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## **Adoption Status and Influencing Factors of Mobile Telephony in Dairy Sector: A Study in Four States of India<sup>§</sup>**

**Prakashkumar Rathod<sup>a\*</sup>, Mahesh Chander<sup>b</sup> and D. Bardhan<sup>c</sup>**

<sup>a</sup>Department of Veterinary and Animal Husbandary Extension Education, Veterinary College, Bidar, Karnataka

<sup>b</sup>Division of Extension Education, <sup>c</sup>Division of Livestock Economics, Statistics and Information Technology,  
ICAR-Indian Veterinary Research Institute, Izatnagar-243 122, Uttar Pradesh

### **Abstract**

The study has analysed the adoption status of mobile telephones in dairying, and enlisted the constraints as perceived by the dairy farmers. It has also identified the factors affecting adoption of mobile telephones in India through the primary data collected from 360 dairy farmers of four states of north India, viz. Haryana, Punjab, Uttar Pradesh and Uttarakhand. The adoption status has revealed that the majority of respondents have been using mobile phones partially in dairying since 3-6 years, followed by adoption since 0-3 years. A significant difference ( $p < 0.001$ ) has been observed among the respondents across the states with regard to adoption of mobile phones in dairying. The application of multinomial logit model has revealed that the model was highly significant and fit for explanation. The variables 'distance to veterinary institution' or 'animal healthcare centre', 'landholding size' and 'scientific-orientation' were significantly associated with the probability that the respondent will be a full adopter of mobile phone in dairying. The study has recommended that appropriate measures need be adopted for effective use of mobile phones in dissemination of livestock-related information in general and dairying in particular to the farming community.

**Key words:** Dairy sector, livestock technology, multinomial logit model, mobile phones, innovation, adoption status

**JEL Classification:** Q16, Q18

### **Introduction**

Information and communication technology (ICT) has significant potential to help farmers in acquiring and accessing information which can be utilized to enhance agricultural and livestock production. At present, a wide range of ICT platforms is available for accessing and sharing agriculture-related information and knowledge in the forms of web pages, audio, video

and text messaging. Among all the ICT tools, mobile phone has emerged as one of the widely accepted and adopted instruments in most parts of the world to ease the information communication process among the farming community (Hayrol *et al.*, 2009). The increasing penetration of mobile phones and delivery of mobile-enabled information services to the farming community can reduce information asymmetry as well as complement the role of agricultural extension services by saving time, offering instant out-reach and ensuring continuity in information availability (Mittal *et al.*, 2010). On similar lines, Mishra (2010) has also found that the most popular mode of availing information related to agriculture and animal husbandry is the mobile phone, followed closely by radio/

\* Author for correspondence

Email: prakashkumarkr@gmail.com

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**Table 1. Locale of the study**

University selected for study (for scientists and extensionists)	District under study (for dairy farmers)	State
Indian Veterinary Research Institute (IVRI), Izatnagar ( <a href="http://ivri.nic.in/">http://ivri.nic.in/</a> )	Bareilly	Uttar Pradesh
G.B. Pant University of Agriculture & Technology (GBPUA&T), Pantnagar ( <a href="http://www.gbpuat.ac.in/">http://www.gbpuat.ac.in/</a> )	Udham Singh Nagar	Uttarakhand
National Dairy Research Institute (NDRI), Karnal ( <a href="http://www.ndri.res.in/ndri/Design/Index.html">http://www.ndri.res.in/ndri/Design/Index.html</a> )	Karnal	Haryana
Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana ( <a href="http://www.gadvasu.in/">http://www.gadvasu.in/</a> )	Ludhiana	Punjab

television, while Sife *et al.* (2010) have emphasized on the role of mobile phones in accessing market information for agriculture and livestock produce. However, despite huge potential inherent in mobile telephony, there are some critical issues that need to be addressed before scaling up these services.

Although many public and private sector organizations are providing mobile-enabled services in India (GoI, 2015), the role of mobile phones in the dairy sector is still low. Lack of customization of these services to serve specific needs of farmers and lack of operational knowledge are some of the impediments in effectively leveraging the potential of mobile phones (Gakuru *et al.*, 2009; Babu and Asokhan, 2011; Katke and Padamlatha, 2012; Inigo *et al.*, 2014).

In spite of dairy being an important component of agriculture, the adoption of mobile phones by the dairy farmers for information access, is an area which has not received its due attention. Although some authors like Rathod and Chander (2014), have pointed out the importance of mobile telephony in the dairy sector, several initiatives are still to be strengthened by the public and private extension and research organizations for effective delivery of information through mobile phones. In the above context, the present study was carried out with the specific objectives of assessing the adoption status of mobile phones, determining the major constraints perceived by the farmers; and identifying the factors that affect adoption of mobile phone use in Indian dairy sector. Some suggestions of dairy farmers are also given to improve the diffusion and adoption of mobile phone use in Indian dairy sector.

## Materials and Methods

A combination of purposive and multi-stage random sampling was adopted in the study to select

the respondents. Four agricultural / veterinary universities and institutes, which are at the forefront of research in the livestock sector, were selected. All the selected universities / institutes have carried out researches in development of ICT-based information dissemination modules, including mobile telephony. The districts in which these veterinary universities / institutes are situated were thus selected to ascertain the extent of adoption of mobile telephony as a means of accessing information related to dairying. Table 1 presents the names of selected universities / institutes and the districts in which the study was conducted. A total of 6 villages from each district were selected randomly at the rate of three villages from each block. Fifteen farmers having at least two dairy animals were then selected from each village using random and snow ball method. Thus, the ultimate sample size was of 360 farmers from a total of 24 villages in four states of north India.

The primary data were collected by interviewing the selected respondents personally using a pre-tested semi-structured interview schedule and also an open schedule. The reference period for which information was collected was from November, 2013 to June, 2014. The data were also collected through observation method and focussed group discussions held at the villages.

## Analytical Framework

To ascertain the extent of use of mobile phone for getting information related to dairying, respondents were asked to elicit their adoption level on a four-point continuum, viz. 'full adoption' (3), 'partial adoption' (2), 'discontinuation' (1) and 'non-adoption' (0). The responses of the farmers regarding number of years of mobile phone use were categorized into respective

categories, viz. 'adoption since past 0-3 years', 'adoption since past 3-6 years', 'adoption since past 6-9 years' and 'adoption since more than 9 years'. The data collected from sample respondents were coded, tabulated, analyzed and presented in the form of tables. The statistical tools, viz. frequency, percentage, mean, standard deviation and Chi-square test were used for analysis using SPSS version 20.0 package. The socio-personal, economic and psychological characters of dairy farmers were classified into low, medium and high categories based on the mean and the standard deviation.

### Multinomial Logit Model

To identify the factors that influence the respondents' degree of adoption of mobile phone, the multinomial logit model (as used by Pundo and Fraser, 2006) was fitted. The multinomial logit model focused not only on the most important decision (use of mobile phone or not), but also on the degree of adoption of mobile phone in dairying. In the fitted model, the dependent variable assumed three discrete values, viz. 0 (when the respondent did not adopt mobile phone in dairying), 1 (when the respondent partially adopted mobile phone-use in dairying) and 2 (when the respondent fully adopted mobile phone-use in dairying). Given the alternatives before a respondent, the probability that an individual  $i$  choose the alternative  $j$  can be expressed by Equation (1):

$$\Pr[Y_i = j] = \frac{\exp(\beta' jX_i)}{\sum \exp(\beta' jX_j)} \quad \dots(1)$$

where,

$\Pr[Y_i=j]$  = Probability that an individual  $i$  belongs to either 'No adoption', 'Partial adoption' or 'Full adoption' category

$j = 1, 2, 3$

$i = 1, 2, 3, \dots, 360$

$X_i$  = Vector of the predictor variables, and

$\beta_j$  = Vector of the estimated parameters.

The multinomial logit model determines the effect of independent variable on the probability that a farmer will belong to one of the three categories, viz. non-adopter, partial adopter and full adopter. This model was estimated by keeping the dependent variable 0 (i.e.

non-adopter) as the reference category. The  $e^\beta$  was calculated, which gave the odds ratio (OR) associated with change in the independent variables. The odds mean the ratio of probability of happening to probability of not happening of an event. The odds are expressed as single number to the ratio to 1. The odds of 2 associated with partial adoption, for example, means that the likelihood of partially adopting an innovation is twice that of not adopting. Zero-order correlation matrix was obtained to ensure that multi-collinearity did not pose any problem in estimating parameters of the mathematical model. The variables having higher multi-collinearity were dropped in the final model to improve the values of the variables. Table 2 depicts the variables used in the model with their expected signs.

## Results and Discussion

### Socio-personal, Economic and Psychological Characteristics of Dairy Farmers

Table 3 reveals that the majority of dairy farmers in the study area of all the four states, viz. Uttar Pradesh, Uttarakhand, Haryana and Punjab, belonged to the medium age group, ranging from 35 to 61 years and the average age of dairy farmers was 48 years. The majority of dairy farmers in pooled data have been found illiterate, followed by those having education up to high school. The majority (73%) of respondents reported that they pursued both agriculture and animal husbandry as their main source of livelihood. The next major occupation was of agricultural labourers (12%). Dairying as the main source of income was pursued only by 5 per cent of the respondents. These findings are in conformation with earlier studies reporting that animal husbandry is mainly a smallholder phenomenon and is followed predominantly as an adjunct to agriculture under mixed farming system (Sone *et al.*, 2015; Singh *et al.*, 2015; Bhoj *et al.*, 2015).

The pooled data (Table 3) also indicated that the majority of respondents had medium levels of family-size, landholding-size, herd-size, experience in dairying and annual family income. The study also revealed that the majority of farmers did not have any social participation and had medium distance to a veterinary institution or veterinary healthcare centre. It was observed that the majority of the dairy farmers were in medium category in terms of information-seeking

**Table 2. Variables used in multinomial logit model and their expected signs**

Variable	Definition and measurement	Expected sign
Age	Age of respondent (in years)	±
Family size	Total number of members in a household	±
Land	Landholding size of household (in acres)	±
Livestock	Number of livestock owned by household in units	±
Distance	Average distance from veterinary institution or animal healthcare centre (in km)	–
Information sources	Information seeking behaviour of respondent from various sources on three point continuum as ‘frequent’, ‘less frequent’ and ‘never’	±
Decision	Decision-making ability of respondent related to dairy farming on three point continuum as ‘low’, ‘medium’ and ‘high’	±
Scientific	Scientific-orientation of respondent on three point continuum as ‘low’, ‘medium’ and ‘high’	±
Economic	Economic-orientation of respondent on three point continuum as ‘low’, ‘medium’ and ‘high’	±
Risk	Risk-orientation of respondent on three point continuum as ‘low’, ‘medium’ and ‘high’	±
educnew=1	Illiteracy of respondent	–
educnew=2	Education up to 10 years of schooling	±
ocupnew=1	Agriculture as major occupation and animal husbandry as subsidiary occupation of household	±
ocupnew=2	Animal husbandry as major occupation of household	±
partinew=1	No social participation of respondents	–
partinew=2	Respondent is member of at least one social organization	±

behaviour, decision-making ability, scientific-orientation, economic-orientation and risk-orientation. Also, there was a significant difference among the respondents across the states with regards to all the studied variables, except age and family size of the respondents.

The one-way analysis of variance was used to determine if there was significant difference between states for socio-personal, economic and psychological characters of dairy farmers. It was found that there was a significant difference across states for all the studied variables, except age. The higher values for family-size and distance from veterinary institution were observed in Uttar Pradesh vis-à-vis other states. The values for characteristics such as landholding-size, livestock possession, decision-making ability, scientific-orientation, economic-orientation and risk-orientation were found higher in Punjab than in other states (Table 4).

### Adoption of Mobile Phone Use in Dairying

Across all the selected states, the majority (83.3%) of respondents adopted mobile phones in dairying only partially and only a small portion (13.0%) used mobile phones to full extent (Table 5). Although all the farmers possessed a mobile phone, they rarely used it for accessing any information related to animal husbandry or dairying. During the study period, it was also observed that only a few respondents used mobile phones for communicating with the universities / institutes to gather scientific information. Further, very negligible number of respondents received voice or text messages from agricultural or veterinary institutions through their mobile phones. The study also revealed a significant difference ( $p < 0.001$ ) among the respondents across the states with regards to use of mobile phones in dairying which may be due to variations in their socio-economic status, educational level and information-seeking behaviour (Table 5).

**Table 3. Socio-personal, economic and psychological characters of dairy farmers in four selected states**

(N=360)

Variable	Category	State				Pooled	Mean± S.D.	$\chi^2$
		Uttar Pradesh	Uttarakhand	Haryana	Punjab			
Age (years)	Young	22 (24.45)	21 (23.33)	20 (22.22)	19 (21.12)	82 (22.78)	48.20± 13.65	3.75
	Middle	48 (53.33)	52 (57.78)	57 (63.33)	49 (54.44)	206 (57.22)		
	Old	20 (22.22)	17 (18.89)	13 (14.45)	22 (24.44)	72 (20.00)		
Major occupation	Agriculture + Animal husbandry	68 (75.56)	61 (67.78)	70 (77.78)	64 (71.11)	263 (73.06)	31.8**	
	Animal husbandry	03 (03.33)	01 (01.11)	06 (06.67)	09 (10.00)	19 (5.28)		
	Business	05 (05.56)	05 (05.56)	05 (05.56)	08 (8.89)	23 (6.39)		
	Government service	01 (01.11)	03 (03.33)	01 (01.11)	06 (06.67)	11 (3.05)		
	Labour	13 (14.44)	19 (21.11)	08 (08.88)	03 (03.33)	43 (11.94)		
	Any other	0 (0)	01 (01.11)	0 (0)	0 (0)	01 (0.28)		
	Family size (No.)	Small	06 (06.67)	09 (10.00)	15 (16.67)	05 (5.55)		
Medium	71 (78.89)	73 (81.11)	64 (71.11)	77 (85.56)	285 (79.17)			
Large	13 (14.44)	08 (8.89)	11 (12.22)	08 (8.89)	40 (11.11)			
Landholding size	Landless	09 (10.00)	17 (18.89)	02 (02.22)	03 (03.33)	31 (08.61)	4.83± 5.87	42.2**
	Small	26 (28.89)	16 (17.78)	18 (20.00)	08 (08.89)	68 (18.89)		
	Medium	52 (57.78)	50 (55.55)	62 (68.89)	62 (68.89)	226 (62.78)		
	High	03 (03.33)	07 (07.78)	08 (08.89)	17 (18.89)	35 (09.72)		
Livestock possession (livestock units)	Low	02 (02.22)	01 (01.11)	03 (03.33)	01 (01.11)	07 (01.94)	4.59± 3.55	25.0**
	Medium	78 (86.67)	86 (95.56)	75 (83.34)	64 (71.11)	303 (84.17)		
	High	10 (11.11)	03 (03.33)	12 (13.33)	25 (27.78)	50 (13.89)		
Social participation	Nil	48 (53.34)	58 (64.44)	56 (62.23)	16 (17.78)	178 (49.44)	63.4**	
	One organization	36 (40.00)	26 (28.89)	31 (34.44)	62 (68.89)	155 (43.06)		

Contd...



**Table 3. Socio-personal, economic and psychological characters of dairy farmers in four selected states — Contd**

(N=360)

Variable	Category	State				Pooled	Mean± S.D.	$\chi^2$
		Uttar Pradesh	Uttarakhand	Haryana	Punjab			
	Two or more organization	03 (3.33)	06 (6.67)	03 (3.33)	12 (13.33)	24 (06.67)		
	Public leader	03 (3.33)	0 (0)	0 (0)	0 (0)	3 (0.83)		
Distance from veterinary institution	Small	0 (0)	0 (0)	30 (33.33)	45 (50.0)	75 (20.83)	4.27± 5.05	187.7**
	Medium	60 (66.67)	90 (100.0)	60 (66.67)	45 (50.0)	255 (70.84)		
	Long	30 (33.33)	0 (0)	0 (0)	0 (0)	30 (8.33)		
Information seeking behaviour	Low	31 (34.45)	24 (26.67)	12 (13.33)	02 (2.22)	69 (19.16)	19.37± 1.92	56.3**
	Medium	55 (61.11)	58 (64.44)	65 (72.22)	59 (65.56)	237 (65.84)		
	High	04 (4.44)	08 (8.89)	13 (14.45)	29 (32.22)	54 (15.0)		
Decision-making ability	Low	33 (36.67)	20 (22.22)	18 (20.0)	12 (13.33)	83 (23.06)	21.59± 2.55	18.0**
	Medium	51 (56.67)	59 (65.56)	56 (62.22)	62 (68.89)	228 (63.33)		
	High	6 (6.66)	11 (12.22)	16 (17.78)	16 (17.78)	49 (13.61)		
Scientific-orientation	Low	51 (56.67)	16 (17.78)	06 (6.67)	0 (0)	73 (20.28)	14.22± 1.73	127.6**
	Medium	38 (42.22)	55 (61.11)	55 (61.11)	49 (54.44)	197 (54.72)		
	High	1 (01.11)	19 (21.11)	29 (32.22)	41 (45.56)	90 (25.0)		
Economic-orientation	Low	30 (33.33)	29 (32.22)	18 (20.0)	0 (0)	77 (21.39)	12.94± 1.72	83.7**
	Medium	56 (62.22)	56 (62.22)	46 (51.11)	48 (53.33)	206 (57.22)		
	High	4 (4.45)	5 (5.56)	26 (28.89)	42 (46.67)	77 (21.39)		
Risk-orientation	Low	26 (28.89)	31 (34.45)	22 (24.44)	0 (0)	79 (21.94)	11.52± 1.28	67.0**
	Medium	54 (60.0)	56 (62.22)	44 (48.89)	53 (58.89)	207 (57.50)		
	High	10 (11.11)	03 (3.33)	24 (26.67)	37 (41.11)	74 (20.56)		

Note: Figures within the parentheses indicate percentage in each variable

**Table 4. Analysis of variance for socio-personal, economic and psychological characteristics of dairy farmers in selected four states**

Characteristics	(N=360)				F-statistic
	Uttar Pradesh Mean $\pm$ SD	Uttarakhand Mean $\pm$ SD	Haryana Mean $\pm$ SD	Punjab Mean $\pm$ SD	
Age	48.17 $\pm$ 14.34	48.43 $\pm$ 13.50	47.93 $\pm$ 12.67	48.26 $\pm$ 14.27	0.02 <sup>NS</sup>
Family-size	9.40 $\pm$ 5.78 <sup>a</sup>	7.63 $\pm$ 3.09 <sup>b</sup>	8.04 $\pm$ 3.88 <sup>b</sup>	8.13 $\pm$ 2.96 <sup>b</sup>	3.14*
Landholding- size	3.46 $\pm$ 4.07 <sup>b</sup>	3.83 $\pm$ 4.75 <sup>b</sup>	4.61 $\pm$ 4.65 <sup>b</sup>	7.42 $\pm$ 8.30 <sup>a</sup>	8.89**
Livestock possession	4.25 $\pm$ 4.11 <sup>b</sup>	3.71 $\pm$ 1.93 <sup>b</sup>	4.30 $\pm$ 3.22 <sup>b</sup>	6.14 $\pm$ 4.07 <sup>a</sup>	8.50**
Distance from veterinary institution	9.00 $\pm$ 7.48 <sup>a</sup>	4.33 $\pm$ 2.15 <sup>b</sup>	2.59 $\pm$ 2.36 <sup>c</sup>	1.17 $\pm$ 1.35 <sup>d</sup>	61.51**
Decision-making ability	20.57 $\pm$ 2.86 <sup>c</sup>	21.49 $\pm$ 2.29 <sup>b</sup>	21.88 $\pm$ 2.53 <sup>ab</sup>	22.41 $\pm$ 2.19 <sup>a</sup>	8.86**
Scientific-orientation	12.54 $\pm$ 1.35 <sup>d</sup>	14.11 $\pm$ 1.60 <sup>c</sup>	14.79 $\pm$ 1.46 <sup>b</sup>	15.43 $\pm$ 0.97 <sup>a</sup>	74.20**
Economic- orientation	12.06 $\pm$ 1.22 <sup>c</sup>	12.18 $\pm$ 1.35 <sup>c</sup>	13.20 $\pm$ 1.92 <sup>b</sup>	14.34 $\pm$ 1.24 <sup>a</sup>	47.91**
Risk-orientation	11.13 $\pm$ 1.08 <sup>c</sup>	10.89 $\pm$ 0.88 <sup>c</sup>	11.70 $\pm$ 1.53 <sup>b</sup>	12.36 $\pm$ 1.05 <sup>a</sup>	28.40**

Notes: The means bearing different superscripts (a, b, c and d) differ significantly in the same row.

\* and \*\* depict significance at 5 per cent and 1 per cent levels, respectively

**Table 5. Adoption status of mobile phones at field conditions (N=360)**

Adoption category	State				Pooled	$\chi^2$
	Uttar Pradesh	Uttarakhand	Haryana	Punjab		
Non-adoption	07 (7.78)	05 (5.55)	01 (1.11)	0 (0)	13 (3.61)	25.1**
Partial adoption	79 (87.78)	77 (85.56)	75 (83.33)	69 (76.67)	300 (83.33)	
Full adoption	04 (4.44)	08 (8.89)	14 (15.56)	21 (23.33)	47 (13.06)	

Notes: Figures within the parentheses indicate percentage of the state; No respondent in all the four states belonged to the 'Discontinued' adopter category.

Inigo *et al.* (2014) have reported that dairy farmers in Tamil Nadu used mobile phones for seeking information related to animal husbandry and dairying, while Mittal and Tripathi (2009) have revealed that mobile phones were being used primarily for social purposes and occasionally for agricultural activities. The study has also pointed out that information regarding seeds was the most frequently accessed information, followed by the market price of various agro-commodities.

#### Adoption Period of Mobile Phone in Dairying

An attempt was also made to categorize the mobile phone users according to the number of years they have been using this tool in dairying and the results are presented in Table 6. The majority of respondents adopted the innovation during 3-6 years (59.4%) prior to the date of survey, followed by adoption during past 0-3 years (25.2%) and 6-9 years (10.2%). The mobile

phones were normally used to contact the veterinarians for treatment of animals, while few farmers in Haryana and Punjab received text or voice messages from universities or institutions. This variation in the level of mobile phone adoption might be due to variations in their educational level and economic status and information access in the study areas leading to a significant difference ( $p < 0.001$ ) among respondents across the states in the use of mobile phones in dairying (Table 6). Inigo *et al.* (2014) have reported that dairy farmers in Tamil Nadu used mobile phones for seeking information related to animal husbandry and dairying, but faced the constraints of language and network coverage in effective utilization of mobile phone-enabled services.

#### Reasons for Adoption of Mobile Phone in Dairying

The reasons for adoption of mobile phone in dairying in the study area were identified during group



**Table 6. Adoption period of mobile phone in dairying (N=360)**

Adoption period category	State				Pooled	$\chi^2$
	Uttar Pradesh	Uttarakhand	Haryana	Punjab		
Non-adoption	07 (7.78)	05 ( 5.55)	01 (1.11)	0 ( 0)	13 (3.61)	
0-3 years	30 (33.33)	21 ( 23.34)	22 (24.44)	18 (20.0)	91 (25.27)	
3-6 years	51 (56.66)	54 ( 60.0)	56 (62.23)	53 (58.89)	214 (59.44)	32.4**
6-9 years	02 (2.22)	08 ( 8.89)	10 (11.11)	17 (18.89)	37 (10.28)	
More than 9 years	0 (0)	02 ( 2.22)	01 (1.11)	02 (2.22)	05 (1.39)	

Note: Figures within the parentheses indicate percentage in a state

discussions and are enlisted below.

- Easy to operate and handle
- Can receive credible information through text or voice message
- Competitive price for maintenance of a mobile phone
- Compatibility to receive text messages in the local language
- Experts can be contacted as per convenience
- Veterinarian or expert can be approached in emergencies
- The retailers/input dealers can be contacted
- Mobile phones use by default for dairy or animal husbandry activities

According to Jensen (2007), introduction of mobile phones to Kerala fishermen decreased price dispersion and wastages by facilitating the spread of information which could make the markets more efficient by reducing risk and uncertainty. Wankhade *et al.* (2009) and Naik *et al.* (2012) have also reported that increased penetration of mobile phones and mobile phone-enabled information services to the farming community reduced the information asymmetry and could complement the role of extension services as it saved time, effort and cut steps of extension process.

#### Reasons for Different Adoption Levels of Mobile Phone in Dairy Sector

The reasons for partial adoption/ discontinuation and non-adoption of mobile phones in the dairy sector,

as perceived by respondents, are listed below.

- Illiteracy/ low educational level
- Poor and disrupted power supply
- Operational difficulties
- High maintenance cost
- Lack of mobile phone compatibility to receive SMS in local language
- Lack of immediate interaction for better understanding
- Human element is missing
- Lack of practical exposure

With regard to the use of mobile phones in dairying, Mittal and Tripathi (2009) have pointed out that although mobile phone act as a catalyst to improve farm productivity and rural incomes, the quality, timeliness and trustworthiness of information were the three important aspects that required special focus to meet the needs and expectations of the farmers. Inigo *et al.* (2014) have reported that dairy farmers in Tamil Nadu faced the constraints of language and network coverage in effective utilization of mobile phone-enabled services in animal husbandry and dairying. Sharma and Arya (2005) have found that high cost, domination of English language, and complexity of information were the major constraints of mobile phone-use in animal husbandry and dairying.

#### Identification of Factors Influencing Mobile Phone Use in Dairying

The factors that significantly influenced the respondents' likelihood of belonging to any one of

adopter categories of mobile phones in dairying (viz. non-adopter, partial adopter and full adopter), were identified using the multinomial logit model and the results of this analysis are presented in Table 7. The

Chi-square value of 65.8 showed that likelihood ratio statistic are highly significant ( $p < 0.001$ ), suggesting that model was a good fit for explanation. The variables significantly associated with the probability that the

**Table 7. Identification of factors influencing mobile phone-use in dairying using multinomial logit model**

N = 360

Variable	Partial adoption			Full adoption		
	$\beta$ (S.E)	Wald	Odds ratio	$\beta$ (S.E)	Wald	Odds ratio
Intercept	25.189 (1692.45)	0		7.012 (664.161)	0	
Age	-0.003 (0.026)	0.015	0.997	-0.011 (0.029)	0.139	0.989
Family size	-0.155 (0.072)	4.613	0.856	-0.091 (0.079)	1.331	0.913
Landholding- size	0.28 (0.197)	2.007	1.323	0.277* (0.199)	1.93	1.319
Herd-size	0.096 (0.131)	0.535	1.101	0.133 (0.138)	0.926	1.142
Distance	-0.019 (0.059)	0.106	0.981	-0.123* (0.078)	2.496	0.884
Information sources	0.065 (0.29)	0.051	1.067	0.302 (0.305)	0.983	1.352
Decision-making ability	-0.197 (0.16)	1.513	0.821	-0.217 (0.175)	1.542	0.805
Scientific-orientation	0.408 (0.272)	2.26	1.504	0.395* (0.304)	1.696	1.485
Economic-orientation	0.24 (0.314)	0.584	1.271	0.176 (0.34)	0.268	1.193
Risk-orientation	-0.168 (0.432)	0.152	0.845	-0.178 (0.459)	0.15	0.837
Educational level 1	-12.107 (664.114)	0	5.52E-06	-12.175 (664.115)	0	5.16E-06
Educational level 2	-10.55 (664.115)	0	2.62E-05	-9.485 (664.115)	0	7.60E-05
Main occupation-1	1.291 (0.74)	3.042	3.638	0.903 (0.841)	1.151	2.466
Main occupation-2	0.201 (1.518)	0.018	1.223	0.552 (1.618)	0.116	1.737
partinew=1	-13.947 (1556.699)	0	8.77E-07	-1.077 (0.798)	1.821	0.341
partinew=2	-13.936 (1556.698)	0	8.87E-07	-1.123 (0)	.	0.325
Wald chi <sup>2</sup>			65.8			
Nagelkerke R <sup>2</sup>			0.25			
log pseudo likelihood			763.65			

Notes: Figures within the parentheses indicate standard errors

\*, \*\* and \*\*\* denote significance at 10 per cent, 5 per cent and 1 per cent levels, respectively

respondent will be a full adopter of mobile phone in dairying were: 'distance to veterinary institution' or 'animal healthcare centre' ( $P < 0.10$ ), landholding-size ( $P < 0.10$ ) and scientific-orientation ( $P < 0.10$ ). The sign of regression coefficient for the variable 'distance to veterinary institution' was negative while for other two variables, viz. landholding-size and scientific orientation, was positive. The landholding-size was positively associated with full adoption of mobile phone, implying that with increase in landholding-size, the farmers moved towards increased adoption level of mobile phones and continued to be in full adoption category. The probability of full adoption increased by 31.9 per cent with an increase of one unit in landholding-size. This indicated that farmers would be more interested to use mobile phones in dairying if their landholding-size increases.

The negative sign associated with the variable 'distance to veterinary institution' in case of full adoption indicated that as the distance to a veterinary institution increased, the probability of full adoption of mobile phone in dairying decreased and that of partial and non-adoption increased. The longer distance to veterinary institution implied lesser chance of contact with livestock extension functionaries, which probably explained the negative association of distance from veterinary institution with higher degree of adoption of this innovation.

The odds ratio associated with the variable 'distance to veterinary institution' suggested that with one kilometre increase in distance to veterinary institution, the likelihood of full adoption of mobile phone decreased by 88.4 per cent. The scientific-orientation of the farmers was positively associated with full adoption, implying that with increase in scientific-orientation, the farmers moved towards increased adoption level and continued to be in full adoption category. The probability of full adoption increased by 48.5 per cent with increase of one unit in scientific-orientation. The earlier studies have reported that the number of contacts with extension officers, as a proxy measure for access to agricultural information, positively contributed to awareness generation and subsequent adoption of new technologies (Adesina *et al.*, 2000; Yirga, 2007). This factor indicated the fact that poor information sources and less contact with extension sources led to poor adoption of innovations.

### Farmers' Suggestions for Effective Use of Mobile phones in Dairying

The dairy farmers had various problems with the existing innovations and hence, they demanded support from different stakeholders like research and extension institutes, government departments, etc. Following are the suggestions of dairy farmers for effective use of mobile phones in the dairy sector.

- Regular supply of power in villages
- Educating the farmers for mobile phone operation
- Low/nominal maintenance cost
- Evolving a process for a direct contact with the experts
- Mobile phone compatibility to receive messages in local language
- Immediate interaction for better understanding must be made more effective
- Engage educated rural youths to provide practical exposure and training on mobile phone use

### Conclusions

The study has revealed that the majority of respondents use mobile phones only partially in dairying and a small portion has their full adoption in the study area. The majority of respondents have adopted mobile phones in dairying during the past 3-6 years, followed by since 0-3 years. The variables 'distance to veterinary institution', 'animal healthcare centre', landholding-size and 'scientific-orientation' have been found significantly associated with the probability that the respondent will be a full adopter of mobile phone in dairying. Since the farmers faced various problems leading to lesser use of mobile phones in dairying, there is a need to address them for increasing the use of mobile phones in dairying. The study has also recommended that effective use of mobile phones may be popularised for dissemination of livestock-related information in general and dairying in particular in India to the farming community.

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