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The Nature of Instability of Oilseed Production in East Burdwan District from 1993-94 to 2017-18: A Block Level Study

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ABSTRACT

Oilseed production plays an important role in the betterment of the Indian economic condition. The study examined the nature and magnitude of instability for two selected oilseed crops, namely, sesame and mustard in the East Burdwan district during 1993-94 to 2017-18. This study estimated the nature of instability by using two methods, one is the trend line fitting method, and the other is measuring Spearman rank correlation. The study also used a separate measure to know the magnitude of instability in the output of each crop for the whole period and sub-periods by using the arithmetic mean, excluding the strong outliers. Secondary data on the production of sesamum and mustard are collected from different issues in the District Statistical Handbook of East Burdwan. The production instability of oilseed for most of the blocks is increasing over the study period in the district. Further, the study also estimated the instability of oilseed production in two sub-periods in the district. The study observed that the production instability of oilseed is comparatively low in the first sub-period compared to the second sub-period in the district.

Key words: Instability, Oilseed, Spearman rank correlation, De-trend statistics

India produces a large number of crops, including cash crops, oilseeds, pulses, and cereals. Aside from grains, oilseeds are one of the important crops farmed in India [1]. An estimated 39669.4 thousand tonnes of oilseed were produced in 2023–2024 on 30192.3 thousand hectares of land in India. With 1002.4 thousand hectares of area dedicated to oilseed production in West Bengal, or around 3.32% of the total area under oilseed cultivation, West Bengal is one of the important oilseed-producing states in the nation. In 2023–2024, West Bengal produced 1333.4 thousand tonnes of oilseeds, or 3.36 percent of all oilseeds produced in India. The main oilseed crops grown in West Bengal are sesame and mustard.

Because of their extensive use and adaptability, oilseed crops are vital to agriculture and the economy. One of the most significant cash crops of India's agricultural economy is edible oil seed [2]. After exhibiting a variable trend before 2016, India's oilseed production has been gradually increasing since 2016–17. Between 2015–16 and 2020–21, India's oilseed production increased by over 43%. India is the world's top importer of vegetable oil and its second-largest consumer [3]. It is anticipated that traditional eating patterns and dietary habits would change towards processed foods with a high vegetable oil content as urbanisation rises in developing nations [4].

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Because of India's rapid population expansion and ensuing urbanisation, it is anticipated that the country will continue to consume a lot of vegetable oil [5]. However, India's oil demand has outpaced its supply, making it necessary to import in 1980s. However, self-sufficiency in oilseeds production was achieved during the early 1990s' due to the policy of "Yellow Revolution". This sufficiency could not be maintained for very long [6]. The use of vegetable oil for both industrial and consumable purposes has increased dramatically in recent years. Sixty per cent of the nation's edible oil needs are met by imports due to the demand-supply imbalance. As the nation's population, urbanisation, and per capita income have all continued to rise, so is the need for edible oils, oilseeds, and oilcake meals [7].

Despite having the world's largest oilseed cultivation area, India now consumes less than sufficient essential nutrients, that is necessary for good health. The expansion in oilseed supply has lagged considerably behind the growth in demand, prompting the government to resort to large-scale imports of edible oil to fill the gap. Achieving self-sufficiency became crucial given the significant drain on foreign reserves from importing edible oil to meet domestic needs. The government has established an oilseed technological mission to work towards oilseed self-sufficiency [8]. The yield of oilseeds has increased dramatically in recent years due to the technology mission's coordinated efforts on all oilseeds. However, the production of oil seeds varies from year to year because of disparities in rainfall across regions. Research on oilseed production in India is essential, given the country's heavy reliance on imports of edible oil. Oilseed production is highly unstable due to its reliance on rainfall [9]. To identify the instability in oilseed production and the variables causing the change in crop output, it is crucial to analyse crop output fluctuations.

Instability means variability or fluctuation in the variable concerned over time. Agricultural Instability means fluctuation in agricultural production, area, or yield [10]. Fluctuations in agricultural production occur due to various reasons like price changes in agricultural products and inputs, variation in rainfall, change in soil condition, technical changes, change in weather conditions, etc. [11]. After the Green Revolution, we got a breakthrough in achieving self-reliance in Indian agriculture. But in recent years agricultural scenario in the country is not very encouraging due to an enormous rise in prices of agricultural inputs coupled with more or less constancy of prices of agricultural outputs, consequently, it is no longer a profitable business to producers. Farmers' suicides have become a common phenomenon in many places of the country. Further, in several agriculturally developed regions, it is found that the 'deceleration hypothesis' has set in. Under this circumstance the study wants to probe the actual state of oilseed cultivation, we like to measure its instability in production, during the post-reform period (more specifically since 1993-94).

MATERIALS AND METHODS

Data base

We have selected the study period from 1993-94 to 2017-18 for evaluating the agricultural instability of oilseed production in the East Burdwan district. East Burdwan district has been divided into 22 numbers of blocks. We have divided the study period into two sub-periods, viz., early liberalization period (1993-94 to 2005-06) and mature liberalization period (2006-07 to 2017-18). We have taken the time series secondary data for our study. The block-wise data on production (in hundred tones), for two crops, namely, sesamum and mustard, are collected from different issues of the Statistical Handbook during 1993-94 to 2017-18.

Methodology for measurement of agricultural instability

Agricultural Instability means the fluctuation around the growth trend of agricultural production or area or yield. Fluctuations in agriculture growth occur due to various reasons like, price changes in agriculture products and inputs, variation in rainfall, change in soil condition, technical changes, change in weather conditions, etc.

From the literature survey we have observed that there are so many methods used for the estimate of production instability namely, coefficient of variation method, Cuddy-Della Valle index, trend line fitting method etc. Boyce [12] used the trend fitting method and Chattopadhyay (2001) also used the detrend statistics for estimation of instability. The study estimated the nature of instability by using two methods, one is trend line fitting method and other is measuring Spearman rank correlation method. The statistic used for measuring nature of instability is absolute value of:

$$X_t \text{ where } X_t = \frac{Y_t - \hat{Y}_t}{\hat{Y}_t} = \frac{e_t}{\hat{Y}_t}$$

Here $\hat{Y}_t$ and e_t are estimated value of Y_t (i.e., agricultural production) and residual respectively obtained by fitting exponential trend on agricultural production for the whole period. Next Spearman rank correlation is estimated between $|X_t|$ and t. Further, to get trend measure of instability the study estimate $|X_t|$ = a+ bt. The parameters a and b have been estimated using OLS. When b takes significantly positive value, the instability is said to be increasing over time. When b takes significantly negative value, this implies that the instability decreases over time. But when b is found to be insignificant, there will be no change in instability over time. Similarly, the sign of Spearman's rank correlation helps us to conclude the nature of instability.

From the nature of instability using the detrended statistic, the study can only infer regarding the movement of instability over time (i.e., whether it is increasing or decreasing or not over time). But the study cannot estimate the actual magnitude or extent of instability over the study period from this measure. The study also used a separate measure to know the magnitude of instability of each crop output for the whole period and sub-periods by using the arithmetic mean of X_t, excluding the strong outliers. The strong outliers have been detected from a graphical representation of the absolute value of $X_{t,}$ and excluding the outliers. The study calculated the me values of $|X_t|$ for the whole period and sub-periods separately.

RESULTS AND DISCUSSION

Nature of instability

Data depicted in (Table 1) indicates that the production instability is significantly increasing for a few blocks, like Ausgram-II, Purbasthali-I, Purbasthali-II and Jamalpur, while two other blocks, namely, Katwa-I and Mangalkote have experienced significantly declining production instability in sesamum during the study period. There are sixtenteen other blocks, namely, Ausgram-I, Monteswar, Kalna-I, Kalna-II, Katwa-I, Ketugram-I, Ketugram-II, Khandaghosh, Raina-I, Raina-II, Memari-I, Memari-II, Galsi-I, Galsi-II, Bhatar and Burdwan Sadar, which are found to have unchanged instability in sesamum production over time in the district [13].

In the case of mustard production, the study observed from (Table 2) that the production instability has increased at Ausgram-I, followed by Ausgram-II, Kalna-I and Kalna-II, while three other blocks, namely, Katwa-I, Khandaghosh and Raina-I have registered declining instability in mustard production in the district. Further, the study observed that the production instability remains unchanged for rest 14 blocks, namely, Monteswar, Purbasthali-I, Purbasthali-II, Katwa-II, Ketugram-I, Ketugram-II, Mangalekote, Raina-II, Jamalpur, Memari-II, Galsi-I, Galsi-II, Bhatar and Burdwan Sadar in the district over the study period.

Level of instability in oilseed production in East Burdwan

From the nature of instability using the de-trend statistic, we can only infer regarding the movement of instability over time (i.e., whether it is increasing or decreasing or remaining unchanged over time). But we cannot estimate the actual magnitude or extent of instability over the study period from this measure. To get the measure of extent of instability we have divided the study period (from 1993-94 to 2017-18) into two sub-periods, one is early liberalization period (1993-94 to 2005-06) and other is matured liberalization period (2006-07 to 2017-18) as before. Then we have used a separate measure for knowing the magnitude of instability of each crop output for the whole period and also for two sub-periods by using the arithmetic mean of X_t (defined earlier), excluding the strong outliers. The strong outliers have been detected from a graphical representation of the absolute values of $X_{t,}$ having their unusual distribution.

The magnitude of instability is measured in 33 cases, which are further subdivided into three types:

1. Low instability whose value is less than 0.5. ($I_1 < 0.5$)
2. Medium instability whose value lies between 0.5 to 1. ($0.5 < I_2 \leq 1$)
3. High instability whose value is more than 1. ($I_3 > 1$)

Data in (Table 1) presents that the production instability of the sesamum crop belongs to the low category at Purbastali-II with a value of 0.2875 and Jamalpur with 0.1881. Two other blocks, namely, Ausgram-II and Purbasthali-I, are found to have the highest instability in sesamum production during the study period, with values 2.0057 and 1.3118, respectively. In the case of Mustard, we see (Table 2) that the Kalna-II block recorded the highest instability in production with a value of 2.3288. Kalna-I block is found to have medium instability in mustard production with a value of 0.5719. Further, there are two other blocks, namely, Ausgram-I (0.1543) and Ausgram-II (0.1689), belonging to the low category in mustard production during the study period in the district.

Table 1 Nature and extent of instability in sesamum production in different blocks in Burdwan, 1993-94 to 2017-18

Block	Nature of instability		Strong outlier(s)		Value of the Summary measure, mean of $\|Z_t\|$		
	$\hat{b}$ (Parametric)	Rank correlation (Non-parametric)	Year(s)	Extreme value(s)	Whole period (1993-94 to 2017-18)	1st sub (1993-94 to 2005-06)	2nd sub (2006-07 to 2017-18)
Ausgram-I	0.250	0.387	2004-05	25.59	2.4884	1.6117	3.9497
	(0.974)	(0.125)					
Ausgram-II	0.294***	0.836	2001-02	13.61	2.0057	1.0218	3.1536
	(2.051)	(0.000)	2012-13	8.61			
Monteswar	0.093	0.064	2007-08	9.79	1.0452	0.8848	1.2322
	(0.742)	(0.820)	2004-05	5.97			
Kalna-I	-0.042	0.029	2001-02	15.31	2.3034	2.6762	1.8774
	(-0.133)	(0.911)	2003-04	27.95			
Kalna-II	-0.119	-0.415	1996-97	7.08	2.0011	2.3138	1.7779
	(-1.290)	(0.140)	2002-03	6.59			
Purbasthali-I	0.267*	0.821	2008-09	7.27	1.3118	0.7006	2.0249
	(3.711)	(0.000)	2010-11	6.84			
Purbasthali-II	0.025**	0.564	2004-05	0.87	0.2875	0.2063	0.3958
	(2.199)	(0.018)	2006-07	0.87			
			2011-12	1.05			
Katwa-I	0.164	0.319	2006-07	14.41	1.8222	1.1841	2.4603
	(1.163)	(0.213)					
Katwa-II	-0.178***	-0.459	-	-	2.6252	3.4944	1.9493
	(-2.006)	(0.074)					
Ketugram-I	0.136	0.444	2002-03	8.26	1.5200	1.0524	2.0656
	(0.915)	(0.085)	2004-05	10.44			
			2006-07	7.47			
Ketugram-II	0.014	0.093	2003-04	7.47	1.0170	0.7714	1.2626
	(0.147)	(0.762)					
Mangalkote	-0.248**	-0.777	1996-97	10.18	1.3577	2.2660	0.6512
	(-2.786)	(0.000)					
Khandagosh	-0.317	-0.509	1998-99	19.33	3.7302	4.8710	2.7320
	(-1.511)	(0.044)					
Raina-I	-0.026	-0.304	1995-96	1.51	0.4798	0.5060	0.4594
	(-1.342)	(0.219)	2001-02	1.62			
Raina-II	-0.036	-0.569	1995-96	1.87	0.4174	0.4581	0.3857
	(-1.599)	(0.014)	2002-03	2.15			
Jamalpur	0.014***	0.334	2012-13	0.85	0.1881	0.1766	0.2025
	(1.992)	(0.149)					
Memari-I	-0.007	-0.156	2001-02	1.51	0.8043	0.8807	0.7193
	(-0.339)	(0.523)	2002-03	1.93			
			2006-07	1.84			
Memari-II	0.228	0.143	2005-06	17.88	2.0014	1.6230	2.4429
	(0.678)	(0.612)	2006-07	25.51			
Galsi-I	-0.399	0.011	1996-97	30.68	1.9210	2.9187	1.4221
	(-1.107)	(0.972)					
Galsi-II	-0.195	-0.704	1996-97	11.20	0.5737	0.8376	0.4272
	(-1.647)	(0.003)					
Bhatar	0.284	0.391	2006-07	21.47	2.9238	2.0235	3.7116
	(1.104)	(0.134)					
Burdwan Sadar	0.055	0.093	2012-13	5.61	1.3576	1.3642	1.3510
	(0.915)	(0.722)					

*Significant at 1% level, **Significant at 5% level, ***Significant at 10% level

$\hat{b}$ is the parameter estimated from $|X_t| = a + bt$, Rank correlation is between $|X_t|$ and t, t ratios are in the parentheses

From (Table 1), the study observed that the production instability belongs to the low category at Purbasthali-II and Jamalpur block in both the sub-periods, with values 0.2063 and 0.1766 in the first sub-period, and 0.3958 and 0.2025 in the second sub-period. Ausgram-II block recorded the highest instability in sesamum production during both the sub-periods, with values 3.1536 in the second sub-period and 1.0218 in the first sub-period. Purbasthali-I block experienced medium instability in sesamum production during the first sub-period (0.7006), but during the second sub-period, it is found to be high with a value of 2.0249 [14-15].

As revealed in (Table 2), presents that the production instability of mustard is low at the Ausgram-I and Ausgram-II blocks in both the sub-periods in the district, the respective values are 0.1048 and 0.0948 in the first sub-period, and 0.2039 and 0.2616 in the second sub-period [16-18]. Kalna-I block experienced low instability in mustard production in the first sub-period (0.4558), while its production instability is medium in the second sub-period (0.7378). Kalna-II block registered the highest instability in mustard production (4.6563) during the second sub-period in the district, while its instability in the first sub-period was in the medium range with a value of 0.7772.

Table 2 Nature and extent of instability in mustard production in different blocks in Burdwan, 1993-94 to 2017-18

Block	Nature of instability		Strong outlier(s)		Value of the Summary measure, mean of $\|Z_t\|$		
	$\hat{b}$ (Parametric)	Rank correlation (Non-parametric)	Year(s)	Extreme value(s)	Whole period (1993-94 to 2017-18)	1st sub (1993-94 to 2005-06)	2nd sub (2006-07 to 2017-18)
Ausgram-I	0.011*** (1.738)	0.589 (0.008)	2002-03	0.65	0.1543	0.1048	0.2039
Ausgram-II	0.024* (4.500)	0.719 (0.001)	2012-13	0.69	0.1689	0.0948	0.2616
Monteswar	-0.006 (-1.489)	-0.251 (0.300)	-	-	0.1240	0.1433	0.1024
Kalna-I	0.044*** (1.908)	0.288 (0.247)	2010-11	2.11	0.5719	0.4558	0.7378
Kalna-II	0.975** (2.196)	0.616 (0.006)	2006-07 2007-08 2008-09	29.06 39.06 30.64	2.3288	0.7772	4.6563
Purbasthali-I	-0.003 (0.394)	-0.0393 (0.705)	-	-	0.2708	0.2773	0.2636
Purbasthali-II	-0.001 (-0.334)	-0.061 (0.803)	-	-	0.1309	0.1463	0.1139
Katwa-I	-0.010*** (-1.772)	-0.367 (0.123)	-	-	0.2329	0.3018	0.1564
Katwa-II	-0.001 (-0.302)	-0.037 (0.881)	-	-	0.2202	0.2254	0.2145
Ketugram-I	0.003 (0.931)	0.130 (0.596)	-	-	0.1395	0.1350	0.1444
Ketugram-II	-0.003 (-0.488)	-0.157 (0.548)	2001-02	0.41	0.1139	0.1258	0.1021
Mangalkote	0.001 (0.152)	0.137 (0.576)	1998-99 2003-04	0.35 0.42	0.0974	0.0739	0.1240
Khandagosh	-0.016** (-2.870)	-0.519 (0.023)	1993-94 1995-96 1996-97	0.59 0.55 0.48	0.1415	0.1546	0.1312
Raina-I	-0.020*** (-2.045)	-0.395 (0.094)	-	-	0.3448	0.4035	0.2795
Raina-II	-0.001 (-0.177)	0.002 (0.993)	1994-95 2000-01	0.47 0.41	0.1659	0.1339	0.1939
Jamalpur	-0.002 (-0.339)	-0.072 (0.770)	2007-08	0.41	0.1686	0.1763	0.1590
Memari-I	0.011 (1.702)	0.389 (0.099)	-	-	0.2478	0.2183	0.2807
Memari-II	0.003 (0.391)	0.156 (0.523)	2002-03	0.83	0.1471	0.1055	0.1886
Galsi-I	0.002 (0.504)	0.125 (0.611)	-	-	0.1548	0.1609	0.1479
Galsi-II	0.001 (0.305)	0.000 (1.000)	2008-09	0.37	0.1296	0.1226	0.1384
Bhatar	-0.005 (-1.096)	-0.218 (0.371)	1996-97	0.50	0.1363	0.1449	0.1277
Burdwan Sadar	-0.002 (-0.274)	-0.051 (0.836)	1998-99	0.55	0.1501	0.1156	0.1845

*Significant at 1% level, **Significant at 5% level, ***Significant at 10% level

$\hat{b}$ is the parameter estimated from $|X_t|$ = a+ bt, Rank correlation is between $|X_t|$ and t, t ratios are in the parentheses

CONCLUSION

After the yellow revolution, the nation achieved great strides in oilseed production, but now the growth rate of oilseed production remains constant. More than half of the nation's domestic needs are still met by imports from other countries, and this percentage will undoubtedly rise in the days ahead as a result of population pressure and rising per capita consumption. This area needs to be addressed immediately, or there will undoubtedly be a greater reliance on imports. This significantly affects the balance of payments of the country. The nation currently spends about 74,000 crores on vegetable oil imports, and at the current rate, that amount will rise to more than 80,000 crores over the next five years. The instability of oilseed production in East Burdwan district also increased at a higher rate due to the climate shock and price fluctuations in the district. To get the nation and East Burdwan closer to self-sufficiency, oilseed growers must be supported through research and development, long-term planning, government regulations, and competitive output pricing.

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