Sustainable development in agriculture using internet of things - A Review

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Abstract. Agriculture is the primary source of food grains and livelihood of rural people in India. The importance of agriculture cannot be ignored as it is also the backbone of country’s economy. There is a remarkable change in the farming conditions for the past several years. There is uncertainty in water availability for agriculture and scarcity of natural resources due to rapid degradation and use of these natural resources but the population across the globe has grown immensely. This addresses the need for implementation of better farming methods such as precision agriculture which contributes in several ways to provide sustainability of production agriculture over a long period by producing more in less time using available natural resources. Over the last few years, there is a gradual increase in the usage of such systems. Nowadays farmers are being trained and are using information systems to improve the crop management and for increasing the productivity. This paves a path to create a platform to manage farm activities, improve biodiversity and also to reduce the consumption of water. Such new invention in turn enhances and develops the farming. This paper analyses about how IoT is laying a strong foundation for sustainable development in agriculture.

1. Introduction

The major source of food production in our country is agriculture. In every sector, the importance of agriculture is blooming day by day. The population across the globe is likely to reach 9.8 billion by 2050. To fulfill the needs of the growing population, the agriculture production must be increased, regardless of challenges such as unpredictable weather conditions, scarcity of water and depletion and exhaustion of soils. Moreover, agricultural labour in most of the countries is declining over the past few years. There is a much demand to increase the production per unit area in spite of above challenges. To face these challenges, new technologies must be adopted in the agriculture industry sector to increase the output and for optimum utilization of resources. In present day scenario, the Internet of Things is one of the most useful technologies and is offering many solutions towards the sustainable development in the agriculture. The use of IoT offers advantages like effective utilization of inputs, optimum utilization of water resources and electricity, monitoring the crop fields, avoids crop losses due to worst weather conditions and diseases and effective planning of farm activities. The
combination of IoT with agriculture systems helps the nation to grow rapidly in economy and can become self-dependent in terms of food production and farms. Further, the net GDP of the country can also be increased. With the use of IoT in farming, various sensors can be deployed in the farm – to the ground, in water, in vehicles etc. in order to collect data. These sensors monitor temperature, soil fertility and humidity. Accordingly, the systems trigger the alerts. In addition to this, IoT can also be used for better management of water and use of pesticides for farming. The cloud server or system can be used to store the collected data and further the farmer can access the data through their mobile phones or internet. This data can also be analyzed and further used for process automation, estimate the situations and to make an improvement in lot of activities, including real-time. Moreover, the interoperability concept among the devices leads to the development of the appropriate tools, so that new applications and services can also be created.

2. Literature Survey

Ajith Jerom. B et. al [1] Water pollution is one of the major source of environmental problems in India. Water may be polluted due to untreated sewage water and unregulated industrial wastage. In addition to this, the contamination of water increases due to dissolution of many toxic agents and chemicals. When this water is used for agricultural purpose, the land gets polluted which causes serious harm to all living species, farming and plants. Therefore, monitoring of water quality is the predominant with the use of IoT in agriculture. Sensors are integrated with a generic buoy system to monitor various water quality parameters like temperature, dissolved oxygen, humidity, pH value etc. the sensors are placed under buoy for analyzing the water bodies. The collection of data from various sensors can be done by using a wireless module which is placed on the buoy system. The data can be collected using cluster header from various sensors and current changes that occur in the sensor can be processed by comparing it with the data obtained previously. The changes are observed and noticed every hour and the real time base is used to reflect the changes in sensor values. The smart water algorithm is used allow the storage of data is significant changes occur in the received data. The water quality can be assessed by monitoring the data, and the availability this data allows the user to make the analysis there by can have complete feedback on the sensor data. Various colour texts are used to indicate the contamination level of water, with blue for normal, yellow for warning and red to indicate over contamination. To display the results a PC or laptop can be used.

Ayaz et al.,(2019) [2] Souvik Biswas et al(2018)[3] The stomach of plants is soil, and to obtain field-specific information, the soil sample is examined in the beginning as a first step and from which various critical decisions can be made at different stages. The soil analysis is done to determine the field nutrient status which in turn helps to take measures if any nutrient deficiency is found. The factors that are to be considered as essential for analysing the soil nutrient levels are type of soil, history of crop, application of fertilizer, irrigation level and land-profile etc.. These factors provide an in-depth information to determine the soil status like chemical, physical, and biological levels and also helps in identifying the limiting factors accordingly the crops can dealt with them. Soil mapping always keeps door open for sowing different crop varieties based on the soil properties in a specific field. Accordingly, it is also possible to decide seed suitability, planting depth, time to sow and to grow multiple crops together which lead to efficient and effective utilization of land for smart agriculture there by simply making use of resources at the best. To test the soil, monitoring the soil parameters like temperature, moisture and acidity is essential which play a critical role to cultivate the field smartly and monitoring of these parameters are essential to get a huge agriculture output using available resources. For continuous monitoring of the above-said parameters, three different sensors namely soil moisture sensor, soil temperature sensor and a pH sensor along with Arduino are used. The input of the sensors are collected and processed by Arduino microcontroller to obtain the moisture, temperature and pH content in the soil. So obtained data can be sent via a GSM module to a mobile phone or remotely located PC. Thus, continuous monitoring of soil parameters takes place and analysis can also be done to increase the stable and efficient crop production. The SMS mode is used as it is the most commonly used real time communication mode with low bandwidth requirement and so that it can reach every corner of the rural areas in the country. From the literature it is found that the optimum soil temperature required for the growth of plants was 25 °C If the soil temperature is below
25 °C, it effects the plant growth that was dependent on fixed nitrogen. At 15 °C, no response is found in plant growth. Therefore, it can be said that the temperature effects the growth of plants and is to be considered as important factor for testing the soil. The pH value of 7 is considered as neutral, values greater than 7 are basic and below 7 is acidic. The pH Values from 4 to 8 are considered for average soil. The optimal growth of each plant has a specific pH range. Phosphorous, which is one of the three primary soil nutrients, mainly depends upon soil pH. Soil levels that are highly acidic or basic decrease the phosphorous availability to plants. Therefore the growth and germination of plants will be affected. Another is moisture content in the soil and plays a key role in transpiration and respiration.

S.B.Saraf et al.,(2017), Monitoring of field irrigation system using wireless technology reduces intervention of human being in fields and permits remote monitoring and controlling using mobile phone. Agriculture using smart irrigation using IoT brings a better solution for the physically challenged and old people to do farming. The purpose of smart agriculture using IoT is to raise the productivity with the proper utilization of available resources when compared to traditional farming. In this IoT based system, all sensors connected in WSN measure moisture content and frequently sends soil moisture measurements, which in turn useful in taking decisions regarding the need for irrigation [6]. When soil moisture at any node falls below the predefined threshold, depending on the values of temperature and humidity sensors next 4 hours the decision is taken to decide whether to irrigate or not. The cloud is also responsible for finding the exact moment to stop the irrigation. Whenever moisture content of soil exceeds or equals the defined threshold it specifies the end of irrigation. As soon as this condition is sensed, the cloud will send a message to WSN to stop the irrigation. Temperature is varied based on the crop type and moisture threshold. Accordingly, the change in duration as well as frequency of watering takes place.

3. Findings
The advent of Internet of Things has opened a new way of doing agriculture. The internet of things is a big opportunity for farmers to monitor their crops and increase the productivity with available resources. The doors were opened up using IoT for numerous productive ways to cultivate the lands and increase the food grain production by using inexpensive and that can be easily installed and also an enormous amount of insightful data. [5]Cultivation by using traditional methods needs to be modified in order to meet the existing demand for agricultural products. Man power and changing environmental conditions are the main issues that are to be considered in present day farming. Checking Water quality is the biggest use of IoT in the agriculture. Water quality monitoring using cloud avoids the use chemical reagent for evaluation. Expansion can be easily done throughout the water resource. Sleep-wake mechanism cycles based sensors were used which supports continuous monitoring and maintenance of network life about 90-120 days. It avoids the risk of sensor damage and maintenance cost is low compared to traditional system. In the agriculture, soil moisture and temperature both show large variation over a day. These two are considered as main factors that determine the stable agricultural output. In remote areas the monitoring of soil is done using GSM network to transmit the data. It consumes less power even when it is transmitted over long distances. 

[7][8]. It is reviewed that the irrigation system presented is an interconnection of technology of IoT, machine to machine, wireless sensors and actuator networks. It is found that there are several developments in the field of agriculture for the past few years, and there exists a problem of addressing on generated and collected data. It reduced water consumption by implementing a soil-moisture dependent automated irrigation system. Inside the green house, according to the requirements of the plant, various sensors measure the environmental parameters to control the environment. The processing of data and application of necessary control action is done with the help of cloud server. The Greenhouse using IoT not only monitors intelligently but also controls the climate conditions. Agriculturalists make better decisions after receiving information from cloud server and achieve specific goals by obtaining optimal data. Automated greenhouses produce most of the crops with enhanced quality and there by seed quality also increases. Regular human intervention is eliminated.

4. Conclusion
The review shows that in India, most of the farmers are uneducated. They do not have awareness about technological advancement in the agriculture and its use. Farmers must be made aware of the technological developments in agriculture, how to use them, where the information they will get, where the devices are available, providing financial aid to make use of the technology in the agriculture. Provision of this type of encouragement helps them to adopt and implement the new technology in their farming. It empowers farmers through knowledge about agricultural condition and maximizes their productivity, quality and profit by using available water resources. The farming system based on IoT is meant for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automating the irrigation system. The real-time data regarding the crop, environmental conditions is provided to the farmers based on which they will make changes in the field and increases the yielding, quality and profit through effective and efficient use of available resources. Thus, sustainable development in agriculture is possible using Internet of Things.

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