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## **Rate of Adoption and Diffusion of Dairy Innovations by the Dairy Farmers in Andhrapradesh**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author GT designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors GRKS and CS managed the analyses of the study. Authors KSR and TR managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Rate of adoption in the present study refers to the acceptance and application by a respondent, some or all the innovations recommended in the package of selected dairy innovations. Rate of diffusion is operationalized as the time taken by the dairy farmer to implement the innovation recommended, to the time from which the farmer is aware of the innovation. A total of 360 dairy farmers, who were first to adopt innovations suggested by the State Animal Husbandry Department from three districts of Andhra Pradesh i.e., Visakhapatnam, Krishna and Chittoor districts were selected purposively for the study. A total of nine dairy innovations were suggested for adoption to the dairy farmers in the study area. Based on adoption quotient computed, the farmers were categorized into low, medium and high adopters and item analysis on adoption of dairy innovations was carried out. Item analysis identified that, out of the nine practices recommended, only five

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practices i.e., package of practices for rearing heifers, pregnant and lactating animals; feeding of area specific mineral mixture, strategies for enhancement of milk yield and quality, marketing strategies to improve milk sales, use of ICT's in adoption of innovations were adopted by majority of dairy farmers while remaining four practices i.e., cultivation and feeding of Azolla, hydroponic fodder, use of milking machine and formulation and feeding of complete feed blocks had shown almost low to nil adoption by sizeable section of the respondents. The reasons for adoption of the above mentioned five practices is due to dominant role played by them in influencing production levels, minimum input costs and high economic returns where as the remaining four practices involved high input costs, sound operational skills, low economic returns and non-applicability in all situations which might have been the reasons for their adoption to a meager extent.

**Keywords:** Rate of adoption; rate of diffusion; item analysis; innovations.

## 1. INTRODUCTION

Adoption is defined as a decision to make full use of an innovation at the best course of action possible Rogers E.M [1]. The relative speed with which an innovation is adopted by the members of a social system is defined as the rate of adoption. Based on the relative advantage that occurs due to adoption of any innovation, the diffusion process takes place into the social system. Diffusion is the process through which an innovation is communicated through certain channels over time among members of a social system. The key components of diffusion are communication channels, time and the social system. Continuous adoption of an innovation leads to its percolation into the social system and helps in effective diffusion into the farming communities and to achieve the same, extension today should go beyond training and help farmers to form groups as well as taking initiatives to address marketing issues, enter partnerships with wide range of service providers and other related organizations Birner K Davis et al., [2].

## 2. METHODOLOGY

Rate of adoption in the present study refers to the acceptance and application by a respondent, some or all the innovations recommended in the package of selected dairy innovations for the past one year or at present as recommended by research/advocated by an extension agency. All the practices included in a package are considered important. A range of adoption is provided for these practices facilitating adjustments based on local conditions. An index for adoption is constructed to measure the rate of adoption using the following formula.

$$\text{Adoption quotient} = \frac{\text{No. of practices adopted}}{\text{No. of practices recommended}} \times 100$$

Each practice adopted within the range by a farmer was given a score of one. Based on the number of practices, the maximum possible score for dairy innovations was nine. An adoption quotient was computed for each farmer. Based on the adoption quotient, the respondents were categorized into 3 groups as shown below, based on mean and standard deviation.

### 2.1 Rate of Diffusion

In the present investigation the rate of diffusion is operationalized as the time taken by the dairy farmer to implement the innovation recommended to the time form which the farmer is aware of the innovation. The continuous adoption of an innovation for a period more than three years by the farmer is considered as diffusion for that particular innovation into the social system.

$$\text{Rate of Diffusion} = \frac{\text{Implementation of the dairy innovation recommended since 1 year from the time of investigation}}{\text{Time from which farmer is aware of the innovation}}$$

## 3. RESULTS

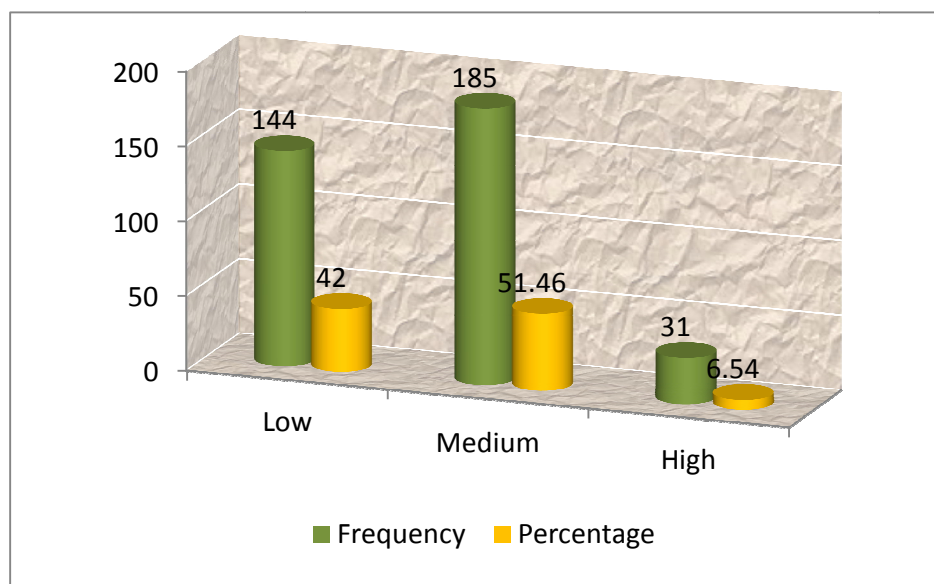
### 3.1 Rate of Adoption of Dairy Innovations

A total of nine dairy innovations were suggested for adoption by the dairy farmers in the study area. Based on adoption quotient computed, the farmers were categorized as shown in Table 1 and illustrated in Fig.1.

A glance at the above table indicated that, only half (51.46%) of the dairy farmers adopted recommended dairy innovations to moderate extent followed a little less than half (42%) of the dairy farmers with low and a meager per cent (6.54) of the respondents with high rate of adoption respectively.

**Table 1. Distribution of dairy farmers based on their rate of adoption of recommended dairy innovations**

Sl. No.	Category	Frequency	Percentage
1.	Low rate of adoption	144	42
2.	Moderate rate of adoption	185	51.46
3.	High rate of adoption	31	6.54
	<b>Total</b>	<b>360</b>	<b>100</b>

**Fig. 1. Distribution of dairy farmers based on their rate of adoption of recommended dairy innovations**

### 3.2 Item Analysis on Adoption of Recommended Dairy Innovations

To gain more insight into the adoption of recommended dairy innovations by the respondents, item analysis was carried out with the help of frequencies and percentages and results were presented in Table 2.

An over view of Table 2 showed that majority of dairy farmers adopted only half recommended innovations in the following rank or order, such as package of practices for rearing heifers, pregnant and lactating animals (75.6%), feeding of area specific mineral mixture (72.4%), strategies for enhancement of milk yield and quality (68.7%) marketing strategies to improve milk sales (66.3%), use of information and communication technologies in adoption of dairy innovations (61.8%), whereas the practices like cultivation and feeding of Azolla (48.4%) and use of milking machine (28.7%). The practices like cultivation and feeding of hydroponic fodder

(13.4%) and feeding of complete feed blocks (5.68%) were adopted by a very meager percent of the respondents.

### 3.3 Rate of Diffusion of Dairy Innovations

Rate of diffusion for recommended nine dairy innovations was calculated as implementation of the dairy innovation recommended by the state AHD's / SVU's at the time of investigation in years from the time (number of years) from which the farmer is aware of the innovation. Based on the scores arrived the farmers were categorized into 5 groups as shown below.

A cursory look at Table 3 and Fig. 3, clearly indicated that half of the respondents belonged to early majority (54%) followed by late majority (22%) groups respectively. A meager percent of the farmers were early adopters (12%) followed by laggards (81%) and innovators (4%) in the diffusion of dairy innovations.

**Table 2. Distribution of farmers according to their frequency of innovation wise adoption**

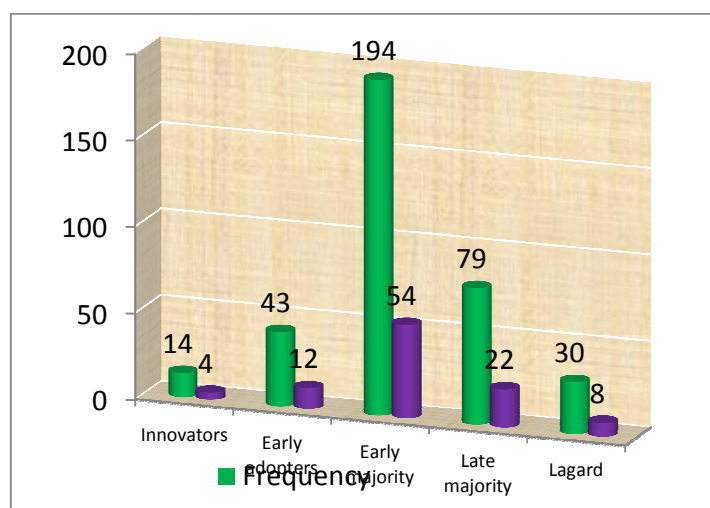
S. No.	Practice	Adopted		Non-Adopted	
		N	%	N	%
1.	Package of practices for rearing for heifers, pregnant and lactating animals	272	75.6	88	24.4
2.	Feeding of area specific mineral mixture	261	72.4	99	27.6
3.	Strategies for enhancement of milk yield and quality	247	68.7	113	31.3
4.	Marketing strategies to improve milk sales	239	66.3	121	33.7
5.	Use of information and communication technologies to adopt dairy innovations	222	61.8	138	38.2
6.	Cultivation and feeding of Azolla	174	48.4	186	51.6
7.	Use of milking machine	103	28.7	257	71.3
8.	Cultivation and feeding of hydroponic fodder	48	13.4	312	86.6
9.	Formulation and feeding of complete feed blocks	20	5.6	340	94.4
		<i>N – Frequency</i>		<i>% - Percentage</i>	

**Table 3. Distribution of respondents based on their rate of diffusion of recommended dairy innovations**

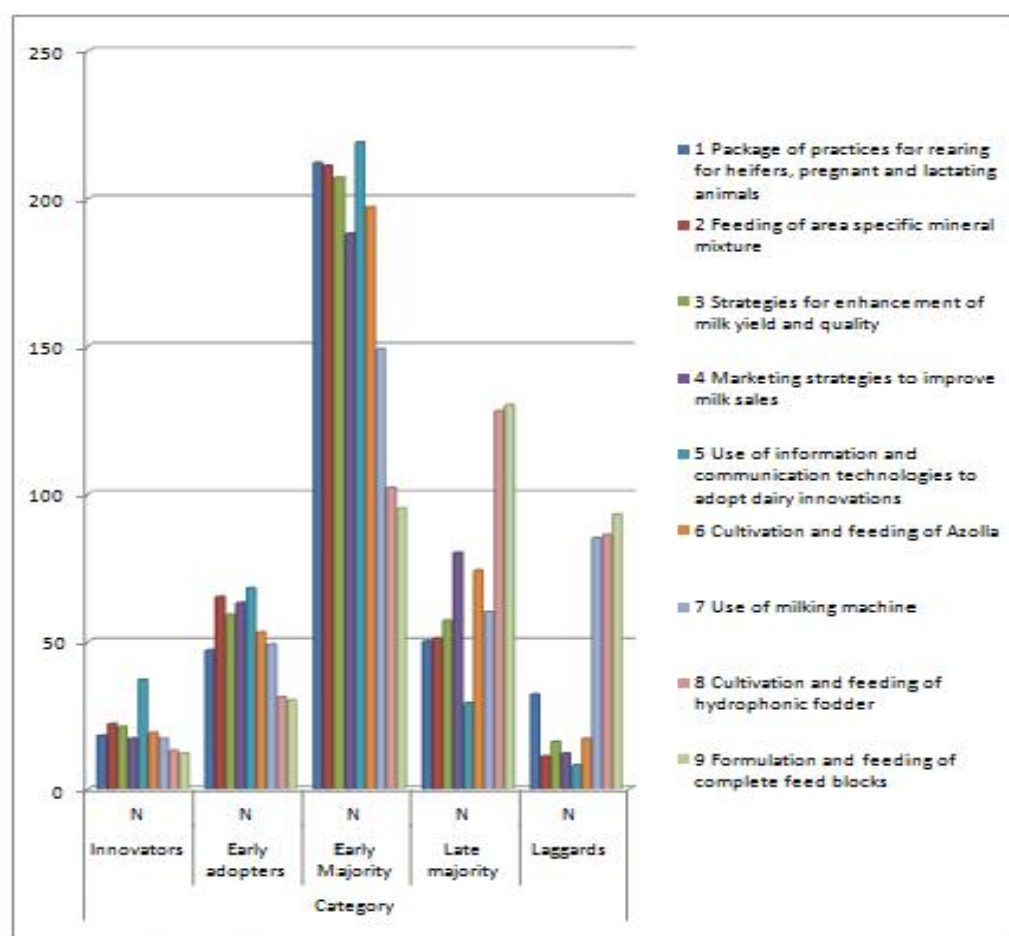
S. No.	Category	N	%
1.	Innovators	14	4
2.	Early adopters	43	12
3.	Early majority	194	54
4.	Late majority	79	22
5.	Laggards	30	8
	<b>Total</b>	<b>360</b>	<b>100</b>
		<i>N – Frequency</i>	<i>% - Percentage</i>

**Table 4. Distribution of dairy farmers based on their rank order of diffusion rate of recommended dairy innovations**

Sl. No.	Dairy Innovations	Category									
		Inno-vators		Early Adopters		Early Majority		Late majority		Laggards	
		N	%	N	%	N	%	N	%	N	%
1.	Package of practices for rearing for heifers, pregnant and lactating animals	18	5	47	13	212	59	50	14	32	9
2.	Feeding of area specific mineral mixture	22	6	65	18	211	58.7	51	14.3	11	3
3.	Strategies for enhancement of milk yield and quality	21	5.7	59	16.4	207	57.6	57	15.8	16	4.5
4.	Marketing strategies to improve milk sales	17	4.8	63	17.4	188	52.3	80	22.2	12	3.3
5.	Use of information and communication technologies to adopt dairy innovations	37	10.2	68	18.8	219	60.7	29	8	8	2.3
6.	Cultivation and feeding of Azolla	19	5.4	53	14.8	197	54.7	74	20.4	17	4.7
7.	Use of milking machine	17	4.6	49	13.7	149	41.4	60	16.8	85	23.5
8.	Cultivation and feeding of hydroponic fodder	13	3.7	31	8.6	102	28.2	128	35.6	86	23.9
9.	Formulation and feeding of complete feed blocks	12	3.3	30	8.4	95	26.4	130	36.2	93	25.7



**Fig. 2. Distribution of respondents based on their rate of diffusion of recommended dairy innovations**



**Fig. 3. Distribution of dairy farmers based on their rank order of diffusion rate of recommended dairy innovations**

Careful observation of results of Table 4, depicted that the practice of ICT's in dissemination of information was found to have highest rate of diffusion with 60.7 per cent of respondents in early majority category followed by early adopters (18.8%), innovators (10.2), late majority (8%) and laggards (2.3%). The innovation package of practices for rearing heifers, pregnant and lactating animals had second highest diffusion rate with 59 per cent of respondents in early majority category followed by late majority (14%), early adopters (13%) laggards (9%) and innovators (5%) respectively.

The practice, strategies for improving milk feeding of area specific mineral mixture ranked 3<sup>rd</sup> with respondents in early majority group (58.7%) followed by early adopters (1.8%), later majority (14.3%), innovators (6%) and laggards (3%) respectively.

The recommendation, strategies for improvement of milk yield and quality ranked fourth in diffusion process with early majority group diffusing the innovation to an extent of 57.6 percent followed by early adopters (16.4%), later majority (15.8%), innovators (5.7%) and laggards (4.5%) respectively.

The practice cultivation and feeding of azolla ranked fifth where respondents in early majority group were 54.7 per cent followed by late majority (20.4%), early adopters (14.8%), innovators (5.4%) and laggards (4.7%) respectively. Marketing strategies to improve milk sales ranked sixth with early majority (52.3%), later majority (22.2%), early adopters (17.4%), innovators (4.8%) and laggards (3.3%) respectively.

Seventh position was given to the recommendation, use of milking machine to quick and efficient milking where only 41.4 per cent of dairy farmers diffused this practice in the early majority category followed by laggards (23.5%), late majority (16.8%), early adopters (13.7%) and innovators (4.6%). Cultivation and feeding of hydroponic fodder was found to have very meager diffusion rate with high number of respondents in later majority (35.6%) category followed by early majority (28.2%), laggards (23.9%), early adopters (8.6%) and innovators (3.7%).

The recommendation formulation and feeding of complete feed blocks was ranked last in the diffusion process with majority of respondents in

late majority (36.2%), early majority (26.4%) and laggards (25.7%) category and only few of the respondents in early adopter (8.4%) and innovators (3.3%) categories respectively.

## 4. DISCUSSION

### 4.1 Rate of Adoption of Dairy Innovations

Implementation of any improved scientific technology in practical field depends on the adoption behaviour of an individual who wants to implement it. The adoption of a specific practice is thus not a result of single decision to act but a series of actions and meaningful decisions. The results gained the support of Mudzengi C.P et al., [3]. Adoption is a process composed of learning, deciding and acting over a period of time.

In the study area, results revealed that only half of the dairy farmers (51.46%) adopted the recommended innovations to a moderate extent and remaining 42 per cent showed low rate of adoption. The respondents showing moderate rate of adoption were eager to improve their efficiency in dairy farming by accessing various sources of information, taking advices at the right time from their technical personnel, knowing timely marketing trends utilizing their vast experience and showed accuracy in decision making which lead to the above trend. The low adoption groups are accounting to 42 per cent which needs focus on extension workers to initiate steps towards transfer of technology through mobile telephony, mass media like radio and television, social media, mobile apps on smart phones and creation of what's app farmers groups etc., since half of respondents have access to latest ICT devices. The observations gained the support of Martins et al., [4] and Vijay Kumar and Singh B.P [5].

### 4.2 Item Analysis on Adoption of Recommended Dairy Innovations

Item analysis on adoption of dairy innovations indicted in Table 2 identified that out of the nine practices recommended only five practices i.e., package of practices for rearing heifers, pregnant and lactating animals; feeding of area specific mineral mixture, strategies for enhancement of milk yield and quality, marketing strategies to improve milk sales, use of ICT's in adoption of innovations were adopted by majority of dairy farmers while remaining four practices i.e., cultivation and feeding of Azolla, hydroponic

fodder, use of milking machine and formulation and feeding of complete feed blocks had shown almost low to nil adoption by sizeable section of the respondents.

The reasons for adoption of the above mentioned five practices is due to dominant role played by them in influencing production levels, minimum input costs and high economic returns where as the remaining four practices involved high input costs, sound operational skills, low economic returns and non-applicability in all situations. These might be the reasons for their adoption to a meager extent. The findings are similar to the observations of Surkar S.H et al [6] and Uma Sah et al., [7].

#### 4.3 Rate of Diffusion of Dairy Innovations

The individuals are classified into five categories in the diffusion process as innovators, early adopters, early majority, late majority and laggards. Venturesomeness is the obsession of innovator which plays an important role in diffusion of innovations from outside of system's boundaries into the social system Rathi N [8]. Early adopters are embodiment of successful and discrete use of new ideas who are considered by many as an individual to check with.

Early majority adopt new ideas just before the average members in a social system. They have a unique position between very early and relatively late to adopt innovations which makes them an important inter connecting link in the diffusion process Bashiru M et al., [9]. Late majority adopt new ideas just after average members in a social system almost after all the uncertainty is removed. Laggards are last in a social system to adopt an innovation. When laggards finally adopt an innovation, it may already have been superseded by another more recent idea that is already being used by the innovators.

The categorization of most of the respondents in early majority category indicated that majority of dairy farmers were trying to diffuse new innovations into the social system only after checking out their compatibility, net profitability and relative advantage over the previous practices which might have resulted in the above categorization. The results are in line with the observations of Amitendu et al., [10].

In the present study, it was interpreted from the results of Table 3 that most of the dairy farmers belonged to early majority category (54%) followed by late majority (22%), early adopters (12%), laggards (8%) and innovators (4%) respectively.

#### 4.4 Item Analysis on Rate of Diffusion of Recommended Dairy Innovations

The results of item analysis on diffusion of dairy innovations indicated in Table 4 represented that the recommendations like use of ICT's in dissemination of information; package of practices for rearing heifers, pregnant and lactating animals; feeding of area specific mineral mixture; strategies for improvement of milk yield and quality; cultivation and feeding azolla showed diffusion rate in the rank order of one, two, three, four and five as expressed by majority of the respondents.

The remaining recommendations i.e., marketing strategies to improve milk sales, technology of using milking machine, cultivation and feeding of hydroponic fodder, formulation and feeding of complete feed blocks ranked six, seven, eight and nine respectively in the diffusion process as expressed by majority of the respondents. The relative advantage of the first ranked five innovations over their previous practices is their simplicity in adoption, net profitability and applicability to local conditions which might be the plausible reasons for diffusion into the social system. The findings are in concurrence with the findings of Njeri M et al. [11]. (the surname is Mercy)

#### 5. CONCLUSION

The innovations which are simple in adoption, relatively profitable, involve minimal skills and applicable to local conditions were easily adopted and diffused into the social system. Informal sources like neighbours, friends and relatives; formal sources like veterinary assistant surgeons, scientists, extension specialists and communication channels like mass media, ICT's may be exploited for adoption and diffusion which may be implemented through campaigning, result demonstration, mass media, extension organizations and NGO's.

#### CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).



## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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