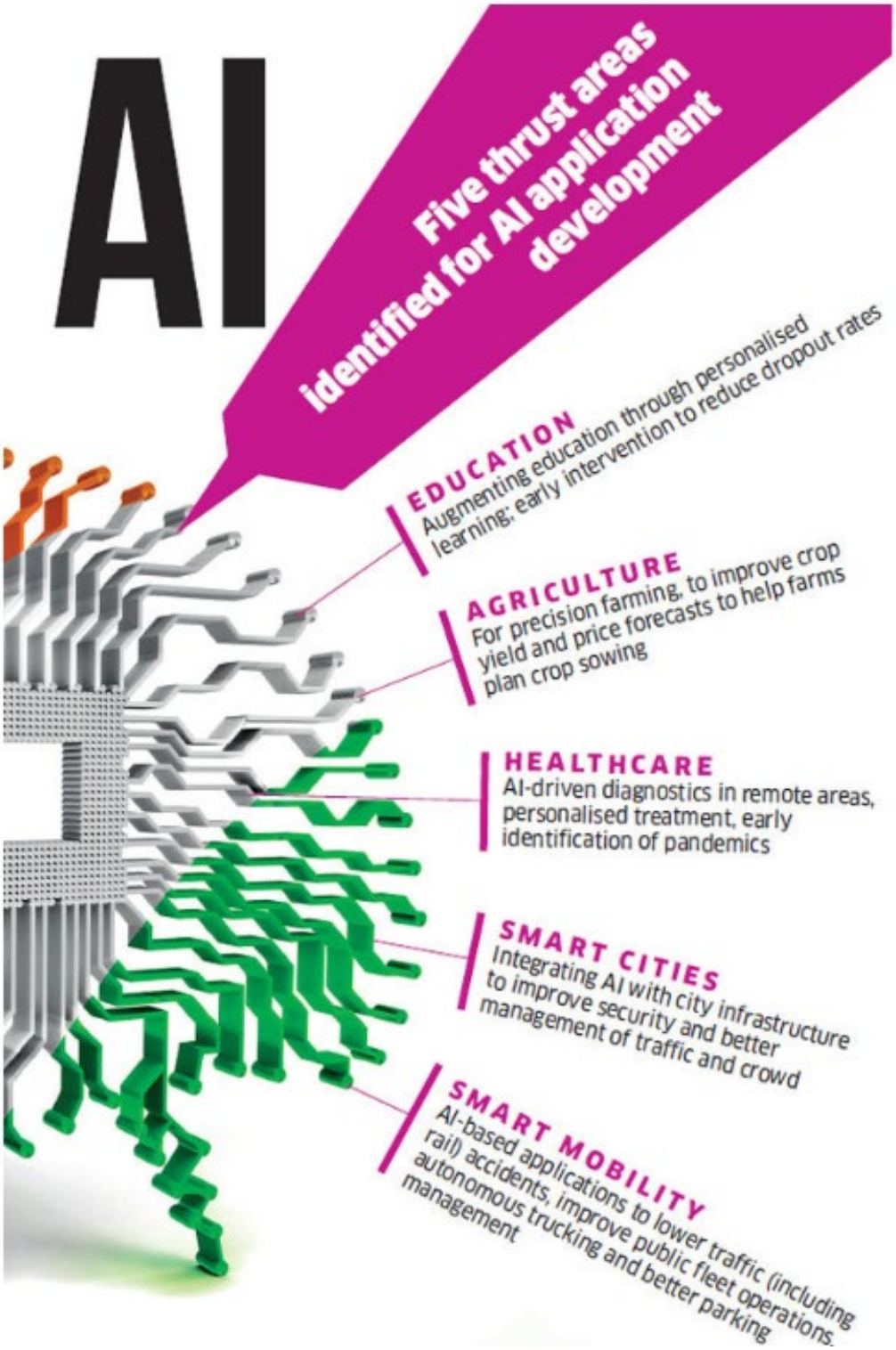
Taking a lead towards intelligent and customised solutions for SMART agricultural practices in J & K

Centre for Artificial Intelligence & Machine Learning in Agriculture

(CAIML)



Artificial Intelligence is like the new electricity and it will transform every secror. ***Niti Aayog CEO Amtabh Kant***

#AIforAll: Technology Leadership for Inclulsive Growth

National Strategy for Artificial Intelligence 2018

Preamble

Jammu and Kashmir has missed the first three industrial revolutions, that have shaped the economies and the prosperity of the societies around the world. The outcome is an economically fragile and technologically backward state. The first industrial revolution witnessed the emergence of machines and mechanization, a process that replaced agriculture with industry as the foundations of the economic structure of society since the 2nd half of 18th century (1765). This revolution used water and steam to mechanize production. The 2ndindustrial revolution from 1870s used electric and chemical energy to create mass production. The 3rd revolution from 1969 used nuclear energy for production, and electronics and information technology to automate the production. Besides the biotechnology emerging as the core sector that transformed health and agriculture. We unfortunately continue to remain as the consumer based society than a contributory one, and therefore a fragile economy.

The 4thindustrial revolution is unfolding before our eyes. It would be largely driven by artificial intelligence, machine learning, robotics, 3-D printing, automation and bio-economy. With exponential expansion, it is characterized by merging technology that blurs the lines between the physical, digital and biological spheres to completely disrupt the way we think, communicate, act; and also the entire production, management and governance systems. Envisaging AI as the single largest technology revolution of our live times, with the potential to disrupt almost all aspects of human existence, NITI Aayog in its policy document on National Strategy for Artificial Intelligence in 2018, has identified 5 core areas viz Education, Agriculture, Healthcare, Smart Cities and Smart Mobility.

The limiting factors of the state of J & K that kept the first three revolutions off its shores, have become irrelevant in the global village swapped by 4th industrial revolution, which is rooted in a new technological phenomenon—digitalization, that enables us to build a new virtual world from which we can steer the physical world. The Euro 92 billion agri-economy of the Netherlands is driven by this technology, where the machines are trained to communicate with plants (Tulip) and soil and weather to predict the most accurate requirements for plant growth in terms of the nutrients and the pest management, and thereafter linking the processes from farm to fork.

SKUAST-Kashmir can be a path breaker by being bold and disruptive in venturing first in AI and ML in the state and in the entire NARES. The proposal on establishment of the Center for Artificial Intelligence and Machine Learning in Agriculture (CAIML) is therefore a strategic move to infuse higher order skills of AI & ML in students and researchers to assure that we catch the bus of 4th industrial revolution in right time, and secure and empower our future generations by compensating the losses of the earlier opportunities.

Be among the first to venture in AI ad ML in the State and NARS and make it integral to agricultural education cirriculum at all levels

Develop NextGen Human Capital equipped with higher order skills in AI and ML to drive 4th Industrial Revolution in J&K

Explore and establish partnerships with organizations that have a high propensity for AI and deep learning

Develop AI driven Decision Support Systems customised for individual Producers, Processors and Business People

Be a centre of excellence on AI and ML in Agriculture in the country

Mandate:

1. **R &D :** Develop AI driven customized Decision support systems for farmers, processors, markets
2. **HRD :** Develop Next Gen Human Capital equipped with 4th Generation skills who shall drive the technology based agri-economy in J&K
3. **Collaborations:** Explore and Establish Partnerships with Organizations having propensity with AI, ML and IoTs in Agriculture.

Prelude

The world population by 2050 is projected to increase by over 2.3 billion and only 4% additional land is expected to come under cultivation by then (FAO, 2009). Therefore, there is a need to double food production by 2050 by intensifying production on almost the same amount of land (FAO, 2018). This is an enormous challenge since nearly 124 million people across 51 countries already face acute food shortage. Other issues like the global climate change and dwindling labour force also add substantially to the problem which our conventional approaches are unable to handle. There is a need for an out of the box solution which could eventually lead to the 2nd Agricultural Revolution. The dawn of the 4th Industrial Revolution is already blurring the lines between the physical, digital and biological spheres and this may prove to be the sine qua non of the next Agricultural Revolution as well (World Economic Forum, 2016).

This collective revolution would largely be driven by Artificial Intelligence, Machine Learning, Big Data Analytics, Heuristics, Fuzzy Logic Systems, Automation, Robotics and Bio-Economy, thus leading to intensification of agriculture and smart interpretation of big data. Intelligent data driven systems and digital fabrication technologies interacting with the biological world, would make it possible to adopt new and innovative approaches to deliver food security, economic opportunity and environmental sustainability.

Problem Statement

Jammu and Kashmir presents tremendous potential for agriculture and allied sectors. Despite this, the economy of the State is currently import based. Traditional crops and indigenous breeds, the products of which could fetch a high market price, are dying out slowly due to negligence and a lack of technological intervention. Residential houses are rapidly erupting over farming areas and people are moving out of agriculture in hoards. This is because agriculture no longer seems to be a viable career choice. The agricultural land in the Union Territory has shrunk by more than 18,000 hectares in the last two decades. The total agricultural area in 1998-99 was 878 thousand hectares, which is now 859.52 thousand hectares. To top it all, unprecedented weather patterns often wreak havoc and cause huge loses to the UT's economy. Also, unemployment in the State is a major problem. The youth lack exposure to latest ground breaking arenas of science and therefore graduates are often unemployable under the current breakneck competitive environment. Therefore, it may be said that the two most powerful resources for any society viz. its youth and its agriculture, are underperforming.

Global Trends in Agriculture Using AI and Machine Learning

The emergence of new age technologies like Artificial Intelligence (AI), Cloud Machine Learning, Satellite Imagery and advanced analytics is creating a global ecosystem for Smart or Precision Farming. Such cognitive solutions are benefiting agriculture in a myriad of ways. Data on historical weather pattern, soil reports, new research, rainfall, pest infestation, images from Drones and cameras etc. is sensed by Cognitive IOT solutions to provide strong insights to improve yield by in-depth field analysis, crop monitoring, scanning of fields, managing adverse weather conditions, crop health management, and yield management. Drones are now being used to produce a 3-D field map of detailed terrain, drainage, soil viability and aerial spraying of pods with seeds and plant nutrients into the soil provides necessary supplements for plants.

Proximity Sensing, Hyper-spectral Imaging, 3d Laser Scanning and Remote Sensing are two technologies are finding their use in soil testing, soil characterization and for building crop metrics across thousands of acres. Hardware solutions pairing data-collecting software with robotics can automate irrigation and prepare best fertilizers, herbicides etc. in addition to other activities to maximize output while optimizing input. Self-driving tractors and combine harvesters trundle round fields without human involvement.

Computer vision technology, IOT and drone data can be combined to ensure rapid futuristic actions by farmers. Pre-processing of images is being used in pest identification, nutrient deficiency recognition and disease diagnosis. Images of different crops under white/UV-A light are captured to determine how ripe the green fruits are. Farmers can create different levels of readiness based on the crop/fruit category and add them into separate stacks before sending them to the market.

Based on multiple parameters, cognitive solutions make personalized recommendations to farmers on the best choice of crops and hybrid seeds. This technology also helps to monitor crops along their entire lifecycle including report generation in case of anomalies.

Neural network-backed computer vision, wearable devices, and predictive analytics algorithms are helping scientists reimagine animal farming too. Animal identification and monitoring is now possible using intelligent integral control systems. Tags, implantable transmitters and receivers for low level signals from animals by telemetry are now commonly used (Puers et al., 1988). AI is also making it possible to analyse animal behavior for animal health management, pregnancy diagnosis, heat identification and early disease diagnosis. Intelligent animal identification systems identifying animals automatically from their sounds (Chesmore, 2001) have also been developed. Robots are now being used for scientific feed management, auto drafting, auto floor cleaning, high-tech milking and robots to diagnose disease and administer remedies/cures to the affected animal (Ishaq, 2018).

AI is also being used for the prediction of the genetic merit and futuristic projections of the animal's production potential (Ghazanfari et al, 2011). Machine learning algorithms are also actively being used for gnomic selection of animals. Data-centric farming powered by AI algorithms collect and analyses massive farm data, regarding humidity, temperature, and food requirements.

All these technologies are producing a giant leap in production and this may help farmers produce 70 percent more food by 2050 (Jones, 2017). It may thus be safely concluded that AI promises a food revolution, from farm to supermarket.

Primary Objectives of the Centre

- Make the study of AI and **ML an integral part of agricultural education** curriculum at all levels.

- Creation of an education, research and extension hub at SKUAST-K to **lay the foundation of AI and ML programs and initiatives** in J&K.
- Attract top AI& ML education, research and entrepreneurial talent to the University for improvement of Agriculture.
- Develop **organic home-grown personalized AI solutions** for temperate agriculture.
- Promote the use of AI& ML as part of an integrative solution for skill development, **upgradation of living-standards and agricultural transformation** in the region and consequently in the entire country.

Immediate/ Short Term Applications

The primary goal of the University is promotion of agriculture in all forms to improve food security and transform lives. Therefore, the establishment of an Artificial Intelligence cum Machine Learning Center would be strengthening all primary mandates of the University viz. education, research and extension. It would be of both long and short term benefit. The immediate implications of the AI&MLCenter would include the following:

- Provide **support to all research activities** at the University and increase technology transfer ability towards major stakeholders (farmers, entrepreneurs etc.)
- **Collaboration with internationally renounced institutes (MIT, IISc and IITs, etc)** and industries (Microsoft, Google, Amazon etc) through MOUs thereby opening up new opportunities to the enrolled students and youth in general.
- Development and testing of cutting-edge tools and technologies to coordinate and monitor the work force activities across diverse verticals (keeping the **unique conditions and challenges of temperate agriculture** in view).
- Creation of **Early Warning Systems** for weather changes, epidemics etc.
- Use of **Farm Management Information Systems** for planning, capture of thousands of farm variables and recording of the workforce activities across diverse fields
- Creation of separate, **centralized database** for crops, fruits and animals.
- Use Automatic Learning Systems like Artificial Neural Networks for data analysis for **personalized farm projections and advisories.**
- **Modification of available technologies** to better suit the temperate agro climatic conditions.
- Enhance production per plant though micro-climatic data, soil condition data and real-time controls for irrigation, seed behavior to make it conducive for a better crop growth for sustainable agriculture.
- **Upgrade traditional farming equipment** (tractors, tillers, milking machines etc.) for automatizing mundane tasks while improving precision and minimizing losses.
- Utilize smart sensors and software to monitor diseases and pest and also to track and trace a perishable's condition for **supervision of the supply chain to minimize spoilage.**
- Create an **online intelligent, integrated demand-supply based market place** with customized projections regarding the rise or fall of demand in the future
- Accurate **identification** of animals and **tracking and monitoring** of feed intake, growth, pregnancy diagnosis, heath through readily available devices and sensors like RFID tags, pedometers, smart cameras etc.
- **Automatic cloud-based data capture and analysis** through automatic milking machines, smart on-body devices, automatic weighing and drafting systems for animal farms.
- Providing better farming conditions and controls through the application of **Internet of Things** (IoT) in animal farms for temperature control, humidity condition sensors, automated feeders, waters and automated milking machines (cows) in animal and poultry houses.
- **Integrate the breeding process with modern genomic tools** to organize the hybridization of desirable characteristics in the crop. Utilize bioinformatics and AI for making superior breeding decisions both for animals and plants. Coordinate plant and animal breeding process from pre- breeding to commercialization phase.
- **Boost conservation efforts** for domestic and wildlife species especially Hangul (the State Animal) through aerial monitoring systems, real-time sensor technologies etc.
- Creation of an **innovation driven ecosystem** by the provision of state of the art IoT labs and facilities for leveraging start-ups, enterprises, institution and individuals for testing and developing the technology solutions.

Centre for Artificial Intelligence & Machine Learning in Agriculture
SKUAST Kashmir

IOT/ AI in Course Curriculum		
Program	**Courses to be Offered**	**Duration**
UG Courses (for BSc Ag/Horti/ Seri/ For / BVSc & AH/ BFSc/ BTech)	Update the Course on " **Biostatistics and Computer Science** 3+1" with chapters on AI and ML, The revised structure could be: o Elementary Statistics. o Concepts and Techniques of Data Science / Data Mining o Introduction to AI and ML techniques	1 Semester
Elective and Certificate Courses (for UG, PG, PhD Outside students)	• Data Science in Agriculture • IoT and Cloud Computing • Crop and animal Modelling • Automation and robotics in agri-operations • Machine Learning • Block Chain Technology	1 month, 2 month, and 3 months
PG Course (for MSc/ MVSc/ MFSc/ MTech)	Machine Learning and Artificial Intelligence and its Applications in Agriculture	1 Semester
Diploma (AI and Machine Learning)	Post Graduate Diploma in Machine Learning and Artificial Intelligence in Agriculture	1 Year
B.Tech AI&ML	Graduate degree programme in AI&ML/IoT & Automation/Blockchain/Robotics & Drone in Agriculture	4 Years