Research paper

Adoption of Wheat Technical Packages Effects on Productivity in Dongola Locality, Northern State, Sudan

Awadia Ahmed Hashim

Department of Agric. Economics, Faculty of Agricultural Sciences, University of Dongola, Dongola, Sudan.

Corresponding author: awadiahashim333@hotmail.com

ABSTRACT

The objective of this study was to evaluate the effect of adoption of recommended cultural practices on productivity of wheat in Dongola Locality, Northern State, Sudan. Multi stage random sampling technique was used to collect data from 150 farmers through structured questionnaire. Descriptive statistics and regression were used as analyzing tools, during 2014/15 season. The recommended cultural practices include sowing date, seed variety, seed rate, urea and superphosphate doses, weeding, number of irrigation and harvesting time. Results showed that all farmers were male and most of them were literate and most of them are in the active age group (26-45). In addition to that, 45% of farmers possessed a family size in the range of 5-10, more than a half of them (52%) owned their farms. However, 68% of the farmers said that the extension services were not available and 63% of them adopted the extension information. Sowing date, number of irrigations, weeding and harvesting time were the more frequently adopted activities. Generally, results showed that high crop production can be achieved by applying the recommended cultural practices. The results revealed that adopting recommended cultural practices can significantly increase the wheat production. The study further suggested strengthening the agricultural policies that lead to increase the rates of adoption of technical package of wheat like enhancing the extension services physically and morally besides subsidizing the prices of agricultural inputs.

Keywords: Adoption, technical packages, productivity.

تأثيرات تطبيق الحزم التقنية علي إنتاجية محصول القمح بمحليه دنقلا ، الولاية الشمالية-السودان

عوضية احمد هاشم

قسم الاقتصاد الزراعى، كلية العلوم الزراعية، جامعة دنقلا، السودان

هدفت هذه الدراسة لمعرفة تأثيرات تطبيق الحزمة التقنية الموصي بها لمحصول القمح علي الإنتاجية بمحليه دنقلا – الولاية الشمالية. العينة الطبقية العشوائية متعددة المراحل استخدمت لجمع البيانات من 150 مزارع بواسطة استبيان خلال موسم 2014/15. الاحصاء الوصفي وتحليل الانحدار استخدم للتحليل. الحزمة التقنية لمحصول القمح تشمل: مواعيد الزراعة ومعدل التقاوي ونوع التقاوى وعدد الريات وازالة الحشائش وجرعات سمادي اليوريا والسيوبرفوسفات أضافه لمواعيد الحصاد. اوضحت نتائج الدراسة أن كل المزارعين من الذكور والأغلبية منهم متعلمين واعمارهم في الفئه العمرية النشطة (26-45). نسبة 45% منهم حجم أسرهم في الفئة 5-10 فردا. اكثر من نصفهم يمتلكون الأراضي المزروعة. أكد 68% من المزارعين عدم توفر خدمات الإرشاد الزراعي و63% طبقوا معلومات الإرشاد الزراعي. أوضحت النتائج أن مواعيد الزراعة وعدد الريات وعمليه النظافة ومواعيد الحصاد هي اكثر العمليات الفلاحية الموصي بها تطبيقا. عموما توصلت الدراسة إلي أن الإنتاج العالي للقمح يمكن تحقيقه بتطبيق الحزمة التقنية الموصي بها. كشفت الدراسة أن الالتزام بالحزم التقنية الموصى بها يزيد الانتاجية معنويا. وأوصت الدراسة ايضا بتقوية السياسات الزراعية والي تؤدي الي رفع معدلات تبني الحزمة التقنية للمحصول مثل دعم الخدمات الإرشادية معنويا وماديا إضافة إلي دعم سعر مدخلات الإنتاج.

Introduction

Wheat is one of the most important food crops, originating from the Levant region of the Near East and Ethiopian Highlands, but the crop is now cultivated worldwide and it almost comes the third most-produced cereal after maize and rice, although sometimes come second after maize (Ibrahim, 2009). It is grown on about 220 million hectares worldwide, covering more land area than any other crop (Ahmed, 2008). Major wheat producing countries include China, India, USA, Russia and France (FAO, 2016). Ibrahim (2009) reported that domestically, the Gezira scheme produces about 50% of the country's wheat production; the rest is produced in the Northern and River Nile States in addition to little areas in Rahad and New Halfa schemes. Production of wheat is insufficient to meet growing needs and imports attempt to cover the deficit because Sudan consumed 2.75 million metric tons of wheat in 2016, and only produced 456000 Tones (ASD, 2016). Table (1) shows the fluctuated planted areas and yields which vary significantly due to weather conditions and other factors. The total currently cultivated areas in Northern State is estimated at 200,000 ha, 75% of which is devoted to winter season crops. However, wheat cultivated areas are about 43% on the average of the total winter cultivated area in the Northern State (Elhori and Babiker, 2009).

According to Rogers (2003), diffusion is a process in which an innovation is communicated through certain channels over time among the members of a social system, and it occurred between persons, while adoption is a decision made by an individual to make full use of an innovation as the best course of action available. Rogers (1983) defined an innovation as an idea, practice, or object that is perceived by individuals or other units of adoption to be new. He also added that there are four main elements in the diffusion of innovation which includes: the innovation, communication channel, time and the social system. Rogers (2003) reported that the social system as an important element in diffusion of innovation was highlighted in early studies. For example, Linton (1952) reported that if we know what society culture is including in its exact system of values and attitudes, we can predict with a fairly high degree of probability whether that bulk of it welcomes or resists a particular innovation. This statement shows the importance of cultural values on individual innovations.

Table (1): Production of wheat in Sudan during the period 2009/10 - 2015/16

Season	Cultivated area (1000 ha)	Yield (ton/ha)	Production (1000 ton)
2009/2010	237	1.70	402.90
2010/2011	196	1.50	294.00
2011/2012	187	1.73	323.51
2012/2013	185	1.51	279.35
2013/2014	137	1.77	242.49
2014/2015	237	2.00	474.00
2015/2016	224	2.04	456.96

Source: Ministry of Agriculture, Northern State

Oladele (2005) argued that social scientists investigating farmer's adoption behavior have accumulated considerable evidence showing that demographic variables, technology characteristics, information sources, knowledge, awareness, attitude, and group influence affect adoption behavior. Rogers (1995) stated that the adoption of innovation is related to innovation decision process through which an individual passes from first knowledge of an innovation, to forming an attitudes towards the innovation, deciding to adopt or reject the innovation, implementing the new ideas, and confirming the innovation decision. Accordingly, Rogers (1995) developed a model that explains the process which consists of five stages that include; awareness, interest, evaluation, trial and adoption stage.

Wheat production in the Northern State faces some problems, some of these are: high inputs prices, inappropriate policies, weakness of the extension services and adoption of technical crop packages. Alnur (2011) stated that the productivity of wheat in the Northern State represented about 40% of that obtained in the research station in Northern state.

The objective of this study was to determine the effect of adoption of recommended cultural practices on productivity of wheat in Dongola locality, Northern State, Sudan. This main goal was fulfilled through; investigating the socio-economic characteristics of the farmers and wheat applied cultural practices compared to the recommended technical packages and determining its effects on productivity.

Methodology

Data collection method

This study depended mainly on primary data through direct personal interview by structured questionnaire. The survey was conducted at the end of 2014/15 winter season, using a multi stage random sampling technique. About 150 respondents were selected which represented almost 10% of the total wheat farmers in Dongola Locality. Data of farmers age, education level, family size, cultural practices were collected. In addition, secondary data related to the problem investigated were obtained from relevant sources.

Data analysis

Descriptive statistics were used to determine frequency and percentages of socio-economic characteristics of the farmers and regression test used to assess the impact of adoption of the recommended wheat technical packages on productivity. Cobb-Douglass production functions (Heady and Dilon, 1961) were used to meet the objectives of the study:

$$\log Y = B_0 + B_1 \log X_1 + B_2 \log X_2 + B_3 \log X_3 + \ldots + B_n \log X_n$$

Where:

Y= dependent variable (productivity)

B_0= intercept

B_1-----B_n= regression coefficients

X_1-----X_n= independent variables: X_1=seed variety, X_2= seed rate, X_3=sowing date, X_4= superphosphate dose, X_5= urea dose, X_6= no of irrigations, X_7= weeding and X_8= harvest time.

Y= yield (sack/feddan)

Results and Discussion

Many aspects pertinent to the adoption of wheat technical packages in the study area were discussed. These include: socio-economic characteristic of farmers, recommended technical packages of wheat versus actually applied and adoption of wheat technical packages.

The socio-economic characteristics of wheat producers in Dongola Locality

Results revealed that all of the respondents are males. This is one of tradition of the people in the Northern State, farms are owned by males and women contribution is limited compared to other states of Sudan. However, now a day, women start to share in the harvest of all crops especially

the spices crops. Most of farmers are literate and young, this was in conformity with that of Elhori *et al*. (2017) in their study of economics of wheat production in Northern State, they found that most of the respondent were literate and almost of them are in the active age group (26-45). Rahamtalla (1982) stated that educated farmers adopted the recommended technical packages more than others. Results also showed that 45% of farmers have family size in the range of 5-10 members and that help in farm activities. These results come in line with Salah (1996) who found that most of farmers families were in this range. In addition, more than a half of the farmers (52%) owned their farms. Further, 68% of the investigated farmers mentioned that the extension services were not available and 63% of them used the extension information. These results are similar with that of Ahmed (2008) and Mohamed (2000). Furthermore, 45% of farmers have small farms (5-10 feddans).

Table (2): Socio-economic characteristics of wheat producers in Dongola Locality

Item	No	%	Item	No	%
Sex			**Family size**		
Male	150	100	Less than 5	57	38
Female	00	00	5-10	68	45
Total	150	100	Above 10	25	17
Age			Total	150	100
Less than 25	7	4.6	**Type of holding**		
26-45	91	60.7	Owned	78	52.0
Above 45	52	34.7	Government	38	25.3
Total	150	100	Rent	23	15.3
Education			Sharing	11	07.3
Illiterate	4	2.7	Total	150	100
Literate	146	97.3	**Farm size/fed**		
Total	150	100	Less than 5	30	20
Application of extension information			5-10	67	45
Yes	95	63.3	Above 10	53	35
No	55	36.7	Total	150	100
Total	150	100	**Extension**		
			Available	48	32
			Not available	102	68
			Total	150	100

Source: Field survey (2015)

Applied cultural practices of wheat and recommended ones

Application of the technical packages of the crops is important tool in reducing fluctuation of the crops productivities, and in turn increasing farmer's income.

Study field survey revealed that the majority (64%) of the farmers used traditional seeds either from previous season(s) or local markets, and that it may be due to unavailability of the improved seeds. Elhori and Babiker (2009) in their study of the optimum winter cropping pattern in the Northern State suggested that the traditional seeds used contribute to fewer crops productivities. Agricultural Research Station, Dongola (ARSD, 2009) recommended that wheat sowing rate per feddan is 50 kg. The study discovered that 53% of the farmers applied seed rate more than the recommended, 4% less than the recommended and 43% applied the actual recommended seed rate. Further, as per this study, almost half of the farmers (54%) grow wheat at the recommended time, 85 % of the farmers applied eight waterings which is recommended, 47 % of the farmers used the recommended urea dose and only 33% applied the superphosphate dose. Many factors might be responsible for that, the most important of which might be, unavailability and expensive inputs. Further, 76% of the farmers applied the weeding process and 85 % of them harvested their crop in the recommended time.

Table (3): Applied cultural practices of wheat and recommended ones

Item	No	%	Productivity	Item	No	%	Productivity
Seed variety				**Urea**			
Recommended	54	36	9.73	Recommended	71	47	9.14
Not recommended	96	64	8..47	Not recommended	79	53	8.70
Total	150	100	-	Total	150	100	
Seed rate				**Superphosphate**			
Less than recommended	6	4	6.83				
Recommended	64	43	9.67	Recommended	49	33	9.98
More than recommended	80	53	7.65	Not recommended	101	67	8.40
Total	150	100	-	Total	150	100	-
Sowing date				**Weeding**			
Recommended	81	54	10.7	Done	114	76	9.44
Not recommended	69	46	7.44	Not-done	36	24	7.23
Total	150	100		Total	150	100	
No irrigation				**Harvest time**			
Recommended	127	85	8.19	Recommended	129	85	9.24
Not recommended	23	15	9.79	Not recommended	21	15	7
Total	150	100	-	Total	150	100	-

Source: Field survey (2015)

Wheat production functions in Dongola Locality

Table (4) shows the *regression equations for* wheat production in Dongola Locality. Results revealed that the adjusted (R^2) of the regression function was 0.62, implying that 62% of the total variation in wheat productivity is explained by the explanatory variables in the models. The F-statistics

which was highly significant (0.000) implying that, the independent variables were collectively important in explaining the variation in the dependent variable (wheat productivity). Weeding and period of harvest were positive and highly significant (0.01 and 0.05). This means that a one percent increase of each of the independent variables increases wheat productivity revenues by their corresponding elasticity. The coefficients of seed rate and urea doses were found to be highly significant (0.000 and 01, respectively), but with negative signs. This means that using of over recommended seed rate and over doses of urea negatively affected the productivity and this confirm the findings of Mohammed (2000) who studied the factors affecting wheat productivity in Northern State.

Table (4): Effect of independent variables on wheat productivity

Independent variables	Coefficient	t-values	Sig
Consistent		6.571	0.000
Seed type	0.188	2.327	0.000
Seed rate	-.121	-1.743	0.021
Sowing date	0.421	5.445	0.053
Superphosphate	0.144	1.968	0.051
Urea	-.201	-2.666	0.009
No of irrigations	0.169	2.405	0.017
Weeding	0.170	2.333	0.021
Harvesting time	0.263	3.777	0.000
R^2	0.62		
F- ratio 14.23			

Source: Field survey (2015)

Conclusion

Results obtained showed that increasing the production and productivity of wheat depends on applying the recommended cultural practices of the crop. The study suggested strengthening the agricultural policies that lead to increase the rates of adoption of technical package of wheat like enhancing the extension services physically and morally besides subsidizing the prices of agricultural inputs to encourage the farmers to adopt the technical packages for the crops.

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