



# Policy Brief

July 2018, No (2)

R & D Issues	Integration	Strategic Policy
<p><b>Natural Resource Management (NRM)</b></p> <ul style="list-style-type: none"> <li>ICAR should consider taking a mega project on development of AI tools for validation and integration of available data on weather, soil and other natural resources.</li> <li>Soil nutrient mapping using appropriate IoT and AI should be given priority for conservation and sustainable utilization of resources.</li> <li>Development and adaptation of indigenous sensors for monitoring of natural resources like soil and water should have sufficient focus so that cost effective and robust sensors are available for deployment of IoT.</li> <li>UAV based tools, protocols and gadgets need to be developed for data collection, modelling, decision making and input application.</li> <li>A digital database on different crops, diseases, insects, pests, animal breeds and their diseases, etc. should be developed so that image processing, audio processing and other such tools in conjunction with AI could be deployed.</li> </ul>	<ul style="list-style-type: none"> <li>Different AICRPs involved in collection and warehousing of such data, ICAR institutes such as NBSSLUP, CRIDA, IASRI, IARI, state departments and NRSA could collaborate for NRM data.</li> <li>CIAE, CSWCRI, IISS should take lead in association with IITs, Universities, CSIR and private for sensor development manufacturers.</li> <li>ICAR-CIAE along with IASRI in association with various commodity institutes could take lead in digital database development.</li> </ul>	<ul style="list-style-type: none"> <li>Encourage investment in projects / infrastructure to support and deliver AI-based services, and partnering with private industry need to be promoted.</li> <li>Developing integrated flagship programs such as 'Niche Area Excellence' in identified consortia of ICAR institutions.</li> <li>ICAR need to play much bigger supportive role for implementing AI and wide spread of AI applications to farmers by strengthening linking with private industries. The kind of hand holding and support is required for private businesses in terms of capacity building and domain consultancy.</li> </ul>
<p><b>Animal &amp; Fisheries Sciences</b></p> <ul style="list-style-type: none"> <li>Animal tracking system; Health monitoring system</li> <li>Traceability of Animal products</li> <li>Quality check system at primary milk cooperative society level.</li> <li>Feed/input management &amp; monitoring</li> <li>Water quality management.</li> <li>Accuracy of sensors (calibration for quality data)</li> <li>Biomass estimation.</li> </ul>	<ul style="list-style-type: none"> <li>All animal and fishery institutes need to network with CDAC and IITs.</li> <li>IoT hardware suppliers.</li> <li>Collaboration with private Business enterprises.</li> </ul>	

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## Artificial Intelligence and Internet of Things: Implications for Human Resources in Indian NARES

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### Introduction

India is the second biggest Populated country with 1.27 billion people and third largest Economy after America and China. India produces larger amount of spices, fishes, poultry, livestock and plantation crops. In India among the entire rural areas 70% of the population prefers agriculture as their primary occupation. Agriculture contributes about 17-18% to India's GDP. There is huge potential for artificial intelligence and machine learning to revolutionize agriculture by integrating these technologies into critical markets on a global scale. The Latest IT technologies involves the incorporation of information and communication technologies into machinery, equipment, and sensors for used to improve the agricultural production systems. Therefore, the aim of this policy brief is to characterize the Indian scientific knowledge about AI and IoT available in the worldwide scientific literature thus assessing the current status and suggest policy strategies. Indian farming system and agricultural industry relies on innovative ideas and technological advancements to help increase yields and better allocate resources with advanced computing tools. This policy paper offers a look at key considerations regarding AI, including a set of guiding principles and recommendations to help scientific communities of National Agricultural Research and Education System (NARES).

### Assessing the Current Status of AI and IoT in Agriculture

To identify the challenges, solutions and impacts for artificial intelligence, internet of things, machine learning in the field of agriculture, we reviewed reputed research databases (Web of Science) for literature from the period 1998 to 2018 with topic and title "internet of things in agriculture", "machine learning in agriculture", "internet of things in agriculture". We found different results with more than 300 records after conclusion of survey. In 2017 results reached the mark with around 120 records, but there were no articles published before 2010 except one paper in 2008. AI, IoT technologies moving towards consideration for interest, research drastically increased from the year of 2010 to 2018. Apart from this we also surveyed about two groups of keywords in google scholar, search engines, various internet articles, blogs, and webpages. We have collected information from various sources of information both practical innovations and theoretical proposals. After collecting the information, we reviewed and analyzed we found more than 10 suggested applications works using AI, IoT concepts for AI, IoT based farming. The detailed trends about research on IoT technologies in agriculture is presented in Figures 1 and 2.

Artificial Intelligence (AI) is being used in several areas of life, we see various home consumables as Internet of Things (IoT). The application of AI and IoT in agriculture is a little recent phenomenon. The Indian Council of Agricultural Research (ICAR), New Delhi has taken a very timely call on this issue to strengthen the subject in National Agricultural Research and Education System (NARES). As one of the action point of ICAR Directors Conference held at New Delhi during 8-9 March 2018, the Academy has conducted a research survey and a national level workshop.

During March and April, 2018, a questionnaire survey was done among 200 young scientists and researchers undergoing training at NAARM in the Foundation Course for Agricultural Research Service (FOCARS) and Foundation Course for Assistant Professors of Agricultural Universities (FOCAU). The results are very encouraging and suggest an identified action plan. Further a 'National Dialogue on Application of AI and IoT in Agriculture' was conducted during 1-2 June 2018. The interaction of senior persons has identified research and development issues, policy issues and integration issues in the areas of crop, animal sciences and natural resources management. The results of survey and national workshop are the main basis of this policy brief.

During my visit to Australia in May 2018, I have noticed that Australian Universities are focussing on application of AI and IoT in agriculture, which results in efficient production system with highest level of resource efficiency. The Indian NARES also can do it and there are several challenges, which will be discussed during higher level brainstorming workshop to be organized by ICAR-Indian Agricultural Statistical Research Institute (IASRI), New Delhi, ICAR-NAARM, and ICAR-Indian Institute of Water Management (IIWM), Bhubaneswar during July 2018. In this workshop, the Directors of several ICAR institutes will participate, the preliminary survey and national dialogues from the Academy will be an input for this workshop. All these efforts would help in development of ICAR policy on AI and IoT in agriculture.

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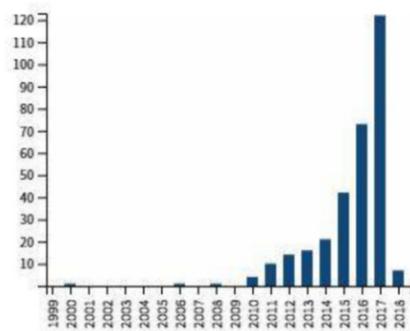


Figure 1: Total Publications by Year for Keyword: (AI and IoT in agriculture)

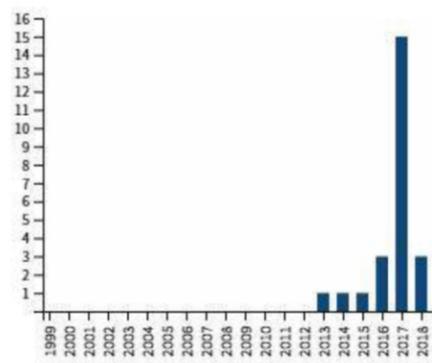
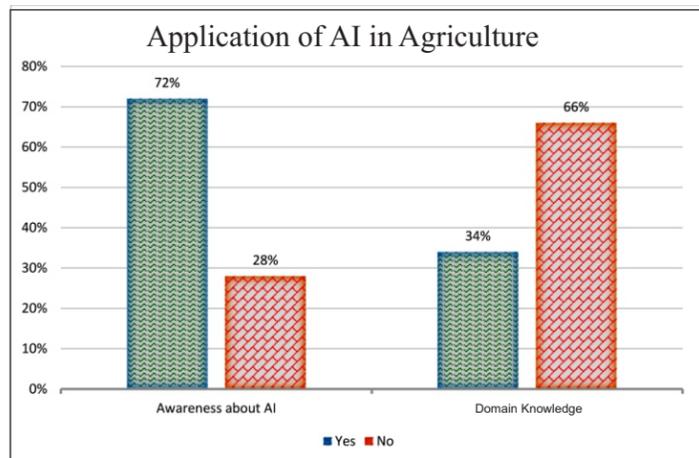


Figure 2: Sum of Times Cited by Year for Keyword: (AI and IoT in agriculture)

### Knowledge Level of Young Agricultural Researchers

A questionnaire survey was conducted during March and April, 2018 among 200 young scientists and researchers undergoing training at NAARM in the Foundation Course for Agricultural Research Service (FOCARS) and Foundation Course for Assistant Professors of Agricultural Universities (FOCAU). This study presents the qualitative results obtained from interviews with agricultural stakeholders.



First, an overview of AI and IoT Applications in India is provided; then, the main barriers to adoption are discussed. The survey results reveals that Agriculture experts need to adopt and learn the IoT, AI concepts. Then only better applicability and usability of IoT and AI will be possible. As depicted in Figure 3, though significant number of respondents are aware of AI & IoT but only 34% and 28% really know application of AI and IoT in agriculture respectively.

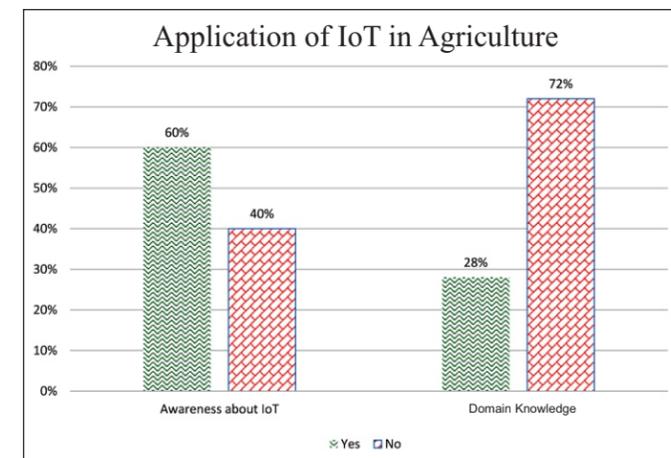


Figure 3: Responses of Different Stakeholders about Awareness and the Application of AI and IoT in Agriculture

### Government of India Initiatives

India and the importance of the local language are inseparable. The government understands it better than anyone else (ministers know the impact of local language, especially during elections). “Using NLP, Niti Aayog is making available a set of tools for developers to build chatbots in local languages,” said the first source. “It’s something like teaching villagers mathematics in their local language.” NLP is short for natural language processing. India needs massive upgradation

programmes in new technologies. As rightly pointed by NITI Aayog CEO Amitabh Kant that IITs and IIITs must redefine themselves as institute driving cutting-edge technologies for the fourth industrial revolution. Governments should partner with industry to promote AI tools to access encrypted data for analysis, while not requiring transfer of the data. Lately NITI Aayog has tied up with IBM to customized advisories to farmers of aspirational districts which underscores the importance of development AI apps for Agriculture sector at large.

### Key Policy Considerations

ICAR-NAARM organized a “National Dialogue on Artificial Intelligence (AI) and Internet of Things (IoT) Applications in Agriculture” during June 1-2, 2018. The programme consists of presentations by the experts

and parallel group discussions with the following theme such as “AI and IoT applications in Crops”, “AI and IoT Applications in Natural Resource Management” and “AI and IoT applications in Animal Science and Fisheries”. The key policy considerations are given in the table.

R & D Issues	Integration	Strategic Policy
<p><b>Crop Sciences</b></p> <p>The two important input factors made available:</p> <p><b>i) Good Quality Data</b></p> <ul style="list-style-type: none"> <li>Collection and quality analysis of data: Data should be collected in coordination with computer applications experts, keeping in view of crop/expert models.</li> <li>For keeping pace with the dynamic environmental conditions, data should be collected on real time basis.</li> <li>Data generated through AICRP trails and satellite data should be optimized.</li> <li>Integration and validation of existing data</li> <li>Digital herbarium/databases like germplasm, climate, field data etc. need to be integrated.</li> <li>Forecasting and crop biomass estimation</li> </ul> <p><b>ii) Sensors</b></p> <ul style="list-style-type: none"> <li>Need based sensors, kind of material that remains sensitive for many years, efficient and cost effective. Safe disposal of field sensors.</li> <li>Handy neuro-chips for farmers, a kind of Fit bit.</li> <li>Application of Drones</li> <li>Development of electronic eye for several purposes.</li> </ul>	<ul style="list-style-type: none"> <li>National level nodal point should be created having linkages with various institutions.</li> <li>Opportunity of sustainable continuum of biologists and electronics.</li> <li>Linkages with private industry for customization of sensors at large scale.</li> <li>Integration with CDAC, IITs, IoT hardware suppliers and other private players in the ecosystem is essential.</li> <li>Develop AI and IoT as area of specialization.</li> </ul>	<ul style="list-style-type: none"> <li>Policy support for developing competent skill in these area; training to young and middle level scientists in AI and IoT in identified institutions abroad.</li> <li>ICAR-NAARM need to act as nodal point for providing capacity building programs in AI/IoT to the NARES which can be extended to industry and agri startups as well.</li> <li>Access to data from AICRPs/KRISHI and other sources through sharing of APIs enabling real time access thus creating a central data warehouse.</li> <li>Incentives for students to pursue courses of study that will allow them to create the next generation of AI.</li> </ul>