GROWTH PERFORMANCE OF NIGER CROP: A STATE-WISE ANALYSIS

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Introduction and Objectives

Niger (Guizofia abyssinica L.f. Cass.) is said to be indigenous to tropical Africa. It comprises of about 3.3% of total acreage and 1.7% of total production of all nine major oilseeds in India (Dinakar, 1988). Niger is cultivated mostly by tribal farmers on marginal and submarginal lands and as an intercrop or border crop (Murthy, 1985). Niger oil is edible and mainly used as a substitute for gingelli oil. It is used for culniary purposes, anointing body, manufacturing of paints, sort soaps, cosmetics, lighting, and lubrication (ICAR, 1984a). Niger cake is a good cattle feed. In India, it is mainly grown in Bihar, Madhya Pradesh, Maharashtra, and Orissa and these four states put together constituted about 87 and 89% of area and production respectively during 1987/88 (1988) (Agricultural Situation in India, 1989).

Since majority of the area under niger cultivation is in the hands of tribal farmers, there is no appreciable break through in production. Also, there is a need to develop technology that suits the tribal social, economic, and cultural practices. Foreign exchange earnings from niger seed exports is about Rs.130 millions and is mostly from General Currency Area (The Economic Times, 1989). However, there is no critical study on niger crop.[1] The over all objective of the paper is to study the past

[1] Government of India conducted a descriptive study on niger seed in 1971.

performance in production, exports, and research on niger crop in India. The present paper is an attempt in that direction.

Broadly, the study aims at: (a) examining the relative shares and trends in acreage, yield, and production in major niger cultivating states during 1964/65 to 1987/88, (b) studying the instability in acreage, yield, and production, (c) analysing the impact of prices on acreage under niger, (d) observing the pattern of changes in export earnings from niger seed, and (e) indicating the need for change in niger research policies.

Data and Methodology

Data on acreage, yield, and production on niger are collected from various issues of Agricultural Situation in India. Data on prices are culled out from Government of India (1977, 1982, and 1987). Foreign exchange earnings from niger are taken from various issues of Monthly Statistics of the Foreign Trade of India. The growth rates are estimated using linear, semilog, and double-log functional forms[2], and coefficient of variation (C.V) is used to measure instability. Nerlove's lagged expectation model is resorted to find out impact of prices on acreage (Nerlove, 1958).

The results are arranged in two sections. Section one deals with production and related aspects among major niger producing

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[2] For a detailed explanation on growth rates see: Rao, V.M. (1980), "Methodological Issues in Measuring Agricultural Growth: Lessons of Recent Indian Researches", **Indian Journal of Agricultural Economics**, 35(2): 13-20.

states during 1965 (1964/65) to 1988 (1987/88); and section two analyses impact of prices on acreage and performance of export earnings from niger. And at last summary and conclusions are discussed.

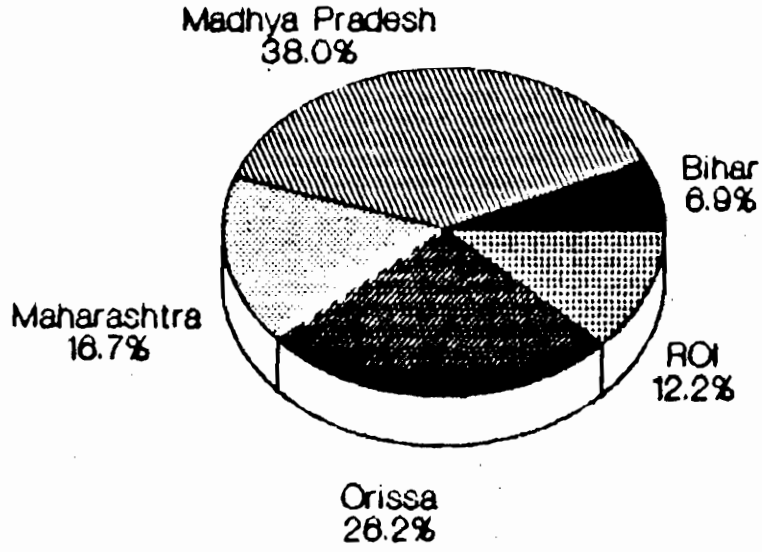
SECTION I

Relative Shares in Area and Production

Relative shares of major niger growing regions in the Indian total niger acreage and production are shown in panels (A) and (B) of Figure 1. During the period 1981-85, Orissa contributed about 42% to total production with 26% area under cultivation. An examination of quinquennial averages discloses that the area under niger is largely concentrated in four states, namely, Bihar, Madhya Pradesh, Maharashtra, and Orissa (Table I). These four states accounted for 87% of the total area allocated for niger in the country during 1988. The relative importance of these states underwent a change with time. The share of Orissa and Maharashtra increased while that of Madhya Pradesh and Bihar declined very sharply. The share of Madhya Pradesh declined from 57% in 1965 to 34% in 1988; Bihar from 11 to 5%; while that of Maharashtra increased from 15 to 19%, and Orissa 10 to 29% during the same period.

Table II presents the average percentage contribution of different states to the over all production of niger. Of the total Indian production, Orissa contributed about 43% in 1988 followed by Madhya Pradesh with 25%, Maharashtra 15%, Bihar 6%,

Indian Niger Seed Acreage
(A)



Indian Niger Seed Production
(B)

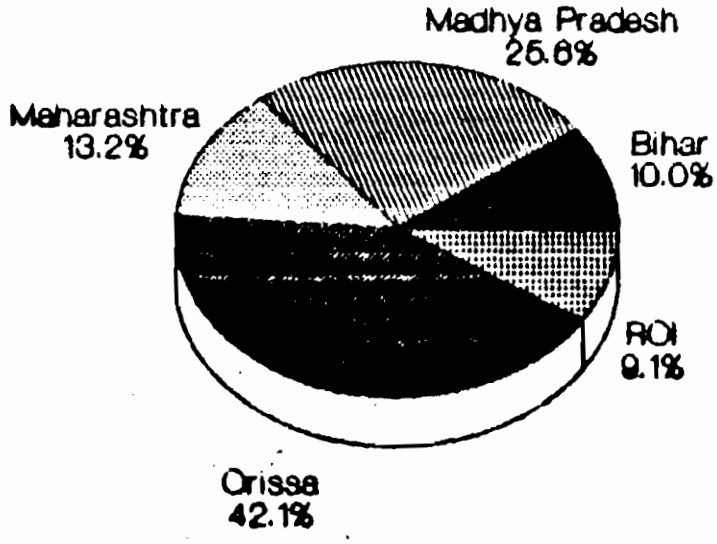


Figure 1: Relative Shares of Major Niger Growing States in Indian Niger Acreage, and Production, 1961-65

Table I: Relative Shares in Acreage Under Niger Across Different States, 1965-88

Period	Bihar	Madhya Pradesh	Maharashtra	Orissa	ROI	India
			000 ha			
1965	53.3(10.94)	278.3(57.15)	70.9(14.56)	47.0(9.65)	37.5(7.70)	487.0(100)
1966-70	46.9(9.67)	262.1(54.02)	78.4(16.16)	65.6(13.52)	32.2(6.63)	485.2(100)
1971-75	54.8(10.45)	268.4(51.16)	79.3(15.12)	82.7(15.76)	39.4(7.51)	524.6(100)
1976-80	51.7(8.65)	255.8(42.80)	104.8(17.54)	118.0(19.75)	67.3(11.26)	597.6(100)
1981-85	39.9(6.90)	220.0(38.06)	96.3(16.67)	151.4(26.19)	70.4(12.18)	578.0(100)
1986	37.0(5.93)	217.3(34.82)	95.9(15.38)	201.2(32.24)	72.6(11.63)	624.0(100)
1987	36.1(6.13)	220.8(37.49)	87.3(14.82)	171.5(29.12)	73.3(12.44)	589.0(100)
1988	33.7(5.17)	218.3(33.47)	121.9(18.69)	192.0(29.44)	86.3(13.23)	652.2(100)

Figures in parentheses are percentages to India total.

Table II: Relative Shares in Niger Production Across Different States, 1965-88

Period	Bihar	Madhya Pradesh	Maharashtra	Orissa	ROI	India
			000 tonnes			
1965	15.5(15.98)	51.1(52.68)	10.0(10.31)	14.8(15.26)	5.6(5.77)	97.0(100)
1966-70	13.8(14.89)	39.7(42.83)	13.2(14.24)	21.0(22.65)	5.0(5.39)	92.7(100)
1971-75	15.8(13.05)	46.0(38.02)	12.1(10.00)	36.2(29.92)	10.9(9.01)	121.0(100)
1976-80	18.3(13.78)	43.9(33.06)	14.4(10.84)	41.3(31.10)	14.9(11.22)	132.8(100)
1981-85	15.0(10.03)	38.3(25.60)	19.8(13.24)	62.9(42.05)	13.6(9.08)	149.6(100)
1986	13.6(7.16)	47.1(24.79)	20.7(10.89)	94.0(49.47)	14.6(7.68)	190.0(100)
1987	13.5(10.23)	32.1(24.32)	10.8(8.18)	60.5(45.83)	15.1(11.44)	132.0(100)
1988	10.9(6.23)	44.1(25.20)	26.2(14.97)	74.4(42.51)	19.4(11.09)	175.0(100)

Figures in parentheses are percentages to India total.

and the 'rest' 11%. The share of Madhya Pradesh in aggregate supply came down from 53% in 1965 to about 25% in 1988, and that of Orissa increased from 15 to 43% during the same period. However, these four states together still continue to dominate the scene despite an alteration in their relative importance.

Trends in Area, Yield, and Production

Of the alternative approaches that can discern the characteristics of observed changes, trend analysis may perhaps be identified as the simplest (Satyapriya, 1989, p.31). Following the above analysis, three trend functions; linear, semilog, and double-log; are fitted for the period 1965-88. All these functional forms have advantages in providing some readymade explanation to the trend coefficient. In the simple trend equation, the coefficient, b, indicates **change by constant amount from year to year**, while in the semilog functional form the coefficient happens to be the **exponential growth rate** or it depicts **constant ratio of change over the data period**. The coefficient in double-log is the **readymade estimate of growth elasticity which is assumed to be constant over the data period.**

The best fitted functions[3] considered are presented in Appendix A. Out of the 18 functions selected, 7 are semilog, 6 linear, and the rest double-log. Most of the trend coefficients are significant and the adjusted coefficient of determination (R^2) ranged between nil to 86%.

A comparison of exponential growth rates[4] of area, yield, and production is made in Table III. At the all-India level growth rate is 1.19, 1.54, and 2.70% respectively for area, yield, and production. While the exponential growth rate for area is positive in Maharashtra, Orissa, rest of India, it is negative in the case of Bihar and Madhya Pradesh. As of yields, exponential growth rate is positive for all the regions studied and is highest in Bihar. Though the growth rate of area in Bihar is negative, the positive growth rate of yield has offset the negative impact of area. Thus, across states the exponential growth rates for area, yield, and production varies substantially.

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[3] Statistical criteria of evaluation include t-test, R^2, and the standard error of the estimate. The econometric criteria include the test for autocorrelation, heteroskedasticity, and multicollinearity. The forecasting performance of the estimated equation is also judged by various criteria, the most common being the Theil's inequality coefficient. For more details, see Koutsoyiannis, A. (1985), and Gujarati, D.N. (1988).

[4] Exponential growth rates are constructed from the semilog functions and the parameter b is taken as exponential growth rate. This is not correct. The correct formula for the purpose is (e^b-1). However, for small values of b the error is not large (Dandekar, 1980).

Table III: A Comparison of Exponential Growth Rates of Area, Yield, and Production, 1965-88

State	Area	Yield	Production
	%/annum		
Bihar	-1.51*	1.55*	0.04
Madhya Pradesh	-1.11**	0.59	-0.45
Maharashtra	1.44**	1.19	2.45*
Orissa	5.77**	0.95	6.73**
Rest of India	4.94**	0.55	5.48**
India	1.19**	1.54**	2.70**

** Significant at 1% level of significance.
* Significant at 5% level of significance.

Source: Appendix A.

Fluctuations in acreage, yield, and production are measured by the coefficients of variation (C.V.). The state-wise estimates of C.Vs for 1965-88 are presented in Table IV. An analysis of Table IV indicated that the annual fluctuations in Orissa are highest for which the C.V was 41%. It is followed by 'others', Bihar, Maharashtra, and Madhya Pradesh. In terms of yield, the fluctuations are maximum in 'others' (36%) which is followed by Maharashtra, Bihar, Orissa, and Madhya Pradesh. The fluctuations in production are much smaller (19%) in Madhya Pradesh compared to those in Orissa, 'others', Maharashtra, and Bihar.

Table IV: State-wise Estimates of Coefficients of Variation in Acreage, Yield, and Production, 1965-88

State	Acreage	Yield	Production
		%	
Bihar	19.05	20.00	23.18
Madhya Pradesh	10.64	16.87	18.59
Maharashtra	14.40	26.22	31.06
Orissa	41.14	18.58	49.24
Rest of India	34.89	35.63	47.10
India	10.82	14.90	22.94

SECTION II

Impact of Prices and Export Performance

Trends and Impact of Prices on Acreage

In current prices, niger seed price increased from Rs. 105 to Rs. 759 per tonne between 1965-87. To understand the trend in prices of niger seed, different trend equations are fitted for the annual whole-sale prices prevailing at Bombay market. Semilog function turned out to be the best and is as follows:

$$\text{Ln Price} = 4.61 + \underset{(13.64)}{0.0806^{**}}\ T$$

$R^2 = 0.90$ D.W. = 1.2929 F = 186.08

Figure in parentheses is t-value. ** Significant at 1% level of significance.

Thus time trend alone explained as much as 90% of variation in price.

A number of studies have been undertaken to measure the impact of price movements on the acreage under different crops (Dharm Narain, 1965; Madhavan, 1972; Askari and Cummings, 1976; Bhagat, 1985; and Sidhu and Sidhu, 1988). The basic assumption in most of these studies is that farmers allocate land on the basis of relative profitability of different crops. However, price may be the only consideration if the yield rate remains unchanged over the period. If the yield rate varies, price may not be the sole decisive factor. Since future prices are not known the acreage under a crop in a particular year is related to the prices of the previous year. In the present study, acreage response of niger is analysed using the following specification:

$A_t = f\ (A_{t-1}, P_{t-1}, Y_{t-1})$

where A_t = area under niger during period t,

A_{t-1} = area in t_{-1}

P_{t-1} = price in t_{-1}

Y_{t-1} = yield in t_{-1}

Out of the three functional forms--linear, semilog, and double-log--tried, linear equation gave a better fit in terms of a priori expected sign and level of significance. The final equation estimated for the all-India has the following coefficients:

Independent variable	Coefficient	t-value
Lagged area	0.5108*	2.56
Lagged price	0.2042*	2.21
Lagged yield	-0.3247	0.86
R^2 = 0.53	D.H. = 0.6992	F = 8.44

* Significant at 5% level of significance.

Source: Estimated.

It is apparent from the estimated equation that both lagged area and lagged price turned out to be positive and significant in explaining the area under niger. The positive and significant coefficient for lagged area, indicates that in the absence of a change in the farmers attitude with regard to niger production the prospects for future increase are bleak. Interestingly, lagged price has a priori expected sign indicating that tribal farmers are no less responsive to changing price levels and other factors affecting supply. The coefficient of lagged yield, a proxy for technological progress, had negative sign but insignificant indicating that it does not influence acreage allocation. When time trend was introduced, it did not improve results.

Performance of Niger Exports

During the 1981-85 period, on an average about 3-4% of niger seed production is exported from India. Further, exports of niger are not commensurated with production (Figure 2). This

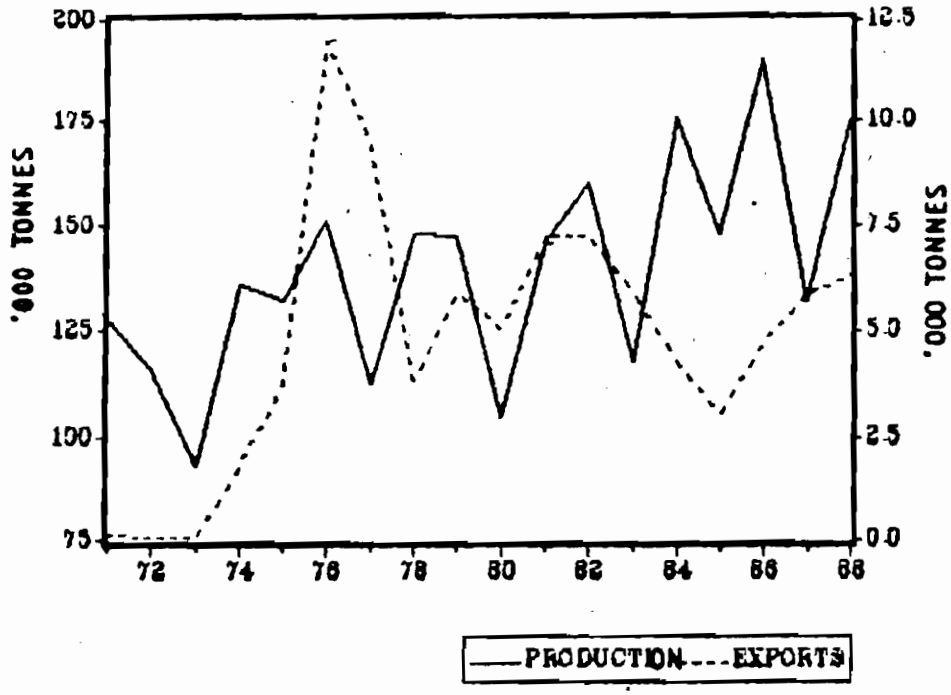

Figure 2: Indian Niger Seed Production and Niger Seed Exports, 1971-88

could be attributed to inadequate market infrastructure and increased consumption levels. Niger seed is being canalised through National Agricultural Cooperative Marketing Federation (NAFED), and Tribal Cooperative Marketing Development Federation (TRIFED) under open general license No.4. Indian oil and produce exporters association is the monitoring agency. However, appointment of these two bodies as canalizing agencies infringe the fundamental rights of citizen under articles 14 and 19 (1) (g) (Financial Express, 1990). Besides India, Ethiopia, and Nepal are the two major world niger exporters. However, India occupies an important place in the international trade of niger seed which is used as a bird feed by the importing countries.

Data on exports of niger seed are readily available only from 1970/71 to 1988/89. During the period 1971-75, on an average, exports increased from 1.15 thousand tonnes to 13.4 thousand tonnes in 1988/89 (Table V). In current prices, earnings increased from Rs. 3.9% millions to Rs. 130 millions during the same time. Exports have increased at an exponential growth rate of 6.04% over study period.[3] Destination-wise USA, Netherlands, and Italy are three major importers of Indian niger. These three countries together absorbed as much as 75% of total niger exports.

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[3] Three types of trend equations--linear, semilog, and double-log--are estimated, and the double-log gave a better fit.

Table V: Trends in Indian-Niger Seed Exports, 1971-89

Period	Quantity (000 tonnes)	Value (million Rs)
1971-75	1.15	3.91
1976-80	7.23	35.09
1981-85	5.52	47.95
1985/86	4.71	46.51
1986/87	5.87	57.82
1987/88	6.30	70.00
1988/89	13.40	130.00

Source: Directorate General of Commercial Intelligence and Statistics.

Niger Research in India

Research work on niger improvement is being carried out at Raichur (Karnataka), Simliguda (Orissa), Jabalpur (Madhya Pradesh), Igatpuri (Maharashtra), and Kanke (Bihar). Improved varieties identified for different niger growing states are given in Table VI.

Despite considerable research efforts, no substantial progress could be made in niger production. It has therefore been proposed to establish a few advance research centres to promote the growth through the generation of advanced breeding materials and new knowledge of crop production.

Table VI: Salient Features of Niger Varities Recommended/Identified for Cultivation in Different Indian States

State	Variety	Duration (days)	Oil (%)	Yield (kg/ha)	Seed colour
Karnataka	No. 16	120	43	420	Medium black
	No. 24	120	40	410	Medium black
Madhya	No.5	90	37-38	220	Shining black
Pradesh	Ootacamund	120-130	37-38	340	Shining black
	No. 87	80	37-38	200	Shining black
Maharashtra	N 12-3	110	40.5	212	Black
	IGP 76	110-125	39.5	250-275	Black
Orissa	GA 2	135-145	42	280	Shining black
	GA 10	135-145	42	310	Shining black
Tamil Nadu	HR 1	125	41.4	260	Black

Source: ICAR (1988b).

SUMMARY

Bihar, Madhya Pradesh, Maharashtra, and Orissa are the major producers of niger in India. Despite alteration in their relative shares, these four states together continue to dominate the scene in terms of area and production. Most of the estimated trend functions have reasonably good predictive performance when judged using Theil's inequality coefficient. Fluctuations in acreage and production are more in Orissa while yield fluctuations are more in Maharashtra. Tribal farmers are no less price responsive to changing price levels and other factors. In order to have high adoption rates, technology developed should suit the tribal social, cultural and economic practices. Despite considerable research efforts, no substantial progress could be made in niger production.

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Appendix A

Trends in Area, Yield, and Production in Niger, 1965-88

State	Dependent variable	Intercept	Coefficient	t-value	R2	F-value	D.W.	U2
Bihar	Area							
	Semilog	4.02	-0.0151*	2.76	0.23	7.64	0.9901b	1.00
Madhya Pradesh	Area							
	Semilog	5.65	0.0111**	4.67	0.49	21.81	0.5944b	1.28
Maharashtra	Area							
	Double-log	4.20	0.1222**	4.21	0.43	17.75	0.8544b	1.07
Orissa	Area							
	Semilog	3.92	0.0577**	11.90	0.86	141.55	2.4045	0.62
Rest of India	Area							
	Linear	23.86	2.4711**	9.34	0.80	87.23	1.1795b	0.87
India	Area							
	Semilog	6.16	0.0119**	4.97	0.52	24.71	1.2449b	0.89
Bihar	Yield							
	Semilog	5.60	0.0155*	2.52	0.20	6.56	2.4261	0.64
Madhya Pradesh	Yield							
	Linear	156.41	0.9585	1.08	nil	1.16	2.8268c	0.58
Maharashtra	Yield							
	Linear	140.88	2.1294	1.61	0.07	2.58	1.4663	0.83
Orissa	Yield							
	Double-log	5.69	0.1079*	2.08	0.13	4.34	1.9407	0.72
Rest of India	Yield							
	Double-log	5.07	0.1163	1.17	0.02	1.37	1.4789	0.82
India	Yield							
	Double-log	5.14	0.1271**	4.49	0.47	20.11	2.3302	0.64
Bihar	Production							
	Double-log	2.68	0.0169	0.02	nil	0.07	2.0975	0.69
Madhya Pradesh	Production							
	Linear	44.50	-0.1930	0.78	nil	0.60	2.7061c	0.60
Maharashtra	Production							
	Linear	10.35	0.3664**	2.96	0.26	8.75	1.8519	0.74
Orissa	Production							
	Semilog	2.82	0.0673**	9.70	0.81	94.10	2.4092	0.62
Rest of India	Production							
	Linear	5.47	0.5148*	3.78	0.38	14.28	0.9976b	1.00
India	Production							
	Semilog	4.49	0.0270**	6.00	0.61	36.00	2.5827a	0.62

** Significant at 1% level of significance.
* Significant at 5% level of significance.
a inconclussive; b positive autocorrelation; c negative autocorrelation.

Source: Estimated.