Original Research Article

Trends in Growth Rates in Area, Production and Productivity of Sugarcane in Bihar

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A B S T R A C T

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The main aim of this study is to analyze the trend as well as growth rate of area, production and productivity of sugarcane crop, measure the instability in production and constraints faced by the farmer in sugarcane cultivation in Bihar. The study is based on time series secondary data to a total duration of 42 years i.e., 1970-71 to 2011-12. The data were collected from Directorate of Economics and Statistics, Bihar Patna. Out of 38 districts of Bihar, three districts namely West Champaran, East Champaran and Gopalganj have been selected on the basis of percentage area and production for the present study. The study finds that area, production and productivity mostly a positive and significant during overall period in the selected districts. The study also revealed that co-efficient of variation suggested that highest inter-annual fluctuation was observed in sugarcane production followed by variation in area and yield during 1970 to 2012. The most important constraints in sugarcane cultivation is shortage of labor during crucial operation. The study has suggested that a combination of technology, policy and institutional innovations is needed for improvement of productivity and profitability of crops.

Introduction

Sugar industry is the second largest agro based industry next to the textile industry in India, its future determines the livelihood of millions of farmers. The industry generates sizeable employment directly in the farm sector and indirectly through ancillary industry and related activities. The sugar industry can be broadly classified into two sub sectors, the organized sector i.e., sugar factories and unorganized sector i.e., manufacture of traditional sweetners like Gur and Khandsari, occupies an important place in the rural economy of the state.

India ranks second in the world in sugarcane production with an average production of 348.38 million tones in

2013-14 and it has a share of 17 percent in world sugarcane production. In sub-tropical region, Bihar is second largest sugar producing state next to Uttar Pradesh with an area and production of sugarcane about 2.52 lakh hectares and 126.00 lakh tones respectively (Indian Sugar- 2014), but its share in area under sugarcane is only 4.90 percent and in production is 4.31 percent of all India production which is very low, with an average yield of 50.0 tones/hec. Which is below the national average (70.10 tones/hec).

North Bihar is agro-climatic very suitable for producing good quality sugarcane with minimum inputs as compared to other states. The district of West Champaran, East Champaran, Gopalganj, Sitamarhi, Siwan and Samsatipur are the main area of sugarcane production in the state, which do not only account for nearly 70 percent cane area but 60 percent of annual cane production of the state . It also accounts for 12 sugar factory out of 28 sugar factory of state.

Sugar industry is an important component of agro-based industry in the state. The total cultivated land in the state is around 53 lakh hec of which almost 3 lakh hectares is under sugarcane. It is estimated that about 5 lakh farmers are engaged in the cultivation of sugarcane and approximately half a lakh as unskilled and skilled workers are engaged in sugar and allied industries particularly in ethanol and captive power generation.

In this view the present study is therefore undertaken to analyse the change in area, production and productivity of sugarcane with the following objectives include to find out trend as well as growth rate of area, production and productivity of sugarcane. To measure instabilities in production of sugarcane. And also to identify the major constraints in sugarcane cultivation and suggests policy options to increase sugarcane production and productivity in the state.

Materials and Methods

The present study is based entirely on time series secondary data with respect to area, production and productivity of sugarcane crop in the North Bihar region of Bihar. The study period for the objectives is confined with a total duration of 42 years i.e. 1970-71 to 2011-12. The data were collected from Directorate of Economics and Statistics, Govt. of Bihar, Patna, Bihar through figures for the present study. The period were visualized as a whole as well as by sub-dividing it into three periods as indicated below:

Period – I :   1970-1971 to 1985-1986
Period – II :   1986-1987 to 1999-2000
Period –III :   2000-2001 to 2011-2012

Analysis of data

In the present study, the compound growth rate (CGR) in area production and productivity of sugarcane in Bihar were estimated by fitting exponential types of equation.

$$y = ab^t$$

Where,

y = Area /production/productivity of sugarcane (hectors, ton, tons/ha).
a = Constant
b = Regression coefficient or trend value
t = Time variable
CGR(%) = (Antilog b-1)×100
The significance of the estimated

compound growth rate with be tested with the help of student's 't' test.

$$t = r/SE \ (r)$$

To study the trend and instability of sugarcane crops production in Bihar, mean ($\bar{x}$), stander error (SE) and co-efficient of variation (cv) were worked out using the formula

$$c.v. \ (\%) = \left(\frac{\sigma}{\bar{x}}\right) \times 100$$

Where,

σ = standard deviation

$\bar{x}$ = arithmetic mean

The co-efficient of variation was used as a measure of instability

Results and Discussion

Out of 38 districts of Bihar, West Champaran, East Champaran, Gopalgang, Sitamarhi, Siwan and Samastipur districts nearly 79.89 percent fall under category of high performing districts in front of growth in area and production under sugarcane cultivation.

For the present study, the three major sugarcane growing districts were selected. The data used for the study like area, production and productivity for the period 1970-2012 perform the growth trend and instability analysis.

West Champaran

The area, production and productivity of sugarcane was found a positive and significant growth trend during the overall period (1970-2012), and it was mounting with a compound growth rate of 0.62, 1.09 and 0.47 percent per annum respectively.

Further it was also observed that growth rate of area and production in the third period was found higher in comparison to the second period, during the same period due to increase in adoption of high yielding varieties and better management of cultural practices in sugar cane cultivation.

Gopalganj

In the district growth rate in area, production and productivity was found negative in the first and second period, but in third period growth trend of area, production and yield noticed with a positive growth rate. At the end of the fourth period (whole period) growth in the area, production and productivity increased by 0.47, 0.66 and 0.19 percent respectively.

East Champaran

East Champaran is a prosperous sugarcane growing district. It was also observed from the Table - 2, that growth in area, production and productivity of the first and second period was found negative productivity because of increased incidence of red-rot and non-availability of red-rot resistant varieties. The higher growth rate might be due to adoption of new technology.

Bihar

While studying the trend of sugarcane production and analyze the component of variance in production, the area, production and productivity declined in the first and second period. On the other hand it had shown significantly positive in the third period. The study revealed the overall growth of area under sugarcane in Bihar was found to be negative (-0.22%)

which might be due to introduction of other crops in the sugarcane area. The positive growth in yield contributed to positive growth in production. Which might be attributable to the modern technologies adopted by the farmers.

Instability in Area, Production and Productivity of Sugarcane Crop in West Champaran District of Bihar

It was observed from the table that the coefficient of variation analysis suggests that inter-annual fluctuation was higher in case of sugarcane production i.e. 59.34 percent followed by variation in area (39.07%) and yield (25.74%) during 1970-2012. During the third period variability in sugarcane production (61.43%) was highest followed by area 45.93 percent and productivity 18.28 percent (Table-2). It was concluded that the production of the sugarcane crop have increased mainly due to the area expansion under the crop.

Instability in Area, Production and Productivity of Sugarcane Crop in Gopalganj District of Bihar

The coefficient of variation analysis that inter-annual fluctuation was highest in case sugarcane production i.e. 30.50 percent followed by variation in productivity 25.74 percent and area 14.39 percent during 1970-85 (Table – 4). Due to high variability in sugarcane production in the district, policies makers could not plan any sugarcane processing plant.

Sub-period 3 (2000-2012) was registered that yield fluctuation was 22.92 percent more than the area variability 21.40 percent. This result in the line of Rao and Raju (2005) in studying the pattern of growth and magnitude of instability in area production and productivity of ground nut and Andhra Pradesh and concluded that a high degree of instability in production was due to instability in area.

Table.1 Production figures of Sugarcane in Bihar

	2001-02	2012-13
Total area under sugarcane (Lakh/ha.)	1.14	2.52
Total production of sugarcane (Lakh/tones)	52.11	126.00
Productivity of sugarcane (tones/ha)	45.90	50.00
Cane crushed (Lakh tones)	38.98	57.16
Sugar produced (Lakh tones)	3.42	5.06
Recovery percentage	8.78	8.86
Crushing duration	116	116

Source: Indian Sugar September, 2014.

Table.2 Compound growth rate (CGR) of Area, Production and Productivity of major sugarcane growing districts in Bihar

Sl. No.	District	Particular	Compound Growth Rate (CGR)			
			I	II	III	IV
1.	West Champaran	(i) Area	0.29	-0.05	1.92	0.62*
		(ii) Production	-0.07	0.90	1.76	1.09
		(iii) Productivity	-0.36	0.95	-0.15	0.47
2.	Gopalganj	(i) Area	-1.01	-0.27	2.00	0.47
		(ii) Production	-1.83	-2.03	3.85	0.66
		(iii) Productivity	-0.82	-1.77	1.85*	0.19
3.	East Champaran	(i) Area	-3.24	-0.52	1.81	-1.23
		(ii) Production	-2.78	-0.63	3.39	-0.97
		(iii) Productivity	0.48	-0.11	5.49*	0.26
4.	Bihar	(i) Area	-1.54	-0.47	2.46	-0.22
		(ii) Production	-1.97	-0.12	3.68	0.20
		(iii) Productivity	0.43	0.35	1.19*	0.42

Note Period I = 1970-71 to 1985-86
II = 1986-87 to 1999-2000
III = 2000-01 to 2011-12
IV = 1970-71 to 2011-12

Table.3 Variability in area, production and productivity of sugarcane crop in West Champaran District of Bihar

Particulars		Sub-Periods			
		Period- I (1970-1985)	Period- II (1986-1999)	Period- III (2000-2012)	Over all Period (1970-2012)
Area	Mean	38.22	47.01	63.22	48.29
	SD	2.82	5.29	29.03	18.87
	CV	7.38	11.26	45.93	39.07*
Production	Mean	1277.14	2313.66	2965.79	2105.12
	SD	303.95	518.99	1822.03	1249.32
	CV	23.80	22.43	61.43	59.34*
Productivity	Mean	33.15	49.20	44.97	41.88
	SD	5.88	9.98	8.41	10.78
	CV	17.74	20.28	18.28	25.74*

SD: Standard Deviation
CV: Coefficient of Variation

Table.4 Variability in area, production and productivity of sugarcane crop in Gopalganj District of Bihar

Particulars		Sub-Periods			
		Period- I (1970-1985)	Period- II (1986-1999)	Period- III (2000-2012)	Over all Period (1970-2012)
Area	Mean	15.46	17.24	22.69	18.22
	SD	2.22	2.83	4.85	4.49
	CV	14.39	16.42	21.40	34.28*
Production	Mean	580.90	924.95	995.42	814.02
	SD	177.17	453.75	342.11	385.01
	CV	30.50	49.05	34.36	47.29*
Productivity	Mean	37.51	52.13	43.22	44.01
	SD	9.65	21.46	9.90	15.98
	CV	25.74	41.17	22.92	36.30*

SD: Standard Deviation
CV: Coefficient of Variation

Table.5 Variability in area, production and productivity of sugarcane crop in East Champaran District of Bihar

Particulars		Sub-Periods			
		Period- I (1970-1985)	Period- II (1986-1999)	Period- III (2000-2012)	Over all Period (1970-2012)
Area	Mean	20.26	11.75	8.42	14.04
	SD	14.30	1.61	4.87	10.53
	CV	70.57	13.75	57.89	75.06*
Production	Mean	763.70	511.98	387.72	572.37
	SD	537.42	135.55	278.43	403.99
	CV	70.37	26.47	71.81	70.58*
Productivity	Mean	37.81	43.33	46.62	42.16
	SD	4.88	8.09	25.48	15.16
	CV	12.91	18.68	54.65	35.95*

SD: Standard Deviation
CV: Coefficient of Variation

Table.6 Constraints faced by farmers in sugarcane cultivation

Sl. No.	Problems	Mean Scores	Garret Ranking
1.	Poor/no source of irrigation	81.50	I
2.	Non availability of fertilizer on time	81.04	II
3.	Lack of timely labor facility	77.03	III
4.	Non-availability of seed in time	76.97	IV
5.	High cost of pesticides	76.78	V

Instability in Area, Production and Productivity of Sugarcane Crop in East Champaran District of Bihar

During overall period of the study the sugarcane area variability was 75.06 percent, whereas production variability was 70.58 percent and yield variability was 35.95 percent.

It was also evident from the table that variability in third period (2000-2012) was found higher in comparisons to the second period of all the three variables viz. area, production and productivity.

Sub period 3 (2000-2012) was registered opposite patterns because area fluctuation was more than yield variability (Table – 5).

Identification of constraints of sugarcane production

Problems faced by farmers in sugarcane cultivation were collected by survey method using schedules for interviewing the individual sugarcane growers. The constraints were prioritized by using Garrett's ranking technique.

It was observed from the table 6 that there were twenty major problems in sugarcane cultivation confronted by respondents. Among these problems poor/no source of Irrigation was observed as the most severe problem with 81.50 average score in Garret ranking, followed by non-availability of fertilizer on time, lack of timely labor facility, with average score of 81.04 and 77.03 respectively.

From discussion, it may be concluded that poor/no source of Irrigation was identified as the major problem due to shortage of power/diesel at the time of operation, high charge and long distance of irrigation sources is the another problems.

The study also revealed that scarcity of labor during field operations was also identified as an important constraints. This was mainly due to higher labor wages and MNREGA was also responsible for scarcity of farm labor, in the study area.

Main reasons for decline in sugarcane yield and sugar recovery in Bihar

Sugar industry in Bihar in plagued with several serious and complicated problems which call for immediate attention and rational solutions. Some of the burning problems are briefly described as under.

Low yield of sugarcane

The yield per hectare is low as compared to some of the major sugarcane producing state of the country. For example Bihar yields in only 50 tones/ha, as compared to national average i.e., 70 tones/hec. This leads to low over all production and results in short supply of sugarcane to sugar mills.

Effects are being made to solve this problem through the introduction of high yielding, early maturity high sucrose content varieties of sugarcane as well as by controlling of disease and pest which are harmful for sugarcane.

Short crushing season

Manufacturing of sugar is a seasonal phenomenon with a short crushing season is of nearly four months only in the state from November to February where as it of as nearly us 7-8 months with South where it starts in October and Continues till May and June. The mills and its workers remain idle during the remaining period of the

year thus creating financial problems for the industry as a whole.

One possible method to increase the crushing season is to sow and harvest sugarcane at proper intervals in different areas adjoining the sugar mills. This will increase the duration of supply of sugarcane to sugar mills.

Low rate of recovery

It is clear that the average rate of recovery in Bihar is 8.97 per cent which in quite low as compared to other major sugar producing states and national average 10.23 per cent in the year 2013 -14.

Fluctuating production Trend

Sugarcane was to compete with several other food and cash crops like cotton, oil seed, rice etc. consequently, the land available to sugarcane cultivation is not the same and the total production of sugarcane fluctuation.

Thus, affects the supply of sugarcane to the mills and the production of sugar also vary from year to year.

High cost of production

High cost of sugarcane production, inefficient technology, uneconomic process of production and heavy excise duty, result in high cost of manufacturing.

Intense research is required to increase the sugarcane production and to introduce new technology of production efficiency in the sugar mills. Production cost can also be reduced through proper utilization of byproducts of the industry.

For example Bagasse can be used for manufacturing paper pulp, plastic, carbon cortex etc. Molasses comprise another important by product which can be gainfully used for the manufacture of power alcohol.

Competition with Khandsari and Gur:-

Khandsari and Gur have been manufactured in rural Bihar much before the advent of sugar industry in the organized sector. Since Khandsari industry in free from excise duty, it can after higher prices of cane to the cane growers. It is estimated that about 40 percent of the cane grown in Bihar is used for making Kandsari and Gur and the organized sugar industry in deprived of sufficient supply of this basic raw materials.

How to overcome these problems

Sugarcane proved to be the highest profit giving crop. Therefore, the government should provide incentives along with farmer's training and demonstration for large scale adoption of improved agronomic practices.

For increasing the area under sugarcane, the crop should be properly and adequately covered under crop insurance scheme. This would motivate the farmers to devote more area under sugarcane without any hesitation.

Season wise and variety wise planting programme should be prepared and implemented.

There is an urgent need to strengthen the extension mechanism by establishing strong linkage between research institution, sugar mills and farmers for efficient transfer of improved technology in sugarcane cultivation.

In conclusion, the study highlighted the fact that the growth of area production and productivity registered mostly a positive and significant during overall period in selected districts of Bihar, where as in West Champaran district it was also observed that growth rate of area and production in the third period was found higher in comparison to the second period, during the same period due to increase in adoption of high yielding varieties and better management of cultural practices in sugar cane cultivation.

The study revealed the overall growth of area under sugarcane in Bihar was found to be negative (-0.22%) which might be due to introduction of other crops in the sugarcane area. The positive growth in yield contributed to positive growth in production. Which might be attributable to the modern technologies adopted by the farmer coefficient of variation of crop in the state varied. High mean value of sugarcane area in Gopalganj district with lower value of coefficient of variation indicates stability in sugarcane production and will give pathway to establish. Sugarcane based agro industries

References

Devraj, D., Sharma, K. and Khare, A.P., (2003). Trends in area, production and productivity of pulses in Bundelkhand region of Uttar Pradesh. Agricultural situation in India Feb.:723-728.

Government of Bihar (2013). Bihar through figures, Directorate of Economics and statistics, Bihar, Patna.

Government of Bihar (2013). Directorate of Economics and Statistic Bihar, Patna.

Kalita, D.C., (2011). Trends of area, production and productivity of fibre crops in Assam, Agriculture station in India LXVIII(7):329-332.

Kumar, S. and Singh, Surender, (2014). Trends in growth values in area, production and productivity of sugarcane in Haryana. *International Journal of advanced Research in Management and Social Sciences.* ISSN-2278-6236:117-124.

Rao, IVYR and Raju, V.T (2005). Growth and instability of groundnut, production in Andhra Pradesh, *Journal of Oil Seed Research,* **22(1)**: 141-149.

Sinha, D.K. and Thakur, Jawahar, (1993). An economic Analysis and growth performance of major food crops in Bihar. Agriculture situation in India, Oct.1993:543-548.