

Technical and Scale Efficiency Analysis of Cash Crops Production in Pakistan: An Application of Data Envelopment Analysis (DEA)

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Abstract: The study has analyzed the technical efficiency of major cash crops' yield in Pakistan from 1948 till 2018. Cotton and sugarcane are the crops selected for analysis with an area of thousand hectares. For carrying out the analysis, data is taken from the Ministry of Food and Agriculture (MINFA), Pakistan Bureau of Statistics, and economic surveys of Pakistan of different years. The technique employed in the study is the non-parametric Data Envelopment Analysis (DEA) technique. The result obtained after technical efficiency analysis reveal the suboptimal cash crop yield in Pakistan throughout the analysis. The average technical efficiency of cotton and sugarcane crops from 1948 to 2018 are approximately 0.80 and 0.84 respectively. Furthermore, the result of scale efficiency analysis showed the monotonous performance of cash crops' production. The consistent variation in cotton and sugar cane crops' yield over the years reported by the efficiency analysis, accounts for Constant Return to Scale (CRS) and Variable Return to Scale (VRS) models, resulted in varying Return to Scale (RTS). The plausible reasons can be attributed to the Increasing Returns to Scale (IRS) or Decreasing Returns to Scale (DRS) in the case of cotton and sugarcane production. An interesting finding is unveiled that out of 70 years, cotton and sugarcane crops achieved the optimal scale efficiencies for only one year. The best possible level of output of cotton and sugarcane crops in the future can be achieved by allocating a lesser area under the cultivation of these crops in Pakistan. It is also imperative that farmers adopt and implement modern farm technologies. Increasing the area under crop production is not a solution, especially in the wake of alarming population growth and urbanization in Pakistan. The formulation of policies encouraging farmers requires modern farm inputs to realize the optimal yield of cash crops in Pakistan. The government should educate the farmers regarding advanced farming and efficient farm management techniques to help to augment the farm output without expansion of the area for these crops.

Key-Words: Cash Crops, DEA, Sugarcane, Cotton, Technical Efficiency, Pakistan.

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1. Introduction

The vast array of literature in the field of Economics has greatly emphasized the universal reality of the paucity of resources in the face of endless needs and wants. In light of this problem, rationality requires the efficient use of limited resources at hand. The efficiency principle calls for inputs to be used in a way to obtain maximum output either through the number of inputs remaining constant while having a greater quantity of output or the same amount of output obtained with a decreased quantity of inputs. The present study focuses on technical efficiency in the production of cash crops throughout the history of Pakistan. Since its inception, the agricultural sector has remained the major contributor to GDP. Initially, the focus of agricultural production had been the survival of the population of the newly formed state and for this matter, only traditional farming techniques were put to use. With time advancements in the agricultural sector kept taking place. From 1965 onwards, the 'Green Revolution' brought remarkable biological and mechanical developments leading to higher agricultural yields while decreasing trends in the later decades due to farm maladministration and farmers' limited knowledge regarding the efficient utilization of modern farm technologies.

This study focuses on the analysis of the technical efficiency of two of the cash crops of Pakistan. Cash crops are crops grown for economic benefits rather than merely fulfilling the needs of people. Cotton is one of the major crops of Pakistan and currently contributes around 1% in total GDP [1]). It had remained high in demand for all the years however, seldom met the expected rate of growth. The present statistics reveal that cotton production became negative for years

2015-16 after 2000-01 and as a result, value-added products faced negative growth as well. For an agricultural economy like Pakistan, the yield of cotton is lower in comparison to other developing nations, such as India and China let alone developed economies.

In the case of sugarcane crop Pakistan ranks 4th in area, 14th in production, and 60th in yield, in the world. While Pakistan is the world's 4th largest cultivator of sugarcane, it has perhaps the lowest yield of this crop in the world [2]). The present tragic sugar price scenario in the country has affected the common man accompanied by the pressure on the Government to make amendments for managing and improving the sugarcane industry and the prices [3]). The adoption of good management policy is the dire requirement of time in the wake of structural shifts and exogenous rise in the demand for sugar and sugar products in Pakistan [4].

Sugarcane crops experienced a growth rate of 4.22 percent in 2015-16 compared to the years 2014-15 [5]. Cash crops showed positive growth in the year 2016-17 however, cotton performed lower than expected with a decreased output and area because of low prices disheartening farmers away from cotton production [1]. [6] examined the land used policy under cash crops in Pakistan from the year 1961-2014. The result of the study highlighted that production of cash crops has increased over the years. But this increase in production is due to intensified use of fertilizer, improved seed varieties, mechanical inputs, and increased acreage under cash crops over time in Pakistan. Although the efficiency in the application of farm inputs was decreased over the years, especially the efficient utilization of land. It is noted that over the years, an area under cash and cereal crops

has been declined due to industrialization and urbanization. Hence, sustainable use of accessible land is direly needed, in order to fulfill the consumers' demand for cash and cereal crops in Pakistan.

This study opts for the Data Envelopment technique to compute the technical efficiency of cotton and sugarcane crop production in Pakistan. Technical efficiency analysis of most of the earlier studies in the case of cash crops is based on cross-sectional data. Earlier studies in most cases were focused on district or province wise analysis at the micro-level. The present study used the time series analysis and estimated the technical efficiency and performance of cash crops in Pakistan from 1948 to 2018 at the macro level. The major objective of this study is to evaluate the technical efficiency of cotton and sugarcane growers in the context of land utilization, which is one of the most important and scarce resources. DEA is a non-parametric technique, is less affected by outliers, compared to the parametric techniques such as Stochastic Frontier Analysis (SFA). It also holds the assumption of homogenous and heterogeneous variance. In the light of earlier literature, it is established that the DEA provides better results under conditions where the empirical model contains single output and input. Hence, this study has used the DAE technique, to estimate the technical efficiency of cash crops in Pakistan.

Numerous studies have estimated the productivity and efficiency analysis in Pakistan and around the world by using the one point in time data, e.g. surveys or cross-sectional data. Few studies [7] [6], [9], [10], [11] and [12] have estimated the technical efficiency of cash crops in Pakistan over the years by using the survey data. The current study is about time-series data of cash crops of Pakistan. Earlier studies have not analyzed the technical efficiency analysis of

cash crops in Pakistan from 1948 to 2018. This study is a well-meaning addition concerning the several ups and downs in cash crop production in the context of land utilization in Pakistan over the years. This is the brigadier research gap that would filled by this study. The major limitation of this study is that data regarding inputs such as fertilizer consumption, pesticide use, mechanization, and technology transfer were not available as per cash crop and year wise. Hence, this study analyzed the technical efficiency of cash crops by using the data of land under.

2. Materials and Methods

The primary objective of this study is to transmit the per hectare technical efficiency analysis of key cash crops in Pakistan since independence till 2018. Data for the present study have been collected from the Ministry of Food and Agriculture (MINFA) and economic surveys of Pakistan for various years. The input-oriented variable returns to scale DEA model is used to calculate the technical efficiency (TE) scores. Two Selected crops have a major share in the agriculture sector as well as in exports of Pakistan. The economy of Pakistan highly depended on cotton and sugarcane crops. Any crumple in the production of any of these crops can aid in drastic impacts on the economy.

This study separately estimated the technical efficiency of cotton and sugarcane crop by taking one input, which is land. Therefore, DEA is one of the most desirable estimation techniques under the scenario of the existing study. It is a non-parametric technique, it did not require any functional form and complexities required in parametric techniques e.g. SFA. Hence, through observing the existing data at hand and objectives of the study, opting DEA method for the estimation of cash crops technical efficiency is desirable and applicable.

Charnes, Cooper, and Rhodes (CCR) pioneered Data Envelopment Analysis

(DEA) in 1978. This method holds the assumption of zero sampling and measurement error and deviations. DEA is one of the non-parametric approaches, first given by [13] that used input and output space to form an isoquant within the production possibility set. Convex efficient and inefficient units are compared to figure out the level of inefficiency. This technique had also been applied by [14] to the multiple input and output situations. In yearly DEA estimations, the area under cotton crop is used as the input and cotton production as output. In the case of sugarcane crop, again area under sugarcane crop is used as input, and production of sugarcane crop is used as output in this study.

For the current research, the DEA model with input-oriented variable returns to scale is employed for technical efficiency estimation, the following specification is given by [15]. The purpose of estimating each year's relative efficiency is served by determining input and output ratio, given below:

Min θ, λ θ ,
 Subject to

$$\begin{aligned} -y_i + Y\lambda &\geq 0 \\ x_i - X\lambda &\geq 0 \\ N1/\lambda &= 1 \\ \lambda &\geq 0 \end{aligned}$$

$N1/\lambda = 1$ depicts a convexity constraint ensuring that against farms of equal size, a year of inefficient crop yield is benchmarked only. For crop yield of N years, Y is the output matrix. For an i^{th} year, total technical efficiency is depicted by θ . λ is a vector of $N \times 1$ constants. For crop yield of N years, X is a matrix of inputs.

For illustrating the absence of scale effects in the variable return to scale, terminology of pure technical efficiency is used in Data Envelopment Analysis (DEA). Scale efficiency is calculated by getting the technical efficiency scores of Constant

Return to Scale (CRS) and Variable Returns to Scale (VRS), hence, it is the ratio of CRS and VRS. The firm will be scale efficient when both the scores (CRS and VRS) are the same. The relationship given by [15] is given as

$$\text{Scale Efficiency (SE)} = \text{CRSTE} / \text{VRSTE}$$

Increasing and decreasing returns to scale can result in scale inefficiency. For i^{th} year, the relation can determine by scale efficiency. Where, $SE = 1(\text{CRSTE} = \text{VRSTE})$ depicts scale efficiency and $SE < 1$ indicates scale inefficiency. The DEA operates in an interesting fashion. The most crucial feature it possesses is the ability to find out if a Decision-Making Units (DMU) is operating in the area of CRS, IRS, or DRS. A DMU displaying CRS possesses the most productive scale size. DMU exhibits DRS when a percentage increase in inputs produces a less than one percent increase in outputs. The DMUs experiencing DRS are above the optimal scale of operation. Furthermore, a DMU exhibits IRS when a percentage increase in inputs produces a more than one percent increase in yield.

3. Result and Discussion

3.1 Cotton Crop (1948-2018) Table.1 reports the Constant Returns to Scale Technical Efficiency (CRTSTE), Variable Returns to Scale, and scale efficiency (SE), next to the panorama of return to scale (RTS). The table.1 reports that out of yields of 70 years, only one-year (2008) gave efficient cotton production under constant returns to scale with a technical efficiency score equal to 1. Under variable returns to scale, cotton production has been technically efficient for the years 1950, 1954, and 1992. The efficient year under CRS defines the efficient frontier of cotton production from the year 1948-2018 and thus form the reference set for inefficient cotton crop

production years. The 70 years' cotton crop production can be determined as the radial distance from the production frontier.

It is important to note that the process of land utilization in the above-mentioned cotton production frontier is not functioning quite well and resources are being wasted. Due to inadequate farm management practices and lack of education, farmers are not being able to employed land resources in a way it has to have functioned. Moreover, most of the farmers are tenants who have lower technical skills considering progressive farming and also have financial constraints. Consequently, land utilization has been compromised because of improper and quality compromised application of inputs (seeds, pesticides, fertilizers, labor, etc.) which has a lesser impact on the production efficiency of the cotton crop and productive use of land resources.

Following best land utilization practices and adoption of most suitable input-output combinations could culminate in movement on the frontier in the past years.

Table .1 demonstrates the frequency distribution of CRSTE, VRTSE, and SE scores in cotton production, which ranges from 0.37, 0.52, and 0.55 to 1, respectively. The minimum technical efficiency score of 0.37 and a maximum score of 1 under CRSTE are obtained for years 1984 and 1992, respectively. Moreover, the average efficiency scores in CRSTE, VRTSE, and SE are 0.67, 0.80, and 0.82 and standard deviations (SD) are 0.12, 0.09, and 0.11, respectively.

Frequency Distribution	CRS (Fq)	VRS (Fq)	Scale (Fq)
0.01-0.20	0	0	0
0.21-0.40	1	0	0
0.41-0.60	18	2	2
0.61-0.80	39	26	29

0.81-0.90	9	32	11
>0.901	4	12	29
Mean	0.67	0.80	0.82
Minimum	0.37	0.52	0.55
Maximum	1	1	1

The minimum level of technical efficiency under VRSTE was obtained for the year 1984 and the maximum score was achieved during the years 1949, 1950, 1954, and 1992. The average level of technical efficiency under VRSTE in cotton production is approximately 81 percent. So, overall technical inefficiency from 1948 to 2018 is found 19 percent in the case of cotton production in Pakistan. Thus, we may conclude that the same level of cotton yield could be produced with 81 percent lesser use of the area under cotton production.

As mentioned earlier, the SE score for each year's cotton crop can be obtained by taking a ratio of CRSTE and VRSTE scores. The value of scale efficiency equals unity when the cotton crop is operating at the most productive scale, which is equivalent to constant returns to scale. Likewise, a value of scale efficiency less than one suggests that cotton crop production is practiced with technical inefficiency, as it is not operating at its optimal scale size. Table 1 holistically show the mean scale efficiency of cotton crop production for the years 1948 to 2018, to be 0.83 with a standard deviation of 0.11. Scale efficiency scores range from a minimum of 0.55 to a maximum of 1. This result demonstrates that scale inefficiency is about 17 percent in cotton crops. Cotton crop attained a scale efficiency score equal to 1 in the only year 1992. So, in the case of the cotton crop from 1948 to 2018, Pakistan did not operate at the most productive scale size. In the remaining years' cotton crop was operating with some degree of scale inefficiency with either Decreasing Returns to Scale (DRS) or Increasing Returns to

Scale (IRS). In the majority of the years' cotton crop was operating with SE above 70 percent.

According to [16] over the last 20 years in Turkey, cotton production has been seen to decline gradually. Farmers of the study area were more inclined to cultivate the other crops compared to cotton. The study concluded that generally, four major benchmarks played a substantial impact on shaping the decision regarding any product design (in current state cotton crop), these criteria are economic, socio-cultural, technical, and environmental. Farmers' rational targets regarding crop selection, the land area specified to selected crop, an adaptation of latest farm technology by considering the soil conditions (e.g. fertility, soil erosion, biodiversity, and water requirement, etc.), production cost, and institutional support towards that selected crop, might be enormously valuable and lucrative.

[17] estimated the technical efficiency of wheat crop by using DEA. The result of the study shows the negative association between farm size and technical efficiency. Earlier studies of [18] [19] [20] estimated the technical efficiency of cotton crop in southern Punjab by using DEA. [21] estimated the comparative efficiency analysis of BT and Non-BT cotton crops in Pakistan. The result of this study found that farmers of study areas were not being able to capitalize on the maximum advantage of BT and Non-BT cotton varieties. It is needed that farmers should have the technical acquaintance regarding the treatment of new cotton seed varieties. Mismanagement of such new varieties would have an adverse consequence on cotton production, alternatively on farm returns. [9] analyzed that typically BT-cotton seed requisite more time for evolvment as compared to non-BT cotton. Hence, this extended time effect on appropriate sowing timings of the next crop,

more supposedly wheat crop, in the cotton-wheat cropping system in Pakistan. The delayed sowing affects the efficiency and productivity of wheat crop in the selected study area.

This study categorized the farm size into three. Category one consists of those farms that have farm size around 1 to 3 acres, referred as small farms. Category two includes farms having size 4 to 6 acres, denoted as a medium farm. The last category consists of those farms that have size above 6 acres, referred as large farms. The result of the study stated that small farms are more efficient compared to medium and large farms. In developing countries, though the crop productivity is different from each other, in most cases, per acre yield of small farms is higher than the medium and large farms. The major reasons behind this variability are soil quality, technology availability and its adoption characteristics, market access, water quality, and availability, and other commercial farm inputs. According to [22] the crop yield in developing countries is higher in small farms compared to large ones. Hence, by increasing the farm size, farmers might be able to increase crop production to some extent; however, one plausible explanation for opting for this practice is that farmers are not utilizing the true potential of their farmland and resources. Farmers should be rational enough in applying the progressive farm techniques to attain higher farm production on existing farmland. Overutilization of farm's scarce resources i.e. land is only a temporary solution. Therefore, it is essential to implement farming methods that lead to sustainable farm practices and production.

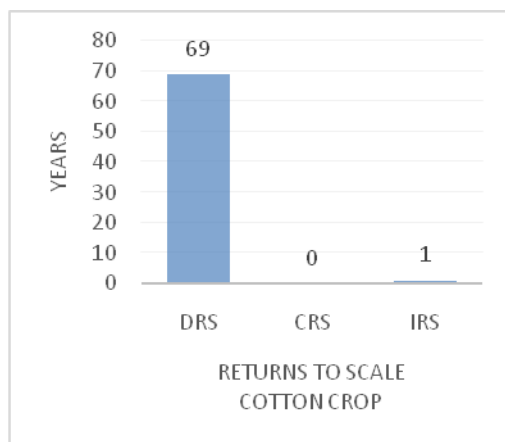


Figure 1. RTS (Cotton)

Figure.1 provides the Returns to Scale (RTS) of each year's cotton production. It demonstrates that for 70 years' cotton crop has been operating at suboptimal or below its optimal scale. Consequently, results display that cotton crop production has exhibited IRS during the period of analysis. Further, only 1-year cotton crop experienced CRS in production. If the cotton crop's VRS technical efficiency is lesser than scale efficiency, then that part of overall inefficiency is due to the yield below the production frontier. By changing the operational scale of cotton farms, cotton growers can increase the cotton yield and scale efficiency as well. Hence, it is indispensable to plan more ways to get better cotton production through the best methods and cultural practices in Pakistan.

The cotton crop had always remained significant in contributing to the GDP of Pakistan. The output from the fields of cotton provided raw materials to the budding-manufacturing sector of Pakistan, resulting in increased demand for cotton, leading to an increased amount of land used for the cultivation of cotton production. Keeping in mind the population growth rate, no significant increase in allocation of the area is observed as shown in Figure. 2 rising trend is clearly not visible for the current data set. For all the decades considered for this study, minimal change in the production

of cotton is viewed with output remaining quite low. The reason for low production in 2015-16 can be attributed to heavy rainfall. Unfortunately, cotton production has faced setbacks in the form of rainfall, pests attack, and low prices discouraging farmers; consequently, the need of the industries remained unfulfilled and the number of raw cotton imports kept increasing [5]. The year 2014-15 experienced recoveries in terms of increased production from the past few years however, after 2015 cotton yield has again witnessed negative growth, performing well-below expected growth rate [1].

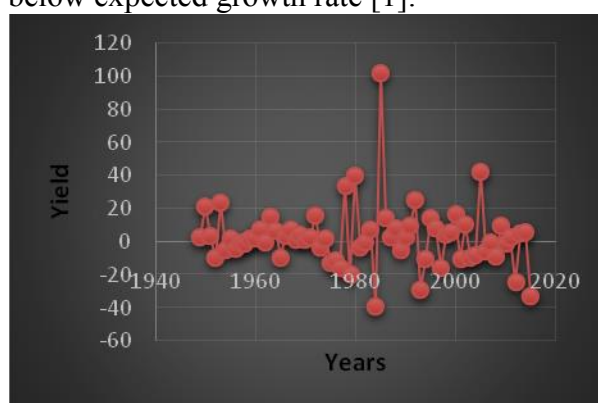


Figure 2 Cotton Yield (Kg/Ha) % Change

The area for cotton production in Pakistan started off with low value. In the 1950s the trend of exporting raw cotton was replaced by exporting cotton textiles, as the outcome of a structural shift of the economy, thereby increasing demand for cotton [23]. The area for cotton cultivation has faced up and down movements throughout history. Positive change is seen during the time period of the Green Revolution as depicted in Fig.3. 2003-04 experienced an upward trend in terms of both yield and area, recovering from the decreasing growth from 2000-03.

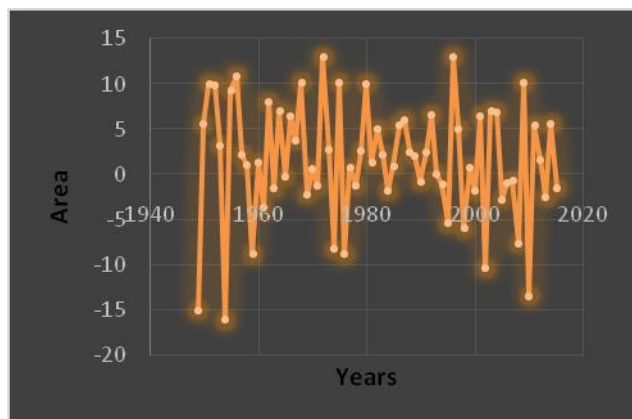


Figure 3 Cotton Area (000 ha) % Change

Again, 2006-07 witnessed a considerable decline in the area for cotton growth, and the reason behind the decreasing trend is flooding in Sind and delay in the harvesting of wheat [25]. Even till 2017, a satisfactory increase in area is not observed with a considerably high decline in the area for 2016-17[1].

3.2 Sugarcane Crop (1948-2018)

Table.2 reports the CRSTE, VRSTE, and scale efficiency. The empirical results attained from the DEA model demonstrate that under CRSTE during only 1949, sugarcane production is overall technically efficient with a score equal to 1.

Under variable returns to scale, the sugarcane production has been technically efficient for the years 1949, 1950, 1951, 2011, and 2014. The sole efficient year in sugarcane production under CRSTE identifies the efficient frontier of sugarcane production for the period of analysis that is the year 1948 and 2018. Hence, it forms the reference for the inefficient sugarcane production years. The remaining years' sugarcane production can be measured as the radial distance from the production frontier.

Table 2. Technical Efficiency Frequency Distribution of Sugarcane Crop

Frequency Distribution	CRS (Fq)	VRS (Fq)	Scale (Fq)
0.01-0.20	0	0	0

0.21-0.40	52	0	41
0.41-0.60	9	0	17
0.61-0.80	3	33	6
0.81-0.90	4	23	5
>0.901	2	15	2
Mean	0.38	0.84	0.44
Minimum	0.21	0.66	0.2.5
Maximum	1	1	1

The results of frequency distribution analysis reveal that CRSTE, VRSTE, and SE scores in sugarcane production range between 0.21 and 1, 0.66 and 1, and 0.25 and 1, respectively. The minimum technical efficiency score under CRSTE is found for the year 1983. The average technical efficiencies under CRSTE, VRSTE, and SE are 0.38, 0.84, and 0.44, and associated standard deviations are 0.17, 0.09, and 0.18, respectively. The minimum technical efficiency score under VRSTE is found for years 1975, 1983, and 1985. The maximum score under VRSTE is found for years 1949, 1950, 1951, 2011, and 2014. The study also points out that for the greater part of sugarcane production years, the scores under VRSTE range between 0.71 and 1, but still far behind utilizing the area under sugarcane crop in an efficient manner.

Increasing the farm size to attain higher sugarcane production is not a sustainable solution. Despondently, this practice is rather common in the farm sector of Pakistan. Sugarcane is one of the most important cash crops in Pakistan, but its yield per hectare is around 50 tons, which is relatively lower than the competitive sugarcane growing countries around the world (Tahir et al. 2014). According to [24], farmers in Pakistan barely practice contemporary farm technologies. On the other hand, mismanagement in the

application of farm inputs resulted in lower yield and higher cost of production.

Another significant demonstration of the results shows about 75% of scale inefficiency is present in sugarcane production. Cotton crop attained maximum scale efficiency score for just a year. Hence, Sugarcane production in Pakistan during the period of analysis did not operate at the most productive scale.

Figure 4 shows the scale efficiency sugarcane crop production in terms of farm size utilization. The result of the study reports that for the period of the 70 years, the sugarcane crop operated with some degree of scale inefficiency. For about 65 years' sugarcane crops faced the decreasing returns to scale (DRS) and for about 3 years faced increasing returns to scale (IRS) in production. Only in two years, which is 2015 and 2017 the sugarcane crop faced the constant returns to scale (CRS). The results suggest that for the majority of the analysis period, the scale efficiency is found to be lower than that of VRS technical efficiency. Hence, the fraction of overall inefficiency can be attributed more to sugarcane production at an inefficient scale.

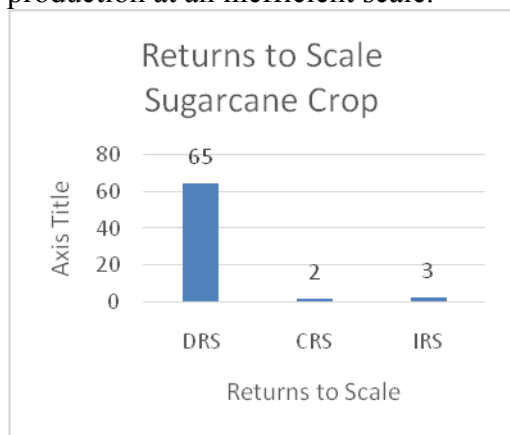


Figure 4 RTS Sugarcane Crop

The population of Pakistan is around 208 million in year 2017-18. Due to the increase in population, water shortage land fragmentation has also increased, with lesser land and water available for current and

future populations. To accommodate the citizens of Pakistan and accomplish Pakistan's vision 2025, it is a prerequisite to practice scarce farm resources most sustainably and efficiently. Utilitarian resource mix along with efficient farm management practices must be considered to attain the best possible cash crop production in Pakistan. According to [18] Pakistan is far behind the developed world in terms of research and development and in embracing the new farm technologies and methods. [25] estimated the profit efficiency of sugarcane crop in KPK. The result of the study reported that profit efficiency less than the potential level. The farmer can increase their profitability through improved output which is possible by augmented the technical efficiency of sugarcane farmers. [24] analyzed that a rise in prices of farm inputs used for sugarcane crop production one hand and continuous drop in sugarcane output on the other hand are the significant factors that disturb the production of sugarcane crops in Pakistan. The other factors such as lesser farm knowledge, skill, and delayed payments from sugar mill to farmers have also influenced sugarcane productivity. [26] estimated the profit efficiency of sugarcane crop and found that in the study area, farmers were not able to maximize the profit margins of sugarcane crop due to lower level of profit efficiency. [27] study pointed out that the efficiency of sugarcane crop production in Pakistan can be increased through refined farmers' formal and informal education, skills, experience, and availability of extension services to the farmers.

Hence, improvement in farm technical efficiency through development in farm management techniques might be one option that needs to be considered to reduce the wastage of farm resources and the cost of production.

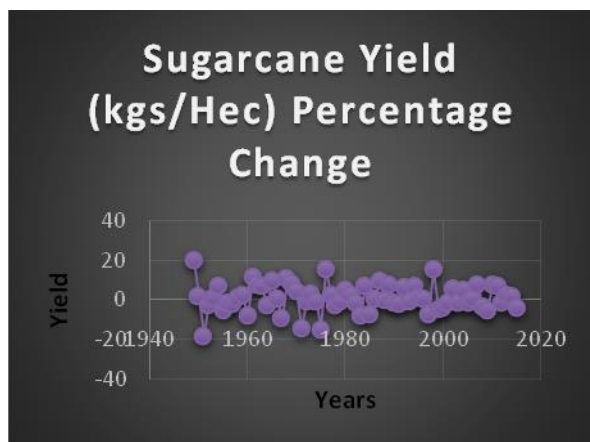


Figure 5 Sugarcane Yield (Kgs/ha) % Change

Figure 5 shows the yields of sugarcane have faced upward and downward movements throughout the history of Pakistan. Although, the newly born country inherited one of the world's best irrigation systems that still serves as one of the major contributors in enhancing agricultural production, nevertheless not fully realizing the potential.

The new state started off well as far as the sugarcane production was concerned. However, the production of sugar cane experienced haphazard movements comprised of considerable increase and decrease. In the beginning, the agricultural sector employed 68% of the working force and it declined with the flourishing manufacturing sector leading to the creation of new job opportunities [23]. In the early 1950s, Pakistan experienced structural change for the reason of the flourishing manufacturing sector during that time period. The 1960s have experienced a remarkable enhancement in sugarcane production, accredited to the 'Green Revolution.' Rapid growth slowed down in the 1970s because of the war situation faced by the country. It took years for the economy to recover and stabilize. Agricultural production stagnated for most of the decades, shown in Fig. 5. The year 2006-07 brought a considerably high amount of production of sugarcane after few

years of low yield [28], and significantly high production for 2016-17 comparative to 2012-15 [1].

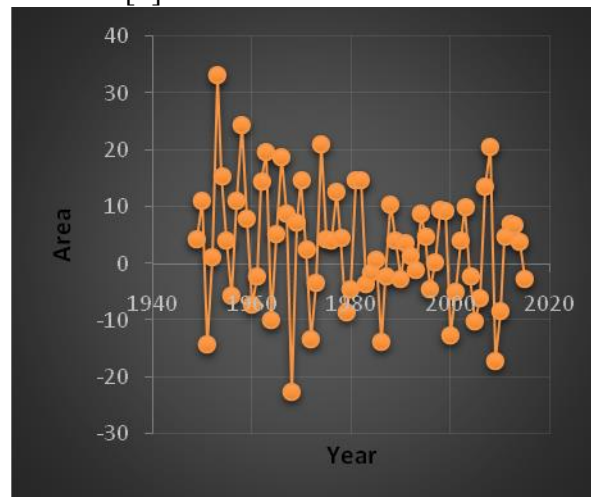


Figure 6 Sugarcane Area (000 ha) % Change

The area under cultivation of sugarcane had been following irregular trends, as depicted by Fig. 6 a shift in the structural setup of the economy required more land to be devoted to the cultivation of sugarcane. Growth in population and enhanced role of manufacturing sector in contributing to GDP increased the demand for value added products of sugarcane. The area under cultivation for sugarcane had been declining over time with few expectations. The decrease in the area can be attributed to the fact of payment struggles. Essentially, from the last decade, sugarcane farmers of Pakistan are not being able to receive the equitable amount of payments from the sugar mill industries, where farmers sell their farm produce leading to its area been given to competitive crops. Especially in the case of small farmers, satisfying loan conditions is a challenge. Even a minor catastrophe like lesser rainfall greatly diminishes the ability of small farmers to pay back (Economic Survey of Pakistan, 2015-16). However, 2016-17 brought a positive development of increased percentage change in an area used for sugarcane growth [5].

4. Conclusion

There is an extensive potential in Pakistan for increasing per hectare yield of cotton and sugarcane through improved management practices. Farmers in the country are not well aware of using the optimum level of inputs and resources. The use of required levels of inputs and other improved farm practices can increase the yield of cotton and sugarcane up to the preferred levels.

The result of the study divulges that the performance of cash crops from 1948-2018 has not been up to the mark. Pakistan has been technically inefficient in cotton and sugarcane production for most of the years of analysis. The mean technical efficiency in a cotton crop is about 80 percent. It shows we are using almost 20 percent additional area under cotton crop. In the case of sugarcane crops, the mean efficiency is about 0.84. This result reveals extra usage of the area under sugarcane crop of about 16 percent. Out of 70 years, only a single year (2008) cotton production is overall technical efficient with a technical efficiency score equal to 1. The remaining 69 years' cotton production can be determined as the radial distance from the production frontier. Moreover, in case of sugarcane crops, only for two years (1958 and 1960) sugarcane production is overall technical efficient with a score equal to 1. The remaining 68 years' sugarcane production can be measured as the radial distance from the production frontier.

Technological progress in any society is greatly dependent upon the existing stock of knowledge in the economy and research and development. However, elevation in the yield per hectare by adopting modern production techniques is only possible by making constant efforts in the field of research and development in the country. Moreover, cotton and sugarcane crops face competition from food and other crops. Consequently, boosting up cotton and

sugarcane production by increasing area will not be feasible in future. Therefore, we must cope with this problem by increasing productivity per hectare. It can be possible through the adoption of modern production techniques. The government should endow common farmers with important knowledge and skills about crop requirements. The yearly crests and troughs in per hectare yield can be allayed by timely and meaningful productive measures of the government.

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