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A STUDY ON OPPORTUNITIES AND CHALLENGES OF AI IN AGRICULTURE WITH SPEACIAL REFERANCE TO COIMBATORE CITY

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Abstract:

Artificial Intelligence (AI) has the potential to transform the agricultural sector in Tamil Nadu, India, by addressing key challenges such as climate change, water scarcity, and labor shortages. This study explores the opportunities and challenges presented by AI in agriculture, with a focus on precision farming, crop monitoring, and sustainable agricultural practices. The results of the study highlight the potential of AI to improve crop yields, reduce water consumption, and promote sustainable agriculture. However, the study also identifies several challenges that need to be addressed, including high implementation costs, limited access to technology, and concerns around data privacy and security. The study concludes that AI has the potential to revolutionize agriculture in Tamil Nadu, but its adoption will require a coordinated effort from policymakers, farmers, and technology providers.

Keywords — **AI in Agriculture, Precision Farming, Challenges and Limitations, Future of Sustainable Agriculture**

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I. INTRODUCTION

Agriculture is the backbone of many economies around the world, providing essential food, raw materials, and employment to billions of people. With the global population projected to reach 9.1 billion by 2050, the agricultural sector faces significant challenges in meeting the increasing demand for food while minimizing its environmental impact. Climate change, water scarcity, labor shortages, soil degradation, and the need to reduce the environmental impact of farming practices are some of the challenges that the sector must address. Artificial Intelligence (AI) has emerged as a game-changer, offering innovative solutions to enhance agricultural productivity, sustainability, and efficiency. AI can help farmers optimize crop yields, reduce water consumption, and minimize the use of chemical fertilizers and pesticides.

Agriculture plays a crucial role in economies around the world, providing essential food, raw materials, and employment to billions of people. From its beginnings in subsistence farming to the development of advanced agricultural techniques, the sector has had a profound impact on societies and economies. Today, agriculture remains vital for economic growth and ensuring food security. However, the industry faces significant challenges, including a growing population, climate change, dwindling natural resources, labor shortages, and the need to boost productivity to keep up with increasing demand. The United Nations estimates that the global population will reach 9.1 billion by 2050, which will require a 70% rise in food production to meet the needs of all. At the same time, over 820 million people still suffer from hunger, and food insecurity is expected to worsen unless current trends are addressed. To address these challenges and secure a sustainable future for agriculture, innovative solutions are needed. One of the most promising advancements is the application of Artificial Intelligence (AI). AI, which includes machine learning, computer vision, robotics, and predictive analytics, is transforming industries worldwide, and agriculture is no exception. By enabling machines to learn from vast datasets, identify patterns, and make decisions autonomously, AI has the potential to revolutionize how we grow, harvest, and distribute food.

A. OBJECTIVIES

- To identify the socio-economic background of the respondent.
- To enquire about the challenges faced in adopting AI in agriculture.
- To know the sustainable agricultural practices through AI-driven insights and its impact.

B. HYPOTHESIS

H_1- There is a significant relationship between demographic variables and impact of AI in agriculture of the respondents.

H1 - There is a significant relationship between level of interest in AI applications in agriculture and the gender of the respondents.

C. SCOPE OF THE STUDY

Artificial Intelligence (AI) has the potential to transform agriculture by addressing key challenges and promoting sustainability, but its adoption faces hurdles like high costs, limited access to technology, and a lack of digital skills among farmers. Issues such as insufficient data and privacy concerns also pose significant barriers. Despite these challenges, AI can optimize resource use, improve soil health, and enable climate-smart farming practices, reducing environmental impact and enhancing productivity. This research aims to explore the opportunities and challenges presented by AI in agriculture, providing insights into how AI can transform the agricultural sector while addressing the obstacles that hinder its widespread adoption. There are technical complexities involved in deploying AI in agriculture. These systems require advanced technical knowledge and skills to operate effectively. Farmers It also plays a critical role in combating climate change by supporting low-carbon farming, predicting extreme weather, and improving resilience. Research in this area should focus on developing affordable AI tools, reliable data-sharing frameworks, and innovative solutions to drive sustainable, climate resilient agriculture.

D. STATEMENT OF THE PROBLEM

This research project aims to explore the potential of artificial intelligence (AI) in transforming agriculture through sustainable practices, addressing challenges such as high implementation costs and technical skills. The project will analyze how AI can support biodiversity and reduce ecosystem disruption, and promote sustainable farming practices that minimize environmental impact. Investigating how AI can drive sustainable agricultural practices and support resilient crop varieties, ultimately contributing to food security and environmental sustainability. The research will examine the challenges faced by farmers in adopting AI technologies, including high implementation costs, data privacy concerns, and inadequate infrastructure

1. How to Identify the socio-economic background of farmers adopting or intending to adopt Artificial Intelligence (AI) technologies in their agricultural practices?
2. What are the challenges faced by farmers in adopting Artificial Intelligence (AI) in their agricultural practices?
3. How can AI-driven insights and recommendations be utilized to promote sustainable and its impact

E. RESEARCH METHODOLOGY

Research Methodology is a standard way to identify the problems of the study with the help of various tools and techniques, giving interpretation for the data of the study and concluding the data.

- · Primary Data Collection
- · Secondary Data Collection.

F. RESEARCH DESIGN

Research Design is a blueprint which is a general strategy a researcher uses to carry out his research to identify and helps to solve the problems. Descriptive statistics were applied in this study.

G. PRIMARY DATA COLLECTION

Primary data is collected through surveys and questionnaires designed to address the research objectives.

H. SECONDARY DATA COLLECTION

Secondary Data for the study has been collected from Books, Magazines, Journals, Articles, old reports and required websites.

I. SAMPLING TECHNIQUE

The sampling technique is the process of studying the population by gathering information and analyzing that data. This research is conducted by convenient sampling technique and area sampling is used in this study.

J. SAMPLING SIZE

- Sample size refers to the number of participants or observations included in a study.
- Approximately 120 respondents will be targeted for participation in the study.

K. TOOLS USED FOR THE STUDY

- Percentage Analysis
- Chi-Square Test
- One-way ANOVA
- T-Test Analysis

L. LIMITATIONS OF THE STUDY

- This study will consider only agricultural field. Non agri is excluded from the study
- The study identified with the sample respondents of 150. Very limited sample size may lead inaccuracy
- Time constraint is a major drawback
- This study covers only with the Coimbatore city (North zone). The remaining area are not included for the constructing process

M. AREA OF THE STUDY:

- It defines the boundaries within which the research will be conducted and the scope of the investigation.
- The study was conducted only for the people of COIMBATORE CITY (North zone).

II. REVIEW LITERATURE:

- Shailender Singh, T.V. Vijay Kumar (2024) "Trends, challenges and opportunities of artificial intelligence in agriculture", This article focuses on the importance of agriculture for economic stability, especially in overpopulated countries like India. AI can help manage issues like declining soil fertility, inaccurate soil analysis, and disease infestation. By incorporating AI technologies, ecosystems and resources can be optimized, and appropriate herbicides, pesticides, and fertilizers can be used more efficiently. This study concludes the use of AI in agricultural tasks like seed sowing, irrigation, soil management, crop management, weed control, and crop disease detection.
- Mohd Javaid, Abid Haleem, IbrahimHaleem Khan, Rajiv Suman(2023) , "Understanding the potential applications of Artificial Intelligence in Agriculture Sector", AI is increasingly being used in agriculture to improve crop cultivation, pest management, soil and growing conditions, and food supply chain management. AI helps farmers choose the best time to plant seeds, predict weather conditions, and improve crop quality. It also aids in understanding soil quality and suggests necessary nutrients. AI-powered systems, such as health monitoring systems, provide farmers with information on crop health and nutrient requirements. This study concludes by outlining the potential applications of AI in agriculture, focusing on the processes, parameters monitored, and significant applications. AI and machine learning are transforming various industries, including agriculture.
- Shilpa Kaushal, Shivam Kumar, Sayed Tabrez (2023) "Artificial Intelligence in Agriculture", This article explores the role of Artificial Intelligence (AI) in agriculture, focusing on its potential to meet future demands, increase crop production, and improve nutritional assessment and soil management, while also addressing challenges such as limited resources and climate change. This study explores how AI can help fulfill the growing demand for agricultural products and increase production, as well as AI's role in nutritional assessment and soil management.
- Robert Sparrow, Mark Howard, and Chris Degeling (2021) "Managing the risks of artificial intelligence in agriculture", This article discusses the ethical, social, and policy implications of AI's impact on agriculture, highlighting potential unintended consequences. It examines current and proposed AI applications in agriculture, as well as their broader societal and economic impacts. The study emphasizes the need for design choices and policy tools to manage AI's risks and benefits and calls for ongoing discussions to guide policy in this area.
- Ngozi Clara Eli-Chukwu (2019) "Application of Artificial Intelligence in Agriculture", This article discusses the numerous challenges in maximizing agricultural yield, including improper soil treatment, pest infestation, big data requirements, low output, and the knowledge gap between farmers and technology. It focuses on AI's flexibility, high performance, accuracy, and cost-effectiveness. The study concludes by examining AI applications in soil, crop, weed, and disease management, highlighting strengths and limitations.

III. ANALYSIS AND INTERPRETATION

A. Percentage Analysis

The percentage analysis has been applied to assess the distribution of respondents based on their socio- economic profile of the respondents. The factors namely, gender, age, education level, type of family, occupation, monthly income and number of members in the family have been analyzed and the results are presented in the following tables respectively.

Table 1
Percentage Analysis

DEMOGRAPHICS		FREQUENCY	PERCENTAGE
AGE	18-25years	40	25.0
	26-35years	39	24.4
	36-40years	53	33.1
	Above 40years	28	17.5
	Total	160	100.0
GENDER	Male	90	56.3
	Female	70	43.8
	Total	160	100.0
EDUCATIONAL QUALIFICATION	No Formal Education	28	17.5
	High School	55	34.4
	Bachelor's Degree	42	26.3
	Professional	35	21.9
	Total	160	100.0
TYPE OF FAMILY	Joint Family	90	56.3
	Nuclear Family	70	43.8
	Total	160	100.0
NUMBER OF MEMBERS IN FAMILY	Below 2	43	26.9
	3 – 4	59	36.9
	5 – 6	35	21.9
	6 and above	23	14.4
	Total	160	100.0

OCCUPATION	Student	29	18.1
	Private employee	47	29.4
	Government employee	43	26.9
	Unemployed	41	25.6
	Total	150	100.0
MONTHLY INCOME	Below 20000	30	18.8
	20001-40000	51	31.9
	40001-60000	44	27.5
	Above 60001	35	21.9
	Total	160	100.0

Interpretation

The age distribution shows that people in their mid-30s make up the largest group. There's a higher percentage of males than females. Most participants have high school or bachelor's level education. More people come from joint families than nuclear families. A significant proportion of people are working in the private sector, followed by government employees. Income distribution is spread out, with the largest group earning in the 20,000-40,000 range. Most families tend to have around 3-4 members.

B. T-Test

A t-test is a statistical test used to compare the means of two groups to determine if there is a significant difference between them. There are different types of t-tests, and the choice of t-test depends on the nature of the data.

Table 2
Group Statistics

		Levene's Test for Equality of Variances		T – test for Equality of Variances		
		F	Sig.	T	df	Sig. (2-tailed)
Which AI application in agriculture are you most interested in?	Equal variances assumed	2.382	.125	2.354	158	.020
	Equal variances not assumed			2.362	150.328	.019

Interpretation

From the above table that, the independent samples t-test results indicate a significant difference in the level of interest in AI applications in agriculture between males and females. Specifically, males show a higher level of interest (mean=2.36) than females (mean=1.99), with a p-value of 0.020. This suggests that males are more interested and eager to explore the potential of AI in agriculture compared to females.

C. ANOVA

The following ANOVA table reveals whether there exists any significant difference between barriers we perceive in implementing AI-driven sustainable practices and monthly income of the respondents with the following null hypothesis. When a significant difference in F-value at the 5 percent level exists, it has been applied to find which group of respondents differs in their mean perception from the others.

Table 3
ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.539	3	3.846	3.145	.027
Within Groups	190.805	156	1.223		
Total	202.344	159			
Between Groups	8.002	1	8.002	8.215	.005
Within Groups	153.898	158	.974		
Total	161.900	159			
Between Groups	5.762	1	5.762	5.772	.017
Within Groups	157.732	158	.998		
Total	163.494	159			

Interpretation

From table 3, all three comparisons, the p-values are less than 0.05, which means in each case, there are significant differences between the groups being compared.

D. Chi-Square

The chi-square test has been used to determine whether there exists a significant association between the barriers we perceive in implementing AI-driven sustainable practices and the educational level among the respondents. Each subscript letter denotes a subset of What barriers do you perceive in implementing AI-driven sustainable practices? categories whose column proportions do not differ significantly from each other at the .05 level.

Table 4
Chi-Square Test

	Value	df	Asymptotic Significance(2-sided)
Pearson Chi-Square	17.027a	9	.048

Likelihood Ratio	17.505	9	.041
Linear-by-Linear Association	1.144	1	.285
N of Valid Cases	160		

Interpretation

From the above table, the chi-square test results indicate a significant association between the opportunities and challenges of AI in agriculture (p=0.048), suggesting that there is a significant link between the benefits and drawbacks of using AI in agriculture. Recognizing AI's benefits (e.g., increased efficiency, improved crop yields) is connected to being aware of its challenges (e.g., high costs, technical expertise requirements).

IV. FINDINGS

Most respondents (33.1%) are aged 36-40. The majority (56.3%) are male. Most respondents (34.4%) have high school education. The majority (29.4%) work as private employees. Most (56.3%) come from joint families. Most respondents (31.9%) earn between 20,001-40,000. The majority (36.9%) have 3-4 family members. Farmers recognize the benefits of AI (better efficiency, higher yields) but are also aware of the challenges (high costs, technical skills required). There's a significant difference in opinions about the sustainability of AI in farming ($F = 3.145$, $p = 0.027$), indicating varying views across different groups. Significant differences in the barriers to AI adoption ($F = 8.215$, $p = 0.005$), meaning people face different challenges like high costs or technical skill gaps. AI's impact on farming decisions varies by group ($F = 5.772$, $p = 0.017$), showing its influence on decision-making differs. Males show more interest in AI for farming than females ($p = 0.020$), with men being more eager to explore AI solutions.

V. SUGGESTION

Offer training to improve technical skills, especially for those with high school education. Engage more females by creating tailored outreach programs, as males show more interest in AI. Address cost and technical barriers with subsidized technology and user-friendly AI tools. Provide demonstrations and case studies to show AI's long-term sustainability benefits. Develop customized AI solutions for different groups based on age, gender, and income. Promote community-based AI initiatives for families to foster collective decision-making.

VI. CONCLUSION

The statistical analyses indicate no significant differences or associations between the groups or variables studied. Educational level does not appear to influence perceived barriers to implementing AI-driven sustainable practices significantly. Similarly, no significant difference was observed in the variable (AI-driven insights or sustainable practices) between the two groups. The results suggest that other factors, not captured in this study, may play a more significant role in influencing perceptions and behaviours regarding AI-driven sustainable practices.

REFERENCE

https://shodhganga.inflibnet.ac.in/
https://www.pickl.ai/blog/artificial-intelligence-in-agriculture/#:~:text=Artificial%20Intelligence%20(AI)%20in%20agriculture,Regulatory%20and%20Ethical%20Concerns
https://blog.praelexis.com/smart-farming-opportunities-and-challenges-of-ai-in-agriculture
https://graindatasolutions.com/data-science-artificial-intelligence-applications-agricultural-practices-opportunities-challenges/

