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I.O.T In Green House Farming

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Abstract
In recent years, the Internet of Things (IoT) has become one of the most familiar names creating a benchmark and scaling new heights. IoT an indeed future of the communication that has transformed the objects (things) of the real world into smarter devices. With the advent of IoT technology, this decade is witnessing a transformation from traditional agriculture approaches to the most advanced ones. In perspective to the current standing of IoT in agriculture, identification of the most prominent application of IoT-based smart farming i.e., greenhouse has been highlighted and presented a systematic analysis and investigated the high-quality research work for the implementation of greenhouse farming. The primary objective of this study is to propose an IoT-based network framework for a sustainable greenhouse environment and implement control strategies for efficient resources management. A rigorous discussion on IoT-based greenhouse applications, sensors/devices, and communication protocols have been presented. Furthermore, this research also presents an inclusive review of IoT-based greenhouse sensors/devices and communication protocols. Moreover, we have also presented a rigorous discussion on smart greenhouse farming challenges and security issues as well as identified future research directions to overcome these challenges. This research has explained many aspects of the technologies involved in IoT-based greenhouse and proposed network architecture, topology, and platforms. In the end, research results have been summarized by developing an IoT-based greenhouse farm management taxonomy and attacks taxonomy.
Purpose – the purpose of this study is to determine the emerging Technology in Farming . How reliable is IOT in Farming when compared to Regular Farming .
Design/methodology/approach – This study uses a hypothesis which is drawn from related literature, quantifiable measures variables with a 1–5 Likert scale, hypothesis testing, and draws the inference about a phenomenon of switching the behavior of MSMEs from physical to online stores due to changes in consumer preferences from a sample of 407 respondents through questionnaire that was circulates using social media platforms. This study uses IBM SPSS and IBM AMOS software to conduct various tests and analysis.

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

The Internet of Things (IoT) has been making waves in various industries, including agriculture. One area of agriculture that is rapidly adopting IoT is greenhouse farming. Greenhouse farming is an agricultural method that involves growing plants in a controlled environment, typically within a structure made of glass or plastic. This method allows for optimal plant growth by controlling factors such as temperature, humidity, light, and nutrient levels.

With the integration of IoT, greenhouse farming can be taken to a whole new level of efficiency, productivity, and sustainability. IoT in greenhouse farming involves the use of sensors, actuators, and other connected devices to gather data on environmental conditions and plant growth. This data can be analyzed in real-time to make decisions on how to optimize the growth of plants, reduce waste, and conserve resources.

IoT devices in greenhouse farming can monitor and control various environmental factors such as temperature, humidity, and lighting. For example, sensors can detect when temperature levels are too high or low and automatically adjust the heating or cooling system to maintain the ideal temperature for plant growth. Similarly, sensors can detect changes in humidity levels and activate misting systems to provide the necessary moisture for plants.

Moreover, IoT devices can also monitor the nutrient levels in the soil, pH levels, and other factors that are essential for plant growth. By collecting data on plant growth, farmers can make informed decisions on when to water, fertilize, or even harvest the plants.

In addition to improving productivity, IoT in greenhouse farming can also promote sustainability. By monitoring and controlling the use of resources such as water, energy, and fertilizer, greenhouse farmers can reduce waste and conserve resources. This, in turn, can lead to a more environmentally friendly and cost-effective farming method. Overall, IoT in greenhouse farming offers a wealth of opportunities for farmers to optimize their operations and improve their yields while reducing their environmental footprint. As such, it is a topic of great interest for research projects seeking to explore the potential of technology in agriculture.

Climate is what decides a farmer's fate. Climate condition, soil fertility, topography, water quality, diseases, insects, pests, weeds is what effects a crop production. The ability to control and manage them makes a farmer feel like smell heaven.

Today's advancement in science and technology and the high qualification of human capital has the ability to farm the field as expected and needed holding the natural conditions out of thought (Ploeg et al., 2014). Smart farming which is going to become today's normal farming where farmers can remotely monitor the field by means of sensors and have automatic irrigation system. There will be computer applications build on sensors which access the crop, soil, climate and Electric power. Such technology helps to improve the quality of the plant and reduce the wastage such as fertilizers, human capital, power etc. All these facts make IOT based farming better than traditional agriculture and also can improve organic agriculture and small farm holders to produce more (Bertino et al., 2016).

IOT based applications are being widely adapted by industries as it benefits in a myriad of ways. Companies like LoRa which works on network radio uses IOT as it helps them in long range communication, less power consumption and also reduces cost investments(Jin et al., 2018). IOT is also used for cameras which verifies the quality of food(Krishna et al., 2017). Sensors used are connected are combined with cloud computing which allows managing Agricultural data through applying big data technology.

Under human supervision, a green home with transparent sheets all over maintains optimal climatic conditions. To maintain the required climatic condition for crop growth, it necessitates continual and frequent human monitoring of temperature, light intensity, soil moisture, and humidity. It serves as a buffer against climate shifts, extending the growth season for crops. A green house is a structure with transparent sheets along the length of it that maintains ideal climatic conditions while allowing for human surveillance. However, to maintain the essential climatic environment for crop growth, temperature, light depth, soil moisture, and humidity must be monitored on a regular basis. Even while Greenhouse helps to protect crop. Its known human challenge to operate it suitably and increase the crops and production. It's a task for human to have round the clock monitoring and adjusting it time to time.

1.2 NEED AND SIGNIFICANCE OF STUDY

Introduction of Sensors and the internet of things have changed the situation of the green house. The entire green house has been automated as can be controlled and surveyed by using sensors, internet of things and the embedded technology(Raj, Ananthi,2019). Challenges of traditional Greenhouse farming and Greenhouse farming. Traditional greenhouse farming involves growing crops in a controlled environment, usually a glass or plastic structure, to protect them from pests, harsh weather conditions, and other external factors that can affect their growth. While this method of farming has been practiced for centuries, it does come with some challenges.

Some of the challenges of traditional greenhouse farming include:

a. High energy costs: Traditional greenhouse farming relies heavily on energy to maintain the optimal growing conditions for the crops. This includes heating, cooling, and lighting the greenhouse, which can be expensive.
b. Limited crop varieties: Traditional greenhouse farming is often limited to a small number of crop varieties that can thrive in the controlled environment of the greenhouse.
c. Disease and pest control: While the greenhouse provides some protection from pests and diseases, they can still find their way in, and once inside, they can spread rapidly.
d. Environmental impact: Greenhouses often require large amounts of water and fertilizers, which can have a negative impact on the environment if not managed properly.

Greenhouse farming, on the other hand, has evolved to address some of these challenges. By using advanced technology, such as hydroponics and vertical farming, greenhouse farmers can grow crops more efficiently, with less water and energy, and in a more sustainable manner.

Some of the benefits of modern greenhouse farming include:

a. Higher yields: Greenhouse farmers can control the growing environment, which allows them to produce higher yields of crops.
b. Reduced environmental impact: With the use of technology such as hydroponics, greenhouse farming can be done with less water and fertilizer, reducing its impact on the environment.
c. Expanded crop varieties: With advanced technology, greenhouse farmers can grow a wider range of crop varieties than traditional greenhouse farming.
d. Pest and disease control: Greenhouse farmers can use integrated pest management systems to control pests and diseases without relying on harmful chemicals.

In conclusion, while traditional greenhouse farming has its challenges, modern greenhouse farming has evolved to overcome these challenges, providing a more efficient and sustainable way of growing crops.This Section presents a selected challenges of traditional greenhouse farming which intend to solve regular farming challenges such as climate, irrigation , nutrition supply etc.

The challenges which IOT eliminates.

a. **Nutrition supply** (Anjini et al,2021)– As, Majority of the work in small scale farming is done by hand. This takes a large time to cover the whole field, it becomes impossible to feed the plants with the proper amount of nutrients, which results in slow growth of crops.

b. **Soil moisture(**hardie,2020)– The quality and quantity of the soil determines the plant's quality. Too little moisture causes plant mortality and yield loss, while too much moisture causes root infections and water waste. Soil moisture (hardie,2020)– Soil quality and quantity decides a plant quality. Too little moisture leads in yield loss and plants death and too much can cause root diseases and water waste.
c. **Temperature and humidity (** hatfield , prueger,2015) – Crop production is the most visible indicator of climate change since it is the metric that both farmers and consumers are most concerned about. Changes in the length of the growth cycle are unimportant as long as the crop yield remains reasonably stable. Depending on the crop's cardinal temperature requirements, yield responses to temperature differ by species. Plant growth and development, as well as crop yield, will be affected by rising temperatures linked to climate change.
d. **Disease Detection** (Mohanty et al ,2016) – Low temperatures, insufficient light, chemical residues, insects, pets, or bacterial diseases are all factors. Almost 90% of plant diseases may be diagnosed by the characteristics of the leaves, such as colour fading, blackspots, and so on. It can be difficult to spot it before it causes damage. In such cases, Al can assist in the early stages of prevention.

Due to the limited integration of data-driven decision aid structures, traditional agriculture is characterised by superfluous human engagement, resulting in greater hard work expenses and susceptibility to severe climate disasters. IoT provides a respite through AI and machine learning-based energy and water-saving methods, automated farm operations, and automation to address crop monitoring challenges (madushanki et al,2019). In light of the negative effects of global warming and weather trade on international food production and food security, the role of era in future farming cannot be overlooked. Unusual weather patterns, as well as high temperatures and precipitation, have been linked to a large drop in agricultural production (Henriksen et al.,2020) .

The ability of IoT-based completely solutions for modern farming demanding situations could be focused on four key areas of IoT system application in smart agriculture and greenhouses, namely the creation of a great microclimate for ideal plant growth, improved irrigation and fertilisation practises, infection control, and improved security. (Ratnaparkhi et al , 2020).

Benefits of IoT in Agriculture

a. Food production has a logistical and qualitative traceability that allows for cost reduction and input waste reduction through the use of real-time data for decision making (Dolci et al., 2017).
b. Business model can to planed which directly connects to consumers.
c. Crop monitoring can be helpful as it allows reducing costs as well as the theft of machinery.
d. Automatic irrigation systems that are controlled by sensors that measure temperature, humidity, and soil moisture (Kaewmard et al.,2014).
e. Automatic collection of environmental parameters through sensor networks for further processing and analysis.
f. Sensor networks collect environmental parameters automatically for future processing and analysis.

Every year, there is a global decline of arable land due to rising population, industrialization, and ongoing climate change. Consequently, the rising need for The production of food and crops is extremely large and substantial. The United Nations Organisation for Food and Agriculture. anticipated that more cropland and water will be needed to meet future food demands due to an increase in global population that would reach 9.73 billion in 2050. In addition, there are other more difficulties in farming, including as, Lack of labour, a lack of water, and rapid climate changes spiral the strain farmers and agriculturists, with Li Minn

Ang serving as the assistant editor in charge of organising the evaluation of this manuscript and authorising it for publication.

IoT technology can completely change the agriculture industry through the creation of intelligent applications and cutting-edge farming techniques. So, one of the best and most effective ways to increase crop yield with the least amount of labour is by integrating IoT in the greenhouse. Farmers and agriculturists can benefit from IoT-based greenhouse farming by learning about the season, soil quality, water quality, the best time to harvest, and the necessary amount of nutrients for the healthy growth of plants. As a result, IoT-enabled greenhouses can create dependable and affordable farming solutions to increase productivity with a low labour cost. Farmers may effectively optimise their resources and manage their farms more effectively in this way.

1.3 RESEARCH QUESTIONS

1. How can IoT-based systems be optimized to enhance resource management in greenhouse farming, reducing water, energy, and fertilizer wastage while maintaining high crop yields?
2. What are the effective methods for integrating AI with IoT sensors to develop real-time disease detection and early intervention systems for greenhouse crops?
3. How can affordable and user-friendly IoT solutions be designed and implemented to support small-scale and organic greenhouse farmers in improving productivity and sustainability?

CHAPTER 2: LITERATURE REVIEW

2.1 ABOUT THE INDUSTRY

The demographic factors categories the answers obtained from the research instrument but these factors do not play a role in affecting the correlation between the independent variables and dependent variables. These variables will help interpret the people's Agriculture type and Amount of Acres holding . The descriptive analysis for these demographic factors indicates that out of all the respondents, 64% are External Farming and 36% Greenhouse Farming . 37% of respondents are of age less than 5 acres, 52.6% percent are Less than 10 and 10.4% have more than 10. These factors, in this study, will affect the relationship moderately between factors and outcomes.

Table 1 Demographics

Factor	Options	Frequency	Percent	Valid Percent
Type	External farming	135	64	64
	Total	211	100.0	100.0
Age	Less than 5	78	37	37
	Less than 10	111	52.6	52.6
	More than 10	22	10.4	10.4
	Total	211	100.0	100.0

The following is the measurement constructs determined for this study.

Table 2 Measurements constructs used in this study

Source	Variables	Construct
	CFC: Climate Effect on crop	CFC1: climate plays a important role in crop production

		CFC2: Having option to control climate gives a divining power
		CFC3: Production through Artificial Climate is a health process
		CFC4: Interested to adapt IOT
	IR: Irrigation	IR1: Water conservation is an important practice
		IR2: Using IOT helps to save lot of water
		IR3: IOT Distributes the water according to the plant need
	FCF: IOT helps to increase Farmers Capital finance	FCF1: IOT helps to increasing farmers wealth
		FCF2: IOT helps to reduce wastage of resources
		FCF3: introducing IOT is a high investment process
		FCF4: Is better for a indian farmer to shift towards greenhouse farming(IOT)
		PVQ5: prices are comparatively cheaper
	NS: Nutrition Supply	NS1: Production in greenhouse farming does not reduce food nutrition
		NS2: Nutrition concentration is more in Greenhouse farming than of external farming

Water supply/Irrigation

In crop production, water supply is one of the principal factors which can determine or effect the growth of a crop. According to FAO (2011), perfect irrigation doubles the production and the number of crops grown per year can also be doubled. Different Crops or plants has its own requirement of water. Plants are classified on based on the water consumption, mainly known as Hydrophytes which require more water and water logging habitats. Mesophytes, these crops get adopted to conditions with moderate water supply. Xerophytes, they are more towards dry conditions (Le and McQueen-Mason 2006).

Evapotranspiration effects the irrigation supply. Which can be controlled by IOT in green house Farming. Evapotranspiration is composed of both Evaporation and Transpiration. Evaporation is a process through which liquid water is converted to water vapour. Transpiration is the process by which moisture is carried through plants from roots to small pores on the underside of leaves, where it changes to vapor and is released to the atmosphere. Air humidity, temperature, wind speed are the factors which effects both evaporation and transpiration (Bhatt and Hossain 2019). IOT uses GPS with Radical Function Network to control irrigation system, it predicts the temperature, maintains the air pressure and also reduces then humidity in water content. It uses IOT sensors uses the environmental data to maintain and predict the plants condition regulating required irrigation system. This helps to reduce the labour cost, cost on infrastructure, also increases productivity. IOT differentiates each plant uniquely and provides it according to its requirements and also let us know the plant condition.

Nutrition

It is been estimated that 60 percent of cultivated soil suffers from growth limiting issues, with mineral nutrient shortages and toxicities occurring all over the world (cakmak 2002).

The preservation of soil fertility, in order for it to give nutrients at the proper time and in the right quantity for growing plants, is an important part of plant nutrition (Johnston and Bruulsema 2014). Plants gets nutrition in two ways, firstly all physiological processes in plants are dependent on the incorporation of one or more mineral nutrients in a form connected to underlying biochemistries, size of plants organs and functioning is dependent on the availability of essential nutrients. Secondly, growth processes are also dependent on the uptake of externally available nutrient which depends on the amounts and availability of stored nutrients and the extent to which recycling occurs within the plant. Nutrition storage and recycling are phenomena which is important for the survival and fitness of individuals in nutrient deficient environment or fluctuating nutrient supply. Affecting characteristics such as soil pH and redox state, which impact the Phyto-availability of mineral nutrients and the concentrations of hazardous substances in the soil solution, unfavorable soil conditions typically limit nutrient supply and plant growth (White and greenwood 2013). Nutrient cycles, soil structure has been affected due to soil acidification which also influences agricultural productivity (Goulding 2016; Holland et al.2018). Also increase in atmospheric CO2 and air temperature make plants need more mineral nutrients (Asif et al 2018). IOT helps to eliminate all the limitations and helps to set according to the needed requirements and helps farmer to have a conform production. Proper Nutrition supply control increases Crop productivity in terms of Size of plant and production per yield.

Climate

Agriculture is strongly influenced by weather and climate. Farmers are well characterized themselves dealing with climatic changes year to year, establishing infrastructure, checking up with potential farming methods. As a result, climate change is likely to have an impact on agriculture, potentially jeopardizing traditional farming systems but also giving opportunity for improvement.

The Farming Practices and nature of agriculture are mainly influenced on the climate conditions of the area. Seasons temperature significantly impacts agriculture productivity, farm incomes and food security (Battisti and Naylor 2009). Higher temperatures may be more immediately damaging, increasing heat stress on crops and water loss through evaporation, in areas where temperatures are already close to physiological maxima for crops, such as seasonally arid and tropical regions. Some crops are more sensitive to warming than others. It's vital to keep in mind that crop yield variations for a given level of warming are highly unknown. By modelling statistical correlations between temperature, precipitation, and world average yield during the growing season. In the mid-latitudes, a 2°C local warming may boost wheat productivity by about 10%, but in the low latitudes, the same level of warming might reduce yields by nearly the same amount (Lobell and field 2007).

Since approximately, increased climate variability in the northwest region may have generated higher inter-annual variability in wheat production. Wheat is a high-risk crop, according to this research, because of the yearly output uncertainty. Even mid-latitude crops may suffer in excessive temperatures due to a lack of flexibility. Summer mean temperatures in the former Soviet Union (USSR) were unusually high, causing substantial disruptions in global cereal markets and food security.

As, the climate is unpredictable and ungovernable state. IOT gives the authority to set depending the need of the plant condition and also helps to analyze situation and act according to that also predicting the production units.

Energy

Consistent power supply is required to harvest a crop securely. Taking Examples of many nations such as India, Nigeria. For a very long time, Nigerian farmers have lamented the situation without getting meaningful assistance.

A significant amount of farm produced are been lost after harvest due to improper power supply management which also results in wastage of expensive input like fertilizers, human labour effort, irrigation facilities. It even effects post-harvest in terms of Quality and quantity of plant. Farmers invest on generators and other sources to maintain the power supply because if irregularity of electricity due to which thereby they end up paying the service providers. This end up getting them inflated in the end and cut down their profit percentage (Mada et al 2014).

IOT here helps to use the electricity consistently and also works on solar power utilizing it resourcefully throughout the requirement. Which cut costs and also give in safe pre and post-harvest . Greenhouse farming is an innovative method of crop production that involves growing plants in a controlled environment within a structure. The use of technology in greenhouse farming has been on the rise in recent years, with the Internet of Things (IoT) being one of the key technologies driving the industry forward. This literature review aims to provide an overview of the current state of research on the use of IoT in greenhouse farming and identify gaps in the literature that can be addressed in future research. The use of IoT in greenhouse farming has the potential to revolutionize the industry by providing farmers with real-time data on various parameters critical for plant growth. According to Nocentini et al. (2020), IoT devices can provide farmers with data on temperature, humidity, soil moisture, and light intensity, among other parameters, enabling them to remotely monitor and control the greenhouse environment. Temperature control is one of the most critical aspects of greenhouse farming. The use of IoT sensors and actuators can help farmers maintain optimal temperature levels within the greenhouse. Katsoulas et al. (2018) describe a system in which IoT sensors are used to monitor the temperature inside the greenhouse, and IoT actuators are used to control the operation of a heating system. Water management is another critical aspect of greenhouse farming. The use of IoT sensors can help farmers optimize their water usage by providing real-time data on soil moisture levels. Mahmood et al. (2018) describe a system in which IoT sensors are used to monitor soil moisture levels, and the data is transmitted to a central control system. The system then uses this data to optimize the irrigation schedule and reduce water supply. Monitoring the growth and development of crops is critical for greenhouse farmers. The use of IoT sensors can help farmers monitor crop growth and development in real-time. Zhang et al. (2019) describe a system in which IoT sensors are used to monitor plant height, leaf area, and chlorophyll content. The data is then transmitted to a central control system, which can be used to make informed decisions about crop management. The use of IoT in greenhouse farming generates a large amount of data. To effectively manage and utilize this data, advanced data analytics techniques are required. According to Mekki et al. (2019), machine learning algorithms can be used to analyse the data generated by IoT sensors and provide insights that can improve crop yields and reduce resource consumption. While the use of IoT in greenhouse farming has shown great potential, there are several gaps in the literature that can be addressed in future research. For example, there is a need to evaluate the economic and environmental impacts of IoT in greenhouse farming. There is also a need to develop more advanced data analytics techniques that can provide more accurate and actionable insights. In conclusion, the use of IoT in greenhouse farming has the potential to revolutionize the industry by providing farmers with real-time data on various parameters critical for plant growth. The literature reviewed in this paper highlights the potential benefits of IoT in temperature control, water management, crop monitoring, and data analytics. However, more research is needed to evaluate the economic and environmental impacts of IoT in greenhouse farming and to develop more advanced data analytics techniques.

CHAPTER 3: RESEARCH METHEDOLOGY

3.1 PROBLEM STAMENT

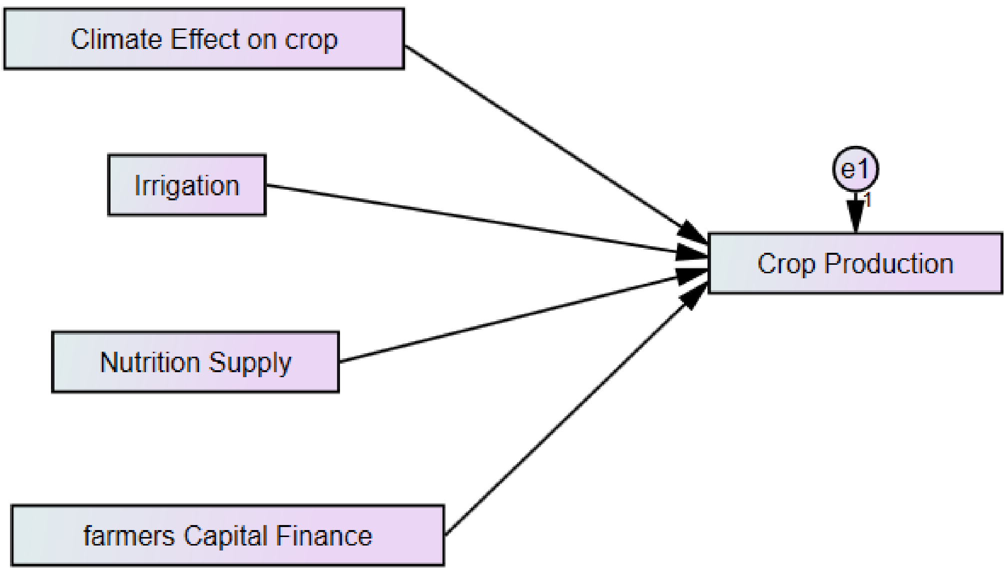
This research is to find the most sustainable method of cropping for farmers. The research is between traditional farming and Green house farming using IOT . It is to introduce the new way of farming to the Farmers by letting them know its working structure and its advantages over traditional farming (Zhang et al,. 2016).

The target audience are the farmers working on the tradition method . A research tells that 67 percentage of Indian farmers hold below five to one hectare . Our aim is to make them know how can they produce more from the normal and cut cost their expenditure. The research takes place by interview method asking their farming style , financing structure , production , profit percentage , Climate effects , irrigation supply etc.

Data is collected in both quantitative and qualitative formats . How satisfying the crop is to the farmer is taken under the qualitative questioner and the crop production and expenditure, profits per acre is taken under quantitative questioner.

We will be covering a Agriculture village and a greenhouse IOT farm comparing them and letting our audience known the difference . The data collected will be numbered on the bases of farmers and acres. Then questionnaire makes us understand a farmers. For the data analysis IBM SPSS have been used to statistical analysis data on the probability basis with 5% margin of error (95% confidence level). In order to avoid the common method bias Harman's single factor scoring technique is being used (Roni & Djajadikerta, 2021).

Dosed research model



Sample Details

Our Research paper is about understanding the Greenhouse and regular Farming values. We choose Indian farmers for the research. People working on external farming and people Farming through greenhouse farming. This is done because the people who are answering the questionnaire can provide accurate raw data with a more accurate value similar to the population size, which helps us fulfil the purpose of the study. The current study's magnitude agile methodology is mainly formulated on the basis offered by Churchill (1979) and supplemented by additional experts (Forsythe et al., 2006; Peter, 1981).

Data Collection Process and Sampling Technique

Our questionnaire is well detailed and elaborative enough to meet the standard requirements. Our team had a good network with various people, where we had divided our population into two divisions: people working on Regular farming and people using greenhouse farming . After carefully identifying our target population, we used multistage cluster sampling based on the three listed divisions. On that, we had done simple random sampling inside the cluster sampling to help get enough respondents from each division, thus meeting our sample requirements.

Data analysis

Cronbach's α, factor loading, AVE, CR, Karl Pearson's correlation, and linear regression statistical tools have been used to perform data gathered and extracted from the research instrument adopted for this study. A sample size of 407 was taken on which the analysis would be performed. All the statistical tools were performed using the IBM SPSS Software. Lastly, SEM structural equation modelling was performed in IBM AMOS Software.

Analysis and findings

Before beginning the main analysis, a preliminary analysis was performed on the Likert scale where mean and standard deviation of the variables was calculated. Table shows the high response rate achieved for all the items included in the study: almost all items close to 100%. This information indicates that the questionnaire is easy to understand and that the users who took part did not have any difficulty in responding to the majority of the items under the variables consulted. To analyze the independent variables of the questionnaires, sample can be observed as understanding all the questions and having differences of opinions.

Table 3 exploratory factor analysis or psychometric table of analysis

Variables and items	Mean	Std. Deviation	Cronbach's α	Factor Loading	AVE	CR
Climate Effect on Crop			0.845		0.554	0.832
CEP1	1.2986	.54419		.768		
CEP2	1.8673	.57023		.760		
CEP3 CEP4	2.3839 2.1754	.96092 .89579		.753		
				.694		
Irrigation			0.869		0.559	0.834
IRR1	1.4076	.54750		.786		
IRR2	1.8910	.78829		.775		
IRR3	2.0095	.92577		.759		
Farmers Capital Finance			0.921		0.514	0.839
FCF1	1.6588	.76666		.847		
FCF2	1.9100	.81442		.750		
FCF3 FCF4	2.5166 2.3744	1.0343 .99384		.688		
Nutrition Supply			0.805		0.629	0.835
NS1	3.0284	1.19887		.852		

NS2	3.2417	1.38817		.821		

First, using the descriptive statistical analysis, the mean and standard deviation of all the items was analyzed. The measurement model's fit was evaluated, with the statistical significance of each loading established between the indicator, the construct, and the measurement reliability of each of the constructs included in our model corroborated. These evaluations also allow to confirm the proposed model's converging and discriminatory validity. The model as a whole was later investigated.

Regarding the discriminatory validity of the scales, the objective was to determine whether each factor represents a separate dimension. This was done using standardized linear or covariance correlations among the constructs. The results show discriminatory validity indexes between the different dimensions analyses as they take values far from 1. To study this reliability in depth, care was taken to make sure that the correlation confidence interval between each pair of constructs did not have a value of 1 (Table ABC) This demonstrates that these factors represent notably different concepts. After validating the discriminatory validity of the scales, and before assessing the CFA findings, it was needed to establish the fits of the estimated model using the indices listed in Table VII. (Hair et al.) defined limit values for the indicators examined (2010). After testing the discriminatory validity of the scales and the model fit, CFA was performed on the entire model, with the results revealing adequate specification of the hypothesized factor structure.

Once the covariance correlations were obtained, next was the R value and R^2 value for the whole model was extracted, thereby guaranteeing the significance of discriminatory validity of the constructs and reliability of the model (Table). Then, Cronbach's α of all the factors was analysed is >0.7, which means all of them can be correctly analysed further for this research study.

Table ABC Discriminant validity

Correlation coefficient

	KMO	CEP	IRR	NS	FCF	CP
CEP	0.602	1				
IRR	0.510	.558**	1			
NS	0.507	.458**	.177**	1		
FCF	0.510	.486**	.617**	.205**	1	
CP	0.623	.141**	.121**	.117**	.155**	1

Table 5 The regression model of independent and dependent factors

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	(Constant)	.885	.192		6.030
	Climate Effect on crop	-.007	.084	-.007	-.089
	Irrigation	.627	.073	.682	8.581
	Nutrition Supply	-.021	.029	-.048	6.749
	Farmers capital Finance	-.239	.075	-.238	5.674

The confidence interval adopted for the model is 95%. The R value of 0.771 represents a high degree of simple correlation between CEC, IRR, NS, and FCF (the independent variable) and CP (the dependent variable). This indicates that the factors chosen for this research design, CEC, IRR, NS, and FCF are correctly leading to the outcome, CP, as per the conceptual design of the research.
The R^2 value of 0.594 represents that there is high degree of variance in PF in regard to the variance of independent factors. This indicates that the 59.4% of the model can be observed and explained by the model's inputs and their variance. The difference between corrected goodness-of-fit (R^2) value and R^2 value is also less, indicating that 59% of the model can be predicted by the inputs or the independent factors of the model. The standard error of estimation is 0.44450.

Table 6 Regression Weights: (Group number 1 - Default model)

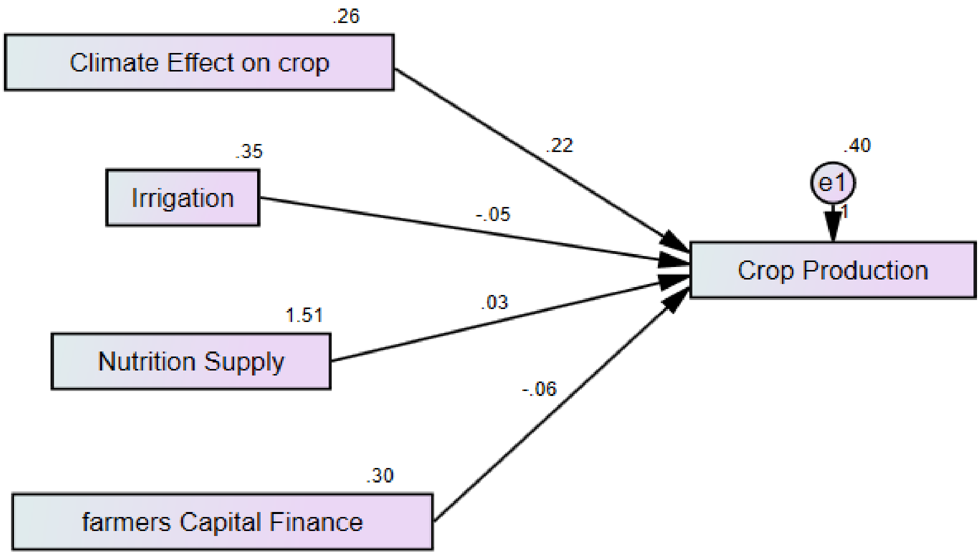
			Estimate	S.E.	C.R.	P	Label
CP	<---	CEP	.224	.086	2.620	***	Supported
CP	<---	IRR	-.051	.074	-.688	***	Supported
CP	<---	NS	.028	.036	.781	***	Supported
CP	<---	FCF	-.57	.081	-.711	.429	Not Supported

Results of the regression model show that the Farmer Capital finance is not linked to the changes in crop production. The P value from (Table) is 0.429 which indicates that there is 42.9% rejection rate. This means that we reject this hypothesis.

Table 7 Model summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.771[a]	.594	.590	.44450

Structural equation modelling



This is the final structural equation model of the research paper which shows the relationship between the independent variables and the dependent variable

CHAPTER 4: CONCLUTION

The limitations for the research were to be able to verify the responses we got from our target audience because we want to ensure that the analysis for the research should be accurate as possible. First, it employs a cross-sectional design, which precludes the investigation of the cause-and-effect connection between two constructs. Longitudinal research with comparable objectives is required to determine causation in a connection. A cross-sectional methodology also prohibits the investigation of dynamic interaction effects between the components under investigation. We excluded major lands from the sample population. As a result, no comparisons between SMEs and large businesses are made. The current sample size of 211 farers is quite tiny, representing less than 0.0000001% of India's Farmers population. Although the sample size satisfied the standards for statistical analysis using SEM, it may restrict the findings' generalizability to the larger farmers community. Future research is required to confirm the current study's findings on a larger sample .

From the factors we listed we get to know that farming largely depends on irrigation system, Climate , Nutrition . Crop production through External farming is highly dependent on the natural Conditions and also is unpredictable whereas when considered to Greenhouse farming its under the operating control how much to release according to then requirements . Considering about the health, Greenhouse farming using IOT is a healthy way it provides the required nutrition even when used the artificial sunlight. IOT even helps to increase the profit and reduces the risk factor. Investment in IOT is Moderate as the profits cutdown the investment.

Indian farmers attachment to the mother earth made them believe more in the natural conditions than of the technology which makes them not to farm with IOT . But when taken the results from the Farmers working through IOT its quite amazing to know their outcome. IOT produces 1.5X production when compared to Regular farming and also cut down the wastage cost.

There is more of research in this field of IOT in agriculture. Our Analysis is a beginning of the process. Time decides the requirement of IOT and Reliability of it.

CHAPTER 5: REFERENCES

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