Factors Affecting Diffusion and Adoption of Improved Sorghum Varieties in South Kordofan State

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Abstract: The current study was conducted in South Kordofan State, Sudan in the working area of south Kordofan rural development programme (SKRDP) for the period (2001-2008).The main objectives of the study were to determine and assess the factors affecting diffusion and adoption of some recommended packages of the improved sorghum varieties approved by the concerned committees, indentify some farmers socioeconomic and demographic characteristics, some relative advantages of the innovation and the extension activities that affect the process of diffusion and adoption of the improved sorghum recommended packages. The primary data were collected via structured questionnaire. A multi-stage stratified random sampling technique was employed to select two hundred house holders systemically form village's population records. Descriptive statistics were used in form of frequency distribution and percentages to profile the sample , and Chi square test at level of significance (0.05,0.01) were used to detect the dependency of the variables of the study (the dependent variables) in affecting change of knowledge and practice of farmers towards some recommended packages of improved sorghum ,and its effect on diffusion and adoption of these packages.The most important findings of the study were:the adoption of seed rate was found to be dependent on source of information on agriculture, kind of training obtained, comparing the revenues, level of education, but it is independent on age of respondents, social status, family size, comparing seed color and the taste of local sorghum with the improved and the preference between improved and local sorghum in making porridge and pancakes (Kisra and Aseida).
the adoption of recommended spacing of sorghum between rows and holes was found to be dependent on comparing the demonstration farm with farmer's farm, participation of farmers in demonstration, source of information on agriculture, Kind of training obtained, comparing the local sorghum with the improved variety in productivity, revenues, maturity and the quality of the straw as forage, but it is in dependent on the age of the respondents, social status, education, seed color and taste.The adoption of the recommended weeding of the improved sorghum was found

to be dependent on social status of respondent, participation in demonstration, sources of information, family size and Kind of training obtained, but it is found to be in dependant on the level of education, age, revenues, seed color and comparing the local sorghum with the improved in making porridge and pancakes .

Key words: Adoption, Improved varieties, Chi-squire, South Kordofan

INTRODUCTION

The agricultural sector in the Sudan is the backbone of country's economy as the main Sudanese exports if neglected the petrol sector is form agriculture and the related activities, and the foreign trade is dependent mainly on agricultural products.

Craige (1991) explained that about 80% 0f the population in the Sudan is dependent on agriculture and the related activities for their subsistence, 87% of the total cropped land in Sudan is rain fed sub sector which contributes substantially to country food production and export of gum Arabic, sesame, groundnut, Roselle, Mellon seeds and sorghum, forming in total 80% of the country agricultural export.

Eldkheri (1997) advocated that agricultural subsectors were generally well supported by varied agro-ecological zones in Sudan.

Statistics revealed that food deficit in the area ranged between 56-91% of the total requirements for the years 1984 to 1997 (Elamin, 1998).

South Kordofan State is selected as study area for some reasons, the most important agricultural rain fed areas in the Sudan where the mechanized and non-mechanized agricultural farming is practiced.

The total area of the state is about 138.000 KM2 equivalent 1.38 million hectares, contributing to the national agricultural crop production by estimates as for sorghum 9% millet 3% sesame 6% groundnut 5% cattle 17.4% sheep 7.5% and goats 9.8%. About 85%

Of south Kordofan land is covered by range and forest (woodland), 14% arable land, and the remaining (less than 1%) is bare areas, settlements and water bodies. The agricultural area in the state is about 1.38 million hectare (14% of the total area) out of which 30% is traditional and 70% is mechanized. Above twenty supporting agricultural services and NGOs have worked in the state (SKRDP, 2009).

South kordofan state lies in area between longitudes 27.5 – 32 east and latitudes 10.25 – 11.5 north. Semi dry and wet climate is dominant in the clay strip of the state with very wide range and diversification in the vegetative cover. The maximum temperatures ranges between 30-40 C^{o} throughout the year, while the minimum temperatures ranges between 17-20 C^{0} in west seasons. Humidity ranges between 20-30% for the period of dry season and up to 80% in the rainy season, (WSRMP, 2007).

METHODOLOGY

To accomplish the objectives of the study, both secondary and primary data were collected using various tools. Primary date were collected through direct survey, Six rural administrative units (RAUs) out of nine constituting 66% of (RAUs) in the selected localities (Kadugli, Dilling, and Rashad) were selected.

Twelve extensions villages out of the 114 extension villages respectively 11% were chosen randomly.

The systematic random sampling technique was used to select the headed household from the village population having total of 200 respondents for the study. Well structure questionnaire was designed to satisfy the needs of the data collection.

Secondary data were obtained from the available annual reports and documents of (SKRDP) and the related institutions as south Kordofan Ministry of agriculture, (RAUs) in the study area, studies, books, journals and the available data in the internet.

Table 1: sample selection technique

Items	Total number	Selected	Percentage
Localities	5	3	60%
RAU	9	6	66%
Extension villages	114	12	11
Households	2000	200	10

Questionnaires were coded and statistical techniques were applied to drive the frequencies and percentage to describe the samples and their distribution on the variables of the study, through using (SPSS), besides using the analysis of chi-square test using the formula:

$$X^2 = £ \frac{(O - E)^2}{E}$$

Where:

O= denotes the observed

E= denotes the expected

Inspection of this definition shows that, X2 is a descriptive measure of the magnitude of discrepancies between the observed and expected frequencies are not the same, X2 will be zero X2 in this definition is always zero or a positive number, a negative number or values cannot occur (George, 1996; Gomez and Gomez, 1983).

RESULTS AND DISCUSSIONS

The results shows that the majority of respondents were distributed in age groups of less than 25 years (3%), 25-35 (20%), and 36-45 (38%) and according the innovators and early adopters were expected to be in these classes which may help much in raising the rate of diffusion and adoption of the new ideas.

Table 1: Frequency distribution and percentage of respondents by age group

Age group	Frequency	Percentage
Less than 25 years	6	3.0
25 - 35	40	20.0
36 - 45	76	38
46 – 55	45	22.5
Above 55 years	33	16.5
Total	200	100

Table 2: shows that 21.5% of respondent were illiterate, whereas the remaining 78.5% obtained different levels of education including 29% khalwa, 45.5% years of education before the university, and 4% were university graduation. The level of education of farmer is assumed to have significant effects on the output of the agricultural crops (Elfeil, 1993).

In fact one of the production constraints in the developing countries has been found to be the lack of knowledge, services and farmer education programmes, 78.5% of educated respondents were able to understand the extension messages which will raise the rate of new ideas diffusion and adoption.

Table 2: Frequency distribution and percentage of respondents by education level

Level of education	Frequency	Percentage
Illiterate	43	21.5
Khalwa	58	29.0
Educational years before the university	91	45.5
University education	8	4.0
Total	200	100

Table 3: shows that 28.5% of respondents were in family size group ranging between 2 – 5 persons, whereas the majority of respondent 48% were in family size group of 6 – 10 persons and 23.5% of respondents were having family size of above 11 persons. It is clear that the average number of family members for the interviewed respondents is above six persons, who can be used as family labor.

Table 3: Frequency distribution and percentage of respondents by family size in persons

Group number	Frequency	Percentage
2 – 5	57	28.5
6 – 10	96	48.0
Above 11	47	23.5
Total	200	100

Table 4: shows that 82.5% of respondents had obtained extension services provided by the extension of south Kordofan state in the area of (SKRDP), whereas 17.5% of respondents have not obtained any extension services. These results give an indication that there is good extension coverage in the area which will change knowledge and practice and lead to diffusion and adoption of the new ideas.

Table 4: Frequency distribution and percentage of respondents by extension services obtained

Status of obtaining extension services	Frequency	Percentage
Obtain extension service	165	82.5
Not obtain extension services	35	17.5
Total	200	100

Table 5: shows the kind of extension services provided by (SKRDP) extension to respondents. About 20% of respondents have obtained improved seed service, 1% pesticides, 6% training and 55.5% of respondents have been provided by multi – extension services, including improved seeds, pesticides, fertilizers, training, intermediate technology, radio programmers', visits, meeting, either all these services or some of them.

Table 5: Frequency distribution and percentage of respondents by kind of extension services obtained

Kind of obtained services	Frequency	Percentage
Improved seeds	40	20.0
Pesticides	2	1.0
Training	12	6.0
Multi – services	111	55.5
Not obtained service	35	17.5
Total	200	100

Chi-square test:

1- The results of Chi-square test showed in the spacing of sorghum between rows and holes by age of respondents (table 1), by social status (table 2), training (table 3), comparing seed color of local variety with the improved varieties (table 4), these variable give no significant relation with the age of respondents.

Table 1: Chi-square test for adoption of spacing of sorghum by the age of respondents:

	Age group of Respondents In year	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum Between holes In 20 cm	>25	3	2.4	3	4.0	6	3.0	0.320^{NS}
	25 -35	21	16.8	19	25.3	40	20.0	
	36- 45	51	40.8	25	33.3	76	3.80	
	46 -55	26	20.8	19	25.3	45	22.5	
	<55	24	19.2	9	12	33	16.5	
	Total	125	100	75	100	200	100	
Spacing of sorghum 60 Cm between rows	>25	4	3.3	2	2.6	6	3.0	0.576
	25 -35	25	20.5	15	19.2	40	20	
	35- 45	44	36.1	32	41.0	76	38.0	
	46- 55	25	20.5	20	25.6	45	22.5	
	<55	24	19.1	9	11.5	33	16.5	
	Total	122	100	78	100	200	100	

Table 2: chi-square test for adoption of spacing of sorghum by social status of respondent:

	Social Status respondents	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	Count	(%)	
Spacing of sorghum Between holes In 20 cm	married	106	84.8	63	84.0	169	84.5	0.358^{NS}
	Unmarried	1	8.0	4	5.3	5	2.5	
	Divorced	7	5.6	3	4.0	5	2.5	
	Widowed	9	7.2	4	5.3	13	6.5	
	Abandonment	2	1.6	1	1.3	3	1.5	
	Total	125	100	75	100	200	100	
Spacing of sorghum in rows 60 cm	married	103	84.4	66	84.6	691	84.5	0.598^{NS}
	Unmarried	3	2.5	2	2.6	5	2.5	
	Divorced	8	6.6	2	2.6	10	5.0	
	Widowed	6	4.9	7	9.0	13	6.5	
	Abandonment	2	1.6	1	1.3	3	1.5	
	Total	122	100	78	100	200	100	

Table 3: Chi-square test for adoption of spacing sorghum by obtaining training:

	Status of obtained training	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	Obtained training	56	44.8	33	44.0	89	44.5	0. 912^{NS}
	Not obtained training	69	55.2	42	56.0	111	55.5	
	Total	125	100	75	100	200	100	

Spacing of sorghum in rows 60 cm	Training	53	43.4	36	46.2	89	44.5	0.707 NS
	Not training	69	56.6	42	53.8	111	55.5	
	Total	122	100	78	100	200	100	

Table 4: Chi-square test for adoption of spacing of sorghum by comparing the taste of the improved sorghum with the local varieties:

	Comparison of seed color of local sorghum varieties with the improved, the later seems	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	More better color	60	65.2	37	34.8	92	100	0.455*
	Better color	29	54.7	24	45.3	53	100	
	No difference in color	16	64.0	9	36.0	25	100	
	Bad color	7	50.0	7	50.0	14	100	
	More bad color	2	100	0	0	2	100	
	Total	114	61.3	72	38.7	186	100	
Spacing of sorghum in rows 60 cm	More better color	56	60.9	36	39.1	92	100	0.279 NS
	Better color	27	50.9	26	49.1	53	100	
	No difference in color	19	76.0	6	24.0	25	100	
	Bad color	7	50.0	7	50.0	14	100	
	More bad color	1	50.0	1	50.0	2	100	
	Total	110	59.1	76	40.9	186	100	

On the other hand, spacing of sorghum between rows and holes give different results by significant and non significant in the variables participation of respondent in the demonstration work (table 4:2:15), information of respondent on agriculture (4:2:18), kind of training obtained by respondent (table 4:2:22), comparing revenues of local varieties with the improved verities (table 4:2:25), comparing the maturity period (table 4:2:30) comparing productivity of varieties (table 4:2:24), and the results of comparing varieties in making Kisra and Aseda (table 4:2:28) . Showed different

results between significance and non significance by the spacing of sorghum in holes and rows.

Table 4.2.15 Chi-square test for adoption of spacing of sorghum by respondent's participation in demonstration work:

	Respondent participation in Demonstration farm	Non adopters		Adopters		Total		Level of Significantcance
		count	(%)	Count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	Participate always	30	33.0	18	28.6	48	31.2	0.206NS
	Mostly participate	16	17.6	20	31.7	36	23.4	
	Participate sometimes	33	36.3	20	31.7	53	34.4	
	Not participate	12	13.2	5	7.9	17	11.0	
	Total	91	100	64	100	155	100	
Spacing of sorghum in rows 60 Cm	Participate always	36	40.9	12	18.2	48	31.2	0.003NS
	Mostly participate	14	15.9	22	33.3	36	23.4	
	Participate sometimes	26	29.5	27	40.9	53	34.4	
	Not participate	12	13.6	5	7.6	17	11.0	
	Total	88	100	66	100	155	100	

Table 4.2.18: Chi-square test for adoption of spacing of sorghum by source of information on agriculture:

	Source of information for Respondents on agriculture	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	Extension agent	31	24.8	16	21.3	47	23.5	0. 216NS
	Neighbors & relatives	14	11.2	34	4.0	17	8.5	
	Radio	7	5.6	3	4.0	10	5.0	
	Different sources	73	5.4	53	70.7	126	63.0	
	Total	125	100	75	100	200	100	
Spacing of sorghum in rows 60 cm	Extension agent	33	27.0	14	17.9	47	23.5	0.003 NS
	Neighbors & relatives	13	10.7	4	5.1	17	8.5	
	Radio	10	8.2	0	0	10	5.0	
	Different sources	66	54.1	60	76.9	126	63.0	
	Total	122	100	78	100	200	100	

Table 4.2.22: Chi-square test for adoption of spacing of sorghum by kind of training obtained:

	Kind of training obtained	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	Pest control	6	10.7	5	15.2	11	12.4	0. 796^{NS}
	Intermediate technology	4	7.1	1	3.0	5	5.0	
	Farm management	5	8.9	1	3.0	6	6.7	
	Farm practices	15	26.8	11	33.3	26	29.2	
	Animal rearing	4	7.1	2	6.1	6	6.7	
	Multi-diverse training	22	39.3	13	39.4	35	39.3	
	Total	56	100	33	100	89	100	
Spacing of sorghum in rows 60 cm	Pest control	9	17.0	2	5.6	11	12.4	0.001*
	Intermediate technology	4	7.5	1	2.8	5	5.0	
	Farm management	4	7.5	2	5.6	6	6.7	
	Farm practices	7	13.2	19	52.8	26	29.2	
	Animal rearing	2	3.8	4	11.1	6	6.7	
	Multi-diverse training	27	50.9	8	22.2	35	39.3	
	Total	53	100	36	100	89	100	

Table 4.2.25: Chi-square test for adoption of spacing of sorghum by comparing the revenues of dropped area of local sorghum varieties with improved varieties:

	Comparing of revenues Between improved and Local sorghum varieties the improved seems to	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	Count	(%)	
Spacing of sorghum in holes 20 cm	More higher	61	70.1	26	29.9	87	100	0. 041^{NS}
	Higher revenues	21	50.0	21	50.0	42	100	
	No diff. in revenues	15	68.2	7	31.8	22	100	
	Less revenues	16	53.3	14	46.7	30	100	
	More less revenues	1	20.0	4	80.0	5	100	
	Total	114	61.3	72	38.7	186	100	

Spacing of sorghum in rows 60 cm	More higher	57	65.5	30	34.5	87	100	
	Higher revenues	17	40.5	25	59.5	42	100	
	No diff. in revenues	15	68.2	7	31.8	22	100	
	Less revenues	17	56.7	13	43.3	30	100	0.055^{NS}
	More less revenues	4	80	1	20.0	5	100	
	Total	110	59.1	76	40.9	186	100	

Table 4.2.30: Chi-square test for adoption of spacing of sorghum by comparing the local sorghum varieties with the improved in maturity period:

	Comparing local sorghum with improved varieties in maturing period, the later seems	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	More early maturing	79	58.1	57	41.9	136	100	
	Early maturing	24	66.7	11	33.3	33	100	
	No diff. in maturing	13	81.3	3	18.8	16	100	0.154^{NS}
	Late maturing	0	0	1	100	1	100	
	Total	114	61.3	72	38.7	186	100	
Spacing of sorghum In rows 60 Cm	More early maturing	70	51.5	66	48.5	136	100	
	Early maturing	25	75.8	8	24.2	33	100	
	No diff. in maturing	14	87.5	2	12.5	16	100	0.004^{**}
	Late maturing	1	100	0	0	1	100	
	Total	110	59.1	76	40.9	186	100	

Table 4.2.24: Chi-square test for adoption of spacing of sorghum by comparing productivity of local variable with improved varieties:

	Kind of training obtained	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	Pest control	6	10.7	5	15.2	11	12.4	0. 796^{NS}
	Intermediate technology	4	7.1	1	3.0	5	5.0	
	Farm management	5	8.9	1	3.0	6	6.7	
	Farm practices	15	26.8	11	33.3	26	29.2	
	Animal rearing	4	7.1	2	6.1	6	6.7	
	Multi-diverse training	22	39.3	13	39.4	35	39.3	
	Total	56	100	33	100	89	100	
Spacing of sorghum in rows 60 cm	Pest control	9	17.0	2	5.6	11	12.4	0.001 *
	Intermediate technology	4	7.5	1	2.8	5	5.0	
	Farm management	4	7.5	2	5.6	6	6.7	
	Farm practices	7	13.2	19	52.8	26	29.2	
	Animal rearing	2	3.8	4	11.1	6	6.7	
	Multi-diverse training	27	50.9	8	22.2	35	39.3	
	Total	53	100	36	100	89	100	

Table 4.2.28: Chi-square test for adoption of spacing of sorghum by comparing local sorghum with improved sorghum varieties in making kisra and asida:

	Comparison local sorghum with improve varieties in making kisra and asida, the improve seems	Non adopters		Adopters		Total		Level of significance
		count	(%)	count	(%)	count	(%)	
Spacing of sorghum in holes 20 cm	More better	45	70.3	19	29.7	64	100	0.026*
	Better	24	53.3	21	46.7	45	100	
	No difference	23	76.7	7	23.3	30	100	
	Bad	20	48.8	21	51.2	41	100	
	More bad	2	33.3	4	66.7	6	100	
	Total	114	61.3	72	38.7	186	100	
Spacing of sorghum in rows 60 cm	More better	41	64.1	23	35.9	64	100	0.073 NS
	Better	21	46.7	24	53.3	45	100	
	No difference	23	76.7	7	23.3	30	100	
	Bad	21	51.2	20	48.8	41	100	
	More bad	4	66.7	2	33.3	6	100	
	Total	110	59.1	76	40.9	186	100	

2- The adoption of seed rate of sorghum showed no significant results by respondent age, social status, comparing farmers' farm with the demonstration farm taste of varieties, comparing seed colour of varieties comparing the straw of local with the improved varieties, comparing maturity period of varieties.The adoption of recommendation seed rate showed non significant results by the above mentioned variables.On the other hand, the adoption of the recommendation seed rate showed significant results by the level of education (table 4:2:19) of the respondent source of information on agriculture comparing productivity of local variety with the improved one comparing revenues (table 4:2:32).

Table 4.2.19: Chi-square test for adoption of seed rate of sorghum by source of information on agriculture:

Source of information for Respondents on agriculture	sorghum seed rate/Mukhamas in Malwa						Level of significant
	Non adoption		Adopters		Total		
	count	(%)	count	(%)	Count	(%)	
Extension agent	40	26.3	7	14.6	47	23.5	0.020^{NS}
Neighbors & relatives	16	10.5	1	2.1	17	8.5	
Radio	5	3.3	5	10.4	10	5.0	
Different sources	91	59.9	35	72.9	126	63.0	
Total	152	100	48	100	200	100	

Table 4.2.32: Chi-square test for the adoption of sorghum seed rate by comparing revenues of local sorghum varieties with the improved varieties:

Comparing productivity of local Sorghum with improved The later seem	Sorghum seed rate per mukhamas (one malwa)						Level of significant
	Non adoption		Adopters		Total		
	count	(%)	count	(%)	Count	(%)	
More higher revenues	70	80.5	17	19.5	87	100	0.016*
Higher revenues	25	59.5	17	40.5	42	100	
No diff. in revenues	14	63.6	8	36.4	22	100	
Les revenues	26	86.7	4	13.3	30	100	
More less revenues	5	100	0	0	5	100	
Total	140	75.3	46	24.7	186	100	

CONCLUSION

The adoptions of seed rate found to be dependent on source of information on agriculture. Kind of training obtained, comparing productivity of local sorghum with the improved, comparing the revenues, but it is independent on age, social status level of education, family size, comparing seed color and taste of local sorghum with the improved and the preference in making Kisra and Aseida.

The adoption of recommended spacing of sorghum found to be dependent on comparing the demonstration farm with farmers farm, participation of farmers in demonstration source of information, kind of training obtained, comparing the local sorghum with the improved variety in productivity, revenues, maturity and the quality of the straw as forage, but it is independent on age, social status, education, seed color and taste.

The adoption of recommended weeding of the improved sorghum found to be dependent on social status, participation in demonstration, source of information, family size and kind of training obtained, but it is found to be independent on the level of education, age, revenues, seed color and comparing the local sorghum with the improved in making porridge and pancakes .

RECOMMENDATIONS

1- Coordination between the national state and local extension bodies is necessary.
2- Condition of extenuation surveys to determine the most important needs and problem of the communities.
3- Strengthening the link between extension research and the farming community unified strategy.
4- More training for extension staff and farmers in putting the research finding practical.

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