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PUBLIC AND PRIVATE AGRICULTURAL EXTENSION SERVICES AS SOURCES OF INFORMATION FOR CAPACITY BUILDING OF SMALLHOLDER FARMERS IN PAKISTAN

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ABSTRACT

Agricultural extension is the main instrument for capacity building of smallholder farmers in Pakistan. Capacity building, in this study, is defined as the ability to gain knowledge and skills of recommended technologies that improve farmers' performances. Since the early 1990s, the government of the Islamic Republic of Pakistan endorsed private extension in an effort to enrich the effectiveness of public extension through competition. This research, conducted in 2016, sought to determine whether private extension providers are more effective than public extension as information sources for smallholder farmers. The specific objectives were to examine the effectiveness of Information and Communication Technologies (ICTs) use by public and private agricultural extension providers and to analyze statistically, the performances of public and private extension systems. A sample of 342 farmers drawn from a list of 2,365 rice growers registered with public and private offices in Gujranwala, the largest rice-producing district in Pakistan, were interviewed. The study found that extension agents in the private sector were less effective than the public sector, in communicating development messages to resource-poor farmers. However, the private sector was more effective in inputs distribution than the public sector. The authors suggest ways public and private extension workers can be more effective in strengthening the capacities of smallholder farmers.

Keywords: capacity building, smallholder farmers, public and private extension services, agricultural extension, information and communication technologies, and agricultural extension.

INTRODUCTION

Pakistan, with a population of 203 million, is the 6th most populous country on earth after China, India, the United States, Indonesia, and Brazil (PRB, 2016). Yet this developing country is fully self-sufficient in food production, thanks to a highly productive agricultural sector (FAO, 2015). Agriculture accounted for one fifth (20.9%) of the country's Gross Domestic Product (GDP) and an annual economic growth rate of 3 percent. Agriculture also provides employment for 43.5% of the national labor force (Govt. of Pakistan, 2015). Of the agricultural outputs, rice is the most prominent. It is a staple food crop and a foreign exchange earner. Rice, sugarcane, and cotton netted 65% of the total foreign exchange earnings in 2016 (USDA, 2016). Pakistan is the world's 4th largest rice producer, followed by China, India, and Indonesia. Rice is the country's 2nd agricultural export commodity after cotton. According to the Trade Development Authority of Pakistan (2016) the rice trade is the most significant bond tying the Islamic countries of Saudi Arabia, United Arab Emirates, Iran, Sri Lanka and Pakistan. Pakistan produces almost 6 million tons of rice annually and the Punjab province is the nation's rice belt, accounting for 58% of total national rice cultivation acreage. In spite of its performance, experts' contented that the country is capable of producing 82 percent more rice (Paris *et al.,* 2008; Govt. of Pakistan, 2013: USDA, 2014).

The main problem is that rice cultivation in Pakistan is still largely in the hands of smallholder farmers, who use primitive tools. The Food and Agriculture Organization of the United Nations (FAO, 2013) says Pakistan's rice growers lacking knowledge and skills in farm management, use poor seed, and generally do not follow modern farming practices. The FAO also noted that these farmers incur post-harvest losses in the range of 15 to 20 percent. Thus, the technical inefficiency of rice growers in Pakistan is a major concern.

In the early 1990s the Government of the Islamic Republic of Pakistan introduced private extension to compete with the public extension sector in the hope of bringing out the best in public sector extension. Since then, public and private agricultural extension services have operated side-by-side. Smallholder farmers in Pakistan receive both extension services (Ahmed *et al.,* 2000; Davidson *et al.,* 2001). Thus, the debate over the

past 20 years has been which one is better, public or private extension?

Purpose and objectives: This study set out to determine whether a private or public extension provider is more effective in helping smallholder farmers to adopt modern farming practices. Capacity building, in this study, is defined as the ability to gain knowledge and skills of recommended technologies that improve farmers' rice yields while the recommended technologies are the theories and practices advised by Punjab Agriculture Board. Therefore, the main purpose of the study is to determine, which is more effective. The specific research objectives are:

1. To determine the socio-economic characteristics of smallholder rice growers;
2. To compare the effectiveness of public and private agricultural extension providers as information sources for farmers;
3. To examine the effectiveness of Information and Communication Technologies (ICTs) use by public and private sector extension systems;
4. To analyze statistically the performance of public and private sectors in use of information sources; and
5. To evaluate performance of public and private sectors in use of ICTs means.

MATEIALS AND METHODS

A survey research methodology was applied to conduct of the study. The study was carried out in Gujranwala, Pakistan, the largest rice-producing district in the country. The population and sampling frame were made up of rice growers registered with the Department of Agriculture (Extension Unit) and also with the largest private extension unit, a pesticide company called Syngenta Agrochemicals. A sample size of 342 farmers was drawn out of 2,365 rice growers from the four tehsils in the district: Gujranwala, Wazirabad, Kamoky and Noshehra Virkan (Fitz-Gibbon & Morris, 1987). Respondents from each tehsil were selected based on the number of farmers in the tehsil. A total of 103 respondents were selected from Gujranwala tehsil; 97 respondents from Kamoky tehsil; 83 respondents from Wazirabad tehsil; and 59 respondents from Noshehra Virkan tehsil. An interview schedule was prepared in English but ad-libbed in Punjabi to respondents (Flower Jr., 2004). The validity and reliability of the study were checked through pre-testing. Data collection was carried out by the lead author through face-to-face interviews. Of the 342 sampled, 289 respondents were interviewed, mainly on their farms (or Deras). The others were interviewed at their homes or shops. Data analysis was done by using the SPSS 24 (Statistical Package for Social Sciences).

Statistical Test: a statistical test, T-test for independent means was performed to analyze statistically the performance of public and private sectors in the use of information sources (Objective #4) and to evaluate performance of public and private sectors in use of ICTs means (Objective #5).

For objective#4: H_0= Effectiveness of private sector is equal to effectiveness of public sector in use of information sources

H_1 = Effectiveness of private sector is greater than effectiveness of public sector in use of information sources

α= 0.05% (right tail)

Degree of freedom = (N_1 -1) or (N_2-1)

= (342-1)

= 341

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}}$$

Critical Region= 1.649

For objective#5:

H_0 = Effectiveness of private sector is equal to effectiveness of public sector in use of ICTs means

H_1= Effectiveness of private sector is greater than effectiveness of public sector in use of ICTs means

α= 0.05% (right tail)

Degree of freedom = (N_1 -1) or (N_2-1)

= (342-1)

= 341

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2}}}$$

Critical Region= 1.649

The small sample size of 342 smallholder farmers is not enough to generalize the results to the whole country or even to the province. Though, it does help to answer the research hypothesis—whether 'private extension services are more effective than public extension services?'

RESULTS

Socio-economic characteristics of rice growers: Socioeconomic characteristics of smallholder farmers are an important determinant of their ability to adopt innovations (Bashir and Albarbarawi, 2011). If they have high incomes, for example, they will be able to buy inputs. The demographic characteristics examined included: age; education; size of landholding, area under rice cultivation; and annual income from rice. Age: Ages of respondents were reported in ranges (Jason *et al.*, 2012). The majority (71.3%) of respondents were less than 50 years. Of the 342 respondents, 7.9% were between 11 and 20 years; 2) 16.1% were between 21 and

30 years; 3) 20.5% were between 31 and 40 years; and 26.9% were between 41and 50 years of age. Those more than 50 years old constituted 28.7 percent (Table 1).

Table 1. Ages of rice growers in 2016

Age (in years)	Frequency (f)	Percentage (%)
11-20	27	7.9
21-30	55	16.1
31-40	70	20.5
41-50	92	26.9
51-60	59	17.3
61-70	26	7.6
71-80	13	3.8
Total	342	100

The second demographic characteristic examined was level of education of respondents. Generally, the higher the education of the farmer, the greater his or her ability to adopt innovations and, thus, to secure higher yields. The corollary is true. Ramzan (2003) found that as illiteracy increases there is greater resistance to innovation adoption and resulting in lower yields and incomes. The level of education was divided into: a) illiterate, those who could not read or write; b) primary, those with school education between 1-5 years; c) Middle, those with school education between 6 and 8 years; d) matriculation, those with school education between 9-10 years; e) intermediate, those with 11-12 years of education; f) graduate, those with 13-14 years of education; and g) master's, those with formal education, that is 16 years of education. The majority of respondents had below matriculation level of education. Of the 342 respondents, 28.1% and 20.5% had schooling between 1 to 5 years and 6-8 years, respectively. Fifteen percent of respondents had matriculation certificates, and 12.3% had intermediate level education certificates. Only 4.1% and 2.0% respondents graduated with bachelors and master's degrees, respectively. Eighteen percent of respondents had no formal education (Table 2).

Table 2. Level of Education of Respondents in 2016

Education Level	Frequency (f)	Percent (%)	Cumulative Percent
Illiterate	62	18.1	18.1
Primary	96	28.1	46.2
Middle	70	20.5	66.7
Matriculation	51	14.9	81.6
Intermediate	42	12.3	93.9
Graduate	14	4.1	98.0
Master	7	2.0	100
Total	342	100	

Size of Landholding and Area under Rice Cultivation: By asking of the size of landholding and area under rice cultivation the researchers sought to understand how much land is under rice cultivation (Hussain *et al.,* 2011). The goal is to determine the potential for increasing rice farmland. Slightly more than two-third (68.7%) of respondents had less than 15 acres of land each. Of 342 respondents: 35.9% had 5 acres or less with average rice cultivation of 3 acres; 19.9% had land between 6 to 10 acres with average rice cultivation on 7.5 acres of total land; 12.9% had between 11 to 15 acres with average rice cultivation on 12 acres of total land.

Table 3. Size of landholding

Size of land holding (acres)	Mean area under rice (acres)	Frequency (f)	Percent (%)	Cumulative Percent
1-5	3.0	123	35.9	35.9
6-10	7.5	68	19.9	55.8
11-15	12.0	44	12.9	68.7
16-20	17.5	38	11.1	79.8
21-25	22.0	30	8.8	88.6
26-30	27.0	27	7.9	96.5
31-35	32.0	12	3.5	100
Total		342	100	

Of the remaining 31.3% respondents: 11.1% had between 16 and 20 acres with average rice cultivation on 17.5 acres of total land; 7.9% between 26 to 30 acres with average rice cultivation on 27 acres of total land; and only 3.5% had between 31and 35 acres with average rice cultivation on 32 acres of total land. It was found that rice is the most significant crop in the area. Generally, the farmers grow rice over more than two-third of total landholdings, which means there is room for increasing rice farmland (Table 3).

The vast majority of rice growers in Gujranwala were smallholder farmers. The soil of Gujranwala is very fertile for rice cultivation, which caused a large majority of farm families to migrate from India in 1947 and settled here. The farm sizes also got increasingly smaller because of rapidly increasing population.

Annual Profits from Rice: Respondents were asked about their annual profits from rice. The goal was to determine if Pakistan smallholder rice growers lived above the international poverty line of $2/day or 2350 calories/day. The study showed that slightly less than one-third (31.9%) respondents had between 46,000 - 60,000 PKR. ($439-571) annual profits from rice,

Table 4. Total annual profits from rice

Annual profits (000 PKR)	Annual profits ($)	Int. Poverty line/year ($2/day)	Frequency (f)	Percent (%)	Cumulative Percent	Annual Profits-2$
<15	<143	730	22	6.4	6.4	-587
16- 30	153-286	730	42	12.3	18.7	-444
31-45	296-429	730	96	28.1	46.8	-301
46-60	439-571	730	109	31.9	78.7	-159
61-75	581-714	730	29	8.5	87.7	-16
76-90	724-857	730	25	7.3	94.5	127
91-105	867-1000	730	19	5.6	100	270
Total			342	100		

(Exchange Rate: $1=105 PKR in June 2016)

A little more than one-fourth (28.1%) and 12.3% respondents were getting between 31,000-45,000PKR ($ 296-429) and 16,000-30,000 PKR ($153-286) annual incomes from rice, respectively. Overall, 87.7% respondents had less than 75,000 PKR ($714) annual incomes from rice. Generally, smallholder rice growers earned low incomes, $ 0.97/day or 1,075 calories/day, which is less than half of the international poverty line ($2/day or 2350 calories/day) (Table 4). Resource-poor farmers lacked awareness and adoption of modern agricultural technologies; cultivated less productive varieties; and lacked economic resources to buy innovative technologies.

Comparison of public & private extension sectors as information providers: In many developing countries, there is a strong competition between public and private extension systems for the attention of farmers, especially smallholder farmers, who are of interest to governments and international aid organizations. This objective examined public/private extension sectors' use of information sources to reach farmers. The information sources we examined included: demonstrations, farmer field days, and exhibitions (Okunade and Akintola, 2007). Are private or public extension workers more skilled in the use of these information sources in reaching farmers?

The rice growers were asked whether public and private extension organizations used the following information sources to reach them. Questions were asked on a "Yes" or "No" scale and also on a scale of "Very low" (1), "Low" (2), "Medium" (3), "High" (4), and "Very high" (5). The statistical calculations (weighted score, mean, standard deviation, and rank order) were presented in Table 4. The respondents argued that public sector agents were effective between low to medium with inclination towards medium in dissemination of information through: 1) demonstrations (W.S/weighted score = 954, X = 2.78, S.D/Standard Deviation = 1.76); and 2) farm & home visit (W.S = 903, X = 2.64, S.D = 1.23) to build capacity of the smallholder rice growers. They were less effective in building capacity of smallholder farmers through: 1) agricultural campaigns (W.S = 714, X = 2.09, S.D = 0.93); 2) farmer days (W.S = 816, X = 2.39, S.D = 0.33); and 3) sign boards (W.S = 697, X = 2.04, S.D = 1.56).

Table 5. Ranking of extension methods used by public and private sectors

Ranking of public sector				Information sources	Ranking of private sector			
W. score	Mean	Std. Dev.	R. Order		W. score	Mean	Std. Dev.	R. Order
954	2.78	1.76	1	Demonstrations	728	2.13	1.49	3
903	2.64	1.23	2	Farm and home visits	806	2.36	1.32	2
714	2.09	0.93	3	Agricultural campaigns	735	1.06	0.77	6
816	2.39	0.33	4	Farmer days	1080	3.16	0.76	1
697	2.04	1.56	5	Sign boards	387	1.13	1.07	5
465	1.36	0.66	6	Literature	475	1.39	1.00	4

Limits: 1-1.50 = Very low, 1.51-2.50 = Low, 2.51-3.50 = Medium, 3.51-4.50 =High, and 4.51-5.0 = Very high

Public extension agents were least effective in dissemination of literature (W.S = 465, X = 1.36, S.D = 0.66); and arranging agricultural exhibitions (W.S = 204, X = 0.59, S.D = 1.89) to update smallholder farmers about innovative technologies. Private sector's agents were more effective in building capacity of the smallholder growers in highly effective ways through farmer field days (W.S = 1080, X = 3.16, S.D = 0.76). The agents were building capacity of the growers in an averagely effective ways through farm & home visits (W.S = 806, X = 2.36, S.D = 1.32) and demonstrations (W.S = 728, X = 2.13, S.D = 1.49). The agents were equally effective in capacity building of the growers through agricultural campaigns (W.S = 477, X = 1.39, S.D = 1.83); and literature distribution (W.S = 477, X = 1.39, S.D = 1.00). The sector's performance was low to very low in transferring agricultural information through signboards (W.S = 387, X = 1.13, S.D = 1.07); and agricultural exhibitions (W.S = 354, X = 1.06, S.D = 0.77) for making smallholder growers efficient rice producers (Table 5).

Generally farmers oscillated between public and private sectors. With respect to their effectiveness For example, the public sector extension workers were more effective in disseminating information through pragmatic ways (demonstrations) while the private extension worker excelled in verbal or theoretical sources (farmer days). The informal discussions showed that private sector extension workers responded more quickly than public sector agents, perhaps because government agents often lack transportation. It was evident that farmers relied on the public sector for information and on the private sector for material inputs or products. In addition it was noted that public sector was performing better in transferring information longitudinal teaching methods (result demonstrations), as well as in face-to-face or traditional contact methods than private organizations. Private extension workers were disseminating information through short period teaching methods (agricultural campaigns) in a better way. Explain what longitudinal; and short term training methods are.

Examination of ICTs use by public & private sector extension systems: Rice growers were asked whether if public and private extension organizations used the following ICTs means and to rate the effectiveness of these sources. Usage of ICTs was asked in "Yes" or "No" and a scale of "Very low" (1), "Low" (2), "Medium" (3), "High" (4), and "Very high" (5) were employed to show the level of effectiveness of ICTs. The statistical calculations (weighted score, mean, standard deviation, and rank order) were presented in Table 6.

Table 6. Ranking of ICT means used by public and private sectors

Ranking of public sector				ICT Means	Ranking of private sector			
W. score	Mean	Std. Dev.	R. Order		W. score	Mean	Std. Dev.	R. Order
696	2.03	1.08	1	Television	471	1.38	1.87	1
591	1.73	1.99	2	Helplines	109	0.32	1.83	5
440	1.29	0.96	3	Radio	415	1.21	1.26	2
170	0.49	0.42	4	Telephones	180	0.59	0.63	3
128	0.37	1.96	5	Social media (Facebook, Twitter etc.)	132	0.39	0.67	4

Limits: 1-1.50 = Very low, 1.51-2.50 = Low, 2.51-3.50 = Medium, 3.51-4.50 =High, and 4.51-5.0 = Very high

Both sectors were low to very low in effectiveness in the use of ICTs as a means of disseminating agricultural information to smallholder farmers. Public sector agents were applying ICT means like, television (W.S = 696, X = 2.03, S.D = 1.08) less effectively in transferring agricultural information. Public sector extension agents were the least effectively used: 1) helplines (W.S = 591, X = 1.73, S.D = 1.99); 2) radio (W.S = 440, X = 1.29, S.D = 0.96); 3) telephones (W.S = 170, X = 0.49, S.D = 0.42); and 4) social media (W.S = 128, X = 0.37, S.D = 1.96) to build capacity of the growers. Private sector's use of ICT means was ranked as: 1) televisions (W.S = 471, X = 1.38, S.D = 1.87); 2) radio (W.S = 415, X = 1.21, S.D = 1.26); 3) telephones (W.S = 180, X = 0.59, S.D = 0.63); 4) social media (W.S = 132, X = 0.39, S.D = 0.67); and 5) helplines (W.S = 109, X = 0.32, S.D = 1.83) (Table 6). Normally, there is no significant difference in effectiveness of public and private services.

The farmers argued that there is no significant difference between public sector and private sector in the use of ICTs means. In addition it was noted that public sector was performing better in transferring information through public ICTs means, such as television, radio etc. than the private sector. Private extension agents were excelled in using personal ICTs means i.e. telephones, social media, and so on.

The Directorate of Agricultural Extension and its Adaptive Research Unit and the private sector trained their extension agents on the use of information sources i.e. telephones, helplines, etc. for capacity building of farmers. The private sector claimed that its extension agents were more modern than the public sector in the use of ICTs means for capacity building of farmers. To

answer this question, the effectiveness in the use of ICTs for capacity building of the smallholder farmers of both sectors was compared. ICTs are opportunities through which smallholder farmers obtain information, such as telephones (use of cell phones or landlines to contact farmers); social media (application of social networks like Facebook, twitter, Skype etc. to disseminate information) television (the advertisement/agricultural programs to introduce new equipment's, technologies/techniques); radio/FM (the advertisement/agricultural programs to introduce new equipment's/technologies/techniques); and helplines (telephonic helplines to address the farming issues i.e. 0800-29000 by Department of Agricultural Information etc.).

Performance of public and private sectors as information providers: The purpose of the statistical analysis was to find out whether private extension providers are more effective in use of information sources to help smallholder farmers in the adoption of innovative farming practices? A statistical test, t-test for independent means was performed to calculate the t-value against each information source to compare private sectors performance with public sector. The t-value of this test plotted in critical region (1.649) of 0.05% right tail α-value. If t-value fell in critical region, it meant the private extension providers were equally effective than the public sector and vice-versa.

Table 7. Analysis of information sources used by public and private sectors

Public sector		Information sources	Private sector		t-value
Mean	S.D		Mean	S.D	
2.78	1.764	Demonstrations	2.13	1.493	5.00*
2.64	1.229	Farm and home visits	2.36	1.322	2.95*
2.09	0.931	Agricultural campaigns	1.39	1.833	4.67*
2.39	0.327	Farmer days	3.16	0.755	-17.11^{NS}
2.04	1.556	Sign boards	1.13	1.068	91.00**
1.36	0.661	Literature	1.39	1.003	-0.48^{NS}
0.59	1.885	Agricultural exhibitions	1.06	0.767	-39.17^{NS}

Critical region/t-value=1.649,α=0.05,=Significant, **=Highly significant, NS=Non-significant*

The results depict that effectiveness of private sectors use of signboards (t-value = 91 [mean/X_1 = 2.04, standard deviation/$S.D_1$ = 1.556, X_2 = 1.13, $S.D_2$ = 1.068]) was highly greater than public sector. The private sectors performance was also greater than public sector in using: demonstrations (t-value = 5 [X_1 = 2.78, $S.D_1$ = 1.764, X_2 = 2.13, $S.D_2$ = 1.493]); farm and home visits (t-value = 2.95 [X_1 = 2.64, $S.D_1$ = 1.229, X_2 = 2.36, $S.D_2$ = 1.322]); and agricultural campaigns (t-value = 4.67 [X_1 = 2.09, $S.D_1$ = 0.931, X_2 = 1.39, $S.D_2$ = 1.833]). The efficiency of public and private sector was equal in application of: agricultural exhibitions (t-value = -39.17 [X_1 = 0.59, $S.D_1$ = 1.885, X_2 = 1.06, $S.D_2$ = 0.767]); literature (t-value = -0.48 [X_1 = 1.36, $S.D_1$ = 0.661, X_2 = 1.39, $S.D_2$ = 1.003]); and farmer days (t-value = -17.11 [X_1 = 2.39, $S.D_1$ = 0.327, X_2 = 3.16, $S.D_2$ = 0.755]). It meant that the effectiveness of private extension The results denote that private sector extension was not more effective than public sector extension in using: a) telephones (t-value = -2.22 [X_1 = 0.49, $S.D_1$ = 0.423, X_2 = 0.59, $S.D_2$ = 0.631]); b) social media (t-value = -0.18 [X_1 = 0.37, $S.D_1$ = 1.956, X_2 = 0.39, $S.D_2$ = 0.666]); and c) radio (t-value = 0.99 [X_1 = 1.29, $S.D_1$ = 0.957, X_2 = 1.21, $S.D_2$ = 1.257]). The private sector extension was greater in effectiveness in the use of: a) helplines (t-value = 8.01 [X_1 = 1.73, $S.D_1$ = 1.991, X_2 = 0.32, $S.D_2$ = 1.829]); and providers is not greater than public sector except in use of information source in building capacity of smallholder farmers in adoption of modern farming practices (Table 7).

Evaluation of ICTs use by public and private sectors: The purpose of statistical analysis of ICTs was to find whether private extension providers are more effective in use of ICTs means to help smallholder farmers in the adoption of innovative farming practices? A statistical test, t-test for independent means was performed to calculate t-value against each means to compare performance of public and private sectors. The t-value of this test plotted in critical region (1.649) of 0.05% right tail α-value. If t-value fell in critical region, it meant the private extension providers are greater effective than public sector and vice-versa.

b) television (t-value = 4.64 [X_1 = 2.03, $S.D_1$ = 1.877, X_2 = 1.38, $S.D_2$ = 1.866]) (Table 8). In general, the efficiency of private extension providers is equal to public sector.

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radio (t-value = 0.99 [X_1 = 1.29, $S.D_1$ = 0.957, X_2 = 1.21, $S.D_2$ = 1.257]). The private sector extension was greater in effectiveness in the use of: a) helplines (t-value = 8.01 [X_1 = 1.73, $S.D_1$ = 1.991, X_2 = 0.32, $S.D_2$ = 1.829]); and b) television (t-value = 4.64 [X_1 = 2.03, $S.D_1$ = 1.877, X_2 = 1.38, $S.D_2$ = 1.866]) (Table 8). In general, the efficiency of private extension providers is equal to public sector.

Table 8. Analysis of ICTs used by public and private sectors

Public sector		ICTs	Public sector		t-value
Mean	S.D		Mean	S.D	
2.03	1.077	Television	1.38	1.866	4.64*
1.73	1.991	Helplines	0.32	1.829	8.01*
1.29	0.957	Radio/FM	1.21	1.257	0.99^{NS}
0.49	0.423	Telephones (landlines, Cell phones)	0.59	0.631	-2.22^{NS}
0.37	1.956	Social media (Facebook, twitter etc.)	0.39	0.666	-0.18^{NS}

Critical region/t-value =1.649, α=0.05,=Significant, NS=Non-significant*

Conclusions and Recommendations: Results of the demographic characteristics revealed that many rice farmers in the study were less educated, old, operated as smallholders, and lived below the international poverty line of $2/day (or on 2,350 calories/day). Given this situation, these rice growers may be less receptive to change since they are resource-poor. For these farmers to increase productivity, therefore, agricultural loans must be provided. Public and private sector extension systems should launch non-formal education programs to increase literacy of these growers.

Next, it was found that public sector agents were using demonstrations (X = 2.78 or medium) as the most effective information dissemination tool, while private sector extension excelled in the use of farmer days (X = 3.16 or medium) for dissemination of agricultural information. Both extension systems were least effective in the use of agricultural exhibitions (Public, X = 0.59; Private, X = 1.06 or very low) and print literature (Public, X = 1.36; Private, X = 1.39 or low) as sources of information. The performance of both extension systems was below average. Therefore, it is recommended that the Higher Education Commission (HEC) enhances the extension curriculum at the BSc (Hons. agriculture) with development and communication courses.

Results of the study also showed that public sector extension agents were more effective in the use of television (X = 2.03 or low) and least effective in use of social media (X = 0.37 or very low). While, private sector extension agents were more effective in the use of television (X = 1.38 or very low) and least effective in use of helplines (X = 0.32 or very low) for capacity building of rice growers. The study also showed that extension agents in both private and public sectors were weak in the use of ICTs and so we recommend that the HEC includes ICT courses in the extension curriculum. The statistical analysis on information sources showed that private sector extension was not better than public sector extension in promoting extension effectiveness.

Finally, the statistical analysis of the use of ICTs means in capacity building of rice growers by public and private extension sectors showed that effectiveness of both sectors were ranked between low to very low category, with an inclination towards very low in use of all ICTs in dissemination of agricultural information. Thus, we conclude that there is no significant difference between the effectiveness of private sector extension and public sector extension with respect to the use of ICTs for capacity building of farmers. So, it is recommended that both sectors should strengthen their communication strategies in an effort to ensure greater efficiency in the use of ICTs for capacity building of farmers.

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