



A Scenario of IT based Agriculture Projects in India

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Abstract: In India agriculture provides employment to large population which lives in villages and fully dependent on it to fulfill their livelihood. In the last decade, an incredible growth has been occurred in the use of electronic infrastructure for agricultural processes and development in India. In the recent time, an impressive development in information technology and electronic infrastructure has brought its usage well in the capacity of common people. The affordability of electronic equipments and IT based applications resulted to a tremendous development in agriculture sector. Farming community at large have started to monitor and control various agricultural activities such as irrigation, foresee climate situation, check soil construction and variety of crop cultures through the various information technology based systems and projects implemented by the Government of India and different State Governments in India. Objective of this paper is to present an overview of various IT based agricultural projects implemented in India. Different electronic and IT applications and services in the background of these projects are also highlighted in the paper.

Keywords: eAgriculture in India, IT in agriculture, cloud computing and agriculture

1. INTRODUCTION

Agriculture sector has a big contribution in the economic development of India. A large population in India depends on agriculture to fulfill their livelihood. Indian agriculture put in 16% of the overall GDP and gives up the employment to approximately 52% of the population [1]. India occupies the second highest position worldwide in the farm output. The primary agriculture based produce in India are fruits like mango and banana, crops like wheat, sugarcane, pulses, ginger, turmeric, cashew nut, groundnut, black pepper, cotton etc. Besides all these, milk and coconut is also produced at a big level. Agriculture in India is blessed with a variety of pros such as wider cultivable land, 20 agroclimatic regions, 46 soil types, sufficient agribusiness system and suitable seasons for different crops [2]. Therefore, under a vast agricultural diversity, a strong information assistance and knowledge system is required for the farming community to achieve the goals. Moreover, Indian agriculture is largely dependent on the natural resources and conducive weather conditions. Therefore, accurate and timely information is vital to the agricultural processes. In the recent time, eAgriculture which includes the use of electronic equipments and IT based applications has provided a major push to the ease and success of agriculture in India. The goal of eAgriculture is to allow the farmers to be directly connected to the consumers and get aware about the Agriculture Produce Marketing Cooperative [3]. Moreover, a numerous IT based projects and applications are implemented in India to put in practice the new techniques and equipments in agriculture. Internet and mobile networks play an intensive role in agriculture. It makes available the agriculture information services at very reasonable, related, searchable and up-to-date form on the mobile phones whenever and whatever a farmer required [4]. The information supplied to the farmer is collected from

agricultural experts and farmers on the basis of their own experience. Moreover, farmers are also getting aware about the retail price of the crops and take decision with the help of decision support system. Purpose of this paper is to present an overview of various IT based agricultural projects initiated by the Govt. of India and different state governments in India to assist the agricultural processes. The paper also discusses various technologies used behind the IT based agricultural projects. Rest of the paper is organized as. Next section introduces the basic IT and electronic technologies applied in the background of numerous agricultural projects initiated in India. Section 3 presents an overview of different agricultural projects implemented in India. Concluding remarks are presented in the last section.

2. IT AND ELECTRONIC TECHNOLOGIES IN THE BACKGROUND OF e-AGRICULTURE IN INDIA

2.1 INFORMATION COMMUNICATION TECHNOLOGY (ICT):-ICT provides the information related to agriculture to Indian farmers at very reasonable and affordable cost. The most recent area of ICT is cloud computing which provides the services and tools on pay-per-use basis. The farmers whenever required any information send the query for the appropriate cloud service and after analysis and processing of the request final result are passed back to the farmer. The request may be related to the latest farming, pest control knowledge and the entire process from production, distribution to consumption [5]. Data related to yield and quality, soil properties and remote sensing are composed from various sources stored to GIS databases and evaluated through geostatistical methods so that it is helpful to the farmers for management zones and decision support systems [6]. Moreover, eAgriculture contributes in the agriculture development as well as rural development. ICT

applications and cloud computing can play an intensive role to enhance the production in agriculture as ICT delivers knowledge database instantly and at very affordable cost which is in the fine quality, sound adapted, updated and protected. Some of the states in India have started to utilize the benefits of modern IT applications (ICT and Cloud computing) very effectively. For example, an agro advisory system is introduced in Gujarat state [7]. It is based on cotton ontology, web services and mobile application development. Farmers can access the queries from cotton ontology related to any needed information such as cotton, mud, farming process, bug, insect and any other. Web services established the communication with different data sources and all these applications are available on simple android phones.

2.2 WIRELESS SENSOR NETWORKS (WSN):-WSN is basically applicable in precision agriculture to manage the climate state according to the crop data sheet [8]. The external sensor node called 'A', gather information regarding exterior climate of green house like temperature, pressure, daylight, moisture, CO₂, wind speed and wind direction. According to the collected information, system will take appropriate decision to control flow of air, screen and sprinkler. The sensor node 'B' works inside the greenhouse to examine the pressure, humidity, light and temperature along with CO₂ percentage inside the greenhouse. The third sensor node called 'C' monitors the various soil conditions like temperature, moisture, pH value and electric conductivity. Wireless sensor actor networks (WSAN) is used to measure the environmental data from the farm that is further helpful in decision making [9]. WSAN sensor nodes monitor the environment data and actor nodes works according to the decision in use by decision making along with wireless medium. Moreover, Zigbee based Wireless Sensor Network (WSN) [10] is basically used for environment monitoring such as moisture of soil and leaf, temperature, weather, irrigation, storage place and identify the bugs. Zigbee WSN increases the production of crops by giving the knowledge of soil and plant conditions on the cell phones of farmers. WSN has mainly three units data gaining, memory & processing, communication unit and power unit. To provide the WSN in affordable condition, Zigbee has developed to fulfill the motive of providing very reasonable cost and data network with low power. Zigbee mainly build up of four layers i.e. physical layer, medium access control layer, network layer and application layer. With the help of management entity service access point and data entry service access point an interface is established between the layers. Moreover, to initialize maintain and control the network, Zigbee works through three devices i.e. co-coordinator, router and end device. Thus, Zigbee is helpful in improving the competence and growth in crop yield.

2.3 INTERNET OF THINGS (IOT):-IOT is a smart technology that comprises identification, sensing and intelligence. IOT is the combination of cloud computing and intelligent sensing network along with ubiquitous network. IOT technology and techniques is used in farm produces and production among plant factory technology as incorporation. The plant factory provides the continual production of crops on whole year via ability to control environment. With the coordination of computer, IOT automatically controls the temperature,

humidity, carbon dioxide attention and the culture resolution of crops in farms [11]. IOT basically give out the plant factory by means of comprehensive sensing, to give reliable delivery and intelligent handling with its three layers that is sensing layer, delivery layer and control layer. In sensing layer environment testing sensor, biosensor, GPS and RFID works jointly to sensing the production process of crops. Further, delivery layer delivered the consistent data to the customer and collected information by sensing layer passes away to control layer. Final output is displayed on the terminal via delivery layer. In delivery layer, 2G GPRS, 2.5G CDMA and 3G wireless broadband are required for remote connection. Control layer has the combination of PDA's, controller, regulation equipment and operating terminal which provides the automation of tools in plant factory. Moreover, it has been able to acquire and evaluate weather information from the internet, so that through the information irrigation plan can be obtained. This is helpful to check the water level of particular plant by means of how much water a plant needed and too much water can be avoided. Moreover, IOT serves in many forms in agriculture such as monitoring the environment, food supply chain, animals, soil and plant and control system. IOT also play good role in precision agriculture, greenhouse and food traceability [12].

2.4 ANDROID APPLICATIONS:- There are two types crops summer/monsoon and winter in India. The information related to these crops is provided on the internet. However, most of the Indian farmers feel difficulty to understand the English language. To overcome this problem a proposal of android app is launched in the Gujarat state of India [13]. Android App provides the summer/monsoon and winter crops disease information in audio form on android phone. Further, information in native language is present totally free anywhere and anytime. Moreover, there is no need of internet connection and PC/Laptop. Android App has many buttons which offers different options related to crop diseases. This app helps the farmers to get aware about the diseases and suggests the suitable pesticide for that particular disease. In addition another application named 'Kissan' is implemented to solve out the key problems of Indian farmers and make available the results in several languages so that farmers can understand the suggestions [14]. The Kissan app has five basic operations which are registration, weather forecasting, news and feeds, multiple language support and market trading. Weather forecasting supply the information based on the integrated quantitative data of the atmosphere at a given place so that farmers can take appropriate decision for their crops. Further, information about crops gives the detail about crop, fertilizers and animals. News and feeds present detailed information and process of different programs launched by Government of India. Market trading gets aware to the farmers about daily updates and changes in the prices of crops in market.

3. SCENARIO OF IT BASED PROJECTS IN INDIA

3.1 NICRA:- Indian Council of Agriculture Research (ICAR) launched the National Initiative on Climate

Resilient Agriculture (NICRA) in February, 2011 [2]. NICRA is a network project. The main objective of NICRA is to increase the flexibility of Indian agriculture, specifically the changes and weaknesses in the climate with the help of strategic research and technology expression. This website also present online weather information including online Weather Station, Crop Weather Outlook, Daily rainfall situation, Rainfall arrears districts. NICRA is helpful to increase the spirit of Indian agriculture by managing the climatic inconsistency through the risk management technologies. The technology packages are especially developed to tolerate the climate risks. This project is beneficial to various crops in Indian agriculture. In India, NICRA villages farmers are applying various technologies related to irrigation, tolerate drought, water harvesting, management of flood, tube-well techniques and management of sodic soil [15]. NICRA has four modules crop production, improving soil health, livestock and natural resource management. Further, these modules increase the spirit of Indian agriculture by enhancing the production through the development and application and the technologies that tolerate the risk. A site specific technology package is displayed on farmer's field to tolerate the present climate risk [16].

3.2 mKisan:- mKisan is a basically SMS portal for farmers that makes available the information, services and advisories from the organizations affiliated to central and state government in agriculture field [17]. Farmers can access the information in the form of SMS in their own language. Farmers can also make a call to Kisan Call Centre whenever they require advice according to the problem faced in agriculture. Farmers can access the information on particular crop given by a panel of experts as well as insects, diseases and nutrition helpline. Regular information related to weather, pests, diseases and market price is delivered to the farmers in the form of voice based message via interactive voice response (IVR) technology. mKisan app is especially beneficial to poor farmers who are low literate. Since the launching of mKisan (i.e. mid 2012), one million farmers are linked to this app. It is extended to Hindi speaking areas such as Madhya Pradesh, Bihar and Uttar Pradesh [18].

3.3 Kisan CallCentres:- Kisan Call Centres scheme is launched by Ministry of Agriculture on January 21, 2004 [19]. The basic function of this project is to provide the answers of farmers question by making a telephone call. A toll free number '18001801551' is provided to various Kisan Call Centers which is working at 14 different places including states and union territories. The number of Kisan Call Centers can be accessed via mobile phone as well as landlines. There are choices of 22 local languages from which any one can be chosen by the farmers based on their resident area. Hence, answer is replied in the selected language so that farmer can easily understand the information. Asked query is firstly forwarded to the Farm Tele Advisor, if he is unable to give the suitable answer then query is moved to higher level expert belongs to any of State Agriculture Department, ICAR and State Agriculture Universities. Information delivered to farmers is accurate, reliable and useful for the farmers. Farmers can get the quick answer of their quires in the working hours and the calls made in the late hours and on holiday are recorded and

replied by post. Moreover, farmers can acquire the solution of the problems very fast and also the latest information helps to enhance the production [20].

3.4 ATMA:- Agricultural Technology Management Agency (ATMA) scheme was approved by the Indian government. ATMA's main aim is to provide program planning and resource allocation. Moreover, it gives training to the farmers regarding farming system modernism, farm organization, technology gaps and natural resource management. ATMA scheme is working on the district level in the seven states of India which are Andhra Pradesh, Bihar, Himachal Pradesh, Jharkhand, Orissa, Maharashtra and Punjab [21]. Four districts have been chosen from each state. Through ATMA farmers get aware about new technologies and latest researches in the agriculture field. Hence, ATMA is connected to the district research organizations, nongovernmental organizations and agencies linked with agriculture development. Farmers are combined into groups and access the information directly from the Common Service Centers or Kisan Call Centers that are required by the farmers. Further the accessed information is made available to the farmers. Moreover, Governing Board decides all the additional activities of ATMA and Management Committee applies these activities [22]. Hence, it is helpful to distribute the technology broadcasting activities to the district level. ATMA makes the coordination to all the departments in a district that contribute in agriculture development such as line department, research organization, nongovernmental, organizations and other agencies.

3.5 HaritaPriya:-Harmonized Information of Agriculture, Revenue and Irrigation for a Transformation Agenda (HARITA) implemented by the government of Andhra Pradesh for the purpose to obtain the data generated by agriculture, revenue and irrigation departments [23]. This project is wireless sensor networks (WSN) based project that is useful to acquire real time data of agriculture and irrigation. Further, according to the collected data better water management and personalized extension services can be done. In this project 20 WSN nodes are mounted at 150m distance and cover up approximately 80 acres in each village. Micro climate senses by nodes at crop canopy level on real time basis and integrated data occasionally passes to the remote server via gateway. Decision Support Models at server level created the alerts for pest forewarning or irrigation scheduling. Furthermore, agriculture experts send their advices to the farmer on alert based in their native language. This project is developed in Hyderabad by Centre for Development of Advanced Computing (CDAC) and associated by the Andhra Pradesh government, the Central Research Institute for Dryland Agriculture (CRIDA), the Indian Council of Agriculture Research (ICAR) station and the Acharya NG Ranga Agriculture University in Anantpur. HaritaPriya project is implemented in Anantpur district. Moreover, HaritaPriya project won the World Summit on the Information Society (WSIS) 2016 prize on 3 May 2016 in eAgriculture category by International Telecommunications Union in Geneva [24].

3.6 Kisan Suvidha and Pusa Krishi Apps:- Both apps are recently launched by the government of India. Kisan

Suvidha app is launched by Prime Minister Narendra Modi to provide the agriculture related information to the farmers [25]. The Kisan Suvidha app has basically five options weather, input dealers, market price, plant protection and expert advisories. App is connected to the Kisan Call Centre, hence when any information is asked by farmer then it passes to the Kisan call centre. Further the agriculture expert give the answer of the query through Kisan call centre and information is provided to the farmer via Kisan Suvidha app. At the starting point farmer registers their mobile number and the bio detail of their living area. There are two optional languages Hindi and English in which farmers can access the information. Weather option specifies the temperature, humidity, wind and rain fall of current to next five days that helps the farmers to take decision in growing the seasonal crops. Market price option provides the detailed price of currently harvested crops in the market of district, state and country. Plant protection button get aware the farmers regarding pest, weed and disease onevery stage of crop development. Last option agro advisory gives the messages delivered by districtagriculture officials. Another mobile app named Pusa Krishi is launched by agriculture minister Radha Mohan Singh to come up the technology in Indian farms [26]. Pusa Krishi app especially distributed theinformation regarding the new selection of crops and latest machinery developed by Indian Council of Agriculture Research. Farmers can access the information related to current and coming weather so thatthey can take appropriate steps to save their crops from unfriendly weather. Pusa Krishi app alsodescribes the methods of cultivation practices.

3.7 Automated Crop disease Advisory Service (ACAS):- ACAS is developed with the combination of Wisekar situated at Delhi [27]. There are various diseases that are affecting the crops. To get the solution for particular disease, farmers sent the images of disease and information collected from agriculture experts is stored on the dashboard. Hence, stored information is supplied to the farmers. It gives the facilities of various application libraries to maintain and combine the development and testing of services on diverse software platforms. ACAS consists of three components which act together. These are dashboard, Wisekar and crop monitor. The dashboard is a PHP level web application and the crop monitor is a application developed in local language to acquire an unprocessed crop image as input and produce the processed image with the disease location marked as output. ACAS works in four steps firstly with a mouse click the information containing farmer data, advisory and images is moved from the dashboard to Wisekar. After that raw image related data is pulled into the crop monitor. In the next step crop monitor uploads the processed crop image and disease details back into Wisekar. Finally, the processed results are accessible on the dashboard.

3.8 Accelerated Irrigation Benefit Programme (AIBP) Bhima Irrigation Project:- In India rainfall is insufficient in many regions and lots of inconsistency exists in the environment. Hence, irrigation makes available the required water to the fields under poor natural conditions. AIBP project is implemented in the Mangalwedha taluka, Solapur district in Maharashtra [28]. Project works with the

combination of satellite data such as Cartosat I, Landsat ETM+, SRTM images with the coordination of additional data such as climatic data, soil and irrigation data. It has two modules, calculating Irrigation Potential (IP) and calculating Agricultural Potential. Irrigation Potential module estimate the irrigation potential with the help of digitization of the canal network and produce an inventory of the hierarchy of the distribution system ranging from Ujjani Right Bank Canal through the Distributaries and to the Minors and Sub Minors. Further, six parameters of the agriculture potential has been calculated that are irrigation potential (IP), humidity index, slope, precipitation, soil and productivity of crops for the study area.

3.9 User Oriented Cloud Service Model:- User oriented cloud service model is supportive to evaluated the farmer's needs and recognize the services in particular area. At the first point connected to the cloud computing to produce cloud environment through the cloud servers. These cloud servers are comparative to weather forecasting, agriculture processing etc. Farmers send their request to the integrated environment in the form of graphical interface query [29]. Once the query is submitted to the relative cloud server identifies the parameters related to the query. Further, parameters comprise availability, response time, process time, process type etc. This model provides the cloud services associated to weather forecasting, rainfall prediction, temperature prediction, crop and disease based suggestion etc.

3.10 Farmer Portal:- It is initiated by Government of India. This is one end store for farmers when they arrive for pesticides, seeds, fertilizers, etc [2]. Farmer's Portal provides information to Indian farmers related to agriculture, animal husbandry and fisheries sectors production. Through the Farmers Portal farmers can get access to the information about his village/block/district or state. Farmers can access the agriculture related information in their native language in any form means text, SMS, email and audio/video with the help of the Map of India located on the Home page. Farmers can also get the answer of any query and feedback also [1].

4. CONCLUSION

eAgriculture plays a vital role to improve the agriculture production at high level, that impacts on the life of rural people in India. Farmer's can access the information related to crops and farm management. eAgriculture provides upto date information of new technologies, pesticides, fertilizer and equipment to farmers deliver by agriculture experts in furnish timely. Moreover, cloud computing provides interface between illiterate farmers and Government Services. Cloud computing is a centralized bank which gives the efficient agricultural information at no cost and on demand. Now a day farmer can use the information by accessing it on their mobile phone, even in some applications internet connection is also not required. Furthermore, Indian government launched various projects on IT based in agriculture to provide the facilities to the farmers and enhance the production. These projects provide the appropriate solution of any problem faced in agriculture. Hence, the advanced technologies employed in agriculture bring amazing development in this sector.

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