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An International Peer Reviewed E-Journal of Multidisciplinary Research

One Day National Multi-Disciplinary
Conference
on
"Recent Trends and Issues in Commerce,
Economics and Management in India"

Saturday, 30th March 2019

Organized by
Anjuman-I-Islam's
Akbar Peerbhoy College of Commerce &
Economics
Grant Road (E), Mumbai
NAAC Accredited College

In Association with
University of Mumbai
Mumbai
Maharashtra

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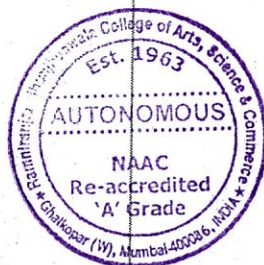Prof. Mohammed Tahir
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Maulana Shaukhat Ali Road, Do Taaki, Grant Road (E),
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Recent Trends in Agriculture and Challenges in the Adoption of Artificial Intelligence in Indian Agriculture

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Abstract - According to UN Food and Agriculture Organization, the population will increase by 2 billion by 2050. However, only 4% additional land will come under cultivation by then. In this context, use of latest technological solutions to make farming more efficient, remains one of the greatest imperatives. While Artificial Intelligence (AI) sees a lot of direct application across sectors, it can also bring a paradigm shift in how we see farming today. AI-powered solutions will not only enable farmers to do more with less, it will also improve quality and ensure faster go-to-market for crops. This research paper highlights recent technology in agriculture and will also discuss how AI can change the agriculture landscape and the challenges in the adoption of AI in Indian agriculture ahead.

Introduction

Agriculture is seeing rapid adoption of Artificial Intelligence (AI) and Machine Learning (ML) both in terms of agricultural products and in-field farming techniques. Cognitive computing in particular is all set to become the most disruptive technology in agriculture services as it can understand, learn, and respond to different situations (based on learning) to increase efficiency. Providing some of these solutions as a service like chatbot or other conversational platform to all the farmers will help them keep pace with technological advancements as well as apply the same in their daily farming to reap the benefits of this service. This research paper highlights recent technology in agriculture and will also discuss how AI can change the agriculture landscape and the challenges in the adoption of AI in Indian agriculture ahead.

Methodology

The chief source of information for this write up is secondary method of data collection. In writing this paper the researcher principally used existing literatures and record relevant to the subject matter of this paper.

Technology Advancement in Agriculture

1. Growth driven by IOT

Huge volumes of data get generated every day related to data on historical weather pattern, soil reports, new research, rainfall, pest infestation, images from Drones and cameras
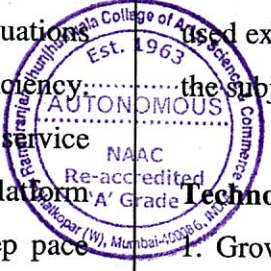
and so on. Cognitive IOT solutions can sense all this data and provide strong insights to improve yield. Proximity Sensing and Remote Sensing are two technologies which are primarily used for intelligent data fusion. One use case of this high-resolution data is Soil Testing. While remote sensing requires sensors to be built into airborne or satellite systems, proximity sensing requires sensors in contact with soil or at a very close range. This helps in soil characterization based on the soil below the surface in a particular place.

2. Identification of optimal mix for agronomic products

Based on multiple parameters like soil condition, weather forecast, type of seeds, infestation in a certain area and so on, cognitive solutions make recommendations to farmers on the best choice of crops and hybrid seeds.

3. Health monitoring of crops

Remote sensing techniques along with hyper spectral imaging and 3d laser scanning are essential to build crop metrics across thousands of acres. It has the potential to bring in a revolutionary change in terms of how farmlands are monitored by farmers both from time and effort perspective. This technology will also be used to monitor crops along their entire lifecycle including report generation in case of anomalies.

4. Automation techniques in irrigation and enabling farmers

In terms of human intensive processes in farming, irrigation is one such process. Machines trained on historical weather pattern, soil quality and kind of crops to be grown, can automate irrigation and increase overall yield. With close to 70% of the world's fresh water being used in irrigation, automation can help farmers better manage their water problems.

5. Importance of Drone

Before the crop cycle, drone can be used to produce a 3-D field map of detailed terrain, drainage, soil viability and irrigation. Nitrogen-level management can also be done by drone solutions. Aerial spraying of pods with seeds and plant nutrients into the soil provides necessary supplements for plants. Apart from that, Drones can be programmed to spray liquids by modulating distance from the ground depending on the terrain. Crop Monitoring and Health assessment remains one of the most significant areas in agriculture to provide drone-based solutions in collaboration with Artificial Intelligence and computer vision technology. High-resolution cameras in drones collect precision field images which can be passed through convolution neural network to identify areas with weeds, which crops need water, plant stress level in midgrowth stage

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...arming

...more accurate and controlled ...de that replaces the repetitive and ...-intensive part of farming. It also ...ovides guidance about crop rotation. Key technologies that enable precision farming are- High precision positioning system, Automated steering system, Geo mapping, Sensor and remote sensing, Integrated electronic communication, Variable rate technology. Optimum planting and harvesting time, water management, nutrient management, pest attacks and so on. By investing in precision algorithm, better, faster and cheaper farming opportunities can be utilized. This enables overall accuracy and efficient use of resource.

7. Yield Management using AI

The emergence of new age technologies like Artificial Intelligence (AI), Cloud Machine Learning, Satellite Imagery and advanced analytics are creating an ecosystem for smart farming. AI sowing app can be used to recommend sowing date, land preparation, soil test-based fertilization, farm yard manure application, seed treatment, optimum sowing depth. Technology can also be used to identify optimal sowing period, historic climate data, real time Moisture Adequacy Data (MAI) from daily rainfall and soil moisture to build predictability and provide inputs to farmers on ideal sowing time.

Indian Agriculture and Artificial Intelligence (AI) Technology

To achieve and maintain an annual growth rate of 8 –10% for the Indian economy, agriculture sector must grow 4% or higher rate. The Government of India has recently prioritized Doubling Farmers' Income as a National Agenda; putting considerable focus on supply chain perspectives in agriculture and market development in addition to productivity augmentation. Despite making impressive progress and receiving government attention, the sector continues to be dependent on unpredictable variables, has weak supply chain and low productivity. India has not been able to completely remove its exploitative dependence on resource intensive agricultural practices. Degradation of land, reduction in soil fertility, increased dependence on inorganic fertilizers for higher production, rapidly dropping water tables and emerging pest resistance are some of the several manifestations of India's unsustainable agricultural practices. As global climate becomes more vulnerable and unpredictable, dependence on unsustainable and resource intensive agriculture will only heighten the risks of food scarcity and agricultural distress. The sector suffers from poor resource utilisation, with the production quantum and productivity still being quite low.

Similarly, use of water in agriculture continues to be high and sub-optimal. The practice of growing water intensive crops, and inefficient water management, makes India a

net exporter of water and puts India's long run agronomic sustainability in question. Despite having just one-third of the gross cropped area under irrigation, agriculture consumes 89% of our extracted groundwater. Comparison of yield and water footprint Agrarian distress in India has increased over time due to a multiplicity of factors. Fluctuating agricultural growth rate, globalised value chains leading to variability in commodity prices, unpredictable changes in monsoon rainfall over years and structurally inefficient domestic agricultural markets are just some of the reasons for income variability of farmers. Various National Sample Survey rounds have shown the reduction in proportion of value share of crops to overall agricultural value from 78% to 69% since the Green Revolution. Thus income disparity between a farmer and non-agricultural worker has increased over the years.

Major Challenges in the adoption of AI:

Though Artificial Intelligence offers vast opportunities for application in agriculture, there still exists a lack of familiarity with high tech machine learning solutions in farms across most parts of the world. Exposure of farming to external factors like weather conditions, soil conditions and presence of pests is quite a lot. So what might look like a good solution while planning during the start of harvesting may not be an optimal one because of changes in external parameters.

1. AI systems also need a lot of data to train machines and to make precise predictions.

2. In case of vast agricultural land, though spatial data can be gathered easily, temporal data is hard to get. For example, most of the crop-specific data can be obtained only once in a year when the crops are growing.

3. Since the data infrastructure takes time to mature, it requires a significant amount of time to build a robust machine learning model. This is one reason why AI sees a lot of use in agronomic products such as seeds, fertilizer, pesticides and so on rather than in-field precision solutions.

4. Although AI presents immense opportunities in agriculture application, there still prevails a deficiency in familiarity with advanced high tech machine learning solutions in farms around the world.

5. A crop raising plan scheduled at the start of the season might not seem to be good at the start of harvesting as it gets influenced by external parameters. As the database takes time to mature, it involves a substantial amount of time to construct a robust AI machine learning model.

6. The future of farming in the times to come is largely reliant on adapting cognitive solutions. Though a vast research is still on and many applications are already available, the farming industry is still not having sufficient service, remains to be underserved. While it comes down in dealing with realistic challenges and demands faced by the farmers, using AI decision making systems and predictive

solutions in solving them, farming with AI is only in a nascent stage.

7. The other limitations are Among difficulty in access to data (more specifically, structured and intelligent data), high cost and low availability of computing infrastructure, lack of collaborative approach to solving for AI combined with low awareness.

Recommendations

India's unique challenges and aspirations, combined with the advancement in AI, and a desire to assume leadership in this nascent technology means India's approach towards AI strategy has to be balanced for both local needs and greater good. The way forward for India in AI has to factor in our current strengths in AI, or a lack there of, and thus requires large scale transformational interventions, primarily led by the government, with private sector providing able support.

1. Concert collaborative efforts by relevant stakeholders, with government playing a catalytic role, could lead to fundamental building blocks that can form the core to India's march towards achieving its goal.

2. Private sector's contribution to AI research has remained low. Despite some encouraging recent developments, a lot of ground needs to be covered.

3. The first set of recommendations focus on turbocharging both core and applied research.

In addition, two frameworks for solving some of AI's biggest research challenges through collaborative, market oriented approach have been proposed.

4. The new age of AI and related frontier technologies would disrupt the nature of jobs of tomorrow and the skills required to realise the true potential of these transformative technologies. The changes and challenges anticipated for the workforce will come from both the demand and supply side: demand for capabilities for jobs that don't even exist today and diminished demand for some of the jobs that could be automated, supply of newl graduates, a large portion of whom may struggle to be gainfully employed.

5. Given our strength in advanced IT sector and the strength of favorable demographics, India may seem more equipped for workforce disruption that AI will bring, however our large numbers may soon turn from potential assets to liabilities if right structures are not put in place.

6. The focus on reskilling of existing workforce and preparing students for developing applied set of skills for the changing world of technology can help in a large way. Early adoption of AI – be it the research community building technology infrastructure, the startup community developing applications and corporations deploying solutions for their business needs, would be one of the key determinants in ensuring leadership in AI.

7. Developing large foundational annotated data sets to democratise data and multistakeholder marketplaces across the AI value chain (data, annotated data and AI models) is required. Ensuring adequate privacy, security and IP related concerns and balancing ethical considerations with need for innovation is equally important.

Conclusion:

Providing framework for developing National Strategy for Artificial Intelligence can bring a significant change in Indian agriculture. To exploit the tremendous scope of AI in agriculture, applications should be more robust. Then alone it will be in a position to handle frequent shifts and changes in external conditions. This would facilitate real time decision making and sequentially utilize appropriate model/program for gathering contextual data efficiently. The AI solutions have to become more viable to assure that this technology reaches the farming community. If the AI cognitive solutions are offered in an open source platform that would make the solutions more affordable, which eventually will result in faster adoption and greater insight among the farmers.

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