Original Research Article

Adoption of Drones in Agriculture: Social, Economic and Personal Factors

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ABSTRACT

Aims: The acceptance of drone technology is gradually rising up owing to its potential being understood by businesses. It is in this aspect that an outlook on the various factors that are responsible pertaining to the drone technology in the recent times has been carried out.

Study design: Ex-post Facto

Place and Duration of Study: Dindigul, Tiruppur, Erode and Namakkal districts of Tamil Nadu

Methodology: Simple Random Sampling was used to select the respondents and to find out the association between the different factors, chi-square test was used.

Results: There was a highly significant association between all the factors such as economic, social and personal with that of utilization of drones in agriculture since the calculated chi – square values are more than the table values

Conclusion: The perceived factors which has been discussed in this article are a positive sign and can be used as an eye-opener to develop more farmer friendly drones and at a reasonable cost for owning them by the farmers

Keywords: Unmanned Aerial Vehicles, Agriculture, Factors, Chi – square test

1. INTRODUCTION

The sector of agriculture, although it contributes to 20.2 per cent of the Gross Domestic Product (GDP) of India (Press Information Bureau, 2021), it gambles with various constraints such as abnormal monsoons, production related issue, low productivity, labour shortage, price fluctuations, etc. Agriculture is the prime work source for man of the rural households. The FAO report on India at a Glance, 2022 in its report have insisted that 70 per cent of the rural households still depend on agriculture and about 82 per cent of the farm households are small and marginal. It is the dire need of all the stakeholders who are involved around agriculture to look into this situation seriously and find out path breaking ways to achieve sustainability for our younger generation. Automation in agriculture is an emerging subject across the world. In the current trend, the concept of Artificial Intelligence has found many applications in building solutions for agriculture related problems, which not only empower the farmers to continue farming amidst eradicating natural resources and also would improve the quality and ensure quick market penetration of various crops. Of all these, a pivotal role is being played by the technology of Unmanned Aerial Vehicles (UAVs), commonly referred to as Drones for agricultural purposes. Although it is in the latent stage and as a much longer road ahead, its presence can be felt in many patches of our country.

Drones, which are technically referred to as 'Unmanned Aerial Vehicles (UAVs)' are useful for carrying out tasks that are sometimes considered impossible for humans to do. These were originally developed for military purposes when the first types of drones were used in First World War. But now it has found its way into mainstream because of the enhanced levels of safety and efficiency they bring. These vehicles do not need a pilot on board and it can either be controlled manually or by relying on a system of sensors (like LIDAR detectors) (Built In, 2022). Drones in general refer to multirotors. A multirotor is fixed with three or more propellers which are used for hovering or flying in any direction. However,

the most commonly used type of drone is the quadcopter having four propellers (GCF Global, 2022).

In the recent trend, drones have become essential for various tasks in different organizations and have also helped a lending hand in uplifting industries that were about to perish. From delivery services of food orders to scan an unreachable military base, drones are very smart enough than humans acting in a more effective and in an efficient way. Moving the work related graph upwards, decrease in work pressure and production costs, excellent accuracy, refining service and customer relations and solving security issues on a large scale are some of the areas where drones find a place.

2. MATERIAL AND METHODS

Based on the data obtained by pilot survey of the units offering drones on a rental basis to the farmers for spraying chemicals to the crops in all the districts of Tamil Nadu, four districts that are having highest number of drone users for agriculture viz., Dindigul, Tiruppur, Namakkal and Erode were selected as the study area. Respondents for the study was selected by following the method of Simple Random Sampling Technique wherein from each district, 25.00 per cent of respondents comprising from all the blocks of a particular district was selected randomly owing to the minimal population of drone using farmers.

Table 1. Number of respondents chosen for the study from the selected districts

S.No.	District	Total number of farmers using drones	Selected number of respondents
1.	Dindigul	298	75
2.	Tiruppur	227	57
3.	Erode	228	57
4.	Namakkal	171	43

A pre – tested and well structure interview scheduled was used for the study and the factors were divided into three categories namely social, economic and personal factors. The response was recorded on a three – point continuum of greater extent, somewhat extent and not an influence factor assigning scores of 3, 2, and 1 respectively and the responses were obtained. The responses were subjected to percentage analysis and the results were tabulated and explained.

3. RESULTS AND DISCUSSION

3.1. Economic Factors

Any new agricultural technology comes into adoption mainly due to because the farmers think that it may have economic benefit when compared with that of the presently undergoing technology. Economic benefits increase the adoption of a particular technology and create more diffusion amongst the other farmers. Hence the factors that were perceived to be the influential economic factors for adopting drones in agriculture and their results are presented below.

Table 2. Economic factors influencing adoption of drones in agriculture (n=235)

S.No	Factors	Extent of Influence		
		Great extent	Somewhat	Not an

				extent		influence factor	
		f	%	f	%	f	%
1.	To obtain more profit	209	88.94	26	11.06	-	-
2.	To increase savings	204	86.81	31	13.19	-	-
3.	High wages of labour	227	96.60	8	3.40	-	-
4.	Large scaled farm	195	82.98	39	16.60	01	04.26
5.	To get subsidy	149	63.40	86	36.60	-	-
6.	Demand driven	96	40.85	139	59.15	-	-
7.	Marketing	87	37.02	148	62.98	-	-
8.	Involvement in other economic activity	160	68.09	75	31.91	-	-

From Table 2, it can be seen that the top most prioritized factor which was responsible to take up drones in agriculture economically was due to high wages of labour that was felt to a great extent by nearly 97.00 per cent of the respondents and the rest felt that it was extent upto a level. This may be due to the reason that the labour force in agriculture is in much grave situation that the availability of labours for performing various agricultural tasks is challenging amidst the growing scenario of technology sector. The other factors which made up the farmers to adopt drones in their fields owing to economic reasons were for obtaining more profit was given by about 89.00 per cent as to a great extent and to increase savings as a factor to a greater extent to use drones in agriculture by nearly 87.00 per cent of the respondents. This shows that the farmers may be more oriented towards economic benefits and to cater this need, drones are used as a helping hand.

The economic factors that were given least importance were demand driving and marketing aspects that were influential only to some extent by 40.85 and 37.02 per cent respectively. This would have arrived due to the reason that farmers may had felt that demand and marketing area continuous activity in agricultural scenario and the involvement of drones in such activity might not show any major difference between conventional farming and precision farming.

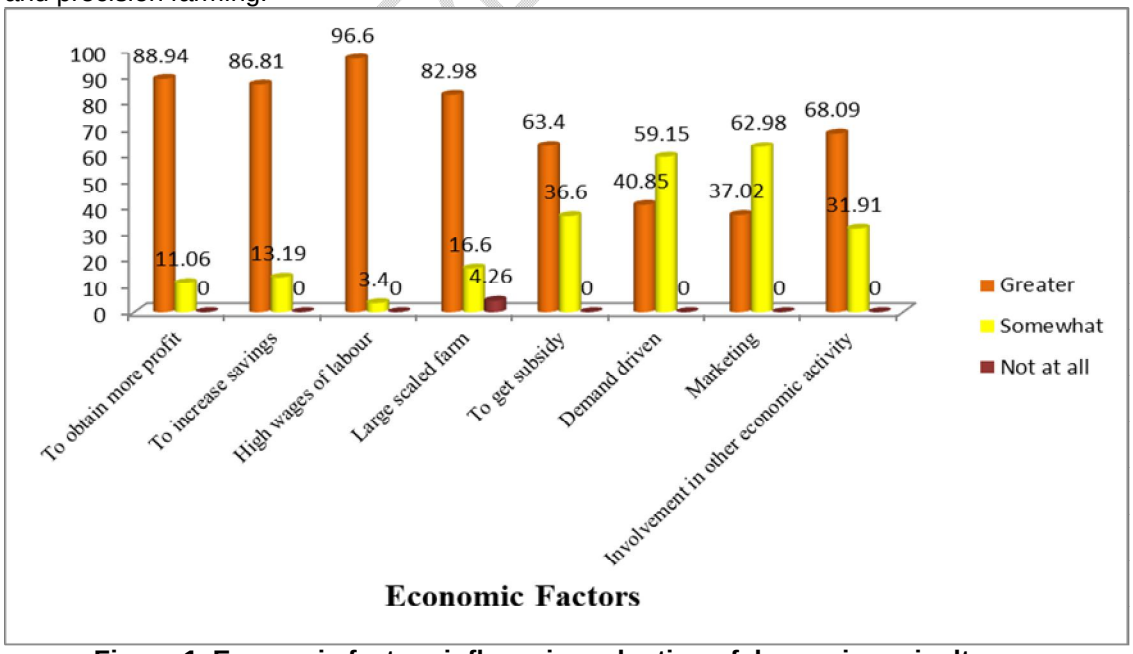

Figure 1. Economic factors influencing adoption of drones in agriculture

3.2. Social Factors

Social factors are the factors that have a direct influence on the society and its culture. India being a diverse country is fond of various societal backgrounds and hence it has a lot of dimensions to be taken into consideration while developing any new technology. It was therefore out of many factors, most important shortlisted social factors were perceived and after conducting the survey, the below results were obtained.

Table 3. Social factors influencing adoption of drone applications in agriculture (n=235)

S.No	Factors	Extent of Influence					
		Great extent		Somewhat extent		Not an influence factor	
		f	%	f	%	f	%
1.	Family background	148	62.98	87	37.02	-	-
2.	Compulsion from family members	163	69.36	72	30.64	-	-
3.	Encouragement from friends	178	75.74	57	24.26	-	-
4.	After looking at the peers	197	83.83	38	16.17	-	-
5.	Influence from the society	193	82.13	42	17.87	-	-
6.	Labour scarcity	198	84.26	37	15.74	-	-

From the above table 3, it can be observed that the most influential social factor influencing farmers to adopt drones in agriculture was labour scarcity that was a greater extent for nearly 84.00 per cent and to some extent were the rest 16.00 per cent respondents. This would have been because the farmers may still face the problem of labour shortage in agriculture sector due to the still prevailing societal differences among the people and which would have affected the normal productivity of crops in the field. The introduction of drones wherein the efficiency when compared with that of humans is more might have combated this problem and so the first priority was given to this factor. The other two top factors contributing to the adoption of drones include after looking at peers and influence from the society by 83.83 per cent and 82.13 per cent of respondents respectively up to a great extent for which the reason may be as determined by Rogers and Shoemaker (1971) the different categories of adopters in a society. The farmer who is more innovative and always have a search in new technology might have first used the technology and this might have influenced others also to do the same in their fields.

The least prioritized social factors include family background (62.98%) and compulsion from family members (69.36%) since adoption of a new technology involves a major contribution of taking the decision to whether to do or not by an individual at the final and hence these factors may have a less effect on the decision to adopt drones in the field.

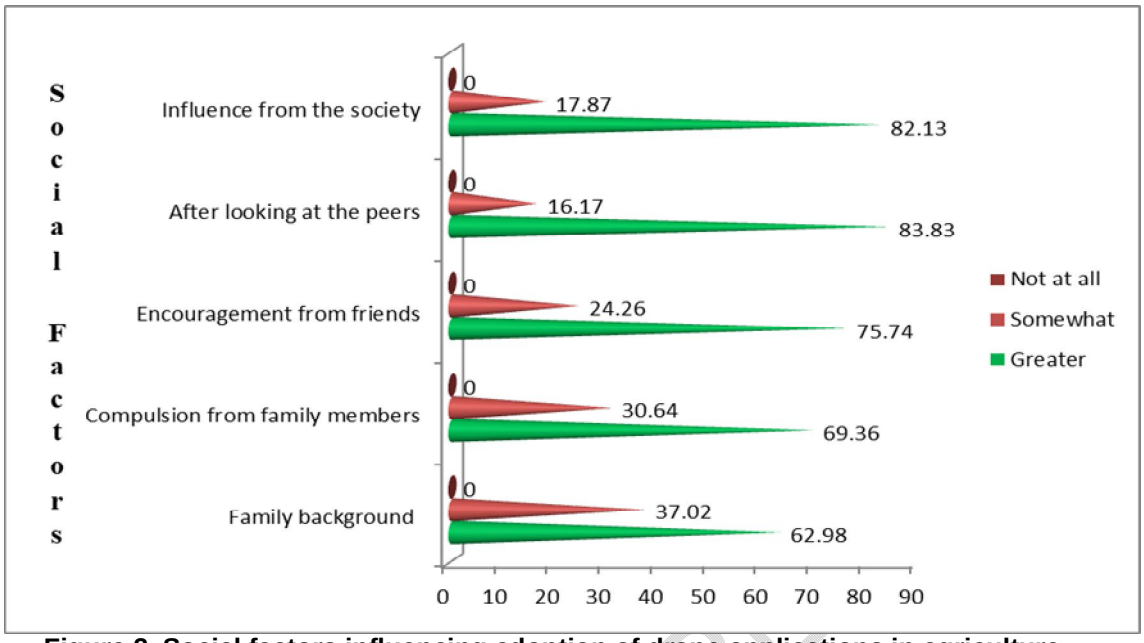

Figure 2. Social factors influencing adoption of drone applications in agriculture

3.3. Personal factors

Factors that are dependent on the attempt of an individual to adopt a particular technology in his / her own field are considered in the personal factors. In this context, the various personal factors that would influence an individual to take up drone technology in the field was perceived after a knowledge gained from the initial pilot survey of the farmers using drones and the results obtained after the original survey is tabulated below.

Table 4. Personal factors influencing the adoption of drones in agriculture (n=235)

S.No	Factors	Extent of Influence					
		Great extent		Somewhat extent		Not an influence factor	
		f	%	f	%	f	%
1.	Self –reliance or independence	84	35.74	151	64.26	-	-
2.	To avoid migration	96	40.85	138	58.72	1	04.26
3.	Saves energy	181	77.02	54	22.98	-	-
4.	Educational status	123	52.34	111	47.23	1	04.26
5.	Scientific orientation	217	92.34	18	7.66	-	-
6.	Risk orientation	201	85.53	33	14.04	1	04.26
7.	Reduces time consumption	225	95.74	10	4.26	-	-

Table 4 shows that more than 95.00 per cent of the respondents expressed the amount of time consumed for agricultural activities was reduced to a greater extent when drones were applied in the field. Conventional farming used to have time constraints for conducting agricultural activities in the field owing to the dependency on various aspects such as labour availability, implement availability, pesticide availability, climate dependency, etc. which ultimately results in loss of time concentrated on agriculture. But when drones are employed for activities such as spraying and their efficiency is high, it definitely saves time for the farmers to focus on other farm activities which may be the reason for such a result.

The other two personal factors that contribute to adoption of drones include scientific orientation by more than 92.00 per cent farmers and risk orientation by 85.53 per cent farmers to a greater extent because the farmers who were under the study area may be innovative in their ideas and hence their personal interest in utilizing the drone facilities in their fields may have influenced the farmers to adopt drones.

The least influential factors to adopt drones by personal factors include self – reliance and to avoid migration which is 64.26 and 58.72 per cent respectively to some extent since the farmers are mostly self – reliant even when they use conventional farming and the migration aspect nowadays is not influential among farmers because the government is focussing equally on all the villages by allocating different schemes and concentrating more on agriculture which might have caused such a result to occur.

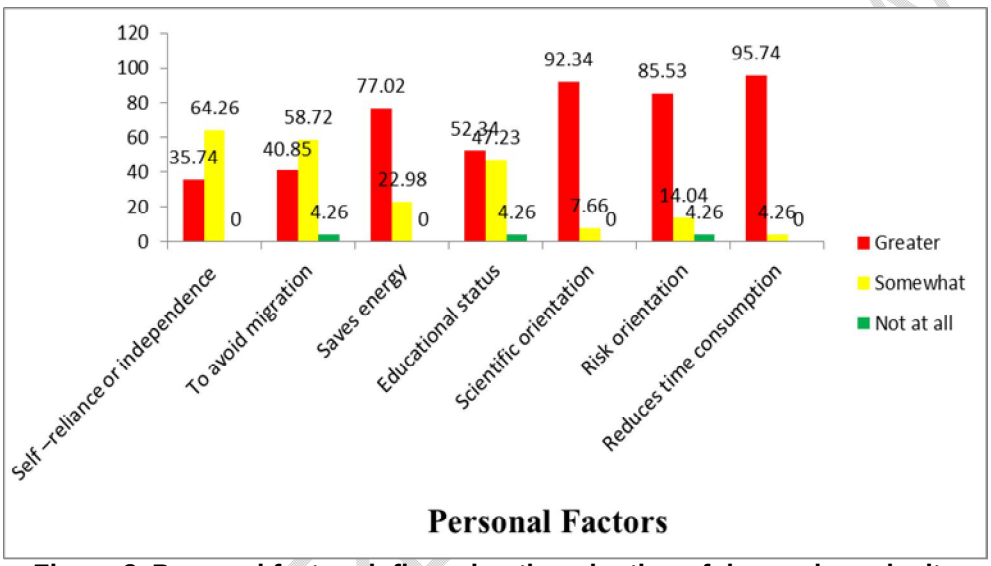

Figure 3. Personal factors influencing the adoption of drones in agriculture

3.4. Association of different factors responsible for using drone applications in agriculture

To find out the association of the factors such as social, economic and personal factors with that of the utilization of the drones in agriculture, chi – square was used.

$$\chi_c^2 = \frac{\sum(O_i - E_i)^2}{E_i}$$

where,

c - Degrees of freedom
O - Observed value
E - Expected value

Table 5. Association of different factors responsible for using drone applications in agriculture

S.No.	Factors	χ_c^2 value
1.	Economic factors	34.55**
2.	Social factors	30.74**

3.	Personal factors	29.24**

Data presented in Table 5 point out that there was a highly significant association between all the factors such as economic, social and personal with that of utilization of drones in agriculture since the calculated chi – square values are more than the table values. This indicates that the usage of drones is dependent on all the above mentioned factors and hence these factors play a significant role in determining the adoption of drones in agriculture.

4. CONCLUSION

Drone technology is definitely a game changer in the field of agriculture. Many Indian start-ups are investing more in low – cost drones that can help farmers and create simultaneously employment opportunities for the rural youth and enhance the knowledge of farmers too. However, the drone industry needs more path breaking reforms by taking into account the rapid increase in population, dire needs of the farmers, operational policies and shrinking farm fields which is a matter to be worried.

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