Vol XXXVII
No. 3

ISSN 0019-5014

CONFERENCE NUMBER

JULY-SEPTEMBER 1982

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

GROWTH AND SUPPLY RESPONSE OF SLOW GROWTH CROPS —A CASE OF PULSES

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Technological change in agriculture has given a face lift to the sector. It is well established by now that the change was confined to better endowed regions and also to elite group of crops, *i.e.*, superior cereals. These crops competed with the other crops for resources and were awarded better part of them, be it research or infrastructure. This in turn hampered the growth of the other crops to a considerable extent. Grain legumes[1] is one such crop group neglected and hence termed as slow growth crops.

Pulses, a main component of grain legumes, not only play a role of cheap protein supplier in the absence of animal proteins for majority of the population, but also carry out a much important task of fertility maintenance by supplying nitrogen to the soil through symbiosis in a cropping sequence. According to one estimate, pulses leave between 30 to 40 kg. of nitrogen per hectare in soil.[2] In spite of this, they are assuming secondary status in the farmer's decision calculus. The per capita availability of pulses is going down at a compound rate of 1.9 per cent per annum. It was barely 43 gm. per day/person in 1977 as against a stipulated minimum of 85 gm. The mute sufferers are the low income groups for whom pulses form an essential part of the diet.

The bulk of the demand for pulses comes from lower and middle income groups. According to a recent study, the income elasticity of demand for the lower and middle income groups is more than unity.[3] This suggests a rising pressure of demand from these groups with a rise in income. Secondly, the estimates of price elasticities of demand from the same study indicate that a rise in price will be met with a less than proportionate fall in demand. In the absence of any response from supply side, this will ultimately force the consumers to substitute vegetables in place of pulses on consumption side and the farmers to adjust their crop pattern accordingly. Since this is undesirable both on nutrition and soil micro climatic grounds, we turn to the issues causing slow growth in pulses.

I

OBJECTIVES, DATA AND METHODOLOGY

We have taken four major pulses of Karnataka State for our analysis. In Karnataka, pulses are mainly grown in the northern region, which forms

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1. Grain legumes are all grain pulses, groundnuts and soybeans.
2. M. von Oppen, "Prospects for Grain Legume Production in Asia", Paper presented at the Symposium on Grain Legume Production, Asian Productivity Organisation, Thailand, November 9-15, 1980, p. 7.
3. R. Radhakrishna and K. N. Murthy, "Models for Complete Expenditure System of India", Working Paper, International Institute for Applied Systems Analysis, Laxenburg, Austria, 1980.

a major portion of the drought zone of the State. One important point to note here is that many intricacies get merged when we study this type of problem at a broader level, say country or even State level. Hence it becomes essential for a researcher to go to the smallest possible regional level, *i.e.*, a district in the case of India. We have chosen districts having more than 5 per cent of the State's area under pulses for our analysis.

In the present paper we are dealing with three main issues. (1) What are the factors contributing to the growth in production of pulses at State level? (2) What is the pattern of growth in pulses across districts? Whether the introduction of new technology in agriculture has changed the pattern of growth? (3) What are the factors governing supply response of pulses at district level?

The data for the present paper are collected from the Bureau of Economics and Statistics, Government of Karnataka.[4] One important point about the collection of area statistics under mixed cropping needs a mention here. In Karnataka, the area under mixed crops is ascertained at field level. This is done in proportion to the number of rows planted or by eye appraisal of relative stands. This system has not been changed over years and an element of subjectivity may always enter the calculations.

Growth rates used in this study are linear growth rates expressed as per cent at mean. We have used the decomposition model used by Vidya Sagar.[5] In order to see the change in growth rates due to technological change, the whole period is divided into two halves leaving the drought years. The models used for supply response analysis are presented in the third section.

II

GROWTH, CONTRIBUTING FACTORS AND PATTERNS

Karnataka is one of the first ten pulse growing States in India. It has experienced higher growth rates in the production and yield of pulses than those of the country. However, within the State, pulses present a dismal picture as against wheat, maize, bajra and sugarcane. Among the major pulses of the State, green gram and red gram have higher growth rates in production, whereas black gram is declining at a faster rate. One common feature that can be observed is that the growth in production is attained mainly through yield. Sawant[6] noted a slightly different situation for the country. She attributes the stagnancy to both area and yield or rather blames yield for not compensating the loss due to area. On the other hand,

4. We are thankful to Shri Balasubramanyam and Shri Govinda Swami for some useful discussions.

5. Vidya Sagar, "A Component Analysis of the Growth of Productivity and Production in Rajasthan: 1951-61 to 1969-74", *Indian Journal of Agricultural Economics*, Vol. XXXII, No. 1, January-March 1977, p. 112.

6. S. D. Sawant: Production of Pulses: Past Performance and Future Prospects, An Interim Report, Planning and Development Unit, Department of Economics, University of Bombay, 1981 (mimeo.).

Kumar[7] held yield solely responsible for the low growth in production. In order to test this at the State level we have used decomposition of the production growth (Table I).

TABLE I—RELATIVE CONTRIBUTION OF DIFFERENT FACTORS TO THE GROWTH OF PULSES PRODUCTION (1961-62 TO 1977-78)

Sr. No.	Factors	Per cent contribution
(A)	Pure effects	
1.	Area	—1·50
2.	Price	45·62
3.	Yield	18·86
4.	Crop pattern	—0·16
(B)	Interactions	
1.	Price-yield	37·76
2.	Crop pattern-Yield	—0·18
3.	Crop pattern-Price	—0·16
4.	Crop pattern-Price-Yield	—0·25

Note:—Decomposition analysis based on the model used by Vidya Sagar, *op. cit.*

As expected, we find that pure price effect and price yield interaction contributed major share to the growth in value of production. Area and crop pattern effects have negatively contributed to the growth in production, this solves the riddle of whom to blame for the slow growth in production. The negative sign of the interaction terms except one further corroborates the hypothesis that area and crop pattern are mainly responsible for the slow growth.[8] It is worth noting that yield effect has contributed the third largest share to the production growth. This is contrary to the experience at all-India level.

Before entering into further discussion, we should make one point clear. The yield of grain legumes and especially that of pulses depend mainly on location specific environments. It is due to the strong dependence on environment that we find different cultivars being used at different locations. Keeping this in view the grain legume breeders are concentrating on environmental insensitive varieties.[9] This highly location specific character of pulses brings us down to district level analysis.

Districtwise Pattern of Growth and Technology

Pulses are grown mainly in the northern part of the State. Table II presents districts classified into two broad categories according to their growth in production.

7. B. L. Kumar, "Declining Trends in Production of Pulses and Factors Affecting It", *Economic and Political Weekly*, Vol. VIII, No. 27, July 8, 1978, p. 1113.
8. Vidya Sagar also observed in his study that the price-crop pattern interaction term turned out to be negatively influenced mainly due to pulses. See Vidya Sagar, *op. cit.*, p. 116.
9. Please see von Oppen, *op. cit.*, p. 6.

TABLE II—DISTRICTS ARRANGED ACCORDING TO THEIR LEVEL OF GROWTH IN PRODUCTION

	Bengal gram	Red gram	Green gram	Black gram
	(1955-56 to 1977-78)		(1961-62 to 1977-78)	
High growth districts ..	Gulbarga Bijapur Raichur	Gulbarga Bijapur Raichur Bidar	Bijapur Gulbarga	Bidar Gulbarga
Low growth districts ..	Bidar Dharwar Belgaum	Chitradurga Dharwar Belgaum	Bidar Dharwar Belgaum	

The high/low growth districts indicate districts having growth rates higher/lower than the State respectively. We find almost equal representation of the districts between the two groups. The majority of low growth districts fall on the western side whereas Gulbarga, Bijapur and Raichur form a group of high growth districts. Belgaum and Dhawar, on the other hand, show lower growth rates for most of the pulses. Both Bidar and Gulbarga have negative rates of growth for black gram but they are slightly better off than the State.

In order to find out whether the pulse growing districts experienced any change in the growth rates due to technological change, we have compared their growth rates between two time periods, *i.e.*, 1955-56 to 1965-66 and 1968-69 to 1977-78.[10] Table III presents the results.

TABLE III—CHANGE IN GROWTH RATES BETWEEN TWO SUB-PERIODS

Sr. No.	District	Bengal gram		Red gram		Green gram		Black gram	
		Area	Yield	Area	Yield	Area	Yield	Area	Yield
1.	Belgaum	I	D	D	D	D	D	nt	nt
2.	Bidar	D	S	I	I	D	D	D	I
3.	Bijapur	I	D	I	D	I	D	nt	nt
4.	Chitradurga ..	D	D	D	D	nt	nt	nt	nt
5.	Dharwar	I	D	D	D	D	D	nt	nt
6.	Gulbarga	I	D	I	I	D	I	D	I
7.	Raichur	D	D	D	I	nt	nt	nt	nt

I=Improvement; D=Decline; S=Stagnant; nt=not taken for analysis.

At first sight, the table presents a mixed picture both for area and yield, however a careful examination reveals that there are more cases where growth rates have declined than those of increased growth rates. The growth rates have declined with a higher magnitude in the case of area. We find only two cases where growth rates both in area and yield have increased, a case indicating change due to technology, as against eight cases of decline in both.

10. In case of black gram and green gram the growth rates of the period 1968-69 to 1977-78 were compared with the whole period growth rates, *i.e.*, 1961-62 to 1977-78.

III

SUPPLY RESPONSE OF PULSES

Supply response functions provide us with useful information on the extent of farmer's response to prices and other economic factors. A large number of studies are available on this aspect for different crops but seldom pulses are considered for analysis.[11] There are several alternative specifications available in the literature. We have selected a few formulations for our analysis. We have selected two districts for each pulse, one with the highest growth rate and the other with the lowest growth rate in production. This presents a good contrast.

Models:

(I) $A_t = a_0 + a_1 A_{t-1} + a_2 RP_{t-1} + a_3 W_t + u_t$

(II) $A_t = a_0 + a_1 A_{t-1} + a_2 RP_{t-1} + a_3 Y_{t-1} + a_4 GI_{t-1} + a_5 W_t + u_t$

(III) $A_t = a_0 + a_1 A_{t-1} + a_2 RP_{t-1} + a_3 Y_{t-1} + a_4 GIC_{t-1} + a_5 W_t + u_t$

(IV) $A_t = a_0 + a_1 RLY_{t-1} + a_2 RLP_{t-1} + a_3 \sigma y + a_4 \sigma p + a_5 W_t + u_t$

(V) $A_t = a_0 + a_1 Y_{t-1} + a_2 FHP_{t-1} + a_3 \sigma y + a_4 \sigma p + a_5 W_t + u_t$

where A_t = area sown under the crop at time t (in hectare),

A_{t-1} = area sown under the crop at time t—1 (in hectare),

RP_{t-1} = real price of the crop at time t—1, *i.e.*, farm harvest prices deflated by wholesale price index of all crops (index),

Y_{t-1} = yield per hectare of the crop at time t—1,

GI_{t-1} = gross income/hectare of the crop at time t—1 (Rs./ha.),

GIC_{t-1} = gross income/hectare of the competing crop at time t—1 (Rs./ha.),

RLY_{t-1} = relative yield of the crop to competing crop at time t—1 (ratio),

RLP_{t-1} = relative price of the crop to competing crop at time t—1 (ratio),

FHP_{t-1} = farm harvest price of the crop at time t—1 (in Rs./quintal),

σy = standard deviation for preceding three years in the yield of the crop (in kg.),

σp = standard deviation for preceding three years in the price of the crop (in Rs.),

W_t = rainfall in the pre-sowing month (in mm.)

11. Please see Hossein Askari and John Thomas Cummings: Agricultural Response: A Survey of the Econometric Evidence, Prager Publishers, Inc., New York, 1976.

Bengal gram

Gulbarga[12] $A_t = 9122.46^{ns} - 0.68^{***}A_{t-1} + 99.03^{***}RP_{t-1} + 120.33^{***}Y_{t-1}$
(high growth district)
$(1.48) \quad (3.31) \quad (6.01) \quad (4.23)$

$- 70.16^{***}GI_{t-1} - 2.92^{ns}W_t \qquad \bar{R}^2 = 0.87$
$(3.97) \quad (0.22)$ No autocorrelation.

Belgaum $A_t = 3726.61^{ns} + 0.45^{*}A_{t-1} + 5.28^{**}RP_{t-1} + 7.98^{**}Y_{t-1}$
(low growth district)
$(1.14) \quad (2.22) \quad (2.27) \quad (2.71)$

$- 2.48^{ns}GIC_{t-1} + 4.61^{ns}W_t \qquad \bar{R}^2 = 0.61$
$(1.00) \quad (0.54)$ No autocorrelation.

We find that lagged area has negative impact in Gulbarga but positive in Belgaum. This indicates a contrast in behaviour between the low growth and high growth districts. Due to the subsistence nature of the crop, the cultivators respond negatively to expected area in the high growth region. The area response to real price and lagged yield is positive and significant in both the regions. The price elasticity of supply is higher in the high growth region (0.99) than the low growth region (0.16). The farmers in the high growth region are sensitive to changes in prices and also yields. In Gulbarga, the gross income per hectare of the crop has a negative impact on area sown. This, if analysed with lagged area, gives us a clue that the self-sufficiency of the crop brings down the growth of the crop due to its predominant subsistence nature. This is also upheld by the negative sign of the gross income from competing crop in Belgaum district.

Red gram

Gulbarga $A_t = 101581.51^{***} - 0.13^{ns} A_{t-1} + 190.41^{***}RP_{t-1} + 43.12^{ns} Y_{t-1}$
(high growth rate)
$(4.98) \quad (0.43) \quad (4.35) \quad (1.11)$

$- 109.23^{**}GIC_{t-1} - 315.94^{*}W_t \qquad \bar{R}^2 = 0.65$
$(3.00) \quad (1.91)$ No autocorrelation.

Belgaum $A_t = 14089.41^{*} + 0.31^{ns}A_{t-1} - 12.47^{**}RP_{t-1}$
(low growth district)
$(1.84) \quad (1.09) \quad (2.41)$

$+ 20.30^{*}W_t \qquad \bar{R}^2 = 0.47$
(1.93) No autocorrelation.

Here also we find lagged area having negative coefficient in the high growth region and positive in the other. But the response to real price is negative in Belgaum district, the price elasticity of supply being — 0.25 only. This may be due to the predominance of competing crops in the district, which fetch almost double the income as compared to pulses. The gross income

12. *, ** and *** indicate the levels of significance of the coefficients at 10, 5 and 1 per cent respectively. ns = not significant. Figures in brackets indicate t-values. This is common for all the equations presented hereafter.

of competing crop in Gulbarga has a negative and significant coefficient, denoting the dominance of competing crop even in the high growth district. The same variable was also tried in Belgaum but since the errors were autocorrelated the model was discarded.[13] An increase in the pre-sowing season rainfall induces area in the low growth district and reduces it in the high growth district.

Green gram

Bijapur (high growth district)

$$A_t = \underset{(4.01)}{8495.05^{***}} + \underset{(2.05)}{0.60^{*}A_{t-1}} - \underset{(0.65)}{6.67^{ns}RP_{t-1}} - \underset{(2.56)}{67.57^{**}Y_{t-1}} + \underset{(2.31)}{47.54^{*}GI_{t-1}} + \underset{(1.03)}{17.30^{ns}W_t}$$

$\bar{R}^2 = 0.83$ No autocorrelation.

Belgaum (low growth district)

$$A_t = \underset{(1.47)}{7262.90^{ns}} + \underset{(1.77)}{0.55^{ns}A_{t-1}} - \underset{(1.07)}{4.74^{ns}RP_{t-1}} - \underset{(1.12)}{17.05^{ns}Y_{t-1}} + \underset{(1.14)}{8.19^{ns}\,GI_{t-1}} - \underset{(0.87)}{10.06^{ns}W_t}$$

$\bar{R}^2 = 0.21$ Autocorrelation test inconclusive

Green gram presents a slightly different picture than the earlier two crops. The area response to prices is negative and not significant. Another surprising result being the negative response of yield rates, whereas the gross income per hectare has positive influence on area planted. These astonishing results may be due to two things: firstly, the crop is of very short duration and mainly grown for home consumption. Hence one year lag may be too long a time to influence the area decision. Secondly, due to its unimportance in coverage the subjectivity that enters at the field level in the collection of data might have affected the area statistics.

Black gram

Bidar (high growth district)

$$A_t = \underset{(3.57)}{78424.19^{**}} - \underset{(0.33)}{5007.75^{ns}RLP_{t-1}} - \underset{(2.44)}{30288.82^{**}RLY_{t-1}} - \underset{(2.14)}{29.92^{*}\sigma y} + \underset{(1.05)}{87.79^{ns}\sigma p} - \underset{(0.71)}{43.37^{ns}W_t}$$

$\bar{R}^2 = 0.37$ Autocorrelation test inconclusive.

Gulbarga (low growth district)

$$A_t = \underset{(9.32)}{38705.50^{***}} + \underset{(1.36)}{21.76^{ns}Y_{t-1}} - \underset{(3.47)}{146.74^{**}FHP_{t-1}} - \underset{(2.68)}{91.13^{**}\sigma y} + \underset{(2.11)}{98.74^{*}\sigma p} - \underset{(1.60)}{51.05^{ns}W_t}$$

$\bar{R}^2 = 0.79$ Autocorrelation test inconclusive.

13. This is due to the fact that OLS method of estimation fails some times and gives inefficient estimates, while using lagged models. In many cases the errors were autocorrelated. Hence we have dropped all those formulations where autocorrelation was present.

We have chosen totally different models for this crop. We encounter inverse relationship of relative yield and relative price of the crop with area sown under the crop. This corroborates our earlier findings about the role of competing crop in the decision-making process. The negative and significant coefficient of standard deviation in preceding three years for yield indicates that the farmers give due weightage to the uncertainty expectation in yield of the crop. On the other hand, the uncertainty expectations for prices show a direct relationship with area sown. This may also be true because by observing uncertainty in prices the farmer may wish to maintain his home consumption with the farm grown pulses, which will induce him to increase the area under the crop.

IV

CONCLUSION

Technological change has not only failed to bring about any positive change in the growth of pulses but has caused its slow growth though indirectly. The slow growth in production can be mainly attributed to stagnancy and decline in area. The supply response analysis indicates a positive response to real price of the crop and its yield. Though the crop is sensitive to real prices, the role of market prices in deciding the cropped area is limited and needs further testing. The positive response of yield is definitely an encouraging signal. The more important is the subsistence character of these crops mainly due to their concentration over small holdings. The insensitivity of small farmers to market prices causes further damage to the existing situation. Given these, the astonishing results obtained in some places should not be surprising; however, a further probe in the situation is needed.