Demand and Supply Gap of Foodgrains in Tamilnadu

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Introduction

CHAPTER - I

I N T R O D U C T I O N

Agricultural development is a key to economic prosperity in developing countries and hence the backwardness of agriculture places a constraint on the over all economic growth. In these countries agricultural sector helps the economy through the provision of necessary food. Hence, one can agree with the view of Simon Kuznets that 'Agricultural development is a key for the human subsistence'. Agricultural development has two components_development of food grains and non-food grains. Food grains may comprise of paddy, wheat, jowar, maize, cholam, cumbu and pulses. Non-food grains are commercial crops including sugarcane, cotton, groundnut etc. Of the two components, increase in the production of food grains is more essential to meet the basic need of the people.

As similar to any other economic good there are two aspects of food grains - demand for food grains and supply of food grains. Basically the demand for food grains is influenced by total population, per capita income and consumer price. However, the supply of food is affected to a great extent by the area under cultivation, inputs and farm harvest price.

There is acute food problem in the World as a whole, since the supply of food grains was in shortage to meet the demand for food grains. Between 1971-1986, World population increased from 3.2 billion in 1971 to 5.5 billion in 1986, there by increasing demand for food. However in the same period, World food production increased from 1237 million tonnes in 1971 to 1432 million tonnes in 1986. But due to high population growth, the per capita available food supply decreased from 330 kilograms to 324 kilograms. The projected World population as 6.6 billion by 2000 A.D is expected to increase the demand for food in future.

The demand ~~for~~ and supply gap of food grains is more alarming in developing countries, due to high population growth and decline in food production. These countries face a widening gap between their production and consumption. As such, the people of developing countries consume food corresponding to 1800-2000 kilo calories per day where as the consumption in developed countries is in the range of 3000-3500 calories per day.

India as a developing country faces food problem. Since 20 percent of the World population lives in India, feeding Indians is to feed almost one fifty of the entire

World population. The demand for food was increasing due to increase in population from 360 million in 1951 to 736 million in 1986. Further the present annual growth rate of population as 2.6 percent aggravates the situation. In tune with increasing demand for food, the supply of food grains increased from 51 million tonnes in 1951 to 156.47 million tonnes in 1986.

However the supply of foodgrains was inadequate to meet the enlarging demand leading to a decline in percapita availability of foodgrains from 19.78 kilograms in 1971 to 19.48 kilograms in 1981. Table I helps to get a better insight into India's food problem.

T A B L E - I

TRENDS IN PERCAPITA AVAILABILITY OF FOODGRAINS IN INDIA

Y e a r	Foodgrains production (in lakh tonnes)	Population (in lakhs)	Percapita availability of foodgrains (in kilograms)
1950-51	508	3569.00	14.20
1960-61	820	4483.00	18.29
1970-71	1084	5479.49	19.78
1980-81	1296	6652.87	19.48

Table I reveals that for the Indian Planning Authority, ensuring a balance between the demand for and supply of food grains is one of the important task. The gap can be reduced by achieving the target of annual increase in foodgrains production as 7.2 million tonnes.

At the State level, Tamil Nadu faces the serious food problem. The accounting factor for the demand-supply gap of foodgrains in Tamil Nadu was faster growth rate of population compared to food supply. Between 1971-81, Tamil Nadu's population increased from 41.19 million to 48.40 million, depicting the percentage variation as 17.56. But in the same period, production of food grains in Tamil Nadu decreased from 7.13 million tonnes in 1971 to 5.65 million tonnes in 1981, presenting the negative percentage variation as 20.8. The projected population for the State as 56.47 million for 1990 provides a warning signal to the Government of Tamil Nadu. The demand and supply gap of foodgrains in Tamil Nadu can be understood from Table II.

T A B L E - II

TRENDS IN PERCAPITA AVAILABILITY OF FOODGRAINS IN TAMIL NADU

Year	Foodgrains production ('000' tonnes)	Population (in lakhs)	Percapita availability of foodgrains (in kilograms)
1950-51	3607	301.19	1.19
1960-61	5395	336.86	1.60
1970-71	7030	411.99	1.70
1980-81	5651	484.08	1.16

Table II reveals that as against the average annual requirement of cereals and pulses as 876000 calories for an adult, the people of Tamil Nadu are able to get only 550857 calories. This brings out the fact that the percentage of availability of foodgrains is only 62.89 in Tamil Nadu.

This calls for an indepth study of the key factors bringing about demand-supply gap of foodgrains in Tamil Nadu. Since the food problem is the fore most problem for the people of Tamil Nadu and for the Government of Tamil Nadu, a study on demand and supply gap of foodgrains is expected to help in focussing the essential strategy to face food problem in future. As such a study was designed to analyse the "Demand and supply gap of foodgrains in Tamil Nadu". The specific objectives of the study were:

1) To identify the factors affecting demand for and supply of foodgrains in Tamil Nadu;
2) To analyse crop-wise variation in food production;
3) To analyse the interdistrict variation in food production;
4) To analyse the rural-urban variation in the demand for food;
5) To estimate income elasticity of demand for food;

6) To forecast demand for foodgrains and supply of foodgrains for 2000 A.D and for 2010 A.D for Tamil Nadu; and
7) To recommend a suitable food policy.

However, the study was subject to certain limitations. The supply of foodgrains was analysed by taking into account only the foodgrains production. Supply from central pool and from other States were excluded. Further, among the foodgrains the study was restricted to rice, cholam, cumbu, maize, ragi, bengal gram, red gram, green gram, black gram, horse gram and total pulses. Above all, due to time constraint, the study was restricted to the period of only eight years from 1970-1978.

However, this study is expected to differ from the earlier studies in some respects. While most of the earlier studies had analysed the food problem either in respect of cereals or pulses the present study tries to combine both. Further in contrast with other studies the current study attempts to forecast the demand and supply of foodgrains for the future.

Review of Literature

CHAPTER - II

REVIEW OF LITERATURE

The review of literature relating to the study on "Demand and Supply gap of foodgrains in Tamil Nadu" is discussed under the following heads.

A) Factors determining demand for food;
B) Estimation of demand for food;
C) Factors influencing supply of food;
D) Estimation of supply of food;
E) Measures to solve food problem; and
F) Specific studies relating to the topic.

A) Factors determining demand for food:

According to Duckham (1980), income is an important factor affecting demand for food. In his view, considerably more food will be consumed as income increases. Further, due to increase in income there will be a general shift towards more expensive and nutritious foods.

Gangwar.A.C and Pandey.R.N (1982) identified the growth of population as an important factor affecting demand for food. According to them demand for food was

positively associated with increasing population.

Pandey U.K. and Saradana P.K. (1984) opined that growth of population, changes in percapita income, relative prices, consumers tastes and preferences and urbanisation are the key factors affecting demand for food.

Timothy R. (1985) viewed that distribution of income is an important factor affecting demand for food. According to him, the norm for calorie intake will also affect the demand for food.

According to Shah.C.H. (1986) demand for food was influenced by household size and income level. According to him, the elasticity of expenditure on food increased with respect to total expenditure percapita.

B) Estimation of demand for food:

Pandey R.K. (1973) attempted to provide an empirical estimate of demand function for foodgrains for India. As per the study, the data on percapita net availability of foodgrains on aggregate basis for India was used to approximate percapita demand for individual grains.

The percapita demand as measured by their net availability was regressed on the whole sale price indices and the percapita income. As per the study, the demand for rice, wheat, total cereals and pulses were inelastic with respect to their prices. The coefficients associated with percapita national income were positive indicating that with an increase in income there will be rising demand for food in the nation.

Narayanan S. and Rao K.R. (1982) made an attempt to estimate the demand for coarse cereals based on 27th round National sample survey of consumer expenditure. The study concentrated on 7 States (Gujarat, Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu, Madhya Pradesh and Uttar Pradesh). The study found that rice consumption function increased almost monotonically but those of coarse grains increased intially but afterwards declined rapidly.

Sardana P.K. (1984) estimated the percapita demand for food for Haryana State. According to him the rate of growth in food consumption was expressed as the product of rate of growth in percapita income and income elasticity of demand for food. As per the study the percapita monthly consumption food in rural area

was greater (14.64 Kg. per month), as compared to urban area(14.23 Kg. per month). Further the study estimated expenditure elasticity for rice, wheat, bajra, maize and total pulses. While expenditure elasticity for all foodgrains were positive for urban area, for rural area the expenditure elasticity for all foodgrains except rice were positive.

Frankenberger and Timothy R. (1985) studied food consumption pattern. According to them there was a shift in consumption from indegenous food to non-indegenous food. The major problem concerning food consumption are high prices, food deficit, market inefficiency and Government trade policies.

Shah C.H. (1986) analysed the demand for food in rural India. The study estimated expenditure on food and proportion of food expenditure for different food groups and elasticity expenditure percapita. Further the study estimated the regression coefficient of demand for food with respect to household size as .24 and it was statistically significant as proved by the high R^2 value of .92. The study found that there was no significant difference in overall allocation of expenditure on food among low, medium and high income groups.

Bidinger P.D. Nag B. and Babu P (1986) analysed seasonal fluctuations in household food availability. The specific hypothesis used in the study was that larger farmer will have an adequate food supply throughout the year. The study revealed that poor dietary intake at the family level will be a reflection of available food. The study concluded regularity in food production as a necessary measure to solve food problem.

Varadarajan S. (1986) estimated percapita consumption of pulses as 21 kilograms between 1981-1990. According to him the aggregate demand for pulses will increases from 10.4 lakh tonnes in 1981 to 11.86 lakh tonnes in 1990. As such there is a need for increase in pulses production in Tamil Nadu.

Krishnaiah J. and Krishnamoorthy S. (1988) studied regional variations in demand for food and specifically they estimated Engel elasticities for foodgrains in Andhra Pradesh. The study was based on consumer expenditure data of Andhra Pradesh for the 32nd round of N.S.S. organisation (1977-78). The functional forms of Engel Curves used were semi logarthimic, linear, double logarithmic, inverse hyper bolic, log-inverse

and log-log inverse. According to the study, the elasticity coefficient for rice and pulses were positive, but they were mostly negative for jowar. It also revealed that the elasticity coefficients were higher for rural population than for urban population in the case of rice. But in the case of other cereals, the elasticity coefficient was higher for urban areas. The study estimated expenditure elasticity for rice as .79 for jowar as .91 for pulses as 1.1 and for other cereals as 1.38. According to the study for 3 regions - Telangana, Rayalaseema and Costal Andhra Pradesh, the expenditure elasticity of rice, jowar and pulses was greater in rural area as compared to urban area.

Ghuman B.S. (1988) tried to estimate demand for food. According to him, the growth of demand for food depends on growth of income, growth of population, price changes and changes in family size and composition. The study made use of double log engel function and log normal distribution. The study was based on the National Sample Survey organisation data on consumer expenditure collected in 28th round during the period 1973-74. The study observed that expenditure elasticity in rural Punjab for food items was relatively low in rural area (.74)

as compared to in the urban area (1.58). According to the study, expenditure elasticity in the case of jowar and maize were negative as revealed by the regression coefficients of - .20 and - .007 respectively.

C) Factors influencing supply of food:

Gangwar A.C and Pandey R.N.(1982) identified monsoon facilities, irrigated area, pest management practices and agricultural prices as essential factors in influencing the supply of food.

Bapna S.L. and Rao K.R.(1986) studied the factors influencing crop output. According to them, quantum of rainfall, irrigated area, fertilizer prices and available infrastructure facilities tend to affect the supply of output in agriculture.

According to Shah C.H. (1986) fertilizer application was an essential factor in influencing the supply of paddy in Andhra Pradesh. According to him protective inputs like irrigation and pesticides tend to increase the supply of output.

Colin Tudge (1988) found that fertilizer consumption, irrigation, water, energy, power, technology and the use of pesticides were the crucial factors affecting the supply of food output.

D) Estimation of supply of food:

Poduval (1981) analysed foodgrain economy of Tamil Nadu. The study analysed the impact of change in food grain policy on the problem of availability of food and access to food. According to him, 58.68 percent of people in rural areas and 44.78 percent of the people in urban areas could not get food as to meet the minimum daily calorie requirements.

Gangwar A.C. and Pandey R.N. (1982) found that the annual growth rate of production and yield of pulses were - .10 and - .53 respectively. He found that the crop yield variability was highest in dry farming areas as compared to irrigated area.

Rao K.P. and Sirohi A.S. (1983) estimated the supply of paddy for Andhra Pradesh during the period 1967-81. According to the study, the mean productivity of paddy

for West Godavari District in Andhra Pradesh was 26.01 quintals. The application of HYV increased the mean yield of paddy to 42.35 quintals. The study also revealed that the yield distribution of paddy in West Godavari District were non-normal in nature.

Srivatsava U.K. (1985) analysed the instability in food production. He defined instability in agricultural production as deviation from an equilibrium. In his view there is an need to increase food production to meet 50 to 75 percent of daily food energy.

Bapna S.L. and Rao K.R. (1986) forecasted crop output. They estimated foodgrains output at the All India level. According to the study the deviation between estimated production and actual production between 1978-82 was expected to be less than 1.

Ashokkumar (1986) analysed the imbalances in pulses productivity. The study was based on the actual productivity of pulses for all the States. According to him, productivity of pulses in India increased from 608.7 tonnes during First Five Year Plan to 1035.0 tonnes during Sixth Five Year Plan. He viewed that production

of pulses will have to be increased at the rate of 20 percent perannum so as to increase the percapita availability of pulses. Through index of performance gap he estimated that the State of Karnataka has got the highest performance gap as 86.93.

Surinder Kumar (1987) analysed the growth pattern of major food crops under different plans in Himachal Pradesh. According to him, the growth rate of pulses production increased from 28.14 percent to 30.12 percent between 1951-80. The study estimated the compound growth rate of foodgrains production during the First Five Year Plan as 11.62, during Second Five Year Plan as 1.91, during Third Five Year Plan as - 1.1, during the annual plan as 2.84, during the Fourth Plan as .79 and during the Fifth Plan as - .53.

Sardana (1987) estimated production of foodgrains for 1986-87. He estimated that between 1986-87 production of cereals will increases by 3.4 percent, production of coarse grains by 193 percent and production of pulses by 208 percent.

E) Measures to solve food problem:

Munshi K.M. (1973) recommended that food production can be increased by expanding irrigated land and by giving due emphasis on minor and major irrigation works. He also viewed that use of fertilizers, and adoption of intensive cultivation method will help to increase the supply of food.

Singh (1980) opined that to fill up the gap in percapita availability of pulses, growth rate of production of pulses should be around 20 percent perannum between 1985-1990.

Ganwar and Pandey R.N. (1982) recommended measures to solve stagnation in the production of pulses. According to them to improve pulses production in the country, high yielding variety of seeds should be used and better education efforts should be undertaken.

Pandey V.K. and Sardana V.K. (1984) recommended that regional incentives have to be provided to increase marketable surplus of food.

According to Vardarajan S. (1986) deficit in food supply can be solved through special efforts to extend area under pulses.

Poduval R.N. (1987) viewed that the public distribution programmes and nutritional intervention programmes have to be strengthened, to solve food problem.

F) Specific studies relating to the topic:

1) Pandey V.K. Sardana P.K. and Veen Manocha (1984) made an estimate of "Demand for and supply of cereals, coarse grains, pulses and oilseeds in Haryana". The study was based on 32nd round National Sample Survey data for Haryana. For estimating rural and urban food consumption the study made use of the following formula.

$$dit = \frac{dio}{yo} (yo + bi (yt - yo)$$

where,

dit = percapita consumption demand for i^{th} foodgrains in the year t;

yo = percapita income in the base period;

yt = percapita income in the projected "t" the year;and

bi = quantity elasticity of demand for i^{th} foodgrain.

According to the study, the supply function of foodgrains was estimated through lagged function of prices, current area and current weather conditions. The estimated crop production in Haryana for the period (1979-87) was given in the following regression equations.

a) Rice Xit = -547.8765+0.3668 yit-1 + 3.9533 dit
(0.7203)

+0.3375 ydit - 3.0856 zit - 0.5954
(0.0216) (0.7547) (0.2159

(ijt-1)3 - 10.3088 wiktci)
(3.6218) 0.9970

b) Wheat xit = -2102.25 + 0.0757 yit - 1 + 2.2439 dit

+0.9952 (0.1206) (0.7678)
(0.1574) xdit - 0.4878 zit +
(0.6258)

2.1936 P(ijt-1) - 28.3201 wikt (1) 0.9942

(1.5332) (28.6838)

c) Pulses

Gram: kit = -629.27 - 0.0361 kit - 1 + 0.6973 kit +

1.0661 ydit - 0.2430 zit+0.3218 P(i)jty)

(0.0285) (0.2971) (0.1354)

-3.4838 wikt (2) 0.9982

(1.0160)

As per the study, the rate of growth of food consumption was expressed as the product of rate of growth in percapita income and income elasticity of demand for food. The study estimated percapita monthly demand for coarse cereals as 14.63 kilograms and for pulses as 61 kilograms in 1980-81. The study also noted that demand for foodgrains will continue to increase at a higher rate in urban areas.

2) Chokkalingam (1984) made a study on "Per adult requirement and supply of staple foodcrops in Tamil Nadu". The study estimated demand for food on the basis of the population of the State and required calorie in take. Supply has been estimated on the basis of average annual crop production of pulses in each district. The study found that for an adult, the average annual requirement of cereals and pulses was 876000 calories but at the State level the supply was only 550807 calories. The study also estimated percentage of calories available to calorie required per adult per year for various districts in Tamil Nadu. According to the study Chengalpattu district has got higher percentage of calories available to calorie required per adult per year 95.53 but the lowest ratio was for Nilgiris district as 5.09.

3) Marlett and Marie (1985) studied about 'Food Production and consumption'. According to the study, to improve food consumption, rural women have to be educated in nutrition principles. Further the food problem can be solved by substituting maize as a supplement to rice dominated diet.

4) Ray W, (1986) made a specific study on 'World food needs and availabilities'. The major objective of the study was to analyse the causes for demand and supply gap of food. The study was based on demand and supply of food in 15 developing countries. According to the study the best index to measure demand and supply gap was percapita food availability. The study recommended that food problem in developing countries can be solved by increasing the regional food production and through food aid.

5) Ashokkumar (1986) made a specific study on 'Demand and supply gap of pulses'. According to him, the percapita availability of pulses in India declined from 61 grams per day in 1951 to 38 grams in 1981. The minimum requirement was 85 grams per day as recommended by nutritional experts. The study estimated yield gap in pulses through the following formula.

$$I(yg) = \frac{P\ (fy) - A\ (fy)}{P\ (fy)} \times 100$$

where,

I(yg) = Index of yield gap or performance gap;

P(fy) = Potential yield rate achieved under national demonstration trials in a State; and

A(fy) = Average productivity of the crop in the State.

The study revealed that though India accounted for largest area in the World in respect of pulses, it ranked sixth among major pulses producing countries regarding productivity. The study found that the gap in yield performance was due to lack of infrastructural facilities and adoption of minimum technology.

6) Leonarod A. (1986) analysed 'Food problem in the third World'. The study attempted to analyse the trends in food production from 1961-80 for 105 developing countries. The study analysed demand for food based on nutritional assessment. According to the study, India, China, and other Asian countries face food deficit problem.

7) Mahajan R.K. and Rao A.V. (1986) made a specific attempt to study about the 'Food problem for India'. The study was based on major rice growing States of Punjab, Haryana, Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh and Bihar. The study was related to the period 1970-75. The study estimated the growth rate of production of rice for India as 3.49 and for Tamil Nadu as 7.64. The study also estimated the percentage contribution of area, towards increasing rice production. As per the study on an average at the All India level, in the reference period, the percentage contribution of area towards towards increasing production was 30 percent and it was 25 percent specifically for Tamil Nadu.

8) Varadharajan S.(1986) studied about the 'Demand and supply of pulses in Tamil Nadu'. The study concentrated on major pulses growing districts and the study was based on the sample of 800 producers, 1600 consumers and 850 traders. According to the study pulses production increased from 99.84 thousand tonnes in 1956-57 to 341.30 thousand tonnes in 1984-85. He viewed that there was scope for intensive cultivation of farms. The study indicated that per month percapita consumption of pulses was highest in Madurai district as .080 kilograms and lowest in North Arcot district as .014 kilograms.

Methodology

C H A P T E R - III

METHODOLOGY

The methodology adopted by the investigator for the study on 'Demand Supply gap of food grains in Tamil Nadu' is discussed under the following heads:

A) Selection of the area;
B) Selection of the crops;
C) Data base of the study;
D) Period of study;
E) Concepts used;
F) Hypothesis framed; and
G) Tools of statistical analysis used.

A) Selection of the area:

Since the major objective of the study was to analyse the extent of gap between demand and supply of foodgrains, the investigator was interested in selecting an area which had been facing severe food problem. Tamil Nadu had been experiencing crucial food problem as the total supply of food grains in the State was

able to meet only 63 percent of the requirements of the people. As such, for the purpose of the study, the investigator had selected Tamil Nadu State. Yet another reason for selecting Tamil Nadu State for the study was due to easy accessibility.

B) Selection of the crops:

To study the demand supply gap of foodgrains in Tamil Nadu, the investigator had concentrated on cereals and pulses. Among the cereals, the investigator selected 5 crops - paddy, cholam, cumbu, maize and ragi, since they are the major cereals in Tamil Nadu. Among the pulses, the investigator has selected redgram, bengalgram, horsegram, blackgram and greengram.

C) Data base of the study:

The data as collected by the investigator for the study were secondary in character. Data relating to area under cultivation, quantum of rainfall, production, yield, farm harvest price and quantum of fertilizers used, population of the State and percapita income were obtained from Season and Crop reports as published by the Ministry of Agriculture, Government of Tamil Nadu, and

Tamil Nadu - An Economic Appraisal, as published by Evaluation and Applied Research Department, Government of Tamil Nadu. Information regarding consumer expenditure on food, and consumer price were compiled from 26th round, 28th round and 32nd round of National sample Survey report for Tamil Nadu State.

D) Period of study:

The study covered the period of 8 years from 1970-1978.

E) Concepts used:

a) Cropping intensity:

This indicates the percentage of land available for cultivation. This can be estimated through the formula.

$$\text{Cropping intensity} = \frac{\text{Net cropped area}}{\text{Total land area}} \times 100$$

b) Productivity:

This denotes per hectare yield of foodgrains. It is obtained by dividing the total production by total area under cultivation.

c) Farm harvest price:

It is the price accruing to the farmers for the crops harvested by them. This is different from the procurment price and minimum support price.

d) Supply price response:

Supply price response indicates the nature of responsiveness of supply to changes in prices. This is a component of area price response and yield price response.

e) Consumer price:

It denotes the price paid by the consumers to buy the foodgrains.

f) Percapita availability of foodgrains:

This denotes the percapita supply of foodgrains in the State. It is estimated by dividing the total production by total population of the State.

F) Hypothesis used:

As a way of analysing demand - supply gap of foodgrains in Tamil Nadu, the investigator formulated the following hypothesis.

a) There is a significant causal relationship between supply of foodgrains and area under cultivation, fertilizer consumption and farm harvest price;

b) The supply price response of foodgrains is positive;

c) There is a significant causal relationship between demand for foodgrains and population, percapita income and consumer price;

d) The income elasticity of demand for food tends to decline as income increases; and

e) The growth rate of demand for food is greater than the growth rate of supply of food.

G) Tools of statistical analysis used:

a) Coefficient of variation:

This was used to find out the extent of variation in area under cultivation. and food production during the reference period. The formula used was

$$\text{Coefficient of variation} = \frac{\sigma}{\bar{X}} \times 100$$

b) Index number:

The investigator has calculated supply index and price index to find the nature of relation between food production and farm harvest price.

c) Correlation analysis:

This was used to estimate the nature of relation between food production and area, food production and quantum of fertilizer used and food production and farm

harvest price. Further it was used to findout the nature of relation between consumer expenditure on food and State population and also between consumer expenditure on food and percapita income. The formula used was

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

d) Growth rate analysis:

With the objective of finding out the influence of time factor on food production and demand for food, the investigator had estimated the growth rate of supply of food and demand for food by using the formula

$$y = Aoe^{\lambda t}$$

where

Ao = Constant term;

λ = Growth rate; and

t = Time period,

e) Simple regression analysis:

This was used to estimate the functional relationship between supply of food and area under cultivation, supply of food and quantum of fertilizer used and supply of food and farm harvest price. Further, to findout the functional relationship between demand for food and State's population, demand for food and percapita income and demand for food and consumer price, this tool was used. By using this, the price elasticity and income elesticity of demand for food were worked-out. The formula used was

$$byx = \frac{\Sigma dxdy - \frac{\Sigma dxdy}{N}}{\Sigma dx^2 - \left(\frac{\Sigma dx}{N}\right)^2 \Sigma dy^2 - \left(\frac{\Sigma dy}{N}\right)^2}$$

F) Multiple regression analysis:

This was used to formulate the supply model of food and demand model for food. The estimated supply equation is of the form.

$$y = bo + b1\ A + b2F + b3\ FP + E$$

Where Y represents the supply of food, b1 is the regression coefficient of supply of food in relation to area under cultivation, b2 is the regression coefficient in relation to quantum of fertilizer used and b3 is the regression coefficient in relation to farm harvest price.

The estimated demand equation is of the form

$$D = bo + b1P + b2PY + b3\ CP + E$$

Where D represents the demand for food, b1 is the regression coefficient of demand for food in relation to State population, b2 is the regression coefficient of demand for food in relation to percapita income and b3 is the regression coefficient of demand for food in relation to consumer price.

g) Projection analysis:

This was used to forecast the future demand and supply gap of foodgrains for Tamil Nadu. The formula used was

$$\hat{P}t = Po\ (1 + r)^t$$

where

PO = The current demand and supply gap of foodgrains.

r = Annual growth rate of demand and supply gap of foodgrains, and

t = Time period.

Results and Discussion

Chapter - IV

RESULTS AND DISCUSSION

The results of the study pertaining to 'Demand and supply gap of food grains in Tamil Nadu' is discussed under the following heads.

I) Demand for foodgrains in Tamil Nadu;
II) Supply of food grains in Tamil Nadu;
III) Extent and projection of demand and supply gap of foodgrains in Tamil Nadu.

I) Demand for foodgrains in Tamil Nadu:

At the State level, Tamil Nadu faces the crucial problem of increasing demand for foodgrains. In Tamil Nadu, consumer expenditure on food is increasing due to rapid growth of population and increase in income. Since the major cause for demand-supply gap of foodgrains was enlarging demand for food, the investigator has analysed the demand for foodgrains in Tamil Nadu under the following heads.

A) Trends in percapita monthly consumer expenditure on food grains in Tamil Nadu from 1970-78;

B) Growth rate analysis of demand for food;

C) Trends in item wise percapita consumer expenditure on foodgrains in Tamil Nadu;

D) Identifying the factors influencing the demand for foodgrains in Tamil Nadu;

   a) Trends in population;

   b) Trends in percapita income;

   c) Trends in consumer price of food.

E) Estimation of elasticity of demand for foodgrains in Tamil Nadu; and

F) Formulation of demand model for foodgrains in Tamil Nadu.

A) Trends in percapita monthly consumer expenditure on foodgrains in Tamil Nadu:

Percapita consumer expenditure on foodgrains is a yardstick to estimate the demand for food and it represents the money expenditure on food by an individual adult person. Generally, an increase in percapita consumer expenditure on food signifies increasing demand for food. Table I represents the trends in percapita monthly consumer expenditure on food from 1970-78 in Tamil Nadu.

Table I indicates the fact that at the State level between 1970-78 per capita food expenditure in absolute terms, nearly doubted itself. The major accounting factor for this was increase in population growth. In the reference period, population of Tamil Nadu increased by 2.3 percent perannum and this inturn brought about increase in consumer expenditure on food at the rate of 9.97 percent per annum. But in percentage terms, at the State level from 1970-78, the percentage of food expenditure to total consumer expenditure decreased from 72.44 percent to 67.81 percent. This may be due to increase in individual income resulting from developmental efforts, providing the people the necessary purchasing power to buy more of comforts denoting non-food expenditure.

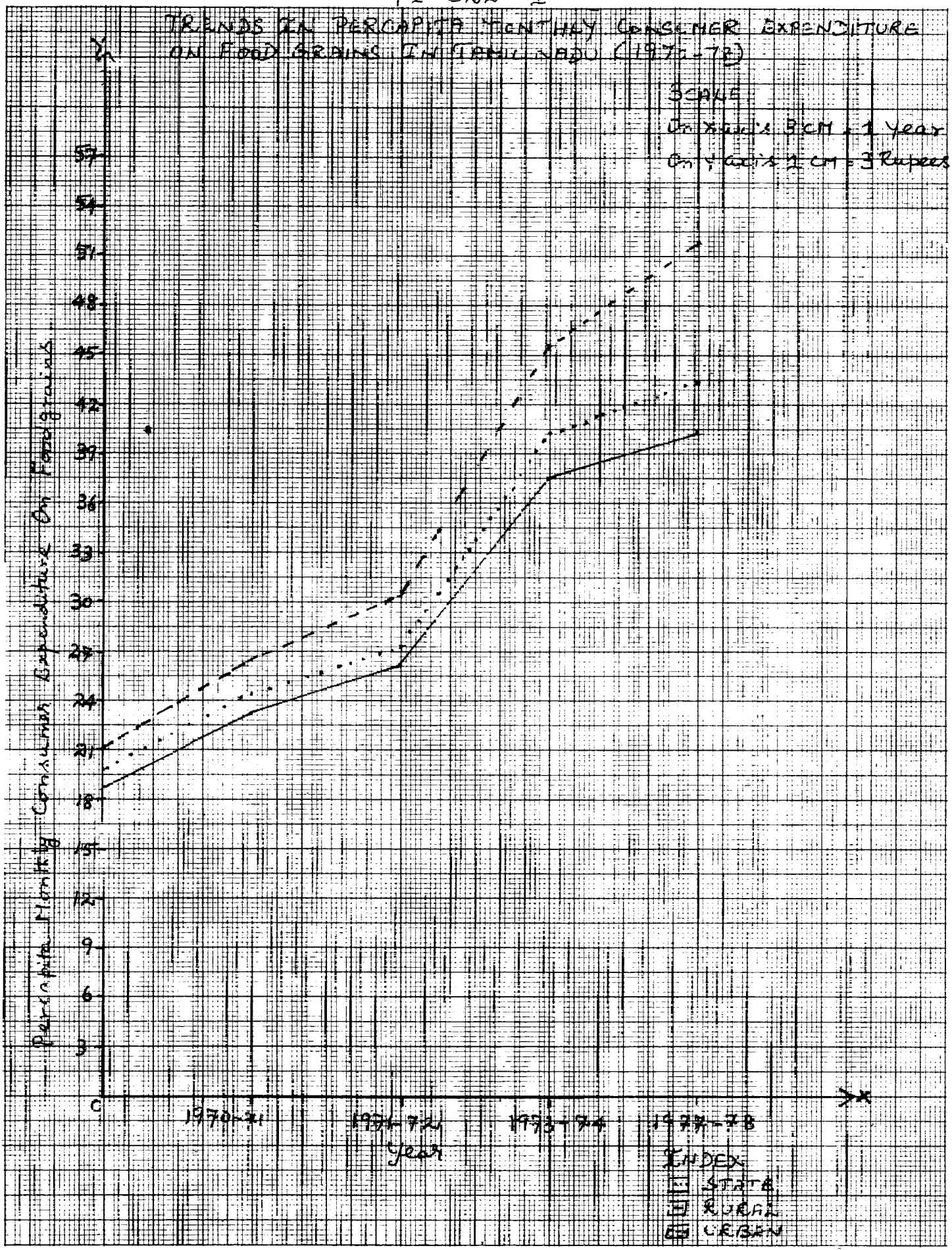
A comparative outlook of percapita consumer expenditure in rural and urban areas reveals that in absolute terms, money expenditure on food was high in urban areas. This may be due to high cost of living in urban areas. But the lower percapita food expenditure in rural areas may be due to absence of monetism and low cost of living in the rural areas.

However, in percentage terms, on an average, rural people were devoting 74 percent of their expenditure on food.

This implies that people of rural Tamil Nadu are still able to meet only their subsistence needs. On the other hand, the urban people were alloting only 66 percent of their expenditure on food. This signifies that urban people of Tamil Nadu are in better position to meet some of the comforts in life. Figure I represents the trends in percapita monthly consumer expenditure on food in Tamil Nadu.

FIGURE - I

TRENDS IN PERCAPITA MONTHLY CONSUMER EXPENDITURE ON FOOD GRAINS IN TAMIL NADU (1970-73)



B) Growth rate analysis of demand for food in Tamil Nadu:

With a view to findout the influence of time on demand for food interms of percapita consumer expenditure the investigator was calculated the growth rate of percapita consumer expenditure on foodgrains. Table II bringsout the relevant information.

T A B L E - II

ESTIMATED GROWTH RATE OF DEMAND FOR FOOD INTERMS OF MONTHLY PERCAPITA CONSUMER EXPENDITURE ON FOOD IN TAMIL NADU.

Item	Ao	λ	R^2	Standard error	t-value
State	35.48	.069	.78	.015	2.00*
Rural	33.88	.056	.71	.015	1.64
Urban	40.74	.075	.72	.02	1.65

(Appendix I)

* Statistically significant at 5 percent level.

From Table II it is apparent that in the reference period demand for food in Tamil Nadu increased by 6 percent. A comparative analysis of growth rate of demand for food between rural and urban area indicates that the growth rate of demand for food in urban area (.075) was greater than that of rural area (.056). The estimated growth rate were statistically significant as indicated by in the R^2 values.

C) Trends in item wise percapita consumer expenditure on foodgrains:

The major items of foodgrains consumed by the people of Tamil Nadu are cereals, gram, cereal substitutes and pulses. At the State level, the percapita food expenditure on various items is not uniform. With a view to findout the major food item for which people are spending greater percentage of their incomes, the investigator analysed trends in item wise percapita expenditure on foodgrains. Table III depicts the trends in itemwise percapita monthly consumer expenditure on foodgrains.

From Table III it can be observed that cereals are the major item of consumption by the people of Tamil Nadu. In percentage terms 65 percent of the expenditure was only for cereals which was higher than All India figure of 62 percent. This indicates the poor qualitative intake of food in Tamil Nadu.

Table III also reveals that in the reference period percapita consumer expenditure on cereals and cereal substitutes was higher in the rural areas in contrast to urban areas. On an average, the rural people were diverting 63 percent of their expenditure only for cereals and for cereal substitutes. From this, it can be interpreted that rural people of Tamil Nadu are still poor and hence not able to buy superior food items like pulses.

The careful study of Table III brings to light the fact that pereapita consumer expenditure in grams and pulses was higher for urban people of Tamil Nadu. On an average, urban people were devoting 5 percent of their expenditure on grams and pulses while rural people were alloting only 3 percent of their expenditure on pulses. From this it can be concluded that there was an improvement in quality of food intake by the urban people since they were consuming protein rich content of pulses.

D) Identifying the factors affecting demand for foodgrains in Tamil Nadu:

For the analysis of demand supply gap of foodgrains, it is essential to identify the key factors affecting demand for foodgrains. As such the investigator has analysed the trends in population, percapita income and consumer price of foodgrains in Tamil Nadu.

a) Trends in population:

Normally demand for foodgrains is positively associated with population. High population, by increasing the number of mouths to feed, is expected to increase the demand for food. So the investigator attempts to study the trends in population in Tamil Nadu from 1970-78. Table IV presents the same information.

T A B L E - IV

TRENDS IN POPULATION IN TAMIL NADU FROM 1970-78 (in million)

Year	Rural	Urban	State
1970-71	28.73	12.11	40.84
1971-72	29.13	12.58	41.71
1973-74	30.18	12.80	42.98
1977-78	33.12	13.15	46.77

From Table IV it can be observed that in the reference period, the population of Tamil Nadu increased by 1.58 percent, perannum. This inturn may be the cause for high average food expenditure in the State.

b) Trends in percapita income:

Generally demand for any commodity and also for food grains is originated from income and hence income is the basic source of consumption. With the objective of finding out the association between income and food expenditure, the investigator has analysed trends in percapita income. Table V helps to analyse the trends in percapita income in Tamil Nadu from 1970-78.

T A B L E - V

TRENDS IN PERCAPITA INCOME IN TAMILNADU FROM 1970-78(in rupees)

Year	Percapita income
1970-71	581
1971-72	599
1973-74	603
1977-78	654
Average	464
Annual growth rate	1.57

Table V reveals that in the reference period, percapita income had been continuously increasing and this may be the reason for steady increase in food expenditure. The estimated annual growth rate of percapita income as 1.57 reveals that developmental efforts in Tamil Nadu have resulted in positive growth rate.

c) Trends in consumer price index of foodgrains in Tamil Nadu:

Consumer price index of foodgrains is an essential factor affecting demand for foodgrains. Since the major objective of the study was to findout the important factors affecting the demand for foodgrains the investigator has analysed trends in consumer price index of foodgrains in Tamil Nadu from 1970-78. Table VI presents the same information.

T A B L E - VI

TRENDS IN CONSUMER PRICE INDEX OF FOODGRAINS IN TAMIL NADU FROM 1970-1978

Year	Consumer price index	Percentage change over the previous year
1970-71	100.00	...
1971-72	123.70	+ 23.7
1973-74	149.30	+ 25.6
1974-78	179.30	+ 27.0

Table VI makes it clear that during the reference period, there had been consistent increase in consumer price index for foodgrains. In contrast to the inverse relation between price and demand for any commodity, the demand for foodgrains interms of percapita food expenditure was increasing in Tamil Nadu at the rate of 9.97 percent perannum, inspite of increase in price by 9.54 percent perannum.

E) Estimation of elasticity of demand for foodgrains in Tamil Nadu:

Elasticity of demand for foodgrains indicates the extent of variation in demand for food. ~~consumer expenditure on food.~~ Generally the change in population, percapita income and consumer price are expected to bring out change in demand for food.

As a stepping Stone to estimate elasticity of demand for food, the investigator has analysed the nature of relation between demand for food and the associated variables through correlation analysis. Table VII represents the estimated correlation coefficients of demand for food in relation to population, income and the consumer price index.

T A B L E - VII

ESTIMATED CORRELATION COEFFICIENTS OF DEMAND FOR FOOD IN RELATION TO POPULATION, INCOME AND THE CONSUMER PRICE INDEX

Variable	r	r^2
Population	.98	.96
Percapita income	.91	.82
Consumer price index	.96	.92

(Appendix - II)

Table VII makes it evident that demand for food in Tamil Nadu was positively associated with population, percapita income and consumer price as indicated by the correlation coefficients as .98, .91 and .96 respectively. Of the three factors, population was a powerful factor, since the coefficient of determination reveals 96 percent change in demand for food was influenced by change in population.

To find out the causal relation between demand for foodgrains and the factors like population, percapita income and consumer price index, simple regression analysis was applied. Table VIII represents simple regression coefficients of demand for foodgrains in relation to population, percapita income and consumer price index.

T A B L E - VIII

SIMPLE REGRESSION COEFFICIENTS OF DEMAND FOR FOODGRAINS IN RELATION TO POPULATION, PERCAPITA INCOME AND CONSUMER PRICE INDEX

S.No.	Variable	$\hat{a}$	$\hat{b}$	Standard Error	R^2	t-value
1.	Population	35.90	0.23	.055	.90	4.18**
2.	Percapita income	135.63	3.34	1.03	.83	3.24**
3.	Consumer price index	-4.57	.28	.055	.92	5.09**

** - Statistically significant at 5 percent and 1 percent level.

(Appendix - III)

From Table VIII it can be observed that demand for foodgrains was more reponsive to change in income as compared to population and consumer price index since the regression coefficient of demand for foodgrains with respect to percapita income 3.36 was greater than for other two items .23 and .28. As such in Tamil Nadu, there was more of income elasticity of demand for food. All the regression coefficients were statistically significant as indicated by the high R^2 value of the estimate.

F) Formulation of demand model for foodgrains in Tamil Nadu:

The demand model for foodgrains was formulated by using multiple regression of the form

$$D = bo + b1P + b2PY + b3CP + E$$

Where

D = Demand for foodgrains.

b1 = The regression coefficient of demand for foodgrains in relation to population.

b2 = The regression coefficient of demand for food in relation to percapita income.

b3 = The regression coefficient of demand for foodgrains in relation to consumer price of foodgrains.

E = Error term.

The estimated demand equation for foodgrains were as follows.

Demand for foodgrains in Tamil Nadu:

$$D = 129.3 + 4.33P + .23\ PY - .51\ CP \quad .. \quad .. \quad .. \quad .. \quad I$$

$R^2 = .97$ $\quad t\hat{b}1 = 12.6$

$t\hat{b}2 = .07$

$t\hat{b}3 = .58$

(Appendix - IV)

Demand for foodgrains in rural Tamil Nadu:

$$D = 43.92 + 16.20P + 1.68PY - .84\ CP \quad .. \quad .. \quad .. \quad .. \quad II$$

$R^2 = .85$ $\quad t\hat{b}1 = 4.28$

$t\hat{b}2 = .53$

$t\hat{b}3 = .21$

Demand for foodgrains in urban Tamil Nadu:

$$D = 19.13 + 2.02P - .15\ PY + .01\ CP \quad .. \quad .. \quad .. \quad .. \quad III$$

$R^2 = .57$ $\quad t\hat{b}1 = .12$

$t\hat{b}2 = .14$

$t\hat{b}3 = .08$

From equation I it can be interpreted that for the State of Tamil Nadu, one percent change in population percapita income will bring out 4.33 percent change in demand for food. However, the influence of consumer price on demand for food was negative. The estimated demand equation for the State was valid as indicated by high R^2 value.

A comparative outlook of the above equation brings to light the fact that both in rural and urban areas, demand for food was more responsive to population. In urban areas, demand for food tends to decline as percapita income increases. This explains the validity of Engels law in the urban area.

II) Supply of foodgrains in Tamil Nadu:

Increasing supply of foodgrains is a basic pre-requisite to meet the enlarging demand for food. Eventhough demand for food increases, there will not be food problem, if there is simultaneous increase in food supply. The investigator has analysed the supply of foodgrains in Tamil Nadu under the following heads:-

A) General information about land utilisation pattern, rainfall, fertilizer consumption and farm harvest price of foodgrains in Tamil Nadu;

B) Trends in area under cultivation of foodgrains in Tamil Nadu from 1970-78;
   a) Cropwise analysis of area under cultivation;
   b) District wise analysis of area under cultivation of food crops.

C) Trends in foodgrains production in Tamil Nadu from 1970-78;
   a) Cropwise analysis of foodgrains production;
   b) Growth rate analysis of foodgrains production;
   c) District wise analysis of foodgrains production;

D) Trends in yield of foodgrains in Tamil Nadu;

a) Cropwise analysis of yield of foodgrains;

b) District wise analysis of yield of foodgrains;

E) Identifying the factors affecting the supply of foodgrains in Tamil Nadu;

a) Impact of area under cultivation on foodgrains output;

b) Impact of fertilizer use on foodgrains output;

c) Impact of farm harvest price on foodgrains output;

F) Formulation of supply model of foodgrains in Tamil Nadu;

A) General information about land utilisation pattern, Rainfall, fertilizer consumption and farm harvest price of foodgrains in Tamil Nadu.:

As a background information, the investigator has analysed land utilisation pattern ~~and~~ variation in rainfall, fertiliser consumption and farm harvest price of foodgrains in Tamil Nadu. Table IX provides this information.

Table IX reveals that in Tamil Nadu from 1970-78 on an average 55,55,000 hectares were under food crops. Of the total cropped area 73 percent was under food crops. This brings out the dominance of food crops over non-food crops in Tamil Nadu. This was greater than All India average of 64 percent.

B) Trends in area under cultivation of foodgrains in Tamil Nadu from 1970-78:

The area under cultivation is a basic factor affecting the food grains output. The production of food is expected to increase if the area under cultivation is extended. As such the investigator has analysed the trends in area under cultivation.

a) Cropwise analysis of area under cultivation:

In Tamil Nadu from 1970-78 there had been fluctuations in the area under cultivation of different food crops. Since the variation in area under cultivation for different food crops is expected to bring about variations in their respective output, The investigator has attempted cropwise analysis of area under cultivation of different foodcrops in Tamil Nadu. Table X helps to analyse the same.

From Table X it can be observed that, in Tamil Nadu more amount of area was alloted for the cultivation of cereals than pulses. This is due to the fact that, On an average 3975000 hectares were under cereals while only 559000 hectares were under pulses. Among the cereals, there had been domination of paddy and 75 percent of the area under foodcrops was used for the cultivation of paddy.

Between 1970-78, the area under paddy, Cholam, maize, ragi and pulses registered an increase. This may be due to favourable farm harvest price for the crops.

However, there had been highest fluctuations in the area under maize and lowest variation in the area under pulses since the estimated coefficient of variation in area under maize (19.16) was greater than that of pulses (8.85). (Appendix - V)

b) Districtwise analysis of area under cultivation of food crops:

In Tamil Nadu, due to variations in agro climatic conditions, there had been interdistrict variations in the area under cultivation of different foodcrops. Table XI helps to explain the same information.

Table XI reveals that, in Tamil Nadu, Thanjavur district has got more area under paddy (608,63,000 hectares) compared to other districts. In respect of area under cholam, Coimbatore district was leading since it has alloted 183.26 thousand hectares for the cultivation of cholam. Tiruchi district was having more area under cumbu as 90.25 thousand hectares. However, in respect of area under pulses, Thanjavur district was predominant since it has got 135.51 thousand hectares for the cultivation of pulses. This interdistrict variation in area under different foodcrops may be due to variation in soil character and water requirements for different crops.

C) Trends in production of foodgrains in Tamil Nadu from 1970-78:

It is essential to augument foodgrains production to meet the demand and supply of foodgrains. The investigator has analysed trends in foodgrains production in Tamil Nadu through cropwise and District wise analysis.

a) Cropwise analysis of foodgrains output:

In Tamil Nadu, from 1970-78, there had been variations in output of different foodgrains. The unsteady nature of foodgrains output is a major cause of food problem in the State. Table XII helps to explain the trends in production of different foodcrops in Tamil Nadu.

Table XII makes it obvious that, in the reference period, on an average, the production of cereals was greater than that of pulses. Among the cereals, the average production of paddy (5016.65 thousand tonnes) was greater than that of other crops. This may be due to more area under cultivation of paddy and the Government of India placing a major thrust on the production of rice since it is a major staple food in the State.

Of the different foodcrops, all the items of cereals registered a positive growth in the reference period. However, there was a negative growth of redgram production as (-24.55 percent). This inturn may account for poor protein intake by the people of Tamil Nadu.

In the study period, the highest fluctuation was found in the production of blackgram and lowest was in the production of paddy, since the estimated coefficient of variation for blackgram (30.2) was greater than that of paddy (14.37).

Figure IIa represents the trends in paddy output in Tamil Nadu from 1970-78 and figure IIb represents trends in pulses output in Tamil Nadu from 1970-78.

FIGURE-IIa

TRENDS IN PADDY OUTPUT IN TAMIL NADU (1970-78)

SCALE:

On X axis 2 CM = 1 YEAR

On Y axis 1 CM = 400 ('000 tonnes)

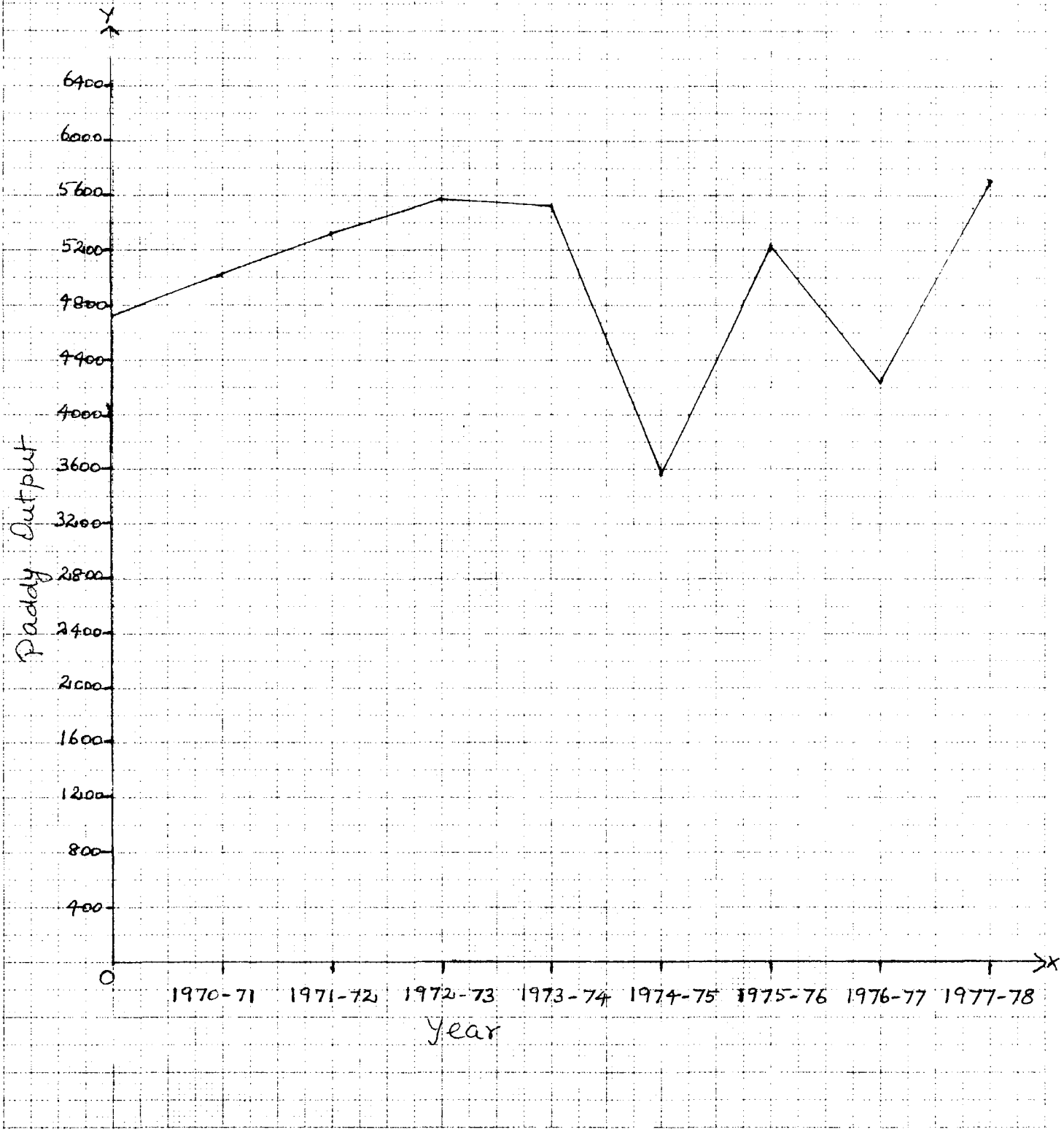
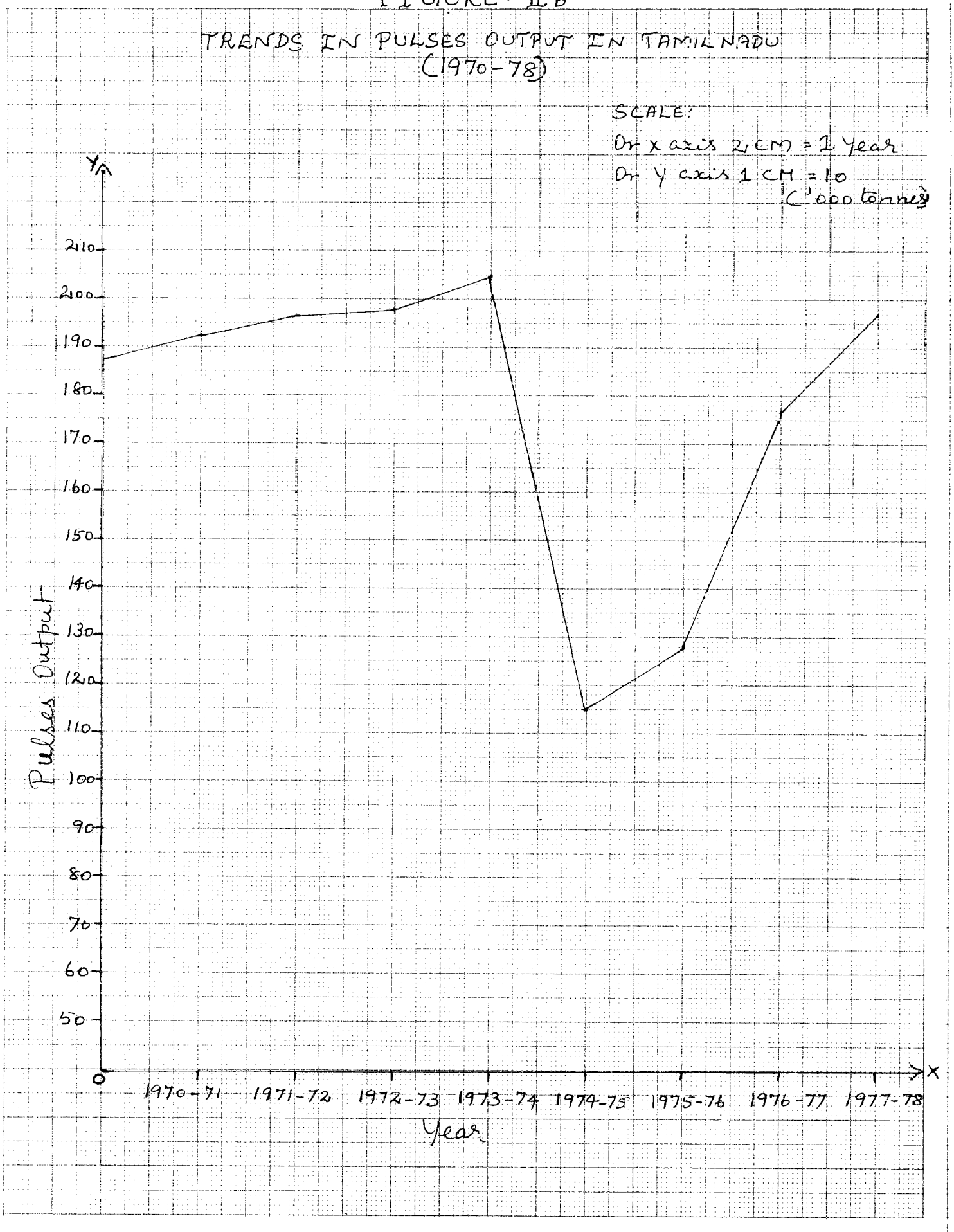


FIGURE - II b

TRENDS IN PULSES OUTPUT IN TAMILNADU (1970-78)



b) Growth rate analysis of foodgrains production:

With a view to find out the influence of time on the growth of foodgrains output, the investigator has estimated the growth rate of foodgrains production. Table XIII brings out the relevant information.

T A B L E - XIII

ESTIMATED GROWTH RATE OF FOODGRAINS OUTPUT IN TAMIL NADU

Crop	A0	λ	R^2	Standard Error	t-value
Total foodgrains	12.3	.03	.63	.002	1.98
Rice	.49	.008	.44	.010	3.01*
Cholam	5.95	.01	.75	.010	3.6*
Cumbu	3.26	.02	.80	.010	0.78
Ragi	3.52	.01	.63	.0019	0.72
Maize	19.79	.04	.20	.010	1.35
Total pulses	18.75	.01	.30	.009	.47

* Statistically significant at 5 percent and 1 percent level.

Table XIII reveals that among the various crops, maize registered the highest growth rate of .04 while rice has got the lowest growth rate of .008. This may be due to the existance of drought in Tamil Nadu in 1976. As such, it is absolutely essential to take measures to increase food supply.

c) Districtwise analysis of foodgrains output in Tamil Nadu:

In Tamil Nadu, among different districts, there had been variation in output of different crops. Table XIV brings out interdistrict variation in foodgrains output.

Table XIV makes it evident that Thanjavur district has got highest production potential of rice as 1170.75 thousand tonnes, and the lowest production was in Nilgris district as 5.66 thousand tonnes. Madurai district was leading in the production of chelam while Tiruchi district was having high potential of cumbu.

In respect of pulses, Thanjavur district was leading as it has got production of pulses as 43.89 thousand tonnes but Nilgiris district was having lowest production of .14 thousand tonnes.

D) Trends in yield of foodgrains in Tamil Nadu:

Yield denotes the productivity of a crop and is obtained by dividing the total production by area under cultivation. Since it is a helpful index of performance, the investigator has analysed trends in yield of foodgrains in output.

a) Cropwise analysis of yield of foodgrains:

In Tamil Nadu, there had been fluctuation in the yield of different foodcrops. Table XV brings out the relevant information.

It is appealing to note that among the cereals, paddy has got the highest productivity of 9925.5 kilograms. This was higher than All India paddy productivity of 1823.2 kilograms. Hence in paddy production, Tamil Nadu has got a comparatively better position. However, as against the All India average productivity of pulses as 386 kilograms, Tamil Nadu has got the lower pulses productivity as 346 kilograms. This calls for specific production strategy to augment pulses production in Tamil Nadu.

Between 1970-78, in terms of yield, all the foodcrops except cumbu registered a positive growth. However, highest fluctuation in yield was for cumbu as revealed by the estimated coefficient of variation as 32.18.

b) Districtwise analysis of yield of foodgrains in Tamil Nadu:

In Tamil Nadu there had been regional variation in the yield of different foodcrops. The interdistrict variation in the yield of different foodgrains can be understood from Table XVI.

Table XVI explains the fact that Tirunelveli district has got the highest yield of paddy as 2399.2 kilograms and Nilgris district has got the lowest yield as 1733.1 kilograms. This may be due to intensive farming method practised by farmers in Tirunelveli district. Similarly, in respect of cholam also Tirunelveli district has got the highest yield as 1629 kilograms. This is because in Tirunelveli district, cholam was raised as a combined crop under mixed farming. However, in respect of pulses, Dharmapuri district has got the highest yield of 570 kilograms while Nilgris district has got the lowest yield of 230 kilograms. The accounting factor for this disparity was differences in fertility of soil.

E) Identifying the factors affecting supply of food in Tamil Nadu:

The supply of food is influenced by factors like area under cultivation, fertilizer consumption and farm harvest price. The investigator by using correlation analysis has estimated the relation between foodgrains production and these factors. Table XVII brings out the same information.

Table XVII makes it apparent that there was positive association between the production of foodgrains and area under cultivation as revealed through the estimated correlation coefficient of .82. This implies that in Tamil Nadu, higher food production can be obtained by extending area under cultivation. But among the foodcrops the production of maize was negatively associated with area under cultivation.

Similarly, there was positive association between foodgrains output and fertilizer consumption since the estimated correlation coefficient was .63. The same relation exists for all the foodcrops. This is due to the fact that fertilizer consumption is an essential component of new agricultural technology and as such trend to increase food production.

The foodgrains output was also positively influenced by farm harvest price. The supply price response of foodgrains was positive as indicated by the estimated correlation coefficient of .52. Among the various foodcrops, there was positive relation between the output of paddy, cholam, cumbu and total pulses and their respective farm harvest prices. This implies that Tamil Nadu has got a prospect of increasing output of their crops through the formulation of favourable price policy.

With the tool of simple linear regression analysis the investigator has analysed the functional relationship

between the foodgrains output and the factors like area under cultivation, fertilizer consumption and farm harvest price. Table XVIII represents the estimated regression coefficients.

Table XVIII reveals that foodgrains output is influenced to a greater extent by the area under cultivation since the respective regression coefficient (10.18) was greater than for other variables. This signifies that one percent change in area under cultivation will bring out 1018 percent change in foodgrains output. All the three regression coefficients of foodgrains output were significant indicating the reliability of the estimate.

Among the cereals, production of paddy seems to be more influenced by fertilizer consumption as revealed through the calculated regression coefficient of 3.05. However, the production of pulses was affected to a marked extent by fertilizer consumption since the respective coefficient (3.06) was greater than that of area under cultivation (.44) and farm harvest price (.03).

F) Formulation of supply model of foodgrains in Tamil Nadu:

As based on the essential factors affecting foodgrains output, the investigator has formulated supply model of food by using multiple regression equation of the form.

$$S = bo + b1A + b2F + b3FP + E$$

where

b1 is the regression coefficient of foodgrains output in relation to area under cultivation, b2 is the regression coefficient in relation to fertilizer consumption and b3 is the regression coefficient in relation to farm harvest price. The estimated supply equations are as follows:

Supply of foodgrains in Tamil Nadu:

$$S = 35.18 + 14.2A + 10.3\ P + 6.8\ FP \quad \cdots\cdots \text{IV}$$
$$R^2 = .73$$

Supply of paddy:

$$S = 65.47 + 12.78\ A + 17.64A + 12.57\ FP \quad \cdots \text{V}$$
$$R^2 = .75$$

Supply of pulses:

$$S = 17.9 + 10.3\ A + 3.68\ F + 1.25\ FP \quad \cdots \text{VI}$$
$$R^2 = .64$$

The above equations signifies the fact that fertilizer consumption is an essential factor affecting the supply of paddy since one percent change in fertilizer consumption will bring about 176.4 percent change in

output. All the three regression coefficients were positive indicating that Tamil Nadu can augument its foodproduction through the extension of area under foodcrops, increase in fertilizer consumption and favourable farm harvest price.

However, in respect of pulses, the impact of area under cultivation was more significant as indicated by the higher regression coefficient of 10.34. All the estimated multiple regression coefficients were statistically significant as indicated by the high R^2 value.

III) Extent and projection of demand and supply gap of foodgrains in Tamil Nadu:

As linked with the over all analysis of demand and supply gap of foodgrains in Tamil Nadu, the investigator has analysed the demand and supply gap of foodgrains in Tamil Nadu. For this purpose the difference between percapita demand and percapita availability of foodgrains was calculated. Table XIX depicts the trends in percapita demand and supply gap of foodgrains in Tamil Nadu.

From Table XIX it is understood that from 1970-78 the percapita demand and supply gap of foodgrains was increasing. This is majorly due to higher percapita demand for foodgrains and a lower percapita availability of foodgrains.

On the basis of percapita demand and supply gap of foodgrains and the total population of the State the investigator has estimated total demand and supply gap of foodgrains in the State. Table XX represents the trends in total demand and supply gap of foodgrains in Tamil Nadu from 1970-78.

T A B L E - XX

TRENDS IN TOTAL DEMAND AND SUPPLY GAP OF FOODGRAINS IN TAMIL NADU FROM 1970-78

(in lakh tonnes)

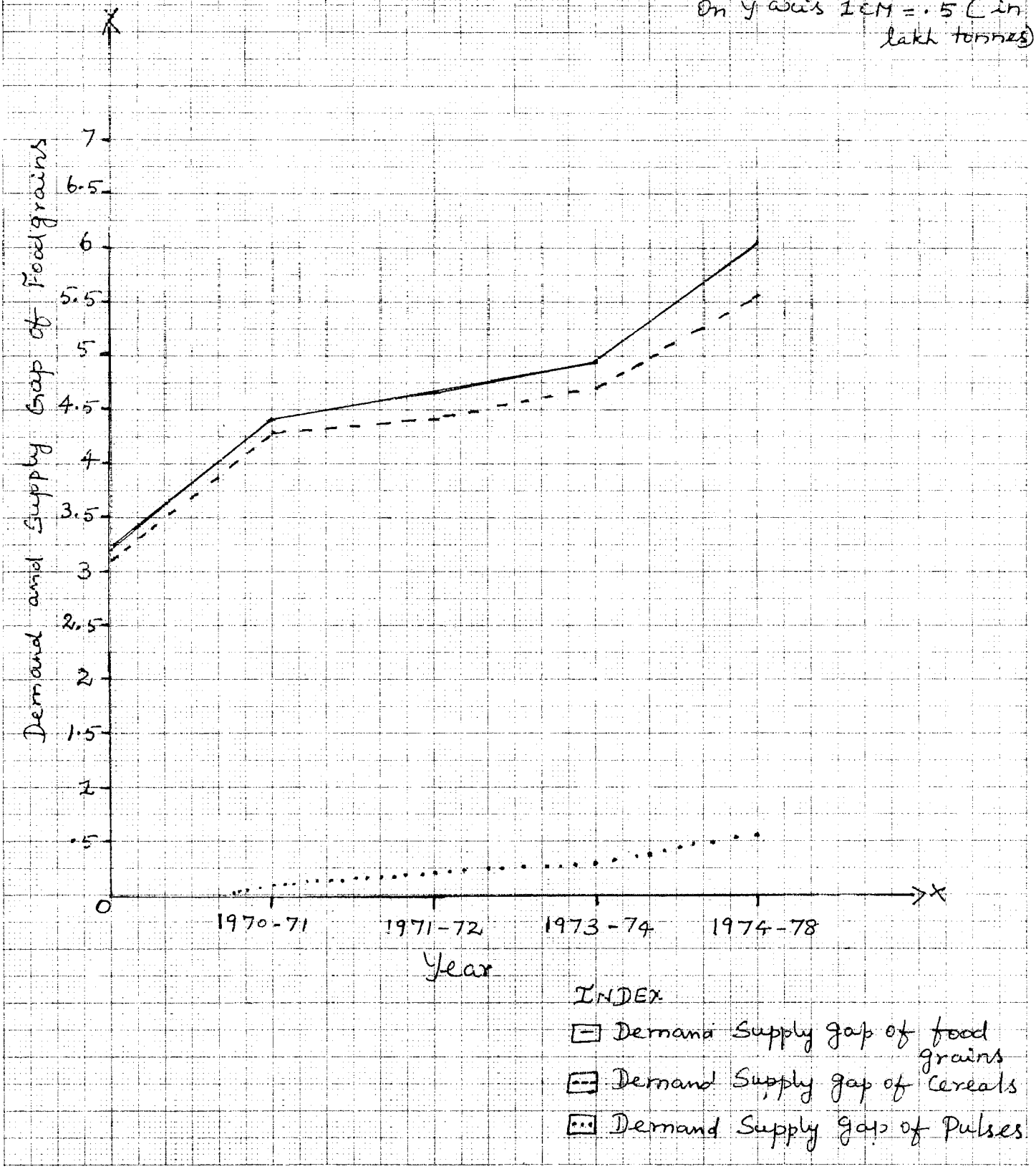
Year	Demand supply gap of foodgrains	Demand supply gap of cereals	Demand supply gap of pulses
1970-71	4.44	4.32	0.12
1971-72	4.64	4.44	0.20
1973-74	4.97	4.67	0.30
1974-78	6.09	5.56	0.53

Table XX makes it evident that in the study period the demand and supply gap of foodgrains increased by 36.8 percent. This calls for still more vigrous efforts to boost up food supply and to control population growth. However, itemwise analysis of demand and supply gap of foodgrains indicate that the gap was more acute for pulses than for cereals. As such there is an emerging need to increase pulses production through better farm practices and intensive cultivation. Figure III depicts trends in demand and supply gap of foodgrains in Tamil Nadu from 1970-78.

FIGURE III

TRENDS IN DEMAND-SUPPLY GAP OF FOOD GRAINS IN TAMILNADU (1970-78)

SCALE:
On x axis 3 CM = 1 year
On y axis 1 CM = .5 (in lakh tonnes)



INDEX
- Demand Supply gap of food grains
- Demand Supply gap of Cereals
- Demand Supply gap of Pulses

Projected demand and supply gap of foodgrains in Tamil Nadu for 2000 A.D. and for 2010 A.D.

Based on the rate of growth of demand for and supply of foodgrains in Tamil Nadu, the investigator has tried to estimated the future demand and supply gap of food grains in Tamil Nadu for 2000 A.D. and for 2010 A.D. Table XXI represents the same information.

T A B L E - XXI

PROJECTED DEMAND AND SUPPLY GAP OF FOODGRAINS IN TAMIL NADU

(in lakh tonnes)

Year	Foodgrains	Cereals	Pulses
For 2000 A.D	9.42	8.74	0.68
For 2010 A.D	11.49	10.73	0.76

(Appendix - VI)

It is alarming to note that by 2000 A.D. in Tamil Nadu there will be a food deficit to the tune of 9.42 lakh tonnes and by 2010 A.D. food shortage will be to the value of 11.49 lakh tonnes. As such, it is absolutely essential for the Government of Tamil Nadu to increase food supply by suitable input and price polices and by extending the essential infrastructural facilities. At the same time there is need for envisaging a suitable population policy to control increased demand for food.

T A B L E - XV

TRENDS IN YIELD OF FOOD CROPS IN TAMIL NADU FROM 1970-78 (in kilograms)

Year	Paddy	Cholam	Cumbu	Maize	Ragi	Total pulses	Bengal Gram	Red Gram	Green Gram	Black Gram	Horse Gram
1970-71	1900	607	522	109.9	1179	328	528	508	359	373	235
1971-72	1971	647	609	1098	1079	330	549	500	374	384	216
1972-73	1954	771	606	1064	1038	300	600	487	350	336	213
1973-74	2057	898	849	1053	1206	300	606	508	336	329	215
1974-75	1597	602	576	646	1230	240	375	461	341	269.6	127.7
1975-76	2029	876	733	1064	1503	270	563	519	209	225	213
1976-77	1846	942	1010	1064	1170	320	575	510	367	345	233
1977-78	2050	958	857	1053	1471	350	588	466	377	421	235
Average	1926.5	787.5	720.25	1017.6	1234.5	346	621.12	501	384.25	383.95	240.71
Percentage change	7.89	57.82	64.17	4.18	24.76	6.70	12.00	35.82	.55	4.82	1.2
Coefficient of variation	6.86	14.37	32.18	12.42	12.54	9.74	11.68	14.6	13.84	16.21	14.31

T A B L E - XII

TRENDS IN PRODUCTION OF FOOD CROPS IN TAMIL NADU (1970 - 78) (000' TONNES)

Year	Paddy	Cholam	Cumbu	Maize	Ragi	Total pulses	Bengal gram	Red Gram	Green Gram	Black Gram	Horse Gram
1970-71	5006.75	450.43	247.76	15.50	334.26	192.13	2.13	49.92	31.28	39.28	52.13
1971-72	5302.03	464.17	272.93	14.92	315.27	196.88	2.16	50.13	33.12	41.16	54.68
1972-73	5569.09	524.30	259.53	16.43	289.48	197.17	5.07	45.81	35.23	49.33	49.97
1973-74	5558.16	575.65	340.47	20.38	317.38	204.78	6.96	48.43	41.04	51.78	46.91
1974-75	3574.70	406.40	214.53	11.59	347.69	114.63	4.84	31.40	25.94	25.81	22.15
1975-76	5202.72	715.56	329.40	26.54	480.78	127.37	4.34	41.87	16.35	20.77	35.58
1976-77	4214.80	793.54	460.53	20.51	339.67	176.52	6.98	42.95	29.63	41.44	45.72
1977-78	5704.96	719.16	374.48	18.87	410.32	196.31	3.37	37.66	33.49	61.72	45.60
Average	5016.65	581.15	312.45	18.68	354.35	175.72	4.48	43.52	30.76	41.41	44.09
Percentage change	5.56	3.05	10.15	3.74	22.75	2.17	58.21	24.55	7.06	57.12	12.52
Coefficient of variation	14.37	20.85	23.58	24.27	17.90	17.78	29.77	14.48	20.43	30.20	20.65

DISTRICT WISE ANALYSIS OF PRODUCTION OF FOODCROPS IN TAMIL NADU ('000 TONNES)

District	Paddy	Cholam	Cumbu	Maize	Ragi	Total pulses	Bengal Gram	Red Gram	Green Gram	Black Gram	Horse Gram
Chengalpattu	606.11	.91	7.76	.05	30.60	2.04	.14	.84	.29	.50	.30
South Arcot	683.80	29.99	72.00	1.98	33.12	9.67	.05	3.50	1.23	3.75	.52
North Arcot	540.61	36.23	16.78	.65	37.58	13.45	.03	9.54	.46	.66	2.36
Salem	139.02	53.29	26.81	.25	37.63	10.94	.19	3.81	.83	1.23	3.87
Dharmapuri	90.68	52.08	8.24	.50	88.45	20.26	.21	3.13	.37	.75	14.38
Coimbatore	190.19	119.99	30.90	10.53	42.85	27.18	4.19	5.30	2.84	1.44	11.25
Periyar	223.96	33.19	27.39	.95	35.91	7.24	.02	1.40	1.02	.60	2.89
Tiruchi	343.38	87.83	53.28	1.07	7.89	12.74	.07	8.67	.47	1.76	1.23
Pudukottai	171.40	15.31	.84	3.62	3.56	2.29	.04	.99	.19	.63	.42
Thanjavur	1170.75	.56	.83	2.61	3.20	43.89	.01	.51	20.74	22.11	.06
Madurai	345.32	136.89	26.55	.42	12.27	12.46	.09	3.96	.72	2.38	4.05
Ramanathapuram	284.72	10.86	31.84	.03	27.71	6.89	.02	1.40	.63	3.21	1.09
Tirunelveli	352.25	45.27	48.53	.07	16.20	14.75	.02	.70	2.14	8.15	2.91
Nilgiris	5.66	.05	..	.01	1.20	.14	.01	.06	.04	..	.09
Kanyakumari	111.35	.09	.04	..	.01	1.39	..	.10	.28	.73	.21

T A B L E - XI

DISTRICT WISE ANALYSIS OF AREA UNDER CULTIVATION OF FOOD CROPS IN TAMIL NADU ('000 HECTARES)

District	Paddy	Cholam	Cumbu	Maize	Ragi	Total pulses	Bengal gram	Redgram	Greengram	Blackgram	Horsegram
Chengalpattu	326.79	.93	5.07	.04	19.96	5.69	.23	1.64	.86	1.46	1.41
South Arcot	305.22	58.11	64.51	.07	17.98	53.65	.08	7.98	3.21	8.69	2.25
North Arcot	263.96	33.40	15.67	.62	22.77	32.44	.05	16.06	1.19	2.34	10.67
Salem	64.05	81.15	40.81	.24	28.61	35.35	.32	6.81	2.43	.30	17.56
Dharmapuri	49.25	57.75	10.84	.48	78.05	81.55	.37	4.91	1.11	2.13	65.52
Coimbatore	91.81	183.26	32.62	10.26	26.80	97.90	7.53	9.64	8.62	4.35	51.65
Periyar	81.02	64.75	25.89	.88	24.07	25.32	.03	2.19	3.20	1.67	12.06
Tiruchi	170.55	133.31	90.25	1.03	6.28	33.15	.11	18.41	1.24	4.57	5.43
Pudukottai	101.00	3.37	1.11	3.48	4.68	.01	.04	2.12	.57	1.83	1.88
Thanjavur	608.63	.02	1.10	2.49	1.28	135.51	.01	1.06	63.02	69.59	.01
Madurai	149.63	137.75	26.13	.46	6.85	41.48	.16	7.14	1.81	6.61	18.57
Ramanathapuram	264.11	12.48	44.85	.03	25.58	23.06	.09	2.96	2.40	11.16	.19
Tirunelveli	145.81	28.00	67.61	.07	8.30	46.01	.05	1.36	5.39	21.17	13.24
Nilgiris	3.40	.08	.02	.01	1.34	3.06	.02	.01	.02	.69	.03
Kanyakumari	51.78	.09	.07	...	.01	4.53	.04	.17	.68	2.38	1.12

T A B L E- IX

TRENDS IN LAND UTILISATION PATTERN. RAINFALL, FERTILIZER CONSUMPTION ND FARM HARVEST PRICE OF FOODGRAINS IN TAMIL NADU FROM 1970-197

I t e m	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
1) Total Geographical area (in '000 hectares)	13008	13008	13008	13008	13032	12999	12999	12999
2) Total cropped area (in '000 hectares)	7623	7641	7699	7648	6640	7235	7147	7768
3) Cropping intensity (in percent)	119.8	120.4	121.6	123.8	119.6	120.8	119.0	123.4
4) Irrigated area (in '000 hectares)	2695	27.10 (46.2)	2815 (47.7)	2816 (48.0)	2438 (45.7)	2565 (46.7)	2330 (42.0)	2836 (47.9)
5) Rainfall (in milli metres)	963.2	968.8	992.3	842.2	647.4	857.2	941.4	1123.7
6) Total area under foodcrops (in '000 hectares)	5602	5693	5844	5681	4951	16622	5495	5953
7) Total area under non food crops (in '000 hectares)	1935	1948	1855	1957	1689	1613	1652	1815
8) Fertilizer consumption (in lakh tonnes)	2.96	3.47	2.87	3.37	2.44	2.83	2.98	4.62
9) Farm harvest price of foodgrains (per quintal)	897.23	925.49	1311.12	1405.81	1422.13	1475.80	1521.01	1557.84

TABLE - X

TRENDS IN AREA UNDER CULTIVATION OF FOOD CROPS IN TAMIL NADU FROM 1970 - 1978

('000 hectares)

Year	Paddy	Cholam	Cumbu	Maize	Ragi	Total pulses	Bengalgram	Redgram	Greengram	Blackgram	Horsegram
1970-71	2635.51	742.45	474.86	14.10	283.40	480.01	2.80	98.13	87.12	105.11	221.65
1971-72	2689.98	777.90	448.64	13.59	292.09	586.91	3.52	100.21	88.53	107.06	223.64
1972-73	2850.57	679.62	427.97	15.43	278.90	680.62	8.42	93.90	101.24	147.08	234.43
1973-74	2703.82	640.94	401.22	18.96	263.10	663.41	11.44	95.32	122.99	158.00	217.87
1974-75	2238.02	675.41	372.50	17.95	282.59	464.20	12.83	68.09	76.07	96.43	173.63
1975-76	2563.61	816.88	449.81	24.96	319.86	470.93	7.70	80.61	78.25	92.5	167.15
1976-77	2283.66	841.75	456.10	19.19	290.28	545.29	12.11	84.27	80.42	120.24	196.71
1977-78	2782.33	750.77	432.20	17.93	290.29	582.30	5.46	80.82	88.76	146.51	193.36
Average	2593.45	733.91	432.91	17.76	287.56	559.20	8.03	87.66	90.42	121.66	203.55
Percentage change	5.57	1.12	8.98	27.16	2.43	21.30	9.5	17.63	1.88	6.7	12.76
Coefficient of variation	9.04	10.08	9.81	19.16	11.25	8.85	15.5	15.5	14.37	22.01	12.28

T A B L E - I

TRENDS IN PERCAPITA MONTHLY CONSUMER EXPENDITURE ON FOOD IN TAMIL NADU FROM 1970-1978

(in rupees)

Year	Rural		Urban		State	
	Percapita food expenditure	Percentage to total expenditure	Percapita food expenditure	Percentage to total expenditure	Percapita food expenditure	Percentage to total expenditure
1970-71	23.30	75.72	26.68	66.93	24.37	72.44
1971-72	26.16	74.25	30.39	65.95	27.16	71.84
1973-74	37.97	70.93	45.50	67.40	40.11	69.75
1977-78	40.33	76.06	51.93	64.13	43.85	67.81
Average	31.94	74.24	38.62	66.10	33.87	70.46

T A B L E - III

TRENDS IN ITEM WISE PERCAPITA MONTHLY CONSUMER EXPENDITURE ON FOODGRAINS

(in rupees)

Items	1970-71			1971-72			1973-74			1977-78		
	Rural	Urban	State	Rural	Urban	State	Rural	Urban	State	Rural	Urban	State
Cereals	13.26	12.00	12.63	15.72	13.82	14.77	20.71	19.77	20.24	21.60	20.67	21.13
Cereal Substitute/	.09	.01	.05	.10	.07	.08	.12	.06	.09	.16	.05	.11
Gram	.03	.03	.03	.02	.05	.04	.03	.07	.05	.12	.12	.12
Pulses	1.10	1.45	1.28	1.27	1.77	1.52	1.52	2.08	2.33	2.19	3.16	2.68
Others	8.78	13.19	10.36	9.05	14.68	5.02	15.03	23.02	16.04	16.26	27.93	19.81

T A B L E - XIX

TRENDS IN PERCAPITA DEMAND AND SUPPLY GAP OF FOODGRAINS IN TAMIL NADU FROM 1970-78

(in kilograms)

Year	Total foodgrains			Cereals			Pulses		
	Percapita demand	Percapita availability	Percapita demand and supply gap	Percapita demand	Percapita availability	Percapita demand and supply gap	Percapita demand	Percapita availability	Percapita demand and supply gap
1970-71	2.78	1.70	1.08	2.36	1.31	1.05	0.42	0.39	0.03
1971-72	2.81	1.69	1.12	2.38	1.31	1.07	0.43	0.38	0.05
1973-74	2.85	1.68	1.17	2.40	1.30	1.10	0.45	0.38	0.37
1974-78	2.93	1.66	1.27	2.45	1.29	1.16	0.48	0.37	0.09

T A B L E - XVIII

ESTIMATED REGRESSION COEFFICIENTS OF SUPPLY OF FOOD AS RELATED TO AREA UNDER CULTIVATION, FERTILIZER CONSUMPTION AND FARM HARVEST PRICE

	Area under cultivation					Fertilizer consumption					Farm harvest price				
Crop	$\hat{a}$	$\hat{b}$	Standard Error	R^2	t-value	$\hat{a}$	$\hat{b}$	Standard Error	R^2	t-value	$\hat{a}$	$\hat{b}$	Standard Error	R^2	t-value
Rice	-28.73	3.05	.46	.89	6.63	31.92	5.68	.4178	.27	-1.36	31.00	1.56	.1405	.21	1.11
Cholam	-519	1.53	.52	.63	2.94	36.38	7.35	.864	.12	.85	68.55	-.83	.207	.32	-.41
Cumbu	-36.67	1.61	1.05	.22	1.53	16.78	4.79	.4712	.17	1.01	36.02	-.41	.673	.23	.24
Ragi	29.02	.26	.29	.14	.89	30.39	1.65	.4192	.13	.39	36.28	-.06	.952	.71	6.01
Maize	- 1.09	1.07	.38	.59	2.81	15.76	.84	.3782	.23	.28	19.33	-.01	.07	.33	-.14
Total food grains	87.86	10.18	.41	.91	7.65	38.44	9.3	1.03	.50	9.06	12.13	.12	.11	.45	1.15
Total pulses	-91.25	.45	.10	.79	4.50	60.52	3.06	.23	.29	1.44	10.18	.03	.01	.35	1.18

T A B L E - XVII

ESTIMATED CORRELATION COEFFICIENT OF FOODGRAINS OUTPUT AS RELATED TO AREA UNDER CULTIVATION, FERTILIZER CONSUMPTION AND FARM HARVEST PRICE

Crop	Area under cultivation		Fertilizer consumption		Farm harvest price	
	r	r^2	r	r^2	r	r^2
Total foodgrains	.82	.67	,63	.39	.52	.27
Rice	.96	.92	.52	.27	.20	.04
Cholam	.62	.38	.31	.09	.01	.0001
Cumbu	.43	.18	.28	.07	.07	.004
Ragi	.38	.14	.16	.02	-.05	.002
Maize	-.08	.006	.12	.01	-.28	.07
Total pulses	.84	.70	.48	.23	.69	.47