

**Sugarcane and Punjab, Pakistan:
Production, Processing and Challenges**



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About Ethical Sugar

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Using a Global Value Chain (GVC) framework his research investigated three main questions. These are: What is the nature of technological and institutional structures within which production, consumption and exchange takes place; what are the determinants of chain evolution and whether there is an element of path dependency explaining this evolution; and how the process of globalisation interacts with these chains and the local political economy.

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Introduction

With over a million hectares (ha.) under sugarcane cultivation, Pakistan is the fifth largest cane producer in the world and the seventh largest global sugar producer. Despite its importance as one of the major sugarcane producing regions globally there has been limited work on the dynamics of sugarcane cultivation and processing in the country. Sugarcane cultivation on a fairly large scale has had a significant effect on the rural economy and the environment. This is especially true in the cane growing heartland in Punjab, Pakistan.

This paper analyses the sugarcane production and processing system in Punjab province and highlights some of the problems afflicting the system. Evidence suggests that there is little comparative advantage in large scale sugarcane cultivation in much of the province. However, the continued dominance of Punjab has been strongly conditioned by sustained state support. Despite this support sugarcane cultivation and processing suffers from a number of systemic issues. These systemic issues manifest themselves in the form of lower yields, cyclical production, high cost of production and consistently low sucrose recovery rates.

This paper has been divided into three sections. The first section looks at the system of sugarcane cultivation in the country highlighting Punjab's importance. In this section a comparison of sugarcane yields within the country and with other large global producers is also undertaken. Intra-province differences in yields and sugarcane production are also brought to the fore. Finally this section deals with changes in the landholding structure and the impact on the structure of sugarcane cultivation.

The second section looks at the growth of downstream sugarcane milling in the country with an emphasis on the Punjab. The importance of state support in the continued survival and growth of downstream milling is also studied. This section also focuses on the regional differences in sugar production in the province. An analysis of the relationship between farmers and downstream millers, the two most important actors in the sugarcane production system is also undertaken.

The third section identifies the major challenges facing sugarcane production and processing in the country and Punjab. It also looks at the importance of public and private action in mitigating these challenges. This is followed by the conclusion.

Sugarcane Cultivation in Pakistan and Punjab's Dominance

Pakistan is situated in a subtropical arid zone and is located between latitudes of 24⁰ and 37⁰ N and longitudes of 61⁰ to 75⁰ E (Muhammad, 1998). The country's economy remains heavily dependent on agriculture not only for food supply but also as a source of raw material for agro-industries and as a source of employment. While agriculture's share in GDP has decreased to about 21 per cent, it provides employment for 44 per cent of the labour force (Government of Pakistan (GOP), 2014). Within agriculture, crop cultivation is dominated by four major crops which account for a quarter of the value added of the sector. These four crops include cotton, wheat, rice and sugarcane.

There are more than 8 million farms in the country and sugarcane is cultivated on almost 1 million of these farms (GOP, 2012). Cane cultivation takes place across the country in the coastal areas and plains of the river Indus and connecting rivers primarily in the provinces of Punjab, Sind and Khyber Pakhtunkhwa (KPK, formerly the North Western Frontier Province

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(NWFP)). Cane growing areas have been classified into north-western, central and southern zones by Qureshi and Afghan (2005) with different climatic conditions. Sugarcane cultivation in the country is primarily undertaken under irrigated conditions in the country as it is a high delta crop and average rainfall in the country remains lower than the plant's requirement.

Sugarcane is sown in two different seasons i.e. fall/autumn and spring. Autumn planting takes place in the months of September and October in some parts of Punjab and in a majority of Sind. In Punjab and KPK, cultivation of sugarcane takes place mostly in spring between the months of February and March (Nazir et al., 2013). Harvest starts in Punjab and KPK in November while commencing in October in Sind. Unlike many other major cane growing areas, the growing period for the crop is much shorter in the two provinces with average season length ranging from 8-10 months while in Sind the period is almost 16 months (FAO, 1997). This is primarily due to climatic constraints in these areas which limit the growth period of the plant to 2-3 months¹ where as in tropical areas the growth stage of the plant is much longer (Attwood, 1992; Bosma, 2013).

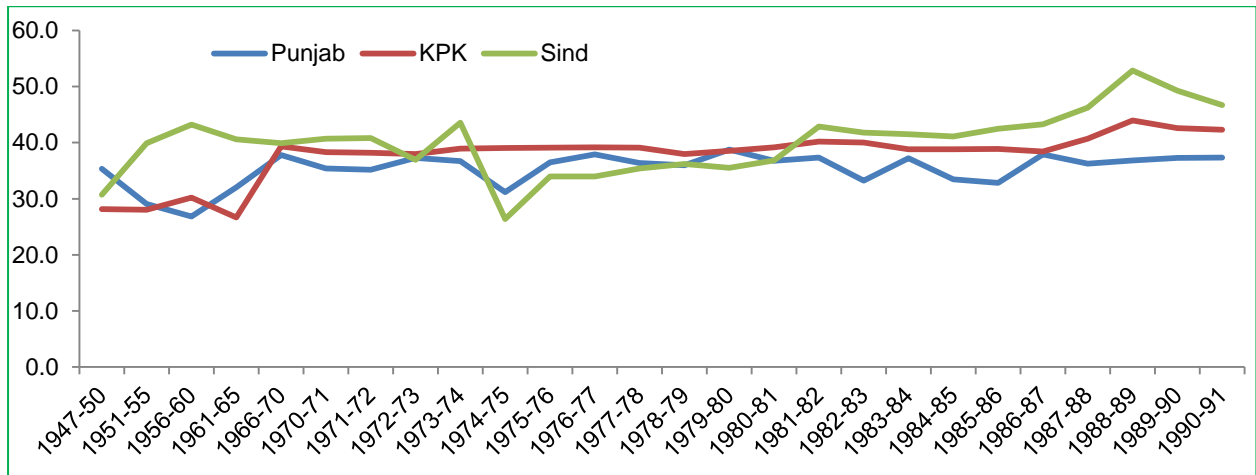
Over time, sugarcane cultivation in the country has witnessed a substantial increase with the area under cane increasing from 189,000 ha. (1948) to more than 1 million ha. in 2012-13. Sugarcane production has also progressively increased from 7 million tons (1948) to more than 60 million tons (2012-13). The dominance of Punjab in sugarcane cultivation in the country is significant. From 1947-2012/13, the province on average accounted for 69 per cent of the area under cane and 65 per cent of the total cane production in the country. Parallels can perhaps be drawn with the dominance of Sao Paulo in sugarcane cultivation and processing in Brazil, however productivity levels remain far lower in Punjab as compared to Sao Paulo.

The increase in sugarcane production post-1947 till 1990 was primarily a result of increase in the area under cane cultivation with limited productivity improvements. This can be corroborated by looking at sugarcane yields in the country. From 1948 to 1992 area under cane increased from 200,000 ha. to almost 900,000 ha. However, while national average yields increased from 31 tons/ha. (1947-50) to 45 tons/ha (1991/92) in Punjab, average yields remained largely *stagnant* at 35 tons/ha during the period. The graph below depicts yields during the period in question, highlighting the largely non-existent yield increases in Punjab:

¹ One of the major problems affecting sugarcane growth is frost which severely damages the plant and in the plains of the Indus frost during the winter months remains quite prevalent

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Figure 1: Sugarcane yields in provinces of Pakistan in Tons/ha. (1947-50 to 1991/92)

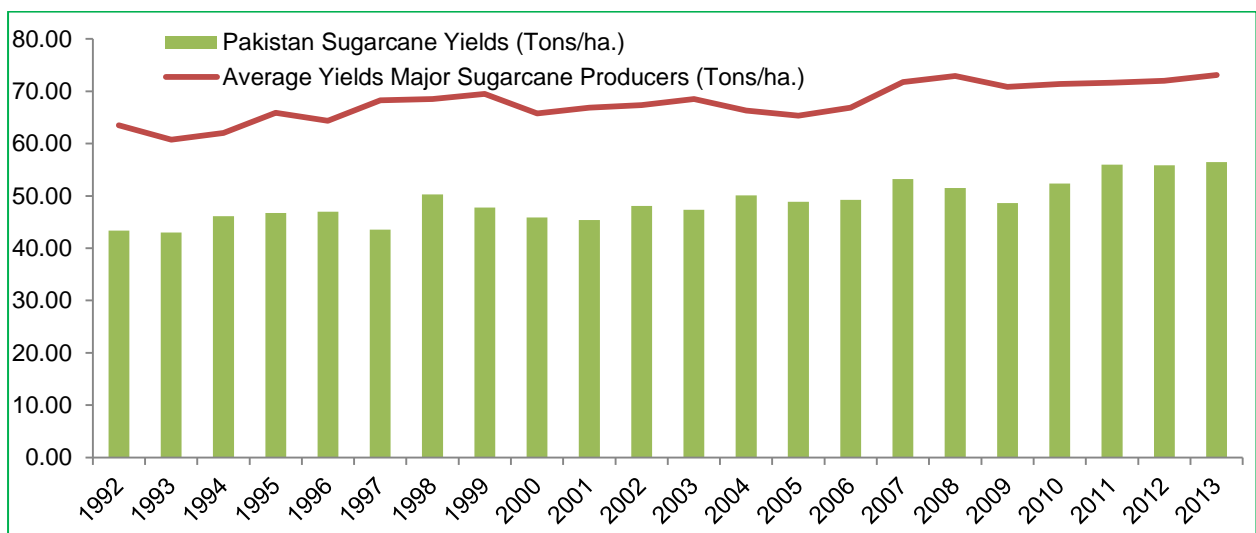


Source: Agricultural Statistics of Pakistan (Various Years)

Over the last two decades yields have witnessed an increase. At a sub-national level, there are substantial differences and while Sind continues to have the highest yields in the country, there has been a substantial increase in yields in Punjab as well, especially over the quinquennium, 2009 to 2014. Despite the improvements in national and provincial yields, they consistently remain the lowest amongst the major global sugarcane producers.

The graph below compares average yields in the top 6 global producers (excluding Pakistan) with yields in Pakistan during the period from 1992 to 2013 using data available with the Food and Agriculture Organisation (FAO):

Figure 2: Average Yields in major sugarcane producers as compared to yields in Pakistan



Source: FAOSTAT, accessed on 5 January 2015 at: <http://faostat3.fao.org/download/Q/QC/E>

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The figure shows the substantial and persistent difference in yields between the leading sugarcane producers and yields in Pakistan. Various reasons have been attributed to these lower yields. Initial research by Ilahi (1978) observed that lower yields were a result of the lack of farmer education and while a few 'progressive' farmers obtained consistently higher yields, a large majority of farmers had below potential yields.

In recent work Malik and Arshad (2009) have highlighted other factors for the lower yields including: unfavorable climate for sugarcane cultivation; issues around water availability; over exploitation of land resources and low quality of available inputs like seeds and fertilizers. Burki et al. (2007) concur with the results of Malik and Arshad (2009) and argue that over time, emergent regional patterns of cane cultivation have been suboptimal leading to increased cultivation in areas ill-suited for large scale cultivation. Their analysis is at an aggregate provincial level. They observe that instead of Sind, sugarcane cultivation was promoted in Punjab where yields remained low. While this analysis is partially true they do not account for the difference in yields within the different regions of Punjab.²

Furthermore, while these reasons are important, there is a lack of coordination between mills and farmers and non-existent vertical integration. Mills have been unable to develop a synergistic relationship with farmers, especially marginal and small holders. Low yields also point to a failure of public sector research and development (R&D) institutions and extension staff.

Sugarcane is cultivated in almost all areas of the Punjab, however three regions stand out, these are Faisalabad, Sargodha and Bahawalpur Divisions³ located in the Northwest, Centre and South of the province. Districts comprising these divisions account for more than 66 per cent of area under cane and 68 per cent of cane production. Faisalabad division alone contributed 36 per cent of area under sugarcane (PunjabBOS, 2014).

Faisalabad has historically been the centre of sugarcane cultivation in the province. Cane cultivation has registered the highest increase in South Punjab bordering Sind and despite lower rainfall⁴ these areas are considered to be climatically more suitable to cane cultivation.

There seems to be a substantial difference in productivity between the southern and central regions of the province. In 2011-12 in Faisalabad District in central Punjab there were 111,000 ha. under cane cultivation with a total production of 5.769 million tons while in Rahim yar Khan District in the South 108,000 ha. were under cane cultivation with a production volume of 7.781 million tons (ibid.).⁵ Despite the difference in yields, a majority of the mills are located in Central Punjab and in the Northwest of the province.

² Punjab can be divided into three major regions i.e. North, Centre and South Punjab. These regions have substantial differences in climate and rainfall

³ The Division is the largest administrative unit after the province in the country. Each division comprises of 3 – 4 districts and so on

⁴ Average rainfall recorded by the meteorology department at Khanpur Station, part of Rahim Yar Khan District from 2000-2010 was 156 mm which is lower than average rainfall in Faisalabad, around 400 mm

⁵ These two districts have the largest area under cane cultivation in the province

Figure 4: Sugarcane field in Faisalabad and Rahim yar Khan



Source: Author's own during field work (2012). The picture on the left is from Faisalabad while that on the right is of cane fields in Rahim yar Khan

Structure of Landholding and Cane Cultivation

Unlike Brazil, Australia and much of Africa, sugarcane cultivation across the Indian sub-continent remains small holder intensive with limited vertical integration between field and mills. Pakistan is no exception with a substantial number of farmers supplying cane to a particular mill. Evidence suggests that there is little cooperation amongst farmers and there are hardly any formal farmer cooperatives in the province with farmers dealing individually with mills.⁶

Monocropping of sugarcane remains limited and in most areas there are well established crop rotation cycles. Individual farmers do not devote their entire land to sugarcane, but rather cultivate the crop on a portion of their land. Ratoon crops are usually kept in the field for only one season as opposed to Brazil where on average ratoon crops are harvested for 5 years after the initial harvest.

At a national level, there has been a significant change in the landholding structure in the country. The number of small and marginal farms has witnessed a substantial increase and there has been a substantial decrease in the average farm size. The number of farms in the country has increased by a quarter in the decade between the two agriculture censuses (2000 and 2010) from more than 6.6 million to more than 8.26 million farms while overall farm area increased by only 5 per cent.

In case of sugarcane while the number of farmers cultivating cane has reduced from 1980-2010, average area under cane cultivation has increased. According to the 1980 Agriculture Census, at a national level average cultivated area under cane was 0.58 ha. while in Punjab average area was 0.5 ha. By 1990 number of farmers cultivating cane dropped, area under cane increased to 0.84 ha. nationally and in Punjab it increased to 0.64 ha. The 2010 agriculture census shows that number of farms cultivating sugarcane has not increased substantially from 1990 however, average area under cane cultivation has risen to 1.2 ha. (national) and in Punjab it has risen to a little more than 1 ha.

⁶ Informal modes of support such as kinship and familial relationships remain important for farmers in dealing with downstream processors

A more interesting analysis is related to changes in area devoted by farmers based on size of landholding to sugarcane cultivation. Across landholding classes in Punjab there has been an increase in area devoted to cane. For both medium (5 ha. to under 20 ha.) and large farmers (20 ha. and above) the increase in average area under cane is substantial doubling during the period 1990 to 2010 from 0.88 to 1.90 ha. (medium farmers) and from 3.57 to 7.40 ha. (large farmers).

In the case of small and marginal farmers' (under 0.5 to 5 ha.) both the number of farms cultivating sugarcane and area under cultivation has increased. While such farms represented 67 per cent of farms reporting sugarcane and 44 per cent of the area under cane in 1990 by 2010 they account for almost 82 per cent of the farms reporting sugarcane cultivation and 57 per cent of the area under cane. The increase in number of small and marginal farmers cultivating sugarcane increases the cost of coordination for downstream processors. Large scale sugar mills require a substantial quantity of cane per day, spread evenly during the season to operate profitably.

Growth of Sugar Mills

There were only two sugar mills in the country at the time of independence in 1947. From humble beginnings, milling capacity has increased substantially over the years as new mills have started operations and older mills have increased their crushing capacity. In 2013, the number of mills in the country increased to 86 with 84 in operation during the season with a combined crushing capacity of 7.5 million tons. It is in the 90s that milling capacity increased at the fastest rate and this expansion can be gauged from the fact that installed milling capacity increased from around 1.5 million tons in 1989 to more than 5 million tons by 1999 (Ali and Malik, 2009).

The growth of the sugar industry in the country has been strongly supported by the state through various measures including subsidised credit and tariff barriers. Annual demand remains significantly lower than the installed capacity with consumption of 4.4 million tons. Despite the increase in number of mills, crushing capacity and sugarcane production there have been substantial episodes of sugar shortages in the country and the government has had to periodically import the commodity to keep prices low. The shortage is due to a number of reasons like: periodic shortage of cane available for crushing due to vagaries of weather, lower cane support prices or delayed payments and in some cases due to hoarding of the commodity.

Lodhi (1989) observes that returns to investing in establishing a new sugar mill were quite high and a stable domestic market meant that local capitalists could generate stable rents while undertaking minimum investments under tariff protection. Significant barriers to entry due to the mode of processing, large scale investment and planning controls meant that state patronage could be limited to a few actors.

The decade of the 90s also saw subsidised loans made available to investors from public sector banks and development finance institutions (DFIs)⁷ to procure milling machinery on the condition that machinery available locally could not be imported. Nationalised banks and DFIs were forced to channel credit towards sugar milling (Ali and Malik, 2009; Burki et al.,

⁷ These DFIs were later privatised on the pretext of corruption and increasing number of non-performing loans (NPLs)

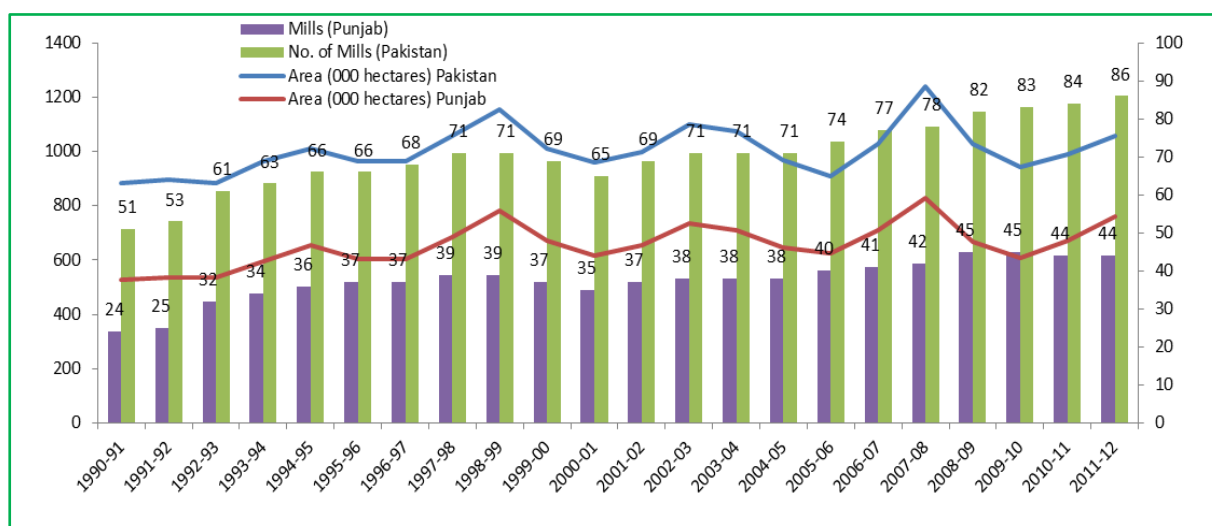
2007; WWF, 2005) and equity requirements for potential investors also remained quite low.⁸ Licenses were issued to new mills with a disregard for the optimal distance between units and led to a situation where areas once supplying cane to one mill now supply sugarcane to three mills.

Expansion in Mills in Punjab

As with sugarcane production, Punjab also accounts for a bulk of the milling capacity in the country. The dominance of the province was further strengthened during the 90s as a bulk of the investment in new mills was earmarked for the province. In 1988-89 there were 21 mills in the province capable of crushing 41,600 tons of cane per day (TCD) however by 2012-13 the number of operating units in the province increased to 44 with a combined crushing capacity in excess of 350,000 TCD.

The figure below shows the variation in area under sugarcane and the number of sugar mills in the country and Punjab:

Figure 5: Area under sugarcane and mills operating in Pakistan and the Punjab



Source: Safdar (Unpublished PhD Thesis, 2015)

While installed capacity has increased substantially, the availability of adequate raw material to run these mills remains limited. This can be corroborated by looking at capacity utilisation figures. Based on an average season length of 150 days, average capacity utilisation in Punjab remains a dismal 55 per cent. There are a number of reasons for this lower capacity utilisation. One of the problems is the low equity threshold which meant that most investors have not been unduly concerned with low capacity utilisation.⁹ Questions have also been raised regarding the veracity of the data collected from individual mills and there have been periodic allegations of mills under-declaring production and generating substantial savings by not paying taxes on production.

⁸ Estimates suggest that rules dictated a minimum equity of 20 per cent

⁹ It is alleged that most of the loans that were given to setup sugar mills in the country, especially in the 90s were written off as non-performing loans (NPLs) by the nationalised banking system

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Within the province there are substantial differences in terms of capacity utilisation between different regions. In Faisalabad and Sargodha Divisions, the traditional sugarcane producing areas, despite increase in number of mills, crushing capacity and cane production, percentage cane utilised by mills remains comparatively lower than in Southern parts of the province. Areas comprising these divisions account for more than 48 per cent of cane produced in areas with sugar mills and 44 per cent of the installed milling capacity in the province, yet they account for only 35 per cent of cane processed by mills.

In South Punjab downstream milling seems to be better integrated and mills in these areas of the province account for 37 per cent of capacity, however during the period 2008-2012 they accounted for 47 per cent of total cane processed by mills. It seems that mills have generally developed a better relationship with farmers in the South of the province as compared to those located in Central and upper Punjab.

Another important reason for this difference could be continued popularity of processing cane into local variants of sugar or *gur* especially in Central Punjab. Processing sugarcane into *gur*¹⁰ has been a popular cottage industry in the subcontinent for centuries. Bosma (2013) observes that *gur* manufacturing has historically fit in well with a period of low activity in India's rural economy between December and March.

Popularity of *gur* has been on the wane due to different reasons including increasing urbanisation and rising incomes which has reduced demand for the product such that it remains limited to rural areas. In South Punjab, the practise of converting sugarcane to *gur* is not as widespread as compared to the upper regions of the province.

Within the province there are also substantial differences in sucrose recovery rates. On average from 2008-2013 while recoveries across the province are lower than other large global producers there remains significant differences between different regions in Punjab. Recoveries of mills in South Punjab are on average 1 per cent higher than mills in other regions. The difference in recoveries means that on average mills in the Southern parts of the province produce more sugar per ton of cane processed.

Despite better recoveries, on average sugar recoveries remain lower even in South Punjab as compared to those in other major sugar producers. One of the major reasons for low recoveries apart from the climate is due to the disjuncture between mills and farmers and a lack of trust between cane producers and processors. There is also a substantial delay between harvest and milling. Debilitated infrastructure in areas where mills are located along with primitive modes of transport mean that there is a substantial lag between harvest and milling leading to lower recoveries. The various modes of transport used by farmers to transport sugarcane to mills in the province is shown below:

¹⁰ *Gur* (jaggery) is an open-pan sugar which is produced by solidifying cane juice after heating in a large open pan. The final product is a hard crystalline with colour ranging from golden yellow to brownish yellow (Baru, 1990) and contains 80 per cent sucrose by weight; small amounts of glucose, fructose and molasses including 6-12 per cent water (Garg, 1979 quoted in Desalanta and Morgan, 1980)

Figure 6: Modes of sugarcane transport in Punjab



Source: Safdar (Unpublished PhD Thesis, 2015)

It is important to note that the payment system does not incentivise farmers cultivating varieties that are high sucrose yielding. Payment to farmers is primarily based on the weight of cane (whatever the sucrose content). On average farmers are paid a certain bonus if the average recovery rate of a mill exceeds 8.5 per cent, however this bonus is paid equally to all farmers regardless of the sucrose content of the cane supplied.

In order to subvert the system, mills use a number of different ways to cut payments if the management considers cane supplied to be of lower quality. The most popular method used is to under weigh the produce there by paying less to the farmer. Other methods include delaying weighing of produce which reduces the moisture in the cane and lowers the weight of cane more than the sucrose content.

The problem of underweighment is pervasive and the state has not been able to devise an alternate institutional mechanism to deal with this issue. A fixed payment system that does not take onboard the quality of cane and price of sugar in the market is seen as being detrimental to the interests of sugar mills. Farmers contend that in many cases the local bureaucracy tasked with protecting their interests does not take note of the exploitation and they are left at the mercy of the mill management.

These issues show that the relationship between mills and farmers is far from cordial especially in central and upper regions of Punjab. Another major bone of contention is the substantial delay in payment to farmers. The law mandates that farmers are paid within 15 days of cane supplying cane, however often delays faced by farmers are much longer than that mandated by law.¹¹ This is especially true in years when there is a good cane harvest and prices of sugar come down.

The delay in payments means that farmers shift away from cultivating cane which leads to a shortage of cane availability after a couple of years. This shortage means that the price of sugar goes up and cane prices rebound as millers are more willing to pay higher prices and the government also raises the minimum support price (MSP). These price incentives work with a lag of a couple of years and sugar production increases. This partially explains the highly cyclical nature of sugarcane cultivation and sugar production in the country.

In essence delayed payments can be seen as a subsidy provided to the sugar mill by farmers. In the absence of institutional safeguards and farmers' cooperatives it is primarily the states' responsibility to ensure timely payments to farmers. This is especially true for the multitude of marginal and small farmers involved in cane cultivation who are often the last ones to be paid even though these farmers face substantial liquidity constraints. However the state and its functionaries seem to be failing in their responsibilities.

The delay in payments is perhaps the single biggest source of antagonism between mills and farmers with significant impact not only on sugarcane but also on investment in subsequent crops. To avoid cash flow problems, some farmers sell their cane to middle men. Middle men usually pay below the minimum price set by the government, however, they pay cash and are therefore preferred by some farmers who are cash strapped as they do not face inordinate delays between supplying cane and receiving payments.

¹¹ There are significant variations with mills in South Punjab on average paying farmers earlier than those located in other regions of the province

Environmental and Institutional Challenges to Sustainability

Having looked at the structure of production and processing, in this section some of the challenges associated with the sugarcane cultivation on a large scale are discussed in greater detail. Some of the most pressing challenges are related to environmental problems. Others are linked to the institutional and technological structures within which production and processing takes place.

Water Scarcity and Sugarcane Cultivation

Pakistan has been identified as one of the most highly water stressed countries in the world. The per capita availability of water has reduced from 5140 m³ in 1950 to 1000 m³ in 2014 (Hussein and Mumtaz, 2014). The World Resource Institute (WRI) identifies the country as an extremely high stress country. Agriculture is the single largest consumer of fresh water resources in the country. The World Bank's World Development Indicators (WDI) shows that agriculture on average accounts for 94 per cent of the total fresh water withdrawal in the country.

Sugarcane is one of the most water intensive crops in the world and requires substantial quantity of water to grow. Pakistan is the most water-stressed country among the major sugar producers in the world and estimates show that sugarcane accounts for 9 per cent of total fresh water use in the country (WWF, 2005). The high-delta nature of sugarcane means that it is cultivated entirely under irrigated conditions in the country and Punjab with the largest area under cane cultivation is susceptible to the impact of increased water scarcity in cane growing areas. This is especially true in South Punjab, where there is lower rain fall and sugarcane cultivation is more dependent on irrigation.

Punjab has one of the largest contiguous canal systems in the world. However, increasing crop production and years of under investment in the operations and maintenance of the canal system means that it can barely cope with the increasing requirements. The problems are further exacerbated because of a pricing mechanism that does not adequately cater for the price of the most important commodity – water – and can be seen as an implicit subsidy. Constraints in canal water supply have led to the increased exploitation of ground-water resources by farmers throughout the province. Sugarcane cultivators across the province depend on both canals and groundwater resources in order to cultivate the crop. The exploitation of ground water resources in turn means that water tables are falling which not only means increased investment in digging deeper to access the water but also means that the sustainability of sugarcane cultivation is questionable.

There have been limited moves towards improving efficiency of water use in the province. The lack of vertical integration means that mills are unwilling to invest in projects to improve water conservation and use efficiency. In areas where yields are higher, sucrose recovery is greater, and the relationship between farmers and mills better, there are limited moves from mills to invest in water conservation initiatives either as a corporate social responsibility (CSR) initiative or in conjunction with the government as a public-private partnership project.

Yet initiatives undertaken by the state are over ambitious in their scope and often suffer from serious implementation failures. These failures are due to a combination of elite capture and chronic human capital constraints not in terms of numbers but in terms of capabilities. The failure of public and private interests means that there is substantial wastage of this most precious resource as farmers generally continue to use archaic irrigation techniques such as flood irrigation.

Institutional Challenges

As highlighted in the previous section there remains a substantial problem of lack of coordination between mills and farmers. These problems are exacerbated by a state apparatus that does not appear to have the capability to mediate between their often divergent interests. In this scenario where there is a contestation for state largesse and support, the government ends up subsidizing both sugarcane farmers and mills. For farmers, instead of direct subsidisation, this support is in the form of higher support prices which are announced prior to the start of the crushing season.

For mills that are much better organised and politically more powerful there have been multiple avenues to maintain rent seeking from the state. In years of excess production, these rents are in the form of inland-freight subsidies to export sugar as most mills cannot sell at the prevalent international market rate because of low recovery rates and higher cost of production. Other incentives include substantial exemption on Federal Excise Duty (FED) on quantity equivalent to that exported.

In years of low production, millers can take advantage of the high market prices till the government intervenes and brings prices down through imports. It is interesting to note that despite not being essential for human survival, the FED rate on sugar is only 8 per cent compared to the 17 per cent charged on many other food items. As mentioned giving licenses to install sugar mills emerged as a key area of patronage in the 90s. This can be evidenced by the large number of mills controlled by families, individuals and companies with political affiliations. In Punjab, leaders of all three political parties i.e. the ruling Pakistan Muslim League (N), the Pakistan People's Party and the Pakistan Tehreek-e-Insaf have shares in sugar mills.

The political nature of sugar means that it is extremely difficult to bring in institutional changes. The Sugar Factories Control Act and Rules were initially approved in 1950 and while some amendments have been introduced to the Act and its Rules, they are quite outdated. The second institutional bottleneck is with respect to the non-applicability of existing laws governing relations between mills and farmers as discussed in earlier sections. Lack of changes in the payment system from weight to other mechanisms is also an example of the institutional challenges. While the systems of sugarcane payment have changed significantly in other major sugarcane producing countries, it has yet to be reformed in Punjab.

The lack of institutional changes means that the relationship between mills and farmers will remain strained. Both farmers but mostly the industry will continue to seek rents from the state while a majority of the mills continue to remain uncompetitive and produce high priced sugar that cannot compete in the global market. Coordination issues facing mills are likely to increase as there is further sub-division of lands through the laws of inheritance. This means that the cost of coordination is also likely to increase. In order to deal with these issues, there has to be a rethink of the relationship between mills and farmers.

For its part the state has to focus on mechanisms to promote horizontal coordination among farmers through mechanisms like cooperatives. However the public sector does not seem to have the capability to engage with the rural economy and develop such institutional mechanisms.

Conclusion

Pakistan is one of the major sugarcane producers in the world, however little is known about the structure of sugarcane production and processing in the country. This paper highlights the dominance of Punjab in the country's sugarcane economy. There has been a substantial increase in sugarcane cultivation over time however despite being one of the major sugarcane producers yields remain substantially lower as compared to those in other major sugarcane producers. In Punjab, yields remained largely stagnant from 1947-1999, however there has been some improvement since then with substantial within province variation in productivity. Sugarcane yields are higher in South Punjab as compared to those in other major cane growing areas.

There is limited vertical integration and sugarcane is cultivated by almost a large number of farmers. The number of farmers cultivating sugarcane has remained stable over time, although the area devoted to cane by individual farmers in all categories has witnessed a substantial increase. This is especially true in case of marginal and small farmers (0.5 ha. to 5 ha.). This has contributed to increase in the cost of coordination.

As with the area under cane, there has been a substantial increase in the number of sugar mills in the country and province. Punjab has been at the forefront of this expansion and from 1990-91 to 2011-12, the number of mills almost doubled from 24 to 44. The result of this expansion is that installed capacity is much higher than domestic sugar demand. Area under cane and average yield has not increased in a commensurate way leading to low capacity utilisation. As with yields there are substantial differences within the province.

Even though the number of mills is greater in Central and Northwest Punjab, cane utilisation by mills is much higher in South Punjab. Similarly in terms of sucrose recovery there are substantial differences in performance with mills in the South outperforming those in Central Punjab. Despite this difference, on average recovery rates remain lower than those in other large sugarcane producers.

There are various reasons for low recovery rates including a disjuncture between the incentives of mills and farmers. The payment mechanism does not incentivise cultivation of high sucrose varieties with farmers paid primarily on basis of weight rather than the sucrose content of cane. Farmers also have to face significant delays in getting payments for cane supplied especially in seasons of ample cane supply. This leads to increased antagonism between mills and farmers. In such times middle men are preferred as a channel to market cane as they do not delay payments. Middle men are a source of liquidity especially for marginal and small farmers who are cash strapped.

Finally, there are substantial environmental and institutional challenges to the sustainability of sugarcane cultivation in Pakistan and the Punjab in particular. One of the greatest environmental challenges is related to the exploitation of water resources for cane cultivation. There are limited moves by mills to work towards improving water use efficiency or to work with the government to this end. In the public sector, there are a number of initiatives to improve efficiency however these projects are broad in their scope and suffer from a number of impediments.

On the institutional side the lack of coordination between mills and farmers is a serious challenge, especially as the number of small and marginal farmers continues to increase. Laws and regulations have not kept pace with the increase in sugarcane production and processing capacity. Mills view the state primarily as a means of rent generation through

subsidies and reduced taxation. The management of many of the mills is controlled by senior leaders of political parties across the spectrum and makes rent generation easier. For the government an important challenge is to promote horizontal coordination at the farmer level and improve sustainability and bargaining capacity of farmers vis-à-vis mills. Evidence however suggests that the state has neither the capability nor the political will to undertake such initiatives.

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