludhiana

INTRODUCTION:

The term "Artificial Intelligence" comprised of two words with distinct meanings—artificial, meaning created by humans and intelligence, meaning having the capacity to think. This term was introduced by John McCarthy in 1955. By definition, Artificial Intelligence (AI) is the ability of a computer or robot to do the tasks that are typically performed by humans. The main purpose of AI is to build smart computers that are capable of carrying out tasks that normally done with human intelligence. It involves creating algorithms and models to help robots learn, understand, and make data-driven decisions. AI encompasses various subfields, such as machine learning, natural language processing, computer vision, and robotics. It aims to incorporate human intellect in machines so that they can solve complicated problems, adjust to changing environments, and grow over time.

AI IN AGRICULTURE FIELD

AI is applied in agriculture in a variety of ways, including soil health assessment, sowing, weed control, water resource management, disease and pest detection, fertilizer application and yield detection (Nawaz et al., 2020). AI technologies have many other applications in agriculture, and their use is growing in popularly in India. This approach has been implemented in many places, drawing in youth and igniting their enthusiasm in farming and gardening. Applications of Artificial Intelligence in agriculture first attempted by McKinion and Lemmon in 1985. They first created GOSSYM, crop simulation model for cotton crop using Expert system.

Table 1: Major AI technologies used in agriculture

1) Drones: used for different purposes such as soil analysis, planting, fertilizing, irrigation, crop monitoring, spraying.
2) Automated Tractors
3) Robots: Used for land preparation, plant treatment, harvesting, yield estimation etc.
4) Wireless sensors: attached in instruments that works on the basis of AI algorithms

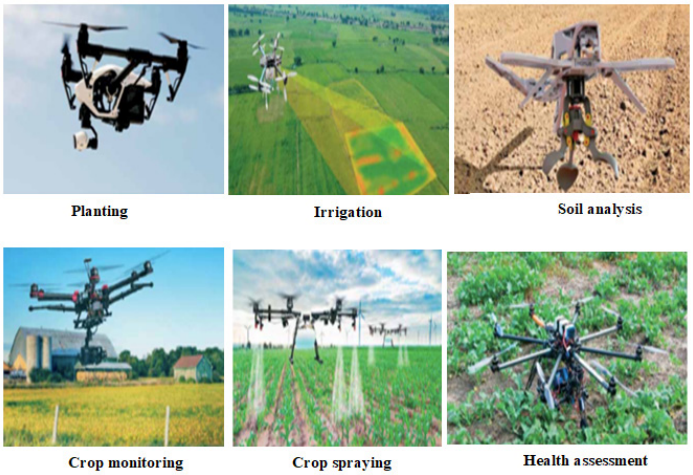

Fig.1: Applications of drone technology in agriculture

Fig.2: Applications of robotics in agriculture

APPLICATIONS OF AI IN AGRICULTURE

1. **Soil and crop health assessment:** Soil and crop health assessment is done by rovers, drones or wireless sensors. These instruments take the picture of whole field which are then processed by a MATLAB algorithm to identify crop diseases and nutrient deficits. On the basis of deficiencies assessed by these techniques, farmers can apply the desired amount of soil amendments to enhance the health of soil which also helps to improve yields.

2. **Agriculture robotics:** Over the past few decades, the agriculture industry has seen substantial transition, moving from human power resources to digitalized technology. Artificial intelligence (AI) and robots are becoming more commonplace, being utilized for jobs like gardening and fruit picking. In addition to labour input activities, these devices are helpful in precision farming and plant breeding. Agriculture-related robots have been developed to do precise and accurate

farming activities. They can also replace or improve human labour in some areas. Self-propelled mobile robots and robotic smart implements that are transported by a vehicle are the two primary categories of robots used in agriculture.

3. **Intelligent spraying:** By gathering data on plants and illnesses using sensors and nozzles through smart AI technologies, precision or need based spraying of pesticide or insecticides can be done. This intelligent sprayer or automated spraying using drones or other AI technologies lowers pesticide consumption, helps in cutting labour, chemical costs and mitigating environmental harm. Apart from this, it increases the chemical's effectiveness and safety by applying it directly to the crop lesions.
4. **Disease diagnosis:** Crop diseases are a major cause of damage to crops. Detecting these diseases early on time is important to ensure successful treatment. Smart systems are able to protect the crops from disease damage by making decisions at the right time. Determining the right strategies to provide treatment is also a key for the successful management (Abu-Naser et al., 2010). Expert systems can help detect the illness and offer precise instructions on the required course of therapy. Schol et al., 2017 detected two viruses: tomato spotted wilt virus and powdery mildew in greenhouse pepper plants using robotic detection system. Classification of RGB Images resulted in higher accuracy i.e., 95% and 90% for powdery mildew and tomato spotted wilt virus respectively.
5. **Precision farming:** Precision farming is a new trend in farming that differs from conventional methods. In addition to geographic data like weather patterns and remote sensing technologies like wireless sensor networks, precision farming makes use of soft computing methods like support vector machines, fuzzy Logic, artificial neural networks, and decision trees. With the goal of enhancing food security, these tools

aid in tracking and forecasting the current and future needs for agricultural produce. Precision farming aims to maximize productivity while reducing adverse effects on the environment and optimizing the use of resources such as seeds, fertilizers, herbicides, water, and insecticides.

6. **Automatic weeding:** Weed control usually depends on physical as well as mechanical methods instead of relying only on chemical weeding (Sabanci and Aydin, 2016). In traditional agriculture, hand weeding is proven as a viable tool but in a modern way of farming, an automated and efficient way for management of weeds in and around the field is called as robotic weeding. It aims to lower the dependency on herbicides. Intelligent spraying robot detect the weeds in a crop and target them with the required amount of herbicide. Bah et al., 2018 identified the weeds present in between the crop rows by using combines convolutional neural networks (CNNs) along with unsupervised training dataset collection. The outcomes obtained with accuracy differences of 1.5% and 6% in spinach and bean field respectively.
7. **Automatic harvesting:** Hand harvesting is the conventional or old approach used in our nation to collect the produce or crops; unfortunately, this method often led to fruit deterioration or damage. While, modern automated harvesting robots have given access to a creative solution that efficiently reduces labour costs and maximizes the harvest schedule. Because of this, it is possible to carry out selective harvesting, greatly increasing the effectiveness. But automated harvesting is done for picking the fruits in a way better than harvesting of cereal crops or other close growing.
8. **Efficient irrigation:** Around the world, the agricultural sector uses 85% of freshwater. Due to changing climate, rainfall pattern is becoming erratic

and some of the areas are facing severe floods and droughts. Also, extraction of groundwater is increasing to ensure the water security which then balances the food security. Several studies predicted that water level is going deeper but population is growing and we need to produce more food. It is impossible to produce the food for growing population with the limited water resources. So, modern way is to use the AI based sensors, which are when installed in the field, able to compute the moisture content of the soil without the need for human interaction. Apart from this IoT (Internet of things) based irrigation is also a smart approach which helps to automatically irrigate the field when needed. So, with the help of this self-sufficient system, we can increase agricultural yields and conserve water in a very efficient manner.

SCOPE OF AI IN AGRICULTURE

Introducing AI techniques can have a transformative effect in a nation like India, where more than 58% of the rural populace depends on agriculture in some form. Apart from it, AI contributes in estimating crop, soil health and yield of crops through farm imagery using satellite data. It also supports the farmers in managing the harm caused through insect, pest, diseases, weeds or abrupt climatic conditions. Number of firms such as SatSure, PEAT, Earth Food, V Drone Agro etc. are providing solutions on the basis of data science, machine learning and artificial intelligence. Apart from this, there are other AI powered tools like, robotics, drones, satellite images, soil monitoring tools and automated irrigation systems etc. are also going to transform the traditional agriculture with modern agriculture.

Pros of AI

- •Fast, accurate and precise results are obtained if coded properly.
- •It has the capacity to work under hash environmental conditions.
- •AI helps in predicting the best times to plant and harvest, and can monitor crop health through sensors and images
- •AI permits need based applications of inputs (like water and fertilizers), which can increase yields and also reduce wastage of resources.
- •Predict the questions, actions, and typed words of a user. They can help in taking variety of actions in addition to being capable assistants.
- •AI saves time and labour through automizing tasks like planting, watering, and harvesting.

Cons of AI

- •Implementing AI technology can be expensive, which might be a barrier for small-scale farmers.
- •Operating and maintaining AI systems require specialized skills. Farmers and workers may need additional training to effectively use these technologies, which can be a challenge in areas where skilled labor is scarce.
- •Deployment of jobs will occur if AI perform all the task that are being done by humans. So, Job displacement is the biggest fear.
- •AI systems can malfunction or face technical glitches, potentially leading to costly problems or reduced productivity.
- •AI systems need a lot of data to work effectively, and poor data quality can lead to inaccurate results.