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Comparative Economics of Normal Sown Vs Zero Tillage Maize in North Coastal Andhra Pradesh

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Abstract

Present study has taken up to know the comparative economics of direct sown maize and zero tillage maize in north coastal Andhra Pradesh. This zone consists of three districts and from each district one mandal with highest area under maize were considered. From, each mandal, two villages with highest area under maize were selected. From each mandal, 10 maize growing farmers were randomly selected for calculating cost of cultivation of maize crop. Thus 60 farmers were interviewed for the study. Secondary data on area, production and yield of maize crop for last twenty years (2002-03 to 2021-22) were collected, divided the data into two periods of ten years each and growth trends were calculated for these two periods (Period-I: 2002-03 to 2011-12 & Period-II: 2012-13 to 2021-22) and the findings showed that during Period-I & Period-II, area, production and productivity of maize showed positive growth trends for entire north coastal zone. Similarly, instability in area had higher effect on production than productivity for both periods in the entire zone. Policy effect on maize production difference was higher than technology affect and interaction affect in the zone for both periods. The results revealed that the total cost of cultivation per hectare of normal sown maize was Rs. 77076/ha and gave an income of Rs. 109920/ha resulted in the BCR of 1.43. Similarly, the total cost of cultivation of zero tillage maize was Rs. 63889/ha with a gross return of Rs 100975/ha gave BCR of 2.09. Major production and marketing constraints of maize were “high labour wages and “non-remunerative price of produce” respectively.

Key words : *Direct sown maize, zero tillage maize, cost of cultivation, CGR, BCR.*

Introduction

Maize regarded as “queen of coarse cereals” and belongs to the family Poaceae. It is native of central America but cultivated all over the world as cereal crop due to its adoptable nature to variable climatic conditions. It is the third most important crop after rice and wheat in India (1,2,3,). It is one of the most important cereal crops in the world and grown over an area of 201 million hectares. India ranks fourth with an area of 10 Mha (4.98%) after China (41 Mha), USA (33 Mha) and Brazil (18 Mha) during 2020-21. Among the states of India, Karnataka had highest area under maize with 15.9 lakh hectares followed by Madhya Pradesh (14 Lha), Maharashtra (12.9 Lha), Rajasthan (9.5 Lha) and Bihar (6.6 Lha). Andhra Pradesh ranked 9th position in the country with 3.01 Lha. Kurnool district occupied first place in maize cultivation with an area of 59000 ha followed by Guntur (41500 ha), Vizianagaram (41000 ha), West Godavari (38000) and Srikakulam (35000 ha). The yields levels were high in East Godavari district (89 q/ha) followed by Guntur (80.5 q/ha) and West Godavari (75.8 q/ha). About 51 per cent of maize produced in the India used as poultry feed, 20-25 per cent as human food, 10-12 per cent as cattle feed, 10-12 per cent as industrial raw material and remaining 1 per cent as seed (4).

Among the top five districts, two districts were located in north coastal zone of Andhra Pradesh. Though yield levels were not in lines with the good yielding districts, Vizianagaram and Srikakulam stood in top 5 districts of maize in Andhra Pradesh. Mostly maize grown as *rabi* crop after *kharif* paddy as an alternative to pulse crops in north coastal zone of Andhra Pradesh. Farmers were growing maize under two methods *i.e.*, normal sown maize and zero tillage maize. The area under maize gradually increasing in Srikakulam and Vizianagaram districts during last two decades. Hence present study has conducted to see the comparative economics of two methods of maize cultivation in north coastal zone of Andhra Pradesh with following objectives :

To estimate the growth trends of area, production and productivity of maize crop in north coastal zone

To examine the comparative economics of maize cultivation and suggest profitable method of cultivation.

To identify major production and marketing constraints.

Materials and Methods

To examine CGR, instability and decomposition analysis, time series secondary data on area, production and

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productivity from 2002-03 to 2021-22 (20 years) was collected from Directorate of Economics and Statistics website. Then this data was divides in to two periods *i.e.,* Period-I (2002-03 to 2011-12) and Period-II (2012-13 to 2021-22) for comparing the growth trends. For calculating cost of cultivation and identifying production and marketing constraints, primary data was collected from a sample of 120 farmers. North coastal zone has three districts and the mandals in each district were arranged in descending order based on highest area under maize crop and top two mandals were selected. From each mandal, two villages were selected with highest area under maize crop. From each village, ten maize growing farmers were randomly selected for collecting primary data. Thus, three districts, six mandals and 12 villages and 120 farmers were finalized for the study.

Analytical tools used

Estimation of Compound Growth Rates (CGR) : Compound growth rates of area, production and yield for periods mentioned earlier were measured by fitting an exponential function of the following form:

$Y = Ab^t$

Log Y = Log A + t. log b

Where, Y = Area/production/yield

A= Constant

b = (1 + r)

r = Compound Growth Rate

t = Time variable in years (1, 2, 3…n)

Estimation of Extent of Instability : To estimate the instability, Coefficient of variation (CV) was utilized. Coefficient of variation explains the fluctuations over the period, which is represented by the following formulae :

$$CV = \frac{\frac{1}{N \quad 1} \sum_{t \ 1}^{N} (X_t \quad \bar{X})^{1/2}}{\bar{X}}$$

Where N = No. of years

X_t = Area/production/yield in the year 't'

$\bar{X}$ = Mean of Area/production/yield.

Estimation of Technology and Policy factors affect on production : (5) utilized two-way component analyses to disaggregate the change in production into area affect, yield affect and interaction affect. In the present study, area and yield variables were taken as proxy for policy and technology factors respectively. This is represented by the following form:

DP = Ao.DY + Yo.DA + DA. DY

Where, DP = Production difference

Yo.DA = Policy affect

Ao.DY = Technology affect

DA. DY = Interaction affect of Policy and Technology

To calculate Cost of Cultivation : The methodology given by CACP, New Delhi was adopted to calculate the total cost of cultivation of paddy crop. Total cost (TC) component divided in to Total Variable Costs (TVC) and Total Fixed Costs (TFC). Total variable costs included value of human labour, bullock labour, machine labour, seed, fertilizers, Farm Yard Manure (FYM), Plant Protection Chemicals (PPCs), irrigation charges, miscellaneous charges and interest on working capital. Total fixed costs included depreciation of inputs, land cess, rental value of land and interest on fixed capital. Interest rates on working capital and fixed capital were 7% and 10% respectively.

Benefit Cost Ratio (BCR) = Gross return/Total costs (TC)

Where TC = Total Variable Costs (TVC) + Total Fixed Costs (TFC)

Gross returns are the total value of both main product and by-product obtained from crop.

Garret's Ranking : To rank the problems faced during maize production and marketing, the respondents were asked to rank the constraints given in the questionnaire from 1 to 5. 1 was given to most important constraint and 5 was given to least important constraint. The order of ranking as given by the sample respondents were converted in to percent position by using following formula.

$$\text{Percent position} = \frac{100\,(R_{ij} \quad 0.5)}{N_j}$$

Where R_{ij} = Rank given for i^{th} constraint by the j^{th} respondent

N_j = number of constraints ranked by the j^{th} respondent

The per cent position of each rank was converted into scores referring to the table given by (6). For each constraint, the scores of individual respondents were added together and divided by the total number of the respondents for whom scores was added. These mean scores for all the constraints were arranged in high to lower order and accordingly ranks were allotted to the constraints.

Results and Discussion

From table-1, it was evident that except in Visakhapatnam district, remaining two districts and entire zone showed positive growth rate in area for both periods. However, the growth in area was more in Period-I (9.00) than Period-II

Table-1 : Compound growth rates of area, production and productivity of maize in north coastal districts of Andhra Pradesh.

Districts	Area		Production		Productivity	
	P-I	P-II	P-I	P-II	P-I	P-II
Srikakulam	21.84	17.72	26.28	17.05	3.82	-0.55
Vizianagaram	11.82	6.13	10.91	8.98	-0.79	2.81
Visakhapatnam	-1.61	-3.99	1.99	-0.35	3.07	4.17
NCZ	9.00	8.91	11.77	11.13	2.21	1.84

Table-2 : Coefficient of Variation (CV%) in area, production and productivity of maize in north coastal districts of Andhra Pradesh.

Districts	Area		Production		Productivity	
	P-I	P-II	P-I	P-II	P-I	P-II
Srikakulam	0.69	0.45	0.77	0.52	0.13	0.12
Vizianagaram	0.34	0.17	0.34	0.25	0.07	0.13
Visakhapatnam	0.06	0.14	0.18	0.10	0.19	0.16
NCZ	0.27	0.24	0.39	0.32	0.07	0.09

Table-3 : Policy and technology affect on change in production of maize in north coastal districts of Andhra Pradesh.

Districts	Technology affect		Policy affect		Interaction affect	
	P-I	P-II	P-I	P-II	P-I	P-II
Srikakulam	3.53	-2.56	77.14	109.21	19.32	-6.65
Vizianagaram	3.43	14.03	91.53	71.95	5.04	14.02
Visakhapatnam	131.62	-68.4	-19.66	139.09	-11.97	29.32
NCZ	15.15	6.83	67.00	85.24	17.85	7.92

(8.91). Similar trend was noticed in production for all three districts during Period-I. During Period-II, Visakhapatnam recorded negative growth rate in production (-0.35). The main reason for negative growth rate was decrease in area. The productivity showed negative growth rate in Srikakulam (-0.55) and Vizianagaram (-0.79) during Period-II and Period-I respectively. Both production and productivity showed positive growth trend for both periods, but Period-I recorded more growth than Period-II. The main reason for higher growth during Period-I was farmers were gradually shifting their focus from pulses to maize in view of its profitability. Even during Period-II, the area under maize increasing but not on par with Period-I.

Instability in area (0.27%) had higher effect on production than productivity (0.07) during Period-I for entire north coastal zone (Table-2). Except Visakhapatnam, remaining two districts also had similar effect on production. In Visakhapatnam, productivity (0.19%) had more effect on production than area (0.06%). Due to dominance of sugarcane crop in Visakhapatnam, farmers were not interested to go for maize even though yields were more. In Period-II, instability in area (0.24%) had more effect on production than productivity (0.09%) like Period-I. During Period-II, the area under maize more or less same, hence area effect on production slightly reduced than Period-I. Visakhapatnam district was exception where instability in productivity (0.16%) was higher than area (0.14%) even in Period-II.

Table-3 showed that policy affect (67.00) was higher than technology affect (15.15) and interaction affect (17.85)) during Period-I for entire north coastal zone except Visakhapatnam district where technology affect (131.62) was higher than policy affect (19.66) and interaction affect (-11.97). Hence, instability in area had higher effect on production than productivity in Visakhapatnam district. During Period-I, policy affect was more on production than technology affect. The magnitude of technology affect ranged between 3.43 (Vizianagaram) to 131.64 (Visakhapatnam) and policy affect ranged between -19.66 (Visakhapatnam) to 91.53 (Vizianagaram) during Period-I. However, during Period-II, the scenario was changed and the technology effect (-68.40) was less than policy affect (139.09) in Visakhapatnam district. Like Period-I, for north coastal zone, except Visakhapatnam, policy affect (85.24) was higher than technology affect (6.83) and interaction affect (7.92) during Period-II. In north coastal districts, increase in the production was mainly due to increase in area rather than productivity. The main reason behind this was lower yield levels of maize in this zone.

Comparative economics of normal sown vs zero tillage maize : The results from table-4 displayed the values of different inputs used, interest on working and fixed capital and values of output *etc*. Among the total costs, human labour occupied major share (27.63%) followed by rental value of land (20.91%), machine labour (17.02%), fertilizers (11.38%), seed (5.95%), irrigation charges (4.15%), PPCs (3.87%), FYM (3.40%) and bullock labour (2.88%) in normal sown maize. Whereas in zero tillage maize, human labour (32.39%) had major

Table-4 : Comparative economics of normal sown maize vs zero tillage maize in North Coastal Zone (NCZ) of A.P.

S. No.	Particulars	Unit	Normal sown maize			Zero tillage maize		
			Quantity	Value (Rs.)	% to TC	Quantity	Value (Rs.)	% to TC
I.	**Variable Costs**							
	Human labour	MD	75.56	21297	27.63	70.33	20691	32.39
	Bullock labour	BP	3.27	2219	2.88			
	Machine labour	Hr	12.52	13115	17.02	6.32	6783	10.62
	Seed	Kg	20.48	4589	5.95	25.22	5511	8.63
	FYM	T	3.61	2618	3.40			
	Fertilizers	Kg	765.45	8774	11.38	790.12	8914	13.95
	PPC's	Lt	2.67	2984	3.87	2.55	3266	5.11
	Irrigation	No.	3.41	3201	4.15	2.82	2678	4.19
	Interest on working capital	Rs.		686	0.89		552	0.86
	TVC	Rs.		59483	77.17		48395	75.75
II.	**Fixed Costs**							
	Depreciation	Rs.		635	0.82		518	0.81
	Land cess	Rs.		274	0.36		257	0.40
	Rental value of land	Rs.		16116	20.91		14219	22.26
	Interest on fixed capital	Rs.		568	0.74		500	0.78
	TFC	Rs.		17593	22.83		15494	24.25
III.	TC=TVC+TFC	Rs.		77076	100		63889	100
IV.	**Output**							
	Main product	Qtl	60.14	106808		55.62	98503	
	Bi-product	Qtl	27.30	3112		22.14	2472	
	Gross returns	Rs		109920			100975	
V.	BCR on TVC			1.85			2.09	
VI.	BCR on TC			1.43			1.58	

*MD=Manday, BP=Bullock pair, hrs: hours, kgs: kilograms, lts: litres, qtl: quintals, t: tons, No.: Number, Rs.: Rupees, TVC: Total Variable Cost, TFC: Total Fixed Costs, TC= Total Cost.

Table-5 : Ranks assigned to constraints based on Garret's Ranking technique in maize production.

Constraints	TGS	MGS	Rank
Higher wages of labour	7980	66.50	I
Low yields	6330	52.75	II
Pest and disease damage	6120	51.00	III
Lack of technical knowledge	5070	42.25	IV
High prices of inputs	4290	35.75	V

*TGS= Total Garret's Score, MGS= Mean Garret's Score

Table-6 : Ranks assigned to constraints based on Garret's Ranking technique in maize marketing.

Constraints	TGS	MGS	Rank
Non remunerative price	7260	60.50	I
High transport charges	6510	54.25	II
Lack of market information	6240	52.00	III
Lack of storage facilities	5280	44.00	IV
Malpractices by middle men	4590	38.25	V

*TGS= Total Garret's Score, MGS= Mean Garret's Score

share in total costs followed by rental value of land (22.26%), fertilizers (13.95%), machine labour (10.62%), seed (8.63%), PPCs (5.11%) and irrigation charges (4.19%). The total variable costs were Rs. 59483/ha and Rs. 47895/ha in normal sown maize and zero tillage maize with a share of 77.17% and 75.75% respectively. There was a difference of Rs. 11088 per hectare noticed in case of zero tillage maize. This was mainly due to lack of preparatory cultivation before sowing in zero tillage maize, no application of FYM in ploughing and mostly grown under residual moisture. All the attributes made zero tillage maize a cost-effective cultivation than normal sown maize. The fixed costs were also had difference of Rs. 2099/ha, and reported as Rs. 17593/ha (22.83%) and Rs. 15494/ha (24.25%) respectively in normal sown and zero tillage maize crops. However, the yields were slightly

higher in normal sown maize *i.e.,* 60.14 q/ha against 55.62 q/ha in zero tillage maize. In case of normal sown maize, all operations were practiced as per requirement, whereas in zero tillage maize, initial land preparation was not there which led to less germination, higher weed growth and more pest & disease incidence. Hence, zero tillage recorded lower yields than normal sown maize. Due to the decreased cost of cultivation in zero tillage maize led to higher BCR (1.58) than normal sown maize (1.43). Hence, zero tillage maize was cost effective practice for the farmers. The results are in confirmation with.

Production and Marketing Constraints : Increasing labour wages were the major production constraint in maize cultivation in the entire zone (Table-5). Due to the urban migration in search regular works, the labour availability for agricultural works gradually decreasing in the recent past. Hence, demand for labour during peak period increased and farmers had to pay as per the demand. Similar results were noticed in Rao *et al*., 2011 from his work on rice fallow maize. The next major production constraint was lower yields as it was witnessed from secondary data, the average yield of north coastal districts was very less when compared to high yielding districts of Andhra Pradesh *i.e.,* around 89 q/ha. Pest and disease damage was the third most important constraint as most of the maize grown under zero tillage method where proper land preparation was not takes place. Lack of technical knowledge regarding crop management and varieties selection also reduced the yields in this zone. High prices of inputs were the least ranked constraint and felt that it was also another reason behind increased cost of cultivation.

A brief view of table 6 revealed that “non remunerative price” was the major marketing constraint faced by the farmers. The price they received was not even Minimum Support Price (MSP). The results are in accordance with. Transportation charges were so high that farmers used to pay while selling their produce at markets. Lack of market information was another constraint as most of the farmers not well aware about market information. Illiteracy of farmers also one of the reasons for not having access for market information. Lack of storage facilities at panchayat level also forced the farmers to sell their produce immediately after threshing. Moreover, the marketable surplus with our farmers also too low to go for storage. Malpractices by the middle men was the constraint with least priority in this zone.

Conclusions

The positive growth rates were noticed in two periods of study in area, production and productivity in the entire north coastal zone. However, productivity growth rate was comparatively lower than area. Hence, instability in area had more effect on production than productivity in the zone. Further, policy affect on production differential was more than technology affect in the zone. These are all clearly indicating there was considerable increase in the area rather than yield. Hence, scientists should concentrate on developing high yielding varieties suitable to this zone. Moreover, the profitability was high in zero tillage maize, but slight decrease in yield was noticed when compared to normal sown maize. Scientists should do research to improve the yields in zero tillage maize as it gave more net income. Mechanization should increase to meet the labour scarcity in most of the operations. Farmers should sell the produce at MSP at government procuring centres would help them to get more revenue. By following above suggestions, farmers can able to increase the overall profits from maize cultivation in north coastal zone.

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