

Linking Technology to Reduce Suicide Ideation in Indian Farmers

¹Dr. Sanya Bhojwani, ²Sheetal Singh, ³Yatharth Arora, ⁴Mradima Singh

Assistant professor, Indian Institute of Information Technology, Bhopal, Madhya Pradesh, India

Student (B.Tech. IInd Semester) Indian Institute of Information Technology, Bhopal, Madhya Pradesh, India

E-mail : ¹sanyabhojwani12@gmail.com, ²sheetalsinghssr@gmail.com, ³yathartharora1999@gmail.com,
⁴mradimasingh2000@gmail.com

Abstract: *The world population will get a huge boom according to various reports by 2050 i.e. it will approximately be doubled by 2050 and we will only get 4% extra land by then so for satisfying the needs of the current and future we need to increase our agricultural production and for this we are using a mixture of AI and IOT for the betterment of today's farming practices. Agriculture has been the core source of support for meeting basic requirements of people in all countries and their economy around the world including India. It has also been a source of employment to the people and enhances the Gross Domestic Product (GDP) of India. For years, people used to think that computers would never be more powerful than the human brain, but as development has accelerated, this has proven not to be the case. AI as a concept refers to computing hardware being able to essentially think for itself, and make decisions based on the data it is being fed. Today when you receive an email, how the e-mail is automatically moved to the spam folder if it's a spam...this is the result of AI algorithm. In February 2019 farmers in Bareilly suffered losses of around Rs. 2 crore as wheat and mustard crops on 1889 hectares of land got heavily damaged in the season's-worst hailstorm. As technocrats it is our duty to provide solutions to the problems of the people who are far from technology. The aim of this report is to evaluate the producer's perceptions and adoption of technologies involving the internet of things and artificial intelligence in precision farming in accomplishing future goals. It is also focused on examining the suicidal effects on the farmers that are emanating from climatic changes. The report also provides a simple solution using modern technical devices to cover the fields of the farmers from unwanted rainfalls, hailstorms and severe heat and showcases a survey which was conducted on various crop farmers about their perception and technologies used on the fields.*

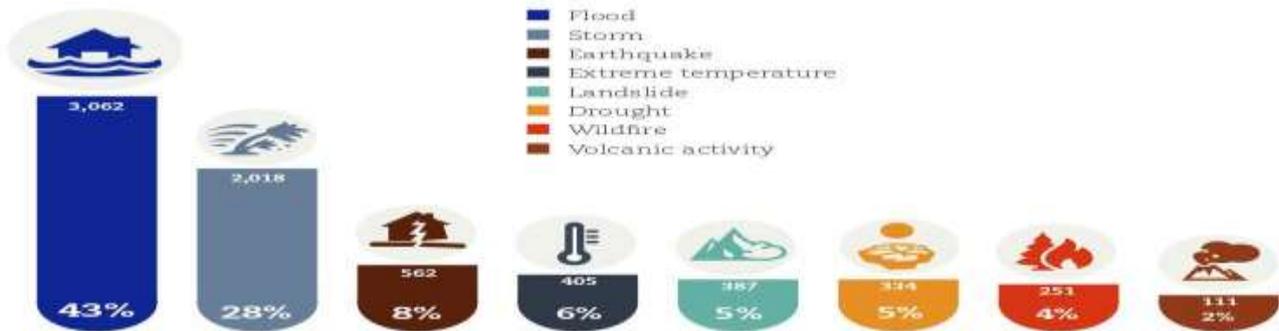
Keywords : *Internet-of-things, Unseasonal Rain, Agriculture, Crop Protection, Technology, precision-farming.*

1. INTRODUCTION:

India has experienced some extreme weather that had significant impact on a wide range of economic activities and environmental resources including agriculture, forestry, water resources, waterfowl, fisheries, recreation, transportation and hydroelectric energy. India has a short growing season and climatic conditions that vary widely across years and regions. The drastic changes in climate has directly or indirectly influenced mankind physically, mentally, economically and spiritually.

India derives 17% of GDP proportion from agriculture whereas the world average is only 4% and the sector employs 47.2% of the population, compared to the global average of 30.7%. The Indian government has taken an initiative by introducing a \$1.3bn crop insurance scheme beginning from this year to help farmers cope with falling market prices and crop failure due to natural disasters. At present only 19% of India's farmers insure their crops due to lack of awareness about the practice of crop insurance, its cost and lack of availability. 1.2 billion people in India are acutely exposed to natural disaster. Since 1995, approximately 3 lakh farmers have committed suicide. A majority of them were concentrated in five major agricultural states of the country – Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka and Chhattisgarh. Even Punjab recorded a high number of farmer suicides in 2015, next only to Maharashtra. Farm suicides have been steadily increasing over the years. On an average, around 15,400 farmers ended their lives each year between 1995 and 2003. This number increased to more than 16,000 between 2004 and 2012. It is important to note that these suicides are happening on a decreasing base of farmers. Farmer count has fallen by 9 million since 2001, which makes the increased suicide rates that much more alarming. Farmer suicides have largely been attributed to debt, drought, crop failure or poor returns.

Percentage of occurrences of natural disasters by disaster type (1995-2015)



This year, unseasonal rain and hailstorm during the phase of February-April has damaged winter crops in parts of at least six states across central, north and western India. So far, damage to rabi crops like wheat, mustard and chickpea has been reported from Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh and Maharashtra. According to a senior government official who is involved in initial assessment of damage of crops, up to 20 per cent of total production could have been damaged.

“The initial figures that we are getting from the states are indicating up to 20 percent of total Rabi crops have been damaged. Mostly, it is the wheat and mustard crops that have been damaged,” says the official on condition of anonymity. “The total cost of damage could be around Rs 10,000 crore,” he adds. Thus, it's more of an urgency to bring such ideas that are in the favour of good crop yield and farmers. The idea is incorporated and not yet developed is the covering of farmland during hailstorm and unseasonal rain, in order to protect the harvest ready crops from the wrath of nature.

When you hear that a hail storm is coming, you usually try to protect your vehicles. Farmers have similar feelings about their crops. Every year, more than 12,000 farmers suicide due to the burden of loan and crop failure according to government sources. Thus, it's more of an urgency to bring such ideas that are in the favour of good crop yield and farmers. One such idea, of covering crops from hail storm using the information from meteorological department about unseasonal rain. This would reduce the damage of crops and the suicide of farmer per year due to poor crop production.

Moreover when the crop production is less due to floods or hailstorms, not only farmers suffer but we as a consumer also suffer. If the production is less the stock of that crop will also be less in the market as a result the prices of that crop will go high, which we are generally observing now a days. Therefore the whole system is affected due to this.

1.1 WHAT IS IOT?

Imagine a hot summer day and you are lying on your bed .You want to switch ‘ON’ the fan but you are really tired and lazy to get up and switch it ‘ON’ .How would you feel if you could switch ‘ON’ the fan with your smartphone which is always in your pocket? Yes, this is very much possible with IOT. In layman terms, IOT basically means connecting everything around one to the internet. As soon as one connects anything to the internet it means that he/she can send some data and also receive some data over internet and this is what makes a device smart. Some devices can only send data, some devices can only receive data while some can do both the tasks. For example, in the fan example, the fan can only receive data that is whether the fan has to be switched ‘ON’ or ‘OFF’. The trend of IOT devices is increasing day by day. The chart shows clearly shows the increasing use of IOT devices among the consumers –

Table 1: IoT Units Installed Base by Category (Millions of Units)

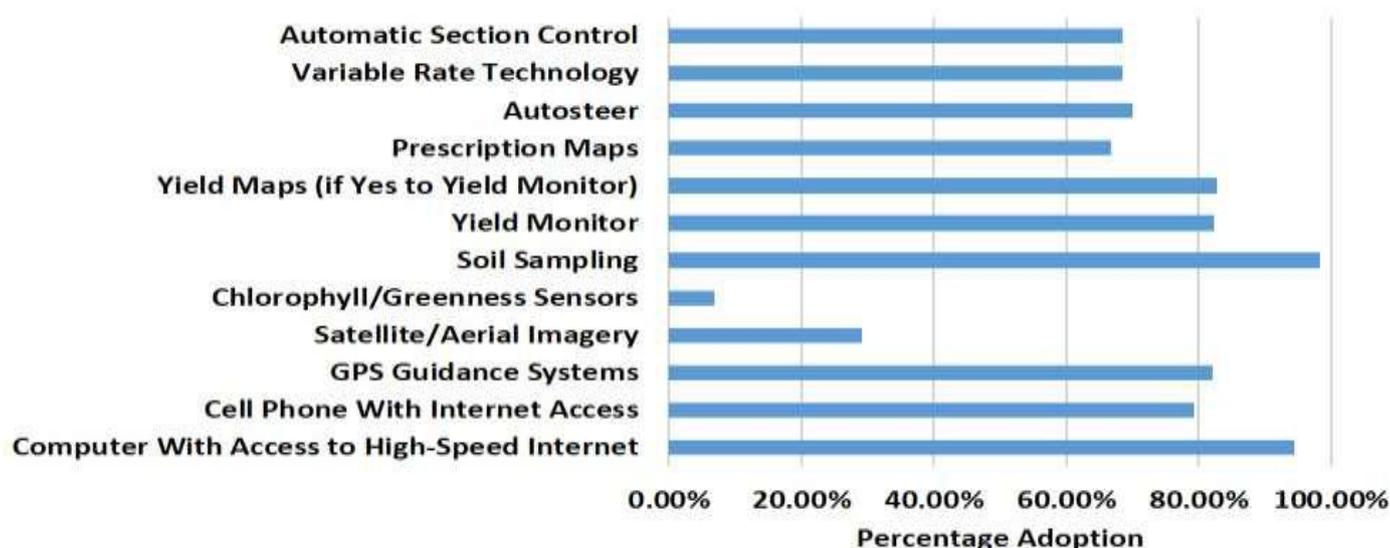
Category	2016	2017	2018	2020
Consumer	3,963.0	5,244.3	7,036.3	12,863.0
Business: Cross-Industry	1,102.1	1,501.0	2,132.6	4,381.4
Business: Vertical-Specific	1,316.6	1,635.4	2,027.7	3,171.0
Grand Total	6,381.8	8,380.6	11,196.6	20,415.4

Source: Gartner (January 2017)

2. PRECISION FARMING:

Precision farming is termed as the application of technology and principles in managing spatial and time-based variability linked with the agricultural production aspects for enhancing environmental and production quality. Precision farming involves the use of the internet of things and artificial intelligence. Internet of things refers to the extension of the connectivity of the internet into devices that communicate and interact with each other over the internet while Artificial Intelligence is the creation of intelligent machines that react and function as human beings. Despite the fact that precision farming is a backbone of India, it remains to be questioned how will it be able to cater to the increasing demands of the continually increasing population of India? Precision farming primarily relies on the measurement and understanding of variability and of which it should be addressed by its major components. The future of internet of things and artificial intelligence in precision farming is very crucial for a nation like India where almost half of the population is not applying technology and three-quarter of it depends on agriculture for their survival.

The chart shows the various technologies and the extent of their applicability in precision farming.



3. SURVEY:

A survey was conducted on a farm in the fields to collect data from various crop farmers about their perception and preferences on the technologies used in the fields. The study was also aimed at investigating the causes of the suicides among the farmers in India. A study population of 250 farmers was sampled to be interviewed. In this study, the respondents were asked several questions concerning the usage and preferences of use, and the impact of the technologies precision agriculture and the services that observable on farms. Moreover, the experiment of pairwise best-worst choice was suitable to define the preferences of the respondents concerning technology importance on precision agriculture. To encourage producer responses, the survey was designed to be completed by respondents in a short period using short and easy questions that are easy to understand. Farmers in India have shown the concern in including technology in the farm processes according to their responses.

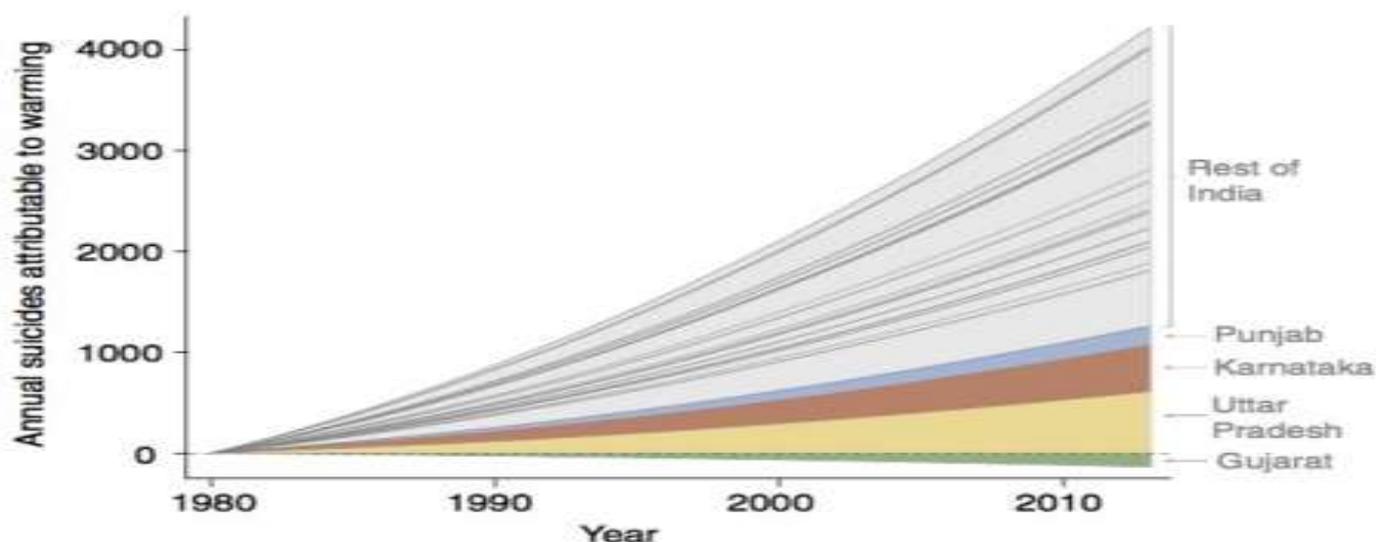
Precision Agriculture Technology/Service or Statement	Percent of Respondents
Farm uses variable rate fertilizer application	73
Farm uses variable rate seed application	60
Farm uses yield monitors	93
Farm uses autosteer	91
Farm uses precision soil sampling	66
Farm uses drones or unmanned aerial vehicle	25
Farm uses satellite/aerial imagery	56
Agrees that precision farming technologies and services are an important contributor to their farm's current financial profitability	88
Precision farming technologies and services have made them a better farm manager	80
Precision farming technologies and services have made their job as a farm manager easier	77
Would consider their farming operation an early adopter of precision farming technologies and services	68

From the responses given by the farmers, it is clear that they embrace technology and greater expectations in advancements which are all aimed to maximize production and reduce costs in the precision farming. Precision farming needs the application, management, evaluation, and analysis, and a large amount of output of time-based and spatial data.

4. INCREASING SUICIDE RATE AMONG FARMERS:

Suicide is midst the primary causes of deaths in the world. According to the reports from the World Health Organization, approximately a million people die as a result of suicide (Mohanty, 2013). Over the years, there has been a rate escalation of suicide in India, even though trends of both escalations and deterioration in rates of suicide have been present. The suicides from Indian farmers may possibly prolifically be defined as public deaths (Muenster, 2015).

In regard to ethnographic research in the district of South India, indicates that suicides committed by farmers become 'public deaths' simply through the arithmetical practices of the country of India and their media scandals (Mohanty, 2013). The dogmatic nature of suicide as public death consequently relies wholly on rates of suicide and the state's production. But the power of exemplifications obscures the ethnographic assessment of arithmetical suicidal knowledge. In regard to a situation in Wayanad district, which was considered a zone prone to suicides by the state of India, suicides' public illustrations have taken their own life (Muenster, 2015). Arithmetic groups together with elucidations of the media of the statistics have had an inquisitive response onto the placed connotations of specific suicides (Mohanty, 2013). Confined elucidations of distinct suicides typically remarked on individual failures of the suicide and on the dangers of hypothetical smallholder farming. Other than the benefits of technology in the farms, there arises a problem among the farmers in India where it is reported that they are committing suicide and has terrified the nation as its rate has gradually been escalating from the previous decades to date. The change in climate has been identified to play a major role in this epidemic where results show that over 10,000 suicides being attributed to an increase in temperatures as from 1980 (Das, 2011). Farming makes 14% of the India's GDP and employs almost 33% of the rural population. Most of these farmers have got no good access to irrigation and only depend on rain to grow their crops, therefore living them vulnerable to drought and other climatic adverse effects such as increasing temperatures (Muenster, 2015). It is believed that if there would be future warming, it would increase the risks of the suicides. Suicides have been reported to result in those farmers growing a genetically modified cotton called BT cotton (Das, 2011). It is found that this type of cotton is expensive and needs various pesticides which increased the risks of the farmers becoming bankrupt. The study reveals that there is a connection between the rates of suicide and the increased temperatures in the season of growing (Muenster, 2015). Results showed that the degree days over 20 degrees Celsius was the major threshold for the Indian's suicide rates among farmers where the degree days have been increasing since 1980 leading to increased temperatures responsible for the many suicide cases (Muenster, 2015).



5. COVERING SYSTEM:

The crops are damaged due to unseasonal rain, since they are dried and ready to be harvested and the rain wets them again leading to rotting and ill output of the grains. During hailstorm sensitive leaves become shredded, pock marked or ripped by hail. Hail crop damage can severely decimate the harvest. A possible solution to this loss is covering the crop by predetermination of the upcoming hailstorm or rain. By the use of technological advancements like IOT this is very well possible.

A. Case Study

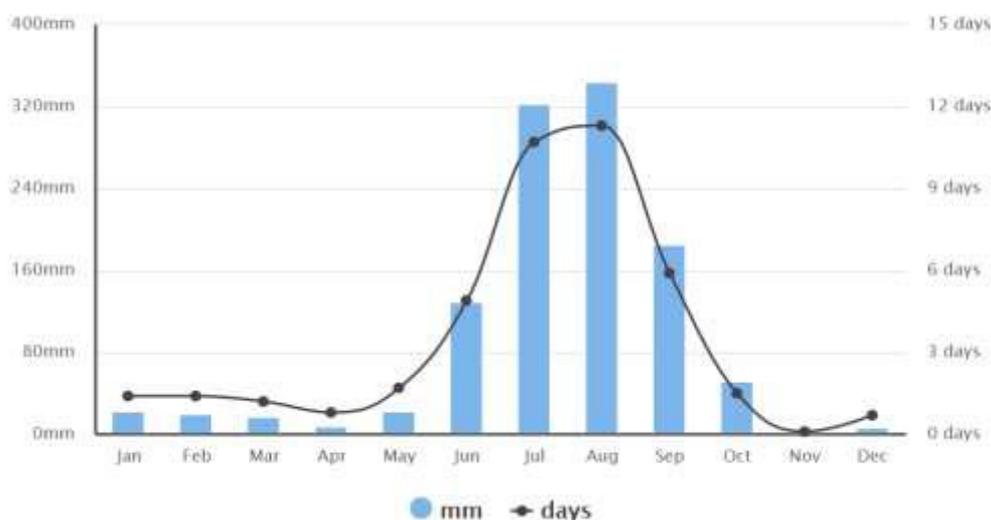
Peasants of Maharashtra ,Madhya Pradesh ,Rajasthan ,Haryana ,Karnataka and Telangana were expecting a good rabi crop of 2013-14 and overcome the losses they suffered from excess rains during the August and September months of the preceding season ,i.e. kharif 2013.However,when rabi crops were in maturity and ready for harvest, the weather behaved otherwise and shattered their hopes by battering the fields with hails that reached the size of a tennis ball at several places. These hail storms were mostly associated with gales and heavy rain, but in some cases it was pure hail fall without rainfall. The spatial distribution and severity of damage from February-March 2014 hail storm is unknown for almost 80 years of recorded history. Reports that appeared in the media accounted for damage ranging from Rs.10,000 to 15,000 crores, with all fields and orchards crops were put together. Apart from crop damage, loss suffered to livestock and infrastructure was also substantial.

On February 27, 2019, a hailstorm, declared as a “state disaster” by the UP Government, took place in the city of Bareilly. Around 2,865 farmers suffered losses of around Rs. 2 crore as wheat and mustard crops on 1889 hectares got heavily damaged in the season’s-worst hailstorm. As many as 21 villages and standing crop of wheat and mustard worth Rs. 2 crore was damaged to a large extent. Agriculture estimates that 90% of crop losses are related to 5 extreme weather. When you hear that a hail storm is coming, you usually try to protect your vehicles. Farmers have similar feelings about their crops. Every year, more than 12,000 farmers suicide due to the burden of loan and crop failure according to government sources.

B. Data analysis of the region

Considering our case study of Bareilly, we need to analyse the crop sowing and harvesting pattern along within the statistics of rainfall received every year, types of crops etc. This will help us in feeding the system about the time that is to be considered as unseasonal otherwise the system may cover up the field even in the rainy season when the fields require the water. So by analysing the above graph the system can be fed with the data that rainfall received in the month of January-May is undesirable .thus can be considered in the category of unseasonal rain.

The graph below shows the average rainfall and number of rainy days per month.



C. Input Data

Data that the microcontroller is taking as an input is directly being fetched from the meteorological department of India over internet. The data regarding rainfall should work or not.

D. Hardware

- 1) Micro-Controller
- 2) DC motor
- 3) Canvas sheet
- 4) Metal Poles
- 5) Wiring frame

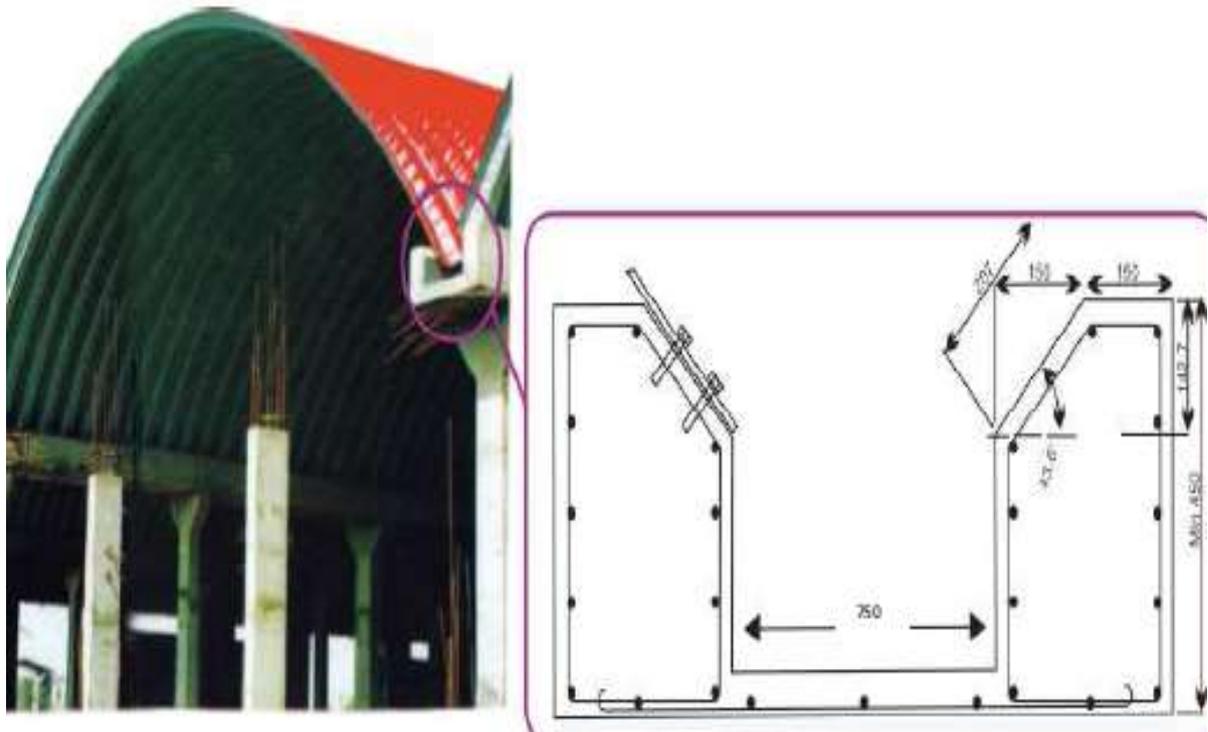
E. Features Of Covering Material

The covering material that is to be used to cover the farm land, should have the following merits:

1. DURABILITY - The material should be able to withstand the harsh weather conditions i.e-high temperature ,strong wind, water resistant, pest resistant etc.
2. AFFORDABILITY-The product is designed ,keeping in mind, the Indian farmers .So cost factor will play an important role in deciding it's widespread utility.
3. LONGEVITY - The product should last longer as short life may degrade its market value .
4. LOW MAINTENANCE-The maintenance cost may prove to be burden on the farmers every year along with the farming cost.so lower the maintenance cost ,better the usability.
5. USER FRIENDLY - The farmers around the globe need not be technology geeks. So easier-to-use interface will reduce the need of any expertise to use the technology.
6. FLEXIBILITY-The material should be flexible to be folded and stored .so that it acquires less space and has more functionality.

F. Structural Design

The farm lands are generally vast .The fields are regularly ploughed and harvested using big machinery .The design of the covering system should be made keeping in mind the above factors. So that the work of such machines is not disrupted. The covering sheet can't withhold itself without poles at regular interval in the field .A possible solution to this problem is a "self-supported roofing system". The improvement or rather the modification in the design will be the opening and closing of the roof that is made up of canvas sheet. The sheet can be rolled up and down on a wire frame according to the requirement.



MERITS OF SELF SUPPORTED ROOFING SYSTEM:

- Stability is ensured based on arch principle without Truss, Purlins or intermediate supports.
- Can provide unobstructed clear span of 9 m to 30 m.
- Roofing panels are mechanically seamed (Interlocked) and free from holes, nuts, bolt overlaps and sealants, thereby ensuring almost zero maintenance.
- Mechanical sealing ensures 100% Leak Proof Roofs.
- Faster Execution and Erection (around 1500 sq. mtrs in 12 hrs).
- No Bird nuisance and hence provides cleaner and more hygienic Building.
- Distinguished Arch Shape and Flexibility of colours result in strong aesthetic appeal.
- Upto 50% Economical compared to Conventional Roofing System.



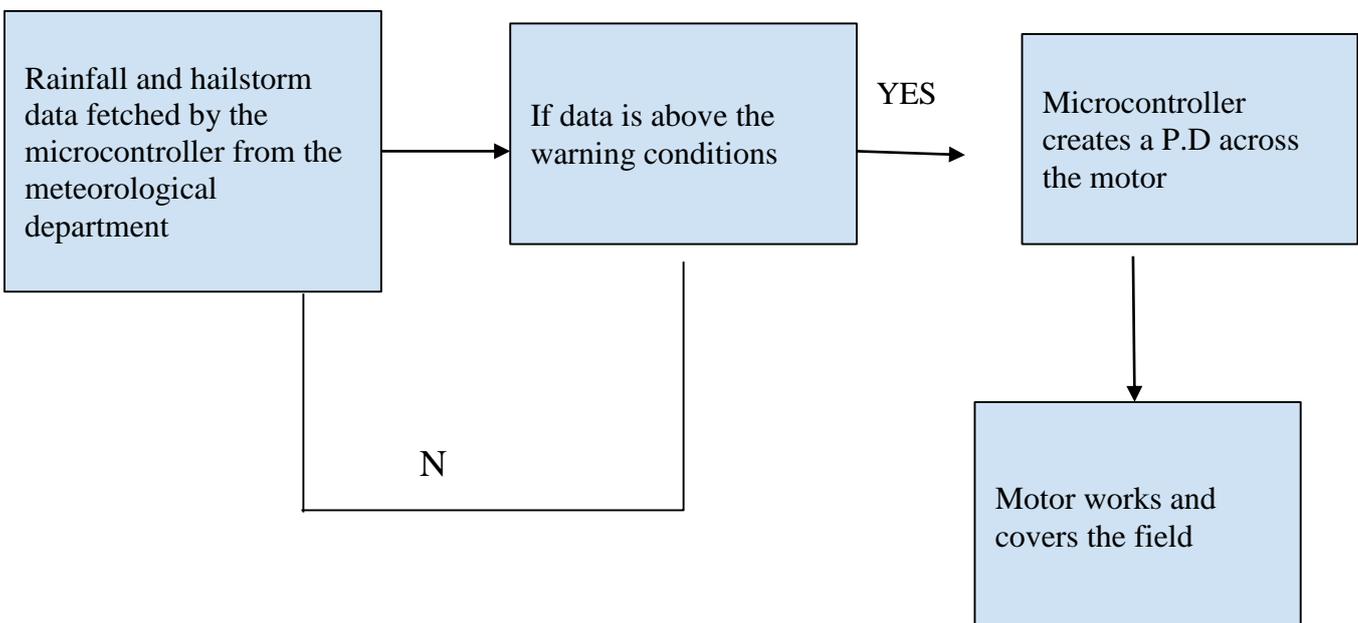
G. Working Description

Excessive Rain or Hail can destroy the hard yarned crop yield and it can be a tremendous loss to the farmers. Therefore, as a technocrat it is our duty to provide solutions to the problems of the people who are far from technology.

The microcontroller basically understands two scenarios-

- 1) High voltage
- 2) Low voltage

The microcontroller will continuously fetch data from the meteorological department over internet and will take actions according to it. If the meteorological department states a warning that there is going to be a heavy rainfall or a hailstorm the next day, the pin of the microcontroller to which the DC motor is connected will become a high potential pin and hence there will be a potential difference across it and the DC Motor will work and cover up the field. In all other cases the pin of the microcontroller to which the DC motor is connected will be at a low potential. Now since the other terminal of the motor is grounded, therefore there is no potential difference across the motor and the field is open for the sunlight. Moreover an addition switch is provided so that the farmer can open the shed once the hailstorm passes. This switch is also connected to the motor, as the switch is pressed the circuit is complete and a potential difference is created across the motor. Therefore the motor starts working and the shed is opened.



H. Challenges In Implementation And Future Research

1. The major challenge that we will be encountering in the implementation of the complete system is the cost factor. In India, farmer are not sufficiently capable to deploy such technology but government interference and support may lead to better adaptability of the high end technology.
2. Since the technology is sensitive to atmospheric condition, maintenance cost and time period can only be certainly predicted and improved after the development and testing of the technology.
3. TIME FACTOR-The thing that needs to be upgraded in future is the timing of covering the farm as the rain and hailstorm occur for a really small period of time but all at once.
4. Even if the predictions are data based, still the chances of wrong prediction stands. Thus, it needs more accuracy and precision, in order to become completely reliable.
5. For the system to work properly, the system should always be connected to the internet which is a big challenge in India as many villages do not even have the facility of internet even today.

6. CONCLUSION:

Through the use of technology and the internet of things (IoT), India has got the chance to open new opportunities in the sector of agriculture via monitoring agricultural activities of production. People in India have can opt to install technology in their farms and incorporating unmanned devices such as the covering system mentioned in the paper. The efficient use of technology can lead better pathways for farmers around the globe in future. IOT is a boon to the agricultural industry in the coming years. The better prospect can be seen by making farmers more aware and technology friendly .This will increase the rate at which currently technological advancements are accepted at ground level. Also, the suicide rates will go down. The pressure of compensation on the shoulder of government will also go down. The growing demand of food on global level can be fulfilled only by taking into consideration the technology. Since, maximum land is being exploited with tons of fertilizers, pesticides, insecticides etc. Green revolution has given its contribution to increase the yield, now it's the turn of technological revolution.

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