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Cotton Crop Performance and its Implications for Farmers in India

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Abstract:

Farmer suicides have always been an issue of major contention amongst the political and academic circles of our country. This is especially so for the case of cotton farmers. This study looks to establish a relationship between prices given to cotton farmers and rising farmer suicides. We mainly use the data starting from cropping year 1990-91 to cropping year 2015-16. This data has been for the most part collected from the databases of Cotton Corporation of India (CCI) as well as the annual reports on Suicides and Accidental Deaths released by National Crime Records Bureau. We try to take into account all such factors that can be controlled, either through policy or by direct intervention of farmers themselves.

The results show that though there exists a certain relationship between cotton prices and farmer suicides they are not entirely caused by the prices. This is only one possible explanation for the farmer suicides. The results also reveal that in recent years i.e. from the years 2010 onwards we have been seeing a steady decline in overall suicide rates among the farmer communities in the country. This is mainly due to two important factors, these being favorable policy implementations that relived some of the previously existing massive financial burdens for the farmers and farmers being able to generate higher yields at economic rates.

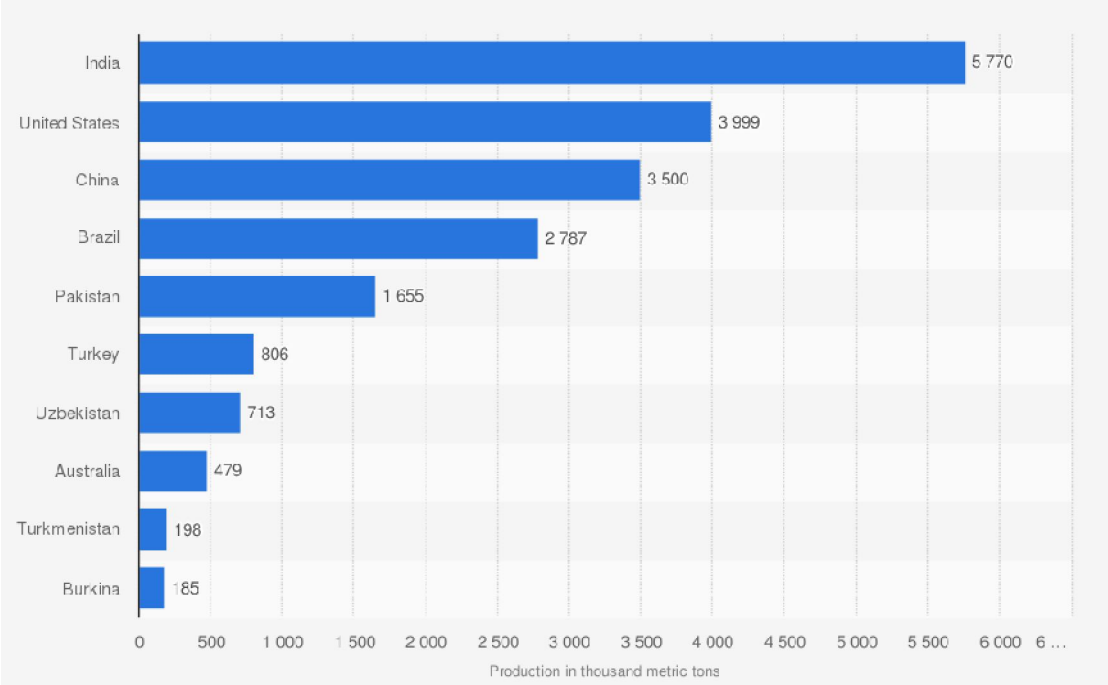
Keywords*: Farmer's suicide, Cotton Corporation of India, Financial Burden.*

1. Introduction:

India is the leading producer of cotton beating USA by a wide margin (Figure 1). Due to its diverse climatic and topographic conditions makes India suitably for cultivation all four major cotton varieties namely Gossypiumarboreum and G. herbaceum (Asian cotton), G. barbadense (Egyptian cotton) and G. hirsutum (American upland cotton) besides hybrid cotton. It is cultivated in about 329.4 lakh hectares across the world and in around 126.07 lakh hectares in the country. Thus, India accounts for around 38.27% of the global cotton area and contributes to 26% (i.e 6.20 Million MT)

of the global cotton produce of 23.92 Million MT. Presently nearly 60 million people depend on cotton cultivation, marketing, processing and exports for their livelihood.

Figure1: Leading Cotton Producing Countries Worldwide in 2018-19



Source: US Department of Agriculture,(2019).

In India, Gujarat, Maharashtra, Rajasthan, Andhra Pradesh, Karnataka and Haryana are major cotton producing states. Of late, the cotton farmers are shifting to the other traditional low value crops in these principally cotton producing states.

The National Crime Records Bureau (NCRB) reported that a total 354,411 Indian farmers had committed suicide since 1995. Of these over 21% were in the state of Maharashtra with remainder spread out in Andhra Pradesh, Telangana, Madhya Pradesh, Gujarat, Chhattisgarh, Orissa, Punjab and Haryana. With Introduction of genetically modified cotton seeds namely BT cotton (*Bacillus thuringiensis* cotton) by the government in 2002-03 this trend was expected to reverse as the new cotton will increase productivity while reducing costs. Contrary to expectations until as late as 2010 the total number of farmer suicides was on a steady rise.

A number of studies proposed a link between expensive genetically modified crops and farmer suicides. Reasoning that increasing costs in farming associated with decreasing yield even with the usage of BT cotton seeds as the main cause of distress among farmers in central India, Scholars say that this BT cotton theory is based on certain assumptions while ignoring the field reality.

2. Literature Review:

India is having reputation of the largest share in area occupying about 35 percent of the world area under cotton and second largest share in production accounting for about 23 percent of

the world cotton production, while its yield is one of the lowest in the world, ranking 70th among all producing countries (Grue`re, et al., 2008). The menace of pests attack is so significant that they cause losses upto the extent of about 50% in cotton productivity because some insects such as Heli 163 Coverpa Armigera and Whitefly have developed resistance to chemical pesticides (Birthalet. al., 2000). The losses in fact have increased from about 18% in early 1960s to about 50% in 1990s (Dhaliwal et. al., 2004). Among the insect pests, the worst predator of Indian cotton is the bollworm, which alone is estimated to have caused an annual damage to the tune of Rs. 120 billion (Chandra, 1998). The farmers have been spending, on an average, about Rs. 5,000 per acre on pesticide spray by using the combination of about 10 to 12 varieties of expensive chemical pesticides 15 to 25 times to control the pest infestations (Parthasarthy and Shameem, 1998).An escalation in the cost of cultivation and depressing yields due to pest attack not only rendered the cotton crop uneconomical but also contributed to a large number of farm suicides and decrease in the proportion of total cropped area allotted for cotton cultivation (Gandhi and Namboodiri, 2006).

In India, BT cotton arrived with intense controversy and shrill invective both for and against, with the respective sides vociferously proclaiming its success or failure on the farm. Bones of contention have included intellectual property, environmental safety and ethics. Even field performances of seeds have been intensely disputed. Nevertheless, the adoption rates of BT cotton in the country was unprecedented and phenomenal which reached about 82 percent of the total cotton area in just eight years of commercialization since 2002-03 by occupying about 70 lakh hectares in the year 2008 (Gulati, 2009; Rao and Dev, 2010).A clear link between the farmer suicides and usage of BT cotton remains unclear to this date. On one hand we have studies proving that there is no such link at the national level and fact the scenario is to the contrary reverse of the expectations, as in the total suicides have gone down drastically following the introduction of BT cotton (Plewis, 2014). On the other hand we have studies that have concluded that in rain fed areas the farmer suicides are directly related to increases in BT cotton adoption (Gutierrez, Ponti, Herren, 2015).

Hence, this paper attempts to answer some of the pertinent questions concerning the cotton crop and farmers culvating the cotton. These are; What are the reasons that could be attributed to the shifting of cotton to traditional crops? Why is the cotton crop losing ground to the coarse cereals? Why are there so many suicides amongst the cotton farmers when it is considered to be a highly profitable crop? Could the failure of government in announcing an appropriate minimum support price (MSP) for cotton crop be one of the reasons?

3. Methodology:

For our study we will be using exploratory statistical analysis with time series data collected from various secondary sources. Through this analysis we will ascertain the cotton crop performance for pre and post BT Cotton periods. This method will be applied for both national and state wise

evaluations. We will be using Compounded Annual Growth Rates (CAGR) to observe the performance of the variables overtime.

$$\textbf{CAGR: In } (y_t) = A + Bt + \varepsilon$$

Where,

$A = \ln (y_0)$, and

$B = \ln(1 + r)$.

The Equation is then fitted to data using "method of least squares" and goodness of fit is assessed by the coefficient of determination R^2. Finally, the compound growth rate is estimated by

$$r\hat{} = \exp (B\hat{}) - 1$$

We will also be using Instability Index to take into account the fluctuations occurring during the time period considered i.e., 1990-91 to 2018-19. For our final objective we will be using the measures of correlation and regression analysis to ascertain the validity of our hypothesis mentioned above.

$$\textbf{Instability index = Standard deviation of natural logarithm } (Y_{t+1}/ Y_t)$$

Where,

Y_t= area / production / yield in the current year,

Y_{t+1} = area / production / yield for the next year.

This index is unit free and very robust, and it measures deviations from the underlying trend (log linear in this case). When there are no deviations from trend, the ratio of Y_{t+1}/ Y_t is constant and thus standard deviation is zero. As the series fluctuates more, the ratio of Y_{t+1} and Y_t also fluctuates more, and standard deviation increases.

The Regression method to be used is a linear regression model. The choice was made after ensuring that-

- The variables are stationary.
- No multicollinearity exists amongst the variables.
- No Autocorrelation exists amongst the variables.
- All linear regression assumptions apply.

$$Y = \beta_0 + \beta X_i + \varepsilon$$

Where,

Y = Dependent Variable.

β_0= Intercept term

X_i= Vector of independent variables.

In this case the independent variables considered are:

- Area under cultivation in lakh hectares.
- Production of cotton in lakh bales of 170 kgs.

- Exports and Imports of cotton in lakh bales of 170 kgs.
- MSP of medium and long staple cotton as declared by Government of India.

4. Data Sources:

The data used in this project has been collected from the following secondary data sources;

a) Cotton Statistics, Cotton Corporation of India.

b) Statistics, Ministry of Textiles.

c) Statistics & News, Cotton Association of India.

d) Indiastat.com.

e) US Department of Agriculture.

f) Commission for Agriculture Cots and Prices, Ministry of Agriculture and Farmers Welfare, Government of India.

g) Suicides and Accidental Deaths Reports, National Crime Records Bureau (NCRB).

5) Analysis & Discussion:

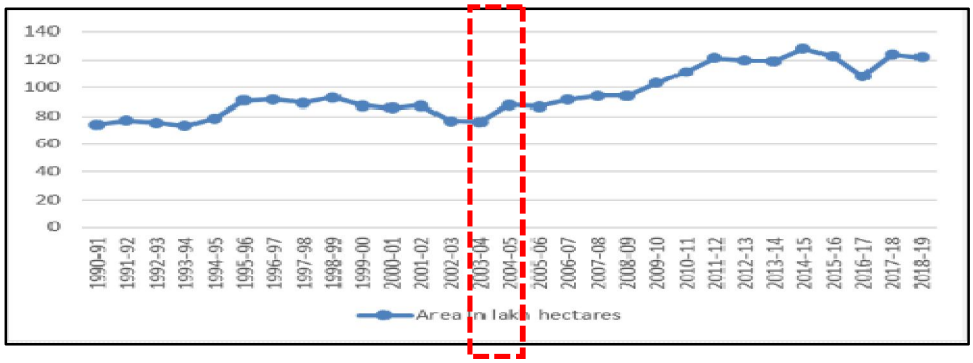
5.1 Cotton Crop Performance at National Level

5.1.1 Changes in Area, production and Yield from 1990 to 2019

As we have already stated cotton is the largest principal commercial crop in India. In March, 2003 the Government of India brought in a policy to encourage farmers to cultivate BT cotton. At that point in time Indian farmers were suffering from large scale infestations of Indian bollworm. After spending exorbitant money on pesticides and insecticides the farmers' profitability, yield and quality of the crop started seeing huge downturns. When introduced BT cotton was seen as good alternative to the problem of high pesticide usages as the BT seeds were specifically engineered to be resistant to Indian bollworm at the same time providing high yields to the farmers.

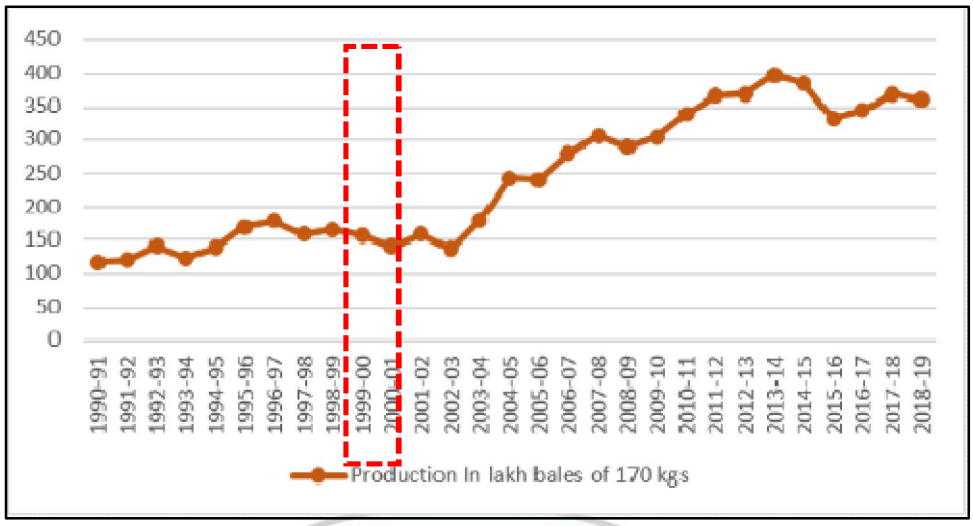
Starting from the very next crop season i.e., 2003-04 farmers all over the country shifted from using desi variety seeds to BT cotton seeds. Over the next four cropping seasons we see that 75% of all the cotton farmers using primarily BT seeds. Due to this reason from this point on we will be classifying the time period from 1990 to 2003 as Pre-BT cotton period. And the period from cropping year 2003-04 onwards as Post-BT Cotton Period.

Figure 2: Area under Cotton Cultivation in Lakh Hectares from 1990-2019



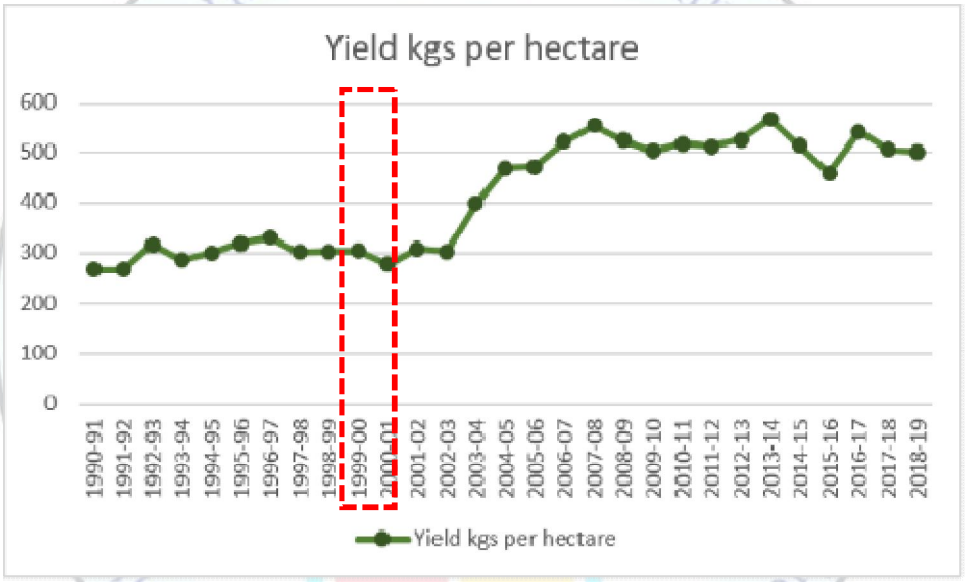
Source: Author's calculations based on data extracted from CCI's database.

Figure 3: Cotton Production for the Period 1990-2019 in Lakh Bales of 170 kgs



Source: Authors Calculations based on data extracted from CCI's database.

Figure 4: Yield in Kgs per Hectare for the period 1990-2019



Source: Author's calculations based on data extracted from CCI's database

From the figures 2-5 we can see that for the pre- BT cotton period has been static in terms of change in the area, production and yield of cotton crop. In fact, we see a decline in area and production for years 1999-2000, 2001-02 and 2002-03. But once the BT cotton was pushed into prominence by the government in March, 2003, we see a marked increase in the overall performance of cotton crop. Production increased from 136 lakh bales of 170 kgs in 2002-03 to 179 lakh bales of 170 kgs in 2003-04 whereas yield increased from 302 kgs per hectare in 2002-03 to 399 kgs per hectare in 2003-04.

5.1.2 Trend Growth Rate for Pre and Post BT Cotton Eras:

Table 1: CAGR for Area, Production and Yield for Pre and Post BT Cotton Era

PERIOD	AREA	PRODUCTION	Yield
Pre BT Cotton (1990-2003)	1.31%	1.47%	2.77%
Post BT Cotton (2003-2016)	5.88%	4.13%	10.25%
Total Period (1990-2016)	3.32%	2.09%	5.47%

Source: Author's calculations based on data extracted from CCI's database.

From this table we can clearly see that there is a marked increase in the trend growth rate of all the variables of interest (i.e. Area, Production & Yield) in the post-BT cotton period. The trend growth rate of area increased from 1.31% per annum in the pre- BT cotton period to 5.88% per annum in the post-BT cotton period. Whereas, the trend growth for the production increased from 1.47% per annum for the pre-BT cotton period to 4.13% per annum in the post-BT cotton period. More than that, the trend growth rate of yield has increased from 2.77% per annum in pre-BT cotton period to 10.25% in Post-BT cotton Period.

6.1.3 Instability Analysis:

Instability is inherent character of agriculture. Hence, it remains imperative to test weather instability in area, production and yield registered increased in post new technology period.

Table 2: Instability Index for the Pre and Post BT. Cotton Periods

PERIOD	AREA	PRODUCTION	Yield
Pre BT Cotton (1990-2003)	4.27	10.06	5.91
Post BT Cotton (2003-2019)	4.93	13.52	6.89

Source: Author's calculations based on the data extracted from CCI and DESMOA database

As can be seen from Table 2 the value of instability index increased in the post reform period with maximum fluctuation being registered by the production.

These results are in line with those of other studies conducted on instability in Indian agriculture. The results of such studies conducted over various periods of growth and stagnation have concludes that the instability in production will be higher during growth period than in period of stagnation. Studies conducted during the period of green revolution found that the introduction of new technology as is the case with BT. cotton increases the production at the cost of greater

instability in production and yield (Larson et.al, 2004, Chand and Raju, 2009). Introduction of BT cotton is a similar situation to that of green revolution but limited only to cotton crop. Hence, we see a higher instability in production that also causes instability in yield too. Hence, we can conclude that instability in cotton cultivation increased post adaptation of new technology.

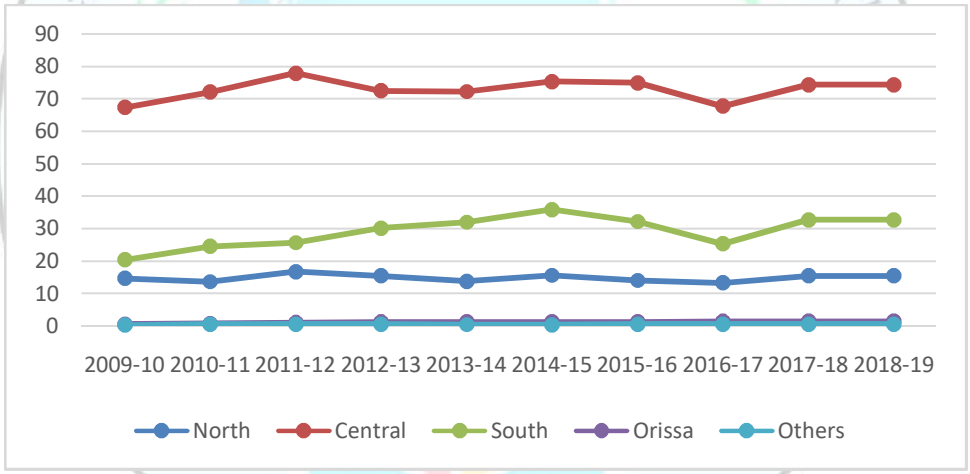
6.2 Region Wise Cotton Crop Performance:

CCI, CAI and MOA divide India into three regions each consisting of three major cotton producing states. This is done for the sake of convenience of reporting and as a way of assessing for policy decisions. For the duration of the report we will also be following the same classification. The regions and major states of these regions are as follows:

- North Zone: Punjab, Haryana and Rajasthan.
- Centre Zone: Gujarat, Maharashtra and Madhya Pradesh
- South Zone: Andhra Pradesh (including Telangana), Karnataka and Tamil Nadu.

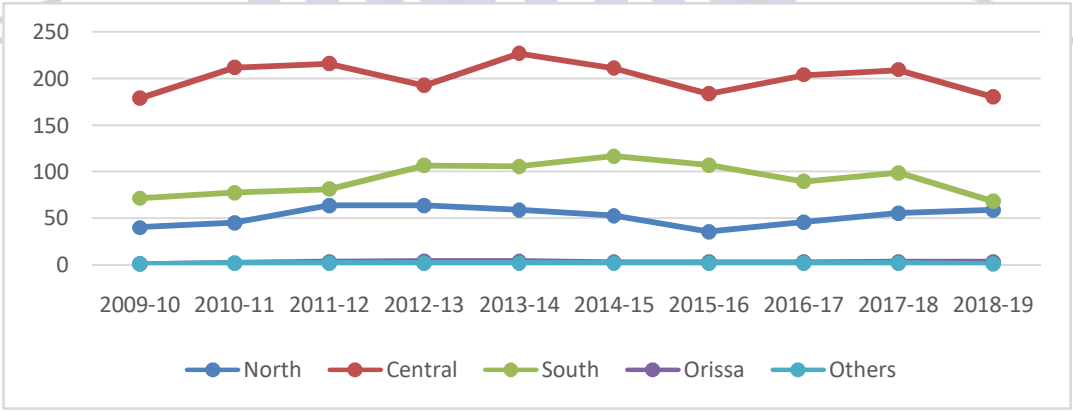
Orissa, Chhattisgarh and other states are classified under the category of others. Orissa is the only state in the eastern region of India that has risen to prominence as a cotton producing state in the recent years.

Figure 6: Region Wise Area under Cotton Cultivation in Lakh Hectares for 2009-19



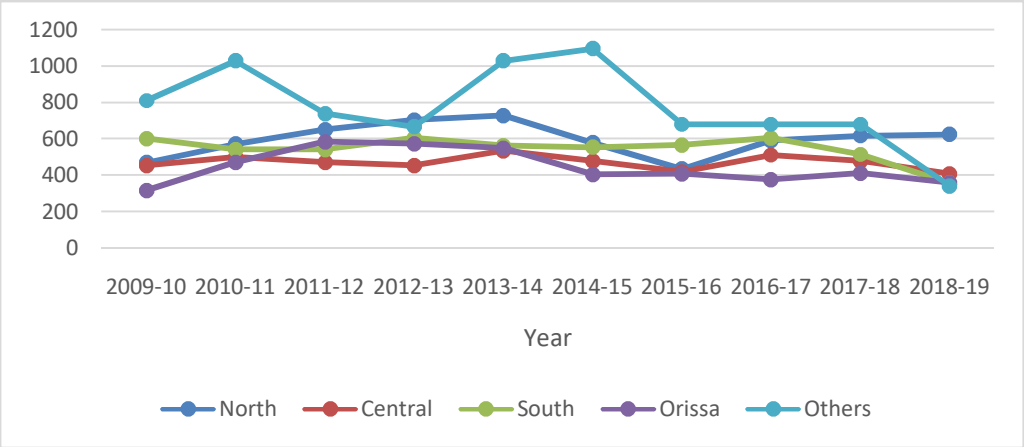
Source: Author's Calculations based on data extracted from CCI and DESMOA's database

Figure 7: Region Wise Production of Cotton in Lakh Bales of 170 kgs for 2009-19



Source: Author's Calculations based on data extracted from CCI and DESMOA's database

Figure 8: Region Wise Yield of Cotton in Kgs per Hectare for 2009-19

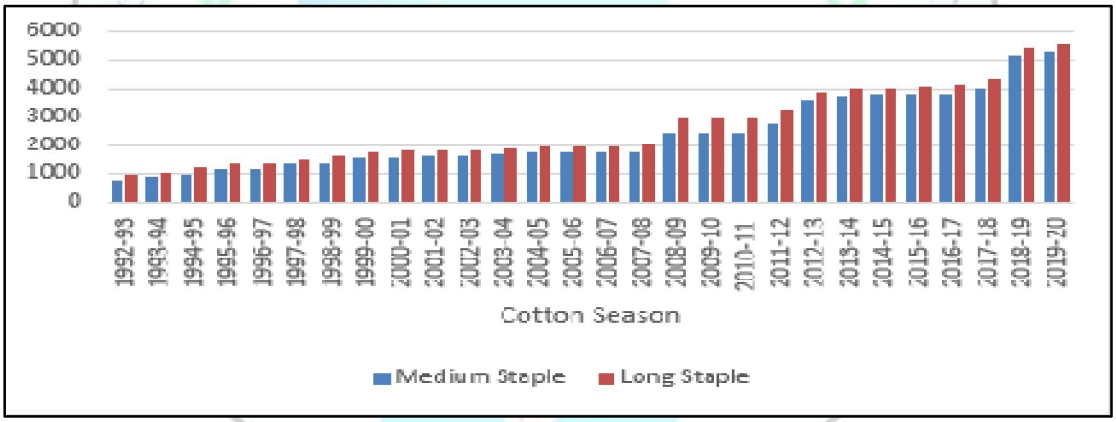


Source: Author's Calculations based on data extracted from CCI and DESMOA's database

6.3 Cotton Prices:

Cotton being a major commercial crop has always enjoyed high prices when compared to commercial crops of similar nature. This led to more farmers showing interest in cultivating cotton than any other crops until 2010. But of late due to continuous downfall in cotton market price and ever rising costs of cultivation has led to the farmers shifting their focus from cotton to other less cost intensive crops such as pulses, soybean, groundnut, etc.

Figure 9: MSP of Medium Staple and Long Staple Cotton for 1992-2020



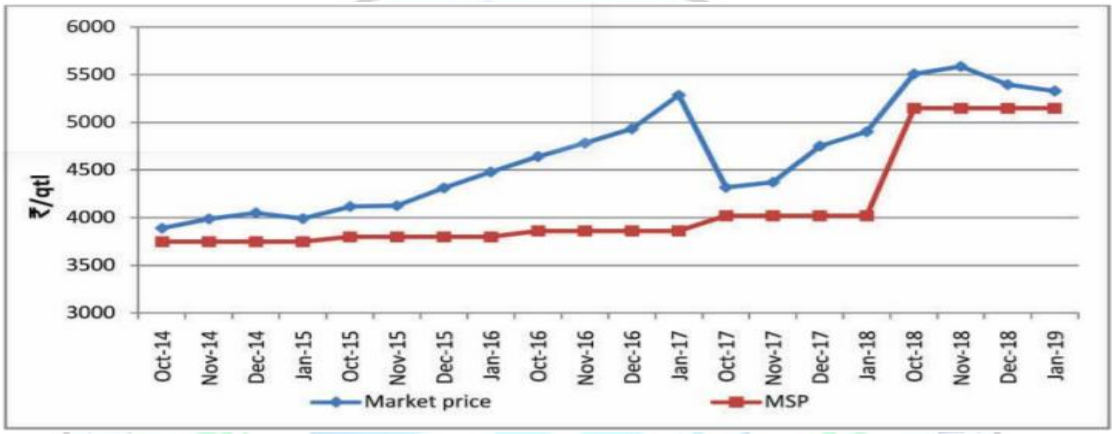
Source: Author's Calculations based on data extracted from DESMOA and CACPs database

Minimum Support Price (MSP) is a policy introduced by Government of India as a way to insure farmers against any sharp falls in farm prices. These prices are announced at the beginning of every crop season for selected crops on the basis of recommendations of CACP. In essence it is a price fixed by the government that acts as a guarantee price for farmers' produce in the years of bumper produce. In case the market prices fall below the MSP set, the government will procure the entire quantity offered by the farmers at the set price.

For every crop year, Government of India fixes a Minimum Support Prices (MSP) for the basic two varieties viz. J-34 (Rajasthan) and H-4. The MSP for other varieties are then fixed by the Office of the Textile Commissioner, Mumbai, depending upon quality differentials and market

differentials of different varieties from the two basic varieties. As and when kapas prices of any variety touch the level of MSP, CCI as a Nodal Agency of Government of India, resorts to immediate market intervention and makes purchases of kapas at MSP without any quantitative limits. The MSPs of different varieties are fixed for FAQ grade kapas stipulating minimum quality parameters on staple length and mic value. Corporation keeps itself ever ready to meet the eventualities of support price operations in all the cotton growing States. Depending upon the intensity of these operations, Corporation creates required infrastructure in the form of regular procurement centres as well as satellite centres so that farmers are not compelled to travel long distances for selling their kapas produce. Processing of kapas through satellite centers, is arranged by CCI at the nearest processing points.

Figure 10: Market Price against MSP for cotton



Sources: Author's calculations based on data extracted form Price Policy Report 2019-20 by CACP

In the years Pre BT cotton period when the production and productivity of cotton were low, the market prices more often than not were below the MSP set by the Government of India. It is only in the Post BT cotton period that the market prices for Indian cotton started seeing an upward trend with domestic prices rising well above the MSP. This trend continued till the 2018-19 crop season.

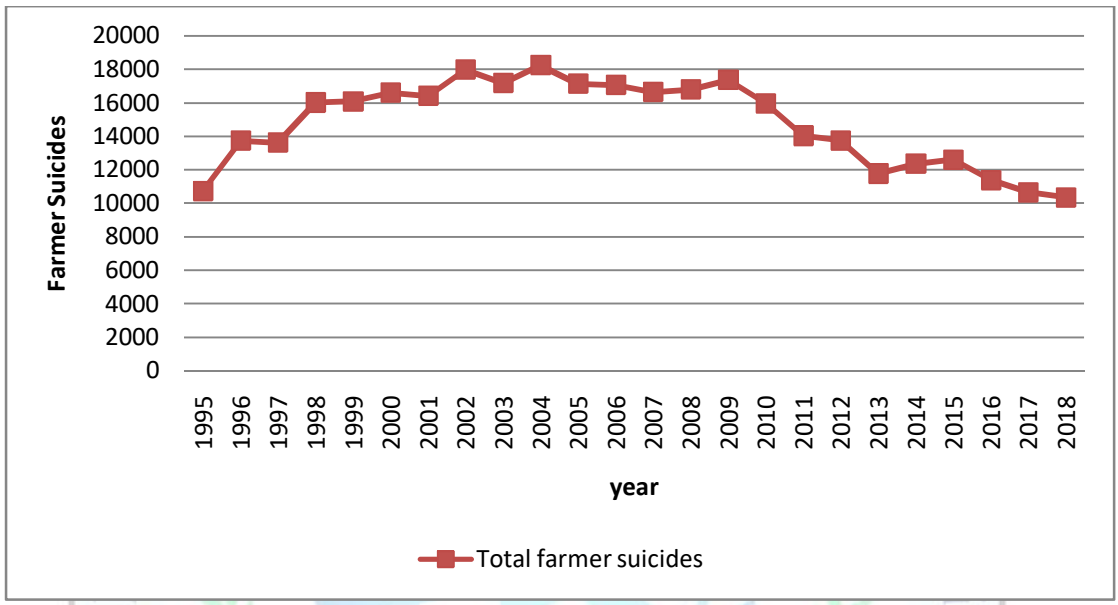
In the current crop season of 2019-20 the cotton prices have seen a massive down fall and for the first time in recent years have fallen well below the set MSP this caused severe consternation amongst the farmers and nationwide protests were held to encourage the government to uphold the MSP. As of November 2019, the market prices for cotton fell to Rs.3,000-3,500 as opposed to the MSP of Rs.5,500.

This is not a standalone scenario. Until as late as 2014, the cotton community as a whole was of the opinion that the MSP set by the government was no longer sufficient and must be adjusted according to the rising International Prices. When the prices fell in 2014 due to the lack of export demand in international community the cotton prices never recovered to their previous highs as the Indian agriculture community as whole was hit by a continuous onslaught of anomalous weather conditions and delayed monsoon which led to severe damages to the cotton produce.

6.4 Farmers' Suicides:

As revolutionary as BT cotton was touted to be upon its introduction, the following years were mired by controversy surrounding the BT cotton. As per NCRB the total farmer suicides have increased from 16,415 in 2001 to 17,060 in 2006. The largest concentration of these suicide cases were found in the Vidharbha region of Maharashtra, northwest of Andhra Pradesh and northern Karnataka, where cotton was planted increasingly since 1990's due to the presence of large scale textile industry in Mumbai and its surrounding regions.

Figure 11: Total Farmer Suicides in India for 1995-2018



Source: Author's calculations based on data extracted from annual Accidental and Suicidal Deaths Reports published by NCRB.

The rising cases of Indian farmer suicides caught the attention of international community as various academics presented their papers and reports on possible causes for this phenomenon of farmer suicides. The presented reason ranged from BT cotton to cash cropping to industrial agriculture to developed-country subsidies that cause the world cotton price to be lowered.

More of than not these reports and their possible causes were contradictory. The main reason behind this contradiction is due to the sources of data used in the analysis. For example, indiastat.com provides relatively low estimates of farmer suicides whereas the annual reports on accidental and suicidal deaths in India published by NCRB of the Ministry of Home Affairs report a relatively larger number of farmer suicides. The numbers reported by NCRB are more consistent across states as well as time (Gruère et.al, 2008)

The share of farmer suicides as a part of total suicides fluctuates between 14.5% and 16% over the considered time period. In recent years starting from 2010 we have seen as gradual but steady decline in the total farmer suicides. The incidence of farmers taking their own lives has been declining over the years, with an occasional spike in rainfall-deficient years, such as in 2015, which marked a second consecutive year of below-average monsoon rains. In 2018, according to NCRB

data, self-inflicted deaths on farms accounted for 4.3% of all suicides reported in India. This was the same share as in 2014 and bears no relation to agricultural output in the intervening years (Mint Jan 9, 2020).

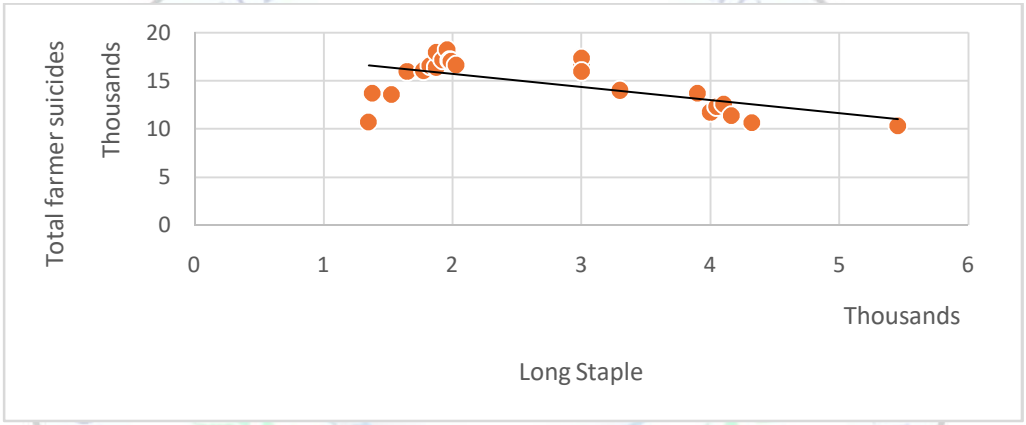
6.5 Establishing the Relationship between Cotton Prices and Farmer Suicides:

The impact of one particular cash crop, the genetically modified BT cotton, is considered one of the most contentious issues surrounding farmer suicides following its introduction in 2002. Many studies were conducted to link the various factors to farmer suicides. But factors that look into the scenario of cotton prices influencing the farmer suicides are very few.

We attempt to use the measures of correlation and regression to ascertain whether our hypothesis that there exists a relationship between cotton prices and farmer suicides holds any weightage.

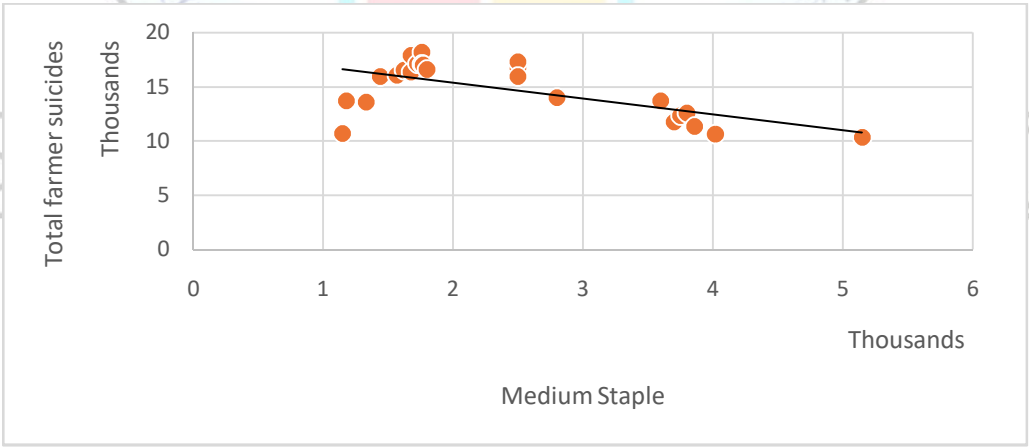
6.5.1 Graphical Analysis:

Figure 12: Scatter plot of MSP of Long Staple Cotton Plotted against Farmer Suicides



Source: Author's calculations based on data extracted from NCRB, DESMOA and CACP's database

Figure 13: Scatter plot of MSP of Medium Staple Cotton Plotted against Farmer Suicides



Source: Author's calculations based on data extracted from NCRB, DESMOA and CACP's database

In the Figures 12 and 13 we plotted the MSP of long and medium staple cotton against the total farmer suicides for the period 1995-2018. We then fitted the scatter plot with a linear trend line to observe the general direction of the data.

From the graphs we can observe that total farmer suicides seem to be highly determined by the MSP of medium and long staple cotton. The trend line is negatively sloped which indicates an inverse relationship between MSP and farmer suicides. While we can ascertain that a relationship exists the exact extent of the relationship is yet to be ascertained.

6.5.2 Regression Analysis:

As observed from figure 12 & 13 there is an inverse relationship between MSP of medium staple and long staple cotton and number of farmer's suicide in India. Now we will try and quantify this relation we observed through the use of Regression analysis method.

Before we observe the regression analysis certain assumptions must be satisfied.

The variables under consideration are as follows:

1. Farmer Suicides in number (dependent variable).
2. MSP of Medium Staple Cotton (regressor).
3. MSP of Long Staple Cotton (regressor).
4. Area under Cultivation (regressor).
5. Quantity of Cotton Produced (regressor).
6. Quantity of Imports and Exports of Cotton (regressor).

We used STATA software to perform our analysis. We started by performing the preliminary test to ascertain that our data adheres to the above mentioned conditions. Through these tests we found that while our variable do not have any autocorrelation the conditions of multicollinearity and stationary are not satisfied. Hence, we chose to modify the variables so that problem of multicollinearity can be eliminated.

We did this in the following ways:

1. Combine MSP of Medium and Long staple cotton by using a simple average of both these variable.
2. Use Yield in place of Production and Area. As yield its self is derived by dividing Quantity produced with Area under Cultivation.
3. Use the variable Trade Surplus, which is the difference between Exports and Imports of cotton.

Later we performed a first order differentiation on these variables to make them stationary. We used the Dickey-Fuller test and Augmented Dickey-Fuller test to ascertain whether our variables are stationary or not.

We used a Portmanteau test for White Noise that was refined by Lung-Box Statistic to determine whether our variables are suffering from autocorrelation. This test returned the Q statistic as significant for all our variables, thus proving that there is no autocorrelation amongst our variable.

Table 3: Correlation Matrix

Variables	Dfarm	davg	dyield	dtrade
dfarm	1	-	-	-
davg	-0.6307	1	-	-
dyield	-0.2695	-0.116	1	-
dtrade	-0.3042	-0.5075	0.1804	1

Source: Author's calculations based on data extracted from multiple secondary sources

Table 4: VIF Test for Multicollinearity

Variable	VIF	1/VIF
Dtrade	1.37	0.727496
Davg	1.35	0.741867
Dyield	1.03	0.966639
Mean VIF	**1.25**	-

Source: Author's calculations based on data extracted from multiple secondary sources

**Note: From this point forward we will be using the following denotations for our variables:*

- *dfarm = First order differentiation of the variable Farmer Suicides.*
- *davg = First order differentiation of the variable Average MSP of Medium and Long Staple Cotton.*
- *dyield = First order differentiation of the variable Yield in Kgs per Hectare.*
- *dtrade = First order differentiation of the variable Trade Surplus.*

Table 3 presents the correlation matrix. The correlation matrix displays the correlation coefficients between variables. Each cell in the table shows the correlation coefficient of the variables corresponding to that cell. We can see that the variables "dfarm" and "davg" have a correlation coefficient of -0.6307. The negative sign implies an inverse relationship between the variables. This agrees with our results from graphical analysis. The absolute value of 0.6307 implies that for an increase of 1 unit in "dfarm" there will be a change by the magnitude of that value in "davg".

Table 4 presents us with results of the VIF test. A Variance Inflation Factor (VIF) test quantifies the extent of the relation between two regressors in a model. It is used for diagnosing multicollinearity. The rule of thumb for the VIF test is that the resulting value should not be higher than 10. As can be seen from the table none of our variables have the values more than 1.5. Hence we can conclude that there is no multicollinearity amongst the variables.

Regression Equation:

$$dfarm = 269.984 - 1.261\ (davg) - 5.642\ (dyield) - 13.447\ (dtrade) + \varepsilon$$

Table 5: Regression Results

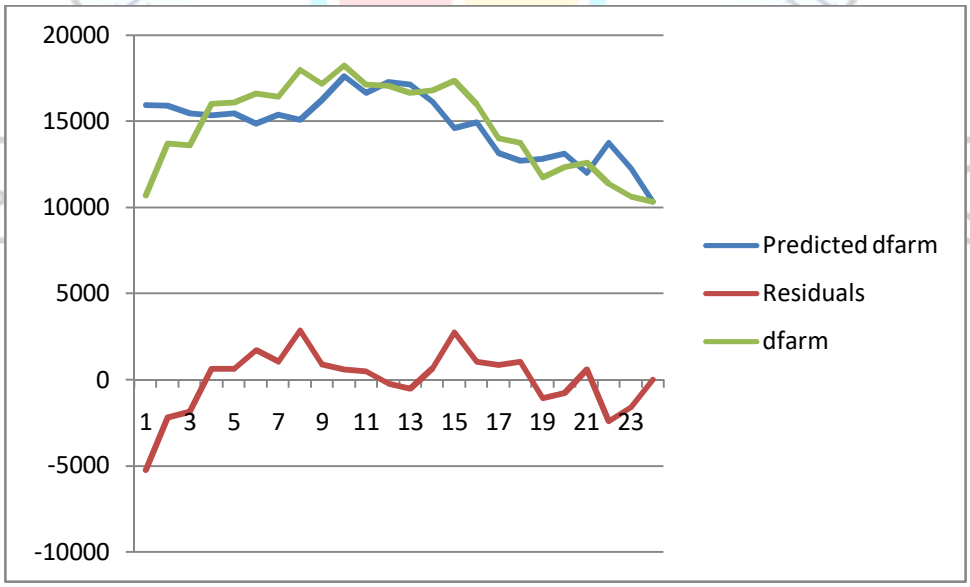
Regression Statistics	
R Square	0.5277
Adjusted R Square	0.4569
Standard Error	1893.2
Observations	24
F(3, 20)	7.45
Prob> F	0.0015

ANOVA			
	Df	*SS*	*MS*
Regression	3	4015563	1338521
Residual	20	29332561	1466628
Total	23	33348124	

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	269.984	318.2876	0.85	0.407
davg	-1.260927	0.990366	-4.43	0.000
dyield	-5.64195	6.548733	-2.29	0.033
dtrade	-13.44736	9.875032	-1.36	0.189

Source: Author's calculations based on data extracted from multiple secondary sources.

Figure 14: Line Chart Showing the Movements of Predicted and Actual dfarm



Source: Author's calculations based on data extracted from multiple secondary sources.

The results of the regression model are shown in Table 5. These results can be interpreted as follows:

From the regression analysis, it comes out that cotton price and yield of the cotton are having negative and significant impact on the farmers suicides. Trade balance is having negative but insignificant impact on the farmer's suicide. From the empirical evidence it comes out that every thousand rupee increase in the minimum support price can reduce the farmers' suicide by 1.50 number and at the same time every Kg increase in the productivity per hectares of cotton will bring down farmers suicide by about six units.

Policy Implications:

The results we have obtained align with the results of various research papers that have worked on the subject of farmer suicides in India. All the papers agree that more than the introduction of BT cotton or insufficient prices the major cause for farmer suicides is stated as increasing costs bought on by a changing lifestyle.

Starting from the 1990's the agriculture growth that was initiated by green revolution started seeing a downward trend. During this time with India opening its borders once again and all the protectionist measures were lifted, the agriculture sector was hit massively. This period was hence mired with stagnation, instability and rising costs of cultivation.

The absence of a safety net or any other insurance support, the ineffective irrigation systems, the presence of abusive banking systems, the wide availability of highly toxic pesticides, and the potential rewards for suicide likely all contributed to farmer suicides. In recent years most of the cotton farmers have chosen to shift their focus from cultivating cotton to less cash intensive crops like Sesame, Soybean, etc. as these crops are assured to give a stable returns compared to cotton whose prices have been on a constant decrease with very few chances of recovery. This can be seen by observing the decreasing trend in Area under cultivation starting from 2015-16.To stop this downward spiral of cotton community various steps have been taken by Ministry of Agriculture and Cotton Corporation of India. These steps include:

- GOI sponsored scheme of Technology Mission of Cotton through which the government aims to increase production and yield of cotton.
- The National Food Security Mission for Commercial Crops was developed to fund cotton producing states in order to increase their production of cotton.
- Under Rashtriya krishi Vikas Yojana (RKVY) a scheme was introduced for cotton development to support farmers for cotton cultivation.

In several states such as Karnataka and Andhra Pradesh, some policy changes have already been proposed. Others have been implemented by the Government of India, with significant budgets but arguably inappropriately designed programs that either reward farmer suicides or offer loan

waivers to only a minor portion of the distressed farming population. Rather than spending more on large programs directed toward farmer suicides because of hype in the media, a rational approach would be to use better-targeted state or district programs for distressed farmers. Also, much more federal and state investment could help prevent the 80% or more other cases of suicides.

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