



# **Sugar Beet a Supplement to Sugarcane for sugar production in Pakistan**

**Report on the Fact Finding Mission**  
from 16<sup>th</sup> April to 10<sup>th</sup> May 2007



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## Abbreviations

ASML	Ashraf Sugar Mills Ltd.
AMRI	Agriculture Machinery Research Institute
C.S	Central Support
DM	Dry matter
ha	Hectare
JDW SM	JDW Sugar Mills Ltd.
K	Potassium
kg	Kilogram
MINFAL	Ministry of Food, Agriculture and Livestock
MOI & SI	Ministry of Industries and special initiatives
Mds	Mounds
MJ	Mega Joule
MSM	Mirpur Khas Sugar Mills Ltd.
O.M.	Organic matter
P	Phosphorous
PZ	Punjab zone
ppm	Part per million
PSMA	Pakistan Sugar Mills Association
% o. c	kg/100 kg cane
% a. b	kg/100 kg beet
Rs	Pakistan Rupees
SMEDA	Small and Medium Enterprise Development Authority
TEVTA	Technical Education & Vocational Training Authority
t/d	Metric tonne per day



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## Executive Summary

The fact finding mission on sugar beet cultivation was organized by SMEDA in cooperation with Beet Tech project Germany. The mission found that under the water shortage and land degradation circumstances, Pakistan will not be able to produce sufficient amount of sugar from sugar cane in the coming years. According to FAPRI projections (2008-2016), Pakistan will be importing about 1 million tonnes of sugar annually which will not only be a huge financial liability on the national exchequer but also an emerging threat to the sugar industry and related beneficiaries i.e. mainly farmers and indirect stake holders in the country. Meeting the increasing demands of sugar in the country with less water will be an appropriate solution. Sugar beet can produce almost two times higher sugar yields per hectare with less water and other input resources in a short period (4-6 months) as compared to cane that needs 12-16 months. Sugar beet crop can provide a solution to these issues if the government along with the sugar industry can set longer term objectives and make appropriate arrangements for the promotion of this crop. The initial technical evolution shows that agronomy wise the crop can be grown as a winter crop both in lower Sindh and Punjab to be sown in October/November and harvested in March/April and May after the cane crushing is over. Sugar beet can fit well into the cropping pattern after the cotton and rice growing regions in Sindh and Punjab and both in the cotton and rice sowing areas. Initially it will compete with wheat and sun flower but in the longer run the areas which are not suitable for sugar cane production due to alkaline soils; beet will take that acreage due to its salt tolerance nature (up to 8.5 pH). The issue of heat stress is still there but can be avoided by starting early campaign in the month of March. There is a possibility to decrease the degradation of beets by quick deliveries to the factory with in 24 hours through mechanical harvesting. It is possible if the mills make arrangements with the large growers and also start growing their own beet. There was a strong fear among the sugar industry about the requirement of extra source of energy to run beet campaign. The visited cane sugar mills in Sindh and Punjab all needed 50 to 60% steam on cane. Here is a big potential to save heat energy which means steam that means bagasse. But it is necessary to upgrade the mills. The evaporation station is to be enlarged, that needs more heating surface, the heaters and the boiling pans are switched to lower vapour pressure and temperature. It needs more investment and know-how. The consultants proposed two scenarios when the steam consumption can be decreased to a level and sufficient bagasse can be saved that will be enough to run the beet campaign.

The sugar beet processing although needs external source for energy but the costs incurred on getting it can be compensated through its by products which are beet pulp and molasses. There is a big market for sugar beet pulp in the country due to higher number of milking and meat herd. The beet pulp can be pressed and transported to the market. The energy is high in pulp as 60 to 70% of dry matter is non starch polysaccharides and 10% of dry matter is raw protein.



## 1. Introduction

### 1.1 General Introduction

Pakistan's agriculture has been suffering, off and on, from severe shortage of irrigation water during the past few decades. This shortage is increasing day by day which accounts to above 30% (82 million-acre feet in 2004 as compared to 103.5 million-acre feet in 1977 to 2001). This situation has caused a major set back in agriculture. The crop farming is relying more and more on the ground water which on one hand is not suitable for irrigation due to higher intensity of unwanted salts in many areas both in Sindh and Punjab province which instead causes severe land degradation issues and on the other hand it costs more due to higher fuel and energy costs. This situation has caused a significant raise in the cost of production of all agricultural commodities (Economic survey of Pakistan 2004-2005). The area under various cash crops especially sugar cane (high delta crop) has decreased up to 10 %. The sugar production was dropped to 2.7 million tonnes against the national demand of 3.8 million tonnes during 2005-2006. The gap between supply and demand is to be fulfilled through imports which costs national exchequer a foreign exchange of about US \$ 500 million.

The per capita consumption of sugar is about 25 kilograms per year which is highest among the developing countries that is driven by eating habits of the people. The demand of sugar in the country is likely to increase more in coming years as a result of growth in population and improvement in the per capita income. It is estimated that the demand of sugar will increase similar to the growth rate in population which is 2.3% per annum. According to a rough estimate by year 2020 the country will need about 5.5 million tonnes of sugar to meet the national demands and require 1.5 million hectares of area under sugar cane crop compared to now of 1 million hectare.

After looking at the hard facts, the area under sugar cane cannot be increased beyond the level which is about 1 million hectare due to competition with other cereal crops that are the staple food source which is mainly wheat. The only possibility will be to increase the yield and sugar contents of the sugar cane per acre through research and development. But during the last 50 years the improvement in yield had not been so significant and there is a fear that this status quo situation will likely to continue.

Under these circumstances various options are being considered by the government. One idea is to test the significance of sugar beet as a supplement to sugar cane for sugar production. Sugar beet is low

delta crop (27 acre inches) of short duration (4 to 6 months) with low irrigation requirements of 5-6 times compared to 25-30 irrigations required by sugar cane high delta crop ( 46 acre inches) which makes a good case for the policy planners to think under the crises situation of water shortage in present and future scenario.



After the successful trials of sugar beet conducted by the Federal Ministry of Food, Agriculture and Livestock (MINFAL) in past five years at various locations in Punjab and Sindh province are still some unsolved questions that are mainly related to the marketing /disposal of sugar beet crop. The sugar beet cultivation is not successful unless there is a buyer of the crop. As the sugar mills are the key players in the chain that offers a market for the sugar beet crop to process it for sugar production. But the sugar mills have been reluctant to make investment in modifications of their existing mills due to lack of confidence on crop agronomy, sufficient raw material availability and know how about handling the beet crop. Now it is a question for the policy makers how to bridge up the gap between producers and the processors.

In order to find a suitable solution the Small and Medium Enterprise Development Authority(SMEDA) took this initiative to carry out a value chain analysis by inviting two senior experts from Germany under Senior Experts Services (SES) program in cooperation with Beet Tech consortium Project Germany (association of beet chain related companies led by Strube Dieckmann - a sugar beet seed company).

## **1.2 Mission Objectives**

The target of the fact finding mission on “sugar beet prospects as a supplement to sugar cane for sugar production” is to give an insight and neutral picture of possibility of growing sugar beet in south of Pakistan both in Sindh and Punjab provinces. There was a need of the subject to conduct a full value chain analysis to find out the weak links in the chain and suggest technology and policy interventions. The fact finding mission took part in meetings and discussions with the stakeholders including the sugar millers, farmers, the provincial and government institutions related to sugar subject during the time period of 16<sup>th</sup> April 2007 to 5<sup>th</sup> May 2007 in Pakistan.

The main objectives of this exercise are;

1. Status quo of sugar beet situation in the country
2. Economic viability of sugar beet as an alternate crop and raw material both for farmer and the sugar millers.
3. Recommendations.



## 2.1 The Sugar Market in Pakistan

Pakistan is a country with a population of about 170 million inhabitants, which includes about 6 million immigrants (3.5 million Afghan refugees, 2 million illegal Bangladeshis, ¼ million illegal other nationalities). Sugar is consumed in each and every beverage of Pakistan which includes soft drinks, tea, cold drinks (*sherbets, lassi*), tea, *kehva* etc. Sugar is also used in sweetmeats, bakery products, other confectionary items and pharmaceutical industry, etc. In short Pakistanis are a sweet tooth nation. The question to be asked is at what price is sugar affordable to the general public, at what cost are the sugar millers producing the sugar per Kg, what is the international bench mark of producing sugar per Kg, and how far is Pakistan away from it. To keep our consumers happy and our sugar millers satisfied what kind of investment is required to improve our processes and savings so that we can reap the benefits in the future.

The sugar industry is the second largest industry of Pakistan accounting for 8% of the total value added in the large scale manufacturing industries and contributing Rs 15-20 billion per annum in the shape of general sales tax (GST), federal, provincial and local taxes. The direct employment in the sugar industry is about 120,000 managerial, skilled, semi skilled staff and in-direct employment is about 4 million people<sup>1</sup>.

Pakistan stands at 5th position in terms of sugar cane production and 7th and 8th in terms of sugar production and consumption. But unfortunately in terms of sugar production per hectare stands still at a very low level of about 4 tonnes per hectare. The sugarcane cultivation in Pakistan currently occupies 5 % of the total cropped area and accounts for 17 % of the gross value added by all crops.

The sugar production in Pakistan follows a fluctuating trend which means that there are some years when the sugar production meets the national demands and some times create a shortage that results into heavy imports. The year 2005/06 was the year when national production was closer to 2.7 tonnes against a demand of 3.9 million tonnes. The government has to import more than 1 million tonnes of white sugar through Trading Corporation of Pakistan (TCP) to fill the gap. Surprisingly during the same time there were record high sugar prices observed in Pakistani market (Rs 35-40 per kg ) as the trend in the international market was higher in the history (white sugar prices were US\$ 450-480 per tonnes during 2006)<sup>2</sup>.

The sugar production is estimated as 3.6 million metric tonnes during 2006/07 crushing season which is a 30% jump as compared to last year production of 2.7 million tonnes. This rise in production is because of higher yields and an increase in sugarcane acreage triggered by high market prices during last

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<sup>1</sup> Pakistan sugar book 2005

<sup>2</sup> The world market white sugar prices fall between US\$ 220-250 per tonnes during 2005.



season and due to favourable weather conditions as a result of good rain fall. Total annual consumption is estimated as 3.95 million metric tonnes during 2006/07.

In Marketing Year 2007/08 sugar consumption is forecast to increase to 4.1 MMT due to increase in population and strong economic growth for the last three years. Total per capita refined sugar consumption is estimated at about 25 kilograms, based on improved domestic supplies and strong demand. Retail sugar prices will continue to hover around Rs. 32 per kilogram, which is about 20 percent below than prevailing prices for last year. The government would like to keep the retail prices at the minimum possible level by timely management of imports (USDA Report April 2007).

In marketing year 2006-2007, (MY 2006/07) sugarcane production is estimated at 54.8 million metric tons (MMT), an increase of 23 percent from the previous year due to increases in both area and yield. Higher cane prices coupled with favourable weather conditions and fewer pests and diseases helped achieve higher yields. Improved profit margin for cane, compared to competing crops especially cotton, led to an increase in cane area in the main cotton belt.

Marketing Year 2007/08 sugarcane production is forecasted at 56 MMT, an increase of 2.3 percent over the previous year due to an expected increase in area and yield as a result of better prices and extension services by the sugar mills. Due to overall sugar shortage in the country, growers were able to manipulate the market to some extent and negotiated better prices for their produce. Increased area due to price incentives, coupled with better management practices, will determine the ultimate size of the crop for MY 2007/08.

Sugar production in Pakistan stood at 2.7 million tons as reported by 76 sugar mills in the financial year 2005-2006. The table below shows the historic production data of the sugar.

**Table 1 Sugar Production in Pakistan (1996-2007)**

<b>Years</b>	<b>Sugar mills</b>	<b>Million tonnes</b>
1996-97	70	2.3
1997-98	69	3.5
1998-99	72	3.5
1999-00	76	2.4
2000-01	76	3
2001-02	76	3.2
2002-03	76	3.6
2003-04	76	4
2004-05	76	3.1
2005-06	76	2.7
2006-07	76	3.6 <sup>3</sup>

<sup>3</sup> Provisional estimates from PSMA cited from GAIN report published by USDA



Sugarcane and sugar production for the past three years has fallen short of requirements, resulting in Pakistan to become a net importer of sugar. Current water availability patterns do not favour crops with higher water requirements, especially sugar cane. However, despite this problem, higher prices for sugar forecast to convince the farmers to shift some acreage from competing crops, such as cotton and rice, to cane.

According to MINFAL data there are 77 sugar mills with sugar production capacity of 7.1 million tons, basically obtained from 1 million hectares of sugar cane crop. The self sufficiency in sugar production has not been achieved because of fluctuating transactional mode between the sugar millers and the sugar cane producers. Despite increase in sugar demand substantial stocks remain with the sugar millers, whose production price according to them remains higher than the present value of wholesale price.

## 2.2: Sugar Prices:

Provincial governments in 2006/07 increased the official cane purchase price for 40 kilograms to Rs. 60 for Punjab, Rs. 65 for NWFP, and Rs.60 for Sindh [\$1 = Rs. 60]. However, prices were a volatile issue between the growers and processors for much of the season. The growers refused to sell the cane at the official price and millers in some areas of Punjab and Sindh delayed the start of crushing season. As a result, market prices for cane ranged from Rs. 70 to Rs. 90, depending on the region. Sources predict sugar mills will enhance field extension activities to encourage increased productivity in the years to come.

Price of 50 Kg sugar bag fluctuated between Rs 1593 to Rs 1655. The table shows the price of a 50 Kg bag in the four major cities of Pakistan in October 2005 & 2006.

**Table 2 Price of white Sugar Bag of 50kg**

City	Oct-05 (Rs)	Oct-06(Rs)
Karachi	1250	1592.5
Lahore	1345	1650
Rawalpindi	1345	1655
Peshawar	1327	1635

The Table 3 depicts the comprehensive details of the sugar and *Gur* prices in Pakistan over the last 58 years. It is important to realize that the retail prices remained stable or increased gradually from 1949 to 1978 owing to stable production in supply and demand accordingly. The retail prices remained stable or



increased gradually from 1949 to 1978 owing to stable supply & demand situation. However instability started creeping in after 1980.

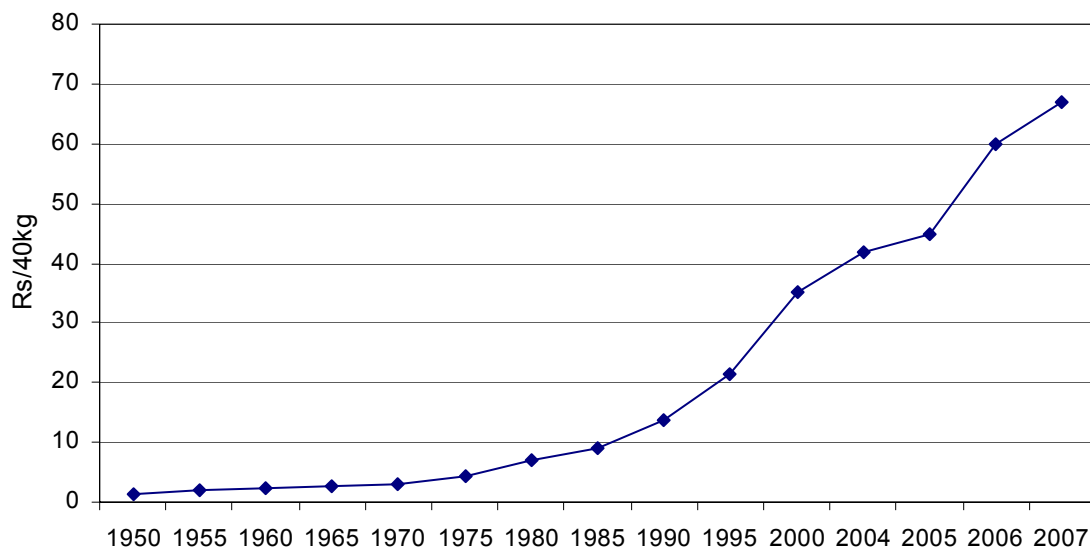
**Table 4 Average Retail Prices of Sugar and Gur**

Year	Sugar/Kg in Rs	Gur/kg in Rs	Year	Sugar/kg in Rs	Gur/kg in Rs
1949-50	1.13	0.39	1978-79		3.27
1950-51	1.20	0.61	1979-80		6.47
1951-52	1.41	0.94	1980-81	10.95	5.14
1952-53	1.35	0.63	1981-82	10.48	4.20
1953-54	1.31	0.56	1982-83	9.14	5.17
1954-55	1.19	0.51	1983-84	8.12	5.08
1955-56	1.16	0.73	1984-85	7.82	4.54
1956-57	1.19	0.87	1985-86	8.92	5.65
1957-58	1.30	0.72	1986-87	9.57	6.63
1958-59	1.46	0.53	1987-88	9.70	5.98
1959-60	1.46	0.83	1988-89	9.69	6.04
1960-61	1.46	1.05	1989-90	11.36	7.94
1961-62	1.46	0.99	1990-91	11.26	8.24
1962-63	1.47	0.70	1991-92	11.62	8.67
1963-64	1.48	0.79	1992-93	12.29	10.03
1964-65	1.61	1.14	1993-94	12.91	10.49
1965-66	1.61	0.84	1994-95	13.74	11.07
1966-67	1.61	0.66	1995-96	16.76	12.18
1967-68	1.59	1.00	1996-97	21.26	13.67
1968-69	1.86	1.04	1997-98	19.54	15.12
1969-70	1.88	0.96	1998-99	19.08	16.27
1970-71	1.88	0.77	1999-2000	21.11	17.72
1971-72	1.80	1.26	2000-01	27.2	17.91
1972-73	2.68	2.22	2001-02	22.9	
1973-74	3.81	2.37	2002-03	22.3	
1974-75		2.33	2003-04	19.8	
1975-76		2.91	2004-05	23.37	
1976-77		2.78	2005-06	28.47	
1977-78		2.36	2006(April)	36.77	
			2006-07	32	30



The sugar cane prices paid to the farmers have showed an annual growth rate of closer to 20% from year 1995 to 2007. The sugar cane prices are mostly dependant on the white sugar prices, but since last few years when there was a shortage of cane, the mills raised their cane purchase prices as part of the cane war competition.

**Ex-Mill Sugar cane price in Pakistan(1950-2007)**



**Figure 1 Ex-sugar mills, cane prices (1950-2007)**

Source: Pakistan sugar book 2005



According to sugar mills survey carried out in April 2007, the sugar millers claim production price of Rs 32/kg, while in May 2007, sugar is being retailed at Rs 30/kg. This means that sugar industry production processes need to be upgraded; more efficiency needs to be brought about in the production and usage of steam, along with the need of weighing and saving of bagasse. This bagasse saved in future years could be the fuel for the boilers working on the sugar beet processing.

The doctrine of unlimited duty free import of sugar to bring down market prices is not a long run solution to the issue. This will leave the millers stocks as they are, blocking their funds which are destined as interest payments to banks or payments to farmers for the sugarcane crop already used up by the mills a few seasons ago. Because of the sugarcane crop price going up to Rs 100/40 kg last season, this year a good volume of crop is expected by the sugar millers. But sugar millers are of the view that the old sugar cane zoning system of pre-1987 times needs to be re-introduced, so that farmer's trolleys do not keep on moving from factory to factory for a higher price. The farmers would like to be protected by a *parchi* system (adant system), where they are given a contract by the sugar millers of purchasing of sugarcane crop at a fixed price on harvesting 11 to 15 months from planting period.

The consultants are of the view that sugar cane farmers and sugar millers should work in harmony in a co-operative system. In this way regular crop for regular sugar cane crushing will be available, provided the sugar millers ensure prompt payment to the farmers.

The onus of the sugar industry is now on the policy makers to devise a long term draft solution, where farmers are given regular contracts from sugar mills on fixed bottom line prices, farmers are paid promptly by the industry on delivery of sugar cane. That sugar cane is priced not by its weight, but by its sugar content % age. There should be a minimum price for certain fixed sugar contents and above that farmers should receive a premium price, While the sugar industry sector is given access to improve process technology generation, where through the help of experts they can improve on their plants and processes, with bottom line being to drop the cost of producing sugar per ton. This will also require improvement in the sugar cane crop being cultivated and Investment in research for better sugar yielding varieties of sugar cane crop. The large scale improvement in the yield of sugar cane crop with better sugar recoveries will be a right step to improve efficiency of the sugar mills.



## 2.3. The Market for By-Products

### 2.3.1. Molasses

In Pakistan, around 150 to 180 000 tonnes per annum of molasses will be produced. Several sugar mills running a distillery for industrial ethyl alcohol. Nearly half of the production is going to export. Beet molasses can be used in the same way for fermentation and also for export. For more information about carbohydrate content ( See 4.3.3. Figure 24. ).

Cane molasses is the main by-product of sugar production. In the past, large quantities of molasses were exported. In 2004/05, Pakistan exported 1.5 million tons of molasses, valued at US \$71.6 million. Summary of export of molasses is given below.

**Table 5 Export of molasses from 1996-2006<sup>4</sup>**

Year	Quantity in million Tonnes
1996	0.7
1997	1.3
1998	1.6
1999	2
2000	1.2
2001	1.4
2002	1.4
2003	1.4
2004	1.5
2005	0.6
2006	0.4

Source: PC-TAS

Since 2005/06, molasses has been used to produce ethanol due to its strong demand in the international market. Export of ethanol from 2003 to 2005 has been shown below.

**Table 6 quantity and value of molasses exports from 2003-2005**

Year	Quantity (×1000 tons)	US \$ Million
2003	70	24
2004	61	21
2005	68	57

Source: PC-TAS

<sup>4</sup> SITC Code # 615.1



### **2.3.2. Beet Pulp**

For beet pulp there is only a small market in NWFP. But the quality of this pulp is very low. The dry matter is 12 – 13%; transportation is difficult because of draining water out of the trucks and one have to transport a lot of water.

In new beet sugar industry you have to press the pulp to dry matter 20 – 22%. So the pulp is transportable without leaking and also it is good for silage. The feed value (in dry substance) is similar to maize silage (for more information on the value of beet pulp see Table 7) .

The best, but most capital intensive way to use the pulp also for export is to dry and then palletising it. In this form it is compatible to citrus pellets.

Concepts to market the by-products of sugar beet processing have to be developed otherwise the by-products could become a severe environmental hazard. The potential market for beet pulp are the livestock owners because beet pulp can be utilized as an additional food for ruminants and horses.

#### **Wet pulp**

Wet pulp is the exhausted beet cossettes, after sucrose extraction. Dry substance is low (6-12 per cent) and shelf life is short.

#### ***Benefits are:***

- It's content of sugar per unit dry substance is the highest of all forms of beet pulp
- It can be ensiled without additives
- It carries no processing cost, and can be transported directly from the extraction plant.
- It's nutrients provided are energy and fibre.

#### ***Disadvantages are:***

- Short shelf life (high storage losses)
- High transport cost per tonne feed value
- Difficult to handle in conventional storage facilities

Due to the disadvantages it will be difficult to find a receptive market for large quantities of beet pulp. In Europe wet pulp is fermented in concrete silage basins.



### **Pressed pulp**

Wet pulp is de-watered in heavy presses to Pressed Pulp, containing 18-22 per cent dry substance.

#### ***Benefits are:***

- Reduced transport costs
- Higher density makes it more attractive as a (high performance) animal feed
- Can be fed fresh (5-7 day shelf life)
- High energy and low protein supplementary feed for ruminants
- Lower production costs than Dried Pulp (reduced energy usage)

#### ***Disadvantages are:***

- Limited shelf life

Pressed pulp is used directly on the farm and the market chances are better as compared to wet pulp. The best way to handle pressed pulp and to sell it easily is done by installing a baling plant at the sugar factory site. Balers that can produce air tight bales of 200 to 1000 allow distributing the pulp all over a large area.

### **Dried pulp**

Pressed pulp can be dried alone, or combined with molasses, and then dried. In most countries it is pelletised and conditioned with steam or water in pellets of diameter varying from 5-6 mm to 12-14 mm. Dry substance content is 87-92 per cent, with molassed pellets above 92 per cent (to eliminate sticking problems).

#### ***Advantages are:***

- Easy to store, to transport and to market
- Low transport cost
- More or less unlimited shelf life

#### ***Disadvantages are:***

- High investment cost for the installation of a pulp drying plant
- High energy usage for drying
- Price of dried beet pulp maybe is not competitive as compared to other feeds.

The most suitable solution to market beet pulp would be to include a stipulation in the beet delivery contract which obliges the sugar beet growers to take back the equivalent amount of pulp (approx. 20 % of the delivered beets). For more information about digestible energy See: 4.3.1. by-products, Figure 22



### 3. Sugar Beet Cultivation

#### 3.1 Assessment of Sugar Beet growth potential in Sindh Province

The shortage of cane production is persisting through out Sindh especially two districts Badin and Thatta got the worst situation due to shortage of water and salinity issue. Sugar cane crop is getting absolute in these districts and going to cause a serious threat to the existing sugar mills in the area. These mills are already working on less than 40% capacity utilization due to uncertain cane supply. Only a few mills are transporting cane from 2 districts across that has resulted into almost double transportation costs.

This situation is causing a threat not only to the huge investment made by the mills but also becoming an un- employment issue to the thousands of small farmers and cane related stake holders (factory workers, other related staff).

Sugar beet crop cultivation seems a possible solution as the crop can tolerate the alkalinity in soils with pH up to 8.5 and maintains good plant growth and requires less water about 5-6 irrigations with in a short time period of 4-5 months.

The experts visited the sugar beet trials at three locations in Sindh,

- Sugar crop research institute at Tando Jam, Agriculture research centre
- Farmer beet trial in Tando Jam
- PARC sugar crops research Institute, Thatta.



Figure 2: Sugar beet variety(SD/PAK, 03/06) trials at Sugar cane research institute, Tandojam



Observation made by the consultants noticed that beet crop can be grown effectively under Sindh climate and can produce higher sugar yield (6-8 tones per hectare). The climatic conditions are very conducive for vegetative growth due to no frosting nights in winter. The farmers showed interest in the new crop if they get a market for the produce. Proper agronomy and date of sowing needs further attention. The agronomy issues can be solved if the mills can decide when they need to start the beet processing campaign. Ideally it will be appropriate to avoid the very high temperatures during the months of May and June due to rotting threat of beet by starting early campaign in the beginning of March. To get a higher yield beet will have to be grown early i.e. September or beginning of October and to be harvested in March till mid of May.

The climatic conditions of lower Sindh are similar to Nile delta valley in Egypt which is already a promising area under sugar beet production since many years. The winter months have mild temperature that is very suitable for vegetative growth of sugar beet. The Hyderabad temperature data is given below in Table 8.

**Table 9 Temperature data of Hyderabad districts**

	<b>Max</b>	<b>Min</b>	<b>Avg daily</b>
October	37.2	22.3	29.7
November	31.9	17.3	24.6
December	26.3	12.5	19.4
January	25.1	11.1	18.1
February	28.1	13.8	20.8
March	33.9	18.5	26.2
April	38.9	23	31
May	41.6	26.2	33.9
June	40.2	28.1	34.1
July	37.1	27.8	32.6

Source: Pakistan Metrological department

### **3.1.2 Water Availability and Irrigation**

Shortage of water is a key issue at the coastal tail ends of river Indus and Kotri barrage in the districts of Hyderabad, Thatta, Badin, Mirpur Khas and Tharparker. Sugar cane crop is facing problem through out Sindh due to water shortage and soil alkalinity. The ground water quality is not suitable for irrigation purpose. The solution is less water requiring crops.



### **3.1.4 Acceptability of Sugar Beet Cultivation by Sugar Mills**

The sugar mills in Sindh are looking for alternatives in case of shortage of sugar cane to run their factories. Sugar beet can be an alternative / supplement raw material for the sugar mill in case of shortage of cane. During the last few years mills have suffered huge losses in cane procurement during the price war competition where mills have to pay up to Rs 120 per 40 kg cane as compared to a normal season price of Rs 67 per 40 kg.

Until now the sugar mills in Sindh are not fully convinced about beet proposition as they have to make new investments. Although the energy issue of sugar factories for beet processing can be solved through optimisation of the steam consumption and saving bagasse for the beet campaign after cane season is over by mid march.

The consultants have the opinion that the factory managers are generally reluctant to include beet in processing line due to lack of their capacity in beet handling. This can only be overcome by training of the factory managers in beet processing either by organizing trips to sugar factories in North or arranging visits to beet growing countries or inviting international consultants to train the managers on the factory. They also found that the owners of the mills are very keen to explore possibility and have showed keen interest to conduct new beet trials with the technical support of beet tech project. They are also willing to conduct their own feasibility study. This study will be able to provide them a basis to make further decision for modification.

Some mills have already conducted sugar beet trials and got very satisfactory results, these were Mirpur Khas Sugar Mills, Dewan Sugar Mills, Matiari Sugar Mills, Nawabshah Sugar Mills and few others. But still mills are interested to see if the beets can produce higher sugar recoveries (more than 10% ) and also longer days of crop availability(minimum 50-60 days). For the mills it is only justifiable to make a new investment on their mill modification to process sugar beets.

Through appropriate agronomy the beets can easily produce up to 13-15% sugar contents and a yield of about 60 tonnes per hectare. To broaden the time window at harvesting, there is need to plant the beets in early months that means in the end of September or October and beets can be harvested in the end of Feb or March. The campaign length can easily be achieved up to 60-70 days by starting factory in the beginning of March and ending by the mid of May.



### **3.1.5 Acceptability of Sugar Beet cultivation by local farmers**

Generally the farm size is big in Sindh province as compare to Punjab. The average size of a farm is about 40-50 acres. There are very few small farmers and mostly are landless farmers called *Harries*. They work as tenants on large farmers fields.

Looking at the typical situation in Matiari district, the farm distribution is; 60% dominant with sugar cane, 30% for cotton, vegetables, etc and 10% is under Mango orchards or banana, etc.

After talking to various small, medium and large farmers, the consultants have filled the questionnaires for desired information. The entire farmers responded positively and showed interest that they are willing to grow sugar beet if they are assured by the sugar mills to buy their crop. They are keen to find a short duration crop then they would have more choices to grow more crops on same fields. They told that with the cane they only get benefit of intercropped onion crop only.

The early sowing means that fields shall be free from earlier crop by end of September which needs to be worked out thoroughly looking at the cropping pattern. As the consultants learned that most of the farmers start planting cane in September and practice inter cropping with the Onion ( a short duration vegetable ). Even if soils are free in October after cotton or Rice, they can be used for beet cultivation. The October sown crop is ready for harvest by mid of March.

The experiments are being conducted at Tando Jam research institute for testing the inter row cultivation trials with the oil seed crops like rape seed, sunflower, cereals (barley and wheat) and even with the cane, it is possible to get a good crop for beet. The dual cropping is very labour intensive situation. This strategy may be suitable for the small farmers due to availability of sufficient family labour to conduct various cultural practices manually. But for large farms and getting better yields and sugar recoveries, the consultants proposed monoculture and also suggesting use of mechanization for sowing, use of weedicides to remove weeds and mechanical harvesters to harvest beets.

The consultants observed that the beet size was quite heavy (beets up to 5 kg) in the trials on ARI, Tando Jam due to lower plant population. It is not true that the larger size of the beets produces more sugar but it is reverse some times. Ideally there shall be 30-40,000 plants per acre to get an optimum size and yield per acre for sugar production. There is also



other very important factor to determine the sugar contents, is the time of application of nitrogen fertilizer. The nitrogen application shall be stopped in early months of vegetative growth.

Boron deficiency symptoms were common on beet trials which stunt in growth and spotting on the leaves with black spots. This is very common in alkaline soils and also soils where cotton crop was grown earlier. This can be solved through spraying the crop with boron. There was also another issue of some beets getting rotten in the fields due to higher temperature above 40 and higher humidity in the fields. This situation can be over come by stopping the irrigations from the end of March..



**Figure 3:** Sugar beet trials, Sugar crop research institute, Tando Jam (SD/PK 03/06 variety)



**Figure 4:** Interviewing farmers at Sujawal together with Dewan sugar mills managers





**Table 10 Cropping strategy for Sindh proposed by Khalid Mahmood, Beet tech Project, Strube-Dieckmann**

	months	days	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Extended Sugar Milling Season	7.5	225												
<b>Sugarcane</b>														
Planting	3	90												
Growing period	13	390												
Harvest	4	120												
<b>Sugar beet (winter)</b>														
Planting	1.5	45												
Growing period	7	210												
Harvest	2	60												
<b>Sugar beet (summer)</b>														
Planting	1.5	45												
Growing period	4	120												
Harvest	1.5	45												
<b>Wheat</b>														
Planting	2	60												
Growing period	5.5	165												
Harvest	1	30												
<b>Sunflower</b>														
Planting	3.5	105												
Growing period	6.5	195												
Harvest	1.5	45												
<b>Cotton</b>														
Planting	1	30												
Growing period	5	150												
Harvest	2	60												
<b>Rice</b>														
Planting	1.5	45												
Growing period	4.5	135												
Harvest	2	60												
<b>Onion</b>														
Planting	1	30												
Growing period	4.5	135												
Harvest	1.5	45												



### 3.2 Assessment of Sugar Beet growth potential in Punjab Province

Results from experimental trials conducted under the beet tech project of Strube Dieckmann on following sugar mills and private farmers fields,

1. JDW Sugar Mills Ltd( about 10 acres)
2. Ashraf Sugar Mills Ltd (1 acre).
3. Layyah farmers(3 farmers on 5 acre)
4. Gojra farmer (1 acre)

The visit of the trials showed that sugar beet can be grown successfully in Punjab Province and that sugar beet cultivation has a great potential for producing sugar.

Two questions still need to be answered:

1. Are the sugar mills capable to produce sugar from sugar beet at a competitive price?
2. Can the farmers supply sugar beet at the required quantity and quality in the right time?



**Figure 5** Sugar beet a possible supplementary crop to sugarcane in JDW Sugar Mills Variety SD/PAK 03/06 at Wali farm April 2007.



### 3.2.1 Climatic Conditions

The climate of the Punjab Province is mainly subtropical arid to semiarid. Weather data were available recorded in the JDW Sugar Mills Ltd (Table 11). Temperature ranges from a minimum of 7 C° during December, to a mean monthly maximum of 39C° during May and June. The most problematic climatic factor hindering the sugar beet productivity is the high temperature in the month of May when the sugar beet is maturing. Harvesting of sugar beet should be started as early from the beginning of March and should be completed in the month of April. The month of May should be avoided and was not recommended by the consultants.

### 3.2.2 Water Availability and Irrigation

The water availability in the Punjab Province is less limited as compared to the Sindh Province. In general, irrigation water is available half of the year by tube well irrigation and the other half by canal irrigation. Most of the farmers have water available round the year and can grow two crops within a year. The most common irrigation system is surface flood irrigation by using the basin and furrow irrigation systems.



Figure 6 State-of-the-art irrigation canal in the Wali Farm of the JDW Sugar Mills (April 2007).



Table 12 JDW Sugar Mills Ltd. Weather Report, Rehim Yar Khan District

	2002			2003			2004		
	Max temp C°	Min. temp C°	Avg. temp C°	Max temp C°	Min. temp C°	Avg. temp C°	Max temp C°	Min. temp C°	Avg. temp C°
January	21,0	5,4	13,1	21,0	5,5	13,4	19,0	8,8	13,9
February	23,0	9,5	16,4	24,0	10,0	13,9	24,0	11,0	17,4
March	29,0	15,0	22,2	33,0	15,0	23,9	32,0	16,0	24,0
April	34,0	19,0	26,8	34,0	20,0	26,9	35,0	22,0	28,6
May	41,0	26,0	33,8	38,0	23,0	30,0	39,0	27,0	32,8
June	40,0	28,0	34,0	40,0	28,0	33,9	38,0	28,0	33,4
July	38,0	27,0	32,5	35,0	29,0	31,8	39,0	27,0	33,3
August	37,0	27,0	31,5	35,0	28,0	31,5	38,0	28,0	33,2
September	37,0	24,0	30,5	34,0	25,0	29,6	37,0	24,0	30,6
October	35,0	18,0	26,2	34,0	15,0	24,9	34,0	18,0	25,9
November	28,0	13,0	20,4	27,0	9,1	18,3	34,0	11,0	22,7
December	22,0	7,8	15,1	22,0	6,5	14,2	24,0	8,9	16,6
Average	<b>32,1</b>	<b>18,3</b>	<b>25,2</b>	<b>31,4</b>	<b>17,8</b>	<b>24,4</b>	<b>32,8</b>	<b>19,1</b>	<b>26,0</b>



### 3.2.3 Soils

The prevailing soils of the Punjab Province have following properties:

**Texture:** Silt clay loam to Silt clay

**pH** : 7.7 to 8.5

**K** : no details

**P ppm** : 1 to 6

**Organic matter %:** 0.22 to 0.44

The soil properties show that the soils are mild to highly saline alkaline pH values. The soils are low in organic matter and low to medium in phosphorous. Most of the soils need reclamation. JDW Sugar Mills Ltd. has shown good progress in land reclamation adding organic matter and gypsum for improvement of the Soil Class C. Due to the high pH value boron deficiency is observed in sugar beet. Trials conducted in Germany for many years proved that boron deficiency has a negative impact on the root yield and the sugar content.



**Figure 7** Symptoms of Boron deficiency in a sugar beet experimental trial at JDW Sugar Mills ( April 2007)

Analysing the soil properties it can be stated that the soils are suited for sugar beet cultivation. More soil samples have to be taken and an analysis of the availability of macro- and micro-nutrients has to be carried out for adequate application of fertilizer.



**Figure 8** Symptoms of Boron deficiency in Sugar Beet experimental trial at JDW (April 2007)

### **3.2.4 Acceptability of Sugar Beet Cultivation by Sugar Mills**

The consultants visited the JDW Sugar Mills Ltd. and the Ashraf Sugar Mills Ltd. Within the Punjab Province both sugar mills there was a great interest to buy up beets and to process sugar beet as a supplement to the sugarcane. But sugar mills still hesitate to invest in additional equipments for sugar beet processing although the conducted experimental trials by both the sugar mills show encouraging results. However most of the equipment of sugar cane factories can be utilized for the processing of sugar beet.

In encouraging the beet production the sugar mills have to enter the next phase in conducting sugar beet trials with the beginning of the coming season 2007/08. These are large scale trials on a commercial base using state-of-art equipment at least for sowing the sugar beet. In this context the sugar mills propose to have a pilot sugar beet processing line established in the Punjab Province before they make risky huge investments.

Taking into account that cultivating sugar beet demands a thorough know-how of the farmers, the consultants recommend that the factories should establish their own sugar beet extension division. The advisory services to the farmers should be provided for free, since most of them can not afford to pay for such services. In view of the key role, which the extension service will have to play, the recruitment of the most appropriate candidates for the



job is crucial. They will have to possess relevant professional qualifications, technical know-how and skills. Other capabilities such as self motivation, social competence, communication skills and trainability etc. are equally important.

The University Agriculture Faisalbad and the existing Punjab agricultural research system that consist of research stations across the province should be linked up with the sugar industry to support and to boost the beet production in the country.

It would be a great advantage for the sugar mills as well as for the farmers having contracting arrangements between the two partners to secure the timely supply of sugar beet and securing the market for the farmers. For this reason the sugar mill management will have to take a leading role in developing the sugar beet production in their belt: In detail, it will be responsible for:

- a. Including a beet processing line in the factory
- b. Contracting farmers to grow sugar beet
- c. The purchase price of sugar beet based on sugar content and impurities
- d. Arranging for the supply of seeds and other farm inputs
- e. Providing extension services to beet growers
- f. Planning in detail the sowing and the harvesting campaign
- g. Arranging the transport of the harvested sugar beet
- h. Utilization of the beet pulp

The same arrangements could be introduced for improving the actual supply with sugarcane.

### **3.2.5 Acceptability of sugar beet cultivation by the local farmers**

During the fact finding mission in April 2007, 10 progressive farmers in the Punjab Province were interviewed and asked for their interest in sugar beet cultivation. The general response was very positive, since most farmers are keen to diversify their crop production through the introduction of a new cash crop. Sugar beet is anticipated to be a crop with a high profitability.



Figure 9 For the time farmers are admiring a sugar beet tuber during an interview in the village of Bahar/Bahawalpur – April 2007

The 10 interviewed farmers are growing mainly the following crops:

- I. Sugarcane
- II. Wheat
- III. Cotton
- IV. Sunflower
- V. Rice.

All of the farmers own at least one tractor and the appropriate implements, threshers and an adequate number of tube wells. They are using fertilizers and pesticides. On average they keep 20 buffalos. They attended courses at different vocational training institutes that means they are well educated.



**Figure 10** Farmers are very interested in growing sugar beet, interview in the village Habi Meson/Bahawalpur – April 2007

### **Crop rotations**

The most common crop rotations are:

- Cotton – wheat – cotton
- Sugarcane – wheat - sugarcane
- Rice – sunflower – rice

Farmers suggest to fit in the sugar beet in the cropping pattern like:

- Cotton – sugar beet – cotton.

### **Layyah Beet Trials**

The sugar beet trials conducted under beet tech project in Layyah were really very successful. The beet performed in extreme high temperatures of above 45c in the month of May and were harvested in first week of June 2007. Farmers showed a keen interest in the new crop and wanted to grow commercially if they get a surety from a mill to buy their crop. The preliminary results are presented below in **table 13**.



**Table 13: Results of sugar beet trials at Layyah farm** (Mukhtar Ahmad Lodhra farms, ch 99/TDA, Karor, district Layyah)

Sowing dates	Varieties	harvesting dates	Crop duration(day)	Crop yield <sup>5</sup> (tones /acre)	Sugar Recovery % <sup>6</sup>
24/10/2006	SD/PK 01/06	03/06/2007	219	37	18
24/10/2006	SD/PK 02/06	03/06/2007	219	35	17
24/10/2006	SD/PK 03/06	03/06/2007	219	45	19
24/10/2006	SD/PK 04/06	03/06/2007	219	32	17
08/11/2006	SD/PK 03/06	03/06/2007	205	30	15
25/12/2008	SD/PK 03/06	03/06/2007	157	31	9
08/02/2007	SD/PK 03/06	03/06/2007	112	25	8



**Figure 11:** sugar beet trials of variety SD/PAK 03/06 under Beet Tech Project at Layyah farmer fields

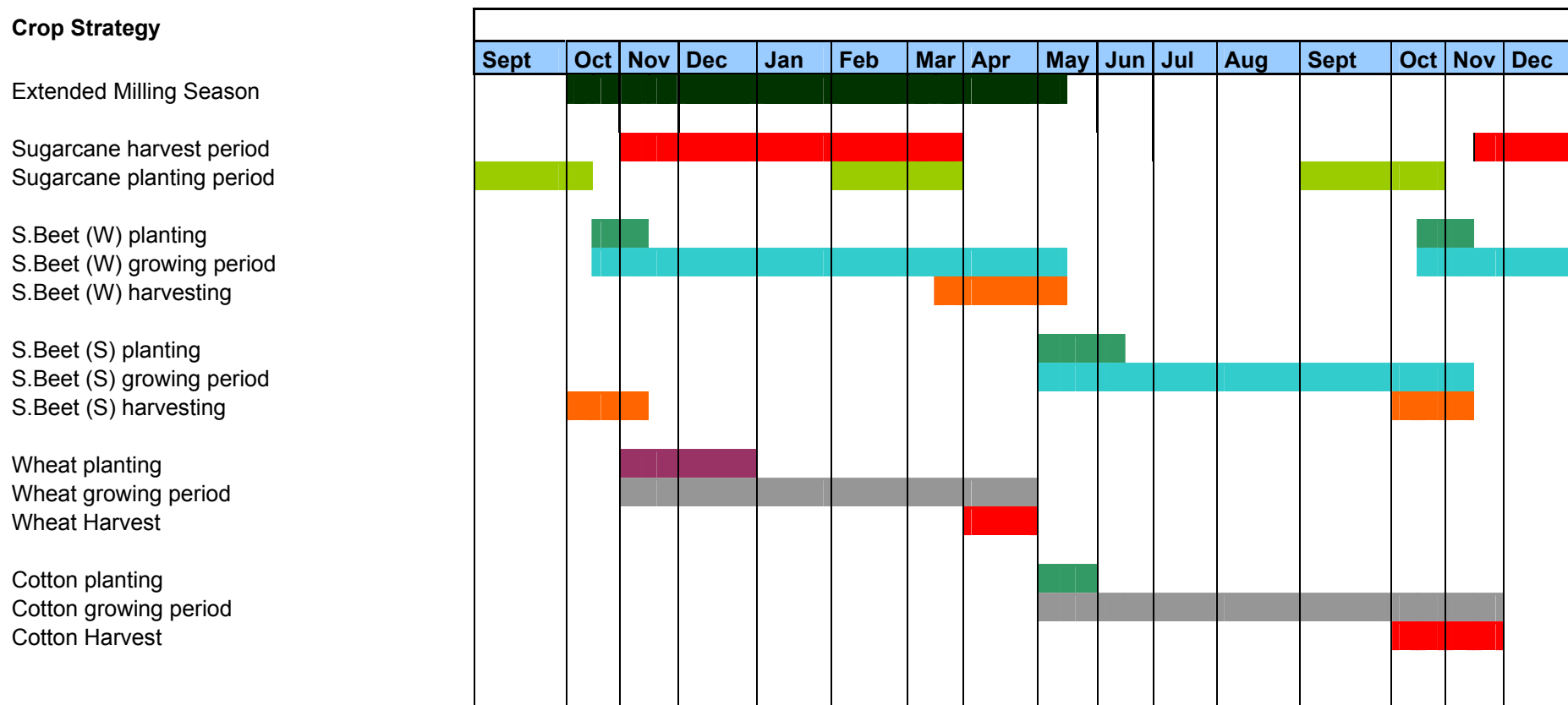
<sup>5</sup> The beet yield was reduced due to rise in temperature. The leaves were more than 50% dried due to heat wave that started from the end of April .

<sup>6</sup> The sugar contents are measured through brix percentage, 3% non sugar and impurities are already deducted.



**Table 14: Proposed agronomy schedule for Punjab<sup>7</sup>.**

**Crop Strategy**



<sup>7</sup> Schedule for the Punjab Province proposed by Mr. Tony McDermott, production manager at JDW mills. He suggested to plant sugar beet in two seasons.



**Season I :**

Planting time: Middle of October to middle of November

Harvesting : Middle of March to beginning of May

**Season II :**

Planting time: May to beginning of June

Harvesting : October to middle of November

The second season will probably make it possible to extend the milling campaign by 45 additional days. Experimental trials in this respect have to be conducted.

Farmers are very aware that the development of sugar beet as an economic crop is totally dependent on the support of the local sugarcane industry and the government agriculture departments both at provincial and federal level. Nevertheless they want to grow beet on their farms between 4 to 40 acres and ask for:

- There must be a reliable market for sugar beet
- The purchasing price should be attractive by Rs 55 /40 kg
- Availability of high yielding varieties well adopted to local climatic conditions
- Provide free extension services by sugar mills
- Improvement of the infrastructure facilities like roads and bridges
- Better provisions for credit facilities for the procurement of farm inputs and equipments.

The consultants recommended that MINFAL should continue to strengthen the sugar sector by:

- I. Involvement of one or two local sugar mills of the Punjab Province in a feasibility study where sugar beet can be processed through the mill.
- II. Establishing a comprehensive variety screening program in the sugar crop research institutes.
- III. Study the optimum management of the sugar beet crop under local environmental conditions.
- IV. Improvement of the funding of research stations to boost their effectiveness.



## 4- Technical Feasibility of Sugar Beet Processing

### Executive Summary

The first step for the sugar mills to get a basic calculation of economy of beet processing is a detailed feasibility study of their own status and the region.

It has to include:

- The expected amount of beet and the recovery.
- The best point of harvesting beets and the optimal length of season in the region.
- The optimal crushing capacity of beets according to the expected acreage.
- Determine equipment for processing beets to that capacity.
- Cost of investment to meet the need for beet processing.
- Check up, what is usable equipment of cane mill.
- Proposals to save energy (steam, bagasse) in cane production.
- Cost of upgrade to save energy.
- Proposals to minimise investment.
  - a.) Import or production in Pakistan?
  - b.) Using second hand equipment?
  - c.) Is pulp drying an economical process?



#### **4.1. Assessment of Sugar Mills in Pakistan**

In Pakistan several sugar mills were established between 1970 and 1980. After this time the cane growing increased and more mills were established and capacities of older mills enlarged. This trend is going on till now, but slower. The reason is that all mills are nearly similar in production system. In the last years the technology in the refinery shifted from double carbonation to Telo Floc technology. Also some new continuous pans and modern batch type centrifugals are installed, especially as the capacity was enlarged.

The steam consumption about 50 – 60 % on cane is always high. Bagasse as a fuel is always available and cheap so there is no pressure to save heating energy.

The maintenance of equipment is somewhere not efficient, so there are several shut downs during the crushing season.

Another important point of having not a good efficiency is due to irregular delivery of cane at the factories. Sometimes the mills have to be shut down because of lack of cane and days later to start again. There is too less cane and also the logistic issue of cane transport is not good enough. So the smooth run of the sugar mills is not possible. It means higher steam consumption and so less bagasse surplus and also decrease of recovery.

#### **4.2. Technological aspects to produce sugar out of sugar beet**

To produce sugar from beets, it is necessary to set up a new factory or a beet line to an existing cane sugar mill. For the existing sugar mills it will be the best economical option to include beet line. To run the beet line in an economical scale the capacity of beet slicing should be between 3 – 5000 tonnes per day. Because of the small harvesting time window, especially at the start up of the beet production this capacity is recommendable.

##### **4.2.1. Beet Yard**

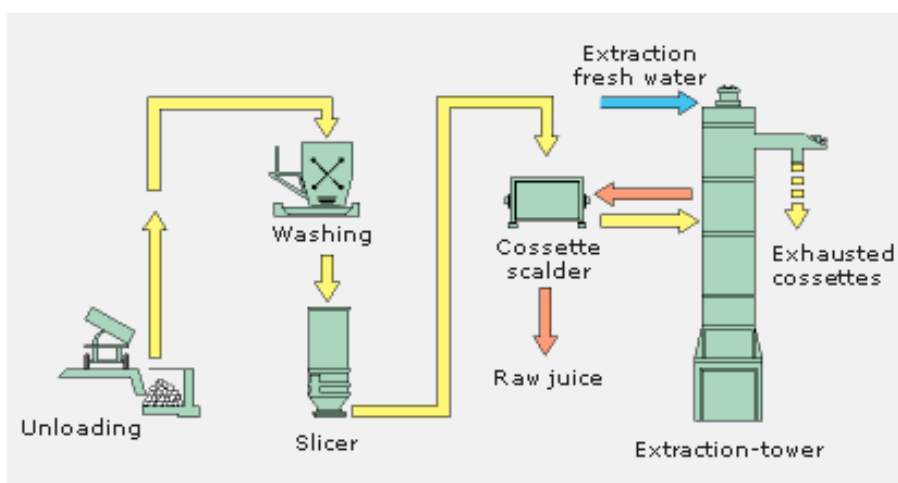
The yard is to install with fluming water to transport and pre-wash the beets. Due to high temperatures during the harvesting months (April, May), storage is not possible because of high sucrose losses and damages of the beets. There is a fear that every hour of storage can reduce the sugar contents and the recovery. While fluming process, the beets takes water with them that causes the sugar contents to decrease and weight to increase.

In the fluming stream there is need to install stone and leaf-catchers, also clay/soils without stones, because scrap iron and bricks can damage the slicer's knives. Leaf-catchers are necessary especially for mechanically harvested crop.

A beet laboratory will be required to be installed near the weighing bridge. During unloading, a sample is taken from each load delivered and is then examined to determine its sugar content and other important constituents. The sugar contents and the theoretical recovery have to be determined for each truck carrying beet to the beet yard.

It is recommended that for achieving higher efficiencies, the payment to the farmers should be based on the sugar contents. A formula has to be designed together with the Pakistan Sugar mills association and the relevant agriculture department. This will encourage the farmers to deliver quality beets by improving the crop agronomy especially the fertilizer application plan.

**Figure 12 Beet Reception, Washing, Slicing, and Extraction**



#### 4.2.2. Beet Washer

Jet-washer is proposed but the drum-washer can also be suitable for Pakistani soils.

#### 4.2.3. Beet Slicing

When the beets have been thoroughly washed, they go into the factory. Via beet-bunker, that will have storage capacity of about 1 hour, the beets go to the slicer as usual in beet plants. There should be two slicers available if one is working; the other stands by for sharpening knives, etc.

#### 4.2.4. Extraction

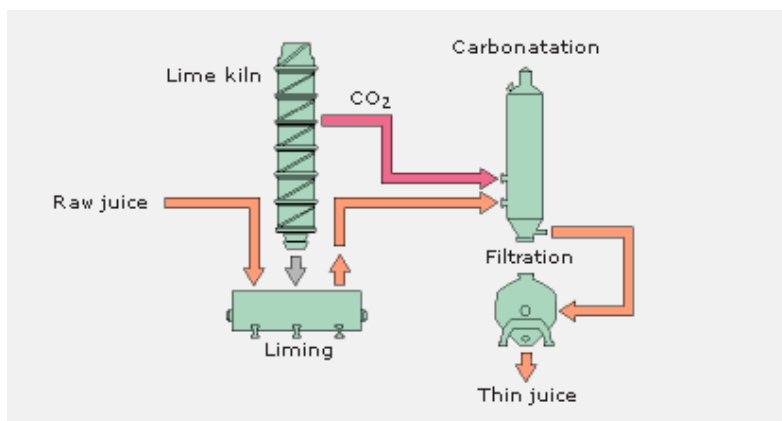
The beet are sliced and preheated in the cossets scalders. In water heated to 70 °C, the sugar is separated from the beet cells and the raw juice is produced. In Europe it is usual to calculate all numbers of the factory in % on beet, so the weight the cossets going to the extraction tower is counted.

For extraction equipment one can choose between several types, nearly all are efficient. The pulp has to be pressed and the press water is recycled to extraction. For pulp: See also 4.3.1 by-products, Figure 22.

#### 4.2.5. Juice Purification

The raw-juice is to be pre-limed (pH 11.3) in a special equipment and then limed (pH ~12) and heated to 95°C. After a reaction time the juice is going to carbonation (pH 10.8 – 11) and then to clarifier. – It is possible to use the clarifier in cane mills. The mud juice comes to vacuum drum filters or filter presses for filtering and de-sweetening. The drum filters used in cane mills are not usable, may be they can be modified. The clear juice and the filtrate of mud filter go to second carbonation stage (pH ~9.2). After filtration and polish filtration, there we get thin juice.

**Figure 13: Juice Purification**



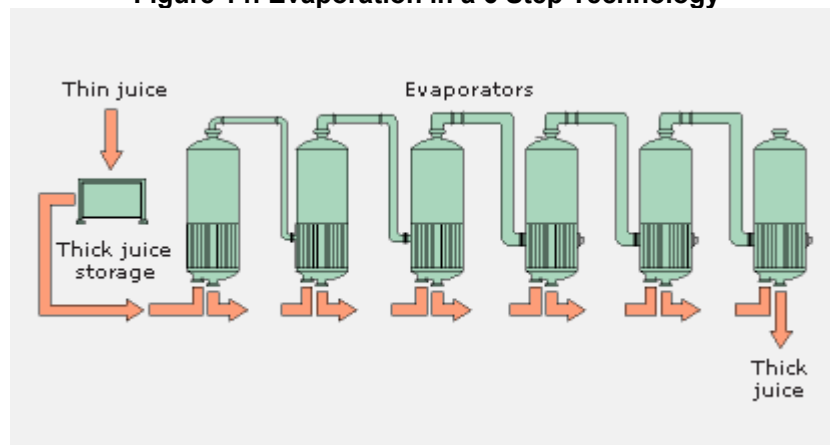
If juice purification works well and the quality of beets is good (not destroyed by heat and the non sugar contents in beets is not too high) one can get good white sugar directly out of syrup from evaporation.

For carbonation mud: See also 4.3.2. by-products, Figure 23

#### 4.2.6. Evaporation and Usage of Existing Mill Equipment

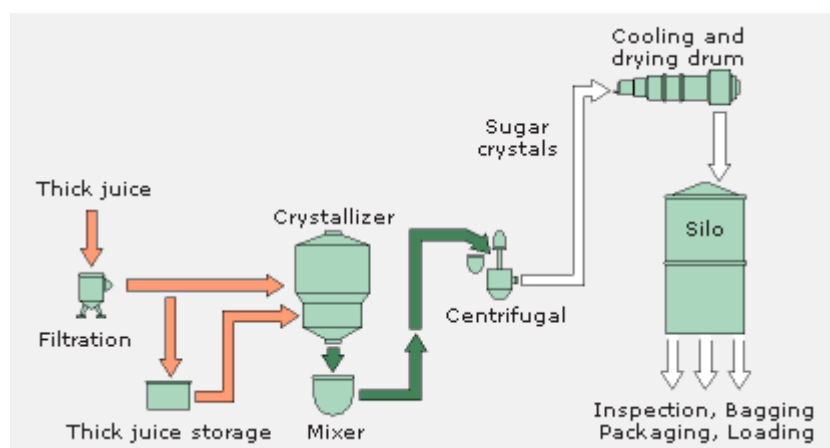
The thin juice is to thicken in evaporation. Therefore one can use the installed vessels. But it is necessary to make a new switching. So also a new heat calculation is required. Sugar pans, centrifugals, sugar dryer, screening and packing are the same as in cane mills.

**Figure 14: Evaporation in a 6 Step Technology**



In a feasibility study all these points need to be cleared and calculated properly. After thorough calculation, it is only possible to get real costs of required equipment, buildings, pipes, pumps, controlling and automation, etc.

**Figure 15 Crystallization Process**





#### 4.2.7. Lime Kiln, Preparation of Milk of Lime

##### 4.2.7.1 Lime Kiln

For juice purification there is need of a bigger amount of lime and CO<sub>2</sub> as in cane production. The lime kiln is designed for a capacity of 6 to 7% lime stone on beet, normal stoked by coke. The limestone has to be of good quality (~96% CaCO<sub>3</sub>).

##### 4.2.7.2. Milk of Lime

For good dosing of CaO there is need of preparation of milk of lime in a drum and cleaning the milk from gravel and sand. A CO<sub>2</sub>-pump brings the gas to first and second carbonation.

#### 4.3. By-products

##### 4.3.1. Beet Pulp

The amount of pulp depend on water-content. By pressing up to 20% dry matter the amount will be about 25% on beet. At this dry substance the pulp is good transportable, without loosing water out of the trucks.

So it can be used fresh as a good fodder for milking cows, buffaloes, fattening beef farms, sheep, goats and also for horses. It is best use for milk and meat production.

The energy is high:

- 60 to 70% of dry matter is non starch polysaccharides
- 10% on dry matter is raw protein.

**Table 15 Digestible Energy of some feeds**

<b>Digestible Energy for Ruminants</b>	<b>MJ/kg Dry Matter</b>
Pressed Pulp (also as silage)	11.87
Dried Pulp	11.93
Maize Silage	10.51
Cane Molasses	12.09
Beet Molasses	12.29
Citrus Pellets	12.28



Source: Sugar Technology 1998 Verlag Dr.A.Bartens

Because of the big amount – at capacity 4000 tonnes per day(TCD) it is about 1000 t/d pulp – fresh feeding is not always possible.

Trials have to be conducted to find out the feasibility to use the silage as a matter of storage of the pulp. In Europe a part of pulp is put in big socks of polyethylene and sealed. It comes to a fermentation of sugars to lactic acid. So pulp can be stored for few months. Is this possible in hot climate? I learned silage of wet maize is used in Pakistan.

The traditional way is to dry the pulp. To be economical you have to press to higher dry matter, about 28 to 30%. It saves heating energy but needs investment. Also a drum-dryer is required. The dried pulp has low density, so it is to check palletising is useful.

#### 4.3.2. Carbonation Mud

The amount of carbonation mud depends on dry matter. If you use drum filters the dry matter will be about 50%, so the amount is ~ 8 – 10% on beet. By using filter presses the dry matter will be about 70% and the amount ~6 -8% on beet. Also it depends on purity of raw juice, if there is much non-sugars you need more of lime and so it comes more carbonation mud. In the case of drum filters the mud is to store in pits nearly a year. After this time the mud can be used as fertilizer. The mud from filter presses is transportable direct and ready for use as fertilizer.

Average analyses of carbonation mud are given in the table.

Table 16 : Carbonation Mud

Carbonation Mud	Low	High
Dry Matter % on Beet	3.2	4.7
Raw Ash in DM	50.5	53.9
Sand in DM	1.1	3.2
CaO in DM	42.1	45.1
MgO in DM	1.1	5.6
K <sub>2</sub> O in DM	0.1	0.1
Na <sub>2</sub> O in DM	0.1	0.1
SO <sub>3</sub> in DM	1.0	1.9
P <sub>2</sub> O <sub>5</sub> in DM	0.8	1.3
CO <sub>2</sub> in DM	20.9	28.4
Total Organic Matter	18.3	25.5

Source: Sugar Technology 1998 Verlag Dr.A.Bartens



### 4.3.3. Beet Molasses

The amount of beet molasses is in the same range as in cane processing, about 4 to 5% on beet. It depends on purity of raw juice and quality and technology of C-station. The purity of good extracted beet molasses is lower 50%. It is compared with cane molasses calculated as total sugar purity. Average analyses of beet- and cane-molasses are given in table below.

**Table 17 Cane and Beet Molasses**

<b>Avg Carbohydrate content</b>	<b>Cane Molasses %</b>	<b>Beet Molasses %</b>
Sucrose	35	48
Glucose	6	0.4
Fructose	8	0.6
Non Fermentable	4	1
Gums	3	1
Dextran	1	3
Raw Protein	4 – 5	7-12

**Source: Sugar Technology 1998 Verlag Dr.A.Bartens**

## 4.4. Energy Requirement for Processing Beets

### 4.4.1 General

Because one can not use beet pulp economical as fuel source to the boilers, beet sugar industry has look for external fuel. In beet countries they use coal, heavy oil or natural gas. The prices of these fuel types have increased in the past and they will increase in the future as well. So the beet sugar producers are pressed to save steam in the process. This happened in the last 30 to 40 years with enormous success. The consumption of steam could be reduced from about 50 to 20% on beet in the best working mills. Of course, it needs a huge investment not only in modern equipment and automation, but also in know-how and having a skill full staff. All steps in process are involved, from better washing to get better cossets and optimise the extraction, heating the juice at first with water and low temperature vapours, setting up more steps in evaporation with better heat transfer and so on till to partial exchange of continuous centrifugals to batch type centrifugals to save washing water.

The way to save heat energy is to use the steam several times to evaporate water out of juices and also spare water going into the process. In modern beet sugar mills they use steam up to seven effects.



**Figure 16:** Bagasse Surplus, Mir Pur Khas Sugar mills, 21.04.2007



#### 4.4.2. Using Bagasse as Fuel

In cane sugar mills bagasse is the common fuel and the boilers are specialised on it. Normally all the mills gets a surplus stock of bagasse during crushing season. If one combines the cane and beet processing in one mill it is possible to use the surplus bagasse as fuel for beet processing. But the today surplus seems not enough.

The visited cane sugar mills in Sindh and Punjab all needed 50 to 60% steam on cane. Here is a big potential to save heat energy, means steam that means bagasse. But it is necessary to upgrade the mills. The evaporation station is to enlarge, you need more heating surface, the heaters and the boiling pans are switched to lower vapour pressure and temperature. It needs much investment and know-how.

##### 4.4.2.1. Estimation for an Emarginated Cane Sugar Mill

###### 4.4.2.1.1. Scenario 1

###### Assumptions

Cane crushing capacity: 4000 tonnes per day cane

Beet slicing capacity: 4000 tonnes per day beet

Crushing season: 100 days (Nov-March)

30% o.c. bagasse, 40% steam o.c. (after upgrading),

1 tonne bagasse = 2 tonnes steam

4000 t/d beet, 40% steam o.b.

###### a- Cane Crushing

Cane processing capacity:  $4000 \times 100 = 400,000$  tonnes

Bagasse produced:  $400,000 \times 0.3 = 120,000$  tonnes

Steam produced:  $120,000 \times 2 = 240,000$  tonnes

Steam requirement for 100 days cane crushing: 160,000 tonnes

**Steam surplus: 80,000 tonnes**

###### b- Beet Campaign

Steam requirement for beet processing per day:  $4000 \times 0.40 = 1600$  t/d steam,



**Steam requirement for a beet campaign of 50 days = 1600x50 = 80,000 tonnes**

**4.4.2.1.2. Scenario 2 ( 7 to 10 000 t/d Cane, 2 Mill Tandem, 4000 t/d Beet)**

Cane sugar mills capacity is enlarged by addition a second mill tandem, and as the cane supply is maximum in December and January and decrease in February and March months so it is feasible to split the production in a cane- and a beet-line. There can be synergies by using half the process- and boiling-house for cane and the other half for beet production. If the mill is upgraded for steam saving the steam supply for beet crushing will be no problem. The other view is: You can get the optimal time of beet harvesting in March and April.

**4.5. Future Development**

Beet seems to be a suitable crop also performing quite good under extreme high temperatures in hot climate (above 40° C). The observation shows that it can be cultivated successfully not only in NWFP but also in Sindh and Punjab. The sugar industry in these parts of Pakistan has to find the optimal technology for processing. The development is going on, the sugar mills have to get the chance to upgrade the existing mills for better recovery and better heat economy. New technologies may be introduced so extraction for cane and beet, falling film evaporators, plate heaters, and more automation. With beet it is possible to work with two kinds of raw material to produce sugar. The economical security will increase for the existing sugar mills if they include the beet line in their mills which will help to increase the profit margins of the factory besides providing more jobs/retaining the employees for more period of time.



## **5. Economic Feasibility**

### **5.1 Economic Feasibility of Sugar Beet Cultivation**

About 20 % of the world's supply of sugar is now a days derived from sugar beet, the vast majority of which is produced in industrialised countries. The cultivation of sugar beet in developed countries is a profitable business for farmers and the crop is well incorporated into their cropping pattern. Since in Pakistan, the sugar is mainly produced by sugar cane and only small amount (about 1%) is produced from the sugar beet which is grown in NWFP province in Peshawar valley. This means that sugar beet is not totally a new subject for Pakistan; there are four sugar factories in the Northern Province which have both sugar cane and beet processing facilities. The other question is that instead of growth in area under sugar beet production, the trend is going down wards due to various reasons mainly the shift in cropping pattern to more cereal crops due to staple food issues.

The water availability in the country is heading towards a crises situation due to lack of sufficient reservoirs for storing the water in up hills during the Monsoon season. The experts are suggesting sugar beet as an alternate to supplement the sugar cane and solve the issue of water shortage to produce sugar in the country.

Introduction of sugar beet in the two provinces of Sindh and Punjab reflects two main questions.

- Can sugar beet be grown on large scale at an economic level?
- Can the farmers supply sugar beet at a required quality and quantity to sugar mills?



### 5.1.1 Margins Obtainable from Competing Crops

The major crops cultivated in Pakistan are presented in the following table.

**Table 18 Major crops cultivated in Pakistan**

Crop	2001/02		2002/03		2003/04		2004/05	
	Area 000 ha	Yield <sup>8</sup> t/ha	Area 000 ha	Yield t/ha	Area 000 ha	Yield t/ha	Area 000 ha	Yield t/ha
Wheat	8,057.5	2.26	8,033.9	2.39	8,216.2	2.37		
Cotton	3,115.8	0.58	2,793.6	.62	2,989.3	0.57		
Rice	2,114.2	1.84	2,225.2	2.01	2,460.6	1.97		
Sugarcane	999.7	48.6	1,099.6	47.43	1,074.5	49.72	967.0	45.82

Source: Pakistan Statistical Pocket Book 2005, Sugar Sector in Pakistan 2006.

The above table presents a gross margin analysis for the major field crops in the two provinces. Most figures quoted in this table are obtained from farmers, who have been interviewed by the consultants. Yield and variable cost figures, have been estimated, as reliable agricultural statistics are virtually non-existent. Leasing payments aren't considered. The prices of the field crops are actual farm gate prices.

The gross margin of sugar cane ranks above the other crops:

- a) Sugar cane
- b) Sunflower
- c) Rice
- d) Cotton
- e) Wheat

Wheat has the lowest profitability, although the price is fixed by the government. However, wheat covers by far the largest acreage in the two provinces. On the one hand it is the most important food source and

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<sup>8</sup> To convert hectares into acres multiply by 2.4711 and to convert yield in kgs/hectare into mds/acre divide by 92.23



on the other hand farmers do not have many alternatives to grow more attractive cash crops during winter on larger scale. One alternate crop is sunflower which is mainly grown in Punjab and Sindh. In 1987-88 the area under sunflower increased to 43.110 ha. On average, of the total cultivated area, 76% is cultivated in Punjab and 21% in Sindh. According to the data presented in table, sunflower is an attractive cash crop for the farmers in the two provinces. Sunflower as a short-duration crop (90-110 days) and with low water requirements fits well into the prevailing cropping pattern. The most common crop rotations are:

- Cotton – sunflower – cotton
- Rice – sunflower – rice.

**Table 19: Estimated Gross Margin calculation of Major Field Crops grown in Sindh and Punjab:**

<b>crop</b>	<b>Wheat</b>	<b>Cotton</b>	<b>Rice</b>	<b>Sugarcane</b>	<b>Sunflower</b>
Yield (Mounds/Acre)	35	20	35	560	25
Price (Rs/Mound)	435	1.050	550	65	700
Wheat straw	1.000				
<b>Gross Income (Rs/Acre)</b>	<b>16.225</b>	<b>21.000</b>	<b>19.250</b>	<b>36.400</b>	<b>17.500</b>
Seed	900	1.000	700	1.200	850
Fertilizer	3.180	3.180	2.600	3.180	1.500
Spray	820	1.200	800	1.500	800
Irrigation	1.440	1.200	1.400	3.500	800
Seed Bed Preparation	800	800	1.200	2.700	800
Sowing Cost	120	250	1.800	2.400	250
Harvesting Cost	1.000	4.800	1.000	4.500	1.000
General Labour	500	500	500	1.000	500
<b>Variable Costs</b>	<b>8.760</b>	<b>12.930</b>	<b>10.000</b>	<b>19.980</b>	<b>6.500</b>
<b>Gross Margin (Rs<sup>9</sup>/Acre)</b>	<b>7.465</b>	<b>8.070</b>	<b>9.250</b>	<b>16.420</b>	<b>11.000</b>

Farmers are realising the highest gross margin from sugar cane per acre. But sugar cane has a vegetation period over 12 months and in comparison to short-duration crops the gross margin of sugarcane referring to the cropped area and vegetation time is therefore less attractive.

<sup>9</sup> The currency conversion is Rs 60 = US\$ 1, Rs 80=1 € (euro)



### 5.1.2 Estimated Gross Margin for Sugar Beet Cultivation

The data presented in the Table 20 shows a gross margin for sugar beet of Rs 13.480 per acre without the cost of leasing rate for the land. The inputs which are recommended by the Beet tech project of Strube- Dieckmann, JDW Sugar Mills and SES for sugar beet production and their costs are shown in Table. Not all of these inputs are available in Pakistan, seed and plant protection products will have to be imported.

The consultants suggested to use pelleted monogerm seed of high yielding sugar beet varieties. This seed is treated with insecticides and fungicides, to minimize damages caused by pests and seed or soil borne diseases. In order to achieve an optimal plant population of 30.000 – 40.000 plants/acre seed rate of 0.6 units<sup>10</sup> of sugar beet seeds per acre should to be sown.

**Table 21 Estimated Gross Margin Calculation for Sugar Beet**

Yield (Mounds/Acre)	550	
Price (Rs/Mound)	55	
<b>Gross Income (Rs/Acre)</b>		<b>30.250</b>
	<b>Rs/acre</b>	
Seed	4.080	
Fertilizer	3.180	
Spray	1.160	
Irrigation	1.800	
Seed Bed Preparation	2.050	
Sowing Cost	500	
Harvesting Cost	3.500	
General Labour	500	
<b>Variable Costs</b>		<b>16.770</b>
<b>Gross Margin (Rs/Acre)</b>		<b>13.480</b>

<sup>10</sup> 1One unit of sugar beet seed contains 100,000 seed pills which is sufficient to sow on one hectare land.

**Farm Inputs for Sugar Beet crop**

<b>Input</b>	<b>Unit</b>	<b>Number of Units/acre</b>	<b>Rs/Unit</b>	<b>Rs/acre</b>
<b>Seed</b>				
Monogerm pelleted seed	1	0,6	6.800,00	4.080
<b>Fertiliser</b>				
N-Fertiliser (Urea)	50 kg bag	2	520,00	1.040
DAP-Fertilizer	50 kg bag	2	1070,00	2.140
<b>Spray</b>				
Goltix 700 Herbicide	1 litre	0,5	2320,00	1.160

Chemical plant protection measures are especially important during the early vegetation period. One application of herbicides and insecticides is recommended after sowing, to control competing weeds and soil pests. Furthermore weeding will be necessary during the various growth stages, which can be done either by the farmers and their families or by hired field workers. At present there are no indications that fungicides have to be applied to protect the plants against leaf diseases.

The fertilizer application rates –2 bags of Urea/acre and 2 bags of DAP/acre - are based on the average nutrient requirements of sugar beet at a yield level of 550 Mds/acre.

Sugar beet will have to compete with other field crops in Punjab and Sindh. Primarily, this will be irrigated wheat as a Rabi crop, which is planted in a double cropping system. At the moment income obtained from wheat production is not very attractive for the farmers. At a price of 55 Rs/Mds for sugar beet and a yield level of 550 Mds/acre the gross margin of sugar beet is already higher than that of wheat and sunflower.

The presented gross margin calculation for sugar beet is based on the technology of small scale farmers considering the following main activities:



## **Advanced Technology Preposition**

### **Land preparation:**

The preparation of the land including the seed bed preparation is fully mechanised by using tractors and the relevant implements like ploughs, disc harrows, cultivators etc.

### **Sowing:**

Planting is done on ridges 50 to 85 cm apart by hand. Seed is sown on top of the ridges 20 cm apart at a seed depth of 2 - 3 cm

### **Fertilizer application:**

The fertilizer is applied manually at the time of sowing before formation of ridges.

### **Weed and pest control:**

Most of the farmers are using herbicides like Goltix 700 and insecticides like Malathion be sprayed by using a knapsack sprayer.

### **Harvest:**

Sugar beet is harvested in the period of middle of March up to the end of April, beginning of May depending on the local climatic conditions and varieties. The harvesting is done by uprooting either manually by using hooks or by using a disk plough or a small sub-soiler.

The critical threshold value for using the small scale technology may be at a size of the cultivated sugar beet area by 10 acres on a single farm. Above 10 acres an advanced technology should be applied to keep the appropriate agronomy schedule which seems to be impossible without mechanisation. However, certain farming operations have to be carried out very precisely and during a limited time period, so that the mechanisation of these operations will be required.

### **Land preparation:**

Successful sugar beet production starts with careful seed bed preparation. It is therefore recommended that seed bed combinations should be imported from abroad. These tractor mounted implements, are widely used in modern sugar beet cultivation, and have proved to be a reliable technique with only low maintenance costs. The working width of the seed bed combinations should be 3 m, so that they can be used without any problem by the available tractors and on the relatively small field plots. The capacity of a 3 m seed bed combination will be about 11 ha per day.

**Sowing:**

It is crucial to sow the seed at the right depth, normally 2-3 cm in order to ensure a satisfactory field emergence. Deeper planting delays field emergence and increases exposure of the small seedling to soil borne diseases and pests. In addition crusting may become a problem with delayed or reduced emergence. Moreover, a fairly uniform distance between the rows and between the seeds within the rows is important to achieve an optimal plant population. For sowing sugar beet seed precision drills must meet the highest requirements. It is recommended to use tractor mounted six row precision drills. About 10 ha per day of sugar beet can be sown with a six row drill per day.

**Fertilizer application, weed and pest control:**

Many husbandry operations such as fertilizer application, weed and pest control has to be carried out by the use of fertilizer spreader and crop sprayers mounted on tractors due to the limited time period.



**Figure 17** Sowing sugar beet with a tractor mounted precision seed drill

Source: Strube-Dieckmann

### Harvesting:

For timely delivery of beets to the sugar factory, it is recommended that sugar beet crop should be harvested mechanically on medium and large scale farms. The above mentioned facts are also valid for the harvest of sugar beet because the sugar beet has to be harvested during a limited time period in large quantities at a high quality standard. The consultants recommend for the mechanised harvest on large scale farming initially with a one, two or three row sugar beet harvester. These harvesters are normally tractor pulled but on a later stage there is need to have self propelled 6 row beet harvester harvesters like wheat combined harvesters which are already common in Pakistan.



**Figure 18:** Tractor pulled two row harvesters, source: Beet tech Project



**Figure 19:** Self propelled 6 row harvester, source: Beet tech Project



### Investment required for farm mechanization

The development of a sugar beet industry would require purchase of specialised sowing and harvest equipment. The assessment of the economic feasibility of sugar beet cultivation therefore includes the consideration of the investment costs for farm machinery.

Suppose a sugar mill is going to establish a processing line for sugar beet at a daily capacity of 4.000 t for a processing period of 45 days the required sugar beet area has to cover approximately 3.300 ha supposing a yield of 55 t/ha. Apart from the area cultivated by the small scale farmers it is supposed that the area of large scale farmers should be 2.200 ha. Table presents the investment cost for farm machinery.

**Table 22 Estimated Investment Costs for Farm Machinery ex Karachi (2.200 ha)**

Machinery	Performance	Available days	No. Units	US \$/Unit	Total US \$
Seed bed combination 3 m	8.5 ha/day	25	10	14.000	140.000
Precision seed drill 6 rows	10 ha/day	25	9	14.200	127.800
Crop sprayer 15 m	15 ha/day	12	15	14.200	213.000
Sugar beet harvester 2 rows	6 ha/day	45	8	46.800	374.400
<b>Total</b>					<b>855.200</b>

The consultants recommend starting the large scale trials in the coming season 2007/08 using a precision seed drill of six rows on private farms as well in sugar mills to assess the commercial potential of sugar beet cultivation with the objectives:

- Interaction between seed, drills and seed bed preparation,
- Irrigation methods and plant establishment,
- Irrigation and yield,
- Irrigation timing and sugar levels,
- Fertilizer application and yield.



## 5.2. Economic Feasibility of Sugar Beet Processing

### 5.2.1. Estimation of Production Cost for Sugar Beet Processing

According to the figures of the federal cane commissioner (Mr. Inayatullah Khan), presented at a sugar related meeting on 11.11.2002 in Karachi and confirmed with the dates given of a visited sugar mill here are the estimation of conversions cost from beet and cane to white sugar. This estimation does not include the costs of raw material (beet and cane) and also not the financial charges, taxes, administrative, and selling expense.

The processing costs are calculated by including all the salaries, wages, benefits, fuel and power – (without bagasse), packing, repair, maintenance, store, insurance, and depreciations. The assumptions for costs are;

- All is calculated to white sugar.
- Bagasse is set to a worth of 500 Rs/t.
- Steam consumption may be – after upgrading – 40% on beet and also on cane.

**Table 23 Estimated Productions Cost Rs/tonne white sugar with out raw material costs**

	<b>Sugar Beet</b>	<b>Sugar Cane</b>
Average Recovery rate	10 %	9%
<b>Processing costs :</b>		
Salaries, wages, benefits, fuel, power (without bagasse) packing, repair, maintenance, store, insurance, depreciation	2, 900	3, 300
Bagasse fired	1 120	1 120
Lime stone	550	-
Oil for lime kiln	400	-
<i>Less: Sales molasses</i>	-1 500	-1 500
<i>Less: Sales Beet pulp</i>	-2 300	-
<b>Total Conversion Cost(Rs per ton)</b>	<b>990</b>	<b>2 920</b>

Conversion Cost



### **Important Note**

The pre-set conditions to this favourable estimation are:

- Upgrade the sugar mill to better heat economy – 40% steam on cane.
- All times full running the mill, without lack of cane or beet.
- The price of pressed pulp with 20% dry matter is considered on conservative side as Rs 1000 / ton.

#### **5.2.2. Estimated Gross Margin for Sugar from Sugar Beet Processing**

The gross margin of sugar mills can increase by using beet as second raw material. The sugar price of beet white sugar and cane white sugar is equal. So the gross margin depends on raw material cost, recovery, and production cost mainly. If there are two possibilities of raw material one can choose the best. The recovery would be higher. The production costs decrease because of better recovery. At longer season the overhead costs decrease.



## 6. Risk Analysis

### 6.1 SWOT-Analysis for Sugar Beet cultivation

The economic operation of every sugar mill which is going to process sugar beet requires a constant and sufficient supply with sugar beet. Also the farmer should know the risk related to sugar beet cultivation. The objective of the SWOT-Analysis is to find out factors, which might negatively or positively affect the sugar beet production and supply can be summarized as follows:

<b>Sugar Beet Cultivation</b>	
<b>Strength</b>	<ul style="list-style-type: none"><li>➤ Sugar beet is an ideal supplement to sugar cane,</li><li>➤ Sugar beet can be grown in Sindh and Punjab Provinces,</li><li>➤ Sugar beet tolerates mild salinity,</li><li>➤ Sugar beet cultivating has a great potential for producing sugar,</li><li>➤ Sugar beet production can have an immense impact on the sugar industry,</li><li>➤ Sugar beet needs less amount of irrigation water as compared to sugarcane,</li><li>➤ Farmers who have round the year water availability can take a second crop</li></ul>
<b>Weakness</b>	<ul style="list-style-type: none"><li>➤ Cultivating sugar beet demands a thorough know-how of the farmer,</li><li>➤ Small scale production of sugar beet is labour-intensive,</li><li>➤ Mechanisation of sugar beet production on large scale has</li></ul>



	<p>to be supported by the sugar mills,</p> <ul style="list-style-type: none"><li>➤ Processing of sugar beet has to be done in dual purpose sugar mills which process sugar cane as well sugar beet</li></ul>
<b>Opportunity</b>	<ul style="list-style-type: none"><li>➤ Sugar beet production will raise the self sufficiency in sugar, saving foreign exchange by cutting in of sugar imports,</li><li>➤ Sugar beet production will create new job opportunities,</li><li>➤ The crushing period of the sugar mills can be extended by 30 to 45 days through sugar beet processing,</li><li>➤ Beet pulp, a by-product of the industry, is valued as feed by livestock operators,</li><li>➤ The farmer has a new chance to diversify his farm activities by growing sugar beet</li></ul>
<b>Threat</b>	<ul style="list-style-type: none"><li>➤ Negative effect of extreme temperature on the sugar content of sugar beet,</li><li>➤ Presently no availability of sufficient sugar beet seed of varieties which are adopted to high temperature,</li><li>➤ Capability of sugar mills to produce sugar from sugar beet at a competitive price,</li><li>➤ The development of sugar beet as an economic crop is totally dependent on the support of the local sugar cane industry, specifically the processing mill</li></ul>

Figure 20 SWOT analysis of sugar beet cultivation

Considering the results of the SWOT-Analysis it is obviously that threats have to be minimised by taking the following measures:

- Researchers must put the main emphasis on screening varieties to find locally adopted varieties which can give high yields,
- Besides the variety testing trials it is necessary to conduct large scale trials with a systematic approach to the management of irrigation, fertility, weed control, disease and pest control,
- Funding for conducting the trials should be done by sugar mills and the government,
- The sugar mills should establish their own sugar beet extension division. The advisory services for the farmers should be provided for free, since most of them cannot afford to pay for such services.



**Figure 21** Promising sugar beet trials at Ashraf sugar mills conducted under beet tech project of Strube Dieckmann, April 2007.



## 6.2 SWOT Analysis of Sugar Beet Processing

For sugar industry to process beets instead or beside of cane it is opportune to know the risks not only of supply beets but also the positive and negative issues in processing beets.

<b>Sugar Beet Processing</b>	
<b>Strength</b>	<ul style="list-style-type: none"> <li>➤ Higher sugar content</li> <li>➤ Higher recovery on beet</li> <li>➤ Good white sugar without refinery</li> <li>➤ Beet pulp use as cattle feed</li> </ul>
<b>Weakness</b>	<ul style="list-style-type: none"> <li>➤ Juice purification more complicate</li> <li>➤ More usage of lime</li> <li>➤ Extern energy supply</li> <li>➤ Short production season for beets</li> </ul>
<b>Opportunities</b>	<ul style="list-style-type: none"> <li>➤ Better heat economy because of thermo-stability of juice</li> <li>➤ Easier maintenance compared to mills</li> <li>➤ Longer crashing season for cane and beets</li> <li>➤ Longer season means longer employment</li> <li>➤ Payment of sugar beets according to quality</li> </ul>
<b>Threats</b>	<ul style="list-style-type: none"> <li>➤ Not enough beets</li> <li>➤ Beet price not competitive to cane</li> <li>➤ The beets are dependent on secondary source of fuel could be bagasse from the sugar cane or other fuel resources like</li> </ul>

	furnace oil, coal , natural gas, etc.
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**Figure 22 SWOT analysis of Sugar beet Processing**

### **7- Commitment of Small & Medium Enterprise Development Authority**

SMEDA is committed to the cause of sugar beet growing as a supplement to sugarcane crop in Pakistan, as far as it helps small and medium sized farming enterprises to increase their farming profits by growing sugar beet. By small sized farmers we mean farms having up to 12-1/2 acres of land, while by medium sized farmers we mean farms having up to 100 acres of land. Farming of sugar beet implies that the same land is available to grow a second crop, after a crop of sugar beet has been cultivated. SMEDA will not be able to take part in beet trials as it is a MINFAL and provincial agricultural department's subject. SMEDA can extend following services for the promotion of sugar beet as a supplement to sugar cane for sugar production in Pakistan,

- I. Awareness among the stake holders about the sugar beet crop for agronomy, processing and use of by products specially the beet pulp as animal feed through organizing training and workshops for the farmers, millers and other stakeholders by inviting national and international experts. There is possibility to get experts from SES if stake holders are interested in a specific subject.
- II. Organize meetings of the stake holders mainly the Pakistan Sugar Mills association (PSMA), farmers and related provincial and federal government departments for exchanging knowledge, information and discussing the issues to come up with short and longer term solutions together with the federal cane commissioner.
- III. SMEDA can play role in the fact finding and supporting policy related issues through its home Ministry of Industries, Production and Special initiatives, the need for improvement of processes in existing sugar making technology.
- IV. Provide technical help to the beet chain related small and medium size engineering sector which includes mainly the agriculture implements manufacturing industry ( sowing seed drills, harvesters, transport wagons/trolleys, etc),
- V. SMEDA can also coordinate the activities of prospective consultants to the individual sugar mills. That is inviting the consultants to bid for the consultancy contract of a sugar mill, to make modification oriented feasibility for the sugar mill, to improve on its steam consumption, saving on its bagasse usage in boilers, or the cost of setting up an ancillary sugar beet processing line. For that the sugar mill will have to pay for the feasibility.



- VI. SMEDA can organize the coordination in the arrangement of seeds and agronomic knowledge to SME growers. It can also carry out some form of monitoring of plantation and harvesting period of the sugar beet crops.
- VII. SMEDA can also help in the publishing of successful data and knowledge on the trials of sugar beet crops. By contributing to the collation of data, its editing and final publication to SME farmers in the field.

<b>RESPONSIBILITY MATRIX FOR PROMOTION OF SUGAR BEET CROP IN PAKISTAN</b>	
<b>Task</b>	<b>Organization</b>
Comparative Cost Benefit analysis Model	SMEDA
Consultants for industry support through SES	SMEDA
Technology Sourcing	Engineering Development Board
Funding Arrangement	Ministry of Finance
Commercial funding of Projects and working capital for beet projects	State Bank of Pakistan
Seed availability	MINFAL
Farmers extension services	MINFAL & Provincial Agriculture Dept.
Agronomic Equipment	Engineering Development Board /Agriculture Machinery Research Institute (AMRI)
Sugar Beet Production Coordination Cell	MINFAL, Sugar commissioner
Conducting beet trials, farmer awareness program through extension	Punjab , Sindh and NWFP agriculture departments
<b>Policy Initiative</b>	
Technical assistance for feasibility, cost of technology transfer for plant & agronomy	MINFAL
Zero rating duties and import control exemption on second hand plant & machinery.	Central Board of Revenue
Zero duty import of sugar beet seed, its sowing, harvesting technology both for new and second hand machinery	Central Board of Revenue
<b>Private sector role</b>	
Identification and modification of selected sugar mills.	PSMA
<b>International Technology linkages</b>	
Transfer of beet chain related technology	Beet Tech Project-Strube Dieckmann



(Support to find second hand beet processing equipment).	Germany
Seed and agronomy support.	Beet Tech Project-Strube Dieckmann Germany

### 8- Recommendations

The fact finding mission organized by SMEDA and Beet Tech Project (Strube Dieckmann) had a very close view of the real situation of sugar beet cultivation in the fields and meeting with the stakeholders in all three provinces( Sindh, Punjab and NWFP) during the month of April and May 2007. The consultants concluded that sugar beet can be grown in new areas depending upon the will power of the sugar mills along with a clear strategy from the federal and provincial governments. The stakeholders are aware about the benefits that they can get by adopting a short duration sugar beet crop that will not only boost the agriculture sector but will also meet the increasing demand of sugar, by products like molasses and beet pulp that can be used as animal feed in the country. Although there are a few challenges that can be solved through applied research and development.

The report of the fact finding mission concludes with some of the following recommendations ;

- I. There is need to devise a policy both at the federal and provincial level to promote the sugar beet cultivation as a supplement to sugar cane for sugar production in the country. It should include all the components with special incentives both for the millers and farmers for an initial grace period of 5 years. These incentives can be duty free import of plant and machinery both for new and second hand, sugar beet seeds and other farming related technologies, easy and subsidized access to credit, tax exemption, etc.
- II. The used equipment from closed sugar beet plants as a result of WTO policy in European Union can be imported on easy terms through inter governmental dialogues or directly with European commission. The sugar mills association shall be involved in this process together with MINFAL, MOIP and SMEDA.
- III. The MINFAL and Provincial agriculture departments shall devise Beet production technology for each region. This means they should conduct large scale trials on different agronomic aspects and come up with an appropriate technology for each area depending on soils and water quality issues.
- IV. The sugar mills shall play their role more actively by including a separate beet line in their existing mills as a first step to build the trust of growers to grow new crop. For that purpose State Bank of Pakistan shall be asked to direct the banks / financial institutions for financing sugar beet related projects on easy terms.



- V. The government shall give incentives to the mills to invest in corporate farming as well to grow beet on large scale areas especially in Sindh and Punjab in order to ensure a consistent and quality supply of sugar beets.
- VI. The government shall encourage the farmers conducting beet trials by offering them a free seed, fertilizer and other inputs along with a certain per acre payment in order to build their confidence on new crop,
- VII. There is a need to up-grade the steam consumption of sugar mills to save energy (sources like bagasse) that can be used for sugar beet processing later on.

**ANNEX****A1: List of Contacted Institutions**

<b>Date</b>	<b>Name</b>	<b>Institution</b>
04/16/2007	Mr. Sultan Tiwana	General Manager SMEDA
04/16/2007	Mr. Imran Chaudhry	Manager SMEDA
04/16/2007	Mr. Zaka Ashraf	Chairman PSMA (Punjab)
04/16/2007	Mr. Naweed Cheema	General Manager TEVTA, Punjab
04/16/2007	Mr. Sohail Akram	Office Assistant SMEDA
04/16/2007	Mr. Inayatullah Khan	Cane Commissioner, MINFAL
04/17/2007	Dr. Muhammad Ishtiaq	Director Hasham Institute of Technology Tando Allahyar
04/17/2007	Mir Jaffar Talpur	Sugar cane specialist, Sugar crop Research Institute, Tando Jam
04/17/2007	Mr. Abdul Sammee	General Manager Dewan SM
04/17/2007	Mr. Mulazim Hussain	Director Cane Dewan SM
04/19/2007	Mr. Dost Muhammad Balloch	Resident Director MSM
04/20/2007	Dr. Imram Mohammad	Director of Production/cane Matiari sugar mills
04/20/2007	Mr. Shamim Haider Lodhi	Resident Director, Mirpur Khas Sugar mills
04/20/2007	Mr. Haideer Baksh Rustmani	Assistant Manager General Mirpur Khas Sugar Mills
04/20/2007	Mr. Tahir Bashir	Assistant General Manager Mirpur Khas Sugar Mills
04/21/2007	Syed Khaleeq Hassan	Resident Director, ABADGAR Sugar mills
04/23/2007	Engr. Jamil Saghir	General Manager Ship Yard Karachi
04/23/2007	Mr. Muhammad Arif Khairi	Deputy Secretary (Tech) Agricultural Dept. Gov. Sindh
04/23/2007	Mr. Muslim Raza	Provincial Chief Sindh SMEDA
04/23/2007	Mr. Dewan M. Yousuf Farooqui	Managing Director, DEWAN GROUP
04/25/2007	Mr. Rana Nasim Ahmed	Resident Director JDW SM Rahim Yar Khan
04/25/2007	Mr. Tony McDermott	Prod. Manager Farms JDW SM
04/25/2007	Mr. Shahid Jameel	Deputy General Manager (Prod) JDW SM
04/28/2007	Brigadier Abdul Aziz	General Manager ASML Bahawalpur
04/28/2007	Major Zulfiqar Ali	Manager Administration ASML Bahawalpur
04/28/2007	Mr. Bashir Ahmad Kalhou	Deputy General Manager ASML Bahawalpur
04/30/2007	Mr. Muhammad Yaqoob Bhatti	Pak German Gov. Poly tech.. Institute of Coop: Agri, Chak-5-Faiz Multan
04/30/2007	Mr. Faisal Imam	Progressive Farmer Kabirwala
05/03/2007	Mr. Abdul Qadar Khattak	Resident Director Premier SM & Distillery Mardan
05/03/2007	Dr. Syed Sabir Hussain Shah	Director Sugar Crops Research Institute Mardan
05/04/2007	Mr. Shahab Khawja	Secretary Min. of Industries, Production & Special Initiatives
05/04/2007	Mr. Tariq Bajwa	Joint Secretary Min. of Industries, Production & Special Initiatives
05/05/2007	Mr. Asmat Ullah Khan	National Coordinator Agribusiness & Diversification Project
05/05/2007	Mr. Tajammal Hussain Nisar	Provincial Coordinator Punjab Agribusiness & Diversification Project
05/05/2007	Mr. Muhammad Ismail Qureshi	Secretary MINFAL
10/05/2007	Mr. Fayyaz Bashir Warraich	Punjab Agriculture secretary
10/05/2007	Mr. Nauman Khan	Al-moiz sugar mills
10/05/2007	Mr. Inyat Ullah Khan	Federal cane commissioner
10/05/2007	Dr. Arshad Chattha	Sugar cane research institute, Faislabad



10/05/2007	Dr. Anjum Ali Butter	Punjab Adoptive research , department
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## A2: Sugar Trade-FAPRI Projection

	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
<b>Net Exporters</b>										
	(Thousand Metric Tons)									
Argentina	646	602	576	570	566	566	568	573	578	578
Australia	3,831	3,752	3,777	3,845	3,925	4,016	4,115	4,219	4,327	4,435
Brazil	19,550	19,857	19,973	20,418	20,705	20,921	21,160	21,378	21,584	21,790
Colombia	835	752	739	754	770	790	813	836	858	880
Cuba	650	491	525	556	580	604	629	654	681	706
European Union-25	-1,349	-600	-1,894	-2,860	-2,814	-2,882	-2,963	-3,046	-3,128	-3,210
Guatemala	1,423	1,383	1,377	1,398	1,425	1,457	1,491	1,529	1,568	1,606
India	2,000	2,278	2,382	2,496	2,400	2,392	2,390	2,400	2,407	2,414
Mexico	120	136	145	166	191	217	241	263	295	319
South Africa	1,034	947	957	990	1,016	1,047	1,077	1,108	1,136	1,164
Thailand	4,300	4,403	4,592	4,735	4,831	4,914	4,985	5,047	5,103	5,159
Total Net Exports *	34,639	34,728	35,160	36,060	36,542	37,061	37,607	38,144	38,673	39,211
<b>Net Importers</b>										
Algeria	1,155	1,198	1,207	1,228	1,255	1,279	1,304	1,328	1,353	1,377
Bulgaria and Romania	747	717	713	716	719	722	725	728	732	735
Canada	1,318	1,333	1,331	1,340	1,356	1,370	1,383	1,398	1,412	1,426
China	790	642	594	660	798	935	1,078	1,227	1,384	1,541
Egypt	1,034	1,145	1,169	1,195	1,242	1,280	1,320	1,360	1,401	1,441
Indonesia	1,800	1,605	1,643	1,705	1,765	1,812	1,866	1,914	1,951	1,988
Iran	650	723	758	799	840	868	892	911	929	947
Japan	1,340	1,296	1,270	1,248	1,229	1,207	1,184	1,160	1,134	1,108
Malaysia	1,215	1,226	1,237	1,260	1,291	1,321	1,351	1,381	1,411	1,441
Morocco	622	700	717	729	752	774	796	818	841	863
Pakistan	850	906	870	841	873	913	954	997	1,044	1,091
Peru	158	187	186	176	177	180	184	189	196	202
Philippines	-230	-127	-117	-133	-135	-137	-137	-137	-135	-133
Russia and Ukraine	3,570	3,726	3,683	3,670	3,652	3,607	3,541	3,463	3,374	3,285
South Korea	1,340	1,373	1,377	1,388	1,405	1,420	1,434	1,447	1,460	1,473
Turkey	-20	5	33	21	24	29	42	52	53	54
United States	1,729	1,680	1,687	1,708	1,734	1,765	1,785	1,811	1,842	1,872
Venezuela	200	263	275	278	290	299	309	320	331	341
Rest of World	9,800	10,432	9,544	9,265	9,354	9,426	9,522	9,620	9,723	9,826
Total Net Imports	34,639	34,728	35,160	36,060	36,542	37,061	37,607	38,144	38,673	39,211
<b>Prices</b>										
	(U.S. Dollars per Metric Ton)									
FOB Caribbean Price	262	229	250	263	265	269	274	278	283	287
New York Spot	453	514	503	500	497	489	484	475	474	473

Note: Sugar is in raw equivalent.

\* Total net exports are the sum of all positive net exports and negative net imports.



### A3: Pakistani Sugar Supply and Utilization : FAPRI Projections<sup>11</sup>

	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17
<b>Sugar Beet</b>											
Area Harvested						(Thousand Hectares)					
	8	8	8	8	8	8	8	8	8	8	8
Yield						(Metric Tons per Hectare)					
	39.04	39.20	39.31	39.40	39.48	39.55	39.62	39.69	39.76	39.83	39.90
Production						(Thousand Metric Tons)					
	321	320	320	321	323	325	326	327	329	330	331
<b>Sugarcane</b>											
Area Harvested						(Thousand Hectares)					
	1,005	1,001	994	998	1,002	1,003	1,004	1,005	1,005	1,005	1,005
Yield						(Metric Tons per Hectare)					
	50.75	50.28	50.29	50.44	50.64	50.87	51.11	51.35	51.59	51.84	52.08
Production						(Thousand Metric Tons)					
	51,000	50,355	50,013	50,327	50,732	51,042	51,326	51,593	51,852	52,105	52,354
<b>Sugar</b>											
Production	3,720	3,701	3,704	3,755	3,813	3,865	3,914	3,963	4,012	4,060	4,109
Beginning Stocks	585	955	1,138	1,209	1,232	1,239	1,239	1,235	1,230	1,223	1,217
Domestic Supply	4,305	4,656	4,842	4,964	5,045	5,104	5,154	5,198	5,241	5,284	5,325
Consumption	4,200	4,424	4,502	4,573	4,678	4,778	4,873	4,966	5,063	5,168	5,276
Ending Stocks	955	1,138	1,209	1,232	1,239	1,239	1,235	1,230	1,223	1,217	1,210
Domestic Use	5,155	5,562	5,711	5,805	5,918	6,017	6,108	6,196	6,286	6,385	6,486
Net Trade	-850	-906	-870	-841	-873	-913	-954	-997	-1,044	-1,101	-1,161

<sup>11</sup> FAPRI is a USA based projections research Institute, [www.fapri.org](http://www.fapri.org)



### Glance at missions meetings with key stake holders



**Figure 23** Meeting with Dewan M. Yousuf Farooqui, MD Dewan Sugar mills in Karachi



**Figure 24** Meeting with Rana Nasim Ahmad, JDW Sugar Mills, Rehim Yar Khan



**Figure 25** Meeting with Shamim Haider Lodhi, Mirpur Khas Sugar Mills, Mirpur khas



**Figure 26:** Meeting with Federal Secretary, MINFAL Mr. Muhammad Ismail Qureshi in Islamabad



**Figure 27:** Meeting with Federal Secretary MOI & SI and CEO SMEDA, Mr. Shahab Khawaja, in Islamabad



**Figure 28:** Meeting with Mr. Inyat Ullah Khan, Federal Sugar Crops Commissioner, Islamabad



**Figure 29:** Meeting with Doost Muhammad Balouch, Matiari sugar mills



**Figure 30** Meeting with Syed Khaleeq Hassan, Sindh Abadgar Sugar mills, Tando Mohammad Khan



**Figure 31** Mr. Sultan Tiwana, GM SMEDA, presenting Shield to Dr. Dietrich Bollman, SMEDA head office Lahore



**Figure 32:** Mr. Fayyaz Bashir Warraich, Secretary Punjab Agriculture department and Ch Zaka Ashraf, Chairman PSMA(PZ) presenting shield to Dr. Gerhard Wandke at SMEDA head office Lahore.

## Contacts

### SMEDA

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### Beet Tech project Germany

Technology support in Beet Agronomy (through seed, technology support for sowing and harvesting beets ) and Engineering through international linkages,

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### Beet process technology

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