



## ROLE OF VARIOUS FACTORS IN SUGARCANE PRODUCTION IN SELECTED AREA OF KHYBER PAKHTUNKHWA, PAKISTAN

Faheem Khan\*, Muhammad Tahir Ali Shah\*\* and Muhammad Zafarullah Khan\*

### ABSTRACT

This study was conducted in the Department of Agricultural Extension, Education and Communication, University of Agriculture, Peshawar, Pakistan during the year 2015 to identify the main factors affecting sugarcane productivity. Two districts i.e. Mardan and Charsadda of Khyber Pakhtunkhwa province were selected for this research study. Moreover, a multi-stage sampling technique was applied for selection of the samples. Some 336 sugarcane growers were selected through a multi-stage sampling technique. Primary data were collected from these growers by a well-designed and pre-tested interview schedule. Results of study confirmed that educated, young, large size land-holders (6.88 to 8.50 ha) and share cropper growers recorded maximum average yields of 110, 69.07, 124.24 and 93.80 tons per hectare of sugarcane. Moreover, a few growers (cultivated area 6.88 -8.50 ha) achieved average yield upto 124.24 tons per hectare. Certainly, these growers have appropriate knowledge about productivity factors. Further, silt loam soil and fallow sowing method (mono-cropping) was associated with improved sugarcane productivity. The silt loam soil and fallow sowing method growers got maximum average yields of 75.52 and 83.17 tons per hectare. Similarly, the growers who had knowledge about the benefits of engaging with agricultural extension department and agricultural extension agents achieved average yields of 88.39 and 74.21 tons per hectare. In addition, the sugarcane growers who planted more productive varieties i.e. CPF 246, NCO 310, SPF 213, Mardan 93 and CP 77/400 obtained average yields of 112.18, 107.89, 85.00, 71.00 and 70.97 tons per hectare, respectively. It was concluded that educated growers were aware of suitable cultivating techniques, appropriate management, proper and timely inputs application and other required information.

**KEYWORDS:** *Saccharum officinarum*; sugarcane; interview schedule; multi-stage sampling method; cultivation methods; tenure; soil types; education; Pakistan.

\*Department of Agricultural Extension, Education and Communication, University of Agriculture, Peshawar-Pakistan.  
\*\*Director Academics, Higher Education Commission (HEC), Islamabad, Pakistan.

**Article received on:**

28/08/2017

**Accepted for publication:**

13/09/2017

### INTRODUCTION

Sugarcane is one of the main cash crops of Pakistan. It is basically cultivated for sugar and sugar-related production alongwith inputs for paper and board industry. It contributes worth 31 percent to agriculture and 0.6 percent to GDP. In addition, it achieved US\$ 171.78 million in sugar exports during July-March, 2015. The sugarcane area cultivated decreased by 2.7 percent, which caused a 7.1 percent decline in production. Further, calculated average yield of sugarcane reportedly declined -4.5 percent (1).

Sugarcane production is a multi-dimensional procedure and is influenced by numerous factors.

The awareness of comparative significance of the influencing sugarcane production factors is essential for the sugarcane growers. Once growers are aware of the complexities of growing cane there can be programmes for introducing beneficial alterations in their processes at the micro level. It provides guidelines for the strategy makers for creating plans to improve agricultural efficiency by modelling using reasonable financial values at the macro level. Production techniques such as planting time, soil type, varieties, use of inputs and ease of irrigation water have a significant role in sugarcane production. Knowledge of input costs, such as DAP, urea, irrigation, FYM, costs of seed and labor used for

harvesting were measured and shown to perform a positive role in sugarcane production.

In view of the declining sugarcane production and increasing poverty in sugarcane belt areas, Kumari and Nakano (7) examined the impact of lease expiry on sugarcane yield, chemical fertilizer use and newly planted cane areas using micro-level data from Ba Province, Fiji. They compared tenure security between three tenure types under the formal land lease system. They observed that lease tenure insecurity has a significant negative impact on productivity and investment in newly planted cane when leases are near expiry. On average, Taukei tenants with leases expiring in 0–5 years achieve lower productivity, by 6.5–11 tons per hectare and make less investment in newly planted cane, by planting on average 0.14–0.25 hectares less ground, compared to freehold and state cultivators.

The present research aimed to find out main factors in sugarcane production, assess the impacts of extension departments and agricultural agents in sugarcane production and formulate suggestions and recommendations for policy makers.

## MATERIAL AND METHODS

This study was conducted in the Department of Agricultural Extension, Education and Communication, University of Agriculture, Peshawar, Pakistan during the year 2015. Sugarcane is mainly cultivated in six districts (Mardan, Charsadda, Peshawar, Swabi, Malakand and Dera Islamail Khan) in Khyber Pakhtunkhwa province of Pakistan. However, Charsadda and Mardan are the main sugarcane districts of

Khyber Pakhtunkhwa (Table 1). Therefore, these two districts were selected for this study. Further, a multi-stage sampling method was applied to select the representative sample of sugarcane growers to interview (Table 2). In first stage of using this technique, two tehsils (the next sub-division below district), namely Takhat Bhai from Mardan and Tangi from Charsadda were selected randomly (Lottery Method) and from each selected tehsil, five union councils (next lower sub-division below tehsil) were likewise randomly selected. From each selected union council, one village was randomly selected. Out of total cane growers of villages only 15 percent of cane growers were selected from each selected village (Table 1 and Table 2) for interview reaching to a total of 336.

A well designed and pre-tested interview schedule was used in the field by principal researcher to collect primary information from sugarcane growers for two years 2012 and 2013 and secondary data, mainly production statistics were collected from authentic published and unpublished sources. Cane yields for individual growers were the mean of two years' results. i.e 2012 and 2013, and were calculated by sampling a small area of a cane. The size of this small area was confirmed by a provincial government employee (Patwari halqa) appointed to the union council base to keep land records. He has extensive knowledge about the land cultivated by the farming community. The interviews with sugarcane growers were conducted at a convenient place like the farmer's home or Community Centre (Hujra). Computer programmes such as Excel and SPSS were used to analyze the primary data.

**Table. 1** Average area (ha), production (tonnes) and yield of sugarcane (t/ha) in Khyber Pakhtunkhwa, Pakistan

Districts	2015-16			2014-15		
	Area	Production	Yield	Area	Production	Yield
Peshawar	8134	422998	52	11376	568800	50
Charasadda	31115	1442903	46.37	30012	1368221	45.58
Nowshera	5263	270003	51.30	4260	219279	51.47
Mardan	30915	1369273	44.29	30689	1381285	45
Swabi	2253	86783	38.51	1651	64507	39.07
Kohat	133	4631	34.81	117	4074	34.82
Hangu	10	400	40	20	510	25.50
Mansehra	8	194	24.25	7	165	23.57
Haripur	102	3212	31.49	112	3527	31.49

Table Contd...

Malakand	4790	185524	38.73	4780	184497	38.59
Bunir	66	1770	26.81	56	1508	26.92
Dir Lower	46	1425	30.97	50	1222	24.44
D. I. Khan	27787	1647738	59.29	26762	1236136	46.18
Tank	116	2315	19.95	459	8996	19.59
Bannu	550	21840	39.70	845	33305	39.41
Lakki Marwat	298	11880	38.86	106	4074	38.43
<b>Total districts</b>	<b>111586</b>	<b>5472889</b>	<b>49.04</b>	<b>111302</b>	<b>5080106</b>	<b>45.64</b>
Mohmand Agency	210	6850	32.61	306	8236	26.91
Khyber Agency	678	15642	23.07	678	15642	23.07
Peshawar F. R	15	463	30.86	16	467	29.18
Bannu F. R	76	290	3.81	76	290	3.81
D. I. Khan F. R	90	2110	23.44	100	2251	22.51
<b>Total FATA</b>	<b>1069</b>	<b>25355</b>	<b>23.71</b>	<b>1176</b>	<b>26886</b>	<b>22.86</b>
<b>Total K-P</b>	<b>112655</b>	<b>5490503</b>	<b>48.73</b>	<b>112478</b>	<b>5106992</b>	<b>45.40</b>

Source: GOP of Khyber Pakhtunkhwa, 2017.

**Table 2. Selection of multi stage sampling technique**

Districts	Tehsils	UCs	Villages	15 % sugarcane growers
Mardan	Takhat bhair	Saro Shah	Ferozshah	302 (45)
		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)
		Gandhera	Payan	180 (27)
		Abazi	Tangi Abazi	195 (29)
		Hisra Nehri	Gumbati	160 (24)
		Sherpao	Hisara Nehri	289 (43)
Total	2	10	10	2236 (336)

Multi-Stage Sampling Selection Procedure

## RESULTS AND DISCUSSION

The data about education level (Table 3) was adopted from an article of Khan and Khan (5) which is a part of this research study. It revealed that only 100 sugarcane growers out of total 336 growers were educated. Moreover, these educated sugarcane growers achieved maximum sugarcane yields upto 110.66 tons per hectare which are approximately double of average yield 63.39 tons per hectare of total growers. The data show that educated growers were using their knowledge about new technologies, recommended doses of inputs and high yielding varieties and recommended sugarcane cultivating practices to obtain better yields than uneducated illiterate growers. Perhaps, these educated growers got suitable information and knowledge

from recognized sources of information. Additionally, the data showed that government and concerned organizations should train illiterate sugarcane growers regarding the application of new technologies, recommended level of inputs and benefits of high yielding varieties. Khan *et al.* (6) observed that mostly 76 percent sugarcane growers were illiterate, while remaining 24 percent were literate. Out of literate, 16 percent sugarcane growers were upto primary and 8 percent had upto a middle level of education. In addition, literate sugarcane growers in study area of Khyber Pakhtunkhwa had above than middle level of education. Tukaew *et al.*, (12) noted that most of 60 percent sugarcane growers had completed primary education in Thailand.

**Table 3. Education level and sugarcane yield (t/ha)**

Level of education	Average yield (t/ha)	Number of growers	Std. Deviation
Graduate	110.66	4	25.20
Matric (SSC)	98.63	8	39.02
F.Sc/F.A	94.85	5	29.07
Middle	87.60	15	27.89
Primary	61.52	37	22.92
Illiterate	59.96	266	24.30
Post graduate	51.38	1	--
<b>Total</b>	<b>63.39</b>	<b>336</b>	<b>26.66</b>

Source: Khan and Khan (6)

Table 4 was also selected from the research article of Khan and Khan (6) which is a part of this research study. It described that only 37 sugarcane growers out of 336 were large land holders having 2.42 to 8.50 hectares. This large sized land holders got maximum average sugarcane yield (124.24 t/ha) as compared with average yield of total growers (63.39 t/ha). This is because large sized land holders had resources like labour, finance and suitable sources of information as opposed to small sized land holders. Khan *et al.* (5) reported that 63 percent sugarcane growers cultivated sugarcane crops in an area below 5 acres (2.02 ha), followed by 30 percent who cultivated 5-10

acres (2.42-4.04 ha) and remaining 7 percent had grown more than 10 acres (4.04 ha) at Peshawar district. Abbas *et al.* (1) reported that mostly large farmers (> 4.04 ha cultivated area) (52.50 -84.80%) were aware of recommended sugarcane production technologies. Among large farmers 20 percent got appropriate information from agricultural extension and research wing while 10-20 percent approached mass media. Majority of small growers (70%) was unaware of suitable sugarcane production technologies. These small growers (< 4.04 ha cultivated area) got information from fellow farmers and progressive growers.

**Table 4. Land size (ha) cultivation with sugarcane yield (t/ha)**

Land size	Average yield (t/ha)	Number of growers	Std. Deviation
6.88-8.50	124.24	6	22.24
4.45-6.47	89.77	7	39.30
8.90 and above	84.97	2	53.09
2.42_ 4.04	75.00	22	22.38
Up to 2.02	60.55	299	24.56
<b>Total</b>	<b>63.39</b>	<b>336</b>	<b>26.66</b>

Source: Khan and Khan (6)

The data collected in this study (Table 5) further showed association with sugarcane growers age and their average yields. It indicated that 56 growers out of total 336 were of age 26 to 35 years (young) and these growers got maximum average yield i.e. 69.07 tons. Forty three growers were of age 46 to 55 years (old and experienced) and they achieved average yield of 65.36 tons per hectare. Besides these observations, only a single grower aged more than 55 years (aged and less energetic) and remaining overwhelming majority (i.e.236) was of 36-45 years age (middle age)

who got average yield of 63.23 and 61.68 tons per hectare, respectively. Khan *et al.* (6) noticed that majority (51%) of sugarcane growers fell in the age group of 31-45 years (young and energetic). It was observed that these were keenly involved in farming activities followed by 23 percent in the age group of 46-55 and 19 percent upto 30 years in Peshawar district of Khyber Pakhtunkhwa. Tukaew *et al.* (12) reported that maximum (38.9%) sugarcane growers were in the age group that ranged between 41 and 50 years in Thailand research area.

**Table 5. Sugarcane growers age (years) with sugarcane average yield (t/ha)**

Age of growers	Average yield	Number of growers	Std. Deviation
26-35	69.07	56	27.56
46-55	65.36	43	24.32
56 and above	63.23	1	--
36-45	61.68	236	26.81
<b>Total</b>	<b>63.39</b>	<b>336</b>	<b>26.66</b>

Source: Field Survey by author 2012 and 2013

Table 6 was also adopted from Khan and Khan (6) as it was a part of this research study. It indicated that 24 share-cropper growers, reported maximum average yield (93.80 t/ha) followed by 42 owners cum-tenant (69.8 t/ha) and leaseholder growers

(67.18 t/ha). Remaining maximum 141 and 125 tenant and owner growers reported average yield of 57.72 and 61.65 tons per hectare, respectively. These average yields were less than average yield of 63.39 tons per hectare of total growers.

**Table 6. Tenure status of sugarcane growers and average yield (t/ha)**

Tenure Status	Average Yield	Number of growers	Std. Deviation
Share Cropper	93.80	24	33.87
Owner cum Tenant	69.82	42	22.56
Lease holder	67.18	4	9.12
Owner	61.65	125	27.42
Tenant	57.72	141	22.13
<b>Total</b>	<b>63.39</b>	<b>336</b>	<b>26.66</b>

Source: Khan and Khan (2015).

The results (Table 7) further showed an association of varieties with sugarcane average yield. It reported that 17, 9, 2, 2 and 64 sugarcane growers, out of total 336 cultivated sugarcane varieties CPF 246, NCO 310, SPF 213, Mardan 93 and CP 77/400, with average yield of 112.18, 107.89, 85.00, 71.00 and 70.97 tons per hectare, respectively. Most of growers (241) cultivated the CP77/400 variety and these growers achieved average yield of 55.83 tons per hectare. Moreover, only a single grower cultivated CP 44/101 variety with average yield of 55 tons per hectare. According to Majid (9), approximately 30 sugarcane varieties are presently cultivated in NWFP (Now Khyber

Pakhtunkhwa) province. Among these 30 varieties CP 77/400 was cultivated on approximately 21 percent area, Mardan 92 on 2.1 percent area, Mardan 93 on 3.2 percent, CP 44/101 on 2.2 percent, NCO 310 on 4.0 percent and SPF 213 on 0.2 percent area in Khyber Pakhtunkhwa. In addition, sugarcane growers were growing non-recommended and inferior varieties with a ratio of 1:1 in Khyber Pakhtunkhwa. It is reported by Sugar-Mills (PRSM, BNSM, FRSM, T.B and CHSM) that sugarcane growers cultivated on an average 55.72 percent approved varieties at four districts i.e. Peshawar, Mardan, Bannu and Dera Ismail Khan of Khyber Pakhtunkhwa (8).

**Table 7. Sugarcane average yield (t/ha) with use of various varieties of sugarcane**

Sugarcane varieties	Average yield	Number of growers	Std. deviation
CPF 246	112.18	17	24.15
NCO 310	107.89	9	20.22
SPF 213	85.00	2	8.48
Mardan 93	71.00	2	5.65
CP77/400	70.97	305	22.72
CP 44/101	55.00	1	--
<b>Total</b>	<b>63.22</b>	<b>336</b>	<b>26.71</b>

Source: Field Survey 2012 and 2013

The results (Table 8) expressed association between growers and average yield compared with various soil types. It shows that a large number of sugarcane growers (i.e.177) cultivated sugarcane on silt loam land and these growers achieved average yield of 75.52 tons per hectare followed by 109 growers who planted sugarcane on clay loam (55.37 t/ha). Remaining 24 and 26 growers grew sugarcane on sandy and waterlogged soil and these growers got average yield of 38.53 and

37.32 tons per hectare, respectively. Tukaew *et al.* (12) reported that 51.5 percent farmers planted sugarcane on silt-loam soil in Thailand which is a medium texture and suitable land for sugarcane production. Similarly 38.8 percent farmers planted on clay and 6.7 percent farmers planted sugarcane on sandy loam soil. However, only 3 percent farmers cultivated sugarcane on lateritic soil which is not suitable for growing sugarcane.

**Table 8. Sugarcane average yield (t/ha) in various soils**

Types of soil	Average yield	Number of growers	Std. Deviation
Silt loam	75.52	177	27.27
Clay loam	55.37	109	18.19
Water logged loam	38.53	24	10.64
Sandy loam	37.32	26	11.70
<b>Total</b>	<b>63.39</b>	<b>336</b>	<b>26.66</b>

Source: Field survey by author 2012 and 2013

The results further showed that 45 growers, planted sugarcane on fallow land (mono-crop) and these growers reported average yield upto 83.17 tons per hectare (Table 9), while 291 growers

cultivated sugarcane using inter-cropped methods (two crops in a field) and got average yield upto 60.33 tons per hectare.

**Table 9 Sugarcane average yield (t/ha) with cultivation methods**

Sugarcane sowing methods	Average yield	Number of growers	Std. Deviation
Fallow Land sowing	83.17	45	26.34
Inter Crop Sowing	60.33	291	25.41
<b>Total</b>	<b>63.39</b>	<b>336</b>	<b>26.66</b>

Source: Field Survey 2012 and 2013

The study further disclosed that 44 growers were reported to be knowledgeable about agricultural field assistants and these growers achieved 88.39 tons per hectare. (Table 10). Remaining maximum 292 growers had no knowledge about agricultural field assistants and these growers

reported average yield 59.62 tons per hectare. A research study (1) revealed that relatively more medium farmers (24.3%) paid visits to the offices of Agricultural Officers while large farmers (18.5%) and small farmers (1.27%) paid visits to the offices of AOs at Punjab Province, Pakistan.

**Table 10. Knowledge about agricultural extension staff verses sugarcane yield (t/ha)**

Knowledge about agricultural extension officers	Average yield (t/ha)	Number of growers	Std. Deviation
Yes	88.39	44	34.06
No	59.62	292	23.20
<b>Total</b>	<b>63.39</b>	<b>336</b>	<b>26.66</b>

Source: Field survey by author 2012 and 2013

The data (Table 11) further show that 139 growers, informed that they knew about agricultural extension department and these growers got average yield upto 74.21 tons per hectare followed

by the majority of growers (i.e. 197) who did not know about agricultural extension department and achieved average yield upto 55.75 tons per hectare against average yield of total growers

(63.39 t/ha). A research study (11) revealed that more than 60 percent sugarcane growers were unaware of recommended sugarcane seed weight and adopted traditional area measurement

units (marlas). Lack or low level of awareness has been reported as a major constraint towards the adoption of recommended practices in sugarcane cultivation in Pakistan

**Table 11. Knowledge about agricultural extension department and sugarcane yield (t/ha)**

Knowledge about AED*	Sugarcane average yield (t/ha)	Number of growers	Std. Deviation
Yes	74.21	139	29.388
No	55.75	197	21.582
Total	63.39	336	26.668

Source: Field survey by author, 2012 and 2013, \*Agricultural Extension Department

The study revealed that education level was observed as one of main concerning factors. It was found that educated growers achieved higher average yields than illiterate growers. Educated grower's management and cultivating practices were better than illiterate growers and this was the case with all cane growing factors including timing and variety selection. Similarly, large sized landholders got more average yield than average yield of total growers. Most probably, these growers had necessary resources and were financially sound so they purchased the necessary inputs, high yielding varieties, new machinery and hired labour. Likewise, young growers upto 26-35 years age had higher average yields than total growers. It is evident that this was a result of these growers being energetic, hardworking and keenly professional agriculturists. In addition, share cropper, owner-cum-tenant and lease-holder growers had the highest average production. It is observed that these growers were professional and commercial agriculturists and younger growers were keen to embrace new technologies and varieties. As a result, the growers who planted new varieties like CPF-246, NCO 310, POJ 213, Mardan 93 and CP 77/400 achieved higher yields than other growers. Certainly, these varieties were developed for specific environments and soil types. Moreover, silt loam soil is the most fertile land for sugarcane crops. On this type of land cultivators got more average yield than other growers indicating the importance of soil type. Further, the fallow land

(mono-crop) crop cultivation method provided a suitable system for sustainable sugarcane productivity. Importantly those growers who had knowledge about agricultural extension agents or agricultural extension departments observed above average yields regardless of other factors.

## CONCLUSION

It is concluded that educated and trained growers were found as knowledgeable about sugarcane productivity. Similarly, large sized land cultivators had the resources required for commercial sugarcane cultivation and production. Young growers performed pioneer roles in extension activities and were observed as professional growers. In addition, fallow land (mono-crop) method was a successful and sustainable method of planting as this technique ensures that sugarcane crop do not compete with other crops for available resource like irrigation, air, sunlight and soil nutrients. Finally, those growers who had knowledge about agricultural extension department and agricultural extension agents obtained higher average yields. This highlights the importance of agricultural education through extension agents, particularly in the light of poor education levels which was shown in the survey as a constraint on production regardless of all other variables. In addition, probably tenant growers had poor financial condition and less information about new sugarcane production technologies and inputs. So concerned government organizations should concentrate towards tenant growers.

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## CONTRIBUTION OF AUTHROS

Faheem Khan	Collected primary data, analysed the data and compiled this article as principal researcher
Muhammad Tahir Ali Shah	Directed and guided in results and discussion as an agriculture extension specialist.
Muhammad Zafarullah Khan	Field specialist and major supervisor in Ph.D. research. Guided and supported in data collection and report writing.