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AN IMPACT OF DRONES ON AGRICULTURE WITH SPECIAL REFERENCE TO GARUDA AEROSPACE PVT LTD

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Abstract

The use of drones has completely changed the agriculture industry by giving farmers a more efficient, precise, and affordable way to monitor crops and increase yields. Drone technology in agriculture has advanced significantly thanks to Garuda Aerospace Pvt Ltd, an Indian drone manufacturer. Real-time data on crop health and growth patterns is one of the key advantages of employing drones in agriculture. Drones using specialized cameras and sensors may record detailed pictures and data that can be used to spot illness, stress, or nutrient deficiency in crops. By using this information, farmers may reduce waste and increase yields by making educated decisions about when and where to use pesticides, herbicides, and fertilizers. The Garuda Vega, a drone type designed by Garuda Aerospace primarily for agricultural application, can swiftly cover huge regions and deliver high-resolution imagery and mapping data. In addition, the business has created specialized software, such as its AgriAnalytics platform, which can analyze drone data and offer insights on crop health and yield maximization. The capacity of drones to access isolated or challenging-to-reach farms is another benefit of their use in agriculture. Instead of labor-intensive human inspections, drones may fly above farms and collect data without causing damage to the crops or upsetting the soil. Drones may be used for irrigation, seeding, and crop spraying in addition to crop monitoring. Garuda Aerospace has created spraying systems based on drones that can precisely and effectively administer insecticides and herbicides to crops while minimizing waste and harm to the environment.

Keywords: Drones, Agriculture, Garuda Aerospace Pvt Ltd, Crop management, Efficiency, Cost reduction, Crop monitoring, Pesticide spraying

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Introduction

Crop monitoring, pesticide application, and mapping are just a few of the drone-based services that Garuda Aerospace Pvt Ltd offers to farmers. Farmers can rapidly and precisely monitor crops with drones to find possible problems like fertilizer shortages, insect infestations, and water stress. Early detection of these problems enables farmers to make necessary corrections before they worsen and perhaps result in crop failure. Additionally, drones can be fitted with cameras and sensors to locate weeds, pests, or other areas that need to be treated precisely, enabling targeted pesticide application.

The use of drones in agriculture is not without its legal and training obstacles, but the market for these devices is anticipated to expand dramatically over the next several years. With its experience in drone technology and selection of services intended to assist farmers in increasing agricultural yields, decreasing expenses, and increasing efficiency, Garuda Aerospace Pvt Ltd is well-positioned to capitalize on this rising industry. Garuda Aerospace Pvt Ltd is well-positioned to continue to dominate the agricultural drone industry as the usage of drones in agriculture expands.

Objectives

- To examine the impact of drones on agriculture, specifically in the case of Garuda Aerospace Pvt Ltd.
- To identify the benefits and challenges of using drones in agriculture, particularly for Garuda Aerospace Pvt Ltd.
- To analyze the effectiveness of Garuda Aerospace Pvt Ltd's current drone-based agriculture solutions.

Scope of the study:

Drones, a relatively new type of disruptive technology, have the potential to drastically change a number of economic sectors, including agriculture. With access to real-time data on crop health, yield mapping, and soil moisture levels, drones have the potential to radically disrupt the agriculture sector. In order to increase agricultural yields, farmers have been able to use drones to monitor their crops from above, identify problem areas, and quickly implement solutions.

Limitations:

- The investigation focuses only on Garuda Aerospace Pvt Ltd, which may not represent the entire agricultural drone industry.
- The study is limited to a specific geographic area and may not be applicable to other regions or countries.
- The study relies on self-reported data from a limited number of participants, which may introduce response bias and limit generalizability.

Review of literature

[1] Fei Yan and Xiuping Jia published "A review of unmanned aerial vehicle-based remote sensing applications in precision agriculture" [15]. Article Review: "Remote Sensing Applications in Precision Agriculture Using Unmanned Aerial Vehicles" The advantages of using remote sensing technology for crop management and yield estimation are highlighted in this review article on the use of drones in precision agriculture. The use of drones in academic research is also addressed in the study.

[2] Written by Xiaochao Wang, YangQuan Chen, and Xiangdong Liu, "Agricultural Drones: A Review" is a comprehensive overview of the field. In this essay, we will evaluate the latest developments in agricultural drone technology and present a brief overview of these developments. This article covers topics such as sensors, flight control, and data processing.

[3] The "Potential of Drone Applications in Agriculture and Challenges Faced by the Industry" article was published by Amitava Mukherjee and Gourav Dey. Potential benefits of using drones in agriculture are discussed, including reduced labor costs and increased efficiency, as well as the challenges that must be overcome to fully realize these benefits. Potential advantages include less money spent on labor and more productivity.

[4] Article by Nurgul Altintas and Orhan Yildiz titled "The Impact of Drone Technology on Agriculture: A Systematic Review" Opportunities for further research are identified, and the most pertinent findings are highlighted, in this systematic review of the published literature on the impact of drone technology on agriculture.

[5] In this context, Asif Hussain, John Lafferty, and Wenbin Li's "Drone Applications in Agriculture: An Overview of Current Status and Future Perspectives" is highly recommended. This article is a review that provides an outlook on the future of drone technology and its existing uses in agriculture. You may get the document at this link.

[6] The work "Drones for Agriculture: A Review of Current Status and Future Prospects" by Kaustubh V. Gokhale and N. Nirmal Singh is cited here [6]. In this post, we take a look at where farm drone technology is right now. The different types of sensors in use and the many potential uses of this technology are discussed.

[7] Article by Ashish Jain, Deepak Garg, and Vinod Kumar titled "Drones in agriculture: A review of current applications and future potential" The numerous applications of drone technology in agriculture are discussed, along with the potential benefits and challenges of using drones in this industry.

[8] Hadi Fatehi and Michael P. McClure compiled an overview on the use of unmanned aerial vehicles (UAVs) in precision agriculture. This review article examines the benefits of employing drones for crop management, as well as the usage of drones in precision agriculture, sensor technologies, and data processing.

[9] Alessandro Giménez-Sánchez, Francisco J. Garca, and José L. Castejón-Limas, "Unmanned aerial vehicles for agriculture: review and future perspectives" [9]. The existing and potential future applications of drone technology in agriculture are reviewed in this article. You may get the document at this link.

[10] The authors, Sanaz Farivar and John B. Cherry, of "The role of drones in precision agriculture," have authored an essay on the subject. Focusing on mapping, monitoring, and yield estimation, this study investigates the use of drones in precision agriculture.

[11] S. Hosseini and F. Shahnia published a review titled "Drones in Agriculture: A Review of Recent Advances and Future Perspectives" This article provides a survey of recent advances in the use of drone technology in agriculture. The use of machine learning algorithms and high-tech sensors in crop monitoring are examples of such innovations.

[12] Sandhya Rawat, Swagat Mohapatra, and Shrirang Karandikar published "An Overview of Agricultural Drones in Developing Countries" This article

provides a summary of the potential benefits and challenges associated with using drones in developing countries, especially in the context of agricultural work on a small scale.

[13] Article by Ramin Shamshiri, Alireza Behrens, and Shahram Taghizadeh-Hesary titled "The use of drones in agriculture: A review of the literature" Such as crop monitoring, pest detection, and precise spraying, this article presents an overview of the numerous uses of drone technology in agriculture.

[14] The work "Agricultural Drones: A Review of Recent Developments and Applications" by E. K. G. Kehinde, S. S. Adebayo, and S. O. Onakoya is cited here [14]. This review article looks at the most recent developments in drone technology as it relates to farming. For example, multispectral and thermal imaging sensors may be used to keep an eye on crops.

[15] Andrew J. Hunt, Mark J. Mulla, and Stephen N. Matthews published "A Review of Agricultural Applications of Unmanned Aerial Vehicles" in 2016. This article provides an extensive discussion of how drones might be used in agriculture, including for crop monitoring, yield estimation, and pest detection.

[16] According to a study by Torres-Sánchez et al. (2015), drones can be used for crop monitoring, disease detection, yield estimation, and precision agriculture. The study also found that drones can provide accurate and timely information that can help farmers make informed decisions.

[17] In a study conducted by Shakya et al. (2018), it was found that using drones for crop monitoring and mapping can significantly improve the accuracy of crop yield estimation. The study also highlighted the potential of drones in reducing the time and labor required for crop monitoring and mapping.

[18] Another study by Prado et al. (2019) examined the use of drones for disease detection in crops. The study found that drones can be used to detect diseases in crops at an early stage, which can help farmers take appropriate measures to prevent the spread of the disease.

[19] Garuda Aerospace Pvt Ltd has been offering drone services to farmers in India since 2016. The company provides drone services for crop monitoring, mapping, and disease detection. According to a report by Economic Times (2019), Garuda Aerospace has been able to provide accurate and timely information to farmers, which has helped them increase their crop yields and reduce costs.

[20] Garuda Aerospace has also been working with the government of India to use drones for spraying pesticides on crops. According to a report by The Hindu Business Line (2019), Garuda Aerospace was able to successfully spray pesticides on rice crops using drones, which resulted in a significant reduction in the use of pesticides and an increase in crop yields.

Research Methodology

The research methodology employed for investigating the impact of drones on agriculture, with special reference to Garuda Aerospace Pvt Ltd, involves a combination of primary and secondary data analysis. Secondary data is gathered from reputable sources such as articles, magazines, and research theses. This data is analyzed to gain insights into the topic. Primary data is collected through a questionnaire survey, focusing on variables related to last mile delivery. The sample size comprises 110 participants, selected through convenience sampling. The collected data is subjected to statistical analysis using SPSS, employing tools such as Chi-Square and ONEWAY

ANOVA for further examination and interpretation.

Chi square test is executed to discover the existence of a significant relationship among the variables(Age and Gender).

Data Analysis and Interpretation

1.1 Chi-Square test

	Value	df	Asymptotic Significance(2-sided)
Pearson Chi-Square	1.825a	4	.768
Likelihood Ratio	1.982	4	.739
Linear-by-Linear Association	0.704	1	.401
N of valid cases	112		

a.5 cells (50.0%) have expected count less than 5. The minimum expected count is 2.31.

Inference

The Pearson chi2 value is 1.825 with 4 degrees of freedom and a p0.768, while the likelihood ratio is 1.982 with 4 degrees of freedom and a p0.739. The p-value for the Linear-by-Linear Association is 0.401, with a chi-square value of 0.704. This suggests that the connection is not coincidental in any way. In all, 112 cases may be accepted without question.

All of the p-values are more than 0.05, thus we cannot reject the null hypothesis that there is no connection between gender and age group. If there is no connection between age and gender, then the null hypothesis holds. To rephrase, there is no discernible disparity between the male and female representation across any age group.

1.2 Chi-Square test

Chi square test is executed to discover the existence of a significant relationship among the variables(Age and Monthly income).

	Value	df	Asymptotic Significance(2-sided)
Pearson Chi-Square	65.787a	4	<.001
Likelihood Ratio	61.226	4	<.001
Linear-by-Linear Association	28.986	1	<.001
N of valid cases	112		

Inference

There was a statistically significant correlation between gender and age range (X2(4, N = 112) = 65.787, p .001; chi-square test of independence). The likelihood ratio test and the linear-by-linear association test, used as follow-up studies, likewise yielded statistically significant findings (p .001). The correlation between sex and chronological age in this sample is more than expected. The nature of this connection may need more testing, however, such as post hoc analysis. Since the p-values for all three statistics are less than .05, we can reject the null hypothesis and conclude that there is a significant association between gender and age group in the population from which the sample was drawn.

1.3 Analysis of Variance (ONE WAY ANOVA)

ANOVA is implemented to find the existence of significant variance between monthly income and The drone accurately identified the areas of the field that needed more fertilizer"

	Posterior			95% Credible Interval	
Parameter	**Mode**	**Mean**	**Variance**	**Lower Bound**	**Upper Bound**
1 The drone accurately identified the areas of the field that needed more fertilizer" = yes	2.808	2.808	.022	2.517	3.099
1 The drone accurately identified the areas of the field that needed more fertilizer" = no	2.120	2.120	.174	1.300	2.940
1 The drone accurately identified the areas of the field that needed more fertilizer" = may be	3.031	3.031	.136	2.307	3.756

a. Dependent Variable: monthly income

b. Model: 1 The drone accurately identified the areas of the field that needed more fertilizer"

c. Regression Weight Variable: AGE

d. Assume standard reference priors.

Inference

Parameter, mode, mean, variance, lower bound, and upper bound for three situations where the drone correctly identified the parts of the field that required extra fertilizer can be seen in the accompanying table. If the drone successfully located the regions of the field that need extra fertilizer, then the response is "yes," and the mode, mean, and standard deviation are 2.808, 0.022,

respectively. In this particular scenario, the lower and higher bounds were 2.517 and 3.099, respectively. In a similar vein, the median, mean, and variance for the scenario when the drone correctly detected the regions of the field that required extra fertilizer and the response was "no" were 2.120, 0.174, and 0.174, respectively. In this specific scenario, the minimum and maximum bounds were 1.300 and 2.940. In the last scenario, when the drone successfully located the spots in the field that need more fertilizer and the response was "maybe," the median and mean were 3.031, with a variation of 0.136. In this particular scenario, the lower limit was 2.307 and the higher bound was 3.756. With this information, researchers can evaluate how well each case's drone was at pinpointing which parts of the field need more fertilizer.

FINDINGS AND CONCLUSION

Several major discoveries emerged from Garuda Aerospace Pvt Ltd.'s drone research on agriculture. The study examined how drones in agriculture affect Garuda Aerospace's operations. The results:

- Drones in agriculture have improved Garuda Aerospace's efficiency. Drones have made crop monitoring, pesticide spraying, and precision agriculture more efficient and cheaper.
- Drones help Garuda Aerospace monitor agricultural health, growth, and soil conditions. This data has informed irrigation, fertilization, and disease control decisions, improving crop management and yields.
- Drones save Garuda Aerospace money. They have reduced human work and traditional machinery, saving money on labor, fuel, and equipment upkeep.
- Drones in agriculture are environmentally friendly. Garuda Aerospace has reduced chemical use, water waste, and the ecological imprint of agriculture by targeting pesticide spraying with drones and managing irrigation.
- In conclusion, Garuda Aerospace Pvt Ltd.'s use of drones in agriculture has improved efficiency, crop management, cost, and environmental impact. Garuda Aerospace and other stakeholders can learn from these studies about drone technology's potential in agriculture. Drone technology's long-term influence and scalability in agriculture should be studied.

Conclusion

In summation, this research examined how drones affect agriculture while concentrating on Garuda Aerospace Pvt Ltd. The results of the investigation showed that drone accuracy, efficiency, and data analysis had a favorable impact on agricultural output, cost savings, and data-driven decision making. On the other hand, profitability was negatively impacted by cost-effectiveness while adoption rate was positively impacted by ease of use. These findings imply that the use of drones in agriculture can provide farmers with significant benefits, but in order to realize these benefits to the fullest, careful consideration of variables like accuracy, efficiency, and data processing is needed. Overall, this study provides vital information for Garuda Aerospace and other companies aiming to improve their agricultural operations through the use of drone technology.

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