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ORIGINAL ARTICLE

Adoption of Automated Irrigation system in Farm business: Evidence from Selected Regions of Tamil Nadu

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ABSTRACT
The smart farming in general and automated irrigation system in particular has received substantial attention among farmers for its perceived ability to contribute significantly in increasing the yield and saving in resources like labor, water, energy and time. In recognition of the importance of the emerging automated system, the paper addressed three important issues in relevance to adoption of automated irrigation system on the farm; Profile of the existing farms, farmers and farming systems, reasons for adoption of automated irrigation system and constraints faced by the farmers in adoption. The results revealed that reduction in the availability of labor and water scarcity were the main reasons for the adoption of automated irrigation system in farm business. High investment requirement is the major constraint as the technology is new and sophisticated.
Key words: *smart farming, automated irrigation system*

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INTRODUCTION

Agriculture in the modern world is changing rapidly. Raising global population is the major cause behind the changes in the agriculture industry. According to UN projections, the human population in the world will reach 8.5 billion by 2030. To meet out the demand, food production has to be increased by at least 70% [1] and workers to look after the crops in the entire life cycle have to be reduced. In order to face the labor shortages, farmers are turning to incorporate technology to make farms more effective. Introduction of advanced technologies shows the farmers a new ways to replace the conventional farming with smart farming to enable the farmers to take real time and profitable decisions. One among the smart farming technologies is application of automation in irrigation [1].

Automation system in Agriculture included automated farming equipments for field operations like autonomous tractors, unmanned aerial vehicles and robotic harvesters. Animal systems included automated monitoring and feeding system, and cultivating systems included greenhouse climatic control, irrigation and fertigation systems. These automated technologies have reduced production costs, curtailed the drudgery of menial labor, improved the quality of fresh harvest, and enhanced environmental control. With the help of mechanization and automation technologies agricultural productivity has increased considerably all through the year [2]. Among all the other farm automation systems, this study is limited to automated irrigation system as this technology is well developed and adopted by large number of farmers by considering the land holding size and cost of technology. Automation offered efficient utilization of water and labor available on-farm by allowing flexible frequency, rate, and duration of water supply with efficient control of the irrigator at the appropriate application spot [3]. A wireless in-field sensor-based irrigation system was improved to supply variable-rate irrigation. Computer controlled the irrigation system which transmitted the control signals to

irrigation controllers centered on field data and GPS location of irrigator via real-time wireless communications [4]. A program logic controller was used to control a solenoid valve which turns the nozzles of drip or sprinkler on and off. When IoT-enabled sensors were paired with Subsurface Drip Irrigation (SDI), farmers could continuously monitor the moisture content and plant condition, so that they could interfere only when human interventions are needed, or else permit the system to function autonomously [5].

MATERIAL AND METHODS

The study was conducted in three districts of Tamil Nadu state *viz*., Coimbatore, Erode and Dindigul where adoption of automation technology in irrigation is higher especially for coconut and banana. To select the technology adopters, the list of farmers from three technology providing firms were collected. For the purpose of the study, 50 technology adopted farmers were selected purposefully and they were interviewed with the aid of well-structured interview schedule which has covered particulars like age, gender, education, farming experience, landholding size, primary and secondary occupation, cropping, source and area under irrigation, information source, reason for adopting the automation technology, constraints faced by the farmers in adoption of the technology. The data collected were analyzed with the help of percentage analysis and Garratt ranking technique.

RESULTS AND DISCUSSION

Demographic profile of sample farmers adopting the automated irrigation system

The demographic profile of the farmers like age, gender, educational qualification, primary occupation, secondary occupation and their farming experience were analyzed with the help of percentage analysis and presented in Table 1.

From the table it could be inferred that majority of the farmers who adopted automated irrigation systems were male (96 percent) and most of them were between 41 to 50 years of age group (54 percent). Majority of the technology adopters completed higher secondary (50 percent). Nearly 58 percent of the technology adopting farmers was doing farming as a primary occupation and 42 percent of the farmers were doing farming as a secondary occupation. Majority of the technology adopters had the farming experience of (96 percent) ten to twenty years.

Landholding details of sample farmers

The existing details of the technology adopted farms such as size of landholding, source of irrigation were analyzed and tabulated in table 2.

The results indicated that 44 percent of technology adopters were medium sized land holding farmers and 36 percent of the farmers mainly depended on open well for irrigation in the farm. About 30% of the sample farmers had bore wells in their farms.

Details of Automated Irrigation System used in the sample farms

The details collected included source of information about the automation system, name of the company and inclusion of fertigation unit. The details are presented in the table 3. The results indicated that majority of the technology adopters got the information about the availability and the use of irrigation automation system through friends/relatives. Among the three companies, 46 % of farmers have adopted the technology provided by Mobitech wireless solution and 76 % of farmers adopted only irrigation automation. Now the farmers are increasingly adopting fertigation automation as it reduced the labor cost for application of fertilizer to the crops.

Changes in the cropping pattern and cropping intensity after adoption of Automation technology

Changes in the cropping pattern among farmers after adoption of automation technology is presented in table 4. From the table 4 it is clear that after automation the Net sown area has increased from 342 acres to 364 acres. The area under banana and coconut has increased whereas the area under sugarcane, turmeric, watermelon, cardamom and pineapple has decreased after the introduction of automated irrigation technology. The important outcome of this technology adoption was that crops required less water and grown more under garden land conditions have not been cultivated after the adoption of the technology. The farmers have increased the area under annual commercial crops.

Reasons for adoption of Automation technology

In order to find out the reasons for adopting automation technology on farms, sample farmers were interviewed and the results were analyzed using Garratt ranking. Nine reasons were ranked according to the perception of the farmers and are given in the table 5. The results indicated that the main reason for adoption of automation technology was non availability of labor. Requirement of labor and the associated cost decreased when automation technology was adopted. Second reason was reduction in water usage.

Once the time and volume of water to be delivered was fixed, the valve delivered the required amount and there was less of wastage/over irrigation.

Constraints faced by the farmers in adoption of technology

Six constraints in continuing the technology were identified by the farmers and these were analyzed with the help of Garratt ranking and presented in table 6.From the table it could be inferred that higher initial investment was the major constraint because there was no subsidy given by the government. The other problems occurred rarely and have very little impact as reported by the farmers.

Table 1: Demographic profile of sample farmers (n=50)

S.No	Characteristics	Category	Number of Farmers	Percentage (%)
1.	Gender	Male	48	96
		Female	2	4
2.	Age (Years)	Below 30	2	4
		Between 31 to 40	11	22
		Between 41 to 50	27	54
		Above 50	10	20
3.	Educational Qualification	High School	11	22
		Hr. Secondary	25	50
		Graduate	12	24
		Post Graduate	2	4
6.	Primary Occupation	Farming	29	58
		Business	11	22
		Job	10	20
7.	Secondary Occupation	Farming	21	42
		Business	4	8
		No Secondary Occupation	25	50
8.	Experience in Farming (Years)	Below 10	24	48
		11 to 20	24	48
		21 to 30	2	4

Table 2: Landholding details of sample farmers

S.No	Characteristics	Category	No. of Farmers	Percentage
1.	**Size of landholdings**	Marginal (< 1 ha)	0	0
		Small (1-2 ha)	19	38
		Medium (>2-4 ha)	22	44
		Large (> 4 ha)	9	18
2.	**Source of Irrigation in Farm**	Open Well	18	36
		Bore Well	15	30
		Bore Well + Open Well	7	14
		Bore Well + Canal	2	4
		Well + Canal	8	16

Table 3: Details on adoption of Automated Irrigation system

S.No	Characteristics	Category	Number of Farmers	Percentage
1.	**Source of Information**	Friends/Relatives	21	42
		Dealers	8	16
		Private Institutions	19	38
		Exhibitions	2	4
2.	**Name of the Company**	Mobitech Wireless Solution	23	46
		Niagara Automation	20	40
		Netafim	7	14
3.	**Type of Automation**	Irrigation Automation	38	76
		Fertigation Automation	12	24

Table 4: Changes in the cropping pattern and cropping intensity after adoption of Automation technology (Area in acres)

S.No	Before Automation			After automation		
	Particulars	**Area in acres**	**%**	**Particulars**	**Area in acres**	**%**
1	Banana	90	26.32	Banana	121	33.24
2	Coconut	153	44.74	Coconut	201	55.22
3	Sugarcane	5	1.46	Sugarcane	5	1.37
4	Turmeric	28	8.19	Turmeric	14	3.85
5	Watermelon	8	2.34	Watermelon	8	2.20
6	Cardamom	13	3.80	Cardamom	13	3.57
7	pineapple	2	0.58	pineapple	2	0.55
8	Groundnut	17	4.97			
9	Maize	9	2.63			
10	Paddy	10	2.92			
11	Sorghum	5	1.46			
12	Tapioca	1	0.29			
13	Sesame	1	0.29			
	Total	**342**		**Total**	**364**	

Table 5: Reasons for adoption of automation technology in irrigation

Factors	**Mean Score**	**Rank**
Less Labor requirement	66.52	**I**
Reduction in water usage	60.70	**II**
saves time and drudgery	57.90	**III**
Easy Monitoring and Controlling of pump and valves remotely	53.04	**IV**
Protection of pumpsets from dry runs, overloads, Phase failures and low voltage conditions	52.34	**V**
Results in better yield	49.64	**VI**
Timely irrigation	41.90	**VII**
Immediate Notification regarding defects	35.08	**VIII**
Zero maintenance cost	23.16	**IX**

Table 6: Constraints faced by the farmers in continuing with the automated irrigation technology

Constraints	**Mean Score**	**Rank**
Higher initial investment	86.02	**I**
Damages due to lightening	68.42	**II**
Frequent problems with the software	52.30	**III**
Poor service quality of the automation firms	40.36	**IV**
Network faults	35.70	**V**
Lack of knowledge about operating the technology	25.60	**VI**

CONCLUSION

The present study investigated the adoption of on form automated irrigation system in selected areas of Tamil Nadu. Realizing the non-availability of labor, water scarcity, insufficient time in the fast moving world, the need of automation was more significant for optimum and efficient utilization of resources in the farms. Farmers should produce commodities at reasonable prices so as to stay in business and automation of farm technologies are one of the best way forward. With the advancement of application of sensors and computers, and decline in automation equipment costs, this is becoming feasible and more

systems will be introduced in the future. The future farm will include integration of advanced sensors, controls, and intelligent software to offer feasible solutions to the complex agricultural environment.

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