

## POTENTIAL OF SUGAR BEET PRODUCTION IN PAKISTAN: A REVIEW

Sidra Majeed\*, Mubbashira Nazir\*, Sumia Bint Zaman \* and Waqas Farooq\*

**ABSTRACT:-** Among developing countries Pakistan has highest demand of sugar i.e., 25 kg per capita per annum. Cane and beet are two major sources of sugar production in Pakistan. Sugarcane production in the country could meet only 75% demand of existing sugar mills. Present study looks into the prospects of sugar beet production especially in water scarce areas to bridge the demand gap and scrutinize the issues and constraints in commercial production of sugar beet. Trends were analyzed using existing published statistics. Water requirement of sugarcane is almost three-fold of the sugar beet. Sugar beet will not put pressure on water resources if cultivated on commercial scale. The government is in favor of beet sugar but sugarcane mill owners are reluctant to encourage sugar beet cultivation due to some technical barrier. Beet growing experiment at different sites of Punjab, Khyber Pakhtunkhwa (KPK) and Sindh have revealed encouraging results.

*Key Words: Sugar Beet; Productivity; Beet Slicing; Water Scarcity; Pakistan.*

### INTRODUCTION

Pakistan is the 5<sup>th</sup> largest country in the world in area under sugarcane, 11<sup>th</sup> by production and 60<sup>th</sup> in yield. Sugarcane is major commercial crop occupying 1172.5 thousand hectare and produced 67460.1 thousand tonnes (GoP, 2013-14). In farming community sugarcane is one of the cash crops therefore, area under sugarcane cultivation has increased more rapidly than any other crops. For sugar industry/sugar mills sugarcane crop provides the primary raw material for the mills production. Currently in Pakistan 86 sugar mills are in business having crushing capacity over 6.1 mt. Sugar mills significantly contribute to the national income as direct and indirect taxes and levies. Sugar manufacturer also provides the employment directly and indirectly to the nation because it provides raw material for the paper, gur, sugar molasses sugar beverages production also for paints, chemicals

and detergents (Chhapra et al., 2013).

In 2009-10, the area under sugarcane exponentially improved which increased the production of refined sugarcane to 3.65mt while the national demand was 4.35 mt, gap between national requirement and production was filled by imports. In 2008-09, sugarcane area dropped down to 15% as compared to previous year whereas refined sugar production was 3.542 mt (raw value).

In Pakistan sugar mills and the sugarcane growers are the main stakeholder of sugar production which covers almost 1 mha land to produce cane and beet in four provinces i.e., Punjab, Sindh, KPK and Balochistan (Chullen, 2002).

To be competitive in the international sugar market and meet future challenges of WTO regime, there is a dire need to harvest more sugar crop by utilizing less water resource. This can be possible if alternate sugar crops are used, like sugar beet crop, to

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supplement sugarcane so as to harvest more per hectare sugar. Sugar beet is not only a short duration crop as compared to sugarcane, which occupies the field for about 10 months in the Punjab and 14-16 months in Sindh, but also that the recovery from sugar beet is much higher than sugarcane. Unfortunately the beet crop is restricted only to KPK province. Successful experiments have been conducted by MINFAL, in collaboration with the Provincial governments, and very encouraging results were obtained. This crop can enhance the farmer's profitability, and can also extend the crushing period of the sugar industry by about 45 days. This alternative source is also important that Pakistan could thereby afford horizontal expansion of sugarcane crop in spite of scarce water-resources. There are 86 sugar mills in the country and there is competition amongst the mills for acquiring more sugarcane (Khan and Jamil, 2004).

Pakistan Sugar Mills Association along with MINFAL started sugar crop development project in Sindh and Punjab and obtained encouraging results. However superfluous research efforts and comprehensive planning are required to make it a potential commercial crop adoptable at industrial scale and make it a success (Rehman, 2009).

Therefore, this study was specifically designed to i) do situational analysis of sugar consumption, sugar production in general and sugar beet production in specific, ii) review and explore the potential of sugar beet production considering water scarcity, iii) find the issues and constraints in commercial production of sugar beet, and iv) propose way forward for expansion of sugar beet production.

## MATERIALS AND METHOD

Secondary data was used including published statistics and existing over time literature. The current study was carried out by using annual time series data during 1990-2013. The data was collected from various issues of Agriculture Statistics of Pakistan, Pakistan Sugar Mill Association (PSMA) and Economic Surveys of Pakistan. Trend analysis was performed using existing published data for sugar beet production (area and yield) consumption, import and export in Pakistan. Graphical presentation was made using MS Excel. Different varieties were brought under discussion utilizing the existing work done. Different policies made for increasing sugar beet production were also scanned.

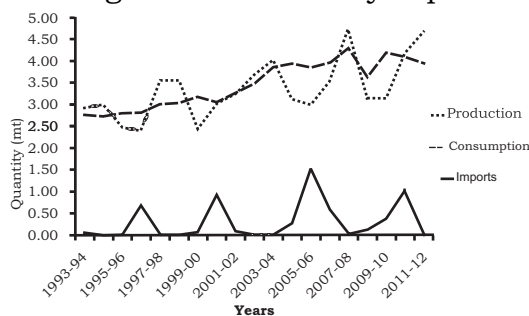
### Situational Analysis of Sugar Production and Consumption

According to ISO (2012), Pakistan is 9<sup>th</sup> largest sugar (raw) producer of world i.e., 4.71mt, whereas, it is 8<sup>th</sup> largest consumer of sugar (raw) by consuming 4.76 mt of sugar. According to PSMA (2012), domestic demand for 180.71 million population with 25kg per capita is expected to be 4.377 mt.

According to Ahmad et al.(2012), sugarcane production is not sufficient for existing sugar mills because sugarcane fulfill the 75% requirement of sugar production while Pakistan ranks 5<sup>th</sup> in cane growing countries with over 1 mha land among developing nation Pakistan has highest demand of sugar i.e., 25 kg per capita.

The consumption of sugar was more than production during 1993-

2012. The production of sugar was 2.92 mt in 1993 and had overall increase except for few years. In 2003, the production of sugar was 4.02 mt and dropped in the preceding years. In 2005, it dropped to 2.99 mt and rose again to 4.75 mt in 2007-08. In 2012, the production was 4.67 mt (Figure 1). The consumption has an increasing trend in 1993, the overall consumption was reported as 2.76, 3.94 and 4.19 mt during 1993, 2004 and 2009, respectively. However, in 2012 the consumption was 3.95 mt. Shortages were covered by imports.



**Figure 1. Trend analysis of consumption, production and imports of sugar in Pakistan**

#### **Sugar Imports and Exports**

Pakistan sugar's production in 2012-13 was more than 5 mt which was satisfactory stock for export and domestic use. In this consequence sugar industry is convincing the government to allow additional exports.

Pakistan is self-sufficient in sugar production. Imports were 433000 t in 1990; it had a decreasing trend in 1995 with the imports of 3000 t sugar. However, in 1996, 2000, and 2005 it was 681, 930 and 1527 thousand tons, respectively while in 2012 there was enough production of sugar and import dropped to only 17000t (PSMA, 2012).

#### **Current Status of Sugar Beet in Pakistan**

##### ***Sugar Crops and Contribution in Sugar Production***

Sugarcane is overwhelmingly used in the production of sugar whereas, sugar beet contribute a little. Sugar beet is grown and processed in the KPK. Government of Pakistan has faced the opposition from the mill owner for the expansion of beet sugar production to make the industry self-sufficient on the following grounds:

- Millers are of the view that more investment will be required for plant installations because existing machines are not equipped accordingly for beet slicing.
- In Pakistan, presently local seed production is not carried out because of higher cost and hence imported from Germany; therefore, in future additional cost will be required to import seed from the other countries.
- Industrialists are reluctant to promote sugar beet because sugar beet is sensitive in high temperature and if it is not processed in time, it will be damaged and create losses.

Beet growing experiment in 15 places of Punjab and Sindh has been done by the government and output was pleasing with 60% water requires in Punjab and in Sindh 35% of the water demanded by the cultivation of sugarcane. Sugar beet is ready to harvest within four to five months and it allows for intercropping. To introduce this crop in agriculture of Punjab and Sindh it was decided that the experiments would continue in future. Poland is knowledgeable in sugar beet and has industry therefore Pakistan has established links with Poland for technology transfer in

sugar beet cultivation and processing (Chullen, 2002).

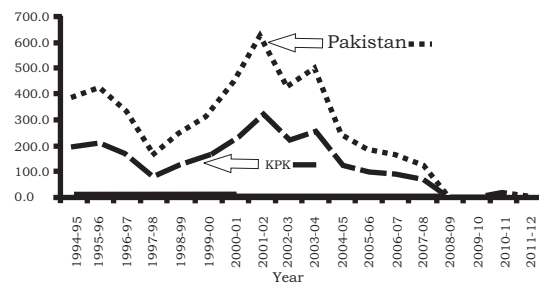
The share of sugar beet though in sugar production is not significant yet it has a potential to contribute in the overall production of sugar (Table 1).

### Sugar Beet Production

In 1976 sugar beet production in Pakistan reached 10000 ha with production averaging 26.3 t ha<sup>-1</sup> and a total of 273000 t of beet produced whereas compares to 700000 ha of cane with production of 36.5 t ha<sup>-1</sup> and a total of 25.5 mt of cane is produced. In 1998 when only 8000 ha of beet was grown with production about the same at 27 t ha<sup>-1</sup>, totaling 213000 t of beet compared to 963000 ha of cane producing an average of 47 t ha<sup>-1</sup> and a grand total of 45.2 mt of cane. It is clear that the focus on crop development has been on sugarcane. Over 22 years, beet area fell and yield remained the same. Sugarcane on the other hand exploded. Sugarcane area increased by 27%, productivity increased by 22%, while overall cane

production increased by 43%.

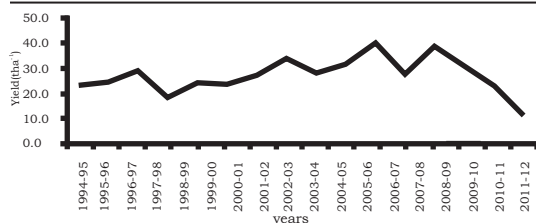
In 1988, 39200 ha were under beet with 39.2t ha<sup>-1</sup> yield for 456000t of beet. In 1994-95 production in KPK was around 195000t (Figure 2) and yield was 25.6 t ha<sup>-1</sup>. Production dropped to 82000t in 1998 with yield almost the same whereas overall production had an increasing trend till 2002 i.e., 317000t with 36.8 t ha<sup>-1</sup> yield production kept on declining and further dropped to 21000 to 1300t only and yield declined from 25 to 13 t ha<sup>-1</sup> in 2011 and 2012, respectively (GoP, 2011-12).



**Figure 2. Trend analysis of sugar beet production in Pakistan**

**Table 1. Beet production and share of sugar beet in total sugar production**

Year	Beet production (t)	Share of beet in total sugar (%)	Year	Beet production (t)	Share of beet in total sugar (%)
1990-91	23312	1.21	2002-03	22066	0.6
1991-92	29009	1.25	2003-04	23797	0.59
1992-93	18916	0.79	2004-05	11373	0.37
1993-94	21933	0.75	2005-06	8934	0.3
1994-95	18370	0.61	2006-07	7865	0.22
1995-96	20435	0.83	2007-08	5532	0.12
1996-97	14610	0.61	2008-09	947	0.03
1997-98	6267	0.18	2009-10	4641	0.15
1998-99	10831	0.31	2010-11	13535	0.32
1999-00	14618	0.06	2011-12	18216	0.39
2000-01	17276	0.57	2012-13	33028	0.66
2001-02	29172	0.09			



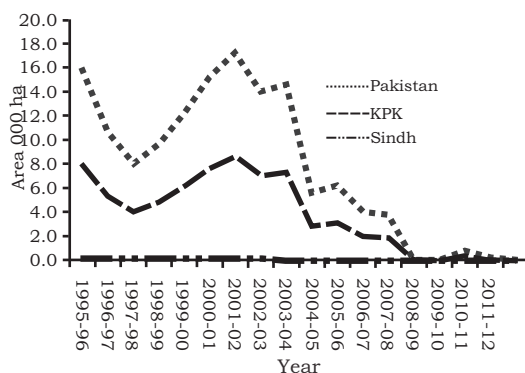
**Figure 3. Sugar beet productivity in Pakistan**

### Sugar Beet Productivity

The yield of beet has been fluctuating in 1994 the yield was around 25.6 t ha<sup>-1</sup>. It improved in certain years like 31.7 in 1996 and increased from 36.8 to 43.2 t ha<sup>-1</sup> during 2001- 2005, respectively. In 2006 it was 41.8 t ha<sup>-1</sup> and dropped to 13 t ha<sup>-1</sup> in 2011-12 (Figure 3).

### Concentration of Sugar Beet Production Areas

In Pakistan almost whole sugar beet is produced in KPK and a negligible area is cultivated in Sindh. Since 1994-2003, around 100 ha was cultivated for sugar beet in Sindh. Whereas in KPK cultivated area kept on fluctuating during 1995, the area decreased from 7900 to 4000 ha in 1997 (Figure 4). Trend of area under



**Figure 4. Outlook at area of sugar beet in Pakistan**

sugar beet increased till 2002 i.e., 8600 ha whereas, it further curtailed to only 100 ha in 2012 (GoP, 2011-

12). Sugar beet is mostly grown in KPK province and the most concentrated areas are Peshawar, Charsada, Nowshera, Mardan, Swabi and Malakand (GoP, 2007). The coastal areas of Sindh and parts of Punjab have also been identified as potential areas for beet production. There's currently about 100 ha grown in Sindh having a better climate for beet production than Punjab (Table 2).

**Table 2. Sugar beet areas**

Concentrated areas of sugar beet in Pakistan				
District	Area (ha)		Production (t)	
	2006-07	2007-08	2006-07	2007-08
Peshawar	27	16	1103	544
Charsadda	565	200	23090	4114
Nowshera	162	21	6620	483
Mardan	1233	1646	50355	58741
Swabi	46	5	1880	148
Malakand	13	2	531	65
Sindh	-	-	-	-
Punjab	-	-	-	-
Balochistan	-	-	-	-
Pakistan	2046	1890	83579	64095

A new factory was built a few years ago in Dera Ismail Khan that produces 10000 t sugar annually. Beet would ideally be sown in October-November and harvested in March-April and May after the cane crush ends, providing a useful compliment for mills. Since 2009 possibility of adding on beet processing technology to existing sugar mills, is considered. Similarly as to what is done when raw refining capacity is added on to sugar beet factories in Eastern Europe, but little progress has been made (Sapp, 2013).

A cultural barrier remains for beet production despite lower water use and significantly shorter growing periods compared to cane. It says the majority of small cane growers do not switch to sugar beet because they have a lifestyle associated with cane; making gur for liquidity and self-employment and chopping off sugarcane tops for animal feed (Sapp, 2013).



### Varieties under Research Trials

Numerous research trials have been undertaken for different sugar beet varieties in Pakistan to determine the best practices for beet production.

Farooq et al. (2011) reported evaluation of 11 sugar beet genotypes, assessed at National Agricultural Research Centre (NARC) during 2009 to check the resistance against root rot caused by *Sclerotium rolfsii*. These genotypes were SD-PAK-04/06, SD-PAK-12970, SD-PAK-09/07, SD-PAK-03/06, SD-PAK-01/07, SD-PAK-07/07, Mirabella, California, Magnolia, Ernstinia, and Sandrina. Result showed that genotype SD-PAK-09/07 has resistant response to the pathogen. Inoculation of 11 genotypes with *S. rolfsii* exhibited resistant response only in SD-PAK-09/07. The remaining nine genotypes showed susceptible to highly susceptible response to the pathogen.

Exotic sugar beet varieties performance has been checked during the *rabi* 2000-01, under selected agro climatic condition of Sindh (Oad et al., 2001). It is concluded that sugar beet performed well in all locations of the province; however, the agro-climatic conditions of Hyderabad district were comparatively better for sugar beet production.

Khan et al. (2004) reported that sugar beet varieties differed in Southern KPK in terms of yield and sugar content like Bannu, Dera Ismail Khan and Kohat districts. Ahmad and Rasool (2011), reported that three years trials of sugar beet have been tested in different parts of Punjab. Different varieties performed differently with respect to germination. Result showed the average beet yield ranged from 36 to 72.8 t ha<sup>-1</sup>.

### Current Capacity for Beet Slicing in Pakistan

In Pakistan, KPK is privileged to grow sugarcane and sugar beet crops in the same field on commercial scale simultaneously. In the region, sugarcane has been commercially cultivated on an area more than 100000 ha, while sugar beet is grown on area about 7000 ha annually. Few of the sugar mills have been equipped with best slicing machinery and are working in Peshawar, where both sugarcane and sugar beet are extensively grown (Khan and Minhas, 2006).

According to PSMA (2012), there were three mills producing sugar from sugarbeet in KPK during the 1998-2004 and in 2012 only two sugar mills in KPK were producing sugar by beet slicing (Table 3).

**Table 3. Mill wise beet slicing sugar production, recovery and molasses production for 2012-13 in KPK**

Mill Name	No of days	Beet Sliced	Production (t)	Recovery (%)	Total Molasses Production	Recovery (%)
Al-Moiz	58	258,963	28461	10.99	9685	3.40
Premier		47,380	4,567	9.64	2,355	4.97
Total		306,343	33,028	10.78	12,040	3.93

### Prospects of Sugar Beet Production in Context of Fresh Water Resources

The availability of water in the Indus basin is quite serious as water received in *kharif* is five-fold than that in the *rabi* season. Sugarcane is a crop of 10-12 months and cover most of the *rabi* season and sugar beet is also grown in the *rabi* season, therefore, water availability will be a serious concern for sugarcane, while sugar beet will not face any problem of water shortage because water requirement of sugarcane is almost three-fold than

that of the sugar beet. That means three crops of sugar beet can be grown as compared to one crop of sugarcane with the consumptive water requirement of sugarcane. However, the country is interested in production of sugar, therefore, it is better to compare water productivity of these two crops instead of crop water requirement. The yield of sugar beet is almost 2.3 fold of sugarcane. Therefore, at least two crops of sugar beet can be grown instead of one crop of sugarcane with same amount of water.

#### **Potential for Enhancing Sugar Beet Area and Productivity**

##### ***Identification of New Potential Areas for Sugar Beet***

In Pakistan, sugar beet is grown commercially only in Khyber Pakhtunkhwa and now in Punjab also, while in Sindh and Balochistan provinces it is grown on marginal scale as vegetable. A new factory was also built a few years ago in Dera Ismail Khan that produces 10000 t of sugar annually. There's currently about 100 ha grown in Sindh but it is seen as having a better climate for beet than Punjab. Government of Pakistan has taken steps to introduce sugar beet in Pakistan. Experiments have been tested in different districts of Sindh and Punjab side by side different varietal diseases resistance tests were performed at National Agricultural Research Centre (NARC). Scarcity of irrigation water is alarming, resultant the area under sugarcane remained at a halt year after year. However, sugar beet is water saving crop and matures within 5 -6 months and can be a good substitute of sugarcane crop. Khyber Pakhtunkhwa land is most suitable for sugar beet and sugar beet has 30% more sugar than

sugarcane (Chullen, 2002; Farooq et al., 2011; Rehman, 2009). Sindh is identified to be most appropriate for sugar beet cultivation than Punjab yet new areas for beet cultivation are required to be identified.

#### ***Practices under Saline Environment***

Sugar beet is most tolerant salt crop but its tolerance deteriorates at the time of germination and emergence level. The coastal areas of Sindh and some parts of Punjab have also been identified as potential areas for beet production. Based on literature sugar beet seeds emerged under moderately saline condition (2-10 ds m<sup>-1</sup>). Nitrogen in well and drainage water proves the effect of salinity and makes the cyclic reuse of saline water on nitrogen sensitive crop like sugar beet. Use of saline water depends on the amount of nitrogen as well as amount of residual N present in crop root zone. Sugar beet is deep rooted crop and takes up water and N from a depth of 9 feet. Thus to manage the sugar beet crop at the time of fertilizer both aspect/sources must be considered (Kaffka, 1999).

#### ***Need and Potential for Salt-tolerant Varieties***

In KPK sugar beet is consumed to produce the sugar at commercial scale and in other provinces successful and convincing trials have been made that substantiated the potential for sugar beet production in Sindh and more specifically in Punjab. However no seed production is taking place currently in Pakistan and seeds are imported from other countries. Salt tolerant varieties can also be imported from the countries having experience in production of sugar from beet.

### ***Expanding Sugar Beet in Saline Environments***

Sugarcane is less sensitive crop, therefore, it has flexibility and survives in cold, drought and salinity conditions however; yield/productivity under critical or unfavorable environment is affected (Katerji et al., 1997; Petkeviciene, 2009).

### ***Government Policy Support***

Federal Ministry of Food Security and Research has taken initiative along with Pakistan Sugar Mills Association to develop the alternate sugar crops in Pakistan and more focus is given to launch sugar beet as industrial and commercial crop. Although there are oppositions from the millers for various reasons mentioned above but increasingly chronic water scarcity has halted the production of sugarcane and sooner or later alternative strategy will be developed to divert the resources towards other alternative substitutes and sugar beet has the coincidental potential being a less duration and low delta crop.

### **CONCLUSION AND RECOMMENDATIONS**

This study was piloted to analyze trend of sugar production & consumption and the prospects of sugar beet production to meet the demand of sugar mills specifically in the context of scarce water resources of the country. Moreover, it was to scrutinize the issues and constraints in commercial production of sugar beet and to propose way forward for expansion of sugar beet production. Water requirement of sugarcane is almost three-fold of the sugar beet and it is also a short duration crop as compared to sugar cane. So it is concluded that sugar beet will not put pressure on

water resources if cultivated on commercial scale. However, the country is interested in production of sugar, therefore, it is better to compare water productivity of these two crops instead of crop water requirement. The productivity of sugar beet is almost 2.3 fold of sugarcane. Therefore, at least two crops of sugar beet can be grown instead of one crop of sugarcane with same amount of water. Based on the discussion, the Following recommendations are proposed for the production of sugar beet in Pakistan

- . To compete in the international sugar market and meet future challenges of WTO regime, there is a dire need to harvest more sugar crop by utilizing less water resource. Production of sugarcane may be restricted to areas where water productivity is higher in the country e.g., areas of lower Sindh where productivity of 150-200 t ha<sup>-1</sup> can be achieved as compared to national average of 55 t ha<sup>-1</sup>.
- . Sugar beet is currently grown in the KPK and the farmers and mill owners are conversant with the sugar beet production. Farmers are quite conversant with the production and mills are having facility for making sugar from beet. Therefore, emphasis must be placed for the expansion of area under sugar beet in the KPK even in areas where either soil is saline and/or water is of marginal quality. These areas are normally not suitable for any other crop and farmers are forced to grow rice.
- . In Pakistan, presently local seed production is not carried out because of higher cost and hence imported from Germany and in future additional cost will be required to import seed from the o



ther countries. Mill owners through Pakistan Sugar Mills Association (PSMA) may be encouraged to provide seed and best practices for the production of sugar beet initially in KPK and then may be extended to other provinces. Salt tolerant varieties can also be imported from the countries having experience in production of sugar from beet.

- International experiences will add value especially from countries having sugar beet. International links be developed looking at the geographical and climatic similarities
- System of buy back arrangement from the farmers by the Sugar Mills in KPK would certainly have greater impact in increasing the area and productivity of sugar beet crop.
- The production of sugar beet in marginalized land and water will provide an economic alternative to the farmers to grow a commercial crop with buy-back arrangements. The southern KPK is having an option of using such marginalized land and water resources for the production of sugar beet.

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#### AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Author Name	Contribution to the paper
1.	Ms. Sidra Majeed	Conceived the idea, Introduction, Results & Discussion & References
2.	Ms. Mubbashira Nazir	Data entry, Data collection, Did SPSS analysis, Conclusion
3.	Ms. Sumia Bint Zaman	Technical input at every step, Comments incorporation, Technical input
4.	Mr. Waqas Farooq	Wrote abstract, methodology, Technical input at every step

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