

Research Article



Knowledge Gap of Improved Management Practices of Sugarcane Growers in Khyber Pakhtunkhwa, Pakistan

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Abstract | Cane crop production is a complex process dependent upon application and arrangement of various factors such as land, labor, finance and management practices etc. This article assessed the knowledge gap of improved cane management practices in Khyber Pakhtunkhwa-Pakistan. Sugarcane growers were selected randomly and Data were collected through interview schedule from 285 respondents in D.I. Khan and Mardan districts during sugarcane cropping season, 2018. Knowledge gap index was applied as a measuring tool. The empirical results indicated that no knowledge gap was found among farmers of D.I. Khan district regarding land preparation, sowing and harvesting time while in case of Mardan district no knowledge gap was observed in sowing and harvesting time. Farmers of D.I. Khan district had low knowledge gap (1 to 20%) in cane varieties, seed quantity, sowing practices, irrigation application, stoppage of irrigation before harvesting and cane cutting whereas farmers of district Mardan had low knowledge gap in length of cane setts, sowing practices, irrigation and cane cutting techniques. Medium knowledge gap (21 to 50%) was observed in length of cane setts, row to row spacing in farmers of D.I. Khan district while in farmers of Mardan district medium knowledge gap was observed in land preparation, improved cane varieties, row to row spacing and stoppage of irrigation before harvesting. High knowledge gap (above 50%) was revealed in cane setts treatment, depth of furrows in case of D.I. Khan district while high knowledge gap in cane setts treatment, depth of furrows and seed quantity per acre in farmers of Mardan district. The results further showed that majority (73.68%) farmers had medium (26.56%) knowledge gap while 13.33 percent farmers were found with low (13.46%) knowledge gap whereas 12.98 percent farmers revealed high knowledge gap (41.48%) in the study area. District wise findings indicated that farmers of D.I. Khan and Mardan districts had 21.87 percent and 32.17 percent knowledge gap, respectively. The overall knowledge gap in the current study was recorded as 26.75 percent. Variation in knowledge gap in sugarcane production technology among the sample farmers of both districts was due to their interests in cane farming, sugar mills support, mono and poly agricultural practices, lack of agricultural extension activities etc. Training and awareness programs through various types of mass media should be launched for reducing the knowledge gap and to equip the cane farmers with latest technology.

Received | August 06, 2018; **Accepted** | February 28, 2019; **Published** | April 29, 2019

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Citation | Farooq, A. and M.Z. Khan. 2019. Knowledge gap of improved management practices of sugarcane growers in Khyber Pakhtunkhwa, Pakistan. *Sarhad Journal of Agriculture*, 35(2): 523-531.

DOI | <http://dx.doi.org/10.17582/journal.sja/2019/35.2.523.531>

Keywords | Knowledge, Gap, Recommended sugarcane technologies and index

Introduction

Sugarcane is one of the main cash crops and the second largest agro-based industry in Pakistan. More

than 1.5 million people directly or indirectly involved as labor (Khan and Deshmukh, 2015). It contributes 3.6% in agriculture and 0.7% in value addition in Gross Domestic Product (GoP,

2018). In Pakistan, sugarcane is mainly grown for sugar and *gur* production. The main by-products of sugarcane are molasses (processed into ethanol) and *bagasses* that are mainly utilized for paper, particle boards manufacturing, animal feed and also used for in-house power generation (Khan and Deshmukh, 2015). Sugarcane tops are used as fodder for livestock when rabi fodder supplies shrink significantly during winter months (Sharif et al., 1994).

Cane crop production is a complex process and depends on application and arrangement of various factors such as land, labor, finance and management practices etc. The variations in use and combination of various factors of production affect the crop yield (Ali et al., 2013). Pakistan ranks 9th among white sugar producing and exporting countries (PSMA, 2017) while 5th in terms of sugarcane area and production and 52nd in respect of per acre yield globally (FAO, 2016). The sugar recovery rate is just 9-10% as compared to developed countries (Zaidi et al., 2013).

In order to maintain the sugar demand for domestic and export purpose, sugarcane was cultivated on area 1.3130 million hectares during 2017-18 with 7.8% increase as compared to last year (GoP, 2018). Province wise comparison shows that Punjab is the leading province in terms of area and production followed by Sindh and Khyber Pakhtunkhwa. Similarly, the cane yield per acre of Khyber Pakhtunkhwa province is very low as compared to Punjab and Sindh provinces (GoKP, 2018).

In Khyber Pakhtunkhwa, sugarcane is cultivated on 0.1116 million hectares and covers 8.55% of the country total sugarcane area. Sugarcane is cultivated in 17 districts of Khyber Pakhtunkhwa. Among the sugarcane growing districts, Charsadda is the leading district in terms of area followed by Mardan, D.I. Khan, Peshawar, Nowshera, Malakand, and Swabi (GoKP, 2018).

Pakistan is a low yielding country (far below than its potential level) in the list of sugarcane producing countries. Pakistan's farmers are facing enormous socioeconomic, technical and institutional constraints. In addition to these constraints, scientific based updated knowledge of farmers is also very crucial.

Nazir et al. (2013) found that gap between the actual and potential yield is very high due to socioeconomic,

technical constraints. Ahmad et al. (2012) reported that possible reasons for low yield per acre in Pakistan were intercropping, high weed infestation, insect pest management, low and irregular application of fertilizers.

Zaidi et al. (2013) identified that shortage of irrigation water, soil salinity, soil erosion and low-yielding varieties were the major problems faced by farmers in sugarcane production. Jaiswal and Tiwar (2014) stated that the farmers had low knowledge of weeds and insect/pest control measures, and potash application. Sahu et al. (2010) found high knowledge gap in the areas of HaNPV, use of trichocards, bio-pesticides and NADEP compost. Sahu et al. (2009) showed that majority of the farmers had poor knowledge about improved varieties, diseases and IPM, seed treatment and weed control etc. Tomar et al. (2012) noted that majority of the farmers had communication gap in adopting recommended chickpea production technologies. Limenih and Tefera (2014) stated that all of the adopter farmers applied crop production technologies below or above the recommended levels. Pillegowda et al. (2010) reported that education, economic motivation, achievement motivation, mass media, participation in training programmes, farm scientist contact, extension agency contact and extension participation had significant relationship with the farmer's knowledge level.

The results of the above scholars have vital importance in the literature. However, the studies in the sphere of farmers' knowledge regarding cane crop were limited in scope. Therefore, an instant study was conducted with objective to assess the knowledge gap in improved cane management practices of sugarcane growers in Khyber Pakhtunkhwa, Pakistan.

Materials and Methods

Selection of the sites and samples

Present study was carried out in Khyber Pakhtunkhwa during sugarcane cropping season, 2018. Multistage sampling techniques were applied in order to cover the full spectrum of sugarcane growing areas of the province and to meet the study objectives. Districts, tehsils and union councils were selected on the basis of sugarcane production while villages were selected randomly in the research area. A total of eight villages were randomly selected from eight union councils

in two tehsils of D.I. Khan and Mardan districts as shown in Table 1. Similar technique was also applied by Limenih and Tefera (2014).

Table 1: Village wise distributions of sample growers in the research area.

Union Councils	Villages	Total Number of Sugarcane Growers	Sampled Sugarcane Growers
Tehsil Mardan (District Mardan)			
Maho	Bakri Banda	125	35
Khazana Dheri	Shiekh Yousaf	140	40
Babeni	Char Banda	130	37
Kandar	Sharif Abad	80	23
Total		475	135
Tehsil Paroa (District D.I. Khan)			
Mahra	Mahra	170	48
Paroa	Paroa	150	42
Naivela	Jatta	150	42
Malana	Kat Shahani	65	18
Total		535	150
G. Total		1010	285

Source: Agriculture Extension Department of Mardan and D.I. Khan districts.

Sample frame

Selection of sugarcane growers: A list of sugarcane growers from each randomly selected village was prepared with the help of Agriculture Extension Department. Out of 1010 sugarcane growers in the selected eight villages, 285 were selected by utilizing Sekaran (2003) sampling procedure. 28% of sample was drawn from the sugarcane growers of each village by using a proportional allocation sampling technique. The distribution of the sample respondents are presented in Table 1. The following proportional allocation technique reported by Sajjad et al., 2012 and Ali et al., 2013 were applied to achieve the requisite sample size:

$$n_i = \frac{N_i}{N} \times n \quad \dots (1.1)$$

Where;

n_i = Number of sampled sugarcane growers in each village; N_i = Total number of sugarcane growers in i^{th} village; N = Total population in the sampled villages; n = Total number of sugarcane growers selected for the present study.

Data collection tools and techniques: This study was based on primary as well as secondary data. Primary

data was directly obtained from sugarcane growers and knowledge test was developed to measure knowledge gap as used by Hakeem and Dipak (2013). For measuring knowledge gap of sugarcane growers, interview schedule was devised based on the recommended sugarcane production technology developed by Sugar Crops Research Institute (SCRI) Mardan. The sample respondents were personally interviewed through a well-structured and pre-tested interview schedule designed for sugarcane growers in the light of the pre-set objectives on the basis of personal observations, agricultural expert consultation and literature review. Primary data was collected from the respondents on their farms and secondary data was collected from various sources including review of published research articles, agricultural statistics, economic survey of Pakistan and internet sources.

Statistical analysis

Knowledge gap: Knowledge gap refers to the difference in knowledge between the recommended practices developed by Sugar Crops Research Institute (SCRI) Mardan and the knowledge possessed by sugarcane growers. To calculate the knowledge gap of sugarcane growers, thirteen different knowledge indicators such as land preparation, varieties, length of cane setts, cane setts treatment, seed quantity, sowing methods, sowing time, depth of furrows, row to row spacing, irrigation application, irrigation stoppage before harvesting, harvesting time and cane cutting were pinpointed (Table 2). For measuring knowledge gap, sugarcane management practice wise score was assigned such as 0 = 'no knowledge', 1= 'partial knowledge' and 2= 'full knowledge' in the knowledge test. Overall score of the thirteen questions were 26 and each question carried two (2) score. The difference between obtainable score and obtained score indicated the knowledge gap of the respondents. This deviation was then expressed in percentage as the proportion to the farmer's maximum possible score. The following knowledge gap index was used to compute the knowledge gap as used by Kundu et al., 2013; Tomar et al., 2012; Ironk we et al., 2008 and Kamruzzaman et al., 2001.

$$KGI = \frac{Kp - Ko}{Kp} \times 100 \quad \dots (1.2)$$

Where;

KGI= Knowledge Gap Index; Kp= Maximum possible score of a grower; Ko= Obtained knowledge score by a grower.

Table 2: *Recommended sugarcane production technologies.*

S.No.	Name of technology	Recommended Practices
1	Land preparation	25 cm deep ploughing after that plough the land with Disc harrow, Rotavator, Cultivator and Planking
2	Improved Varieties	Early maturing varieties: CP-77/400, Mardan-93, Jn-88/1, Abid-86, S.N.98 etc. Medium maturing varieties: MCP-80/1827, Mardan-92, SPSG-394, MCP-421, Mardan-2005, HSF-240, CPF-246 etc.
3	Length of sett cane (seed)	Use about 1.5 feet long sett with three buds.
4	Treatment of setts (seed dressing)	-Keep the setts (seed) 3-5 minutes in pesticides solution such benlate, vitavax, di-thane M-45 or -Keep the seed in hot water or 50-52 centigrade for 2-2.5 hours heat.
5	Seed Quantity	Setts basis: -28000-30000 Two budded setts per acre -18000-20000 Three budded setts per acre; Cane weight basis: 80-100 maunds setts per acre; Area basis: 12-16 marla per acre
6	Sowing Practices	parallel, half parallel setts and end to end placement of cane setts in two rows cultivation techniques etc.
7	Depth of furrows	Make 8-10 inches deep furrows
8	Row to row Spacing	Row to row spacing is 3-4 feet apart and Cover the cane setts with thin layer of soil (3cm soil)
9	Sowing time	Autumn: 15-September-30-October; Spring: 15-February-15 March and
10	Irrigation	-16-20 number of irrigation needed or - 1800-2200ml water need to sugarcane crop
11	Harvesting month	ratoon crop is November to December and for cane setts crop is January to February
12	Irrigation stop before harvesting	Stoppage of irrigation one month before harvesting
13	Cane Cutting	- Cut cane at ground level 1-1.5 inch below

Source: *Sugar Crops Research Institute (SCRI) Mardan.*

Results and Discussion

Sugarcane growers level of knowledge and gap

The main objective of the instant study was to unveil the knowledge gap of the farmers that exists at various stages of the sugarcane production which is articulated in thirteen (13) recommended cane production technology developed by Sugar Crops Research Institute (SCRI) Mardan, Khyber Pakhtunkhwa. These technologies are land preparation, varieties, length of cane setts, cane setts treatment, seed quantity, sowing practices/methods, sowing time, depth of furrows, row to row spacing, irrigation application, irrigation stoppage before harvesting, harvesting time and cane cutting.

Land preparation

The farmers' knowledge regarding land preparation was measured on the basis of recommended techniques used for sugarcane cultivation. The ratoon crop is kept for a maximum period of three years by sugarcane growers in the study area. For this, proper and adequate land preparation is an essential pre-requisite to achieve maximum cane yield per acre. The recommended ploughing depth is 25 cm. Afterwards the land is prepared using disc harrow, rotavator, cultivator and planking. The data in Table 3 shows

that all the respondents had complete knowledge of land preparation practices regarding cane crop in D.I. Khan district. Therefore, no knowledge gap was observed in respect of land preparation for sugarcane crop. However, 58.5% of the respondents of Mardan district had partial knowledge and gap was recorded as 30.0 % which was at par with recommended practices of the cane cultivation. The reasons of no knowledge gap in D.I. Khan district might be due to well mechanized farming and agriculture extension efforts by focusing on cane farming for sugar industries therefore these farmers applied the recommended ploughing practices whereas farmers of Mardan district had more knowledge gap due to practicing poly farming, small land holding along with majority of tenants who cannot afford the cost of recommended ploughing practices. Our results regarding land preparation are almost in conformity with those of Gujar et al., 2017 who found that vast majority of trained (91.67%) and untrained farmers (81.67%) had complete knowledge. Jaiswal and Tiwari, 2014 also reported similar results in their studies.

Sugarcane varieties

The National Agricultural Research Systems (NARS) of Pakistan developed various sugarcane varieties on the basis of diseases and insect resistance, sugar recovery and maturity period. The Knowledge gap

regarding improved varieties were reviewed and found that overwhelming majority (95.3%) of farmers in D.I. Khan district had complete knowledge followed by partial knowledge (4.0%) and no knowledge (0.7%) where the knowledge index revealed 3.0% gap in improved cane varieties. In Mardan district, the result depicts that majority (89.6%) farmers had partial knowledge whereas 7.4% and 3.0% of the farmers had complete and no knowledge, respectively in respect of improved cane varieties and the knowledge index indicated 48.0% gap in sugarcane varieties. The knowledge of the farmers in D.I. Khan district regarding cane varieties were more and updated due to number of sugarcane industries in the area as compared with Mardan district. The maximum farmers of the D.I. Khan district were landowners with more land and most of the area was devoted to cane crop along with growing various varieties of sugarcane crop. They were also facilitated by premier sugarcane industries in various ways like provision of improved cane varieties, fertilizers, trainings in cane management practices, demonstration plots, technical support along with attractive incentives regarding sale and services whereas in Mardan district majority of the farmers were small and tenant farmers. The farmers of Mardan district were mainly interested in cane varieties suitable for quality gur production. Our findings are almost similar to Samntaray., 2017 who reported 30 percent gap in sugarcane variety. While our findings are contrary to those of Jaiswal and

Tiwari, 2014 who reported 57.11% knowledge level in respect of improved cane varieties.

Length of cane setts

The recommended length of cane setts is about 1.5 feet with three buds. The results in Table 3 illustrated that majority (46.7%) of respondents of D.I. Khan district had complete knowledge followed by partial knowledge (45.3%) regarding length of cane setts. The knowledge index showed that farmers of the D.I. Khan district had 31.0% gap in length of cane setts while 63.7 and 36.3% farmers of Mardan district had complete and partial knowledge, respectively. 18.0% knowledge gap was observed in length of cane setts in Mardan district. The logic of low gap in Mardan district in respect of cane length might be due to self-involvement of farmers in cutting of cane setts while the farmers of D.I. Khan district mostly hired labors for cutting the cane setts.

Cane setts treatment/seed dressing

Seed dressing refers to precautionary measures and is an important technology to prevent the cane crop from various diseases and insects' attacks. The farmers' knowledge regarding seed dressings were measured as per recommended cane setts treatments. The results exhibited in Table 3 that majority (86.0%) farmers of D.I. Khan district had no knowledge regarding seed dressings followed by partial knowledge (12.7%) and complete knowledge (1.3%). The knowledge index

Table 3: District wise distribution of sugarcane growers regarding knowledge level and knowledge gap.

S.No.	Technology	D.I. Khan N =150				Mardan N=135			
		No Knowl- edge	Partial Knowledge	Complete Knowledge	KG In- dex (%)	No Knowl- edge	Partial Knowledge	Complete Knowledge	KG In- dex (%)
1	Land Preparation	0 (0)	0(0)	150(100)	0	1(0.7)	79(58.5)	55(40.7)	30
2	Improved Varieties	1(0.7)	6(4)	143(95.3)	3	4(3)	121(89.6)	10(7.4)	48
3	Length of Setts	12(8)	68(45.3)	70(46.7)	31	0 (0)	49(36.3)	86(63.7)	18
4	Setts Treatment	129(86)	19(12.7)	2(1.3)	93	107(79.3)	27(20)	1(0.7)	90
5	Seed quantity/acre	6(4)	5(3.3)	139(92.7)	6	64(47.4)	38(28.1)	33(24.4)	62
6	Sowing Practices	0 (0)	31(20.7)	119(79.3)	10	0 (0)	3(2.2)	132(97.8)	1
7	Sowing time	0 (0)	0 (0)	150(100)	0	0 (0)	1(0.7)	134(99.3)	0
8	Depth of furrows	64(42.7)	63(42)	23(15.3)	64	77(57)	39(28.9)	19(14.1)	72
9	Spacing row to row	0 (0)	135(90)	15(10)	45	0 (0)	122(90.4)	13(9.6)	45
10	Irrigation Application	0 (0)	36(24)	114(76)	12	0 (0)	21(15.6)	114(84.4)	8
11	Irrigation stop before harvesting	13(8.7)	18(12)	119(79.3)	15	33(24.4)	39(28.9)	63(46.7)	39
12	Harvesting time	0 (0)	0 (0)	150(100)	0	0 (0)	0 (0)	135(100)	0
13	Cane cutting	2(1.3)	18(12)	130(86.7)	8	2(1.5)	14(10.4)	119(88.1)	6

Source: Field Data 2018.

showed that 93% gap existed in seed dressing techniques in D.I. Khan district whereas in Mardan district, 79.3% farmers had no knowledge while partial knowledge was noted in 20% farmers and complete knowledge was observed in 0.7% farmers regarding seed dressing. The knowledge index revealed 90.0% gap about cane setts treatment in Mardan district. High knowledge gap regarding seed dressing or treatment techniques was due to lack of awareness and training programs. Our result disagrees with those of [Gujar et al., 2017](#) who reported that 63.33% trained and 25.0% untrained farmers had complete knowledge while 36.67% trained and 75.0% untrained farmers had partial knowledge regarding cane setts treatment whereas 19.33% and 36% gaps were estimated by [Samntaray, 2017](#) and [Jaiswal and Tiwari, 2014](#), respectively.

Seed quantity

As per SCRI recommendations, the seed quantity acre^{-1} should be 28000-30000 two-budded or 18000-20000 three-budded cane setts. Based on weight, 80-100 maunds cane setts acre^{-1} or 12-16 marla acre^{-1} sugarcane area should be used. The results ([Table 3](#)) revealed that 92.7% farmers of D.I. Khan district had complete knowledge while 4.0% and 3.3% of the farmers had no knowledge and partial knowledge, respectively about cane setts quantity acre^{-1} and the knowledge index showed 6% gap while in Mardan district, 47.4% farmers had no knowledge followed by partial (28.1%) and complete knowledge (24.4%). The knowledge index showed that farmers of Mardan district had 62.0% gap in respect of seed quantity acre^{-1} . The reasons of minimum knowledge gap in D.I. Khan district might be due to cane focused farming and sugar mills who supported farming communities while in Mardan district farmers were interested in intercropping with seasonal crops and due to lack of agriculture extension activities. Likewise, [Ameen et al., 2014](#) reported that more than half (56%) respondents did not know the recommended seed rate in sugarcane crop. [Raza et al., 2016](#) found 4.87% gap in cotton crop regarding seed rate.

Sowing practices

The NARS developed various sugarcane cultivation techniques such as parallel, half parallel and end to end placement of cane setts in two rows cultivation techniques. Our findings indicated that maximum number (79.3%) farmers of D.I. Khan district had complete knowledge while 20.7 farmers had

partial knowledge regarding sowing practices and knowledge index indicated 10.0% gap about sowing practices whereas 97.8% farmers of Mardan district had complete knowledge followed by partial knowledge (2.2%) and knowledge gap was recorded as 1.0% in respect of sowing techniques. The reasons of high and complete knowledge might be due to their interest and awareness about improved sowing practices. Our findings are in contrast with [Samntaray, 2017](#) and [Raza et al., 2016](#) who estimated 27.0% and 35.5% gap in respect of sowing method. However, our results are almost similar to [Gujar et al., 2017](#) who calculated time of sowing and methods together and found that 90.0% trained farmers and 76.67% untrained farmers had complete knowledge while partial knowledge was noted in 10.0% trained farmers and 23.33% untrained farmers regarding time of sowing and methods. Our findings are dissimilar to [Jaiswal and Tiwari, 2014](#) who reported 67.50% knowledge level regarding methods of sowing.

Sowing time

Autumn and Spring are the two seasons of sugarcane cultivation. The recommended time for Autumn cultivation is from 15th September to 30th October while in Spring cultivation is started from 15th February to 15th March. The farmers' knowledge was measured on the basis of the recommended sowing period. The results revealed that all of the sample respondents of D.I. Khan district had complete knowledge and the farmers had no knowledge gap regarding sowing time as compared with Mardan district where overwhelming majority (99.3%) of farmers had complete knowledge while 0.7% of farmers had partial knowledge with no knowledge gap. The logic of the sample farmers was observed and found that both districts had zero knowledge gap due to their expertise and awareness regarding cane sowing time unlikely, the findings of [Raza et al., 2016](#) who reported 14% gap in time of sowing.

Depth of furrows

The recommendation of the agricultural research department regarding depth of furrows ranged from 8-10 inches deep placement of the cane setts and covered by 3cm thin soil layer. Majority (42.7%) farmers in D.I. Khan district had no knowledge followed by 42% with partial knowledge and 15.3% had complete knowledge about depth of furrows. Knowledge index showed 64.0% gap regarding depth of furrows for cane setts cultivation. 57% of farmers in Mardan

district had no knowledge whereas 28.9% and 14.1% farmers had partial and complete knowledge, respectively whereas in Mardan district, the farmers had 72.0% knowledge gap regarding depth of furrows for cane cultivation. The main cause of low knowledge regarding depth of furrows might be due to lack of awareness and communication gap of the surrounding communities including agricultural services providers about this technology.

Row to row spacing

The recommended row to row spacing is 3 to 4 feet for sugarcane crop. The farmers' knowledge was measured on the basis of row to row distance. The data showed that majority of farmers (90% in D.I. Khan and 90.4% in Mardan districts) had partial knowledge while 10.0% and 9.65% farmers of D.I. Khan and Mardan districts, respectively had complete knowledge regarding row to row spacing in cane crop. The knowledge gap of D.I. Khan and Mardan districts were measured 45% each in respect of row to row spacing in sugarcane crop. The major reasons of medium knowledge gap might be due to farmers perception and assumption regarding distance between rows as well as their unawareness about the latest techniques and knowledge. Abura et al., 2013 also reported that majority of the sample farmers did not know the appropriate spacing practices.

Irrigation application

The recommended number of irrigations for sugarcane crop is 16 to 20. The farmers' knowledge was estimated on the basis of number of irrigations. The findings depicted that mass population of farmers (84.4% in Mardan and 76.0% in D.I. Khan districts) had complete knowledge while 24.0% and 15.6% farmers of D.I. Khan and Mardan districts, respectively had partial knowledge. The Knowledge index exhibited that farmer of D.I. Khan district had 12.0% knowledge gap whereas in Mardan district, this gap was 8.0%. The actual cause of minimum gap in number of irrigation application was because of water availability at right time, although they were well aware of irrigation intervals in cane crop. Our findings regarding irrigation knowledge showed more positive results as compared with [Gujar et al., 2017](#) who reported that 66 percent trained and 40 percent untrained farmers had complete knowledge while 60 percent untrained farmers and 33.33 percent trained farmers had partial knowledge.

Irrigation stoppage before harvesting

The irrigation should be stopped one month before harvesting as recommended by Sugar Crops Research Institute Mardan. The data showed that majority (79.3%) farmers of D.I. Khan district had complete knowledge whereas 46.7% farmers of Mardan district had complete knowledge. Similarly, 28.9% farmers of Mardan district and 12.0% of D.I. Khan district had partial knowledge about stoppage of irrigation before harvesting cane crop. The percentage of no knowledge was measured in 24.4% and 8.7% farmers in Mardan and D.I. Khan districts, respectively. The knowledge index revealed 39.0% and 15.0% gap in Mardan and D.I. Khan districts, respectively. Soil profile in research area of D.I. Khan district was the main reason of irrigation stoppage. In D.I. Khan soil is sandy loam where water is leached down and cane crop becomes dried soon whereas in Mardan district the soil is clay loam which retains water in soil for a couple of days even weeks. Moreover, in D.I. Khan, irrigation system mostly depends on tube wells followed by canals whereas Mardan district mostly depends on canal irrigation.

Harvesting time

The recommended harvesting time for ratoon crop is November to December and for cane setts crop is January to February. The farmers' knowledge was measured on the basis of cane harvesting time. The findings stated that all of the sample respondents of research area had complete knowledge regarding harvesting. The index exhibited that no knowledge gap existed in harvesting time. The reason is based on their sugarcane farming experience from generation to generation.

Sugarcane cutting

The farmers' knowledge was recorded on the basis of sugarcane cutting above the soil. The results showed that majority (88.1%) farmers of Mardan district and 86.7% of D.I. Khan district had complete knowledge, while 12.0% and 10.4% farmers of D.I. Khan and Mardan districts, respectively had partial knowledge. Small number of farmers (1.5% and 1.3% of Mardan and D.I. Khan districts, respectively) had no knowledge regarding cane cutting. The knowledge index showed 8% and 6% gap about cane cutting above the surface of the soil in D.I. Khan and Mardan districts, respectively. The major reason of low gap in sugar cane cutting was farmers' awareness and expertise.

Table 4: Categorization of knowledge gap of the sugarcane growers in District DI Khan and Mardan.

Knowledge gap	D.I. Khan		Mardan		Overall		Std. Dev.
	Frequency	Percent gap	Frequency	Percent gap	Frequency	Percent gap	
High (Less than 16.84 Score)	4 (1.40)	40.38	33 (11.58)	41.61	37 (12.98)	41.48	3.025
Medium (Between 16.85-21.24 Score)	112 (39.30)	23.8	98 (34.38)	29.71	210 (73.68)	26.56	4.964
Low (More than 21.25 Score)	34 (11.93)	13.35	4 (1.40)	14.42	38 (13.33)	13.46	2.323
Overall	150 (52.63)	21.87	135 (47.37)	32.17	285 (100)	26.75	8.48

Source: Field Data 2018 Figures in parenthesis are percentage $X = 19.04$; Std. Dev. 2.204.

Categorization of Knowledge Gap of the Sugarcane Growers

The sample respondents' knowledge gap was categorized into three groups such as high, medium and low on the basis of their score obtained. Those farmers who scored upto 16.84 ranked as high knowledge gap in recommendation of sugarcane production technology followed by medium knowledge gap who received a score between 16.85 and 21.24 and low knowledge gap who obtained above 21.25 score in the study area. The data revealed in Table 4 that out of the total respondents, majority (39.30%) and (34.38%) farmers of D.I. Khan and Mardan districts, respectively had medium knowledge gap whereas 11.93% farmers of D.I. Khan district had low knowledge gap followed by high knowledge gap (1.40%) whereas 11.58% farmers of Mardan district had high knowledge gap and 1.4% farmers had low knowledge gap. The overall results showed that majority (73.68%) farmers had medium knowledge gap followed by low knowledge gap (13.33%) and high knowledge gap of 12.89% in the study area. Knowledge index revealed medium gap (23.80% and 29.71% in D.I. Khan and Mardan districts, respectively). Overall knowledge gap was measured as 26.56% in recommended cane management practices in the study area. Our finding regarding medium knowledge gap is more positive as compared with Gujar et al., 2017 who found that 58.33% of the respondents had medium level of knowledge followed by low (28.33%) and high (13.34%).

Conclusions and Recommendations

Major findings of the study revealed that majority of the sample respondents had medium knowledge gap about improved cane management practices. Maximum knowledge gap was found in cane setts treatment, furrows depth, row to row spacing. The results showed that respondents of Mardan district had more knowledge gap in improved sugarcane management practices as compared with D.I.

Khan district because of land ownership along with facilitation by sugarcane industries of D.I. Khan through provision of improved cane varieties, fertilizers, marketing facilitation, demonstration plots and technical guidance in the study area. The study suggested that training program should be organized for sugarcane growers regarding improved sugarcane management practices. The Sugarcane industries should be legally bound to facilitate growers and make them competent technically and professionally. Moreover, growers should involve skilled labor from sowing to harvesting. Awareness programs should be launched through mass media to reduce the knowledge gap of sugarcane growers about improved sugarcane management practices and equip them with the latest technologies. Provincial agriculture staff should be motivated and facilitated to remain in close contact with cane growers to make them competent to get higher production and financial returns in order to improve their living standards.

Author's Contribution

This research article is a part of PhD dissertation of Arshad Farooq. He developed the questionnaire, collected the data and performed its analysis and then wrote the research article. Muhammad Zafarullah Khan supervised this research as Major supervisor and contributed in designing of the study and also helped in every stage during development of this article.

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