



Descriptive and Econometric Analysis of Wheat Production in Afghanistan (A Case Study in Paktia Province)

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MKA and ME designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors MKA, ME and DZ collected the data. Authors MKA and ME managed the analyses of the study. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/SAJSSE/2019/v5i330146

Editor(s):

(1) Dr. Gerald Aranoff, Professor, Department of Economics and Business Management, Ariel University, Israel.

Reviewers:

(1) İsmail Ukav, Adiyaman University, Turkey.

(2) Emmanuel Etim, Lagos State University, Nigeria.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/53212>

Original Research Article

Received 28 September 2019

Accepted 06 December 2019

Published 14 December 2019

ABSTRACT

The agricultural sector in Afghanistan faces many challenges in general that have directly affected the production of crops. Especially wheat crop because of its great importance to the population sector as it is the first source of food in Afghanistan. Problem of this study due to wheat production in Afghanistan is insufficient for domestic consumption. Therefore, the Afghan government is relying on foreign markets to cover the gap between production and consumption. The study aims to assess the current situation of wheat production and consumption in Afghanistan, as well as to understand the farmers' perceptions and attitudes towards the problems facing them. The agricultural sector in Afghanistan faces many challenges in general that have directly affected the production of crops. Especially wheat crop because of its great importance to the population sector

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as it is the first source of food in Afghanistan. The current study applied simple regression analysis in estimating the general trends to determine the productive and economic indicators of Wheat crop. Also, we use Analysis of variance (One Way ANOVA) to understand the farmers' perceptions and attitudes towards the problems facing them. The results showed that wheat productivity averaged 1.77 tons per ha and ranged between a minimum of 1.23 tons per ha in 2008 and a maximum of 2.20 tons per ha in 2015. On the other hand, the estimated regression equation indicates that productivity of wheat crop followed an increase trend, at an annual rate of 0.047 ton per ha and a statistically significant rate of change amounting to 2.66% of the study period's average productivity.

Keywords: Afghanistan; consumption; farmers' perception; attitude; production.

1. INTRODUCTION

Afghanistan's economy is still largely agrarian, and the agriculture sector makes essential contributions to economic growth, employment creation, poverty reduction, food security, and the fiscal health of the nation [1]. Therefore, we call agriculture is the backbone of the Afghan economy. The contribution of agriculture to the country's gross domestic product (GDP) is 23% in 2017, while the labor force engaged in this sector is almost 62%. The annual growth rate is predictable at 3.6%. Therefore, Agriculture plays a significant role in their livelihoods. Mostly afghans farmers are small scales. They have small farms and low productivity over the years; those farmers produce to satisfy the food needs of their households [2]. Cereal crops are the major producing agricultural products in Afghanistan generating cash income and provide subsistence food dietary to the farm families. Domestic cereals production is not self-sufficient across the country but the level of self-sufficiency is fluctuating over the time period ranging from the lowest about 53% in 2004 to the highest of 96.6% in 2009 [3] hence, the deficit cereals demand (especially for wheat) is adjusted by import from the neighboring countries. While, the potential domestic production could alter scenario toward self-sufficiency through appropriate policies and technical knowledge of production management. In the last one and half decade Afghans have witnessed of several policies developed to enhance the agricultural sustainable development, but the policies did not contribute to the field situations and real life of farmers. Indeed, agricultural production occurs in a dynamic environment; therefore, factors influencing farmer's management decision should be monitored [4]. Wheat has significant importance for developing economies in Afghanistan and accounting over half (59.5%) of the caloric intake of the entire population while rice and maize contribute consequently.

Therefore, it is a major and staple food crop, accounting for almost 75% of the cultivated area. According to the [5] statistical yearbook wheat production estimated about 4.3 million tones, which shows a 6 percent decrease from 4.55 million tons compared to 2016-2017. In 2015 Wheat crop accounts for 6% of National Gross Domestic Product (GDP) and 27% in agricultural addition. Annual per capita wheat consumption is about 160kg, one of the highest rates in wheat consuming countries around the world [6]. In food composition patterns (percent of total daily dietary caloric intake), Afghanistan among central Asia countries or in the world has placed on the top of wheat consumption [7]. In Afghanistan, the major largest wheat production areas are in the northern side of the country [8]. The province of Baghlan, Kunduz and Takhar tend to have the most massive wheat surpluses of the availability of irrigated water. Nevertheless, the adequate precipitation (rain and snowfall) the wheat production surpluses extend to the neighboring provinces of Herat, Badghis, Faryab, and Sar-e-pul, where the wheat crop is more rainfed. Kabul and other central, eastern, and southern regions are the deficit area in wheat production [7]. The problem arises as wheat production in Afghanistan is insufficient for domestic consumption. Therefore, the Afghan government is relying on foreign markets to cover the gap between production and consumption. So, the study aims to assess the current situation of wheat production and consumption in Afghanistan, as well as to understand the farmers' perceptions and attitudes towards the problems facing them. The agricultural sector in Afghanistan faces many challenges in general that have directly affected the production of crops. Especially wheat crop because of its great importance to the population sector as it is the first source of food in Afghanistan. Therefore, this research aims to shed light on studying the production indicators of this major crop. In addition to Knowledge of

farmers' Perception Regarding Production, Problems Confronted Them to solve these problems and make recommendations to help decision-makers.

2. REVIEW OF LITERATURE

It is obvious that in developing countries, crops are mainly produced by small-scale farmers, which is characterized by small land survival and different physical and socioeconomic constrictions [9]. According to the Food and Agricultural Organization of the United Nations Statistical Database (FAOSTAT), worldwide production of wheat was 713 million tons in 2013, making it the third most-produced cereal after maize (1016 million tons) and rice (745 million tons). In addition, it is the fourth most commodity in the world [10]. According to World Bank reports that 2.5 billion people depend on agriculture as their main sources of livelihood and among them 1.3 billion people are small scale farmers and landless workers [11]. So, Afghanistan is a net importer of wheat, which is the main staple food in the country. On average, the country wheat imports are almost 30-35% to meet its domestic consumption, food demand too [8]. As reported the annual cereal demand (2017-2018) was 6.488 million tons (MT) including the wheat demand for 4.281 million tons (MT) wheat is grown under both irrigated and rained circumstances in the country [5]. The impact of past wheat breeding on traits answerable for the attained increase in yield potential has reported in a number of countries [12]. Increasing agricultural productivity or yield is critical to economic growth and development. It can be attained by applying improved agricultural technologies and management system [13].

3. MATERIALS AND METHODS

To achieve the research objectives, we used the simple regression analysis to estimate the general trends to determine the productive and economic indicators of Wheat crop.

3.1 Simple Regression Model

$$\hat{Y}_t = \alpha + \beta_1 x + \beta_2 x + \beta_3 xD + \varepsilon$$

Where,

\hat{Y}_t : the dependent variable
 X : the independent variable (time)
 ε : Error term

Beside we used Analysis of variance (One Way ANOVA) to understand the farmers' perceptions and attitudes towards the problems facing them. Two sets of data were employed in this study: (1) secondary data. (2) primary data, and Primary data is a random sample of wheat farmers during the agricultural season 2019 in order collect data required to serve the research objectives and identify the main problems confronted in wheat production. The sample comprised the statistical population of all wheat farmers in Paktia province. A random sample comprising 255 wheat farmers was drawn from Paktia province in order to identify farmers' opinions regarding problems facing them in the study crop and the different impacts thereof, the most important of which is the Low production, followed by High prices of automated services, High wages of labor and High irrigation costs. High prices of pesticides, High prices of organic fertilizers and High prices of chemical fertilizers. Low level of irrigation water, Low wheat area and Agricultural labor migration to the city. Problems Difficult access to agricultural loans. Spread of agricultural diseases and pests and Deterioration the qualities of commercial type. Spread of weeds in the crop and Not disinfection of irrigation drains and Use of internationally prohibited pesticides.

3.2 Description of the Study Area

The study area is situated in Ahmad Abad district of Paktia Province, Afghanistan. The area is characterized with distinctive economic, social and climatic conditions. The study site is situated in a rural area where the main occupation of livelihood is small-scale farming, and grain is the major producing products. Climate in Paktia is varying from season to season, winters are cold, following by a short period of warm springs and the summers are typically dry and hot. Because of the long winter and cold weather, only one-season grain products could be harvested in the study area.

Paktia borders the Pakistani-ruled tribal areas of Kurram Agency to the northeast. Within Afghanistan, it borders Logar Province, Ghazni Province, Paktika Province, and Khost Province, in counterclockwise order. Paktia is a largely mountainous province, with most of the population living in the central valley stretching from Ahmad Khel in the east down through Zormat and into neighboring Paktika province. The eastern part of the province, particularly Chamkani and Dand wa Patan, is a second valley leading into Pakistan.

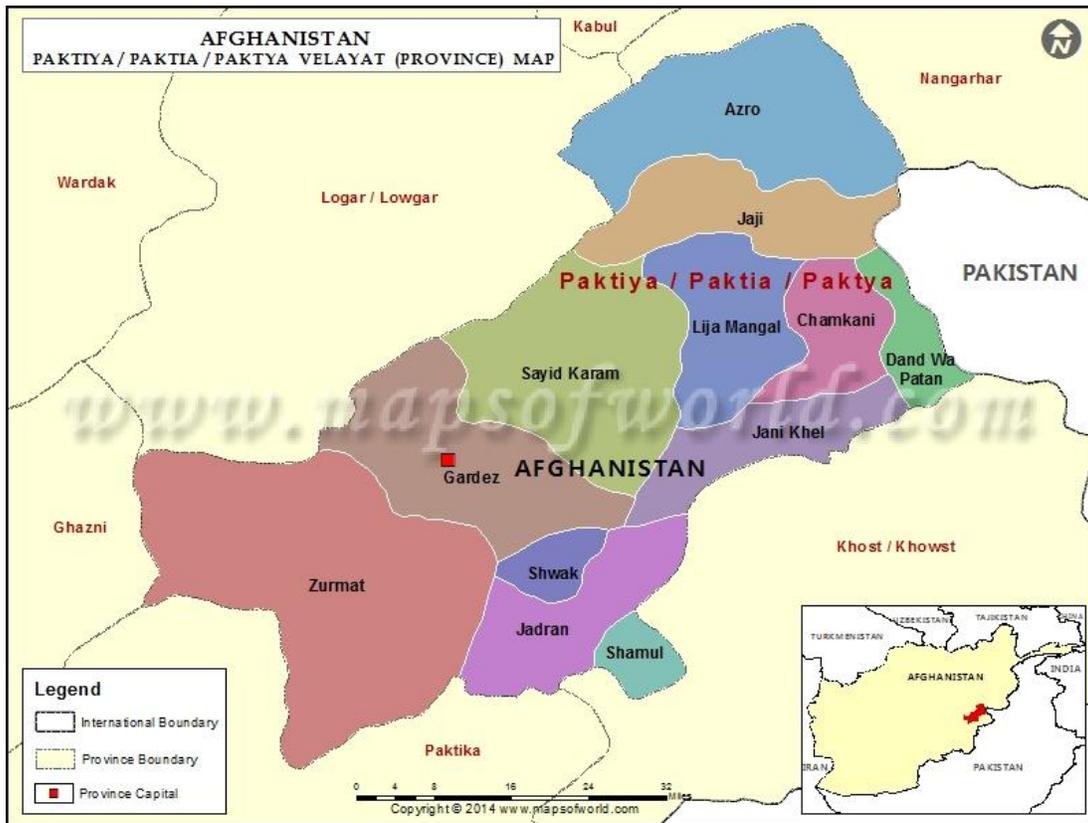


Fig. 1. Study map Afghanistan

Source: Utilizing base map from the Central Agency. Satellite map via Google Earth

Paktia province has been selected on the basis that it occupies an important position of wheat planted area in Afghanistan, estimated at 34.062 thousand Ha, representing 1.62% of the total area under wheat in Afghanistan, amounting to 2.104 million Ha. Also representing 0.354% of the total area under agriculture in Afghanistan, amounting to 9.610 million Ha.

3.3 Sources of Data

The research relied on published and unpublished secondary data from various sources, including the Ministry of Agriculture Irrigation and Livestock (MAIL), National Statistics and Information Authority (NSIA), United States Department of Agriculture (USDA), Food and Agriculture Organization of the United Nations (FAO STAT), THE WORLD BANK, UNdata A world of information and in addition to other websites specialized in publishing data. The research also used some references and researches relevant to the study subject.

4. RESULTS AND DISCUSSION

4.1 Growth over Time of Wheat Production Indicators

This part of the research focuses on analyzing the production indicators of wheat crop over the period 2002-2017.

Planted area: as shown in Table 1, wheat planted area averaged 2.30 million ha and ranged between a minimum of 1.74 million ha in 2002 and a maximum of 2.65 million ha in 2014. On the other hand, the estimated regression equation No. 1 in Table 2 indicates that wheat planted area followed an increase trend, at an annual rate of 0.017 million ha and a statistically significant rate of change amounting to 0.74% of the study period's average planted area. The adjusted coefficient of determination (\bar{R}^2) indicates that 11% of the change in wheat planted area is due to the time variable.

Yield: wheat productivity averaged 1.77 tons per ha and ranged between a minimum of 1.23 tons per ha in 2008 and a maximum of 2.20 tons per ha in 2015. On the other hand, the estimated regression equation No. 2 in Table 2 indicates that productivity of wheat crop followed an increase trend, at an annual rate of 0.047 ton per ha and a statistically significant rate of change amounting to 2.66% of the study period's average productivity. The adjusted coefficient of determination (\bar{R}^2) indicates that 49% of the change in wheat productivity is due to the time variable.

Total production: data in Table 1 indicate that total wheat production averaged 4.59 million tons and ranged between a minimum of 2.390 million

tons in 2004 and a maximum of 5.370 million tons in 2014. The estimated regression equation No. 3 in Table 2 indicates that total wheat production increasing by 0.133 million tons/annum, a statistically significant annual rate of 3.25% of the period's average wheat production. The adjusted coefficient of determination (\bar{R}^2) indicates that 39% of the change in total wheat production is due to the time variable.

Domestic consumption: data in Table 1 indicate that wheat consumption averaged 5.32 million tons and ranged between a minimum of 3.188 million tons in 2002 and a maximum of 6.950 million tons in 2017. Regression analysis results, (equation 4 in Table 2) indicate that

Table 1. Evolution of production indicators of wheat crop grown in Afghanistan over the period 2002-2017

Year	Total area (million ha)	Yield Ton /ha	Total production (million tons)	Total consumption (million tons)
2002	1.742	1.54	2.686	3.186
2003	2.320	1.50	3.480	3.800
2004	1.888	1.27	2.390	3.268
2005	2.342	1.82	4.266	4.300
2006	2.444	1.38	3.363	4.400
2007	2.466	1.82	4.484	5.500
2008	2.139	1.23	2.623	5.850
2009	2.575	1.97	5.064	6.055
2010	2.354	1.92	4.521	5.400
2011	2.232	1.52	3.388	4.500
2012	2.512	2.01	5.050	6.040
2013	2.553	2.03	5.169	6.045
2014	2.654	2.02	5.370	6.200
2015	2.128	2.20	4.673	6.800
2016	2.300	1.98	4.555	6.900
2017	2.104	2.03	4.281	6.950
Average	2.30	1.77	4.09	5.32

Source: Calculated using data collected from the Central statistics organization, Different Issues

Table 2. Estimated regression equations for wheat planted area, yield, total production and total consumption over the period 2002-2017

Eq. No	Dependent variable	Model equations	Annual average	Amount of change	Annual Chang rate%	\bar{R}^2	F
1	Total Area (million ha)	$\hat{Y}_t = 2.151 + 0.017x$ (16.72)* (1.290)**	2.30	0.017	0.74	0.11	1.66
2	Yield (Ton /ha)	$\hat{Y}_t = 1.366 + 0.047x$ (11.79)* (3.92)*	1.77	0.047	2.66	0.49	15.37
3	Total Production (million tons)	$\hat{Y}_t = 2.958 + 0.133x$ (7.43)* (3.22)*	4.09	0.133	3.25	0.39	10.38
4	Total consumption (million tons)	$\hat{Y}_t = 3.297 + 0.239x$ (11.34)* (7.93)*	5.32	0.239	4.49	0.81	62.91

Source: Authors Calculation

* Significant at the level 0.01

** Significant at the level 0.05

Table 3. Relative importance of the problems wheat farmers in Paktia province confront based on results of the survey carried during the agricultural season 2019

Problem	Yes	%of the total problems confronted	% of the total number of sample farmers	No	%of the total problems confronted	%of the total number of sample farmers
1 High wages of labor	190	7.63	90.47	20	2.29	9.52
2 High prices of automated services	200	8.03	90.23	10	1.14	4.76
3 High prices of chemical fertilizers	165	6.62	78.57	45	5.16	21.42
4 High prices of pesticides	177	7.11	84.28	33	3.78	15.71
5 High irrigation costs	189	7.59	90	21	2.41	10
6 Deterioration the qualities of commercial type	130	5.22	61.90	80	9.18	38.09
7 Spread of weeds in the crop	125	5.02	59.52	85	9.75	40.47
8 Spread of agricultural diseases and pests	134	5.38	63.80	76	8.72	36.19
9 Low level of irrigation water	160	6.42	76.19	50	5.74	23.80
10 Not disinfection of irrigation drains	121	4.86	57.61	89	10.21	42.38
11 Low wheat area	155	6.22	73.80	55	6.31	26.19
12 Use of internationally prohibited pesticides	89	3.57	42.38	121	13.89	57.61
13 Agricultural labor migration to the city	144	5.78	68.57	66	7.57	31.42
14 High prices of organic fertilizers	167	6.70	79.52	43	4.93	20.47
15 Low production	203	8.15	96.66	7	0.80	3.33
16 Difficult access to agricultural loans	140	5.62	66.66	70	8.03	33.33
Total	2489	100	-	871	100	-

Source: Calculated based on field data collected using questionnaire

Table 4. Results of applying ANOVA to problems wheat farmers in Paktia region confront based on results of the survey carried during the agricultural Season 2019

Source of variation	df	Sum of squares	Mean square	F
Between problems	15	72.77	4.85	28.34**
Within problems	3344	572.44	0.171	
Total	3359	645.21	—	—

**Significant at the 0.01 level

Table 5. Farmers' perceptions regarding problems confronted in wheat production in in Paktia region during the agricultural Season 2019, arranged in descending order using LSD method

Problems	Average	X12	X10	X7	X6	X8	X16	X13	X11	X9	X3	X14	X4	X5	X1	X2	X15
		1.576	1.423	1.404	1.380	1.362	1.333	1.314	1.262	1.238	1.214	1.205	1.157	1.100	1.095	1.047	1.033
X12	1.576	-															
X10	1.423	**0.15	-														
X7	1.404	**0.17	**0.19	-													
X6	1.380	**0.20	**0.43	**0.24	-												
X8	1.362	**0.21	**0.61	**0.42	-												
X16	1.333	**0.24	0.09	**0.71	**0.47	-											
X13	1.314	**0.26	0.11	0.09	**0.66	**0.48	**0.19	-									
X11	1.262	**0.31	**0.16	**0.14	**0.12	**0.10	0.07	0.05	-								
X9	1.238	**0.34	**0.19	**0.17	**0.14	**0.12	0.09	0.08	0.02	-							
X3	1.214	**0.36	**0.21	**0.19	**0.17	**0.15	**0.12	**0.10	0.05	0.02	-						
X14	1.205	**0.37	**0.22	**0.20	**0.18	**0.16	**0.13	**0.11	0.06	0.03	0.02	-					
X4	1.157	**0.42	**0.27	**0.25	**0.22	**0.21	**0.18	**0.16	**0.11	0.08	0.05	0.04	-				
X5	1.100	**0.48	**0.32	**0.30	**0.28	**0.26	**0.23	**0.21	**0.16	**0.13	**0.11	**0.10	0.06	-			
X1	1.095	**0.48	**0.33	**0.30	**0.29	**0.27	**0.24	**0.22	**0.17	**0.14	**0.12	**0.11	0.06	0.03	-		
X2	1.047	**0.53	**0.38	**0.36	**0.33	**0.31	**0.29	**0.22	**0.19	**0.19	**0.17	**0.16	0.05	0.04	-	-	-
X15	1.033	**0.54	**0.39	**0.37	**0.35	**0.33	**0.30	**0.28	**0.23	**0.21	**0.18	**0.17	**0.12	**0.67	**0.62	**0.14	-

**Significant at the 0.01 level (L.S.D. critical value is estimated at 0.055)

Source: Calculated using field data collected from sample farmers with the help of the designed questionnaire

wheat consumption has been increasing by 0.239 million tons/annum, at a statistically significant annual rate of 4.49% of the period's average wheat consumption. The adjusted coefficient of determination (\bar{R}^2) indicates that 81% of the change in domestic wheat consumption is due to the time variable.

4.2 Wheat Farmers' Perception of Production Problems

Studying the relative importance of problems wheat farmers confront indicate that Low production ranks first (8.15%), followed by High prices of automated services ranked second (8.03%), High wages of labor and High irrigation costs ranked third (7.63%) and fourth (7.59%), respectively. High prices of pesticides ranked fifth (7.11%), while High prices of organic fertilizers and High prices of chemical fertilizers ranked sixth (6.70%) and seventh (6.62%), respectively. while Low level of irrigation water ranked eight (6.42%), Low wheat area and Agricultural labor migration to the city ranked Ninth (6.27%) and tenth (5.78%), respectively. While occupied problems Difficult access to agricultural loans, spread of agricultural diseases and pests and Deterioration the qualities of commercial type ranked eleventh (5.62%), twelfth (5.38%) and thirteenth (5.22%) respectively. Spread of weeds in the crop and Not disinfection of irrigation drains ranked fourteenth (5.02%) and fifteenth (4.86%), respectively. while Use of internationally prohibited pesticides sixteen and last by accounting for 3.57% of the problem's wheat farmers in Paktia region confront, as shown in Table 3.

Results of applying ANOVA, presented in Table 4, indicate that F value is statistically significant at the 0.01 level, which means that significant differences exist between the abovementioned problems.

In order to identify overlaps between the sixteen problems in terms of relative importance, "L.S.D" method was applied (Least Significant Difference), as shown in Table 5, where the identified problems were arranged in descending order based on average ranks of farmers' opinions. It was found that Use of internationally prohibited pesticides (X12) and Not disinfection of irrigation drains (X10) ranked on top of the problem's wheat producers confront, where no

significant differences exist. Spread of weeds in the crop (X7) and deterioration the qualities of commercial type (X6) ranked second, with no significant difference also. spread of agricultural diseases and pests (X8) and Difficult access to agricultural loans(X16) ranked third, with no significant differences. Agricultural labor migration to the city (X13) and Low wheat area (X11) ranked fourth, with no significant difference. Low level of irrigation water(X9) and High prices of chemical fertilizers (X3) ranked fifth, with no significant difference. High prices of organic fertilizers (X14) and High prices of pesticides (X4) ranked sixth, with no significant difference. High irrigation costs (X5) and High wages of labor (X1) ranked seventh, with no significant difference. High prices of automated services (X2) and Low production (X15) ranked eighth, with no significant difference.

5. CONCLUSIONS AND RECOMMENDATIONS

The agricultural sector in Afghanistan faces many challenges in general that have directly affected the production of crops. Especially wheat crop because of its great importance to the population sector as it is the first source of food in Afghanistan. Therefore, this research aims to shed light on studying the production indicators of this major crop. In addition to Knowledge of farmers' Perception Regarding Production, Problems Confronted them to solve these problems and make recommendations to help decision-makers.

The current study applied simple regression analysis to estimate the general trends to determine the productive and economic indicators of Wheat crop. Also, we use Analysis of variance (One Way ANOVA) to understand the farmers' perceptions and attitudes towards the problems facing them. The results showed that wheat productivity averaged 1.77 tons per ha and ranged between a minimum of 1.23 tons per ha in 2008 and a maximum of 2.20 tons per ha in 2015. On the other hand, the estimated regression equation indicates that productivity of wheat crop followed an increase trend, at an annual rate of 0.047 ton per ha and a statistically significant rate of change amounting to 2.66% of the study period's average productivity. In addition, wheat production averaged 4.59 million tons and ranged between a minimum of 2.390 million tons in 2004 and a

maximum of 5.370 million tons in 2014. The estimated regression equation indicates that total wheat production increasing by 0.133 million tons/annum, a statistically significant annual rate of 3.25% of the period's average wheat production.

In addition, Studying the relative importance of problems wheat farmers confront indicate that Low production ranks first (8.15%), followed by High prices of automated services ranked second (8.03%), High wages of labor and High irrigation costs ranked third (7.63%) and fourth (7.59%), respectively. High prices of pesticides ranked fifth (7.11%), while High prices of organic fertilizers and High prices of chemical fertilizers ranked sixth (6.70%) and seventh (6.62%), respectively. while Low level of irrigation water ranked eight (6.42%), Low wheat area and Agricultural labor migration to the city ranked Ninth (6.27%) and tenth (5.78%), respectively. While occupied problems difficult access to agricultural loans, spread of agricultural diseases and pests and deterioration the qualities of commercial type ranked eleventh (5.62%), twelfth (5.38%) and thirteenth (5.22%) respectively. Spread of weeds in the crop and Not disinfection of irrigation drains ranked fourteenth (5.02%) and fifteenth (4.86%), respectively. while Use of internationally prohibited pesticides sixteen and last by accounting for 3.57% of the problem's wheat farmers in Paktia region confront.

Based on the research results, we recommend the following:

- I. Policy should be devised for stable input prices with timely supply of inputs that is necessary for sustaining higher wheat productivity.
- II. Research and extension system should be reinvigorated to inform/train wheat grower in both price and non-price factors (crop management and agronomic prices).
- III. Government must be comensate farmers by reducing the prices of inputs like quality seeds, fertilizers; etc.
- IV. Government is required to make policy regarding floods area to protect farmers' rights.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/53212>