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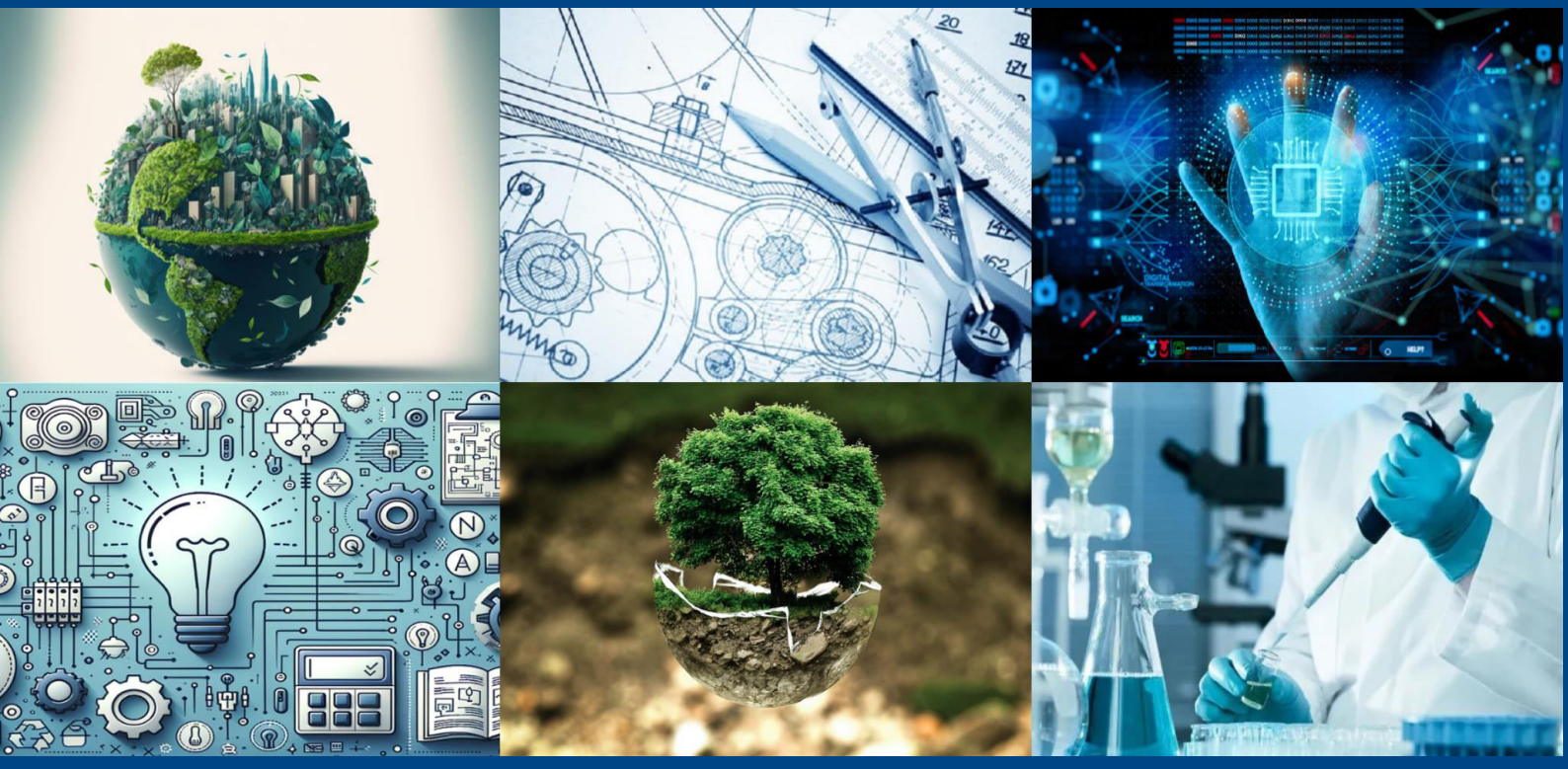

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Analysis of Farmers' Behaviour Towards Kisan Drones in Akola District of Maharashtra"- A Study

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ABSTRACT: Drone technology has emerged as a transformative tool in modern agriculture, offering solutions for precision farming, crop monitoring, and resource optimization. However, the adoption of Kisan drones among farmers in India, particularly in the Akola district of Maharashtra, remains limited due to various socio-economic, technical, and regulatory challenges. This study aims to analyze farmers' behavior towards Kisan drones, focusing on their awareness, perceived benefits, barriers to adoption, and future prospects. Using a mixed-method approach, data was collected from 100 farmers through structured questionnaires and in-depth interviews. The findings reveal that while farmers recognize the potential benefits of drones, factors such as high initial costs, lack technical knowledge, and regulatory hurdles hinder widespread adoption. The study concludes with recommendations for policymakers and stakeholders to promote the adoption of drone technology in agriculture.

KEYWORDS: Adoption barriers, precision agriculture, Drone technology, agricultural technology.

I. DEPLOYMENT OF DRONES A THEORETICAL ASPECTS

Drones, or unmanned aerial vehicles (UAVs), are now more commonly used in the Indian agriculture sector. Drones have innumerable benefits for farmers like higher productivity and yield increase, cost cut and precision farming. On the other hand, there also exist some challenges which may act as a hindrance to its adoption: such as fear of job losses; lack of knowledge and training; cost of a drone system; and barriers of the regulatory environment.

This paper discusses the present status, potential, and challenges in the use of drone technology in agriculture in India. Current Status of Drone Technology in Agriculture in India The Indian government encourages more use of drones for agricultural purposes by giving more importance to crop assessment, digitizing records of land holdings, and spraying insecticides and nutrients. The Indian government has made National Drone Policy and Drone Rules 2021 public so that easy possession and operation by the country is made easier for people and companies. The government has even come up with the Kisan Drone Scheme which encourages institutions, individual farmers and entrepreneurs to acquire drones for agriculture and subsequently provides them with monetary opportunities later. A report coming from FICCI-EY suggests that the industry for drones is likely to add around $50 billion to India's manufacturing potential by 2030 and create over 500,000 direct and indirect jobs. According to an estimate, Indian drone market size will be around $885.7 million in 2021. Agriculture is one of the other big leading sectors that is going to be in huge demand.

Some of the major drone companies and startups in India providing solutions for the agriculture sector are:

1. Aarav Unmanned Systems : End-to-end drone solutions provider focused on the accurate Farming, Crop Health Monitoring, Soil Mapping, Irrigation Management and Pest Detection in this firm which is located in Bangalore.
2. Skylark Drones: This Firm is located in Bangalore and provides drone-based data analytics to agriculture, mining, infrastructure, and energy industries. Skylark uses drones to capture resolution images with data enabling action insights towards farmers and agribusiness.
3. SenseHawk Headquartered in California with a presence in Bangalore and Mumbai, SenseHawk offers a cloud-based platform for managing and analyzing drone data. Applying AI and machine learning, it makes available its solution across several industries from agriculture, solar, construction and mining. Page |

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4. [Agritech]: It's an entity that, based in Hyderabad, sprays for farmers using drones and claims to decrease the spraying cost to half of the normal sprays. Secondly, water consumption will be 90 percent lower than in conventional sprays.
5. Garuda Aerospace: This is a Chennai-based startup that offers drone-based solutions to diverse industry verticals like agriculture, healthcare, disaster management, and surveillance. The firm has used drones for pesticide and fertilizer spray, medicine and vaccine delivery, and aerial survey.

II. LITERATURE REVIEW

The review of literature is based on the deployment of drones in agriculture as well as on the behavioral, technological, economic, and environmental issues. The core focus remains on the literature regarding general benefits and challenges of drones, specifically in the case of small farmers and regional agricultural practices.

1. **Kulkarni R., & Pawar, A. (2017):** This study has an introduction about the agricultural problems Maharashtra faces that demands innovation through drones in the fight against such challenges like labor shortages, misutilization of resources, and low productivity.
2. **Muliya, V. S., & Kulkarni, R. (2021):** The paper addresses crop productivity because of the adoption of technology in Maharashtra and how improvement in the tech line, including drones, can increase yield and reduce cost-of-operations.
3. **Zhang et al. (2018):** It articulated the role of precision agriculture technologies, including drones, far as site specific crop management is concerned. It reports that drones significantly lower the input cost and raise productivity and lessen the environment impact. In an article on the trend of agricultural land use in Maharashtra, Todkari writes of technological factors- drones, for example, that have an effect on efficiency in farming. In his opinion, drones are likely to remove pitfalls because of unpredictable climatic conditions.
4. **Nagy, J., & Kozma, T. (2019).** Current use of drones in the European context of agriculture: This study examined the use of drones in European agriculture. In the meantime, adoption of drones is increasing, and their input optimize opportunity can also provide near real-time crop conditions information and reduce the environmental damages.
5. **Yadav, S. et al. 2020.** One is to smallholder farmers in India - explores how differences in technological literacy impact the adoption of new technologies such as drones. Authors have found that farmers with higher levels of education are more likely to adopt drones.
6. **Banu, J., & Naik, R. (2021:** This study tries to search for a probability economics of drones for small-scale farm households in India. The study brings out the fact that if 'the long-term economic efficiency, with associated savings in labor and input cost is indeed a reality, then the investment towards this new technology is worthwhile'.
7. **Patel and Shah (2019):** Explaining the use of smart farming technologies in the study by Patel and Shah reveal that drones increasingly boost crop monitoring. According to their study, there was improvement in the crop health monitoring of farmers adopting drones.
8. **Qureshi, A., & Rathore, S. (2021):** This paper elaborates the environmental perspective of drones in agriculture wherein, due to precise pesticide spraying, drones reduce the usage of chemicals at farmlands, and therefore, agriculture can be undertaken sustainably.
9. **Choudhary, P. (2018):** The author Choudhary, in the paper, ascertains that knowledge, the cost, and other technological variables were hindering the adoption of drones among Indian rural people, however, govt. benefits would assist in increasing its adoption
10. **Kang, Y., & Kim, J. (2019):** This is going to be a discussion paper on how drones play an important role in the smart farming process. It relates that it enhances the farming process by providing real-time data on the condition of soil and crops.

III. SURVEY-BASED EXPLORATORY RESEARCH

This research used a descriptive study design with a mixed-methods data collection method. Primary data was collected via structured questionnaires administered online through Google Forms for easy access and effective response capture. The questionnaire tool was fashioned to obtain quantitative measures as well as qualitative perceptions of farmers on Kisan drone technology. 100 respondents were randomly sampled by Convenience sampling technique from the farming communities of Akola district with a view to ensure representation of different farm sizes and populations. Secondary data were collected by conducting a thorough review of corporate websites, government

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reports, agricultural journals, and pertinent scholarly articles in order to situate the primary results within current knowledge frameworks. This mixed-methods strategy enabled data triangulation, improving the validity and reliability of the research findings and offering both statistical trends and in-depth understanding of adoption impediments.

Objectives: The present study was carried out primarily with following objectives in mind.

1) To understand the application of Kisan drones in agriculture.
2) To study the behaviour and attitudes of farmers towards Kisan drones in the Akola district.
3) To explore the future prospects and adoption potential of Kisan drones in the region.
4) To analyse the benefits and challenges associated with the use of drones in farming.
5) To evaluate the impact of drones on crop management and yield improvement.

Data collection method:

1. Primary Method of Data Collection:-

- Questionnaire method

2. Secondary Method of Data Collection:-

- Corporate website
- Internet/Books/Journals and other written data about company and Topics

✓ **Research type:** Descriptive type of research

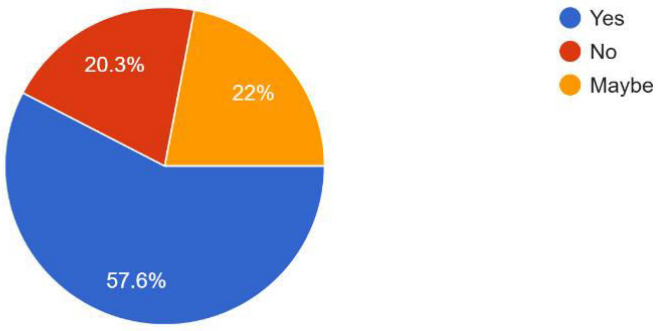
✓ **Sample size:-** 100

Sampling Techniques: Convenience Sampling
Collection of data through: Through online using Google Forms

IV. ANALYSIS AND INTERPRETATION

Analysis:

1) Farmers Willingness to Adopt Kisan Drones



The high percentage of farmers in the "Maybe" category suggests that while there is interest in drone technology, many farmers remain hesitant due to perceived challenges. Addressing these barriers—such as providing financial subsidies, offering training programs, and demonstrating the effectiveness of drones—could encourage more farmers to move from uncertainty to adoption. The "No" responses highlight the need for targeted interventions to build trust and awareness among skeptical farmers. Meanwhile, the "Yes" responses indicate a promising foundation of early adopters who can serve as role models for others in the community.

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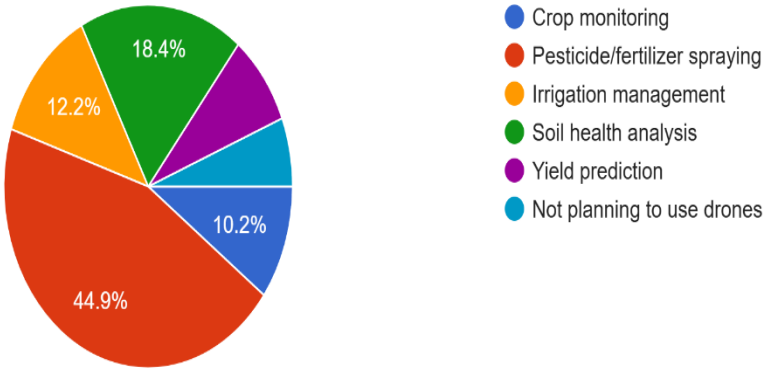
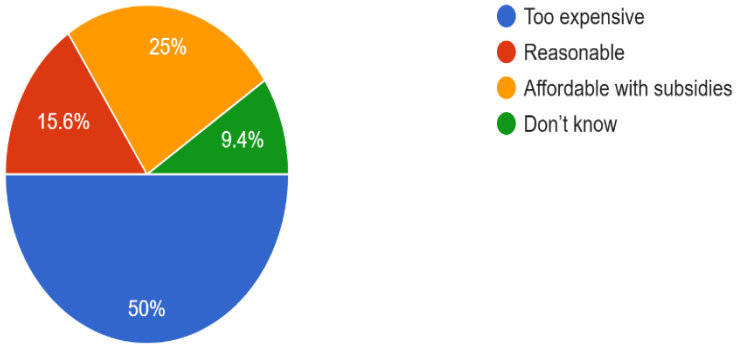
2) Preferred Application of Kisan Drones among Farmers



The preference for pesticide/fertilizer spraying and crop monitoring highlights the practical benefits of drones in improving efficiency and reducing labor costs. These applications align with the core challenges faced by farmers, such as resource wastage and the need for timely interventions. The interest in irrigation management and soil health analysis suggests that farmers are also looking for ways to optimize resource use and improve sustainability. The absence of "Not planning to use drones" responses indicates that farmers who are open to adoption have clear and specific use cases in mind, which can guide targeted interventions and training programs.

3) Farmers Perceptions of the Cost of Adopting Drones Technology



The perception of drone technology as "too expensive" by a significant portion of farmers underscores the need for financial interventions, such as subsidies or low-interest loans, to make the technology more accessible. The fact that *50%* of respondents are unsure about the cost suggests a gap in information dissemination. Providing clear and transparent pricing details, along with information about available subsidies, could help farmers make informed decisions. The small percentage of farmers who find the cost reasonable or affordable with subsidies indicates that targeted financial support could significantly enhance adoption rates.

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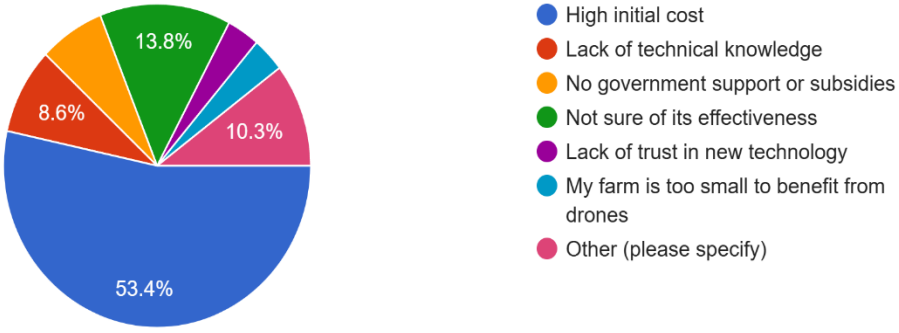
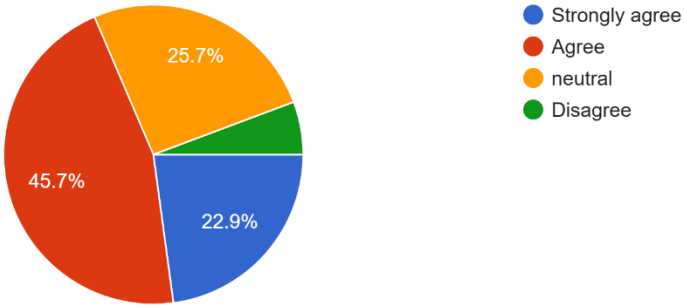
4) Barriers to Kisan Drone Adoption Among Farmers



Non-adoption factors analysis shows deep insights into farmers' resistance towards drone technology. A dramatic 53.4% of respondents mentioned high upfront costs as the main inhibitive factor, highlighting the budget limitations of small and medium-scale farmers. Technical complexities came out as the second important barrier, with 13.8% suggesting lack of technical knowledge as a hindering factor. Notably, 10.3% of the farmers were doubtful of the technology's efficacy, and 8.6% identified the lack of government support or subsidy as a cause for technology avoidance. These results as a whole point toward an intricate convergence of economic, technical, and psychological hindrances for technology adoption. The low rates for "farm size constraints" (1.7%) indicate that scalability issues might be less of a determinant than one might expect in the adoption of drones. These barriers provide obvious intervention points for policymakers and technology suppliers who want to spur agricultural drone uptake in the region.

5) Perceived Contribution of Drones to Farm Efficiency and Yield Increases



The survey results provide interesting insights into farmers' hopes for the potential of drone technology to improve agricultural yields. Together, 71.4% of the respondents (45.7% strongly agreed and 25.7% agreed) think that drones can greatly enhance farm productivity, showing high confidence in the capability of the technology. This overwhelming support is consistent with the research goal of evaluating the effect of drones on crop management and yield enhancement, indicating farmers see drones as having potential for precision agriculture use. Interestingly, fully 22.9% of farmers are neutral, perhaps indicating a lack of exposure to drone demonstration or confusion over particular benefits. The very small level of disagreement (5.7%) means that extremely low resistance exists to the overall principle of drone effectiveness, but perhaps this is more a measure of theoretical rather than practical willingness to adopt. These results strongly validate the objective of yield improvement, as positive attitudes among farmers are most likely due to projected gains in:

- Accurate use of inputs (pesticides/fertilizers)
- Early identification of crop stress factors
- Enhanced monitoring of large areas
- Data-driven decision making

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V. CONCLUSIONS

The research on Analysis of Farmers' Behavior Towards Kisan Drones in Akola District of Maharashtra" was carried out with the key goals of gaining insights into the usage of Kisan drones, assessing farmers' attitudes and behavior, investigating adoption prospects, and measuring the advantages and disadvantages of using drone technology for agriculture. In light of the findings, the following can be concluded:

1. Usage of Kisan Drones: The research identifies the various uses of Kisan drones in farming, which are crop monitoring, spraying pesticide/fertilizer, irrigation control, and soil health testing. Farmers also see the potential for drones to improve precision agriculture, lower labor costs, and maximize resource efficiency. Limitation to these uses comes in the form of high expenditures and a lack of technical experience.

2. Farmers' Attitude and Behavior: The study indicates that although a large percentage of farmers know about Kisan drones, they are willing to adopt the technology based on factors like education, income, and farm size. Farming households with high education and income levels are inclined to adopt drones, especially compared to small-scale farmers who are reluctant because of lack of money and lack of confidence in the effectiveness of the technology.

3. Adoption Potential: Farmers have strong interest in adopting drone technology for uses like spraying pesticides/fertilizers and crop monitoring, the study finds. Adoption potential, however, is thwarted by constraints like prohibitive initial expenditures, absence of technical skills, and regulatory requirements. Overcoming these constraints via interventions like subsidies, training courses, and de-bureaucratization can raise adoption dramatically.

4. Advantages and Disadvantages: The study emphasizes the probable advantages of Kisan drones to enhance agricultural efficiency, sustainability, and productivity. Nevertheless, disadvantages related to high costs, lack of awareness, and technical difficulties need to be overcome in order to avail the advantages. Government initiatives and local networks also find mention in enhancing awareness and adopting drone technology.

5. Future Prospects: The research concludes that Kisan drones can revolutionize agriculture in the Akola district by solving major issues like labour shortages, wastage of resources, and low productivity. But this potential can be achieved only through a joint effort from policymakers, agricultural bodies, and technology providers to establish an enabling environment for the use of drone technology.
the research offers useful insights into farmers' behaviour and attitudes towards Kisan drones and provides practical recommendations for encouraging the uptake of this technology. By overcoming the barriers identified and tapping into the potential advantages, Kisan drones can be a game-changer in increasing agricultural productivity and sustainability in the Akola district and other areas.

Need for Additional Research:
Though this research offers valuable information on farmer behaviour towards adopting drones in Akola district, some points require further exploration. Subsequent research needs to study:
1) Long-term financial effects of drone adoption on farm profitability for various crops systems
2) Comparative analysis of adoption trends between districts with diverse agro-climatic settings
3) Relative effectiveness of various training processes in addressing technical challenges
4) State-level subsidy scheme policy analysis and its influence on adoption rates
5) Designing tailored drone solutions for small holdings (<2 acres)

There are also research opportunities in exploring:
- Women farmers' role in the adoption of drone technology
- Merging of drone data with other digital agri-platforms
- Designing vernacular interfaces to enhance usability
- Lifecycle analysis of drone technology in Indian agricultural environments
These research avenues would greatly increase knowledge of the potential of drone technology while filling existing knowledge gaps in the field.

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