



Review Article

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Factors Affecting Adoption of Improved Varieties of Sorghum, Millet, Groundnut and Sesame in North Kordofan State



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Abstract

This study was carried out with the objective of analyzing the factors affecting adoption of improved varieties of sorghum, millet, groundnut and sesame by farmers in three localities of Sheikan, Umrawaba and Elrahad in the North Kordofan State. Data for this study was primarily from farm household surveys conducted in seven seasons (2006/2007 to 2014/2015) in three localities of Sheikan, ElRahad and Um Rawaba in North Kordofan State. A random sample of 794 households was randomly drawn from different villages in the study area. Multi-stage random approach was adopted. Logit model, used to assess the factor affecting adoption of improved varieties in the study area. Results show that Adoption degrees of the improved varieties varied considerably from year to year depending on availability and distribution of improved varieties.

Logit regression analysis showed that family members male ($P < 0.073^*$), female participated in the farm work ($P < 0.060^*$), knowledge about the technology package ($P < 0.052^*$), availability of improved varieties ($P < 0.018^*$) and participation on training ($P < 0.029^{**}$) were the most influential factors that significantly lead to adoption of the improved varieties of sorghum.

Factors which positively affected farmers' decision to adoption improved varieties of millet were education (0.016), attending training (0.223), family members male (0.004) and sex of HH (0.198). Logit regression analysis showed that male Family members participated in the farm work ($P < 0.012^{***}$), knowledge about the technology package ($P < 0.035^{**}$), availability of improved varieties ($P < 0.000^{***}$) and participated on training ($P < 0.021^{**}$) were the most influential factors that significantly lead to adoption the improved varieties of groundnut. Logit regression analysis showed that female family members ($P < 0.054^*$), participation in training ($P < 0.056^*$), farm income ($P < 0.030^*$) and rented labors ($P < 0.015^{***}$) were found to be the most influential factors that significantly lead to adoption the improved varieties of sesame.

Introduction

Agricultural research and technological improvements are therefore crucial to increase agricultural productivity and thereby reduce poverty and meet demands for food without irreversible degradation of the natural resource base. Agricultural research and technological improvements are also crucial in reducing poverty. Barriers to technology adoption, initial asset endowments, and constraints to market access may all inhibit the ability of the poorest to get a share in the gains from agricultural productivity growth. This agricultural productivity growth can also be driven by improved farm technologies, including improved seeds, fertilizer, and water control [1].

Problem statement

In general, agricultural production and productivity could be increased by allocation of more resources to agriculture and improvement of agricultural technology which requires more

investment in education, health and infrastructure. In the context of Sudan profile, various governments have declared a policy aiming at self-sufficiency in food. The means towards achieving this objective has always been an expansion in cultivated area and/or improvement in yield.

A main feature of farming in North Kordofan is continuous deterioration in the natural resources base and production. Such deterioration has resulted from various influential factors, among them are poor genetic resources, biophysical factors including topography, low rainfall, soil quality, insect, diseases.

Objectives of the study

The overall objective of this research is to measure adoption of improved varieties on the yields of sorghum, millet, groundnut and sesame, this research also aims to achieve the following specific objectives:

- a. To analyze adoption of the improved varieties of sorghum, millet, groundnut and sesame in Sheikan, Elrahad and Umrawaba localities in North Kordofan State.
- b. To identify and analyze socioeconomic factors that influences the adoption of improved varieties of sorghum, millet, groundnut and sesame among farmers.
- c. Research hypotheses
- d. Adoption of improved varieties leads to high yields of crop.
- e. Farmers' perception of technology characteristics significantly affects their adoption decision.
- f. Availability of improved seeds and participating on training were significantly affects on adoption of improved varieties.

Methodology

The sampling and model

Data for this research study comes primarily from farm household surveys conducted in seven seasons (2006/2007 to 2014/2015) in three localities: Sheikan, Elrahad and Umrawaba in North Kordofan State. Multi-stage random approach was adopted.

Analysis was undertaken using STATA12 and SPSS22 software packages according to which results and hypotheses were drawn.

The log it regression model is used to simultaneously estimate the farmer's decisions regarding the factors affecting the adoption of improved varieties of field crops.

The new dichotomous variable is used as a dependent variable which is regressed against a set of explanatory variables

in the logistic regression (Table 1).

Table 1: Variables used in the logistic regression for sorghum, millet, groundnut and sesame.

Explanatory Variables	Type	Description
Sex of household head	Dummy	1=male; 0=otherwise
Use of family members	Dummy	1=yes; 0=otherwise
Number of males family members	Continuous	Number of persons
Number of females family members	Continuous	Number of persons
Farmer's experience	Continuous	Years
Total area grown	Continuous	Ha
Area under improved varieties	Continuous	Ha
Farmer renting the land	Dummy	1=yes; 0=otherwise
Farmer's education	Dummy	1=yes; 0=otherwise
Farmer's age	Continuous	Years
Attending training	Dummy	1=yes; 0=otherwise
Availability of improved seeds	Dummy	1=yes; 0=otherwise
Farm income	Continuous	SDG
Farmer know cultural practices	Dummy	1=yes; 0=otherwise
Participating of males Family members	Continuous	Number of persons
Knowledge of cultural practices	Dummy	1=yes; 0=otherwise
Participating females Family members	Continuous	Number of persons
Participating children Family members	Continuous	Number of persons

Results and Discussion

Cultivation methods

Most of the farmers grow sole crops with few cases practicing intercropping and mixed cropping (Table 2 & 3).

Adoption rate

The crop varieties grown by farmers are usually local varieties with very few cases where improved varieties are used in small acreage (Table 4).

Table 2: Distribution of farmers according to Cultivation methods of main food crops for seasons 2007-2015.

Crop variety	Sole		Sole		Mixed	
	Freq	Percentage	Freq	Percentage	Freq	Percentage
Ashana	30	93.8	2	6.3		
Dembi	464	98.3	4	0.8	4	0.8
Zenari	273	83.5	19	5.8	35	10.7
Arfaagadamek	75	93.8	3	3.8	2	2.5
Urwasha	60	96.8	2	3.2		
Wad Ahmed	21	95.5	1	4.5		
Gadam Elhamam	8	100				
Butana	15	88.2	1	5.9	1	5.9
Tabat	22	95.7	1	4.3		
Feterita	88	91.7	5	5.2	3	3.1
Arous Elremal	1	100				

Source: Field surveys.2007-2015.

Table 3: Distribution of framers according to Cultivation methods of main cash crops for seasons 2007-2015.

Crop variety	Sole		Intercropped		Mixed	
	Freq	Percentage	Freq	Percentage	Freq	Percentage
Herheri	371	84.7	26	5.9	41	9.4
Obeid1	81	95.3	3	3.5	1	1.2
Bromo	14	60.9	9	39.1		
Gebaish	54	96.4	1	1.8	1	1.8
Sodri	75	97.4	2	2.6		
Barberton	415	95.5	9	4	1	0.4

Source: Field surveys. 2007-2015.

Table 4: Distribution of local and improved seeds among farmers in seasons 2007-2015.

Crop	Variety	Type	Utilization of seeds	
			Frequency	Percentage
Millet	Dembi	Local	550	90.2
Millet	Ashana	Improved	60	9.8
Sorghum	Arfagadamk	Improved	109	18
Sorghum	Gadamelhamam	Improved	15	2.6
Sorghum	Zenari	Local	403	62.7
Sorghum	Urwasha	Improved	29	4.9
Sorghum	Wad ahmed	Improved	25	4.2
Sorghum	Aroose elremal	Improved	16	2.7
Sorghum	Tabat	Improved	15	2.6
Sorghum	Botana	Improved	19	2.3
Groundnut	Barberton	Local	261	63.3
Groundnut	Sodri	Improved	79	19.2
Groundnut	Gebaish	Improved	72	17.4
Sesame	Herhri	Local	468	79.7

Source: Field surveys, 2007-2015.

Table 5: Average distribution of farmers according to adoption of improved varieties in Sheikan, Umrawaba and Elrahad localities. Seasons 2007-2015.

Improved varieties	Adopter		Non adopter	
	Freq	Percentage	Freq	Percentage
Sorghum	209	37.7	403	62.7
Millet	60	9.8	550	90.2
Groundnut	151	36.7	261	63.3
Sesame	119	19.3	468	79.7

Source: Field surveys, 2007-2015.

Table 6: Distribution of farmers according to the trend of adoption rate of improved varieties of different crops .2007-2015.

Improved Varieties	Adoption	2006 -2007	2007 -2008	2008 -2009	2009 -2010	2010 -2011	2012 -2013	2014 -2015
Sorghum	Adopters%	26.8	18.5	65.1	50	52.5	56.9	26.2
	Non adopters%	73.2	81.5	34.9	50	47.5	43.1	73.8
Millet	Adopters%	10.2	13.2	12	9.5	12.7	6.1	5
	Non adopters%	89.8	86.8	88	90.5	87.3	93.1	95
Groundnut	Adopters%	40.3	41.3	23.7	54.5	70	21.7	24.3
	Non adopters%	59.7	58.7	76.3	45.5	30	78.3	75.7
Sesame	Adopters%	11.9	15.8	9.7	16.7	20.5	21	29.5
	Non adopters%	88.1	84.2	90.3	83.3	79.5	79	70.5

Source: Field surveys, 2007-2015.

Despite the expected gains from the adoption of improved varieties, the level of adoption of improved technologies among these farmers was low (5). Most of these farmers use low-yielding crop varieties and poor agronomic practices (Table 4- 6).

Factors affecting adoption of improved varieties

Factors affecting adoption of improved varieties of sorghum: Results of the estimated parameters of logit regression model for sorghum are summarized in Table 7. The estimated dependent variable was the adoption of sorghum improved variety. Six out of fifteen explanatory variables were found to be the most influential factors that significantly lead to the adoption of the improved varieties of sorghum .These are males family members ($P<0.073^*$), female participation in the farm work ($P<$

0.060^*), knowledge about the technology package ($P<0.052^*$), availability of improved varieties ($P<0.018^*$) and respondents' participation in training ($P<0.029^{**}$). An increase numbers of males and females family members participated in farm work farm by one person would increase the adoption of improved sorghum seeds by 1.79 and 0.50, respectively. Attending training, availability of improved varieties and knowledge of technology increased the adoption of improved varieties of sorghum by 0.02, 0.01 and 0.05, respectively. Despite the insignificance of age, education, sex of the household head (HH), family member's males and females, total area of improved varieties, total area grown and agricultural income, still they have positive effect on adoption of improved variety of sorghum Table 7.

Table 7: logistic regression for factors affecting adoption of sorghum improved varieties.

Explanatory Variables	Odd Ratio	P<(z)	Coef	P<(z)
Age (years)	0.9603563	0.112	-0.0404	0.112
Education (1,0)	0.5558787	0.423	-0.5872	0.423
Sex of headed household(1,0)	3.646126	0.272	1.2936	0.272
Family size male(number)	0.9773892	0.914	-0.0228	0.914
Family size female(number)	1.181151	0.439	0.1664	0.439
Males Family members participated in farm work	1.792685	0.073*	0.5837	0.073*
Females Family member participate in farm work	0.5032782	0.060*	-0.6866	0.060*
Knowledge of technology	0.2467847	0.052*	-1.3992	0.052*
Attending Training	6.527868	0.029**	1.876	0.029**

Availability of improved seeds	0.4560696	0.018*	-0.7851	0.018***
Total area sown with improved seeds (ha)	1.131289	0.439	0.1233	0.439
Total area cultivated (ha)	0.9863987	0.488	-0.0136	0.488
Agricultural income(SDG)	1	0.494	0.0001	0.494
Constant	0.3102378	0.695	-1.1704	0.695
Hired labor	2.096621	0.256	0.7403	0.256
Used of Family labor	38.69926	0.037***	3.6558	0.037***
Prob <chi2		0.0000***		0.0000***
Pseudo R2		0.4365		0.4365
Log likelihood		-42.386417		-42.3864
Number of obs		123	123	

Symbols *, ** and *** indicate significant differences at 0.1, 0.05 and 0.01 levels of significance, respectively.

Table 7: logistic regression for factors affecting adoption of sorghum improved varieties. Knowledge influences adoption. Farmers who have adequate knowledge of technology use are likely to adopt it [2,3]. Farmers' attitudes determine adoption of improved technology. Attitudes are evaluative responses towards the technology, and are formed as farmers gain information about it. Adopters tend to hold positive attitudes towards the technology [4].

More educated farmers will gain higher benefits from improved information and it will be easy to convince these farmers to adopt new practices.

This result is confirmed by Feder et al. [5], adoption of new varieties requires more labor inputs.

Factors affecting adoption of improved varieties of millet

A result of the estimated parameters of logit regression models for millet was summarized in Table 8 presenting the estimated dependent variable, namely the adoption of millet improved variety. Availability of improved seeds ($P < 0.000^{***}$) and participation in training ($P < 0.000^{***}$) were found to be the most influential factors that significantly led to adoption of the improved varieties of millet.

Availability of improved millet seeds and attending training increased the adoption of improved millet seeds by 0.19 and 58.06, respectively. Despite the insignificance of age, education, sex of HH, sizes of males and females in the household, total area of improved varieties, total area grown, still they have positive effects on the adoption of improved millet variety.

This result agrees with CIMMYT [6]; education is expected to enhance the decision making and the adoption of agricultural technologies.

Knowledge influences adoption. Farmers who have adequate knowledge of technology use are likely to adopt it [2,3]. Farmers' attitudes determine adoption of improved technology. Attitudes are evaluative responses towards the technology, and are formed as farmers gain information about it. Adopters tend to hold positive attitudes towards the technology [4].

Factors affecting adoption of improved varieties of groundnut

Results of the estimated parameters of log it regression models for groundnut were summarized in Table 9. The estimated dependent variable was adoption of groundnut improved variety.

Male family members participation in the farm work ($P < 0.012^{***}$), previous knowledge about the technology package ($P < 0.035^{**}$), availability of improved varieties ($P < 0.000^{***}$) and participation in training ($P < 0.021^{**}$) were found to be the most influential factors that had significantly effect on the adoption of the improved varieties of groundnut.

Male family members' participation in the farm work, previous knowledge about the technology package, availability of improved varieties and participation in training increased adoption of improved varieties of groundnut by 0.63 ,0.45,0.33 and 2.43, respectively (Table 9).

This indicates that family with large number involved in adopting the new technology during their farm production effort.

The coefficient of knowledge of technology was found to be significant at 0.03 in influencing the decision to adopt improved groundnut seeds (Table 8). This is expected because farmers' with more knowledge of technology may induce better skills and access to new information about improved technologies. It could also imply that knowledge gained over time from working in uncertain production environments may help in evaluating information; thereby influencing adoption decisions.

Table 8: Logistic regression for factors affecting adoption of improved millet varieties.

Explanatory Variables	Odd Ratio	P<(z)	Coef	P<(z)
Age of HH	1.0598	0.456	1.0598	0.456
Education	0.1763	0.208	0.1763	0.208
Sex of HH	18.3945	0.195	18.3945	0.195
Number of males in the family	1.1698	0.535	1.1698	0.535
Number of females in family	1.0038	0.991	1.0038	0.991
Participation in Training	58.061	0.000***	58.061	0.000***
Availability of improved seeds	0.1953	0.000***	0.1953	0.000***
Total grown area	0.9791	0.354	0.9791	0.354
Constant	0.8935	0.969	0.8935	0.969
Prob <chi2		0.0001***		0.0001***
Pseudo R2		0.4289		0.4289
Log likelihood		-13.6		-13.6
Number of obs		120		120

Symbols *, ** and *** indicate significant differences at 0.1, 0.05 and 0.01 levels of significance, respectively.

Table 9: logistic regression for factors affecting adoption of groundnut.

Explanatory Variables	Odd Ratio	P<(z)	Coef	P<(z)
Age of HH	0.9593	0.415	-0.00652	0.583
Education	0.9461	0.883	-0.3142	0.348
Sex of HH	1.4816	0.399	-0.122	0.773
Number of males in Family	1.011	0.537	0.1157	0.187
Number of males in Family	1.1142	0.25	0.0745	0.385
Male family labor participation in farm work	0.6325	0.012***	-0.4129	0.010***
Female family labor participating in farm work	1.1962	0.285	0.0078	0.96
Participation in Training	2.4341	0.021**	0.9012	0.009***
Availability of improved seeds	0.3383	0.000***	-0.3324	0.010***
Knowledge of technology	0.4551	0.035**	-1.1245	0.001***
Agricultural income	0.9999	0.521	4.144	0.7
Constant	55.62	0.000***	2.3275	0.014
Prob <chi2		0.0000***		0.0000***
Pseudo R2		0.3195		0.1997
Log likelihood		-128.956		-149.57
Number of obs		278	278	

Symbols *, ** and *** indicate significant differences at 0.1, 0.05 and 0.01 levels of significance improved varieties. Respectively.

This finding agreed with Abebaw & Belay [2]; Rogers [3] that farmers who have adequate knowledge of technology use are likely to adopt it; knowledge influences adoption.

Factors affecting adoption of improved varieties of sesame

A result of the estimated log it regression models for sesame was summarized in Table 10. Dependent variable estimated,

namely the adoption of improved sesame variety.

Number of female family members ($P < 0.054^*$), participation in training ($P < 0.056^*$), farm income ($P < 0.030^*$) and hired labor ($P < 0.015^{***}$) were found to be the most influential factors that significantly led to adoption the improved varieties of sesame. These factors would respectively increase the adoption of improved varieties of sesame by 1.31, 0.36, 1 and 0.64 (Table 10).

Table 10: logistic regression for factors affecting adoption of improved varieties of sesame.

Explanatory Variable	Odd Ratio	P<(z)	Coef	P<(z)
Age	1.0226	0.449	0.0223	0.449
Education	0.4751	0.122	-0.7441	0.122
Sex of HH	0.6074	0.407	-0.4985	0.407
Male family members	1.0806	0.589	0.0775	0.589
Female family members	1.3146	0.054*	0.2736	0.054*
Family member male participate in farm work	0.9196	0.711	-0.0837	0.711
Family member female participated in farm work	0.7208	0.153	-0.3273	0.153
Family member children participated in farm work	1.5004	0.349	0.4057	0.349
Participated in Training	0.3642	0.056*	1.0456	0.056*
Total grown area	1.012	0.279	0.0119	0.279
Experience of farmer (years)	0.964	0.233	-0.0366	0.233
Farm income	1	0.030**	.0001	0.030**
Hired labor	0.6432	0.015***	-1.009	0.015***
Constant		0.964	0.0611	0.964
Prob <chi2		0.0000***		0.0000***
Pseudo R2		0.2208		0.2208
Log likelihood		-85.67		-85.67
Number of obs		180		180

Symbols *, ** and *** indicate significant differences at 0.1, 0.05 and 0.01 levels of significance, respectively.

This result supports the result obtained by Salasya et al. [7] on the adoption of improved maize varieties in Kenya. There was a positive and significant relationship ($\rho \leq 0.01$) between farmers' expenditure on hired labor and adoption of improved varieties of sesame in the study area (Table 10). This means that sesame farmers who had resources to hired labor were more likely to adopt improved sesame as a production technology compared with farmers who depended solely on the family labor. This agreed with Bamire & Manyong [8] that family labor, even though it constitutes a bulk of the labor force used in agriculture in Nigeria, is not readily available for farm operations [9,10]. This is expected because more experienced farmers may have better skills and access to new information about improved technologies.

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