Present Scenario of Agricultural Growth and Patterns of Cropping Diversification in West Bengal

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Abstract

Agriculture is the main pillar of the Indian economy. We have estimated the growth rates of different agricultural crop production in West Bengal during 2000-11 to 2020-21. The secondary data on area, production and productivity of the selected crops are collected from the Ministry of Agriculture, EPWRF and different issues of Statistical Abstract of West Bengal. The growth rates of the area, production and productivity of the selected crops are estimated by using the exponential trend equation. The patterns of cropping diversification have been estimated by the using Simpson Diversification Index (SDI). The production growth rates in few high valued food crops, horticultural crops and commercial crops are significantly positive but most of the food crops are found to have an either negative or insignificant growth over the study period in the state. The production growth rates are significantly negative due to mainly negative area growth in the state. The Simpson Diversification Index score also represents that the cropping pattern of horticultural crops, oilseed and high valued food crops concentrate to its own group over the study period. The score of the index decreases over the study period. The cultivation of the traditional food crops and other traditional crops significantly decreased over the study period which means the index value of these crops significantly increased over the period.

Key words: Compound growth, Simpson diversification index, Crop diversification, Horticultural crops

One of India's principal agricultural states is West Bengal. Since the introduction of advanced seed-fertilizer-water technology for high yielding during the Green Revolution in the mid-1960s, Indian agriculture has undergone substantial expansion and change. Region-wise growth, however, has been uneven, and the new technology has had varying effects in different places at different periods. The 1970s saw the north-west take the lead at first, followed by a few states in the south. Beginning in the early 1980s, the eastern region had notable agricultural expansion following a period of stagnation. Since the early 1980s, the use of modern agricultural technology has made a significant contribution to the state's economic prosperity. The abrupt spike in growth in both rice acreage and rice output during the Green Revolution period marked a significant shift in West Bengal's rice economy. In addition to rice, which is the main crop grown there, West Bengal also produces other grains and pulses. However, due to rice's immense significance, West Bengal's development in total food grain production closely tracked that of rice. West Bengal has since maintained the region's most remarkable record of agricultural development. The state's non-food grains sector has grown significantly, and West Bengal's agricultural productivity has not only increased in the food grains sector. There has been an enormous amount of diversification [1]. Following an outstanding growth rate in the 1980s, West Bengal's principal crops have seen a dramatic fall in growth since the mid-1990s. The breakdown of output growth

throughout the state and across the districts demonstrates that yield growth is the primary driver of output growth. The yield component outweighed the area extension's impact. Since the 1980s, the state's growth has never been significantly attributed to changes in the cropping pattern. The state's output growth slowed down mostly due to a steep decline in yield growth in the 1990s [2]. In order to take advantage of globalization and attain a higher growth path in agriculture in the state, they analyzed the causes of the recent decelerating trend in West Bengal agriculture as well as its sources. Finally, it recommended implementing extension programmes that are appropriately adjusted with crop diversification dynamics. Since 2000–01, the yield rate of several food and cash crops has increased across the majority of West Bengal's districts, contributing to an improvement in agricultural production. The average harvest price from the previous year, the average amount of rainfall, and the average money wage rate of agricultural labourers all contribute positively to the increase in the average yield rate in agricultural production [3]. According to Bureau of Applied Economic and Statistics (BAES) land utilization data, net cropped area in the state fell 1.05 percent from 2000-01 to 2013-14. In 2000-01 state cropping intensity was 168%. It rose to 185% in 2014-15. West Bengal's agriculture is dominated by food grain crops which are classified as cereals and pulses. Some important cash crops grown in the state are oilseeds, jute, tea, potatoes, sugarcane etc. West Bengal produced more food grains than any other state in

India. Even though the state did well compare to other Indian states in producing food grains, there are signs that the growth rate of food grain production has slowed down in recent years.

Diversification raises agricultural output by switching from low-value to high-value crops. A crop's land use percentage is its cropping pattern. Area under different crops changes with cropping pattern or diversification. Food grain crops dominate West Bengal's cropping pattern due to its good soil and atmosphere [4]. Agriculture development was measured by a composite z-score from defined agricultural parameters and agricultural diversification by the Herfindahl index [5]. Crop diversity and agriculture development vary per district-wise in West Bengal. Irrigation, cultivators, gross sown area, and agricultural development as a whole all exhibit a strongly positive association with crop diversification, indicating that crop diversification has increased with agricultural progress. Some West Bengal districts have limited crop diversification due to lack of irrigation, frequent droughts, irregular rainfall, poor asset base, lack of knowledge and training, lack of finance, traditional agricultural practices, average land holding size, and per capita income.

MATERIALS AND METHODS

The study depends on mainly time series secondary data. We have collected time series data on area, production and productivity for major food grains, namely, rice, wheat, jowar, bajra, gram, ragi, keshor, arkud, total oilseed, Jute and Mesta, total spices, total horticultural crops, total vegetables, total fruits etc. in West Bengal from different issues of Statistical Abstract, BAES, and the Ministry of agriculture in India, Economic and Political Research Foundation from the period 2000-01 to 2020-21.

We have estimated the compound growth rates of area, production and productivity of different food crops, commercial crops and horticultural crops by using the exponential trend equation.

$$Yt = AB^t U_t \text{ .... (1)}$$

We have taken natural logarithmic method and transformation this equation turns into its linear form as follows:

$$lnY_t = lnA + (lnB)t + lnU_t$$
$$\text{i.e., } y_t = a + bt + u_t \text{ .... (2)}$$

The log transformation is representing by the small letters. Here compound growth rate is measured by $100 \times b$.

The student's t statistics has been used for checking the significance of the growth rates with n-2 degrees of freedom. Further, we have also checked the autocorrelation problem by using DW statistics and in its presence, we have used Cochrane-Orkut two steps procedure for correcting it using either first-order or second-order autoregressive scheme.

We have estimated the cropping diversification of different agricultural crops by using the most valuable index like, Simpsons diversification index (SDI in West Bengal.

The Simpsons Diversification index is a modified version of Herfindal Index. The following equations are given below:

$$SDI = 1 - \sum \left(\frac{n}{N}\right)^2 \text{ .... (3)}$$

Where n represents that the area of ith food crops (i = 1, 2, . . . 13); N indicates that the total gross cultivated area of the state. The index value lies between 0 to 1. If the index value is equal to 1 i.e. the cropping pattern completely diversified towards the food grains in the state. If the index value is equal to 0 i.e. there are no diversifications of the crops in the state.

Table 1 The estimated compound growth rates of area, production and productivity of the selected crops in West Bengal from 2000-01 to 2020-21

Crops	Area	Production	Yield
Rice	-0.4**	0.7***	1.1***
	(-2.70)	(3.55)	(13.10)
	[1.74]	[1.77]	[2.06]
Wheat	-1.4***	0.3*	1.3***
	(-4.09)	(2.29)	(7.06)
	[2.01]	[2.06]	[1.85]
Total cereals	-0.4**	1.0***	1.4***
	(-2.46)	(5.22)	(16.53)
	[1.64]	[1.59]	[1.76]
Total food grains	-0.2	1.1***	1.2***
	(-1.13)	(5.46)	(18.22)
	[1.35]	[1.50]	[2.21]
Jowar	-19.6***	-27.6***	0.2
	(-4.09)	(-5.29)	(0.75)
	[2.00]	[1.90]	[2.12]
Bajra	-4.7**	-11.4***	-5.2***
	(-2.36)	(-4.30)	(-5.48)
	[1.58]	[1.60]	[1.77]
Maize	11.5***	16.8***	5.3***
	(19.61)	(19.92)	(13.39)
	[1.84]	[1.49]	[1.43]
Ragi	-4.9***	-5.2***	-0.3
	(-4.22)	(-4.44)	(-0.98)
	[1.55]	[1.54]	[2.09]
Gram	-1.8*	1.0	1.6***
	(-1.90)	(0.80)	(6.06)
	[1.60]	[1.36]	[1.77]
Tur	1.0	4.0	3.0***
	(1.30)	(1.43)	(2.80)
	[1.38]	[1.75]	[2.48]
Peas	3.2***	5.5***	2.4***
	(4.80)	(6.02)	(3.54)
	[1.63]	[1.48]	[2.00]
Kulthi	-3.9***	-4.0***	-0.1
	(-4.39)	(-3.73)	(-0.18)
	[1.84]	[1.69]	[1.82]
Moog	9.8***	11.7***	1.9***
	(3.23)	(4.09)	(2.30)
	[2.26]	[2.28]	[1.88]
Urad	1.4*	1.8**	0.4
	(2.07)	(2.91)	(1.26)
	[1.47]	[1.59]	[2.02]
Kesari	4.9***	6.2***	1.3
	(3.92)	(3.83)	(1.45)
	[1.33]	[1.76]	[1.75]
Total pulses	3.4***	4.6***	1.2***
	(3.58)	(4.59)	(3.52)
	[1.58]	[1.71]	[2.20]
Oilseed	2.3***	4.0***	1.8***
	(10.66)	(11.79)	(6.57)
	[1.56]	[1.98]	[2.09]
Mustard	1.6***	3.6***	2.0***
	(4.39)	(6.47)	(6.39)
	[1.55]	[1.77]	[2.06]
Sesamum	4.1***	3.8***	-0.2
	(9.51)	(5.40)	(-0.42)
	[1.96]	[1.51]	[1.61]
Jute and Mesta	-1.0***	-0.3	0.8***
	(-8.21)	(-1.29)	(5.25)
	[1.66]	[1.99]	[2.15]
Total Spices	1.0	6.4***	5.4***
	(1.33)	(6.89)	(8.97)

	[1.76]	[2.26]	[2.22]
Total horticultural crops	1.5*** (18.14)	2.9*** (9.23)	1.4*** (4.45)
	[1.93]	[2.05]	[2.28]
Total vegetables	1.7*** (18.68)	3.1*** (26.63)	1.7*** (16.74)
	[2.28]	[1.89]	[1.98]
Total fruits	4.1*** (26.69)	5.7*** (12.71)	1.5*** (4.22)
	[1.96]	[1.54]	[1.99]

***Significant at 1% level, **Significant at 5% level, *Significant at 10% level. t- Values are within parentheses and D.W values are within square bracket

RESULTS AND DISCUSSION

Growth

The growth rates of selected crop production have been divided into five categories:
I. Significantly low growth which lies between 0 to 2%
II. Significantly medium growth which lies between 2 to 5%
III. Significantly high growth which lies above 5%
IV. Significantly negative growth
V. Insignificant growth

From the (Table 1) we exhibited that the production growth rates of five most important food crops namely, rice (0.7 percent) wheat (0.3 percent), total cereals (1.0 percent), total foodgrains (1.1 percent) and urad (1.8 percent) are lie in the category of significantly low growth while six other crops namely, oilseed (4.0 percent), peas (2.9 percent), mustard (3.6 percent), sesamum (3.8 percent), total horticultural crops (2.9 percent) and total vegetables (3.1 percent) lies in the category of significantly medium growth in the state. The production growth rate of maize is significantly very high with a value 16.8 percent followed by moog (11.7 percent), total spices (6.4 percent), kesari (6.2 percent) total fruits (5.7 percent) and peas (5.5 percent) in the state. The production growth rates of four other crops namely, Jowar (-27.6 percent), Bajra (-11.4 percent), ragi (-5.2 percent) and kulthi (-4.0 percent) are found to have significantly negative category in the state over the study period. Rest of the other crops namely, jute and mesta, gram and tur are found to have statistically insignificant i.e., the production growth rate is remained constant over the study period in the state [6-7].

The production growth rates of the few food crops namely rice, wheat, total cereals, total foodgrains and total spices increased by the mainly productivity growth in the state over the study period. The production growth rates of the three other crops namely kesari, urad and sesamum increased by the mainly area growth in the state. But in the case of the production growth rates of high valued food crops like, maize, peas, moog and total pulses, horticultural crops, total vegetables, total fruits, total pulses, mustard and total oilseed are increased by the both area and productivity growth in the state. The production growth rate is significantly negative of Jowar, jute and mesta, ragi, and kulthi due to mainly negative area growth in the state over the study period [8-9].

Table 2 Estimated results of Simpson Diversification Index in West Bengal from 2000-01 to 2020-21

Rice	Total foodgrains	Total cereals	Total pulses	Total oilseed	Jute and mesta	Total spices	Horticultural crops
0.645	0.539	0.579	0.999	0.996	0.995	0.988	0.977
0.615	0.516	0.550	0.999	0.996	0.995	0.988	0.979
0.623	0.527	0.562	0.999	0.996	0.995	0.988	0.977
0.633	0.532	0.567	0.999	0.995	0.996	0.988	0.976
0.631	0.538	0.569	0.999	0.995	0.996	0.988	0.975
0.632	0.543	0.574	1.000	0.996	0.996	0.991	0.974
0.652	0.564	0.593	1.000	0.995	0.996	0.987	0.971
0.656	0.575	0.600	1.000	0.995	0.996	0.989	0.971
0.633	0.555	0.580	1.000	0.995	0.996	0.990	0.970
0.651	0.571	0.596	1.000	0.995	0.996	0.990	0.969
0.687	0.604	0.631	1.000	0.994	0.996	0.990	0.962
0.663	0.582	0.608	1.000	0.995	0.996	0.990	0.966
0.669	0.586	0.613	1.000	0.994	0.996	0.990	0.966
0.671	0.574	0.612	0.999	0.994	0.996	0.990	0.966
0.692	0.600	0.632	0.999	0.994	0.997	0.990	0.966
0.688	0.583	0.627	0.999	0.994	0.997	0.992	0.965
0.673	0.576	0.612	0.999	0.993	0.997	0.992	0.964
0.735	0.643	0.696	0.998	0.991	0.997	0.992	0.965
0.694	0.592	0.649	0.998	0.991	0.997	0.992	0.962
0.697	0.579	0.639	0.998	0.991	0.997	0.992	0.962
0.687	0.562	0.621	0.998	0.991	0.997	0.984	0.962

Diversification

From (Table 2), we have seen that the Simpson Diversification Index score represents that the cropping diversification of few most important food crops is prevailing in the states over time. The increasing index value from 0.645 in 2000-01 to 0.687 in 2020-21 indicates that the cropping pattern is diversified from rice to the other high valued crops over the study period. In the case of total foodgrains and total cereals, we also observe that the cropping pattern diversified to the other high valued crops or commercial crops [10]. The index value has increased from 0.539 to 0.579 for total foodgrain and from 0.579 to 0.639 for total cereals in the state. The estimated SDI value did not give any clear picture about the concentration or diversification of the cropping pattern for total pulses in the state. But in the case of oilseed and horticultural crops, we observed that the estimated index clearly indicates that the cropping pattern concentrated to its own group i.e., the cultivation of oilseed and horticultural crops has been continuously increasing in this state. The index value of these two crop groups is decreased from 0.96 to 0.991 for oilseed and 0.997 to 0.962 in the state. The index value of other commercial crop like total spices indicates that the pattern of this crop

cultivation has diversified to the other crops. Its value increased from 0.988 to 0.991 over the study period in the state [11-13].

CONCLUSION

From the analysis we have seen that the estimated production growth rates of few food crops like, rice, wheat, moog, kesari, urad and maize are found to have significantly positive growth but most of the other food crops in the state experienced either negative or insignificant growth in this production over the study period. In the case of horticultural crops and few oilseed crops, we observe that the production growth rate is significantly positive. The growth rates of area are either negative or insignificant for most of the traditional food crops and other traditional commercial crops in West Bengal over the study period. The production growth rates of traditional food crops like rice, wheat, total cereals and total foodgrains occurred due to mainly productivity growth. Productivity growth rates were also significantly positive for total spices where positive production growth occurred where as both area and productivity played significantly positive role for improvement of production growth in horticultural crops. From this scenario, we may conclude that the farmers probably changed their cropping pattern from traditional paddy crops to other high valued crops or horticultural crops in the country. The Simpsons diversification index score also validate this argument because the score of indices in traditional food and traditional commercial crops has continuously increased over the study period. Also, the Indian agriculture in respect of food crops specifically paddy and wheat are mostly experiencing the deceleration or at best stagnation hypothesis in its agricultural production in the state.

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