

Research Article



Role of Education in Enhancing Sugarcane Yield in Mardan and Charsadda Districts of Khyber Pakhtunkhwa, Pakistan

Faheem Khan*, Muhammad Zafarullah Khan

Department of Agricultural Extension Education and Communication, Faculty of Rural Social Science, The University of Agriculture, Peshawar, Pakistan.

Abstract | Sugarcane is important cash crop in Pakistan, however, its yield per hectare remains low. The present research aims at evaluating the role of education in enhancing sugarcane yield. Two districts namely Mardan and Charsadda of Khyber Pakhtunkhwa Province were selected for this purpose. A multi-stage sampling method was used to draw sample of 336 sugarcane growers for the present study and an interview schedule was used to solicit responses that addressed the research objectives. The findings from the study showed that 80 percent of respondents were illiterate while the 20 percent of respondents who were literate had achieved various levels of education. In the years 2012 and 2013, the average yield of educated sugarcane growers was 76 t/ha while illiterate sugarcane growers was 64 t/ha. It is recommended that sugarcane growers should be educated through Farmer Field School and other extension programs and extension agents should motivate and train the growers to cultivate sugarcane using scientific techniques, paying special attention to those who are illiterate, to the point of developing special extension tools for those who cannot read.

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***Correspondence** | Faheem Khan, The University of Agriculture, Peshawar, Pakistan; **E-mail** | faheem314@gmail.com

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Introduction

Sugarcane is one of the important cash crops of Pakistan. It generates income for the farming community and is also a source of employment for youth of the country. It boosts the economy by adding value as well as providing essential raw materials for other industries like chipboard and paper. The sugar industry's share of value added to agriculture and the Gross Domestic Product (GDP) in Pakistan was 3.6 % and 0.8 % respectively in 2011-12 (GOP, 2013).

According to the Federal Bureau of Statistics Report 2011-12, sugarcane was grown on an area of 1.046 million hectares. The cultivated area of sugarcane was

about six percent greater than the previous year 2010-11 (988 thousand hectares). Sugarcane production in the year 2011-12 was 58.038 million tonnes against 55.309 million tonnes for the year 2010-11. This indicates an increase of about 5 % in production during 2011-12. The main factors contributing to the increase in agricultural production are profitable market prices and the use of more agricultural inputs. In Pakistan, farmers are being encouraged to grow more sugarcane as there is high demand of sugar due to population growth. However, the decline in yield of cane (kg/ha) between years 2010-11 and 2011-12 caused a reduction in sugarcane production. The flood of 2010 enhanced soil fertility for much of the sugarcane growing area in Pakistan and as a result can yield (kg/ha)

was about 7 % higher in year 2010-11 compared with 2011-12 ([Federal Bureau of Statistics, 2013](#)).

According of province of Khyber Pakhtukhwa Bureau of Statistics, annual agricultural statistical data indicate that there were 107 thousand hectares of sugarcane in the province in year 2012-13, an increase of 1 % over the previous year. Sugarcane production in the Khyber Pakhtunkhwa province has therefore increased in-significantly from 4.684 million tonnes in 2011-12 to 4.770 million tonnes in 2012-13 ([Khyber Pakhtunkhwa Bureau of Statistics, 2013](#)).

The annual agricultural statistical data of Mardan and Charsadda districts were collected from Khyber Pakhtunkhwa Bureau of Statistics 2008-09 to 2012-13. The final annual agricultural statistical data showed the cultivated area of sugarcane in Mardan district during 2008-09 was 28,428 hectares, while sugarcane production was 1,309,744 tonnes and calculated yield was 46 t/ha. In 2012-13, total cultivated area under sugarcane in Mardan district was 30,436 hectares, sugarcane production was 1,420,488 tonnes and calculated yield was 47 t/ha. During the period of five years (2008-09 to 2012-13), yield of sugarcane increased from 46 to 47 (t/ha) which meant that average sugarcane yield increased by only one t/ha over five years. On the other side in Charsadda district, total area of cultivated cane was 30,771 hectares, production was 1,376,173 tonnes and calculated yield was 44 t/ha in year 2008-09. Total area of sugarcane cultivated in 2012-13 was 34,593 hectares, production was 1,502,268 tonnes and calculated yield was 43 t/ha, a reduction of 1 t/ha. The cane yield decreased slightly in Charsadda district. This may be due to the fact that growers were illiterate, not using modern technologies for farm management and un-aware of recommended doses of inputs.

Over five years (2008-09 to 2012-13), the annual agricultural statistical data for Khyber Pakhtunkhwa province showed that sugarcane yield decreased by 1 t/ha in Charsadda district ([Khyber Pakhtunkhwa Bureau of Statistical 2012-13](#)). This substantial drop in yield over the five-year period was probably due to traditional growing methods, lack of irrigation, lack of or lower use of other inputs in contrast to Mardan where modern varieties, effective functioning of the agricultural extension department and higher use of inputs was observed.

Education is one of the most important basic elements for social, political and economic development.

The history of the developed nations shows that their economic development has a positive relationship with education. Education plays an important role in allocating labour to farm activities and off-farm activities usually give a higher return to education than on-farm work ([Jolliffe, 2004](#)). In a similar way, research in agriculture plays its due role in enhancing agricultural production. Research induced technical change resulted in 20 % growth in agricultural production in China since 1965 ([Fan and Pardey, 1997](#)). Education plays a significant role in poverty alleviation ([Laszlo, 2008](#)). However, the small farmers in developing countries are often unable to cope with changing world conditions due to lack of education. The participation of illiterate farmers in Farmers Field Schools (FFS) can result in immediate and development benefits because this approach creates awareness among illiterate farmers regarding use of modern technologies, recommended doses of inputs and land preparation. The agricultural extension agent educate the farmers in the field regarding the farm management, use of recommended inputs and modern technologies ([Berg and Jenice, 2007](#)). The FFS approach can help to decrease input costs and increase sugarcane yield ([Habib et al., 2007](#)).

The present study is aimed at a detailed investigation of education level of farmers and its impact on sugarcane yield. It has been reported that educated farmers get more crop yield than uneducated ones, however, how the different education levels impact the yield of sugarcane have not been investigated in detail. Therefore significance of farmers' education and its role in increasing the sugarcane crop yield needs to be studied. Investigations into this area will help making out strategies to improve sugarcane yield through education of farmers.

Materials and Methods

In Khyber Pakhtunkhwa, sugarcane is grown in Mardan and Charsadda, Peshawar, Dera Ismail Khan, Malakand and Swabi districts that is six districts out of the total 29 districts in the Province. However, the major areas for sugarcane production according to Khyber Pakhtunkhwa Bureau of Statistics were Mardan and Charsadda districts. Therefore, these two districts were purposely selected for this research study because of the significance of their production as shown in [Table 1](#).

A multi-stage sampling method was used to select the required sample of sugarcane growers to interview.

Table 1: Area, production and yield of sugarcane in Khyber Pakhtunkhwa, 2012

District	Area (ha)	Production (tons)	Yield (t/ha)
Charsadda	34593	1502268	43
Mardan	30436	1420448	46
D.I Khan	13565	575674	42
Peshawar	11106	576850	51
Malakand	4670	175529	37
Swabi	4336	170161	39

Source: Khyber Pakhtunkhwa Bureau of Statistics, 2013

In the first stage of sampling, two tehsils (the next sub-division below district) namely Takhatbhai and Tangi from Mardan and Charsadda districts respectively were randomly selected. From each selected tehsil, five union councils (next lower sub-divisions) were randomly selected namely Saro Shah, Madey Baba, Pir Saddi, Mian Issa, and Lundkhwar from Takhatbhai and Koz Behram Dehri, Gundhera, Abazi, Hisara Nehri and Sherpao from Tangi. From each selected village namely Ferozshah, Akbarabad, Qutabgarh, Mi-angano Killi, Gulmera, Dobandi, Payan, Tangi Abazi, Gumbati and Hisara Nehri, 15% of sugarcane growers were randomly selected. The method of selecting respondents is described in Table 2.

The research study was based on primary as well as secondary data. A well designed interview schedule was used in the field by the researcher to collect primary information for years 2012 and 2013 from the sugarcane growers and secondary data were collected from other published and un-published sources. The farmers were categorized into age groups of 26 – 35 year, 36-45 year, 45-55 year and 56 years and above. Age is very important factor which determines the response

of a person during various stages in their life. A rational decision making process can also be influenced by age. Young people will generally be willing to adopt changes rapidly and are more responsive to any activity particularly in communication and understanding (Jensen, 1982; Basant, 1998; Tsur et al., 1990).

The interviews with sugarcane growers took place at a convenient place for the sugarcane growers like the farmer's home or community Centre (Hujra). Computer programs such as Excel and SPSS were used to analyses the primary data from sugarcane growers. These computer programs were also used for paired t-tests, chi-square tests and to calculate percentages. The paired t-test for convenience is described as:

$$t = \frac{\bar{d}}{sd/\sqrt{n}}$$

Where, d is the difference between two sample observations and n is the number of pairs. The statistic t follow a t-distribution with (n-1) degrees of freedom (McDonald, 2014).

The chi-square statistic for convenience is described as:

$$\chi^2 = \sum_{i=1}^r \sum_{j=1}^c \frac{(O_{ij} - e_{ij})^2}{e_{ij}}$$

Where, O_{ij} indicates the observed frequency and e_{ij} shows the expected frequency. The χ^2 statistic under the null hypothesis (H_0) follows a χ^2 distribution with (r-1) (c-1) degrees of freedom (Tai, 1978).

Table 2: Detail of samples selected in Mardan and Chasadda districts

Districts	Tehsils	Union Councils	Villages	Sugarcane growers	Total
Mardan	Takhatbhai	Saro Shah	Ferozshah	302(45)	1212 (183)
		Madey Baba	Qutabgargh	224(34)	
		Pir Saddi	Akbarabad	217(33)	
		Mia Issa	Miangano Killi	232(35)	
		Lundkhawar	Gulmera	237(36)	
Charsadda	Tangi	Koz Behram Dehri	Dobandi	200(30)	1024 (153)
		Gandhera	Payan	180(27)	
		Abazi	Tangi Abazi	195(29)	
		Hisra Nehri	Gumbati	160(24)	
		Sherpao	Hisara Nehri	289(43)	
Total					2236 (336)

The values in parenthesis indicate sampled sugarcane growers

The paired t-test was used for the year-wise comparison of sugarcane yield while the chi-square tool was used to find out the association between sugarcane yield and education.

Results and Discussion

During collection of primary data in the field, it was observed that neither educated nor illiterate sugarcane growers were cultivating sugarcane professionally. The survey collected information on the personal characteristics of sugarcane growers who responded to the survey with the view to seeing which if any had an effect on sugarcane yield and production. Some of the characteristics investigated were age, education, and farm size.

Age

Table 3 shows that out of total 336 respondents, a significant proportion of 236 respondents belong to the age group of 36-45 years. In each of the villages Gulmera, Miagano Killi, Akhbar Abad, Qutabgarh, Feroz Shah, Dobandi, Payan, Tangi Abazi, Hisara Nehri and Qumbati respectively the largest number of came from this group, followed by 56 farmers in the age group of 26-35 years, while another 43 of the respondents were in the age category of 46-55 years. Only a single individual interviewed was in the age group of 56 years and above.

Table 3: Distribution of respondents by age

Districts	Villages	Age (years)				Total
		26-35	36-45	46-55	56 & above	
Mardan	Gulmera	7 (19)	23 (64)	5 (14)	1 (3)	36 (100)
	Miagano Killi	10 (29)	18 (51)	7 (20)	-	35 (100)
	Akhbar Abad	12 (35)	16 (47)	6 (18)	-	34 (100)
	Qutabgarh	7 (21)	23 (70)	3 (9)	-	33 (100)
	Feroz shah	1 (3)	37 (81)	7 (16)	-	45 (100)
	Dobandi	7 (23)	23 (77)	-	-	30 (100)
	Payan	4 (15)	23 (85)	-	-	27 (100)
Charsadda	Tangi Abazi	1 (3)	26 (90)	2 (7)	-	29 (100)
	Hisara Nehri	6 (14)	29 (67)	8 (19)	-	43 (100)
	Qumbati	1 (3)	18 (75)	5 (21)	1	24 (100)
	Total	56(17)	236(70)	43(13)	1(0.3)	336(100)

Source: Field data 2012-2013; Values in parenthesis are percentage

Farm size

Farm size plays an important role in the diffusion, dissemination and adoption of new agricultural technologies among the farming community. The rate of diffusion and adoption of agricultural technology usually occurs more quickly on large landholdings and vice versa. Farm size differs from country to country and even considerable variations in farm size can be observed within a region. The distribution of farm size by village is reported in Table 4.

Table 4: Distribution of respondents in Mardan and Charsadda districts by farm size

Districts	Villages	Farm Size (Acre)				Total
		Up to 5	6-10	11-21	22 & above	
Mardan	Gulmera	33 (92)	1 (3)	2 (7)	-	36 (100)
	Miagano Killi	33 (94)	2 (6)	-	-	35 (100)
	Akhbar Abad	33 (97)	1 (3)	-	-	34 (100)
	Qutabgarh	29 (88)	1 (3)	2 (6)	1 (3)	33 (100)
	Feroz Shah	36 (80)	2 (4)	6(13)	1(3)	45 (100)
	Dobandi	25 (83)	5(17)	-	-	30 (100)
	Payan	25 (93)	2 (7)	-	-	27 (100)
Charsadda	Tangi Abazi	23 (79)	3(10)	3(10)	-	29 (100)
	Hisara Nehri	40 (93)	3 (7)	-	-	43 (100)
	Qumbati	22 (92)	2 (8)	-	-	24 (100)
	Total	299(89)	22(6)	13(4)	2(0.5)	336(100)

Source: Field data, 2012-2013; Values in parenthesis are percentage

Table 4 shows that an over-whelming majority of respondents (299) were small farmers operating on less than 5 acres of land that was the case in all villages Gulmera, Miagano Killi, Akhbar Abad, Qutabgarh, Feroz shah, Dobandi, Payan, Tangi Abazi, Hisara Nehri and Qumbati surveyed in the study area. They were followed by 22 farmers who had between 6 and 10 acres land. Only 6 of the respondents had between 17-22 acres followed by 2 who had more than 22 acres of land. According to Govt. of NWFP (2005), agriculture in the NWFP (now called Khyber Pakhtunkhwa) in general and in the mountain area in particular, is majority a small farm activity and small farmers are 41 % of total farming area, which is 87 % of total number of farms.

Another important characteristic of the farm population is literacy. Table 5 shows that out of total 336

respondents 70 (21 %) were educated while 266 (79 %) were illiterate. The results of research of [Perviaz et al. \(2013\)](#) showed that majority (90 %) of the farmers were illiterate in union council Malakander, Peshawar of Khyber Pakhtunkhwa Province.

Education

The researcher observed in the field during collection

Table 5: Distribution of respondents by literacy

Dis- tricts	Villages	Education		Total
		Literate	Illiterate	
Mardan	Gulmera	7 (19)	29 (81)	36 (100)
	Miagano Killi	5 (14)	30 (86)	35 (100)
	Akhaber Abad	5 (15)	29 (85)	34 (100)
	Qutabgarh	4 (12)	29 (88)	33 (100)
	Feroz Shah	22 (49)	23 (51)	45 (100)
Charsadda	Dobandi	4 (13)	26 (87)	30 (100)
	Payan	7 (26)	20 (74)	27 (100)
	Tangi Abazi	8 (28)	21 (72)	29 (100)
	Hisara Nehri	6 (14)	37 (86)	43 (100)
	Qumbati	2 (8)	22 (92)	24 (100)
Total		70 (21)	266 (79)	336 (100)

Source: Field data 2012-2013; Values in parenthesis are percentage

Table 6: Distribution of respondents by level of education

Districts	Villages	Education Level					
		Primary	Middle	Secondary	Certificate	Graduate	Post graduate
Mardan	Gulmera	2 (29)	1 (14)	1 (14)	1 (14)	2 (29)	-
	Miagano Killi	-	3 (60)	1 (20)	-	-	1 (20)
	Akhbar Abad	3 (60)	-	-	2 (40)	-	-
	Qutabgarh	2 (650)	2 (50)	-	-	-	-
	Feroz Shah	7 (32)	6 (27)	5 (23)	2 (9)	2 (9)	-
Charsadda	Dobandi	3 (75)	-	1 (25)	-	-	-
	Payan	6 (86)	1 (14)	-	-	-	-
	Tangi Abazi	6 (75)	2 (25)	-	-	-	-
	Hisara Nehri	6 (100)	-	-	-	-	-
	Qumbti	2 (100)	-	-	-	-	-
Total		37 (12)	70 (20)	8 (2)	5 (1)	4 (1)	1 (0.3)

Source: Field data 2012-2013; Values in parenthesis are percentage

Table 7: Association between education and sugarcane yield

Education	Sugarcane Yield (t/ha)							Total
	Below 25	25.1-50	50.1-75	75.1-100	100.1-125	125.1-150	Above 150.1	
Illiterate	40 (15)	82 (31)	83 (31)	49 (19)	9 (3)	3 (1)	0 (0)	266 (100)
Literate	7 (10)	14 (20)	14 (20)	23 (33)	8 (12)	3 (4)	1 (0.3)	70 (100)
Total	47 (14)	96 (29)	97 (29)	72 (21)	17 (5)	6 (2)	1 (0.3)	336 (100)

Source: Field data, 2013; Chi- Square: 25.062; P. value: <0.005; Gamma Value: 0.593; Values in parenthesis are percentage

of primary data that educated sugarcane growers were helpful, cooperative and aware from modern farm practices, recommended inputs and local and national market. [Table 6](#) shows the distribution of respondents by level of education. Field data reported in [Table 6](#) shows that 70 respondents out of total 336 respondents were educated. Out of the educated respondents, 37 had primary education, 15 went to middle school, 8 completed secondary school, 5 held sub-tertiary certificates, 4 had graduated with a bachelor's degree and one had a post-graduate qualification. The Feroz Shah Village of Mardan district where almost an equal number of respondents were educated and aware from modern farm practices because the farmers of Feroz Shah Village were consist near provincial agricultural research department. The research study of ([Ali et al., 2013](#)) shows that educated, young and experienced sugarcane growers are to be more efficient in their operations and can get maximum output using same level of inputs.

Association between education and sugarcane production

[Table 7](#) shows association between education and sugarcane yield. Sugarcane yield is statistically strong-

ly significant as (P value = <0.005). The positive sign of Gamma value (0.593) showed that education directly related with sugarcane production which means that sugarcane production increase with rate of literacy level. The research showed that education effect positively on sugarcane production because educated farmers utilized modern farm practices and recommended inputs in the field. Another research study showed that education, use of fertilizers and area under cultivation are the most important determinants of production of sugarcane in Khyber Pakhtunkhwa province (Rehman et al., 2012).

Average yield of literate and illiterate sugarcane growers

Table 8 shows that the sugarcane grower's average sugarcane yield of 2012 and 2013 seasons of the 70 literate respondents was 76 t/ha and 266 illiterate respondents achieved an average yield of only 61 t/ha while average yield of all growers was 64 t/ha. The results shows significant difference between average yield of sugarcane and education (literate and illiterate) (p-value = 0.000) in the study area. It is because that the educated growers adopted improved farm practices and professionally utilized recommended farm inputs. Therefore, their yield per hectare is more than illiterate. Ullah et al. (2011) concluded from research that extension workers communicate the sugarcane growers to utilize improve farm practices for higher production and also adopt cost effective production technique.

Table 8: Average yield of literate and illiterate sugarcane growers

Education	Average yield 2012-2013 (t/ha)	No. of Respondents	Std. Deviation	P. value
Literate	76	70	12598	0.00
Illiterate	61	266	11074	
All farmers	64	336	11677	

Source: Field data, 2012 and 2013

Table 9 indicates that the average yield (t/ha) over two seasons (2012 and 2013) was considerably higher for literate than illiterate sugarcane growers. There was distinct trend for average sugarcane yield to correlate with education level. Average yield achieved by graduate sugarcane growers was 111 t/ha, certificate holders 95 t/ha, growers with Middle education 88 t/ha and Primary education 61 t/ha. Illiterate sugarcane growers also achieved an average yield of 61 t/ha. The only exception to this general trend was one sugarcane grower with post-graduate qualifications whose average yield was 51 t/ha. He is cultivating sugarcane as

part time grower and he is not a professional agriculturist which may explain the low yield. The report of (Khan, 2014) shows that Mardan district was famous for high production of sugarcane crops and there was a time that Asia's largest sugar mill existed in Mardan. But now time has changed and the yield has been declining in Mardan. The report recommended that sugarcane growers need education for use of recommended varieties and adopting modern farm practices for high yielding of sugarcane crop.

Table 9: Average yield (2012 and 2013) of sugarcane with level of education

Education	Average Yield (t/ha)	Number of Respondents	Std. deviation
Illiterate	61	266	11074
Primary school	61	37	9282
Middle school	88	15	11292
Matriculation	99	8	15799
Certificate	95	5	11771
Graduate	111	4	10203
Post-Graduate	51	1	---
Total	64	336	11677

Source: Field data 2012 and 2013

Table 10: Yearly comparison of sugarcane yields (t/ha) and cultivated areas (ha) in the study area

Years	Mean yield	Std deviation	Mean difference	t-ratio	P. value
2012	68.03	29.974	-7.87	-5.621	0.000
2013	60.21	35.584			
Area (ha) of Sugarcane					
	Mean area	Std deviation	Mean difference	t-ratio	P. value
2012	1.54	1.818	-0.0132	-3.29	0.001
2013	1.53	1.821			

Source: Field data 2012 and 2013

Cultivated area and yield of sugarcane in the study area

The average area of sugarcane cultivated per farm in the study area was 1.53 ha in 2013 while in 2012 the cultivated area was 1.54 ha. The significant association showed between sugarcane cultivated area and yield of sugarcane as (P. value 0.001 and t-ratio -3.29). Table 10 show that the average yield of sugarcane was 60.21 t/ha in 2013 while in 2012 the yield of sugarcane was sustainably higher at 68.03 t/ha with average mean difference (-7.87 t/ha). These results confirm the significant association between yield of sugarcane

and years of cultivation (p -value = 0.000 and t -ratio -5.621). The yield of sugarcane decreased 8 t/ha during 2013 in study area. But the yield of sugarcane is higher in Mardan and Charsadda districts from average yield (45 t/ha) of KP Province due to more fertile land, better irrigation and use of inputs like fertilizers, insecticides and weedicides. On the other hand, cultivated area of sugarcane decreased very less because of ratoon crops. The annual report of Khyber Pakhtunkhwa Bureau of Statistic showed that average yield of sugarcane was 45 t/ha within 2012 and 2103 (Khyber Pakhtunkhwa Bureau of Statistic, 2013). The Federal Bureau of Statistic showed that the sugarcane yield decreased 6 t/ha in Pakistan within five years from 2008-09 to 2012-13 (Federal Bureau of Statistics, 2013).

Conclusions

It is concluded that educated respondents get more sugarcane yield per hectare than illiterate sugarcane growers. Majority of the sugarcane growers surveyed were illiterate, most were in the age group of 36-45 years and almost all of them operated quite small farms. The sharing of superior knowledge of educated sugarcane growers, staff of provincial agricultural extension department and concerned NGO's might be used to motivate the illiterate sugarcane growers to cultivate sugarcane using modern and scientific technology. In order to run farming activities on a more scientific basis the sugarcane growers should be provided with appropriate information's through electronic media channels and other sources in their local languages. Illiterate growers should be provided with information through Farmers Field School approach in a way which could be understood without the need to read or write and this approach should avoid the technical jargon as much as possible.

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