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ICT BASED SUSTAINABLE FARMING FOR SUSTAINABLE FUTURE IN VIEW OF INCREASING POPULATION

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Abstract

The swelling population brings numerous issues, causing global concern since the late 1950s. This has been discussed extensively on international platforms, including numerous conferences, conventions, and in UN reports. According to one of the United Nations (UN) report, the world population will reach 9.7 billion by 2050, up from 7.7 billion today [1]. This is a concerning situation, as the Global Hunger Index for 2024 stands at 18.3, classified as moderate [2], which raises significant apprehension. One possible solution is to increase agricultural production by optimally using limited available resources. This research article proposes the idea of using information and communication technology (ICT) in farming in order to achieve sustainability by optimal utilization of the limited available resources and this would definitely increase both the quantity and quality of the farm product. In order to accomplish this goal, an application is designed specifically for farmers that can be efficiently accessed through a computer or smartphone. This application will serve as the central point of access for all of the information/problems that arise throughout the crop lifecycle. This application will also make use of machine learning, which will result in increased precision for each and every subsequent instance. With this, it is possible to rapidly transition each and every farmer towards ICT-based SMART FARMING for the sustainable future.

Keywords: SMART FARMING, ICT in Farming, Sustainable Farming, Global Hunger Index, Population.

I.Introduction

With the introduction of agriculture 12,000 years ago, human living underwent a significant transformation. Unlike migratory hunter-gatherer tribes, they established permanent agricultural villages [5] and since then the agriculture started developing. As we see the history of the agriculture it is evolving ever since it first thought of, to cater the demand of population, but now since many years with the rapidly growing population and shrinking of agricultural land, the hunger has become a global threat. Now the global population is expected to increase at a rate of approximately 0.85 percent per year in the year 2025 [3]. The annual population growth is anticipated to be approximately 70 million individuals [3], which is a serious concern as it adversely affects the overall sustainability of our planet and hunger is the one of the primary negative repercussions of the growing population. The Sustainable Development Goal

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2030 explicitly includes Goal of ZERO HUNGER by 2030. It is anticipated that over 600 million individuals globally would confront hunger by 2030, underscoring the significant challenge of attaining the zero hunger objective. To attain zero hunger by 2030, immediate coordinated efforts and policy interventions are essential to tackle the issue and one of the ways could be to invest in sustainable agricultural methods [4]. Sustainable agriculture is the need & demand of the present and the future. In this research, we are using ICT based SMART FARMING to bring out the sustainability in the agriculture with the limited available resources.

For developing the ICT based Smart Farming tool, we first understand the factors that impact most and that needed attention in making the good ICT based SMART FARMING tool to bring the sustainability in the farming for the growing population.

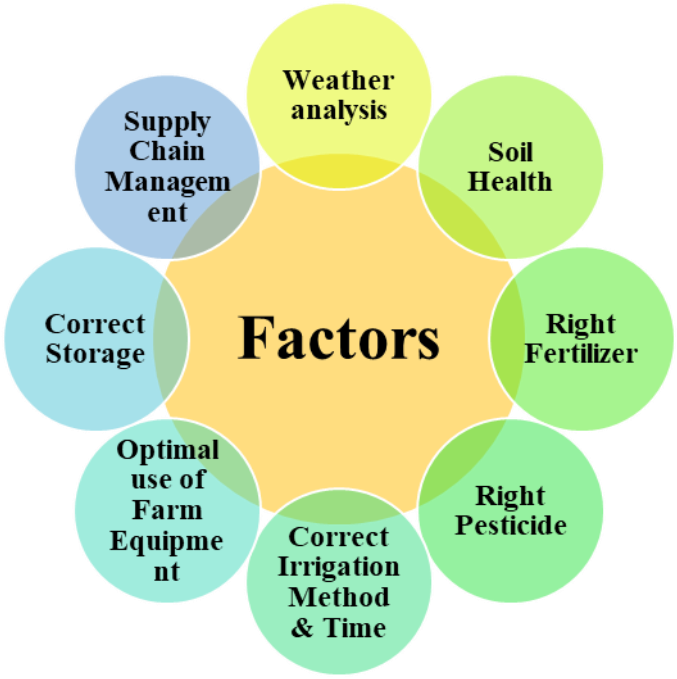

Fig 1: Factors that most significantly impacting farming

The following are the factors that most significantly impacted farming-

1. **Weather:** The weather has the greatest impact on any form of farming, and it would be really beneficial if we could forecast the weather ahead of time using already accessible technologies or by installing some sensors in the field area.

2. **Soil Health:** Soil health is an important factor because it contributes to the overall health of the crop. If we analyze the health of the soil ahead of time, we can easily work toward the health of the soil by adding the right composition of fertilizer in the right quantity. Additionally, depending on the health of the soil, we can choose the right type of seed for the best output.

3. **Right Fertilizer:** It is critical for our planet's sustainability to use the proper fertilizer in the right volume. Fertilizer overuse and underuse have substantial negative consequences for plant health and the environment. Overuse can cause nutritional imbalances, soil

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degradation, water contamination, and even plant harm. Underuse, on the other hand, leads to nutrient deficits, stunted development, and lower yields.

4. **Right Pesticide:** Pesticides are frequently regarded as a quick, simple, and cost-effective method of controlling weeds and insect pests. However, pesticide use has a high expense. Pesticides have corrupted virtually every aspect of our environment. Pesticide residues are present in soil, air, surface, and ground water all around the world. Pesticide pollution creates considerable threats to the ecosystem and non-target creatures such as beneficial soil microbes, insects, plants, fish, and birds. Using safer, non-chemical pest control methods and avoiding overexposure is the most effective way to prevent pesticide pollution in our environment [7].

5. **Correct Irrigation Method & Time:** Employing the appropriate irrigation technique and timing maximizes water efficiency, improves crop vitality, and elevates yields. This results in enhanced production, decreased expenses, and increased environmental sustainability.

6. **Optimal use of Farm Equipment:** The optimal utilization of agricultural machinery provides several benefits, such as enhanced efficiency, diminished labour expenses, and augmented yields. Employing contemporary machinery and technologies enables farmers to augment output, reduce physical exertion, and attain greater profitability.

7. **Correct Storage:** Properly storing agricultural grains provides multiple benefits, such as maintaining grain quality, minimizing waste, and enhancing farmers' income. By sustaining a regulated environment, producers may safeguard grains from pests, moisture, and other elements that induce spoiling and deterioration. This results in a more reliable supply of premium grain for consumption and sale, hence enhancing farmers' financial stability.

8. **Supply Chain Management:** A number of advantages, such as less post-harvest losses and more stable prices, come with storing agricultural products. However, there are also some disadvantages, including higher storage costs and the risk of pest infestations. Farmers may maximize revenues and maintain food security with effective storage, but substantial losses and economic suffering can result from inappropriate storage.

Considering the above factors, we designed the SMART FARMING tool, that will be used by farmers for better and Smart Farming.

II.Materials and Methods

Smart Farming refers to the application of Information and Communication Technology (ICT) in agriculture. ICT encompasses a broad range of communication devices and applications, including radio, television, cellular phones, computers, network hardware, software, satellite systems, and associated services such as videoconferencing and distance learning [8]. While modelling the smart farming tool for the farmers we will consider the above-mentioned factors that impacts the most on the agriculture and also the other necessary factors that requires to make the farmers friendly smart farming tool. This tool assists the farmers throughout the crop lifecycle and also sends the messages/alerts on fixed interval/as required.

The steps required for the development of Smart Farming Tool are-

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Step 1- Data Collection : - This is the initial step where data will be gathered from different reliable sources and also from the farmers during registration process where the farmer inputs the details about the previous crop, season, soil type, soil health card if available, pesticides used details

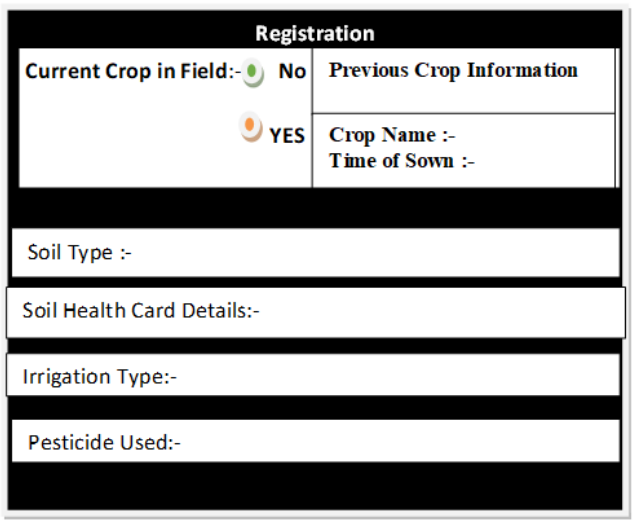

Fig 2: Farmers Registration form

Step2-Data Cleaning: - After the collection of data the next step will be cleaning of data as per the required parameters, here we have listed the required parameters based on the factors impacting most, as mentioned in above section and also considering other important factors. For cleaning we will design the algorithm that specifically helps in fetching the specified parameters.

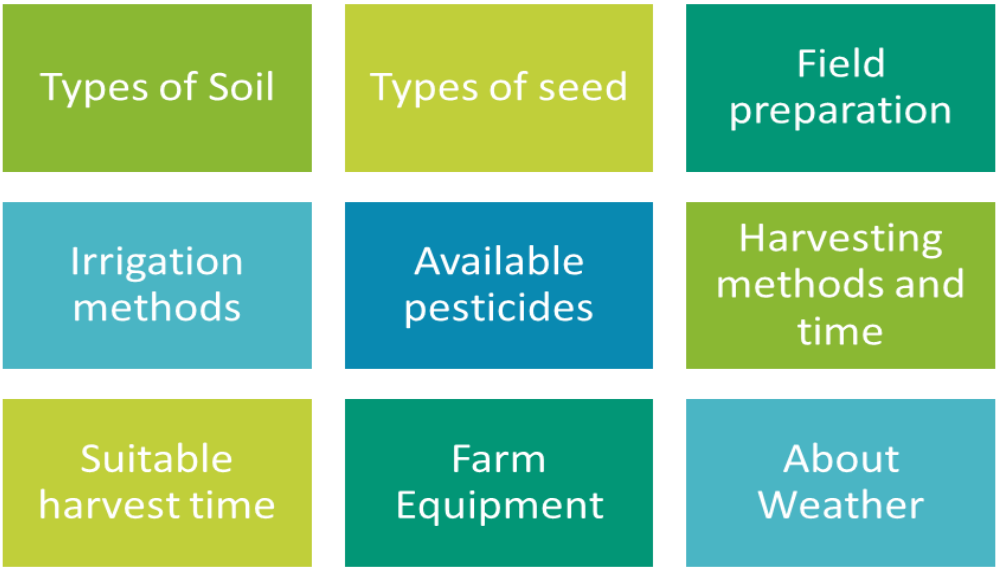

Fig 3: Defined Parameters for cleaning and analysis of data

Step 3- Data Analysis: - On cleaned data, we apply decision algorithms to analyze the data and convert it into useful information depending on the defined required parameters as shown

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in fig 3 and the same information is passed to the farmers throughout the crop lifecycle via SMS/ Alerts or to assist if some problem occurs.

Step 4- Timely Alerts/Information passing to the farmers - The useful information is sent via SMS, website, or mobile application following data analysis.

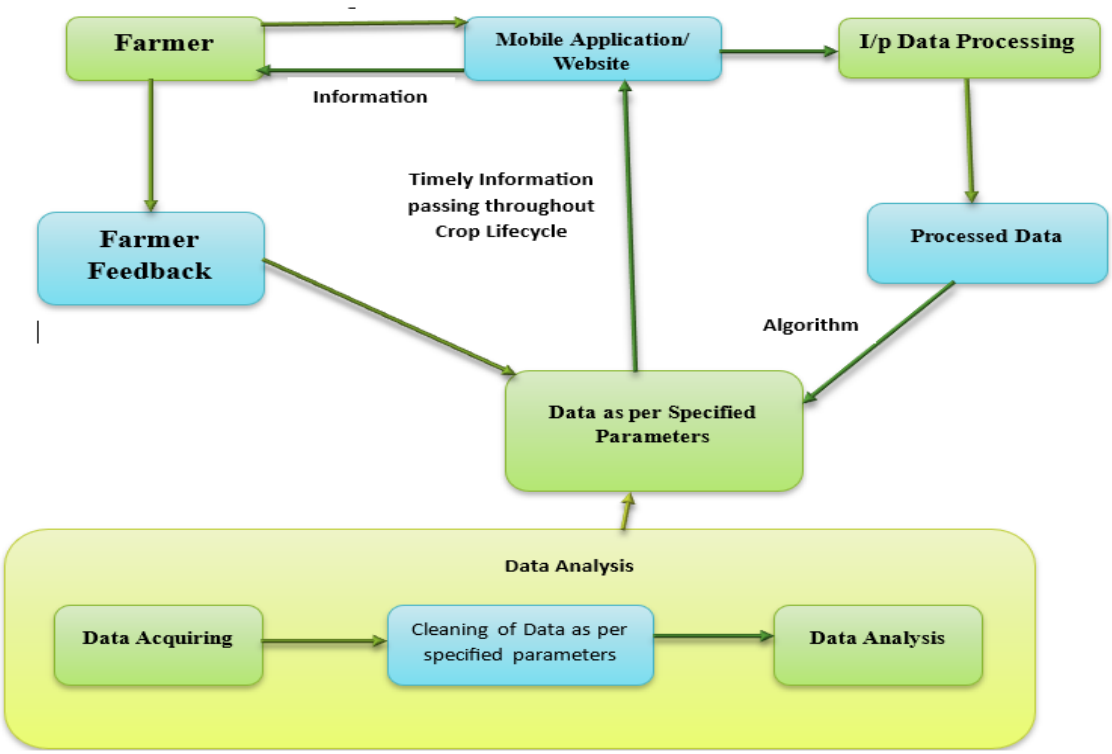

Fig 4: Diagrammatic Representation of SMART FARMING process

Step 5- Feedback used as Input: After the completion of the crop lifecycle the farmer will give the feedback and the same is used as the input and using the machine learning algorithm this feedback will help in more accurate results for every next time.

III.Result and Discussion

The proposed ICT based Smart Framing Mechanism would surely benefit the farmer by giving timely warnings and analyzing it based on the information that was initially supplied by the farmer as well as the information that has been gathered and analyzed. Using Internet of Things-based smart farming has the following benefits:

a) The application of smart farming can help even small farmers.
b) The end product's quality and production volume both increases.
c) The feedback process will produce information for the next time that produces better result for every next time.

d) The timely distribution of meteorological signals to conserve water and vegetation.
e)Applying the right quantity of each fertilizer and insecticide
f)The harvesting will be finished on schedule to produce better quality product and also helps

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from getting destroyed due to many reasons.
g) Soil conservation.
h) Using agricultural equipment as efficiently as possible.

IV.Future Scope

In light of the fact that ICT based smart farming is both the present and the future of farming, it is possible that we may integrate additional modules in the future in order to make it more fit for the requirements of the farming industry. It is without a doubt that this will be of assistance in sustainable farming as well, which is the demand of the future in order to produce food for the growing population.

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