



Evaluation of Selected Agricultural Extension Approaches Operating in the Sudan

Ahmed M. Abdel Rahman, Musa H. Elfaki and Elbadawi K. H. Khalifa

Department of Agricultural Extension and Training, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan

Received: 13 June 2021

Accepted: 15 July 2021

Published: 30 July 2021

ABSTRACT

The main objective of this study is to evaluate selected agricultural extension approaches operating in Sudan to recommend the suitable ones to suit the conditions of the country. Field surveys were used to collect data from 160 extensionists and 400 farmers. Two types of close-ended questionnaires were constructed and used in data collection. The collected data were coded, fed to the computer, and statistically analyzed using the Statistical Packages for Social Sciences (SPSS), discussed and interpreted using percentage, frequency distribution, and the F Test. The results showed that the FFS approach is the suitable one for Sudan conditions among the selected approaches operating in the country. From the present study, it can be concluded that the FFS approach is a superior approach in the majority variables of the study and with minor improvements FFS approach can be more appropriate for Sudan conditions.

Keywords: Agricultural extension, Extension approaches, Evaluation, Sudan conditions, Sudan

1. Introduction

During the past twentieth century, almost all agricultural extension approaches were originally organized as departments within their country's ministry of agriculture. As a result, the majority of these extension organizations are government agencies with a top-down management structure. The primary national agricultural development goal in most countries following independence was to achieve national food security. Therefore, most extension programmes focused primarily on technology transfer activities that would improve the production of basic food crops, with far less attention and fewer resources being given to other extension programs and activities, including livestock, horticulture, fisheries, and natural resource management. Over time, national governments and donors became increasingly concerned about the performance of national extension systems, and different models have been tried and tested (Swanson and Riikka 2010). In Sudan agricultural extension services were started in 1959 as ministry-based agricultural extension services (known as National Agricultural Extension Administration at the federal level) after the Second World War as a part of American technical aid for developing countries. From that time to nowadays many development and structural changes were made to this administration. In the year (2004) its name was changed to the Administration of Extension and Technology Transfer. This administration has a branch in each State Ministry of Agriculture of the country and dominated the majority of organizations that provided agricultural extension services in the country (Abdel Rahman and Omran, 2016).

The use of the term extension approach is very heterogeneous, some sort of a definition in advance seems to be useful. We would like to use the extension approach in a wide understanding synonymous with the extension system (Hoffmann, 2006). The agricultural extensional approach is like a doctrine for the system, which informs, stimulates, and guides such aspects of the system as its structure, its leadership, its program, its resources, and its linkages. Axinn (1988) cited that the approach is the style of action within the system. It's like the drummer which sets the pace for all activity of the system. Hagmann *et al.* (2000) defined an approach as a way in which different guiding principles are

Corresponding Author: Ahmed M. Abdel Rahman, Department of Agricultural Extension and Training, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan.
E-mail: mirghani999@yahoo.com

applied in a specific situation to fulfill different purposes. It consists of a series of procedures for planning, organizing, and managing the extension institution as well as for implementing practical extension work by staff with technical and methodological qualifications and using the necessary and appropriately adapted means. Various extension approaches completed successfully by giving satisfactory results in past to improve the farmers' knowledge regarding newly developed agricultural technologies. Some of them are continuously running in the present along with newly developed extension approaches and require little modifications in the future to increase the agricultural potential of the country (Kamalpreet and Prabhjot, 2018).

In various parts of the world, agricultural extension approaches have addressed themselves to the problems and issues with different types of agricultural extension approaches. Some of these approaches are more likely to fit much better than others, in any particular situation and time. Some approaches are much better suited to certain purposes than other approaches. Some of them are most costly than others. With certain assumptions, some approaches are better than others. Many approaches have been tested and adopted by countries in Africa to improve the effectiveness and efficiency of the technology dissemination process. Two major approaches of agricultural extension have dominated the landscape of these countries since independence. The quantitative ideas of the sixties were that technology would be developed in the temperate areas and transferred to Africa through the traditional top-down transfer of technology model. This idea did not yield the required dividend and it paved way for the Training and Visit (T&V) approach-a highly decentralized, management-oriented approach (Axinn, 1988).

The World Bank introduced the T & V approach to Africa in the 1980s. By the end of the 1980s, the T & V was used by at least 30 African countries. Despite the funding and promotion by the World Bank, the T & V approach is ineffective, inefficient, and unsustainable. The debate over the merits of one approach over another has become a distraction, even though, in most countries, some approaches operate at the same time, complementing each other and satisfying the varied needs of different types of farmers. Thus, the question is not which single approach is best, but rather, what approach is most appropriate to a particular situation or extension programme (Axinn, 1988). The effective extension approach is the approach that was based on principles of agricultural extension which were described by many researchers. Different methodologies were used by many researchers to measure the effectiveness of several extension approaches, models, and services (Abdel-Maksoud, 2019).

In Sudan, many efforts have been exerted to improve the effectiveness of agricultural extension function in agriculture and rural development. Some agricultural extension approaches were applied through the past years without any evaluation studies to select the appropriate ones that suit the conditions of the country. These approaches include training and visit approach T&V and Farmer Field School approach (FFS) (IFPRI, 2012). Until now, agricultural extension organizations in Sudan apply many extension approaches such as the General Extension approach, Commodity Development approach, Training & Visit approach, Integrated Agricultural Development approach, Integrated Rural Development approach, and Farmer field school (FFS) approach (El Hassan, 2004; Mohamed, 2010; Omer, 2013). Therefore, there is a need to study those approaches, to know the problems confronting them and see how they can be modified to suit the local conditions. Approaches that have been tried in some parts of Sudan and which will be subjected to evaluation and comparison are: (1) The General Extension approach (2) The Commodity Development approach (3) The Project approach (4) The Farmer Field Schools approach.

The main objective of this study is to evaluate selected agricultural extension approaches operating in Sudan to recommend the suitable ones to suit the conditions of the country. Results may recommend modification of some approaches to be efficiently applied in the prevailing conditions.

The specific objectives of this study are to compare four agricultural extension approaches that were operating or are operating in Sudan. These are the General Agricultural Extension approach, Commodity Development approach, FFSs approach, and the Project approach according to the following criteria (aspects of agricultural extension): From one to seven as used by Axinn:

- 1- Programme.
- 2- Clientele.
- 3- Field personnel.
- 4- Organization structure.
- 5- Financial affairs.
- 6- Leadership.

7- Linkages.

We added and used the following four criteria

8- Management.

9- Monitoring and evaluation.

10- Communication patterns.

11- Infrastructure and social services

2. Materials and Methods

This study was conducted in the Gezira State (private farms), the Gezira Scheme, and the Kadugli locality (Southern Kordofan State). The study population was divided into two main categories, i.e., 1- extensionists and 2- farmers. The population size of agricultural officers of three approaches (General extension approach, project approach, and farmers field Schools approach) are small therefore all extension officers of each approach were selected in addition to a sample of 60 extension officers for commodity development approach using the simple random sampling technique. According to the population size of farmers of each agricultural extension approach, the sample size of 100 farmers was determined for each approach.

Field surveys were used to collect data from 160 extension officers and 400 farmers randomly selected using the simple random sampling technique. Two types of close-ended questionnaires were constructed and used in data collection, one for extension officers and the second one for farmers. The collected data were coded, fed to the computer and statistically analyzed using the Statistical Packages for Social Sciences (SPSS), and interpreted using percentage, frequency distributions, and analysis of variance (ANOVA test) at 0.05 significance level or less.

ANOVA Table

Variance Source	Degrees of Freedom (df)	Sum of Squares (SS)	Mean Sum of Squares (MS)	F-Statistics	P-value
Treatment Effect (Between Group)	k-1	$\sum_{i=1}^k n_i (\bar{y}_{i.} - \bar{y})^2$	$MST(Between) = \frac{SST(Between)}{df(Between)}$	$F_o = \frac{MST(Between)}{MSE(Within)}$	$P(F_{(df(Between), df(Within))} > F_o)$
Error (Within Group)	n-k	$\sum_{i=1}^k \sum_{j=1}^{n_i} (y_{i,j} - \bar{y}_{i.})^2$	$MST(Within) = \frac{SSE(Within)}{df(Within)}$		F-Distribution Calculator
Total	n-1	$\sum_{i=1}^k \sum_{j=1}^{n_i} (y_{i,j} - \bar{y})^2$	as		ANOVA Activity

2.1. ANOVA Hypotheses

The general form of the ANOVA hypotheses is:

$$H_o : \mu_1 = \mu_2 = \mu_3 = \dots = \mu_k$$

$$H_a : \mu_i \neq \mu_j \text{ for some } i \neq j$$

Note that H_o is compound hypothesis, when $k > 2$, so rejecting H_o doesn't tell us which μ_i 's are different. It only tells us that some two are not equal.

Test Statistics: The test statistic:

$$F_o = \frac{MST(Between)}{MSE(Within)}$$

If F_o is large, then there is a lot of between group variation, relative to the within group variation. Therefore, the discrepancies between the group means are large compared to the variability within the groups (error).

Hence, large values of F_o provide strong evidence against H_o .

3. Results and Discussion

3.1. Comparison between the four extension approaches using the descriptive analysis

The comparison between the four extension approaches using the descriptive analysis is presented in table 1 and table 2.

3.1.1. Farmers

This part covers farmers' perception about the four approaches regarding clientele, linkages, communication patterns and infrastructure and social services.

Table 1: Ranking of indicators as perceived by the farmers in the four extension approaches

Indicators	FFS approach		Project approach		General approach		Commodity development approach	
	Score%		Score%		Score%		Score%	
1. Clientele coverage	97	4	100	4	94	4	73	3
2. Focus of the approach	99	4	100	4	85	4	85	4
3. Focus of the approach on ethnic and social groups	100	4	100	4	89	4	87	4
4. Types of land ownership	78	4	100	4	89	4	65	3
5. Adjust to change	98	4	98	4	71	3	70	3
6. Farmers Linkages with fellow farmers and friends	100	4	100	4	73	3	63	3
7. Farmers linkages with extension organizations	100	4	100	4	60	3	64	3
8. Farmers linkages with rural organizations	100	4	100	4	51	3	63	3
9. Farmers linkages with inputs supply organization	100	4	100	4	56	3	71	3
10. Farmers linkages with agricultural research and education institutions	100	4	100	4	70	3	72	3
11-Use of communication methods	70	3	37	2	46	2	32	2
12-Nature of extension message	87	4	93	4	52	3	64	3
13-Cost of information support	95	4	51	3	38	2	50	2
14-source of the message	76	3	93	4	73	3	71	3
15. Kind of available power	100	4	93	4	71	3	85	4
16. Availability of good roads	100	4	100	4	100	4	92	4
17. Availability of airports ad seaports	100	4	100	4	100	4	92	4
18. Kind of machines available	89	4	93	4	54	3	76	4
19. Availability of cash or credits for farm investment	55	3	100	4	100	4	80	4
20. Source of finance for farm investment	91	4	100	4	100	4	83	4
21. Utilization of cash or credit facilities	100	4	100	4	100		83	4
22. Reasons for not utilizing cash or credit facilities	100	4	100	4	100		00	1
23. Impact of utilization of cash or credit facilities	00	1	00	1	00		57	3
24. Types of organizations working in the area	87	4	100	4	100		71	3
25. Export and import policies for farm produce and inputs	98	4	100	4	100		90	4
26. Incentives given to farmers	69	3	100	4	57		50	2
Total	97		98		86		83	

Ranking levels:

0 — 25 = 1 26 — 50 = 2 51 — 75 = 3 76 — 100 = 4

Table 1 shows the following

1- Based on the indicator used (coverage of the approach should be local), the project approach, farmer's field schools approach and general approach respectively seem to be the appropriate approaches for Sudan conditions.

- 2- Based on the indicator used (the focus of the approach should be on a broader range of people including smaller, self-sufficient mixed crop and livestock farm families (Ltanobi *et al.*, 1997)), the project approach, farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions.
- 3- Based on the indicator used (the focus of the approach should include spread of ethnic and social groups), the project approach, farmer's field schools approach, the general approach and the commodity development approach respectively seem to be the appropriate approaches for Sudan conditions.
- 4- Based on the indicator used (the suitable type of land ownership is the private ownership), the general approach seem to be the appropriate approach for Sudan conditions.
- 5- Based on the indicator used (the approach should likely to be able to adjust to change in local availability of agricultural inputs), farmer's field schools approach and the project approach respectively seem to be the appropriate approaches for Sudan conditions. This result agrees with result cited by Axinn (1988).
- 6- Based on the indicator used (the approach should encourage farmer's linkages with fellow farmers and friends (Swanson, 1997), farmer's field schools approach seem to be the appropriate approach for Sudan conditions.
- 7- Based on the indicator used (the approach should encourage farmer's linkages with extension organizations working in the area (Swanson, 1997)), the farmer's field schools approach seem to be the appropriate approach for Sudan conditions.
- 8- Based on the indicator used (the approach should encourage farmer's linkages with rural organizations working in the area (Swanson, 1997), the farmer's field schools approach seems to be the appropriate approach for Sudan conditions.
- 9- Based on the indicator used (the approach should encourage farmer's linkages with inputs supply organizations working in the area (Swanson, 1997), farmer's field schools approach seem to be the appropriate approach for Sudan conditions.
- 10- Based on the indicator used (the approach should encourage farmer's linkages with agricultural research and education institutions (Swanson, 1997), farmer's field schools approach and general approach respectively seem to be the appropriate approaches for Sudan conditions.
- 11- Based on the indicator used (the approach should tend to facilitate the use of direct contact methods (individual and group contact methods) (Axin, 1988)), farmer's field schools approach and project approach respectively seem to be the appropriate approaches for Sudan conditions. Similarly, N. Mollel and Antipas (1999) found that in the T & V use of mass method was found to be very little in Tanzania.
- 12- Based on the indicator used (the approach should tend to use wide- ranging technology to meet local needs and interests), the farmer's field schools approach seems to be the appropriate approach for Sudan conditions. This result opposes the result reported by Axinn (1988) who mentioned that the general approach tends to use one simple standardized technology at the time. This result agrees with the result cited by Axinn (1988) who found that the project approach tends to use one simple standardized technology at a time, also farmer's field schools approach and commodity development approach tend to use a wide- ranging message to meet local needs and interests.
- 13- Based on the indicator used (the approach should have a lower cost for information support), the farmer's field schools approach seems to be the appropriate approach for Sudan conditions.
- 14- Based on the indicator used (the approach should tend to seek appropriate messages (technology) wherever they may be found and thus is more independent of other organizations) , the project approach and farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions. This result agrees with the result cited by Axinn (1988) who indicated that the participatory approach and commodity development approach tend to be more independent as they can seek appropriate technology wherever it may be found. This result also opposes the result reported by Axinn (1988) who mentioned that some approaches tend to be absolutely dependent on agricultural research organizations to give them the message they take to farmers, these approaches include the general approach and project approach.
- 15- Based on the indicator used (the approach should tend to use all available energy especially petroleum) ,the farmer's field schools approach and commodity development approach respectively seem to be the appropriate approaches for Sudan conditions.

- 16- Based on the indicator used (good roads should be available), no significant difference was observed between the four extension approaches.
- 17- Based on the indicator used (airports and seaports should be available), no significant difference was observed between the four extension approaches.
- 18- Based on the indicator used (tractors and their equipment should be available), the farmer's field schools approach seems to be the appropriate approach for Sudan conditions.
- 19- Based on the indicator used (cash or credit for farm investment should be available), the project approach, general approach and commodity development approach respectively seem to be the appropriate approaches for Sudan conditions.
- 20- Based on the indicator used (source of finance should be available especially from Sudanese Agricultural Bank), the project approach, general approach, and farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions.
- 21- Based on the indicator used (sources of finance should be utilized), the commodity development approach seems to be the appropriate approach for Sudan conditions.
- 22- Based on the indicator used (mortgage should be below), no significant difference was observed between the four extension approaches.
- 23- Based on the indicator used (all types of organizations can be found in the area), no significant difference was observed between the four extension approaches.
- 24- Based on the indicator used (export and import policies for farm produce and inputs should be well-identified), no significant differences were observed between the four extension approaches.
- 25- Based on the indicator used (availability of all inputs with reasonable prices should be applied), the project approach seems to be the appropriate approach for Sudan conditions.

3.1.2. Extension officers

This part covers the extensionists' perception about the four approaches regarding agricultural extension programme, field personnel, financial affairs, organization structure, leadership, management and monitoring and evaluation.

Table 2 revealed the following

- 1- Based on the indicator used (scope of agricultural extension programme should be an area or locally-oriented (Ltanobi *et al.*, 1997), the project approach seems to be the appropriate approach for Sudan conditions.
- 2- Based on the indicator used (the programme should satisfy individual, family and neighborhoods' needs (Ltanobi *et al.*, 1997), the farmer's field schools approach, commodity development approach, project approach and general approach respectively seem to be the appropriate approaches for Sudan conditions.
- 3- Based on the indicator used (the objectives of the programme should aim at increasing food production and consumption for family and the country, increasing production of export crops and improving family living standards), the farmer's field schools approach seems to be the appropriate approach for Sudan conditions.
- 4- Based on the indicator used (the programme should be able to change in response to feedback from rural villages (Ltanobi *et al.*, 1997) ,the general approach, farmer's field schools approach and project approach respectively seem to be the appropriate approaches for Sudan conditions. This result opposes the result reported by Axinn (1988) who found that some approaches tend to be much less responsive in their programme to local people's views when it comes to changing the programme; these include project approach, general approach. This result also agrees with the result cited by Axinn (1988) who mentioned that the commodity development approach is not responsive to local rural village feedback and the participatory approach is responsive to local rural village feedback.

Table 2: Ranking of indicators as perceived by the extension officers in the four approaches

Indicators	FFS approach		Project approach		General approach		Commodity development approach	
	Score%		Score%		Score %		Score %	
1-Scope of the programme	75	3	87.5	4	79.42	4	63.3	3
2-Programme satisfaction	100	4	82.5	4	82.35	4	91.67	4
3-Objectives of the programme	70	3	67.5	3	67.65	3	41.67	2
4-Flexibility of the programme	95	4	85	4	97.06	4	73.33	3
5-Focus of the programme	85	4	100	4	82.36	4	70	3
6.Distribtuion of extensionists according to their communities	85	4	87.5	4	76.47	4	91.67	4
7. Qualifications	100	4	82.5	4	88.24	4	100	4
8. Number of training courses attended	85	4	62.5	3	88.4	4	85	4
9. Movement	90	4	72.5	3	88.24	4	91.67	4
10. Nature of appointment	100	4	50	2	100	4	85	4
11. The payment	75	3	72.5	3	55.88	3	50	2
12. Sex ratio	100	4	95	4	50	2	100	4
13. Frequency of reporting extension activities	80	4	100	4	91.18	4	50	2
14. Frequency of contact with farmers	65	3	95	4	61.77	3	51.67	3
15. Extension services given to farmers	90	4	72.5	3	64.71	3	63.33	3
16-Source of financial support	80	4	87.5	4	82.36	4	65	3
17-Provision of jobs	80	4	65	3	58.83	3	58.34	3
18-Cost of transportation	50	2	60	3	50	2	58.33	4
19. Control of organization	55	3	57.5	3	82.35	4	73.33	3
20. Use of subject matter specialists	70	3	52.5	3	76.47	4	78.33	3
21. Participation of rural people	95	4	60	3	58.82	3	60	3
22- Authority of organization	60	3	42.5	2	94.12	4	81.67	4
23- Representation	90	4	92.5	4	55.88	3	66.67	3
24- Origin of leadership	85	4	90	4	51	3	75	3
25. Skilled farmers	95	4	80	4	91.18	4	86.67	4
2.6 Time length of the approach	95	4	50	2	91.18	4	66.67	3
27-Type of evaluation followed	95	4	97.5	4	67.65	3	81.67	
28- Time of implementing evaluation	70	3	95	4	58.82	3	60	
Total	98		96		98		91	
General total	199		194	4	184		174	
General mean	69		3.59		3.40		3.25	
Rank	1		2		3		4	

Ranking levels

0 — 25 = 1 26 —50 = 2 51 —75 = 3 76 —100 =4

- 5- Based on the indicator used (the programme should focus on both farming production technology and lifting social and educational standards of rural life) , farmer's field schools approach and general approach respectively seem to be the appropriate approaches for Sudan conditions.
- 6-Based on the indicator used (the extensionists should be from inside the rural community of assignment), the commodity development approach, project approach and farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions. This result opposes the result cited by Axinn (1998) who mentioned that most agricultural extension approaches are likely to be accompanied by field personnel selected from persons who are outsiders to the rural community.
- 7- Based on the indicator used (the extensionists should have at least a bachelor’s degree in agriculture or related field (Vijayaragavan and Singh 1997) , farmer's field schools approach, commodity development approach, general approach, and the project approach respectively seem to be the appropriate approaches for Sudan conditions. This result opposes the results reported by Vijayaragavan and Singh (1997) (cited in Swanson *et al.*, 1990) who mentioned that a worldwide analysis of the status of agricultural extension reveals the low level of formal education and training of field extension agents in developing countries.

- 8- Based on the indicator used (the extensionists should attend training sessions during their periods of work (Vijayaragavan and Singh 1997), the general approach seems to be the appropriate approach for Sudan conditions. This result agrees with the results reported by Vijayaragavan and Singh (1997) (cited in Swanson *et al.*, 1990) who mentioned that a worldwide analysis of the status of agricultural extension reveals the low level of formal education and training of field extension agents in developing countries. Also, this result agrees with the result reported by Abdul Halim *et al.*, (1997) who found that the deficiencies in knowledge, skills and ability among extension personnel particularly those of Asia, Africa, and Latin America are remarkable.
- 9- Based on the indicator used (the extensionists should remain at the post for a longer period of time), the general approach seems to be the appropriate approach for Sudan conditions.
- 10- Based on the indicator used (period of appointment should be more than 10 years (permanent)), the general approach, farmer's field schools approach and commodity development approach respectively seem to be the appropriate approaches for Sudan conditions.
- 11- Based on the indicator used (the payment (salary) should be high for all scales), no significant difference was observed between the four extension approaches. This result agrees with the result reported by Wiggins (cited in Vijayaragavan and Singh 1997) who mentioned that the extension agents are not only poorly paid but are paid late and after reminders or visits to headquarters.
- 12- Based on the indicator used (the approach should have gender sensitivity(Axinn, 1988)) , the farmer's field schools approach, commodity development approach, and the project approach respectively seem to be the appropriate approaches for Sudan conditions. This result agrees with the result reported by Jiggins *et al.* (1997) who found that in the overwhelming majority of countries, extension services have been staffed predominantly by men. Only countries such as the Philippines have women field staff deployed in sufficient numbers and with sufficient resources to become effective agents of change among women farmers. In some countries, individual contact has been complemented by group contact, especially, but not only, where it may be difficult for male change agents to have any type of contact with individual women other than their own relatives. In many cultural settings, group extension significantly increases women's access, because the group context calms the fears of male extension agents, husbands, and women about transgressing norms of approved social contact. This may be particularly true in Islamic areas where women are in partial or total seclusion. Furthermore, in Islamic societies, there are probably not enough qualified adult females who can take up the post of a change agent at the field level.
- 13- Based on the indicator used (frequency of extension activities reports (documentation) should be at least once every 30 days (monthly)), the project approach, general approach, and farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions.
- 14- Based on the indicator used (frequency of contacts with farmers should be every week), no significant difference was observed between the four extension approaches.
- 15- Based on the indicator used (services given to farmers should include problem- solving practices, new information, and arrangement for inputs supply (Ltanobi *et al.*, 1997), the farmer's field schools approach seems to be the appropriate approach for Sudan conditions.
- 16- Based on the indicator used (financial support of the approach should be from different sources), no significant difference was observed between the four extension approaches. This result opposes the result reported by Axinn (1988) who mentioned that total financial support is most likely to come from central government with the general approach, commodity development approach and, the project approach.
- 17- Based on the indicator used (the approach should provide jobs for both rural and urban people), the farmer's field schools approach seems to be the appropriate approach for Sudan conditions. This result also opposes the result reported by Axinn (1988) who cited that several approaches tend to provide more jobs for urban educated unemployed people; these include the general approach and commodity development approach. By contrast the agricultural extension participatory approach tends to provide more jobs for trained rural youth.
- 18- Based on the indicator used (the approach should have reasonable cost for transportation), the project approach seems to be the appropriate approach for Sudan conditions.
- 19- Based on the indicator used (the approach should tend to fit decentralization of control of organization), the project approach and farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions. This result agrees with the result reported by Axinn

- (1988) who found that the general approach and commodity development approach tend to be centrally controlled. The other approaches tend to fit decentralization of control of organization include extension participatory approach. This result also opposes the result reported by Axinn (1988) who cited that some approaches tend to fit centralization of control of the organization, these include the project approach.
- 20- Based on the indicator used (the approach should tend to emphasize the use of subject matter specialists (S.M.S.)), the project approach seems to be the appropriate approach for Sudan conditions. The result of this study agrees with the result reported by Abdul Halim and Ali (1997) who found that the ratio of subject matter specialists (SMS) to field staff is low in Asia, Africa, the Near East and, Latin American countries.
 - 21- Based on the indicator used (authority of organization can be part of central, local (State) government and scheme administration authority Axinn (1988), no significant difference was observed between the four extension approaches.
 - 22- Based on the indicator used (the organization should be a representation of broader rural development fields), the project approach and farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions.
 - 23- Based on the indicator used (origin of leadership should be originated among clientele personnel), the project approach and farmer's field schools approach respectively seem to be the appropriate approaches for Sudan conditions. This result agrees with the result reported by Axinn (1988) who cited that with some approaches leadership tends to be within central government and emerge through the bureaucracy, these include the general approach. Also, this result opposes the result reported by Axinn (1988) who found that with some approaches leadership tends to be within central government and emerge through the bureaucracy, these include the commodity development approach and the project approach. This result also agrees with the result reported by Axinn (1988) who mentioned that extension participatory approach in which leadership tends to be at a local level and emerges through local services.
 - 24- Based on the indicator used (the majority of farmers should be skilled (technical)), no significant difference was observed between the four extension approaches.
 - 25- Based on the indicator used (time length of the approach should be extended more than 10 years), the general approach seems to be the appropriate approach for Sudan conditions.
 - 26- Based on the indicator used (type of evaluation followed should be summative evaluation (Ltanobi et al., 1997), farmer's field schools approach and the commodity development approach respectively seem to be the appropriate approaches for Sudan conditions.
 - 27- Based on the indicator used (time of implementing evaluation should be before, during and, after implementing the programme evaluation (Ltanobi et al., 1997), the project approach seems to be the appropriate approach for Sudan conditions.

According to above the descriptive analysis of this study the four extension approaches can be ranked as shown in table 1 and 2 as follows

1. FFS approach.
2. Project approach.
3. General approach.
4. Commodity development approach.

4. Comparison between the four extensions approaches using the test of significance (one way ANOVA test)

4.1.Farmers

4.1.2. Clientele

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in clientele is shown in table 3:

The results indicate that there was a significant difference between the four extension approaches in the clientele of the approach. Using the descriptive analysis of this study the four extension approaches can be ranked according to their suitability for Sudan conditions as indicated in table 1.

Table 3: ANOVA test for the suitability of four extension approaches for Sudan conditions in clientele

Clientele	Project approach	FFS approach	General approach	Commodity development approach	Significance
1. Clientele coverage	100	97	94	73	0.015
2. Focus of the approach	100	99	85	85	
3. Focus of the approach on ethnic and social groups	100	100	89	87	
4. Types of land ownership	100	78	89	65	
Total	400	374	357	310	
Mean	100	93.50	89.25	77.50	
Rank	1	2	3	4	

Significance level 0.05 or less

4.1.3. Linkages

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in linkages is presented in table 4

Table 4: ANOVA test for the suitability of four extension approaches for Sudan conditions in linkages

Linkages	FFS approach	Project approach	Commodity development approach	General approach	Significance
1. Adjust to change	98	96	70	71	0.00
2. Farmers Linkages with fellow farmers and friends	100	87	63	73	
3. Farmers linkages with extension organizations	100	58	64	60	
4. Farmers linkages with rural organizations	100	70	63	51	
5. Farmers linkages with inputs supply organization	100	59	71	56	
6. Farmers linkages with agricultural research and education institutions	100	99	72	70	
Total	598	469	403	381	
Mean	99.67	78.17	67.17	63.50	
Rank	1	2	3	4	

Significance level 0.05 or less

The results showed that there was a significant difference between the four extension approaches in linkages of the approach. Using the descriptive analysis of this study the four extension approaches can be ranked according to their suitability for Sudan conditions as represented in table 1.

4.1.4. Communication patterns:

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in communication patterns of the approach is shown in table 5:

Table 5: ANOVA test for the suitability of four extension approaches for Sudan conditions in communication patterns

Communication patterns	Project approach	General approach	FFS approach	Commodity development approach	Significance
1-Use of communication methods	37	46	70	32	0.235
2-Nature of extension message	93	52	87	64	
3-Cost of information support	51	38	95	50	
4-source of the message	93	73	76	71	
Total	274	209	328	217	
Mean	68.5	52.25	82	54.25	
Rank	2	4	1	3	

Significance level 0.05 or less

The results revealed that there was no significant difference between the four extension approaches in communication patterns, but despite of this, the FFSs approach remains the suitable one for Sudan conditions.

4.1.5. Infrastructure and social services

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in Infrastructure and social services is shown in table 6:

Table 6: ANOVA test for the suitability of four extension approaches for Sudan conditions in Infrastructure and social services

Infrastructure and social services	Project approach	FFS approach	General approach	Commodity development approach	Significance
1. Kind of available power	93	100	71	85	0.034
2. Availability of good roads	100	100	100	92	
3. Availability of airports ad seaports	100	100	100	92	
4. Kind of machines available	93	89	54	76	
5. Availability of cash or credits for farm investment	100	55	100	80	
6. Source of finance for farm investment	100	91	100	83	
7. Utilization of cash or credit facilities	100	100	100	83	
8. Reasons for not utilizing cash or credit facilities	100	100	100	00	
9. Impact of utilization of cash or credit facilities	00	00	00	57	
10. Types of organizations working in the area	100	87	100	71	
11. Export and import policies for farm produce and inputs	100	98	100	90	
12. Incentives given to farmers	100	69	57	50	
Total	1086	989	982	859	
Mean	90.50	82.42	81.83	71.58	
Rank	1	2	3	4	

Significance level 0.05 or less

The results showed that there was a significant difference between the four extension approaches in the value addition of products of the approach. Using the descriptive analysis of this study the four extension approaches can be ranked according to their suitability for Sudan conditions as presented in table 1.

4.2. Extensionists

4.2.1. Programme

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in the programme of the approach is presented in table 7:

Table 7: ANOVA test for the suitability of four extension approaches for Sudan conditions in programme

Programme	Project approach	General approach	FFS approach	Commodity development approach	Significance
1-Scope of the programme	87.5	79.42	75	63.33	0.504
2-Programme satisfaction	82.5	82.35	100	91.67	
3-Objectives of the programme	67.5	67.65	70	41.67	
4-Flexibility of the programme	85	97.06	95	73.33	
5-Focus of the programme	100	82.36	85	70	
Total	422.5	408.84	425	340	
Mean	84.5	81.77	85	68	
Rank	2	3	1	4	

Significance level 0.05 or less

The results showed that there was no significant difference between the four extension approaches in the programme, but despite of this, the FFSs approach remains the suitable one for Sudan conditions.

4.2.2. Field personnel

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in the field personnel of the approach is shown in table 8:

Table 8: ANOVA test for the suitability of four extension approaches for Sudan conditions in field personnel

Field personnel	FFS approach	Project approach	Commodity development approach	General approach	Significance
1. Distribution of extensionists according to their communities	85	87.5	91.67	76.47	0.033
2. Qualifications	100	82.5	100	88.24	
3. Number of training courses attended	85	62.5	85	88.4	
4. Movement	90	72.5	91.67	88.24	
5. Nature of appointment	100	50	85	100	
6. The payment	75	72.5	50	55.88	
7. Sex ratio	100	95	100	50	
8. Frequency of reporting extension activities	80	100	50	91.18	
9. Frequency of contact with farmers	65	95	51.67	61.77	
10. Extension services given to farmers	90	72.5	63.33	64.71	
Total	870	790	768.34	764.89	
Mean	87	7.79	76.83	76.49	
Rank	1	2	3	4	

Significance level 0.05 or less

The results indicate that there was a significant difference between the four extension approaches in the field personnel of the approach. Using the descriptive analysis of this study the four extension approaches can be ranked according to their suitability for Sudan conditions as presented in table 2.

4.2.3. Financial affairs

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in financial affairs of the approach is shown in table 9:

Table 9: ANOVA test for the suitability of four extension approaches for Sudan conditions in financial affairs

Financial affairs	Project approach	General approach	FFS approach	Commodity development approach	Significance
1-Source of financial support	87.5	82.36	80	65	0.525
2-Provision of jobs	65	58.83	80	58.34	
3-Cost of transportation	60	50	50	58.34	
Total	212.25	191.19	210	181.68	
Mean	70.83	63.73	70	60.34	
Rank	1	3	2	4	

Significance level 0.05 or less

The results revealed that there was no significant difference between the four extension approaches in financial aspects, but despite of this, the project approach remains the suitable one for Sudan conditions as shown in table 2.

4.2.4. Organizational structure

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in the organizational structure of the approach is presented in table 10:

Table 10: ANOVA test for the suitability of four extension approaches for Sudan conditions in the organizational structure

Organization structure	FFS approach	General approach	Commodity development approach	Project approach	Significance
1. Control of organization	55	82.35	73.33	57.5	0.061
2. Use of subject matter specialists	70	76.47	78.33	52.5	
3. Participation of rural people	95	58.82	60	60	
Total	220	217.64	211.66	170	
Mean	73.33	72.53	70.55	56.67	
Rank	1	2	3	4	

Significance level 0.05 or less

The results indicate that there was a significant difference between the four extension approaches in the organizational structure of the approach. Using the descriptive analysis of this study the four extension approaches can be ranked according to their suitability for Sudan conditions as shown in table 2.

4.2.5. Leadership

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in leadership is presented in table 11:

Table 11: ANOVA test for the suitability of four extension approaches for Sudan conditions in leadership

Leadership	Project approach	General approach	FFS approach	Commodity development approach	Significance
1- Authority of organization	42.5	94.12	60	81.67	0.410
2- Representation	92.5	55.88	90	66.67	
3- Origin of leadership	90	51	85	75	
Total	225	201	235	223.34	
Mean	75	67	78.33	74.45	
Rank	2	4	1	3	

Significance level 0.05 or less

The results revealed that there was no significant difference between the four extension approaches in leadership, but despite of this, the FFSs approach remains the suitable one for Sudan conditions.

4.2.6. Management

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in management is presented in table 12:

Table 12: ANOVA test for the suitability of four extension approaches for Sudan conditions in management

Management	FFS approach	General approach	Commodity development approach	Project approach	Significance
1. Skilled farmers	95	91.18	86.67	80	0.053
2. Time length of the approach	95	91.18	66.67	50	
Total	190	182.36	153.34	130	
Mean	95	91.18	76.67	65	
Rank	1	2	3	4	

Significance level 0.05 or less

The results revealed that there was a significant difference between the four extension approaches in the management of the approach. Using the descriptive analysis of this study the four extension approaches can be ranked according to their suitability for Sudan conditions as indicated in table 2.

4.2.7. Monitoring and evaluation

The F test for one way ANOVA to test the suitability of four extension approaches for Sudan conditions in monitoring and evaluation of the approach is presented in table13:

Table 13: ANOVA test for the suitability of four extension approaches for Sudan conditions in monitoring and evaluation

Monitoring and evaluation	Project approach	General approach	FFS approach	Commodity development approach	Significance
1-Type of evaluation followed	97.5	67.65	95	81.67	0.231
2- Time of implementing evaluation	95	58.82	70	60	
Total	192.5	126.47	165	141.67	
Mean	96.25	63.35	82.5	70.84	
Rank	1	4	2	3	

Significance level 0.05 or less

The results showed that there was no significant difference between the four extension approaches in monitoring and evaluation, but despite of this, the project approach remains the suitable one for Sudan conditions.

4.3. Ranking of the four extension approaches using the F test

According to the significant differences between the four extension approaches in their suitability for Sudan conditions, these four extension approaches can be ranked as follows:

1. FFS approach.
2. Project approach.
3. General approach.
4. Commodity development approach.

Similarly, Olayemi *et al.*, (2021) found that in Sub-Saharan, the review of top-down and participatory extension approaches has been studied shows that all the paradigm of the participatory extension were considered to be most beneficial to smallholder farmers.

5. Conclusions

From the present study, it can be concluded that the FFS approach is a superior approach in the majority variables of the study and with minor improvements FFS approach can be more appropriate for Sudan conditions.

References

- Abdel Rahman, A.M. and A.Y. Omran, 2016. Role of private agricultural extension sector in Gezira State, Sudan. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*. 25 (1): 281-288. www.asrjetsjournal.org.
- Abdel-Maksoud, B., 2019. The effective agricultural extension approach. *Asian Journal of Advanced Research and Reports*. 4(3): 1-8. <https://doi.org/10.9734/ajarr/2019/v4i330114>.
- Abdul Halim and M.M. Ali, 1997. Training and Professional Development. Chapter fifteen, Improving Agricultural Extension. A reference Manual published by FAO, Rome, Italy.
- Axinn, W.G., 1988. Guide on alternative extension approaches. FAO.
- El Hassan, I.M., 2004. Comparative study of Agricultural Extension approaches adopted in Rahad Agricultural Corporation. PhD thesis, University of Khartoum.
- Hagmann, J., C. Edward and G. Oliver, 2000. Learning about stakeholder/gender differentiation in agricultural research and extension. IFPRI discussion paper no. 00141 at Washington, D. C.
- Hoffmann, V., 2006. Extension approaches between blueprints and approach development. Hohenheim University publication No.RCE-06, Germany.
- IFPRI, 2012. Agricultural Extension and Advisory Services Worldwide: Republic of the Sudan. Available at <http://www.worldwide-extension.org/africa/republic-of-sudan>.

- Jiggins, J., R.K. Samanta, and J.E. Olawoye, 1997. Improving women farmers' access to extension services Chapter nine, Improving Agricultural Extension. A reference Manual published by FAO, Rome, Italy.
- Ltanobi, E., M. Omer and S.O. Elsadik, 1997. Fundamentals of Planning and Execution of Agricultural Extension Programmes. Publication of Omer Elmokhtar University, Lybia.
- Kamalpreet, K. and K. Prabhjot, 2018. Agricultural extension approaches to enhance the knowledge of farmers. *International Journal of Current Microbiology and Applied Sciences*, 7 (2): 2367-2376.
- Mohamed, M.A. 2010. Agriculture in Sudan. Technology Transfer press, Khartoum.
- Mollel, N., and U. Antipas, 1999. A comparison study of two agricultural extension approaches in Dodoma Region, Tanzania. *S Afr. J Agric. Ext/S Afr. Tydskr Landbouvoorl*, 28.
- Olayemi, S.S., A.O. Alo and C.W. Angba, 2021. Evolution of agricultural extension models in Sub-Saharan Africa: A critical review. *International Journal of Agricultural Extension and Rural Development Studies*, 8 (1): 29-51.
- Swanson, B.E. and R. Riikka, 2010. Strengthening agricultural extension and advisory Systems: Procedures for assessing, transforming, and evaluating extension systems. Agriculture and Rural Development Discussion Paper 45, the Word Bank.
- Swanson, B.E., 1997. Strengthening Research-Extension Farmers Linkages. Chapter nineteen, Improving Agricultural Extension. A reference Manual published by FAO, Rome, Italy.
- Vijayaragavan, K., and Y.P. Singh, 1997. Managing Human Resources within Extension. Chapter fourteen, Improving Agricultural Extension. A reference Manual published by FAO, Rome, Italy.