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RESEARCHERS' AND EXTENSION WORKERS' PERSPECTIVES ON AGRICULTURAL RESEARCH-EXTENSION LINKAGES IN THE KINGDOM OF SAUDI ARABIA

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ABSTRACT

There have been multiple mechanisms employed to improve research-extension linkages in the Kingdom of Saudi Arabia. Improving access and adoption of agricultural innovation is the indirect outcome of the research-extension linkages. This study was conducted to describe existing linkages in terms of implementation and strength levels. Moreover, the study identifies factors affecting linkages and explores appropriate approaches to develop and strengthen sustainable research-extension linkages. Data were collected from122 research personnel and 221 extension workers from all regions of the kingdom. Data were generated by administering a structured questionnaire. Percentages, means, standard deviations, the critical ratio (C.R), and t-test were used as statistical tools. The results indicated a significant difference between extension workers and researchers regarding joint technology development and determining farmers' needs. It was observed that lack of physical/financial facilities and routine administrative work were among the factors inhibiting extension- research linkages. The study recommends several improvement measures, such as developing the provision of extension services by utilizing ICTs, forming a national coordination committee for planning, and merging research and extension into a single new administration.

Key words: research, agricultural extension, linkages mechanisms, assessment, Saudi Arabia.

INTRODUCTION

Globally, the strength of an innovation system relies on the coordination (extent and quality of linkages) and collaboration among the stakeholders (World Bank, 2014). In the agricultural sector; the urgent need for a highly effective agricultural extension system has attracted the attention of policy makers to make administrative adjustments in organizational structure, human resource management, and functioning of the technology transfer mechanisms(APO, 2003).The success of the agricultural plans in the different countries in terms of agricultural production and raising the living standards of the rural poor depend on strong linkages among the three main pillars of agricultural innovation system: research, extension, and farmers (Ashraf *et al.*, 2007).

Linkage mechanisms refer to the structured collaboration, communication, and working relationships established between two or more organizations to bridge the gap between components of the system and allow regular information flow and feedback to enhance productivity (Agbamu, 2000; Kaur &Kaur, 2013; Sah *et al.*, 2014). A careful adaptation of formal and informal mechanisms is a prerequisite for the dissemination and utilization of knowledge (World Bank, 2014). Spielman *et al.* (2012) confirm that investing in creating and strengthening research-extension linkages provides effective dissemination of information and promotes the ability of the research system to transfer agricultural innovations to the extension system, as well as the ability of the extension service to provide timely feedback to research. FAO (1997) identified important principles to establish effective research–extension linkages that included as shared vision between institutions, perceived advantages to participate in the activities through linkages, proximity of location among the groups, linkage activities that are compatible with the other activities, rewards for individuals participating in the linkage activities, and effective communication and free flow of information.

Temel *et al.* (2002) reported that planning and review, programme activities, use of resources, information, and training are the key linkage mechanisms to perform the diverse activities in agricultural extension work. Lemma and Tesfaye (2016) emphasized that weaknesses in the management of linkage mechanisms, choice strategies to implement linkage policies, and an inappropriate institutional environment are the prime factors that limit the effectiveness of linkages in the agricultural innovation system.

The existence of weak linkages between national agricultural research and extension has been identified as one of the most difficult institutional problems confronting ministries of agricultural organizations, clearly indicating that research results will not reach the farmers, and if they do, farmers will not be able to use

them (Adesoji and Tunde, 2012; Altaye, 2012; Swanson, 1998). Therefore, the constraints that hinder research-extension-farmers linkages can potentially affect the agricultural output of the farmers, especially the majority of small, subsistence, and resource-poor farmers (Belay, 2003).

Agricultural research in the Kingdom of Saudi Arabia has a long history, dating back to 1951. Agricultural extension is the responsibility of the Deputy of Agriculture, while agricultural research falls under the deputy of planning at the Ministry of Agriculture. A study conducted by Al-Zahrani and Shalby (2014) in the KSA explored that collaboration between researchers and extension workers was weak in various agricultural fields. However, a number of linkages were tested to strengthen research-extension in the international literature (Agbamu, 2000; Altaye, 2012, Ogunremi and Olaniran, 2012; Rathore *et al.,* 2008). The situation in the KSA is still unclear regarding the linkages implemented and their quality. This gap exists, establishing the need to develop strategies to strengthen research-extension linkages. This study, therefore, with the broader objective aimed to investigate the research-extension linkage in Saudi Arabia. To achieve this purpose, three objectives were formulated:

(1) Examine the linkage mechanisms between research and extension;
(2)Identify the main constraints, hampering the integration between research and extension;
(3) Determine the most appropriate approaches to support extension-research linkage from the view point of the respondents.

Hypotheses of the study include
(1) There is no significant relationship between researchers and extension agents regarding the implemented linkage mechanisms.
(2) There is no significant relationship between researchers and extension agents concerning the strength of the linkage mechanism.

MATERIALS AND METHODS

The study was conducted in different regions of the Kingdom of Saudi Arabia. The population consists of all agricultural researchers of agricultural research stations administered to the Ministry of the Environment, Water, and Agriculture who were available on a roll at the time of collecting field data. The total number of researchers reached 148. Furthermore, the universe consists of 266 extension workers who had been working in all regions. All researchers and extension workers were targeted for data collection. Due to different circumstances of the respondents, the authors collected data from only 122 researchers and 221 extensionists, representing 80% and 88% of the universe, respectively.

A questionnaire was designed to achieve the study's objectives. Face to face interviews were conducted to collect data from the respondents. The instrument for data collection was divided into four sections based on the objectives. The first section presents personal characteristics of the respondents. The second section addresses the issues on the linkage level between research and extension. Possible linkage mechanisms presented by Temel *et al*. (2002) were listed. Respondents were asked to indicate whether each linkage mechanism was implemented. If yes, the respondents were asked to clarify the strength of the linkage by identifying the (i) level of linkage: strong (2), moderate (1), weak (0); (ii) types of linkage: formal (1), informal (0); and (iii) frequency of contact: monthly (2), annually (1). The level of linkage was calculated by collecting a score of the strength of linkage, type of linkage, and frequency of contact with a maximum score of (5) points for each mechanism.

Section three probes into the different problems mentioned in the literature, hampering the integration of research-extension. The respondent's response in this section was on a 3-pointLikert scale: great extent (3), moderate extent (2), and little extent (1). Finally, section four presents the different approaches suggested by Zahran (2009) to strengthen the coordination between research and extension. Researchers and extension workers determine the capability (%) of each approach to support research-extension linkage under local circumstances.

Data collected was coded and subjected to descriptive and inferential statistical analyses. Frequency distribution, percentages, means, and standard deviations were used for descriptive analysis of the different variables. Critical ratio test (C.R) was used to determine differences between researchers and extension workers regarding implementation levels (%) of research-extension linkage mechanisms. Furthermore, a t-test was used to determine differences between the researchers and extension workers in terms of the strength of linkages studied.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics of Respondents: Table 1 presents the socio-demographic characteristics of the extension workers and researchers included in the study. The results on age show that of the majority of the extension workers interviewed, 59.7% were 30 to 40 years old, whereas approximately 52% of researchers fell in the same age group. Therefore, the workers and researchers were in the early stages of their careers. Early career researchers and extension workers are perhaps more malleable than older and more enthusiastic staff.

Regarding the level of education, less than one-half (48%) of extension workers had a bachelor degree,

while the majority of the researchers (66.7%) had a bachelor's degree, and 28.5% of researchers obtained a master's degree. The results on the level of education indicate that researchers were equipped with a higher level of education than extension workers. Differences in level of education between extension workers and researchers contributed to the low level of involvement of extension workers in joint activities which led to the weak linkages (Table 2). Similar results were also reported by Agbamu (2000) and Chiligati (2010) indicating that the lower level of education of extension workers was among the prime reasons responsible for weak research-extension linkages.

Findings of the study indicate that respondents were equipped with the diversity of specializations. With regard to the specialized areas of the interviewed extension workers, most were specialized in the areas of plant production (29.9%), plant protection (14%) and general agriculture (12.7%).Conversely, of the researchers interviewed regarding their areas of specializations, 37.4% were specialized in plant production,19.5% in plant protection and 12.2% in soil science. The diversity of skills, expertise and multiple areas of specialization of the researchers and extension workers could be a positive factor in diagnosing and solving farmers' problems. However, on the contrary, the results of the study indicate that due to weak linkages among the researchers and extension workers, the activities in the joint implementation of the different programmes were adversely affected (Table 2).

Table 1. Demographic characteristics of the respondents

Variables	Researchers		Extension workers	
	N	%	N	%
Age (years)				
< 30	11	8.9	43	19.5
30-40	64	52	132	59.7
40-50	29	23.6	30	13.6
> 50	19	15.4	16	7.2
Level of Education (degree)				
Secondary School	-	-	60	27.1
Bachelor's	82	66.7	106	48
Master's	35	28.5	32	14.5
PhD	6	4.9	23	10.4
Areas of Specialization (last degree)				
Plant production	46	37.4	66	29.9
Plant Protection	24	19.5	31	14
Soil Science	15	12.2	16	7.2
Agricultural Engineering	12	9.8	25	11.3
Animal Production	4	3.3	15	6.8
Agricultural Extension	4	3.3	18	8.1
Food Science	4	3.3	5	2.3
Agricultural Economics	2	1.6	17	7.7
General Agriculture	12	9.8	28	12.7
Work Experience (years)				
1-5	55	44.7	160	72.4
6-10	17	13.8	22	10
11-15	19	15.4	11	5
>15	32	26.1	28	12.6

Regarding work experience, the results of the study show that 72.4% of extension workers had been in extension service for a period from 1 to 5 years, while 12.6% percent had been in service for more than 15 years. Regarding work experience of the researchers, the study reveals that approximately 44.7% of researchers have been involved in research activities for a period of 1 to 5 years, while 26.1% had been in research for more than 15 years. The results on the duration of stay in the current job show that 82.4% of extension workers had been at their present job for 1 to 10 years, while 58.5% of researchers had also been at their present job for the same period. It became apparent from the study that both the extension workers and researchers stay in their positions for a brief period; a possible reason could be lack of a culture of working together in the friendly environment that resulted in weak participation leading to the inability to develop formal and informal linkages. Resulting from such problems as lack of incentives, lack of physical and financial facilities and administrative routine, these

workers and researchers preferred to not stay longer in their present positions (Table 3).

Existing Research – Extension Linkages: The data presented in Table 2 describes the implementation and strength of linkages from extension workers' and researchers' points of view.

Findings revealed that researchers and extensionists perceived low to medium linkages amongst each other in the majority of mechanisms tested. The overall average of 49.5% for the researchers regarding the implementation level of linkages was realized, whereas it reached 43.5% for extensionists. Reporting similar results, Kaur and Kaur (2013) perceived that the researchers and extensionists in Pakistan had a low extent of participation in linkage mechanisms with each other (43.3%), and the farmers could be within the medium extent of participation (45.3%).

As seen in Table 2, more than one-half of both extensionists and researchers agreed that the most common mechanisms utilized to establish linkages include joint technology demonstration, sharing of information, joint writing and reviewing of the extension publications, joint reporting, holding of seminars and workshops through joint efforts, and conducting and jointly organizing training sessions for the stakeholders (short-term).Many studies conducted in other developing countries report similar findings. For instance, Altaye (2012) mentioned that the linkages between research and extension in Ethiopia were established through such activities as participation of farmers, researchers and extension agents in setting both research and extension agendas and use of collaborative activities, such as joint adaptive trials and conducting surveys.

A study conducted by Okoedo-okojie and Okon, (2013) in Nigeria showed that field demonstration trials, agricultural shows and exhibitions, jointly organized campaigns and field trips were effective linkage mechanisms. Similar findings by Pezeshki-Raad and Dehkordi (2006) in Iran have been reported; more than one-half of the researchers and extension workers showed high participation in training programs/activities, agricultural research committees, education and extension in neighbouring provinces and joint workshops.

Results of the present study indicated significant differences between extension workers and researchers regarding implementation of the following four mechanisms: joint development of strategies (C.R= 2.3, $p>0.05$), joint technology development (C.R= 2.3, $p>0.05$), joint seminars and workshops (C.R= 2.4, $p>0.05$), and jointly determining the needs of the stakeholders (C.R= 2.6, $p>0.01$). These findings are in agreement with the results of Ogunremi and Olaniran (2012). To these scholars, researchers are more involved in the linkage activities than extension agents. Aforementioned findings and discussions lead to the conclusion that there is a need for a closer collaboration between researchers and extension workers to enhance and strengthen the meaningful linkages.

In addition to identifying existing linkages, the study also provides information on the strength of those linkages presented in Table 2. As depicted by the table, strong linkages were only realized in three items: sharing of information, joint seminars and workshops, and joint training of the stakeholders (mean ≥ 2.3). Other existing linkages received low responses from extension workers and researchers (mean less than 2.3). A comparison between extension workers and researchers regarding the strength of linkages indicated a significant difference when they jointly developed technologies ($t = 2.95$, $p > 0.01$) and determined needs of the stakeholders in association ($t= 2.41$, $p>0.01$). Such linkage activities received different responses because researchers were more qualified and actively involved in the development of technologies and organizing training programmes for the extension workers.

Table - 2 Differences between researchers and extension workers depending on the strength of linkages between research and extension.

Linkage Mechanisms	Implementation Level (%)			Strength of Linkage					
	R	E	C.R	R		E		t	P
				Mean	SD	Mean	SD		
A. Planning & Review									
Joint problem diagnosis	52.8	49.3	0.62	2.07	2.03	1.95	2,07	0.53	0.59
Joint priority setting and planning	34.1	27.1	1.3	1.23	1.77	1.03	1.74	1.01	0.31
Joint development of strategies	38.2	25.8	2.3*	1,41	1.85	0.94	1,65	2.43	0.15
Joint programme planning	44.7	36.7	1.5	1.6	1.85	1.38	1.87	1.03	0.3
Joint programme evaluation	36.6	35.5	0.2	1.34	1.84	1.28	1.78	0.31	0.75
B. Programme Activities									
Joint research projects (local and international funding)	35	32.1	0.5	1.27	1.78	1.21	1.81	0.31	0.75

Joint technology development	44.7	32.1	2.3*	1.66	1.91	1.14	1.71	2.95**	0.01
Joint technology demonstration	56.9	51.6	0.9	2.21	2	1.96	1.97	1.1	0.26
Joint technology evaluation	31.7	32.1	0.1	1.16	1.74	1.23	1.85	0.37	0.7
C. Use of resources									
Exchange of personnel/staff rotation	46.3	46.2	0	1.83	2.04	1.8	2.02	0.14	0.88
Joint use of facilities (e.g., laboratories, equipment)	45.5	43.9	0.3	1.77	2.01	1.78	2.09	0.06	0.94
Sharing of financial resources and materials	39.8	39.4	0.1	1.48	1.89	1.54	1.97	0.25	0.8
D. Information									
Sharing of information (e.g., office visits, telephone)	65	56.6	1.6	2.73	2.11	2.42	2.2	1.26	0.2
Jointly writing and reviewing of the extension publications	60.2	51.6	1.6	2.21	1.78	2	2.02	0.91	0.36
Joint reporting	56.1	50.2	1.1	2	1.81	1.88	1.95	0.54	0.58
Holding joint seminars and workshops	80.5	69.2	2.4*	2.92	1.55	2.57	1.83	1.77	0.07
E. Training									
Jointly determining the needs of the stakeholders	57.7	43	2.6**	2.07	1.78	1.57	1.84	2.41**	0.01
Organizing Joint training sessions for the stakeholders (short-term)	65	62.9	0.4	2.31	1.77	2.37	1.91	0.25	0.79
Overall Average	49.5	43.6	1.05	1.87	1.86	1.66	1.91	0.33	0.71

(R) Researchers (E) Extension workers
*significant at 0.05 level ** significant at 0.01 level

Constraints hampering research-extension linkage: The findings of problems facing the respondents in effectively collaborating with each other are shown in Table 3. A lack of incentives (mean 2.49; SD 0.7) was identified as the major constraint, obstructing the implementation of linkage mechanisms. Similarly, a study conducted in Tanzania by Chiligati (2010) recommended an incentive system that rewards the research and extension staff for their collaborations that aim at strengthening research-extension-farmer linkages. Among the constraints, lack of physical and financial facilities ranked2nd (mean 2.4; SD 0.75). It was noticed in the study that implementation of linkage is negatively impacted due to lack of such activities as on-farm trials and quarterly training workshops. Adequate funding was needed to support an increased involvement of partners to ensure regular implementation and follow up the linkage activities. To increase funding for linkages, the central government must recognize agriculture as a priority sector. The findings of the study are in agreement with Dimelu and Emodi (2012), as they also believed that inadequate sources of funding and the government attaching poor commitment to the extension were the major constraints resulting in weak research-extension linkages in Nigeria.

In addition, the findings presented in Table 3 revealed that administrative routines between research and extension are another negative factor, ranking 3rd (mean 2.35; SD 0.76) and resulting in the weak linkage as identified by the researchers and extension workers. Slow official procedures employed in the linkage activities could be improved by the government by replacing them with new information management systems. Application of new information management systems could be an effective way to facilitate information flow between organizations.

Approaches to support research-extension linkage: Respondents were also asked about their views on the level of capability of approaches suggested for strengthening linkage activities as shown in Table 4. The ranking order was calculated on the basis of mean and standard deviation to identify the priority for each approach. The results revealed that approaches of the use of ICTs (mobile- virtual networks) in extension work and establishment of a national coordination council (consisting of research and extension representatives) ranked first and second with percentages of 77.44% and 72.35%, respectively. The rest of the approaches appeared to be moderate in their levels with percentages between 44-59%.

ICT networking is known to provide upstream/downstream movement as well as backward/forward collaboration and cooperation between research and extension. According to Hansen *et al*., (2014) ICT has a great potential for facilitating platforms for communication, interaction, knowledge sharing, preservation of information and, as such, stimulate multi-actor innovation.

In the present study, the respondents highlighted the importance of establishing and institutionalizing the coordination committee at the national level to link up research and extension units. The

national committee would fill the linkage vacuum at the ministry level and help improve coordination between research and extension. In a similar vein, Al-Rimawi *et al*. (2013) state that setting up a broad-based committee is very important to coordinate activities, strengthen linkages and determine how efforts can best be allocated to meet the most urgent research and technology transfer needs.

Table 3. Constraints confronting research-extension linkage from the view point of the researchers and extension workers

Problems	Mean	SD	Rank
Overlapping tasks between research and extension.	2.17	0.78	9
Unclear specific role of researchers and extension in the joint activities.	1.97	0.8	12
Unclear role of researchers and extension in the joint activities.	2.08	0.72	11
Unclear laws and legislations organizing research-extension relationship	2.22	0.82	6
Administrative routine between research extension	2.35	0.76	3
Variation of expected goals between research and extension	2.18	0.75	8
Lack of physical and financial facilities to undertake joint activities.	2.4	0.75	2
Lack of incentives to encourage cooperation between research and extension	2.49	0.7	1
Researchers' perception that their role is limited to conducting research	2.23	0.73	4
Lack of farmers' trust and confidence in research outcomes.	2.22	0.74	5
Non-existence of priorities and problems of farmers in different regions.	2.2	0.67	7
Applied research is not oriented towards real problems of farmers.	2.14	0.74	10

Table 4. Capability of suggested approaches to support linkage mechanisms between research and extension

Approaches	Mean	SD	Rank
Establishing a national coordination council consisting of the research and extension representatives	72.35	25.593	2
Forming an annual committee to coordinate the joint activities	59.18	23.345	4
Training of the staff and their recruiting	59.09	26.537	5
Conducting workshops to explain roles and eliminate sensitivity between researchers and extension workers	57.86	26.295	6
Combining research and extension under a unified leadership	59.49	28.305	3
Conducting administrative adjustments by dividing Ministry of Agriculture to geographically based directorates (North-South, etc.), whereas each province consists of extension and research staff.	53.29	30.534	7
Dividing Ministry of Agriculture to field based directorates (animal production, horticulture, etc.) and provided with extension and research staff in each discipline	44.21	32.053	8
Development use of ICTs (mobile-virtual networks) in extension work	77.44	28.551	1

Conclusions: This study analysed the implementation and strength levels of 18 mechanisms employed to strengthen research-extension linkage. The sharing of information, joint seminars and workshops, and joint training of the stakeholders were only identified as strong mechanisms by the respondents' points of view. The negative factors that inhibit linkages were lack of incentives, lack of physical and financial facilities, and administrative routines. To strengthen the research-extension linkages, the study suggests developing and using ICTs (mobile-virtual networks) in extension work and establishing a national coordination council, including research and extension representatives. Based on the findings of the study, it is recommended to develop the provision of extension services by utilizing ICTs, forming a national coordination committee for planning, implementing and evaluating different linkage activities, increasing incentives for researchers and extension workers based on joint work in different linkage activities, focusing on participatory approaches in implementing extension methods with farmers, and reconsidering job descriptions of researchers and extension workers in accordance with joint activities.

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