Journal of Agriculture and Rural Development in the Tropics and Subtropics
Vol. 117 No. 1 (2016) 1–10

urn:nbn:de:hebis:34-2015111749373 ISSN: 2363-6033 (online); 1612-9830 (print) – website: www.jarts.info

Identifying the factors governing attitude towards the e-Agriservice among dairy farmers in Maharashtra, India

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Abstract

Information and communication technology (ICT) projects have a great potential to revolutionise the information delivery system by bridging the gap between farmers and extension personnel. aAQUA (Almost All Questions Answered) portal was launched by the Developmental Informatics Laboratory (DIL) at Indian Institute of Technology (IIT) Mumbai, Maharashtra, India in 2003 as an information providing system to deliver technology options and tailored information for the problems and queries raised by Indian dairy farmers. To measure the effectiveness of this service the attitudinal dimensions of the users of aAQUA e-Agriservice were investigated using a 22 item scale. A simple random sampling technique was used to select 120 dairy farmers from which data were collected and subjected to factor analysis to identify the underlying constructs in this research. From the attitude items, four components were extracted and named as the *pessimistic, utility, technical* and *efficacy perspective*, which influenced the development of varied level of attitudinal inclination towards the e-Agriservice. These components explained 64.40 per cent of variation in the attitude of the users towards the aAQUA e-Agriservice. This study provides a framework for technically efficient service provision that might help to reduce the pessimistic attitude of target population to adopt e-Agriservice in their farming system. The results should also be helpful for researchers, academics, ICT based service providers and policy makers to consider these perspectives while planning and implementing ICT projects.

Keywords: attitude scale, aAQUA e-Agriservice, Likert's scaling technique, Principal Component Analysis (PCA)

1 Introduction

In agriculture the integration of Information and Communication Technologies (ICTs) has been assumed to have the potential to revolutionise the information delivery system towards the farmer in many developing countries. In recent years, the government of India initiated many ICT projects in agriculture to enrich the knowledge and tackled information asymmetry problems of farming community. *The services (like weather and marketing services, input and output price information, good agricultural and dairy farming practices, inputs availability, and government subsidies and schemes) provided by ICT tools via internet in online as well as offline mode to the target group, is called as 'e-Agriservice'.* The e-Agriservice uses the power of global computer networks and telecommunication networks, which help to gather, transfer, transform, store, retrieve and disseminate information and knowl-

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Published online: January 15, 2016

edge among different stakeholders. The service provides information on different aspects of farming like crop planning as per market demand, best management practices for crops, animal husbandry, and dairy, input and output prices, sector wise availability of subsidies, weather and market services, which save information searching time and acts as an effective medium of empowerment of farmers through efficient knowledge sharing. Thus, it helps to strengthen the linkages between research-extension-farmers by providing timely and location based information. ICT radically change the ways in which knowledge and information are constructed (Bolter, 2001; Brunner, 1992; Logan, 1995).

aAQUA e-Agriservice is one such ICT based project, launched by the Developmental Informatics Laboratory (DIL) at Indian Institute of Technology, Mumbai in collaboration with the Farm Science Centre (*Krishi Vigyan Kendra*, KVK), Baramati and Vigyan Ashram (NGO), Pabal, Maharashtra in 2003 as an information providing system to deliver technology options and tailored information for the problems and queries raised by Indian dairy farmers. It is capable of multi-lingual retrieval in 3 Languages spoken among Indian farmers – Marathi, Hindi and English, allowing the registered users (anybody can register freely) to search, ask, see and/or select agricultural keywords on the database. In addition to this, they get information on crop, livestock, government schemes and subsidies, weather and market information for proper planning and management of their farms. The field engineer prints the new queries, allocate these to the Farm Science Centre's (KVK-Baramati) extension personnel on the basis of their area of expertise, get the answers and upload these on aAQUA. It normally provides answers to farmers queries (agri-dairy-livestock and other related) within 24 to 48 hours depending on its difficulty. After the queries are answered and uploaded on aAQUA, the kiosk operators or the users can check these. With this the farmers' query resolving process is completed (Ramamritham *et al.*, 2011).

Many of such ICT initiatives are implemented in rural India, to deploy ICT based services for farming communities and thereby strengthening the research-extension system (Saravanan, 2012). However, the information must be relevant and meaningful to farmers, in addition to being packaged and delivered in a way preferred by them (Diekmann *et al.*, 2009). Context-specific information has higher impacts on the adoption of technologies and increases farm productivity for marginal and small agricultural landholders (Samaddar, 2006). So, it is of importance to investigate whether the psychological traits like attitude and perception of farmers can influence the utilisation of the e-Agriservice rendered by public and private functionaries.

An attitude refers to one's positive or negative opinion about a concrete subject. Attitudes are learnt; they are mouldable and may change with experience of the stimulus objects and with social rules or institutions (Binder & Niederle, 2006). Ajzen (1988) described an attitude as a predisposition to respond favourably or unfavourably to an object, person, or event. Attitude toward ICT usage has been defined as a person's general evaluation or feeling towards ICT and specific computer and internet related activities (Smith *et al.*, 2000). Li (2002) has pointed to a wide range of factors affecting attitude toward ICT. The variations in the factors identified by different researchers might be attributed to differences in the context, participants, and type of research. A Positive attitude towards ICTs is widely recognized as a necessary condition for their effective implementation (Woodrow, 1992). Therefore there is need to explore the attitude of farming communities towards a particular technological intervention (e.g. aAQUA e-Agriservice). Therefore a study was conceptualised to identify factors governing attitude towards the aAQUA e-Agriservice.

2 Materials and methods

2.1 Sampling

The Maharashtra state situated in the western part of India was purposively selected for the present study as the aAQUA e-Agriservice was launched as a pilot project in this state in 2003 and still continues to deliver its services to the farmers of this state (www.aaqua.org). Four out of eight pilot districts (*Pune, Nasik, Jalna* and *Amravati*) were selected randomly. Using the list of users from the service provider of aAQUA (Presently Agrocom Software Technologies Pvt. Ltd., Mumbai), thirty users (who asked at least one query per season to the aAQUA e-Agriservice and rearing at least five dairy animals) from each district were randomly identified and surveyed using pre-tested interview schedule. Thus, a total of 120 respondents were considered for the data collection and subsequent analysis.

2.2 Instrument

The items used to measure the attitude of dairy farmers towards aAQUA e-Agriservice (i.e. attitudes scale) were developed based upon discussions with the extension professionals, ICT experts, from reviewed literature

as well as on author's own experience and knowledge on the basis of criteria given by Edwards (1957). These items were further assessed and modified based on the summated rating scaling technique as suggested by Likert (1932). One benefit of the summated rating scale is its ability to represent the multiple aspects of a concept in a single measure (Hair Jr. *et al.*, 2006). The items were pre-tested by administering these to 60 agricultural extension scientist, to indicate their degree of agreement or disagreement on each item using a three point continuum *'Agree'*, *'Uncertain'* and *'Disagree'* with scoring 3, 2, and 1, respectively for positive items and vice-versa for negative items. Finally, twenty two items were selected based on an item analysis of the pre-test (i.e. based on the 't' value equal to or greater than 1.75).

2.2.1 Data Analysis

The scale containing 22-items was administered to the 120 users of the aAQUA e-Agriservice. The subjects were asked to respond using a five-point scale (strongly agree, agree, neutral, disagree, and strongly disagree). The score 1 represented the option "strongly disagree" while score 5 on the scale represented the category "strongly agree". Out of 22 items, 10 of the items were negatively worded and the rest were positively worded (see Appendix 1). For the analysis of the data, all negatively worded items were reversed so that a higher numbered response on the Likert scale would represent positive attitude. Thus, the overall possible minimum and maximum scores of users ranged from 22 to 110.

2.3 Factor Analysis

The item wise score of each respondent with their cumulative score was subjected to factor analysis by Principal Component Analysis (PCA) method using SPSS statistics 20.0. Factor analysis is a technique for identifying groups or clusters of variables towards any object (Field, 2005). The items were used for assessing factors governing attitude of users' towards the e-Agriservice related to one another for the i^{th} respondent in a general form as follows:

$$Y_e = \sum_{f=1}^{n} a_{e,f} X_f; \quad f = 1, 2, \ldots, n$$

Where,

Y_e : Attitude of e^{th} respondent
$a_{e,f}$: Assessment of the f^{th} item by e^{th} respondent
X_f : f^{th} item
n : Number of items

Prior to performing factor analysis, test of sample adequacy was done through Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. The KMO test is the measure of sampling adequacy, which varies between 0 and 1. The values closer to 1 are better and the value of 0.6 is the suggested minimum. Further Bartlett's test of sphericity confirms the adequacy of the sample population by testing the null hypothesis that the variables in the population correlation matrix are uncorrelated and inadequate.

Null Hypothesis (H0): There is no statistically significant interrelationship between factors affecting the attitude of users towards e-Agriservice.

Alternate Hypothesis (H1): There may be a statistically significant interrelationship between factors affecting the attitude of users towards e-Agriservice.

The Bartlett's test of sphericity had the p-value (Sig.) of $0.000 < 0.01$, which indicated that the sample population was adequate so the null hypothesis was rejected and accepted the alternate hypothesis (H1) that there may be statistically significant interrelationship between factors. The KMO and Bartlett's test measure of sampling adequacy was used to examine the appropriateness of Factor Analysis. The approximate of Chi-square was 1767.737 with 231 degrees of freedom, which is significant at 0.01 level of significance. The KMO statistic is greater than 0.60 (0.825). Thus, the data was suitable and supports the factorability of the correlation matrix.

3 Results and discussion

Table 1 show the demographic characteristics of the users of the aAQUA e-Agriservice in Maharashtra, western part of India. These include age, education, occupation, farming experience, land holding, herd size, annual income, and mass media exposure. One third of the users (26.67 %) were between 36 to 40 years, 34 per cent were educated up to secondary level and 39 per cent had a dairy farming and agriculture as their main occupation. Most of the users (45 %) had 14 to 18 numbers of herd size, includes cattle and buffalo. Furthermore, 29 per cent of the users had 10 to 14 years of farming experience, and 34 per cent possessed less than 1.34 ha of land while 29 per cent had Rs. 47,814 to 65,921 of annual income. Most users had access to print and electronic media for getting farming and related information, as two third of the respondents had medium to very high level of mass media exposure.

Table 1: *Demographic characteristics of the users of the e-Agriservice (n=120)*

Sl. No.	*Variable*	*Category*	*Percentages*
1	Age (Years)	Less than 35	24.17
		36–40	26.67
		41–45	25.83
		46–53	13.33
		More than 54	10.00
2	Education	Primary (1^{st} – 5^{th} Standard)	5.00
		Middle (6^{th}–8^{th})	16.67
		Secondary (9^{th}–10^{th})	34.17
		Higher secondary(11^{th}–12^{th})	33.33
		Graduate and above	10.83
3	Occupation	Dairy farming	32.50
		Dairy farming + Agriculture	39.17
		Dairy farming + Business	20.00
		Dairy farming + Agril. labourer	8.33
4	Farming Experience (Years)	Less than 9	28.33
		10–14	29.17
		15–18	18.33
		19–24	17.50
		Above 25	6.67
5	Land Holding (ha)	Less than 1.34	34.17
		1.35–3.42	23.33
		3.43–5.60	19.17
		5.61–9.08	19.16
		Above 9.09	4.17
6	Herd Size (Numbers)	Less than 8	7.50
		9–13	22.50
		14–18	45.00
		19–20	5.83
		Above 21	19.17
7	Annual Income (Rs.)	Less than 33,557	13.33
		33,558 to 47,813	17.50
		47,814 to 65,921	29.17
		65,922 to 83,776	22.50
		Above 83,777	17.50
8	Mass Media Exposure	Very Low (< 9)	9.17
		Low (10–12)	24.17
		Medium (13–15)	30.00
		High (16–18)	20.83
		Very High (> 19)	15.83

3.1 Factor Analysis

The descriptive statistics shown in Table 2 present the means, standard deviations and communalities of the rating of the attitude towards e-Agriservice for each of the items or variables (see also appendix 1). For example, "the e-Agriservice improves the efficiency of extension workers (IMPRVEFF)" and "It is the best means to collect information on market prices of agricultural and non-agricultural products (MRKTPRINFO)" were the most important items that influence the users to use this e-Agriservice. These items had the highest mean of 4.41 and 4.22 respectively. The standard deviation (SD) for "the e-Agriservice facility is a time consuming activity (TMCNSA)" found to be 1.19, which shows that users differed in their opinion about total time requirement in availing the e-Agriservice facility while for the items "MRKTPRINFO" the SD was 0.62, meaning users had similar opinion on the appropriateness of marketing information provided by the e-Agriservice.

The communalities of the attitude items show how much of the variance of the items has been accounted for by the extracted components. Items with high values are well represented in the common factor space, while items with low values (< 0.4) are not well represented (Bryant & Yarnold, 1995; Loehlin, 2004). For instance 80 per cent of the variance in "the e-Agriservice does not improve the knowledge regarding different aspects of dairy farming (NTIMPRVKNW)" is accounted for, while only 47 per cent of the variance in "the service provider helps to retain and attract new users with the efficient mobilisation of its activities (SERPROV)" is accounted for.

Table 2: *Descriptive statistics of raw scores on attitude scale items (n=120; 5-point scale)*

Sl. No.	*Variable* †	*Mean*	*SD*	*Communalities*
1 *	TMCNSA	3.58	1.19	.756
2 *	PROPAGANDA	3.25	1.18	.650
3 *	COTHERSER	3.72	1.04	.690
4 *	EAGSSTOP	3.89	1.10	.749
5 *	NTLOCSP	3.92	1.09	.731
6	DEVESFREL	3.91	0.94	.702
7	CONTWRK	3.86	0.99	.594
8	MRKTPRINFO	4.22	0.62	.634
9	GNRTEMPLY	3.14	1.06	.620
10	IMPRVEFF	4.41	0.77	.526
11	WEATHERSERS	3.79	1.06	.526
12 *	NTRELWRTHY	3.52	1.20	.786
13 *	NTIMPRVKNW	3.90	1.08	.802
14 *	TCHSVYPB	3.40	1.26	.548
15	DEVECAPA	3.73	1.00	.692
16	IMPRSTNDLV	3.87	0.90	.621
17	SERPROV	3.44	1.05	.478
18	ALTERNATEP	3.68	1.07	.725
19 *	ALNTSLVPRB	3.40	1.23	.620
20	EFFECTW	3.81	0.77	.635
21 *	INTUNAOBCT	3.83	0.92	.485
22	ANSWTM	3.83	1.02	.599

Note: * Negative items
† the explanation of variables is mentioned in App. 1

The eigenvalues ≥ 1 were considered for the number of components to be generated. The eigenvalues associated with each component represent the variance explained by that particular linear component (Field, 2005). Table 3 shows all the factors extractable from the analysis along with their eigenvalues, the percent of variance attributable to each factor, and the cumulative variance of the factor and the previous factors. The eigenvalues of the first four components from the principal component analysis were larger than 1 i.e. 8.88, 2.28, 1.82 and 1.19, respectively. The variance explained by these four components were 40.36, 10.37, 8.25 and 5.41, per cent respectively. All the remaining components were not significant. The first component accounted for the highest variance (and hence had the highest eigenvalue) and the next component accounted for as much of the left over variance as it could, and so on. Thus, these four components accounted for 64.40 per cent of variance which is regarded as satisfactory in social sciences (Hair Jr. *et al.*, 2006).

3.2 The Extracted Factor Loading by Variamax Rotation

In order to obtain a meaningful representation of items and factor mapping along the principal axis, the resulted principal component was rotated using orthogonal transformation by varimax. The items with loadings equal to or greater than 0.4 were considered meaningful and extracted for factor analysis (Field, 2005). Table 4 reveals how the item analysis reduced the original 22 items to four independent constructs. The results show that the factor loadings ranging from 0.718 to 0.777 were substantially loaded on the component 1 subscale, from 0.477 to 0.778 on the component 2 subscale, from 0.519 to 0.800 on the component 3 subscale and from 0.478 to 0.711 on the component 4 subscale.

The behaviour of individual items in relation to others within the same subscale provides good evidence for content validity because the highest factor loading is central to the domains assessed by these subscales (Francis *et al.*, 2000). Table 4 depicts the factor loadings after VARIMAX rotation which is shown under four components.

Table 4: *Varimax rotated component matrix score for variables*

Variable *	*Component*			
	1	2	3	4
TMCNSA	.777			
PROPAGANDA	.768			
COTHERSER	.755			
EAGSSTOP	.743			
NTLOCSP	.718			
DEVESFREL		.778		
CONTWRK		.729		
MRKTPRINFO		.654		
GNRTEMPLY		.637		
IMPRVEFF		.567		
WEATHERSERS		.477		
NTRELWRTHY			.800	
NTIMPRVKNW			.720	
TCHSVYPB			.681	
DEVECAPA			.620	
IMPRSTNDLV			.587	
SERPROV			.519	
ALTERNATEP				.711
ALNTSLVPRB				.696
EFFECTW				.650
INTUNAOBCT				.511
ANSWTM				.478

Note: * the explanation of variables is mentioned in App. 1

Table 3: *Total variance explained by the generated principal components*

Component	*Initial Eigenvalues*			*Extraction Sums of Squared Loadings*			*Rotation Sums of Squared Loadings*		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	8.88	40.36	40.36	8.88	40.36	40.36	4.30	19.53	19.53
2	2.28	10.37	50.73	2.28	10.37	50.73	3.58	16.29	35.82
3	1.82	8.25	58.98	1.82	8.25	58.98	3.55	16.14	51.96
4	1.19	5.41	64.40	1.19	5.41	64.40	2.74	12.43	64.40

3.2.1 Component 1 – Pessimistic Perspective

In this case the mean score for negative items found to be 3.76, indicates that dairy farmers disagreed with the negative worded items, which means this process consumes less time of users to solve the farming queries rather than searching/ finding solutions from any other sources. They did not face any problems to avail and use this service. The adoption of mobile telephony by farmers helped to reduce their information searching, transportation and transaction costs (Aker & Mbiti, 2010; Bhatnagar, 2008; de Silva & Ratnadiwakara, 2008; Jensen, 2007). Thus most of the negative items fell in component 1 having strong correlation with each other. Hence it was named *'pessimistic perspective'* (items 1 to 5 as mentioned in App. 1). It explains 40.36 per cent of the variability on the attitude of users towards the e-Agriservice. This component suggest the service provider should pay attention to loopholes of technology and make it more user friendly by providing timely & location specific solutions to the problems and establishing kiosks (computer based system to access the information through e-Agriservice) in cluster of villages to provide easy accessibility and affordability. The need based and hassles free information flow contributed immensely in developing positive attitude towards the e-Agriservice and to attract new users & retain the existing users.

3.2.2 Component 2 – Utility Perspective

Most of the positive items explaining the usefulness of the e-Agriservice fell in component 2, therefore it was named *'utility perspective'* (items 6 to 11). It explains 10.37 per cent of the variability on the attitude of users towards the e-Agriservice. It provides the market and weather information to plan the farming activities, by making them self-reliant for getting timely information and thereby makes them knowledge empowered, which leads to improving the efficiency of extension workers in reaching a large number of farmers with less effort. CTA (2007) and Jenson *et al.* (2004) have shown that farmers with access to market information obtain higher farm prices. Similarly, Raj *et al.* (2011) conducted action research in Nagapattinam district in the state of Tamil Nadu, India using intervention of mobile technology and found that the net income of the intervention farmers was 15.2 % higher than that of the control group. Uphoff (2012) has also mentioned that the ICT empowers farmers by enabling them to gain access to and control over more and better resources, access to new or better technologies and link them into organizations.

3.2.3 Component 3 – Technical Perspective

The items 12 to 17 (App. 1) comprises the technical perspective of the e-Agriservice. It explains 8.25 per cent of the variability on the attitude of users towards the e-Agriservice. This component suggests the service provider need to provide accurate and specific information to retain the interest of farming community in availing the e-Agriservice. David & Foray (2003) also suggested that the access to correct and relevant (and timely) information makes emancipatory and participatory action possible, which has capacity to empower people. Further this would lead to better farming output, helps farmers to improve their socio-economic level. The technicality of the service provider may be reduced and facilitator may be deployed to cater the needs of the farmers in using the service as well as enhancing e-literacy.

3.2.4 Component 4 – Efficacy Perspective

The fourth component (items 18 to 22) characterises the efficacy perspective of the e-Agriservice. This component explains 5.41 per cent of the variability on the attitude of users towards the e-Agriservice. The e-Agriservice can be more effective in timely dissemination of information if uninterrupted internet facility is provided at village level. This would reduce the overdependence on face-to-face interaction with extension functionaries for getting relevant information on farming.

Thus, the service provider must focus on the utility, technical and efficacy perspective to reduce the pessimistic attitude in order to sustainable use of e-Agriservice by farming communities. The findings are in line with the Feng *et al.* (2007) who have developed the conceptual model for identifying factors affecting the success of ICT based knowledge transfer such as knowledge quality, system quality, service quality (with sub-dimensions of e-service quality and extension quality, use, user satisfaction and net benefits. Rogers (2003) also indicated that "trialability" and "observability" are the two attributes of an innovation that might increase the rate of adoption of innovations. Further to confirm the findings, Cronbach alpha coefficients as a measure of reliability focuses on the internal consistency of the set of items forming the sub-scale was calculated. The Cronbach alpha value for four components viz. pessimistic, utility, technical and efficacy subscales were 0.90, 0.81, 0.84 and 0.77, respectively and it was calculated to be 0.91 for the entire items. Thus, the results show that the alpha coefficients for all components were significantly high, suggesting the internal reliability in-

dex was adequate. The same set of items could be useful for assessing the attitude of farmers towards other ICT based services as well.

In this psychological analysis, the overall attitude towards e-Agriservice may not give clear representation of the qualitative data. Therefore, a factor analysis was carried out to reduce the number of variables into a meaningful component, which could help in identifying factors responsible for developing the favourable attitude towards e-Agriservice. The outcome of this study could be helpful in planning and implementing rural ICT projects in developing countries. The findings could also be helpful in successful penetration of ICT services in rural areas and sustaining interest of target population.

4 Conclusion

Many ICT projects in developing countries are involved in providing timely and relevant information to the farming community. Most of them are funded by the external agencies and donor agencies in the selected area on pilot basis. However, the need, preferences and attitude of the target group is perceived as key indicator in predicting acceptability of any technological intervention among farming community. In this paper an attempt was made to identify the factors, which govern the attitude of dairy farmers towards the aAQUA e-Agriservice. The factor analysis by principal components has been used for the evaluation of the attitude items towards the e-Agriservice. The results obtained revealed four components viz. pessimistic perspective, utility perspective, technical perspective and efficacy perspective, which governed the attitude of farmers towards the aAQUA e-Agriservice. The aforementioned perspectives explained the majority of the variability in the dependent variable, i.e. attitude towards the aAQUA e-Agriservice. The service provider must focus on the utility, technical and efficacy perspective of e-Agriservice to reduce the pessimistic attitude of target population for developing and sustaining favourable attitude towards the aAQUA e-Agriservice. Therefore, policy makers and service providers must consider these four components, in order to assure end-users acceptance of technology and its sustainability.

Acknowledgement

The author acknowledges the University Grant Commission (UGC), Government of India for financial support to carry out research work.

References

Ajzen, I. (1988). *Attitudes, personality and behavior*. Open University Press, Bristol, UK.

Aker, J. C. & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *Journal of Economic Perspectives*, 24 (3), 207–232.

Bhatnagar, S. (2008). Benefits from Rural ICT applications in India: Reducing transaction costs and enhancing transparency? LIRNEasia presentation at public lecture on ICT in Agriculture, Colombo, Sri Lanka. URL `http://www.lirneasia.net/wp-content/uploads/2008/02/bhatnagar_public_lecture.pdf`.

Binder, M. & Niederle, U. (2006). Institutions as determinants of preference change- A one way relation? Papers on Economics and Evolution # 0607, Max Planck Institute of Economics, Jena, Germany. URL `http://www.econ.mpg.de/deutsch/research/EVO/discuss.php#p2006`.

Bolter, J. D. (2001). *Writing space: Computers, hypertext and the remediation of the print*. M. J. Lawrence Erlbaum Associates, Mahwah.

Brunner, C. (1992). *Integrating technology into the curriculum: Teaching the teachers*. Centre for Technology in Education, New York (ERIC document reproduction service No. EJ 553816).

Bryant, G. & Yarnold, H. (1995). Principal components analysis and exploratory and confirmatory factor analysis. *In:* Grimm, L. G. & Yarnold, P. R. (eds.), *Reading and understanding multivariate analysis*. American Psychological Association Books.

CTA (2007). Annual Report 2006. Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA), Wageningen, The Netherlands.

David, P. A. & Foray, D. (2003). Economic Fundamentals of the Knowledge Society. *Policy Futures in Education*, 1 (1), 20–49.

Diekmann, F., Loibl, C. & Batte, M. T. (2009). The economics of agricultural information: factors affecting commercial farmers' information strategies in Ohio. *Review of Agricultural Economics*, 31 (4), 853–872.

Edwards, A. L. (1957). *Techniques of attitude scale construction*. Vakils, Feffer and Simons Private Ltd. Ballard Estate, Mumbai.

Feng, W. Z., Duan, Y. Q., Mathews, B. & Fu, Z. T. (2007). Measuring ICT based agricultural knowledge

transfer under a sender advantage asymmetric information structure. *New Zealand Journal of Agricultural Research*, 50 (5), 1307–1314.

Field, P. (2005). *Discovering statistics using SPSS for Windows: Advanced techniques for the beginner*. Sage, London, UK.

Francis, L., Katz, Y. & Jones, S. (2000). The reliability and validity of the Hebrew version of the Computer Attitude Scale. *Computers & Education*, 35 (2), 149–159.

Hair Jr., J. F., Black, W. C., Babin, B. J., Anderson, R. E. & Tatham, R. L. (2006). *Multivariate Data Analysis, 6th Edition*. Pearson Education, Inc., Upper Saddle River, New Jersey.

Jensen, R. (2007). The digital provide: Information (Technology), market performance and welfare in the south Indian fisheries sector. *Quarterly Journal of Economics*, 122 (3), 879–924.

Jenson, M., Myers, M. & Southwood, R. (2004). The impact of ICT in Africa. Paper Prepared for the Commission for Africa.

Li, N. (2002). *Culture and gender aspects of students' information searching behaviour using the Internet: a two culture study of China and the United Kingdom*. Ph.D. thesis, Open University United Kingdom, ProQuest Digital Dissertations.

Likert, R. A. (1932). *A technique for the measurement of attitude*. Archives of Psychology, New York.

Loehlin, J. C. (2004). *Latent variable models: An Introduction to factor, path, and structural equation analysis, 4th Edition*. Erlbaum Associates, Hillsdale NJ.

Logan, R. K. (1995). *The fifth language: Learning a living in the computer age*. Stoddart, Toronto, ON.

Raj, D. A., Poo Murugesan, A. V., Aditya, V. P. S., laganathan, S. O. & Sasikumar, K. (2011). A crop nutrient management decision support system: India. *In:* Grimshaw, D. J. & Kala, S. (eds.), *Strengthening Rural Livelihoods. The impact of information and communication technologies in Asia*. Practical Action Publishing Ltd., pp. 33–52.

Ramamritham, K., Bahuman, C. & Bahuman, A. (2011). aAQUA: ICT-enabled Knowledge Services to Farmers in India. *In:* Hazelman, M. & Attaluri, S. (eds.), *Success Stories on ICT/ICM in AR4D in Asia and the Pacific Region*. FAO.

Rogers, E. M. (2003). *Diffusion of Innovations (5th Ed.)*. Free Press, New York, London.

Samaddar, A. (2006). Traditional and Post-Traditional: A Study of Agricultural Rituals in Relation to Technological Complexity among Rice Producers in Two Zones of West Bengal, India. *Journal of Culture and Agriculture*, 28 (2), 108–121.

Saravanan, R. (2012). ICTs for Agricultural Extension in India: Policy Implications for Developing Countries. Proceedings of the AFITA/WCCA 2012 - 8th Asian Conference for Information Technology in Agriculture (AFITA) and World Conference on Computer in Agriculture (WCCA) during September, 3-6, 2012, at Taipei, Taiwan.

de Silva, H. & Ratnadiwakara, D. (2008). Using ICT to reduce transaction costs in agriculture through better communication: A Case-study from Sri Lanka. LIRNEasia, Colombo 08, Sri Lanka. URL `http://lirneasia.net/wp-content/uploads/2008/11/transactioncosts.pdf`.

Smith, B., Caputi, P. & Rawstone, L. (2000). Differentiating computer experience and attitude towards computers: An empirical investigation. *Computers in Human Behavior*, 16, 59–81.

Uphoff, N. (2012). Empowerment of farmers through ICT. Draft paper for ECOSOC expert group meeting on promoting empowerment of people in advancing poverty eradication, social integration, and decent work for all, UN HQ, NYC.

Woodrow, J. E. (1992). Locus of control and student teacher computer attitudes. *Computers in Education*, 14 (5), 421–432.

Appendix 1: *Variable names to the items*

Sl. No.	*Variable*	*Items*
1 *	TMCNSA	The e-Agriservice facility is a time consuming activity
2 *	PROPAGANDA	The e-Agriservice is more of propaganda & less usage for dairy farming
3 *	COTHERSER	I could have contacted other sources for dairy related queries
4 *	EAGSSTOP	The aAQUA e-Agriservice should be stopped
5 *	NTLOCSP	The e-Agriservice cannot meet location specific needs of the farmers
6	DEVESFREL	The e-Agriservice helps to develop self-reliance among farming community
7	CONTWRK	The e-Agriservice empowers me to have control over farming activities
8	MRKTPRINFO	It is the best means to collect information on market prices of agricultural and non-agricultural products
9	GNRTEMPLY	It helps to generate employment opportunities among farming community
10	IMPRVEFF	The e-Agriservice improves efficiency of experts and extension workers in reaching a large number of farmers with less effort
11	WEATHERSERS	The weather services provided by the e-Agriservice are satisfactory
12 *	NTRELWRTHY	The services provided by the e-Agriservice are not realistic and worthwhile
13 *	NTIMPRVKNW	The e-Agriservice does not improve the knowledge regarding different aspects of dairy farming
14 *	TCHSVYPB	The tech-savvy people can benefit more from the aAQUA e-Agriservice
15	DEVECAPA	It is not just the agro-advisory service but also develop my capability in dairy farming
16	IMPRSTNDLV	It aids to increase income which leads to enhance standard of living
17	SERPROV	The service provider helps to retain and attract new users with the efficient mobilisation of its activities
18	ALTERNATEP	The aAQUA e-Agriservice is an alternative to the present dairy extension system
19 *	ALNTSLVPRB	e-Agriservice alone would solve the problems of farmers
20	EFFECTW	It enhances users effectiveness about dairy farming
21 *	INTUNAOBCT	The internet unavailability obstruct the accessibility of the e-Agriservice by the farmers
22	ANSWTM	It provides appropriate answers to farmers queries within a short period of time

Note: * Represents negative items.