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TAPIOCA PRODUCTION AND UTILISATION IN INDIA

(An Analysis of Past Trends and Projections for 2000)

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CONTENTS

TAPIOCA PRODUCTION AND UTILISATION IN INDIA

1. Introduction

1.1. Importance of Tapioca[1/]

Tapioca is grown in India for a number of years and its orgigin is traced back to either Brazil from where it was introduced by the Portugese during the 17th Century or brought from South America in 1840. However, the spread of tapioca cultivation is attributed to a famous ruler[2/] of the former Travancore State who had encouraged cultivation of popular varieties from Malaya and other places to overcome rice shortage in the State, especially among the low income group consisting of small farmers and labourers engaged in hard physical labour. Since tapioca is somewhat drought resistant its spread was mainly on un-irrigated rainfed land without the application of chemical fertilisers.

During 1983-84, the area under tapioca in India was 304.7 thousand hectares and its production was 5800.2 thousand tonnes. At the all India level, area under tapioca was less than 0.2% of the total cropped area and the rice equivalent of tapioca production

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1/ Tapioca is known as Cassava in many other countries

2/ Visakham Thirunal Maharaja (1880-1885) of Travancore State, which currently forms a part of the Kerala State.

(2.6 million tonnes) was about 6% of the total production of rice in the country.[1/] Though the area under tapioca and its production do not occupy an important position in the Indian agricultural economy, because of the geographical concentration of production, it is an important crop in the agricultural economy of a few states, especially Kerala and Tamil Nadu. Kerala, where the crop was first introduced in India accounted for about 76% of the area under tapioca and the neighbouring state of Tamil Nadu accounted for another 16% of the area.[2/] The shares of production of Kerala and Tamil Nadu were 67% and 26% respectively of the all-India production. In Kerala the area under tapioca accounted for about 145% of rice production in the State. The importance of tapioca in the agricultural economy of the different regions can be visualised from Table 1.

1/ 2.22 tonnes of raw tapioca is considered as equivalent to one tonne of rice in calorific value.

2/ A part of the area in Tamil Nadu belonged to the former Travancore State before the re-organisation of States in 1956.

Table 1

Area and Production of Tapioca: All India, Kerala and Tamil Nadu: 1983-84

		India	Kerala	Tamil Nadu
1.	Area (1000 hectars)	304.7	233.0	48.1
2.	Production (1000 tonnes)	5800.2	3903.2	1500.4
3.	Yield (kg/ha)	19036	16751	31193
4.	Tapioca area as a percent of			
	(a) foodgrain area	0.30	27	0.93
	(b) foodcrop area	0.25	13	0.86
	(c) total cropped area	0.18	8	0.66
5.	Rice equivalent of tapioca production as a percent of rice production	5	145	15

1.2 Regional Characteristics

During early sixties Kerala accounted for 89% of the area under tapioca, Tamil Nadu had about 8% of the area and only 3% of the total area was accounted by the other States. During the last quarter Century there was a substantial improvement in the share of area in Tamil Nadu and marginal increase inother regions at the expense of Kerala's share.

The area under tapioca is not uniformly distributed within Kerala and Tamil Nadu. Of the 12 districts in Kerala, three districts[1/] (Trivandrum, Quilon and Kottayam) accounted for 57.4% of the area under tapioca and 59.7% of the production during 1983-84. Similarly in Tamil Nadu the districts of Salem and Kanyakumari accounted for 78% of the area and 77.8% of the production of tapioca in the State. While Trivandrum district accounted for only about 7.9% of the total cropped area in Kerala, it had 23.7% of the tapioca area and 27.3% of the production in Kerala. Similarly Quilon district with 10.2% of the cropped area in the State accounted for 24.3% of the area and 21.6% of the production of tapioca in the state.

The yield levels in Kanyakumari, a contiguous district of Trivandrum district, was about 15 tonnes/hectare as compared to about 21 tonnes/hectare in Trivandrum and 16 tonnes/hectare in Kerala. However, the yield of tapioca in Salem district was 37.7 tonnes/hectare. It may be recalled that the average yield of tapioca in Tamil Nadu was over 31 tonnes/hectare against 16 tonnes/hectare in Kerala, and

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1/ These three districts form part of the former Travancore State. The Travancore region accounted for about 65 per cent of tapioca production in Kerala.

the high yield level obtained in Salem district accounts for the high yield level in Tamil Nadu. While tapioca cultivation in Kerala and Kanyakumari is mainly for home consumption, a large proportion of tapioca produced in Salem district is utilised for industrial purposes, especially for starch and sago production. Most of the land utilised for tapioca in Kerala and Kanyakumari are rainfed areas; but in Salem district irrigated land is utilised for tapioca cultivation.

Thus more than half the area and production of tapioca in India is concentrated in three districts of Kerala (Trivandrum, Quilon and Kottayam) and one district of Tamil Nadu (Salem). Table 2 indicates the nature of concentration in these districts.

Table 2: Area and Production in four major producting Districts

	Trivandrum	Quilon	Kottayam	Salem
1. Area as a percentage of				
(a) tapioca area in the state	23.7	24.2	9.5	54.8
(b) All-India tapioca area	17.6	18.0	7.0	8.7
(c) Cropped area of the district	23.6	18.6	9.3	5.0
2. Production as a percentage of				
(a) state production	27.3	21.6	10.8	66.4
(b) All-India production	19.4	15.4	7.7	17.2
3. Yield/hectare (tonnes)	20.96	16.30	20.73	37.75

1.3 Uses of Tapioca

The major uses of tapioca include (1) human consumption (2) manufacture of starch and (3) as an ingredient in animal feed. Tapioca is mainly consumed as baked tubers and small quantities are used in the form of chips, flour and sago. As mentioned earlier, the spread of tapioca in Kerala was mainly because of its use in supplementing the foodgrain availability of the state. Tapioca used to be the main staple diet for many low income households over a number of years. Though the dependence on tapioca by the poor has somewhat declined with relatively easy access to rice, in many low income families tapioca continues to be an important item of consuption. Available data on tapioca utilisation in Kerala indicated that during 1971 about 60% of the raw tubers was consumed as food and the remaining was marketed for other uses.[1/] In Tamil Nadu,, the domestic consumption was estimated at 48%.[2/]

Industrial use of tapioca started during the second World War when manufacture of starch and flour were initiated to overcome the nonavailability of maize and

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1/ Government of Kerala, Report of the Subcommittee of Tapioca Market Expansion Board, 1972, p.63.

2/ Marketing of tapioca in Madras State (1965).

potato starch from the western countries and tapioca starch from Indonesia for the textile mills. When the Government of Travancore introduced controls over export of tapioca products to ensure its availability as a cereal substitute, some areas in Tamil Nadu developed tapioca processing and gradually tapioca cultivation also expanded around these regions. Limited quantities of tapioca were used in different products such as Dextrines, Manio meal and Glucose. Starch is also used in the manufacture of sago, 1/ mostly in Tamil Nadu. However, there are wide variations in the estimates of tapioca use for starch and sago ranging from about 41% of the total tapioca production in 1961 2/ to about 75% of the tapioca production in Tamil Nadu. 3/ Data on starch production also indicate a range. The total starch production in India during the beginning of the '80s was estimated by Government of India to be about .14 million tonnes.

1/ Wet starch (containing about 40% moisture) is rolled into small globules in a special machine. These are classified to separate the oversize and undersized material, roasted, dried and finished, most by small industry.

2/ Marketing of Tapioca in Tamil Nadu.

3/ S.P.Ghosh, Trends in Disposition of Cassava and scope for Developing Cassava based industry in India, J.Root crops, 1984. p.1-6.

Srivastava and Phandis (1982) had estimated the tapioca starch production in India at about .2 million tonnes.[1/] Considering the installed capacity of starch manufacturing units and their capacity utilisation, Ghosh has estimated that the present tapioca starch production (including sago) should be more than .3 million tonnes.[2/]

Studies based on composition of animal feeds have indicated that dried tapioca could replace at least 20% of the cereals now used for poultry feed and even more than that for cattle and pig feed. However, there is very limited use of tapioca in compound feeds. At the same time many farmers use tapioca chips and other tapioca waste for feeding cattle at home.

1.4 Objectives of the Study

The main objective of the study is to analyse the production and utilisation pattern of tapioca in India with a view to make an assessment of its future potential. In particular, the following objectives were kept in mind:

(a) to analyse past trends in area, yield and production as well as domestic utilisation of tapioca for various purposes;

1/ Srivastava and Phandis (1982)

2/ Ghosh (1984)

(b) to give a broad indication of the supply and demand prospects of tapioca in 1990 and 2000; and

(c) to suggest appropriate policies for realising the full potential of tapioca production, utilisation and trade in India.

1.5 Data Base

Data on area, yield and production of tapioca are obtained regularly through the land utilisation surveys and crop cutting surveys conducted by the concerned government departments.[1/] Prior to the introduction of these measures in the sixties, revenue department was responsible for data collection. Since tapioca was not an important crop from the revenue point of view, the data gathered by the lower revenue staff might have been based on general impressions. In addition to the available data on area, yield and production according to districts, data are also available on farm harvest prices of tapioca. However, there exists very little information on the existing marketing and utilisation patterns of tapioca. Though a few studies were initiated in the sixties and early seventies to determine the tapioca utilisation pattern, no systematic attempt was initiated to maintain continuity with the result that very little information is available on this aspect for the last 15 years. Even on items such as production of tapioca starch, available data from different sources indicate a substantial divergence.

1/ Crop-cutting experiments on tapioca are conducted on a regular basis from 1964-65 onwards.

2. Trends in Area, Yield and Production

2.1. Area

The area under tapioca in India increased rapidly in the mid-sixties and retained the position till mid-seventies before the decline had set in. Tapioca area in 1960-61 was 274.0 thousand hectares, increased to 347.1 thousand hectares by 1967-68, reached the peak level of 392.0 thousand hectares by 1975-76 and then declined to 340-7 thousand hectares in 1983-84.

The changes in area under tapioca in India reflect the changes of Kerala where the 1960-61 area of 242.2 thousand hectares reached a peak level of 327 thousand hectares in 1975-76 and then declined to 233 thousand hectares in 1983-84 which was even below the 1960-61 level. However because of the somewhat steady level of area in Tamil Nadu the all-India area declined at a slower rate. Figure 1 gives the pattern of changes in area in Kerala, Tamil Nadu and all India.

The changes in area over the years have also affected the relative importance of Kerala and Tamil Nadu in the all-India area under tapioca. While Kerala retained its dominant position regarding the tapioca area in India over the entire period, its share declined from 88.4% in 1960-61 to 76.5% in 1983-84. However, the share of Tamil Nadu in the all-India tapioca area increased from 9.0 per cent in 1960-61 to 15.6 per cent in 1983-84. (Table 4).

Table 4

Area under Tapioca in Selected Years

Year	Kerala		Tamil Nadu		All India
	Area (1000 Hectares)	Percent	Area (1000 hectares)	Percent	Area (1000 hectares)
1960-61	242.2	88.4	24.6	9.0	274.0
1967-68	297.6	85.8	29.5	8.5	347.1
1970-71	293.6	85.1	38.6	11.2	345.2
1975-76	326.9	83.4	50.1	12.8	392.0
1983-84	233.0	76.5	48.1	15.8	304.7

The all-India annual growth rate[1/] of area under tapioca between 1960-61 and 1983-84 was 1.32 per cent. Most of the increase in area occured during the sixties when the annual growth rate was 4.08 per cent. While the growth rate was still positive (0.25%) during the seventies, because of the fall in area in the late 70's and '80s the growth rate for the period 1970-71 to 1983-84 was negative (-1.20 per cent). The growth rates in Kerala indicate a high positive rate in the 60's but negative rates for both periods starting 1970-71. The overall growth rate (1960-61 to 1983-84) of area for Kerala was only 0.68 per cent. However, the growth rates of area for all periods remained positive in Tamil Nadu, though the rate of growth in recent years do not match with the rate of growth of the earlier period.

1/ Growth rates were obtained from a semi-logarithmic regression equation of the form $\log A_t = a + bt + e_t$

Figure 1: Area Under Tapioca

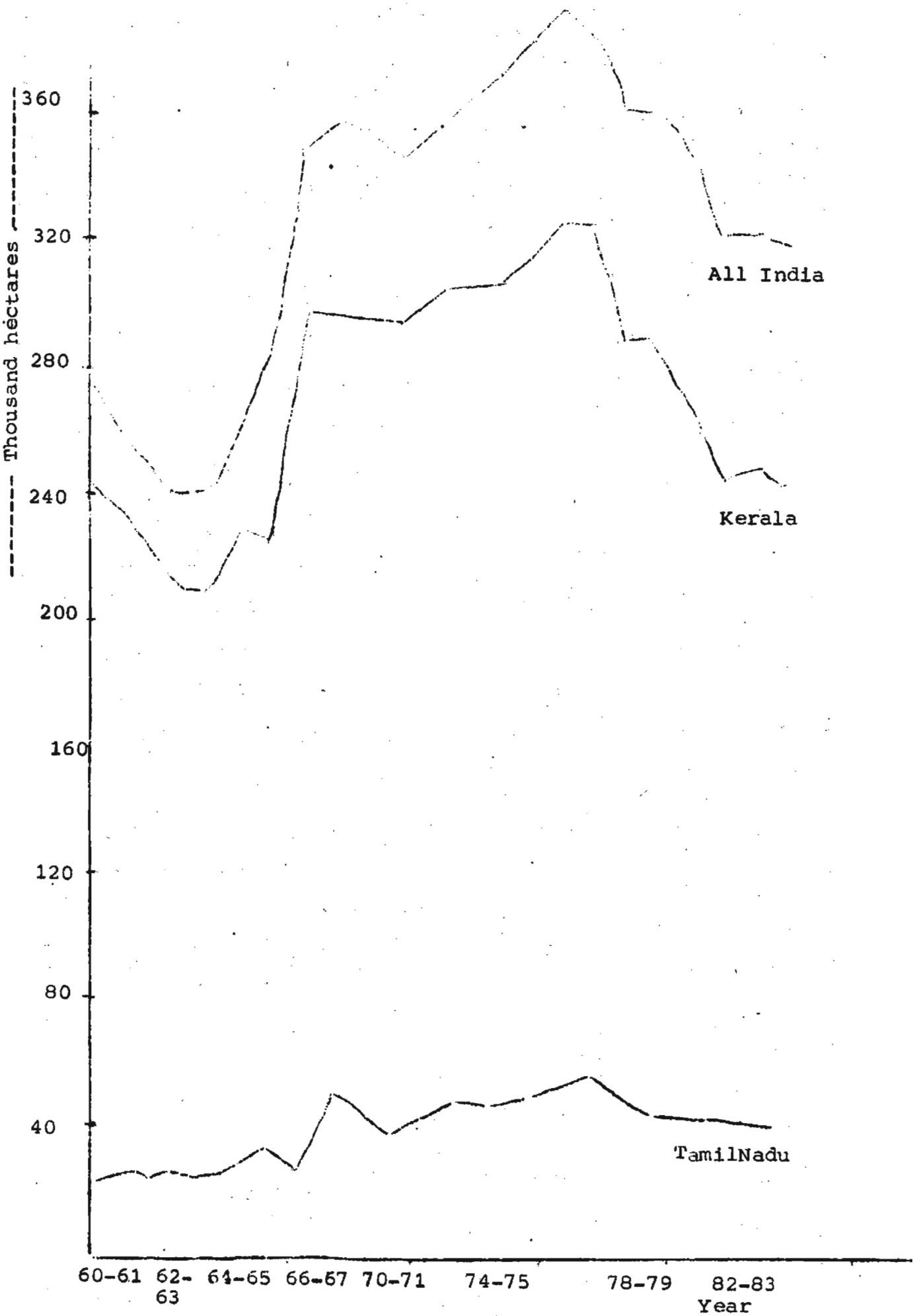


Table 5

Growth Rates of Area Under Tapioca

Period	Kerala	Tamil Nadu	All India
		(percent)	
1960-61 to 1969-70	3.12	9.38	4.08
1970-71 to 1979-80	-0.61	3.50	0.25
1970-71 to 1983-84	-2.27	1.30	-1.20
1960-61 to 1983-84	0.68	2.93	1.32

2.2 Yield

The all-India yield of tapioca increased from 7.2 tonnes/ha in 1960-61 to 19.0 tonnes/ha in 1983-84. There was a sudden increase (which may be partly due to the change in estimation procedures) from 7.1 tonnes in 1962-63 to 11.6 tonnes in 1983-84 and then the increase was more or less gradual until it reached another peak level of 17.5 tonnes in 1972-73.

The all-India yield levels display two distinct phases of yield levels in Kerala and Tamil Nadu. In the first phase, lasting until 1974-75, yield levels in Tamil Nadu remained more or less stagnant around 10 tonnes/ha and during most of these years, Kerala had much higher levels of yield. However, in the second phase starting 1975-76, yield levels in Tamil Nadu showed a substantial increase and the tempo was maintained till the end of that decade. At the same time yield levels in Kerala were either stagnant or declining. The direction

of change in yield levels can be observed from Figure 2.

The increased yield levels of Tamil Nadu after the mid-seventies had kept the all India average yield above the yield levels in Kerala. In 1983-84, the Tamil Nadu yield of more than 31 tonnes/ha was substantially higher than the yield levels in Kerala (16.8 tonnes/ha). The actual yield levels for a few years are available in Table 6.

Table 6

Yield of Tapioca in Selected Years

Year	Kerala	Tamil Nadu (kg/hectare)	All India
1960-61	6,949	9,638	7,186
1963-64	12,023	9,604	11,556
1970-71	15,726	12,088	14,860
1974-75	17,695	10,719	16,321
1975-76	16,489	22,272	16,934
1983-84	16,752	31,193	19,035

The all-India annual growth rate of yield from 1960-61 to 1969-70 was 3.36 per cent, most of which can be attributed to the growth performance during 1960-61 to 1969-70. While the growth rate for 1960-61 to 1969-70 was 8.61 per cent, it was only 0.15 per cent during 1970-71 to 1979-80, and a slightly higher rate of 0.47 per cent was obtained during 1970-71 to 1983-84. Most of the yield increase during 1960-61 to 1969-70 was accounted by the high growth rate of yield in Kerala. However, for the period beginning 1970-71 the growth rate of yield in Kerala was negative but the high positive growth rate in Tamil Nadu had maintained the all-India growth rates at positive levels. (see Table 7).

Figure 2. Yield of tapioca

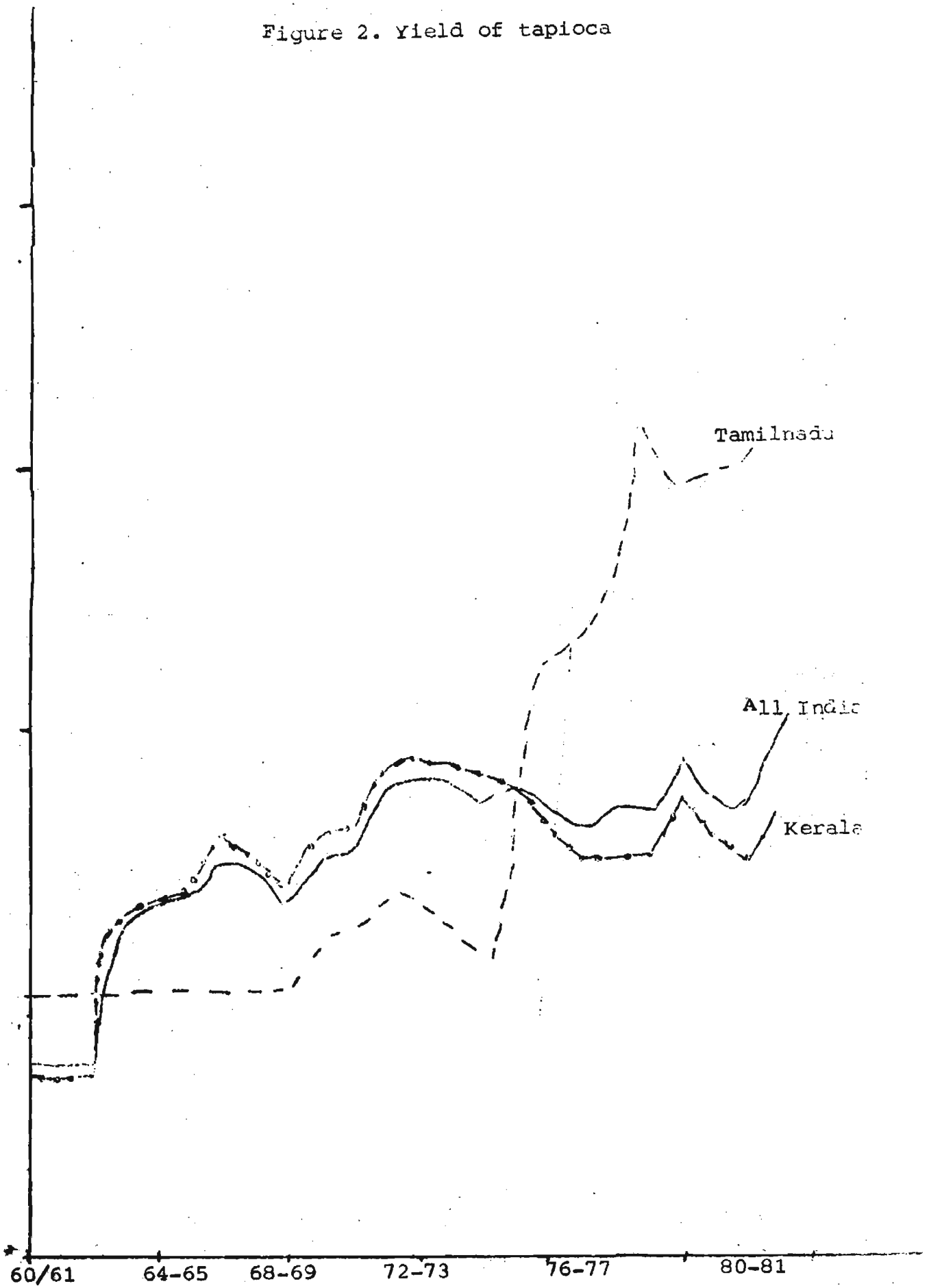


Table 7

Growth Rates of Yield of Tapioca

Period	Growth Rates in		
	Kerala	Tamil Nadu (per cent)	All India
1960-61 to 1969-70	10.50[1/]	2.17	8.61
1970-71 to 1979-80	-2.31	11.79	0.15
1970-71 to 1983-84	-1.01	8.64	0.47
1960-61 to 1983-84	2.88	7.20	3.36

1/ This is mainly on account of the low yield levels reported during the first three years. Since there is a change in the methodology of estimating uield from 1963-64, data for the period 1963-64 to 1969-70 indicates a growth rate of yield only to the extent of 3.4%.

2.3 Production

The changes in area and yield mentioned earlier had resulted in an increase of tapioca production from 1.97 million tonnes in 1960-61 to 5.8 million tonnes in 1983-84. The production increase was rapid from 1960-61 to 1969-70 (from 1.97 million tonnes to 5.2 million tonnes) and then there was a somewhat gradual increase until 1975-76 when the production level reached an all time record of 6.6 million tonnes. After 1975-76, there had been some annual fluctuations in production levels but the 1975-76 level was never achieved.

During the sixties, the all India production level of tapioca was closely linked with the production levels achieved in Kerala. The 1960-61 production of tapioca in Kerala was 1.7 million tonnes, it increased to 5.7 million tons

in 1972/73 and then declined to 3.9 million tonnes by 1983-84. However, there had been a steady increase in the production levels in Tamil Nadu where tapioca production increased from .2 million tonnes in 1960-61 to 1.5 million tonnes in 1983-84. The trends in the growth of tapioca production in India and in the major producing states are available from figure 3.

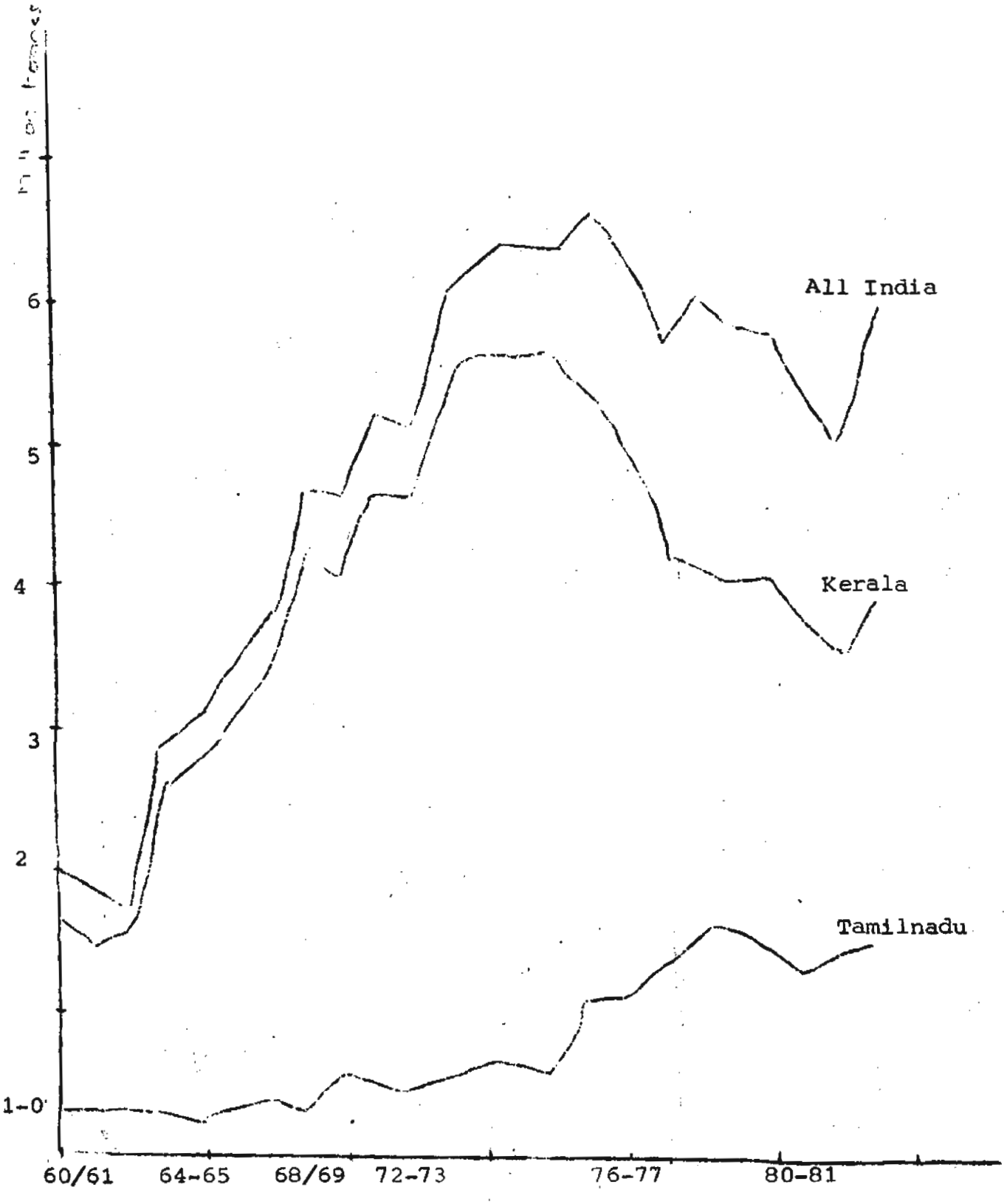
The changes in production levels had also affected the relative shares in the producing states. During 1960-61, Kerala accounted for 86.8 per cent of the tapioca production in India and Tamil Nadu accounted for 12.0 per cent. By 1983-84 Kerala's share has declined to 67.3 per cent and Tamil Nadu's share had gone up to 25.9 per cent. As indicated earlier, the changes in area and yield in these states had played important roles in shifting the production pattern. The levels of production and the share of Kerala and Tamil Nadu in the total production for a few years are available from Table 8.

Table 8

Production of Tapioca in Selected Years

year	Kerala		Tamil Nadu		All India
	Production (1000tonnes)	Percent	Production (1000 tones)	Percent	Production (1000 tones)
1960-61	1683.0	86.8	237.1	12.9	1969.0
1970-71	4617.2	90.0	466.6	9.1	5129.6
1975-76	5390.2	81.2	1115.8	16.8	6638.3
1980-81	4097.8	69.8	1539.3	27.2	5868.1
1983.84	3903.2	67.3	1500.4	25.9	5800.2

Figure 3: Production of Tapioca



The all-India growth rate of production of tapioca during 1960-61 to 1983-84 was 4.68 per cent. Most of the increase in production levels occured during the sixties when the annual growth rate was as high as 12.69 per cent. The growth rate during the 60's were consistently high in both Tamil Nadu and Kerala. However after 1970-71, the growth rate of production in Kerala was negative. Inspite of the negative growth rate of production in Kerala during 1970-71 to 1979-80, the high growth rate of about 15 per cent in Tamil Nadu during this period enabled the all-India growth rate of production to be a small positive value. However, during the period 1970-71 to 1983-84 the positive growth rate in Tamil Nadu was not sufficient to offset the negative growth rate of Kerala with the result that the all-India rate of growth of production turned out to be negative (Table 9).

Table 9

Growth Rates of Production of Tapioca

	Growth Rates in		
	Kerala	Tamil Nadu (per cent)	All India
1960-61 to 1969-70	13.62[1/]	11.55	12.69
1970-71 to 1979-80	-2.92	15.29	0.40
1970-71 to 1983-84	-3.28	9.94	-0.73
1960-61 to 1983-84	3.56	10.13	4.68

1/ When data for 1960-61 to 1962-63 are omitted, this rate is reduced to 10.5%.

The trends in area, yield and production of tapioca in Kerala indicated that mid-seventies represented a turning point in tapioca area, yield and production in Kerala. As indicated earlier, the role of tapioca as a cereal substitute was highlighted during the period prior to 1974-75, but this aspect was not given adequate emphasis in the subsequent period. This has a bearing on the rice availability from within the state and imports from outside. Though tapioca is not a major competitor for rice in terms of area allocation, the competition on the demand side is reflected in the allocation of other resources for tapioca production. For example, about 3/4 of the gross irrigated area in Kerala was accounted by rice, about 40% of the rice area was covered under High Yielding Varieties and a major portion of the fertilize used in Kerala was accounded by rice.[1/] Compared to the position of rice, less than 3 per cent of tapioca area was irrigated, leaving 97% to be grown on rainfed area.[2/] Though HYVs of tapioca were introduced by the CTCRI since 1963, there has not been much effort to spread it.[3/] An evaluation study by the State Planning Board had indicated that 64.5 per cent of rice was treated with fertilisers, while the corresponding percentage for tapioca was only 15.1 per cent.[4/]

1/ NSS 26th Round (July 1971-September 72), Fertilizer Use in Agricultural Holdings, South Zone Rural Sector, Government of India, March 1976.

2/ Agricultural Census 1976-77

3/ K.N. Ninan, Cereal Substitutes in a Developing Economy p.43

4/ Kerala State Planning Board, Extent of Adoption of Improved Agricultural Practices, An Evaluation Study.

3. Tapioca Utilisation and Prices

There is no systematic procedure for obtaining data on domestic utilisation of tapioca for different uses and therefore it is not possible to obtain reliable time series data on tapioca utilisation in India.[1/] Though FAO has brought out time series data on tapioca utilisation in India, it is based on some unrealistic assumptions. The FAO data for 1961 to 1983 indicate that for the whole period 5% of the production is treated as waste and 95% is processed. Of the quantities processed, 96% is converted to flour of tapioca, 1% as cassava tapioca and 3% as dried tapioca throughout the period. Since data based on such assumption of constant proportionality over the years in deriving domestic utilisation pattern indicates only production changes, it is not reported here. Instead whatever fragmentary evidences available from various sources are brought together to give some idea of domestic utilisation pattern.

3.1 Food

The role of tapioca in supplementing the deficit foodgrains production in Kerala was realised more than a century ago. While rice imports were also possible in the early periods of tapioca introduction, when rice imports were cut off during world war II, there had been

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1/ Though tapioca leaves can be used to feed cattle, this aspect is left out from the current discussion. Here we shall concentrate only on the use of tapioca roots.

an increased dependence on tapioca. The importance of tapioca in the Travancore-Cochin portion of Kerala is evident from the fact that during 1950, the total supply of rice and wheat available for a population of .93 million persons was only about .56 million tonnes (Of which only .27 tonnes were produced within the State) while the total supply of dried tapioca came to about .75 million tonnes.[1/]

A family budget survey of labourers in 1950[2/] had indicated that all persons in Travancore-Cochin used tapioca as supplement to their rice diet. During periods of food scarcity tapioca was used as a substitute for rice by the lowest income categories. An average labour household had a per capita daily consumption of a pound of raw tapioca (or half a pound of dried tapioca). The per capita consumption was higher in some groups, especially among those engaged in hard physical labour. The conclusions of the survey included the following:

(1) The fairly large consumption of tapioca in Travancore-Cochin has been mainly due to the non-availability (and high prices) of rice.

(2) The demand from those who prefer tapioca on the ground of its being sustaining diet to do hard physical labour is on the decline.

1/ Government of Travancore-Cochin, Tapioca Enquiry Committee Report, 1952, p.33.

2/ Government of Travancore-Cochin, Final Report of the Tapioca Enquiry Committee, 1952, p.37.

(3) The growing demand for tapioca from middle class families with fixed income has reached its maximum.

(4) Considering all these aspects, it is possible to coclude that there cannot be any further expansion of the demand for tapioca for food purposes.

Another consumer survey was conducted in 1971 by the sub committee of the Tapioca Market Expansion Board in Kerala.1/ This survey, with coverage throughout the state, indicated that nearly all households used tapioca either as supplement to their rice diet or as a side dish. The average per capita daily consumption of tapioca in Kerala was estimated to be 0.2 kg in rural areas and 0.1 kg in urban areas. Thus an average rural family of 5 members had consumed 1 kg of tapioca daily, and an urban family had consumed half this quantity. The conclusions of the survey were similar to those obtained from the earlier survey. The per capita daily consumption in the different districts indicated the levels in Table 10.

The 32 round of the National Survey (1977-78) indicated that the average tapioca consumption per person for 30 days was 5.55 kgs in rural areas and 2.59 kgs in urban areas (Exhibit 1). This is consistant with the results from the 1971 survey.

1/ Government of Kerala, Report of the Sub Committee of the Tapioca Market Expansion Board, 1972.

Table 10

Percapita Daily Consumption of Tapioca

District	Raw tapioca		Processed Tapioca	
	Rural	Urban	Rural	Urban
	(kg/day)			
Trivandrum	0.23	0.17	-	-
Quilon	0.33	0.26	0.07	-
Alleppey	0.30	0.21	0.03	-
Kottayam	0.07	0.07	-	.06
Ernakulam	0.09	0.10	0.05	.02
Trichur	0.10	0.04	-	-
Palghat	0.03	-	-	-
Malappuram	0.11	-	-	-
Calicut	0.15	0.15	-	-
Cannanore	0.15	0.04	0.14	-

- negligible

Source: Report of the subcommittee of the Tapioca Market Expansion Board.

National Sample Survey data from the 17th round (1961-62) and 28th round (1973-74) based on consumer expenditure surveys indicated that over this period rice consumption in Kerala has declined, but tapioca consumption has increased. The daily per calorie consumption from rice was 1136 in 1961-62 and it declined to 840 in 1973-74. During the same period the calorie consumption from tapioca increased from 182 to 278. These estimates were somewhat consistent with estimates from food balance sheets as far as

rice was concerned, but they turned out be under-estimates for tapioca.[1] The per capita consumption of rice did not indicate much variations between urban and rural areas, but there had been large variations in tapioca consumption. For example, the 28th round of NSS indicated per capita consumption of 845 calories in rural areas and 840 calories in urban areas from rice, and 366 calories in the rural areas and 190 calories in the urban areas fromtapioca. In the two lower expenditure groups of the rural areas, calories from tapioca exceeded calories from rice (Exhibit 3).

A food habits survey conducted by the Operations Research Group (ORG) during early 70's has indicated that the average daily consumption of tubers and roots (mostly tapioca) among adults, school children and pre-school children were 175.3 gms, 120.8 gms and 30.9 gms respectively. The distribution according to sex and urbanization indicated the pattern in Table 11.

The ORG study also had provided the calories from rice and tapioca according to income groups. While the calories from rice increased with the income levels, calories from tapioca declined with income. An IFPRI study also indicated the same trend of increased calories from rice with increases in income and reductions in calories from tapioca with increased income levels (Table 12).

1/ The Centre for Development Studies estimates based on Food Balance sheets indicated that the average per capita availability of 920 calories from rice and 628 calories from tapioca during 1961-62 to 1970-71.

Table 11

Per Capita Consumption of Roots and Tubers

	Male	Female	Rural	Urban	Total
			(gms/day)		
Adults	222.9	133.9			175.3
School Children	117.5	122.9	126.9	87.7	120.8
Pre-School Children	31.0	30.8	32.4	24.3	30.9

Source: Protein Foods Association of India, Food Habits Survey, 1972.

A few studies especially in the 50's and early 70's have attempted to estimate the utilisation of tapioca production for various purposes. The findings from these studies are summarised in Table 13. While in Kerala about 70% of the total production is used for human food, in Tamil Nadu about 25% of the production is used for direct consumption.1/

1/ Ghosh (1984)

Table 12

Consumption of rice and tapioca according to income groups

(a) ORG Study

	Annual percapita income			
	Less than Rs.100	Rs.101-200 (per capita daily calories)	Rs.201-500	Above Rs.500
Rice	810	1031	1068	1213
Cassava	291	265	180	139

(b) IFPRI Study

	Monthly percapita income group					
	Less than Rs.15	Rs. 15-24	Rs. 25-34	Rs. 35-49	Rs. 50-75	above Rs.75
Rice	396	616	750	777	839	970
Cassava	1013	898	819	817	729	213

Source: (a) ORG estimates See Protein Foods Association, op.cit.

(b) IRPRI Study, Subh Kumar, op.cit.

Table 13

Statement of Utilisation of Tapioca from different Studies

Period	Region	Retained by producers for domestic consumption	consumed raw for household purpose (Per cent)	Converted into chips	Industrial purpose
1950-51 to 1952-53	Travancore* Cochin	31.5	40.9	27.2	0.4
1950-51	Tamil Nadu	12.7	46.0	15.2	26.1
1952-53	Tamil Nadu*	19.6	43.1	8.6	28.7
1960-61	Tamil Nadu*	8.3	42.3		49.4
1971	Kerala		60		40
1981	Kerala		70		30
	Tamil Nadu		25		75

Source: *Directorate of Marketing and Inspection, Report on the Marketing of Tapioca, 1956, p.10

The Utilisation pattern indicated in Table 13 indicates that about 3 million tonnes of tapioca was used for human consumption in 1981.

The income elasticity for tapioca in Kerala was obtained from three rounds of National Sample Survey data. The estimates from the 1970-71 survey indicated an expenditure elasticity of 0.289 for rural areas and -0.156 for urban areas. The expenditure elasticities from the 1977-78 survey indicated 0.145 for rural areas and -0.457 for urban areas; and the estimates from 1983 survey were 0.253 for

rural areas and -0.086 for urban areas. When the expenditure elasticities for different expenditure groups were estimated,[1/] the following tendencies emerged.

(1) The elasticities for the bottom expenditure groups were greater than one and they declined with increases in the expenditure levels and turned out to be negative beyond certain expenditure levels. The rate of decline in urban areas was faster than the rate in rural areas.

(2) In the lowest expenditure groups, expenditure elasticities for urban areas exceeded those for rural areas. However this relationship was reversed in the higher expenditure groups.

(3) There was a general decline in the elasticities from 1970-71 to 1977-78, but from 1977-78 to 1983 there was an increase in the values.

The values of elasticities from the three rounds are available in Table 14.

1/ Expenditure elasticities for different expenditure groups were obtained from regression equations of the form

$$\log y = a + \frac{b}{x} + c \log x.$$

Table 14

Expenditure Elasticities for Tapioca in Kerala for Different Expenditure Groups from three rounds of National Sample Survey

Expenditure Group		1970/71 Survey		1977/78 Survey		1983 Survey	
		Rural	Urban	Rural	Urban	Rural	Urban
Bottom (lowest)	1	2.519	2.673	2.304	5.725	2.347	3.249
	2	1.693	1.752	1.058	2.787	1.601	2.156
	3	1.275	1.427	0.770	1.789	1.210	1.477
	4	1.039	0.958	0.522	0.956	0.953	1.074
	5	0.833	0.745	0.402	0.511	0.789	0.786
	6	0.671	0.462	0.342	0.327	0.629	0.536
	7	0.546	0.254	0.279	0.119	0.498	0.310
	8	0.437	0.095	0.220	-0.076	0.377	0.115
	9	0.323	-0.072	0.177	-0.219	0.269	-0.064
	10	0.209	-0.251	0.149	-0.318	0.175	-0.216
	11	0.101	-0.407	0.118	-0.423	0.092	-0.358
	12	0.007	-0.542	0.075	-0.568	0.036	-0.447
	13	-0.124	-0.765	0.039	-0.682	-0.080	-0.628
(Highest) top	14			-0.001	-0.766		
	15				-0.853		
Average		0.289	-0.156	0.145	-0.457	0.253	-0.086

3.2 Industrial Use

Tapioca is a raw material for a number of industries such as starch, sago, glucose and dextrine. However, since diversion of tapioca for industries adversely affected the food position in Kerala, the State Government had imposed a number of constraints on its industrial use. In 1942, the State Government imposed a ban on export of tapioca in any form from the State except through a valid permit. In 1943, there was another order prohibiting the manufacture of starch from tapioca. In spite of this order it is estimated that 18,000 tonnes of tapioca starch was manufactured in 1943. Controls were also introduced on the wholesale transactions of tapioca, inter-regional movement within the state, and storage of tapioca. With such stringent controls on tapiocabased industry in Kerala, Salem in Tamil Nadu has emerged as a major Centre for tapioca processing industry.

It is stated that a trader from Salem who came to purchase dried tapioca from Kerala started starch-making in Salem and later on switched over to sago. Soon a number of sago making units were started in Salem and a virtual monopoly position was created. Though tapioca was smuggled from Kerala in the early period, later on tapiocacultivation was introduced in Salem, replacing sugarcane from many areas. Even when restrictions on tapioca utilisation were removed in Kerala, tapioca processing units were not able to compete effectively with those in Salem.

According to the Report on the Marketing of Tapioca, in 1950-51, 27.2 per cent of the production in Kerala was converted to chips and 0.5% as starch. However, in Tamil-Nadu 15.2% was converted into chips, 12.1% for sago and 14.0% for flour. Tamil Nadu which had 40 manufacturing units in 1950 producing 6,000 tonnes of sago, witnessed a rapid increase in sago production so that by 1955 there had been 109 units producing 22,000 tonnes. By 1960-61, the total availability of tapioca in Tamil Nadu was about 3,88,000 tonnes including 125,000 tonnes imported from Kerala. About 41 per cent of the total available quantitywas utilised for the preparation of sago, 5% for preparation of starch and 12% for the preparations of flour. In 1960, Salem district accounted fo 150 units producting 40,000 tonnes of sago and 5,000 tonnes of starch. By 1985, Salem District had about 699 units. During 1984-85 these units had sold 87,700 tonnes of sago and 36,700 tonnes of starch valued at 315.4 . . million rupees.

The available data on starch production indicate a wide range. The Director General of Technical Development's estimate of starch production in India, based on the actual production levels of 10 major units, for 1980 and 1981 were 140 and 138 thousand tonnes. This is a considerable under-estimate on account of the exclusion of a number of units (Ghosh). The Indian Textile Bulletin shows that between 1977 and 1981 maize starch dominated the starch industry approximately in the ratio 10:1 for maize and tapioca. Average

production of 1980 and 1981 indicated that against a production of about 105 thousand tonnes of maize starch, tapioca starch production was around 10 thousand tonnes. An estimate of Srivastava and Phandis indicated tapioca starch production in 1982 at about 200 thousand tonnes (about double the maize starch production.) According to the Salem sago and Starch Manufacturers Association, about 175 thousand tonnes of sago and starch were produced in 1980. Since Salem production accounted for about 60% of the Indian production, Ghosh estimated that the present tapioca starch (including sago) production in India should be more than 300 thousand tonnes. Considering a recovery rate of 23% for sago and starch [1] this would imply that about 1,300 thousand tonnes of tapioca (about 37% of the production in 1982) was used for starch and sago.

The concentration of Salem district in starch production is significant. Production of about 175 thousand tonnes of tapioca (or about 80% of the total production in Salem district) was utilised for this purpose. At the same time, in Kerala the 76 units manufacturing tapioca starch had produced only 14.4 thousand tonnes during 1980-81. Other estimates of tapioca starch production in Kerala indicate 54 thousand tonnes (Lynam 1983) and 30 thousand tonnes (Srivastava and Phandis). These estimates would imply that starch production in Kerala account for 1 to 4% of the total tapioca production in the state.

1/ Starch yield was about 21.4% by weight and sago yield was about 25% by weight.

3.3 Animal Feed

Feed manufacturers do not use tapioca as a main ingredient in feeds even though the technical feasibility was established. At the same time, it is a common practice for tapioca growers in Kerala to use dried tapioca chips as cattle and poultry feed. It was estimated that about 27 percent of the tapioca produced in Travancore-Cochin during 1950-51 to 1952-53 was converted to tapioca chips. However, a survey conducted in 1976-77 indicated that only 5 per cent of the tapioca produced on the farms was processed into chips.[1/] The Survey further indicated that about 72.7% of the tapioca output was marketed and the rest retained at home. On an average about 70 per cent of tapioca retained by the producers is set apart for self consumption, 17 per cent was used as cattle feed and 13 percent was given to wage labour and farm servants. The distribution of farmers according to size of holdings indicated that farmers with holdings of 5-10 acres had utilised 36.6% of their retentions for feeding livestock. This is probably on account of the awareness of the beneficial effects of giving limited quantities of tapioca as feed to livestock.

3.4 Trade

Imports: At present there are no imports of tapioca to India. Prior to 1950, small quantities of Cassava products such as sago and flour were imported to India for which separate data are not available.

1/ Ninan (op.cit), p.215

With the ban on imports of tapioca products in January 1959, imports have completely stopped.

Exports: Prior to 1952-53, there had been no exports of tapioca or tapioca products from India. During 1952-53 a small quantity (about one tonne) of tapioca flour was exported to New York. Between 1955-56 small quantities of tapioca chips from Kerala was exported to West Germany, Holland and Belgium for conversion to animal feed. In the subsequent period also export was negligible accounting for a small portion of the total production. After 1978-79, exports have been either non-existent or negligible.

Table 15

Exports of Tapioca Products from India

Year	Sago and Substitute		Tapioca chips		Starch	
	Qty	Value	Qty	Value	Qty	Value
	(tonnes)	(1000 Rs.)	(tons)	(1000Rs.)	(tons)	(1000Rs.)
1973-74	18.2	39.7	1.7	3.0	37.1	69.9
1974-75	9.3	27.8	0.8	19.3	3.0	8.8
1975-76	11.7	34.4			100.0	225.9
1976-77						
1977-78			19.2	16965		
1978-79			52.8	42000		

Belgium, Netherlands and the Federal Republic of Germany were the major countries to which tapioca chips were exported.

3.5 Prices: In Kerala, during the fifties about 1/3 of the production was sold directly to the consumers and the rest was assembled by the village merchants who carry the produce to the nearest market centre. Ninan's study indicated that during 1976-77, 36.3 per cent of sales was directly to village consumers, 34.3 per cent to village traders and 29.4 percent to the agents. In Tamil Nadu direct sales to the consumers is negligible and bulk of the produce is assembled by the village merchants. Sometimes a small number of producers sell standing crop at a stipulated price to the village merchants who make their own arrangements for harvesting transport and marketing. In the Salem district some village merchants take contract of the standing crop for sales to the sago factories.

In the forties, the Travancore-Cochin Government had imposed price controls on tapioca and a licence system was introduced for wholesale transactions in some areas. Purchase, sale or storage for sale in wholesale quantities was prohibited except with a licence from the Government. There were no price controls in the Madras state but restrictions were imposed on movements in the Malabar region which later on became a part of Kerala.

Since data on all-India prices of cassava are not available, it is possible to analyse only the price trends in the major production areas, espedally Kerala. The farm price of tapioca in Kerala increased from Rs.7.85/quintal in 1960-61 to Rs.70.02/quintal in 1983-84.

1 quintal = 100 kilogrammes

The increase during 1964-65 and during 1973-74 over the immediately preceding year's price levels had been substantial. While the overall tendency of increased prices was maintained throughout the period, between 1960-61 to 1983-84, there were 9 years when the farm price levels declined over the previous year's price level. In fact the tendency that an year of high prices would be followed by an year of declining prices was noticed even in the fifties, and the tapioca Enquiry Committee explained this through the farmers behaviour to bring additional land under the crop during the year following a high price and when the prices declined in the next year the additional area was taken out of cultivation.

Empirical evidence supported the observation that farmers made acreage adjustments according to price changes until mid-seventies. During this period, the area under tapioca indicated a good response to the previous year's price. The relationship between current area and lagged tapioca price during 1961-62 to 1975-76 provided statistically significant results. The estimated equations were:

$$A_t = 191.54 + 4.15\ P_{t-1};\ R^2 = .68$$
$$(5.3)*$$

$$\log A_t = 4.74 + .299 \log P_{t-1};\ R^2 = .72$$
$$(5.8)*$$

(* t values highly significant)

Where A_t = area under tapioca during year t

P_t = Price of tapioca during year t-1

However, after the mid-seventies, tapioca prices did not exercise any influence on acreage allocation. In spite of the increasing trend in tapioca prices during this period, area had declined, so that the regression equation gave a negative co-efficient for lagged prices. The estimated equations for 1975-76 to 1983-84 were:

$$A_t = 361.66 - \underset{(1.92)}{2.115}\ P_{t-1} \ ; \ R^2 = .34$$

$$\log A_t = 6.873 - \underset{(1.99)}{.342}\ \log P_{t-1} \ ; \ R^2 = .36$$

Because of these conflicting results for the two periods, area and lagged prices for the combined period indicated only a poor relationship. The estimated equations for the period 1961-62 to 1983-84 were:

$$A_t = 254.66 + \underset{(1.00)}{.593}\ P_{t-1} \ ; \ R^2 = .04$$

$$\log A_t = 5.24 + \underset{(2.15)}{.110}\ \log P_{t-1} \ ; \ R^2 = .18$$

Thus the influence of tapioca prices on area allocation was nonexistent from the mid-seventies, though it was strong for the previous years. The co-efficient of variation of area for 1960-61 to 1975-76 was .155 and it declined to .108 between 1976-77 to 1983-84. The decline in the co-efficient of variation and the nonresponsiveness of tapioca area to prices after mid-seventies indicate that the tapioca area is becoming more stable over the years and that there is not much

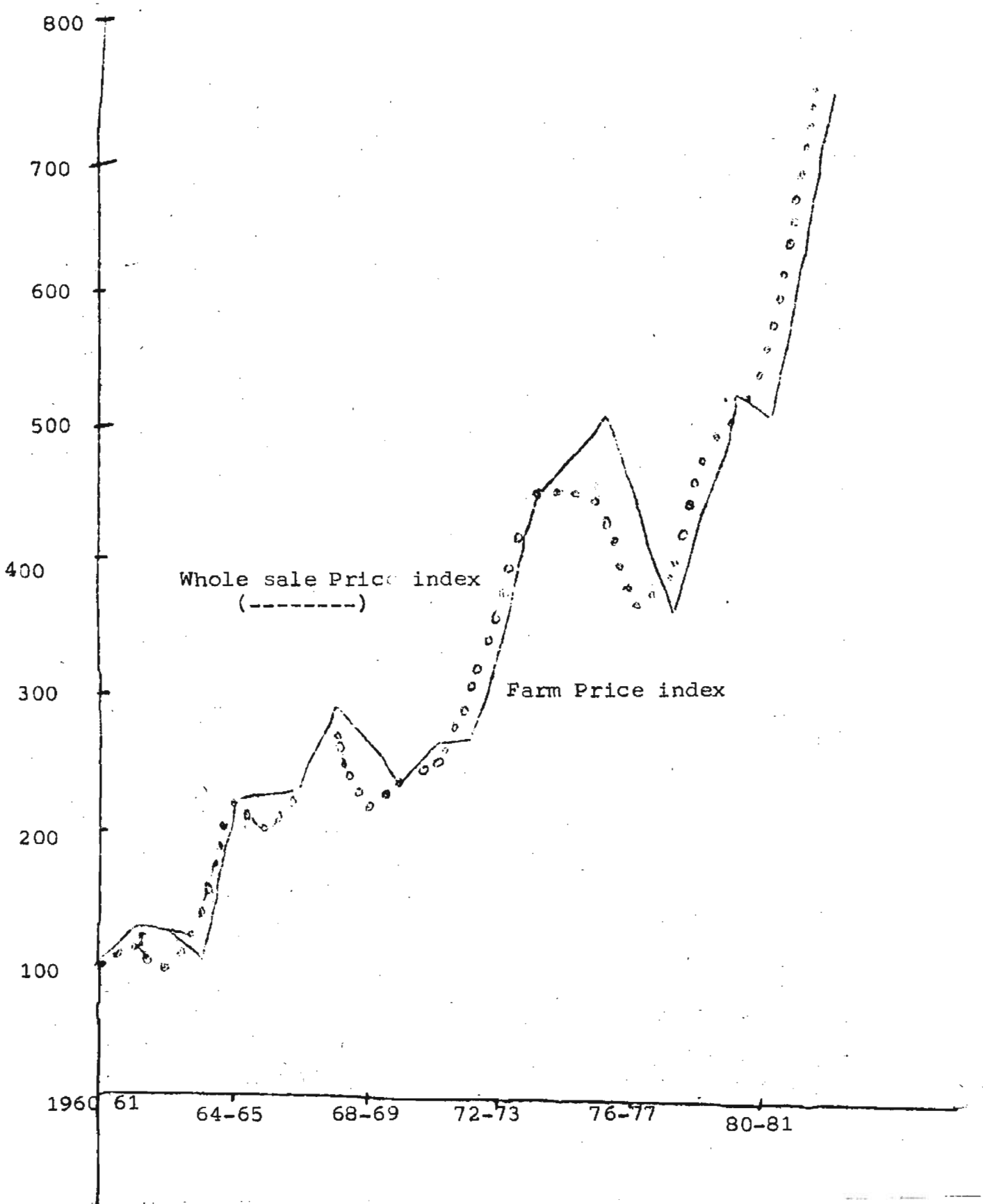
scope for year to year variations, probably on account of conversion of area used for occasional cultivation of tapioca to perennial crops such as rubber.

Actual levels of wholesale prices and retail prices are available for different locations and annual index of wholesale and retail prices of tapioca are available for the state. The index of wholesale price for 1982 (with 1961=100) stood at 729. The movements of farm level and wholesale price index can be visualised from figure 4 and Exhibit 4.

In the absence of state average wholesale and retail prices, it is not possible to obtain an estimate of the marketing margins involved. However, an analysis of the wholesale and retail prices at certain regions indicated that the retail prices of fresh tapioca were 16 to 60 per cent higher than the wholesale prices, though in a majority of cases the margin was less than 35%.

It is also useful to compare the changes in tapioca and rice prices. As pointed out earlier in recent years easy availability of rice in Kerala has introduced a fall in the demand for tapioca for human consumption. The availability position of rice is also reflected in the prices. The retail price ratio of rice to cassava was as high as 7.2 in 1966-67, but it had gradually declined except for some period during mid-seventies. It may be also recalled that mid-seventies had a peak level of tapioca production and a high level of rice price.

Figure 4: Farm Price and Wholesale Price Index of tapioca, Kerala



The levels of wholesale price of tapioca, retail price of tapioca and the ratio between rice and tapioca retail price in the Kottayam district the provided in Figure 5 and Exhibit 5 to indicate the nature of changes.

Outlook for Tapioca

Any framework for supply and demand projections of tapioca should review the ongoing research efforts in relation to technology and yield, and also assess the potential for substituting tapioca at the production and utilisation levels. Here an attempt is made to review some of these aspects with a view to generate a meaningful framework for supply and demand projections for tapioca.

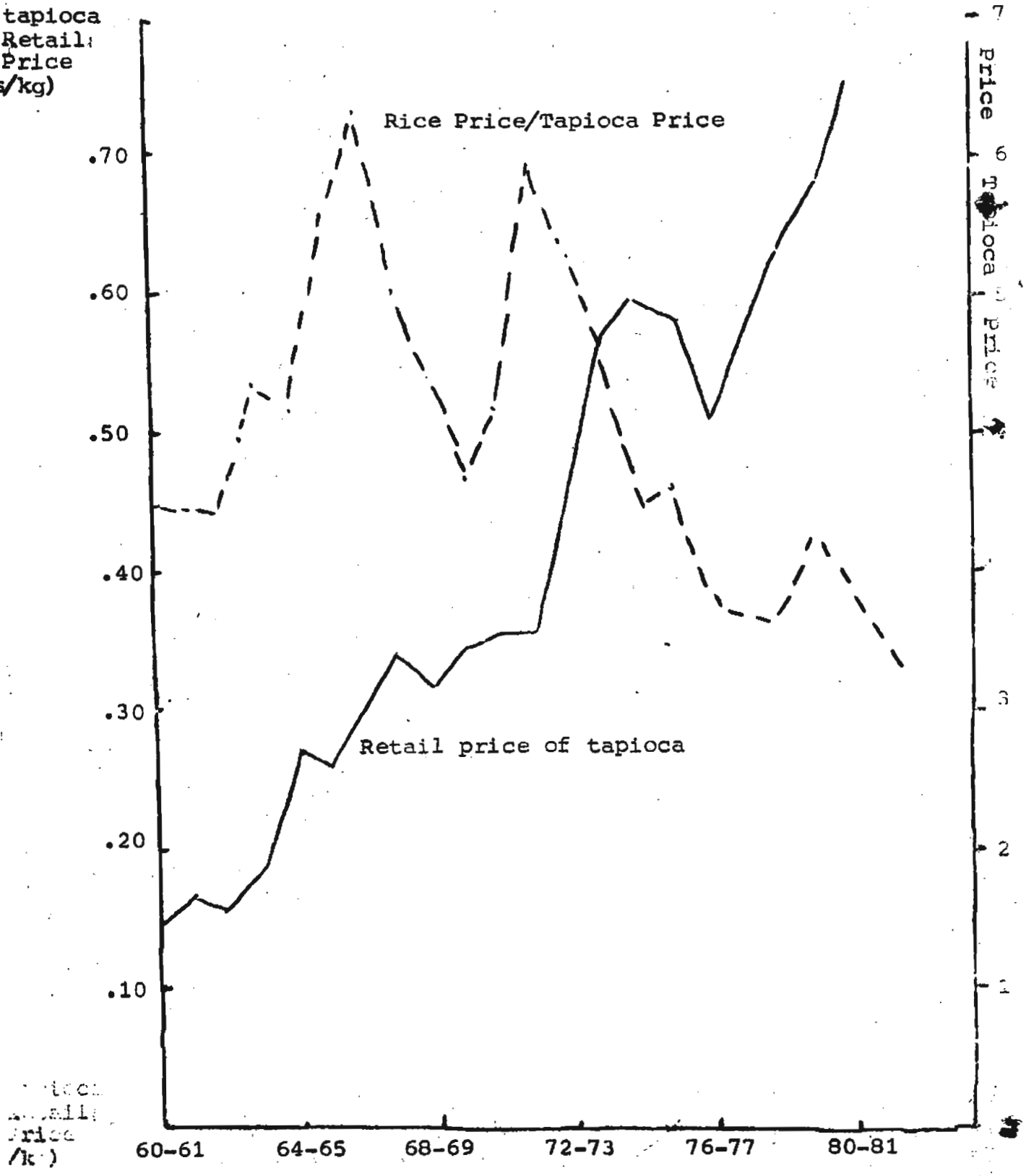
4.1 Research

Research on tapioca is carried out primarily at the Central Tuber Crops Research Institute (CTCRI) and the Agricultural Universities of Kerala and Tamil Nadu. The CTCRI, was set up in July 1963, in Trivandrum as a national centre for conducting and coordinating research on all aspects of tuber crops such as tapioca, potato and yam. The Institute has an area of 21 hectares of hill-slope land and its objectives include:

(1) Breeding of high yielding better quality diseases and pest-resistant varieties of tuber crops concentrating on tapioca and sweet potato.

(2) Determination of the best practices for cultivation, manuring and storage with particular reference to the soils of Kerala.

Figure 5;Retail Price of Tapioca and Ratio of Rice Price and Cassava Price K[illegible]ayam District, Kerala



(3) Survey and analysis of control possibilities of major disease and pests.

(4) Production, multiplication and distribution of disease free planting materials based on improved varieties; and

(5) Carrying out fundamental research on the breeding and genetic pattern of tuber crops and their agronomic, chemeical, technological and nutritional features.

The activities of the Institute are organised in seven divisions: Genetics, Crops and Soils, Crop Physiology, Plant Pathology, Entomology, Extension, and Technology. Until 1970, its annual budget was around .3 to .4 million rupees and by 1985 this has gone up to 3 million rupees. The major achievements of CTCRI include the following:

(1) Germplasm: It maintains a total of around 1350 germplasm collection of tapioca, the evaluation and documentation are in progress.

(2) HYV varieties of tapioca capable of producing about 30-40 tonnes/ha have been evolved.

(3) Recommended package of practices for tapioca for adoption by the farmers have been brought out.

(4) About 35 diseases and an equal number of pests have been identified. There has been extensive work on the development of 'mosaic' resistant varieties. A tissue culture unit was established to take up meristem culture for developing virus free plants.

(5) Inter cropping tapioca with groundnut gave an additional income of Rs.1500/ha over Rs.2100/ha when tapioca was grown as a single crop.

(6) The Institute has developed a standardised process of preparing alchohol and a process to increase the shelf life of sun dried tapioca chips. It has also developed a manually operated chipping machine.

(7) The extension unit imparts training on various aspects of tuber crops to farmers and it has adopted 200 farm families under lab to land programme to familiarise with improved tapioca varieties and use of suitable cultivation techniques and practices.

Research studies on tapioca at the Agricultural Universities are concentrated on cropping systems, water management and fertiliser responses. Some of these studies have evolved tapioca in inter cropping systems and established economics of irrigation practices and inter-cropping patterns.

4.2 Yield

The all-India yield of tapioca in 1983-84 was about 19 tonnes/ha which is a substantial improvement over the 1960/61 level of about 7 tonnes/ha. The yield levels in Tamil Nadu (about 32 tonnes/ha) had been substantially higher than the yield levels in Kerala (16.3 tonnes/ha). The difference in the yield levels reflects the nature of land under tapioca cultivation and the cultural practices. In Kerala, tapioca is usually grown on hill slopes, or as an intercrop in garden lands without applying chemical fertilisers. In most cases such lands are not considered suitable for other food crops and only very rarely is tapioca competitive with rice for marginal land.[1/] In Tamil Nadu tapioca is grown on irrigated land and the use of chemical fertilisers is common. The major difference in tapioca cultivation of Kerala and Tamil Nadu is that in Kerala it is grown as a cereal substitute and

in Tamil Nadu it is an industrial raw material.

Some indications of the variations in yield according to the size of holdings and variety used ca be obtained from the results of a survey conducted during mid-seventies in three villages of Kerala.[2/]

1/ In Kerala Tapioca competes mainly with tree crops such as coconuts and rubber.

2/ Agricultural Economic Research Centre, Madras, "Study on Tapioca Cultivation in Kerala", University of Madras, 1976.

Table 16

Yield levels of tapioca in three Kerala Villages

Size of holding	Yield per acre		
	HYV	Local	Average
(acres)		(kgs)	
Below 1	12,000	12,353	12,348
1 - 2.5		13,128	13,128
2.5- 5.0	15,000	10,890	11,457
5 - 10	16,500	9,906	10,950.

The per acre fertiliser application levels of HYV were 20 kg, N, 21 kg P, and 26 kg,K; and for local varieties they were 6 kg N, 6 kg P, a d 9 kg K. Among the cultivators 51% had used fertilisers. The yield response for fertiliser use followed the pattern in Table 17.

Crop estimation survey conducted during 1978-79 indicated an average yield of 27,384 kg/hectare in Tamil Nadu and the range was from 14,395 kgs/ha to 32, 240 kgs/hectare in the different districts. A maximum yield of 84,167 kgs/ hectare was obtained from one field. Some production characteristics in Salem and Kanyakumari districts of Tamil Nadu are summarised in Table 18.

Table 17

Yield levels obtained for HYV and local varieties tapioca

	Yield/acre		
	Local	HYV	Total
		(kgs)	
Fertiliser Users	13,276	15,750	13,839
Non Users	9,203	12,000	9,207
Total	11,029	15,727	11,579

Table 18

Some aspects of tapioca production in Salem and Kanyakumari

Characteristics	Salem	Kanyakumari
Average yield (kg/ha)	31,540	14,933
Maximum yield	68,850	56,000
Percentage farmers using improved seed	7	38
chemical fertilisers	42	12
Irrigation	93	20

The Central Tuber Crops Research Institute (CTCRI) had conducted field trails for determining the yield response under different soil conditions and fertiliser application levels. These results indicated that yield of tapioca ranged between 11.34 tonnes/ha in marginal land (without irrigation and fertilisers) and 33.23 tonnes/ha from ordinary soil (with irrigation and fertiliser) for the variety H-1687.

Table 19

Yield of tapioca from field trials at CTCRI

Farm Condition	Yield (tonnes/ha)
1. Marginal land without irrigation and fertilisers	11.34
2. Ordinary soil with irrigation (20mm/week) and low level of fertilsers (50:100:50)	22.55
3. Ordinary soil without irrigation and with fertiliser (100:100:100)	21.67
4. Ordinary soil with irrigation (20mm/week) and fertilisers (100:100:100)	33.23

Source: CTCRI Annual Report 1977, Trivandrum p.27
Nair TVR, Mohan Kumar B and Pill N.G., Productivity of Cassava Under rainfed and irrigated conditions, Journal of Root Crops, Vol.2, 1985.

With a view to accelerate the adoption of research findings among farmers, the CTCRI has launched a Lab to Land Programme. Information on cultivation of High Yielding Varieties and local varieties were obtained from the participating farmers and the results indicated that during 1984-85 they realised an average yield of 26.28 tonnes/ha from high

yielding varieties and 14.30 tonnes/ha from local varieties as against 30 tonnes/ha of hi h yielding variety from the CTCRI farm.

Yield levels obtained from research stations had indicated yields upto 60 tonnes/ha. In an advance trial of tapioca at the CTCRI the selection 8/75 gave a tuber yield of 60 tonnes/ha, S-'82 gave 51 tonnes/ha, and 14/25 gave 44 tonnes/ha. Compared to the yield realised from hybrids H-2304 (40 tonnes/ha,) H-1687 (43 tonnes/ha) and the popular cultivar M_4 (30 tonnes/ha) these varietal selections at advanced stages hold good potential. The CTCRI had also conducted trials on tapioca based multiple cropping systems and a maximum tuber yield of 47.8 tonnes/ha obtained when tapioca was grown in association with banana.

Under technology transfer through lab to land programme of the CTCRI 67 field trials were conducted in Salem during 1979-81 using the varieties, H.97, H.226, H.1687 and H.2304 along with the local variety (Burma) covering an area of about 25 hectares. The variety H.226 recorded the maximum tuber yield of 48.5 tonnes/ha.

The Kerala Agricultural University had conducted some experiments to determine the nutritional requirement of tapioca based intercropping systems. In an experiment during July 1980 to April 1981 to select out suitable leguminous component crops to be grown as intercrops and to study the effects of different NPR ratio on the growth and yield of

Table 20

Performance of High Yielding Varieties of Tapioca under irrigated conditions in Salem, 1979-80

Variety	Tuber Yield	
	Average	Maximum
H 97	20.25	30.25
H 226	33.25	48.50
H 1687	25.75	36.25
H 2304	27.75	37.00
Local (Burma)	19.00	25.00

Source: CTCRI, Trivandrum, Summary Report - Lab to Land Phase - 1.

different crops in the system, 15 major treatments and two sub plot treatments were used. The levels of tapioca yield as influenced by inter cropping at different levels of fertiliser use are available in Table 21.

Considering the slow progress in adoption of HYV and the relative low importance placed on tapioca development, it may be possible to speculate that the all India tapioca yields in 1990 may be around 20 tonnes/ha and by 2000 it might go upto 25 tonnes/ha.

4.3 Constraints for increasing output

The High Level Committee on Land and Water Resource appointed by the Kerala Government[1] had identified the following constraints in increasing output of tapioca.

1/ Government of Kerala (May 1984), p.43

Table 21

Yield of Tapioca as influenced by inter cropping at different levels of fertiliser use

Main Plot Treatment			Sub Plot Treatment		
N	P	K	Tapioca + Cowpea	Tapioca + Groundnut	Mean
(kgs/ha)			(tonnes/ha)		
50	50	50	23.0	20.4	21.7
50	62.5	62.5	28.9	22.6	25.8
50	75	75	17.8	17.8	17.8
62.5	50	62.5	22.8	21.5	22.2
62.5	62.5	50	22.8	21.9	22.4
75	50	75	23.7	20.7	22.2
75	75	50	21.8	19.3	20.6
75	75	75	24.3	19.9	22.1
75	93.75	93.75	18.8	21.3	20.0
93.75	75	93.75	23.5	25.1	24.3
93.75	93.75	75	24.7	24.8	24.7
75	112.5	112.5	22.6	20.2	21.4
112.5	75	112.5	19.2	22.1	20.6
112.5	112.5	75	21.1	23,9	22.5
50	50	50	--	--	35.9
	Mean		22.5	21.5	--

1) The prevalance of low yielding varieties

2) Slow adoption of modern production technology and lack of awareness of improved package of practices

3) Use of uncertified diseased planting material and absence of plant protection practices

4) An uncertain market and fluctuations in prices

5) Poor avenues of alternate use of produce to generate larger market demand.

It is envisaged that some of these constraints might be overcome through the research conducted at the CTCRI, especially through evolving high yielding, disease resistant crop varieties, determining efficient cultural practices, research and extension activities and proper minitoring devices for the control of pests and diseases.

4.4 Substitability of tapioca at the production level

Tapioca grows on diverse soils and it can produce economic yields on soils which are considered unsuitable for economic cultivation of many other crops. Warm humid climate with adequate rainfall and sunshine is suitable for tapioca cultivation.

Kerala agriculture is characterised by its emphasis on plantation crops, especially rubber and coconut. Because of the permanent nature of these crops and the high returns from them, tapioca does not compete with these crops. At the same time wth increasing returns for these crops there had been a tendency to bring even somewhat marginal lands under rubber and coconut so that area available for tapioca might decline. The economics of paddy (the major food crop)

and some of the subsidiary food crops like tapioca and yam had been compared with that the fodder crop (Hybrid Napier) in a study on the economics of cross bred cattle in Kerala[1/] during the mid 70's. Net income from the cultivation of these crops in the plains and hilly areas of Kerala indicated that income from tapioca had been less than the incomes from paddy and fodder crops. (See Table 22.)

Table 22

Estimates of income from selected crops

	Cross returns	Net income
	(Rs./hectare)	
(a) Plains		
Paddy (Autumn)	3,227	1,386
Paddy (Winter)	2,807	840
Yam	934	-462
Tapioca	1,253	178
Hybrid napier	1,974	912
(b) Settler Farmers		
Paddy (Autumn)	4,561	2,147
Paddy (Winter)	2,582	892
Yam	981	- 546
Tapioca	1,379	395
Hybrid napier	3,884	1,512

Source: NDRI Study , p.85

1/ National Dairy Research Institute, Economics of Cross bred Cattle, NDRI Karnal, 1976.

An experiment station for tapioca located near Salem in Tamil Nadu has released data on costs and returns of tapioca on rainfed and irrigated areas. The net returns per hectare from irrigated area was about double the returns from non-irrigated (rainfed) area.

In some areas of Kanyakumari district, dry land can grow paddy, tapioca and banana. A sample survey in these areas indicated that returns from banana would be substantially higher than those from both paddy and tapioca. However banana cultivation was a very capital intensive operation. Between paddy and tapioca, net returns from tapioca exceeded the returns from paddy. It is also possible to observe that farmers in this area did not use manures, fertilizers and insecticide for tapioca cultivation (Table 24).

The CTCRI had collected information on cultivation of local and high yielding varieties of tapioca from 50 farmers of the villages where the lab to Land programme was in operation during 1984-85. The data from this survey indicated a net return of Rs.2839 from one hectare of local variety of tapioca and it increased to Rs.5,110 by shifting over to High Yielding Varieties. The net income from the High Yielding Varieties cultivated at the CTCRI farm was Rs.6,085. The unit cost of production of high yielding varieties was less than the cost/kg at the CTCRI farm (Table 25).

Table 23

Cost of Cultivation and Returns of Tapioca

	Rainfed	Irrigated
		(Rs.)
Cost/acre		
Land preparation	236	324
Farm yard manure	200	200
Chemical fertilisers	150	250
Labour for fetiliser application	36	60
Seed materials and planting	342	291
Weeding and interculture	146	356
Plant Protection	70	140
Irrigation charges	--	270
harvesting	120	170
Total	1300	2061
Returns/acre		
Value of tuber	1750	3500
Seed material	500	500
Total	2250	4000
Net returns/acre	950	1939
Net returns/hectare	2090	5265
Cost/kg	0.26	0.21

Source: Note on the Tapioca Experiment Station, Mulluvadi, Attur, Salem District.

Table 24

Cost structure of Competing Crops on the Paddy fields of Kanyakumari District

	Paddy	Banana	Tapioca
		(Rs./acre)	
Human labour	797	3036	464
Bullock	400	--	--
Seedings	114	304	32
Manureand Fertilisers	828	3056	--
Insecticides and pesticides	84	115	--
Transport to Market	--	386	157
Land and water tax	85	85	85
Interest on Capital	124	356	36
Rent on land	1,353	2,102	1,300
Gross Revenue	3,999	16,001	3,561
Cost A	2,327	6,982	738
B	2,451	7,338	774
C	3,804	9,440	2,074
net revenue based on Cost A	1,672	9,019	2,823
Cost B	1,848	8,663	2,787
C	195	6,561	1,487

Source: Peter D, Economics of Cropping Pattern of Kanyakumari District, Thesis submitted to the Madurai Kamaraj University, October 1979.

Table 25

Costs and Returns of Tapioca Production 1984-85

	Farm level		HYV on CTCRI Farm
	Local varieties	HYV	
Cost/hectare		Rs.	
Planting material	250	250	250
Labour	3,061	3,599	4,490
Farm yard manure	1,057	1,144	1,250
Fertiliser	249	1,240	1,425
Total	4,617	6,233	7,415
Yield (tonnes/ha)	14.30	23.28	30.00
Gross return	7,456	11,343	13,500
Net return	2,839	5,110	6,085
Cost/kg	0.32	0.24	0.25

Source : CTCRI, Trivandrum

The data on costs and returns from different sources indicate the following conclusions:

(1) Tapioca do not compete effectively with tree crops such as coconut and rubber or with garden land crops such as banana.

(2) In most cases tapioca is grown on areas where it has some comparative advantage on account of its agro-climatic requirements. On the production side, tapioca does not normally compete for land with food or feed crops with which it competes on the demand side, except in some dry land areas in a few districts similar to Kanyakumari.

(3) New varieties offer scope for reducing the unit cost of production and through adoption of such varieties it may be possible to overcome, at least to a certain extent, some of the disadvantages of comparative position of area at the production stage. The potential high yields could contribute towards increased production of tapioca.

4.5 Substitutability of tapioca at Utilisation Level

The comparative postion of tapioca for food and starch was already discussed in the third chapter. However, utilisation of tapioca in livestock feeds is an important area which has not been systematically explored in the past. Since this will depend on the possible expansion of livestock, an analysis of trends in livestock products and projections are provided in Appendix 1.

Feed manufacturers are hesitant to disclose information on feed composition and cost of production. However, data from one plant indicated that the two formulations used by the plant included 7 to 8% tapioca. The composition of the two formulations followed the pattern in Table 26.

In a linear programming study on optimum feeding practices involving 52 situations (cross bred cows weighting 300 kg and yielding 1 to 15 kgs, cross bred cows weighing 350 kg and yielding 1 to 15 kgs, murrah graded buffaloes of 300 and 400 kg yielding 1 to 11 kgs), Dhas (1984) had obtained the composition of different feeds in a Tamil Nadu

Tanle 26

Composition of Cattle Feed in a Government Cattlefeed Plant

Item	Formulation I	Formulation II
	(Per cent)	
Groundnut extraction	10	10
Rapeseed or soyabeen cake	10	--
Niger or mustard cake	10	5
Ambadi cake	8	5
Groundnut or cotton seed cake	7	15
Common salt	2	1
Afla meal	-	5
Molasses	10	10
Deoiled rice bran	10	10
Wheat bran	25	25
Cassava	7	8
Mineral Mixture	1	1
Damaged wheat/rice	-	5

district. Of the 52 comninations obtained, tapioca appeared in the optimum solution for only cross bred cows of 300 kg yielding 10 kg milk. The optimum solution indicated a 9% savings from the practice existed among the farmers (Table 27).

Table 27

Existing and Optimum feeding schedule for Crossbred Cows 300 Kg giving 10 kg milk in a Tamil Nadu District

	Quantity		Expenditure	
	Existing (kg/day)	Optimum	Existing (Rs./day)	Optimum
Cholam fodder	1.0	16.67	.75	12.50
Groundnut cake	-	1.28	-	3.20
Tapioca flour	-	1.01	-	1.92
Rice bran	1.44	0.49	0.72	0.24
Cholam straw	10.0	-	10.0	-
Napier grass	0.8	-	.40	-
Cottonseed cake	.63	-	1.38	-
Coconut cake	1.25	-	5.00	-
Cotton seed	.25	-	.55	
Total			18.80	17.06

In the absence of actual data on feed composition and cost of production, a survey was conducted among the feed manufacturers to ontain some idea of the potential for the use of tapioca in feed. Of the 13 manufacturers responded six had been using tapioca in animal feeds and one had used it in poultry feed. However, the maximum quantity of tapioca use in animal feed was 10%; and in poultry feed, tapioca accounted for only 1% of the ingredients. Four manufacturers had only less than 2% of the ingredients from tapioca and one had 7%. All the feed manufacturers were willing to include

tapioca in animal and poultry feed, provided good quality dried tapioca was available throughout the year at an economic price. They would replace maize, jowar and broken rice in the feeds with tapioca upto a maximum level of 20%. In most cases, the manufacturers were willing to use tapioca to the extent of 10% of the ingredients in the feed mix.

The manufacturers were also asked to indicate the price level of tapioca which would induce them to switch over from foodgrains to tapioca. They were purchasing maize at prices ranging between Rs.2,400 - 2,600 per tonne, jower at prices ranging between Rs.1,400-1,750 per tonne and broken rice for about Rs.1,250 per tonne. In response to their reservation prices at which they would switch over from feedgrains to tapioca prices ranging between Rs.1,000 to 1,400 per tonne were indicated. Assuming an average price of Rs.1,250 per tonne of dried tapioca at the plant level, and providing an allowance of Rs.250 towards processing charges, transportation charges and margins to the dealers, this will imply a price around Rs.1,000 per tonne of dry tapioca at the farm level. The raw tuber/chips ratio is expected to be in the range of 2.5 : 1 to 3:1. An average ratio of 2.75:1 would imply that the economic price at which feed manufacturers would substitute feedgrains with tapioca which is considerably below the price level prevailed in 1983-84. At the price level of Rs.360/tonne and at the levels of costs and yield realised by the farmers growing high

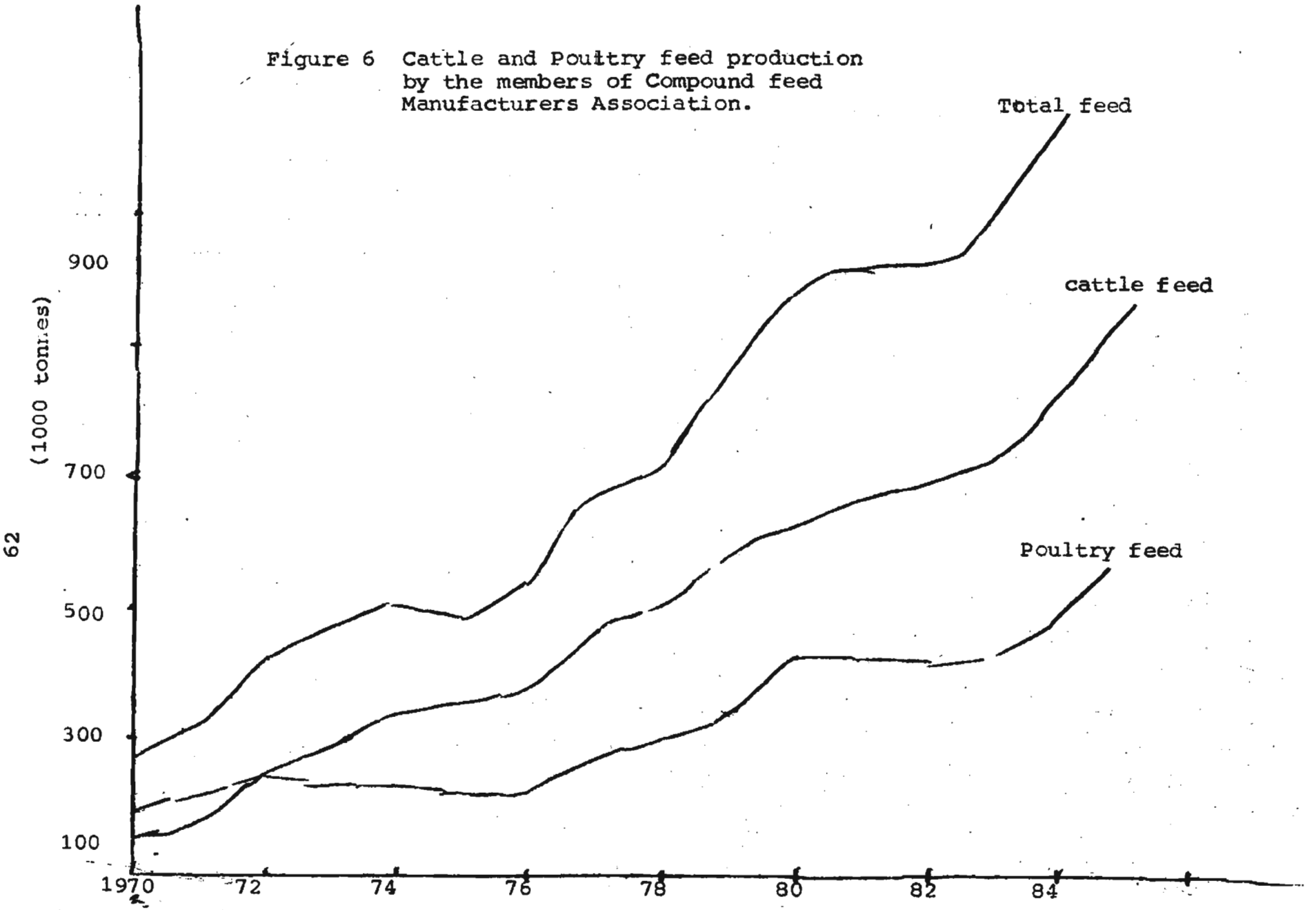
yielding varieties in the CTCRI lab to Land programme, the net returns would be Rs.3,228/hectares. Though the net returns to the farmers at this price levels turns out to be much less than the net returns of Rs.5,110 realised from high-yielding varieties in 1984-85, it is higher than the net returns of Rs.2,839 realised by farmers growing local varieties of tapioca.

Compound Feeds

Data on compound feed production are systematically collected from the members of the Compound Livestock Feed Manufacturers Association (CLFMA). It was estimated that in 1985, production of the members of CLFMA accounted for approximately 60% of the compound cattle feed and for 50% of poultry feed by the organised sector of the feed industry.

There had been a substantial increase in the production of cattlefeed and poultry feed by the members of the Association. Between 1970 and 1985, the production of the members had increased from 209 thousand tonnes to 1,370 thousand tonnes. While a portion of this increase may be due to increased membership of the association, the increase still represents a major improvement in production. In 1970, the production of cattlefeed was 125 thousand tonnes and this had gone upto 867 thousand tonnes in 1985. Between 1970 and 1985, the poultry feed production had gone up from 84 thousand to 502 thousand tonnes (Figure 6).

Figure 6 Cattle and Poultry feed production by the members of Compound feed Manufacturers Association.



The 69 ordinary members of the Association had 100 production units with an installed capacity of 2.28 million tonnes. The production levels in 1985 indicated a capacity utilisation of about 80 per cent.

The share of CLFMA in the production of cattle and poultry feed (60 % of cattlefeed and 50% of poultry feed) would indicate a total production of 1,445.5 thousand tonnes of cattle feed and 1005.6 thousand tonnes of poultry feed, together accounting for 2451.1 thousand tonnes of compound feed. If the capacity utilisation of the non-members of CLFMA is assumed to be the same as the members, the installed capacity of cattle feed manufacturers would turn out to be 4085.2 thousand tonnes.

The ownership pattern of the 69 members of CLFMA indicated 52 private, 11 cooperatives and 6 government feed manufacturing units.

Composition of feeds

The composition of feeds vary from region to region and from season to season. However, most feed manufacturers are unwilling to disclose their feed ingredients. Data from one feed manufacture, indicated in Table 26, had indicated two formulations of cattle feed. Depending upon the local availability of different ingredientsConcentrate mixtures for different types of animals are evolved. An illustrative example of the concentrate mixtures suggested for cows in the

north, central, east, west and south zones of the country (Exhibit 6) indicates substantial variations in the ingredients and their proportion in the mixtures.

While there had been a number of studies on least cost rations for dairy cattle using a linear programming framework, most of them had not included tapioca as an ingredient. Even studies in Kerala where tapioca production is important only tapioca residues was included as an item in some of the feed composition studies. For example, a study 1/ based on the data collected from a cross section survey of 175 cattle owning households in Alleppey district treated tapioca residues along with plantain leaves and other leafy items. In the linear programming exercises with digestible crude protein, total digestible nutrients, calcium, and roughage as minimum restrictions; and dry matter, phosperous and paddy straw as maximum restrictions the optimum solution contained mainly local grass, paddy straw, groundnut oil cake, rice bran and compound cattle feeds. The optimal diet pattern could introduce some savings in feed cost of milk production from cross-bred cows, but it increased the feed cost per litre of milk from non-descript cows. The existing pattern of feeding and the optimal solution are available in Exhibit 7.

To sum up, there is a growing market for both cattlefeed and poultry feed. It is possible to expand the use of tapioca in preparing Livestock feeds. The major constraints for enlarged use of tapioca in livestock feed originate from

uneconomic tapioca prices for the feed producers and inadequate linkage between farmers and feed producers. The economic price level of Rs.360/- tonne of tapioca suggested by the feed manufacturers offers a viable price for the farmers if the cost of production can be kept around the cost incurred by the Experiment Station in Salem or the cost of production of HYV achieved by the CTCRI experiments.

5. Supply and Demand Projections for Tapioca: 1990 and 2000

5.1 Supply projections

The supply projections are obtained from independent estimates of area and yield based on current technology and price relations.

5-1.1 Projected Area

(a) Extrapolation of Trend: Trend growth rates of area indicated a wide range according to the number of years included in the estimation process. It may be recalled that the all-India growth rates of area as well as those for Kerala and Tamil Nadu remained positive for the period 1960-61 to

From page 64

1/ T.P.Gangadharan, Feed Economy in Milk Production, A probe under New Dairy Farm Technology in Kerala, Indian Journal of Agricultural Economics, Vol.XXXV, No.4, p.135 - 138.

1983-84. However, when the sixties were excluded, during the period 1970-71 to 1983-84, there had been a negative rate of growth in area for Kerala and all India, but Tamil Nadu had a positive growth rate. In view of the differing nature of trends, it is assumed that the estimates based on the recent past (shorter period) represented a lower bound and those based on the longer period an upper bound. The projected levels of area for 1990 indicated a lower bound of 288.1 thousand hectares and an upper bound of 354.c thousand hectares. The lower and upper bounds of area for 2000 were 257.6 and 406.4 thousand hectares (Table 28).

Table 28

Projected Levels of Area under Tapioca based on trend estimates

	Average of 1981-82 to 1983-84	1900		200	
		Lower bound	upper bound	Lower bound	Upper bound
		(thousand hectares)			
Kerala	242.1	201.4	260.6	160.0	274.2
Tamil Nadu	49.4	55.2	61.7	63.4	81.3
Other regions[1/]	25.1	31.5	31.7	34.2	50.9
All India	316.6	288.1	354.0	257.6	406.4

1/ Obtained as a residual

(b) Other estimates: The National Commission on Agriculture had estimated that by 2000 the area under Tapioca can be raised to 1.0 million hectares. The Commission's estimate was based on the following logic:

> "In the major producing state, viz. Kerala, there already appears to be saturation in the matter of tapioca area. The neighbouring state of Tamil Nadu, However, affords an opportunity for area expansion .....Karnataka has also got suitable soil and climatic conditions for growing tapioca on the Western side. Andhra Pradesh and Assam region provide suitable conditions for growing tapioca and can undertake substantial increase in area. Maharashtra and Orissa also offer some scope".1/

Keeping these possibilities in view, and assuming a baselevel of 350 thousand hectares (being the average area of 1969 - 70 to 1971-72) the commission envisaged that the area under tapioca in 2000 A.D. to be one million hectares spread over the different states as follows:

State	Area (thousand hect.)
Kerala	325
Tamil Nadu	200
Karnataka	125
Maharashtra	50
Andhra Pradesh	125
Orissa	75
Assam Region	100
Total	1,000

1/ NCA, p.289

In view of the fact that the average area of 1981-82 to 1983-84 was only 316.6 thousand hectares and that the growth rates had declined during the seventies it is unlikely that the NCA projections will materialise. Considering the possible changes in area in different regions, and assuming that the area in Kerala will stabilise around the 1990 projected levels here it is estimated that the area under cassava in 2000 would be very near to the 1969-70 to 1971-72 average levels. The position in Kerala, TamilNadu and other regions might follow the pattern in Table 29.

5.1.2 Projected Yield

As in the case of area, there had been major changes in the growth rate of yield between the two periods considered. The growth rate of yield in Tamil Nadu was fairly high for both periods. However, during 1970-71 to 1983-84 Kerala had experienced a negative growth rate of yield (1.01%) against a moderate growth rate of 2.88 % during 1960-61 to 1983-84. When these trend growth rates are used, the projected all India levels of yield for 1990 ranged between 17, 741 and 22,131 kgs per hectare. The projected levels of yield for 2000 indicated a range between 18,578 and 30,549 kgs per hectare. The range for individual states had been very large (Table 30).

Table 29

Potential area under Tapioca in 1990 and 2000

	1969-70 to 1971-72 average	1981-82 to 1983-84 agerage	Projected level	
			1990	2000
	(1000 hectares)			
Kerala	267.5	242.1	231.0	231.0
Tamil Nadu	42.0	49.4	58.5	72.3
Other areas	10.5	25.1	40.0	55.0
All India	350.0	316.6	329.5	358.3

The National Commission on Agriculture had envisaged that by 2000 A.D the all India yield level would be 40 tonnes per hectare. The yield levels projected on the basis of past trends for Tamil Nadu and the NCA estimate appear to be beyond the reach on the basis of currently available varieties and the rate of adoption of new varieties. Therefore some adjustments were made on the trend estimates based on the progress of adoption of improved varieties and the use of irrigation and fertilisers to obtain the projected levels of yield in Table 31.

Table 30

Projected levels of yields basedon trend est. nates

	1990		200	
	Lower bound	Upper bound	Lower bound	Upper bound
	(kg/hectares)			
Kerala	14,256	19,142	14,256	25,234
Tamil Nadu*	50,466	56,363	100,693	129,121
All India	17,741	22,131	18,578	30,549

* In Tamil Nadu lower bound corresponds to the growth rate for 1960-61 to 1983-84. The large estimates for Tamil Nadu reflects the high growth rate in the initial period. It is highly improbable that the trend estimates of Tamil Nadu will materialise.

Table 31

Projected levels of Tapioca yield based on assessment of current research efforts.

	1969-70 to 1971-72 average	1981-82 to 1983-84 agerage	Projected levels	
			1990	2000
	(1000 kgs/ha)			
Kerala	16.4	15.3	17.0	19.7
Tamil Nadu	11.6	29.0	34.4	43.6
Other regions	5.2	10.3	15.5	19.5
All India	15.5	17.1	19.9	24.5

5.1.3 Projected supply

The projected levels of area and yield indicate that production of tapioca in 1990 will be 6,557 thousand tonnes, and by 2000 it will go upto 8,778 thousand tonnes. The current share of different states in all-India tapioca production (average of 1981 - 82 to 1983-84) indicated 59%, in Kerala 26% in Tamil Nadu and the remaining 5% in other states. By 1990, Kerala's share in all-India production will decline to 60% and by 2000 it will be only 52%. At the same time, the share of Tamil Nadu will increase to 30% in 1990 and to 36% by 2000. The states other than Kerala and Tamil Nadu will account for 10% of production in 1990 and for 12% of production in 2000.

Table 32

Projected Levels of Tapioca Production in 1990 and 2000.

	1969-70 to 1971-72 average	1981-82 to 1983-84 average	Projected levels	
			1990	2000
	(thousand tonnes)			
Kerala	4,883	3,712	3,927	4,551
Tamil Nadu	488	1,431	2,012	3,152
Other regions	54	258	618	1,075
All India	5,425	5,401	6,557	8,778

5.2 Demand Projections

5.2.1 Prospects for Cassava Utilisation for Food

Tapioca is used for human consumption mainly in Kerala State and the Kanyakumari district of Tamil Nadu. In 1981, 70% of the gross tapioca production in Kerala and 25% of the production in Tamil Nadu was utilised for human consumption. Thus, the quantity of tapioca used for food was, 2,956 thousand tonnes.

The National Commission on Agriculture had estimated that the average annual net consumption of tapioca for the period 1969-70 to 1971-72 to be 2,116 thousand tonnes. It was also estimated that about 25% of average production was wasted in the process of harvesting and marketing. Since this appears to be an over estimate, an estimated 15% wastage leads to a gross consumption estimate of 2489 thousand tonnes for this period. Thus the annual growth rate in aggregate consumption of tapioca between 1970-71 to 1981 was 1.5 per cent.

hanges in the demand for tapioca for human consumption occurs through changes in population, income, relative prices, and tastes and preferences. The estimates of income elasticity for tapioca from the National Sample Survey data indicated positive values for lower income groups and negative values for higher income groups. Further the aggregate income elasticity was positive for rural areas and negative for urban areas. Some of the cross section surveys had also indicated a negative relationship between tapioca consumption and income. While there

will be an increase in tapioca consumption for the low income groups, improved income levels of the middle class families and changes in income distribution will reduce tapioca consumption. In view of these estimates the income elasticity for tapioca was assumed to be close to zero and therefore the effect of income changes on consumption levels was not explicitly included in the projection frame work.

In recent years rice availability in the major tapioca consuming areas is at a satisfactory level. With an improvement in the availability of rice and other cereals in Kerala, the demand for tapioca has been depressed during the last few years. With improved rice and wheat availability market prices of cereals are kept within certain limits and it is unlikely that the relative prices will move in favour of tapioca. Therefore no increase in the demand for tapioca for human consumption is envisaged on account of favourable relative prices for tapioca. It is also assumed that there would be no major change in the tastes and preferences of consumers in the important consuming centres over the period of projection. Thus population change will be the major factor influencing consumption of tapioca.

The annual growth rate of population in Kerala during the last few years had been slightly less than two percent. Considering the fact that the annual growth rate of consumption of tapioca between 1970-71 to 1981 was about 1.5 percent,

and that population increase would be the major factor contributing to the increase in consumption of cassava, it is estimated that the demand for cassava for human consumption would increase at an annual rate of 1.5 per cent, so that the quantity demanded in 1990 and 2000 would be 3330 and 3850 thousand tonnes.

7.2.2 Non-food Uses of Cassava

The major non-food uses of tapioca include preparation of starch and use in animal feed. It was estimated that the current use of tapioca for starch preparation was about 1300 thousand tonnes. With an allowance of 20% for wastage, this accounts for 1625 thousand tonnes of tapioca. In view of the availability of maize and the starch manufacturer's preference for maize starch, it is visualised that the demand for tapioca from starch manufacturers may not show any substantial increase. Therefore it is assumed that the utilisation of tapioca for starch preparation in the near future will increase only marginally.

As pointed out earlier, there is ample scope for utilising tapioca in the cattle feed manufacturing units. It was estimated that the shortfall in concentrate feeds of plant origin in 2000 AD would be at least 5.76 million tonnes. Since about 25% of this deficit could be potentially met from tapioca[1/] there is a demand for about 1.4 million tonnes

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1/ It may be recalled that cattlefeed manufacturers were willing to use upto 20% tapioca. Also cattle and poultry feed ratios could accommodate about 20-30% tapioca and therefore a rough estimate of 25% is used in this analysis.

tonnes of dried tapioca for this purposes. Assuming the ratio between raw tapioca and dried tapioca to be 2.75 :1, the demand for raw tapioca in 2000 for animal feeds will be about 3.85 million tonnes.

In addition to the industrial demand for domestic markets, it is possible to export tapioca pellets if the raw material cost can be brought down. During 1985, the export price of tapioca pellets from Thailand was about 85 U.S. dollars/tonne and if the cost of tapioca can be brought down to about Rs.350/- tonne it may be possible to compete effectively in the export markets. With favourable price and some exports it is possible to achieve a potential export target of about 500 thousand tonnes of tapioca by 2000.

5.2.3. Expected Demand

The total expected demand for tapioca in 2000 is estimated to be 10,090 thousand tonnes. The potential uses as described earlier are summarised in Table 33.

Table 33

Potential Uses of Tapioca in 1990 and 2000

	1981-82 to 1983-84 average	Projected levels in 1990	Projected levels in 2000
		(thousand tonnes)	
Human Consumption	2,956	3,330	3,865
Starch*	1,625	1,750	1,875
Cattle feed	820	1,850	3,850
Exports	--	100	500
Total	5,401	7,030	10,090

*include 20% waste

5.3 Demand - Supply Gap

The demand and supply projections indicate that by2000, the potential demand for tapioca will exceed the potential supply by 1312 thousand tonnes.[1/] The alternatives available for bridging the gap can be based on strategies with emphasis on area expansion and yield increase. Since the scope for increasing the area under tapioca in Kerala and Tamil Nadu above the projected levels is limited, if the entire gap is to be filled by area expansion it will require an additional area of about 68 thousand hectares from the other states. On the other hand if yield increase is considered, it will require yield levels to go upto 28.16 tonnes/hectare, or an

1/ Here it should be emphasized that the potential demand is dependent as price reductions from efficient production processes. In the absence of such price reductions, the excess demand over supply may not exist.

increase of 15% over the projected yield levels. In view of limitations to increase the area, it may be necessary to concentrate on strategies to expand yield.

The key factor that accounts for the realisation of projected demand is the expansion of domestic market through tapioca use in cattle feed. Development of export market is also a possibility. Both these will involve favourable tapioca prices, stable supply, and linkage of producers and processors through appropriate marketing arrangements. Technology has a vital role to play in expanding yield and in reducing unit cost to the levels at which tapioca can effectively compete with other alternatives as an ingredient in cattle feed production and in the international markets. Thus utilisation of tapioca to the full demand potential and bridging the supply - demand gap would depend upon (1) development and adoption of improved technology at the farm level (2) evolving suitable processing technology and (3) integration of producers and processors with cattle feed manufacturers.

6. Summary and Conclusions

India accounts for about 2.6% of the worl's area and 5% of the world production of tapioca. Though tapioca area in India had reached a peak level of 3.9 million hectares in 1975-76, it had declined to 3.0 million hectares by 1983-84. The peak production of 6.6 million tonnes was achieved in 1975-76, but by 1983-84, production had declined to 5.8 million tones.

Tapioca production in India is concentrated in the two southern states of Kerala and Tamil Nadu. In the chronic rice deficit state of Kerala, tapioca was popularised as a cereal substitutes towards the end of the last century and this position has continued even today. In Tamil Nadu, the Kanyakumari district (which is geographically contiguous to Kerala, and formed part of the Travancore State before 1956) produces tapioca mainly for supplementing the rice diet. However, introduction of tapioca in the Salem district of Tamil Nadu, which is a development after the Second World War, was influenced by the industrial use of tapioca for manufacture of starch. During 1960-61 Kerala accounted for about 88% of the tapioca area in India, and Tamil Nadu accounted for another 9% of area. By 1983-84, Kerala's share of area has declined to about 76% and Tamil Nadu has increased its share to about 16%. More than half the area in Kerala came from the three southern districts of Trivandrum, Quilon and Kottayam, but in Tamil Nadu, Salem district alone accounted for more than half the area in the State.

During the sixties, area under tapioca in India increased at an annual rate of about 4 per cent, with a growth rate of 3 per cent in Kerala and about 9 per cent in Tamil Nadu. However, during 1970-71 to 1983-84, Kerala had experienced a negative growth rate in area (-2.3%), but Tamil Nadu had a positive growth rate of 1.3%,

The all-India average yield of tapioca during 1983-84 was about 19 tonnes/hectare (16.7 tonnes/ha.in Kerala and 31.2 tonnes/ha in Tamil Nadu). Between 1960-61 to 1983-84 yield of tapioca increased at an annual rate of 2.9 per cent in Kerala and 7.2 per cent in Tamil Nadu resulting in an all-India growth rate of about 3.4 per cent. While Kerala had a relatively higher growth rate of yield during the Sixties as compared to Tamil Nadu, the Seventies and early Eighties witnessed a negative growth rate of yield in Kerala and a growth rate above 8.6 per cent in Tamil Nadu.

About 2/3 of the all India production of 5.8 million tonnes of tapioca came from Kerala, and the Tamil Nadu's share was about 1/4 of the all-India production. During the Sixties, the annual growth rate of production of tapioca exceeded 12% (about 13.6 per cent in Kerala and 11.6 per cent in Tamil Nadu). However, in the Seventies and early Eighties Kerala experienced a negative growth rate of production (-3.3%) and Tamil Nadu's annual growth rate was about 10%. Between 1960-61 ro 1983-84, production of tapioca in India increased at an annual rate of 4.7 percent (3.6 per cent in Kerala and 10.1% in Tamil Nadu).

Though tapioca is not a major competitor of rice in terms of area allocation, the competition on the demand side is reflected in the allocation of other resources for tapioca production. The major difference in the use pattern of tapioca in Kerala and Tamil Nadu (cereal substitute VS industrial

raw material) has introduced major variations in the input use pattern, and organisation of production and marketing in these two states.

About 70 per cent of the tapioca produced in Kerala was used for human consumption. In Tamil Nadu, human consumption accounted for only about 25 per cent of tapioca production and it was mainly from the Kanyakumari district. Non-availability of rice was the major factor responsible for increased tapioca consumption. Available data from consumer surveys indicate that the income elasticity for tapioca is high among the poorest households and the elasticity declined with increased income achieving negative values for high income groups.

Though there are varying estimates of starch production, it is estimated that about 30% of the tapioca production in India is utilised for the manufacture of starch. With 55 per cent production of tapioca going for human consumption, only about 15 per cent of the production is utilised for other purposes such as directly feeding cattle.

Tapioca prices indicated substantial annual fluctuations. Retail prices of tapioca were about 35 per cent higher than the wholesale prices. With improved rice availability, the ratio of retail rice and tapioca prices have declined during the recent years.

In recent years there has been an improvement in the production of livestock items and this has generated improved demand for livestock feed. The supply position of available

raw materials for cattle feed indicates that the supply will fall short of anticipated demand. Utilisation of tapioca in manufacturing cattle feed can be an effective means to bridge the gap in feed availability.

Though research and extension of tapioca is carried out only on a limited scale, it was possible to evolve some high yielding varieties. The cost of production of these high yielding varieties were such that they could effectively compete with other raw materials used in the manufacture of starch and cattle feed, and at the low competitive rates these varieties offered enough incentives for farmers to adopt improved cultivation practices through realisation of higher yield levels.

Supply projections indicate that by 2000, tapioca production in India may be around 8.8 million tonnes. Kerala's share will come down to 52 per cent of the all-India production and Tamil Nadu's share will go to 36 per cent. The potential demand for tapioca in 2000 will be around 10.1 million tonnes consisting of about 3.9 million tonnes each for human consumption and cattle feed, 1.9 million tonnes for starch and the rest for export. The major source of market expansion is likely to come from the use of tapioca in cattle feed. Thus, by 2000, the likely demand will exceed the supply by about 1.3 million tonnes.

Increased dependence on technology will be the only answer to bridge the gap between potential demand and supply as the scope for increasing area under tapioca beyond the

the projected level of 3.6 million hectares is difficult to achieve. Realisation of the potential demand is conditioned by the adoption of tapioca as an ingredient in the manufacture of cattle feed, for which technical feasbility exists. However the economic feasibility of utilisation of tapioca in livestock feed will be conditioned by its reduced unit cost of production. Thus increased reliance on yield increasing technology is an important consideration in achieving the full potential use of tapioca and in bridging the demand-supply gap. It is also important to give reasonable levels of income from cultivation of tapioca to the farmers so that enough incentives are available for adoption of new technology at the farm level.

Assured supply of good quality tapioca on a continuing basis at competitive price levels is important to induce feed manufacturers to switch over to tapioca. Therefore, in addition to the existence of improved technology, it is important to evolve suitable processing facilities and to integrate cultivators and feed manufacturers through appropriate organisational mechanism. Such integration has already proved to be effective in the case of starch production in Tamil Nadu. Most tapioca producers are small farmers and many of them may also have some cattle. Organisation of milk collection through farmers' organisation and supply of cattle feed through these organisations are gradually being achieved. In this chain it may be possible to introduce tapioca also, at least in the major tapioca producing regions, so that an effective link can be established among the functions of supply of tapioca for cattle feed production, distribution of cattle feed, and organisation of milk collection,

Exhibit 1

Monthly Per Capita Consumption of Tapioca in Kerala: 1977-78

Expenditure Class (Rs)	Rural (Kgs)	Urban (Kgs)
0 - 10	1.24	0.06
10 - 15	3.45	1.87
15 - 20	3.18	1.91
20 - 30	4.16	2.48
30 - 35	4.53	3.07
35 - 40	5.01	3.33
40- 50	5.76	2.46
50 - 60	6.17	2.98
60 - 70	5.75	3.72
70 - 80	5.82	2.67
80 -100	7.06	2.55
100 -150	5.60	2.30
150 -200	4.74	1.84
200 -300	5.24	1.29
Above 300		1.22
All classes	5.55	2.59

Source: National Sample Survey: 1977-78.

Exhibit 2

Monthly Percapita Expenditure on Tapioca in Kerala, 1970-71

Expenditure Class	Rural Area			Urban Area		
	Expenditure on tapioca	Total expenditure	% expenditure on tapioca	Expenditure on tapioca	Total exp.	% expenditure
	Rs.	Rs.	Rs.	Rs.	Rs.	
0 - 8	0.33	6.69	4.9	0.35	7.70	4.5
8 - 11	0.74	9.48	7.8	.89	10.30	8.7
11 - 13	0.96	12.02	8.0	.11	11.69	0.9
13 - 15	0.92	14.16	6.5	1.14	14.52	7.9
15 - 18	1.24	16.76	8.4	.88	16.32	5.4
18 - 21	1.46	19.60	7.4	1.10	19.52	5.6
21 - 24	1.57	22.53	7.0	1.30	22.82	5.7
24 - 28	1.83	25.92	7.1	1.06	26.20	4.6
28 - 34	1.84	30.77	6.0	1.10	31.04	3.6
34 - 43	2.34	37.84	6.2	1.11	38.70	2.9
43 - 55	2.04	48.43	4.2	1.29	49.25	2.6
55 - 75	2.57	63.83	4.0	.47	64.49	0.7
75 & above	1.66	115.38	1.4	.53	132.27	0.4
All classes	1.78	36.12	4.9	.97	46.63	2.0

Source: National Sample Survey 25th Round 1970-71

Monthly Calorie Consumption Per Person of Tapioca and Rice: Kerala

Monthly per-capita expenditure classes (in Rs.)	NSS 17th Round (Sep.1961 to July 1962)				NSS 28th Round Oct.1973 to June 1974)			
	Rural		Urban		Rural		Urban	
	Rice	Tapioca	Rice	Tapioca	Rice	Tapioca	Rice	Tapioca
	(thousand calories)							
0-13	21.0	8.0	18.9	2.0	6.8	7.9	No sample	
13-15	45.3	3.8	31.6	1.0	6.1	13.1	12.5	0.3
15-18	32.1	11.9	31.8	0.6	11.8	7.3	5.8	19.6
18-21	41.3	5.9	37.4	6.1	11.0	11.9	10.2	5.1
21-24	33.0	11.1	36.8	2.4	15.0	10.1	14.6	4.8
24-28	43.6	6.2	45.7	1.1	17.2	8.1	14.1	8.8
28-34	42.5	7.9	42.1	2.5	17.5	11.8	19.4	4.8
34-43	60.9	14.2	39.0	1.1	20.9	10.2	19.3	6.4
43-55	43.9	3.3	49.7	1.1	25.1	12.2	27.0	6.3
55-75	38.7	0.2	46.3	5.1	29.2	11.3	25.3	7.4
75 & above	45.0	5.2	36.0	2.1	40.7	11.3	33.1	4.1
All classes	34.0	8.1	34.2	2.2	25.4	11.0	25.0	5.7

Source: 1. Computed from NSS 17th Round, September 1961 to July 1962, Integrated Household Survey (sch.27), No,184, Tables with notes on Expenditure, Cabinet Secretariat, Govt.of India, 1974.

2. NSS 28th Round, October 1973 to June 1974, No.240, Tables on Consumer Expenditre, Dept.of Statistics New Delhi, 1977.

Exhibit 4

Farm Price and Wholesale Price of Tapioca in Kerala

Year	Farm Price		Wholesale price
	Actual (Rs./quintal)	Index (1960-61 = 100)	(1961 = 100)
1960-61	7.85	100	100
1961-62	10.11	129	121
1962-63	9.59	122	95
1963-64	8.85	104	133
1964-65	17.55	224	222
1965-66	17.42	222	197
1966-67	17.95	229	227
1967-68	23.02	293	273
1968-69	20.55	260	216
1969-70	18.48	235	238
1970-71	20.84	264	247
1971-72	20.82	265	281
1972-73	25.43	324	364
1973-74	34.83	444	457
1974-75	37.45	477	456
1975-76	40.22	512	445
1976-77	35.57	453	366
1977-78	28.59	364	385
1978-79	34.45	439	475
1979-80	41.22	525	508
1980-81	40.06	510	564
1981-82	49.86	635	729
1982-83	61.91	789	801
1983-84	70.02	898	905

Source: Statistics for Planning (Various Issues)

Exhibit 5

Wholesale and retail price of tapioca and ratio of retail prices of rice and tapioca in Kottayam Dist.

Year	Wholesale price of tapioca (Rs./kg)	Retail price of tapioca (Rs./kg)	Ratio of retail rice price to retail tapioca price
1961	.08	.14	4.4
1962	.10	.16	4.4
1963	.10	.15	4.4
1964	.15	.18	5.3
1965	.21	.27	5.1
1966	.18	.26	6.5
1967	.25	.30	7.2
1968	.27	.34	5.9
1969	.24	.31	5.4
1970	.28	.34	4.6
1971	.25	.35	4.4
1972	.29	.35	5.1
1973	.39	.45	6.8
1974	.48	.56	6.2
1975	.51	.59	5.3
1976	.43	.57	4.4
1977	.33	.50	4.5
1978	.41	.55	3.8
1979	.44	.63	3.6
1980	.46	.66	3.6
1981	.55	.75	4.2
1982	.66	.89	3.8
1983	.73	1.01	3.2

Source: Statistics for Planning (Various Issues)

Exhibit 6

Illustrative Concentrate Mixtures for Cows

Ingredient	Proportion in				
	North	Central	East	West	South
Coconut meal	--	--	--	--	10
Maise	17	12	--	15	--
Maizegluten	10	--	--	--	--
Barley	15	--	--	--	--
Groundnut-meal	10	10	15	22	--
Cottonsead - meal	10	--	--	--	--
Mustardseed-meal	10	--	--	--	--
Molasses	5	--	--	--	--
Wheat bran	20	10	--	10	--
Mineral Mixtures	3	3	3	3	3
Sorghum	--	10	--	--	--
Guar meal	--	10	--	--	--
Beet pulp	--	10	--	--	--
Seasame meal	--	10	--	--	25
Linsead meal	--	10	--	--	--
Gram husk	--	5	--	--	5
Rice bran	--	10	10	10	10
Arhar chuni	--	--	10	--	--
Horse gram	--	--	7	--	--
Rice grit	--	--	20	--	--
Linseed cake	--	--	20	--	--
Molasses	--	--	5	--	10
Rice polish	--	--	10	10	--
Pearl millet	--	--	--	10	--
Gram chuni	--	--	--	10	--
Oats	--	--	--	--	5
Brewery grain	--	--	--	--	10
Tamarind seed	--	--	--	--	5

Source: S.P.Arora, Feeding of Dairy Cattle and Buffaloes, Indian Council of Agricultura Research, New Delhi, 1978.

Exhibit 7

Existing and Optimal feeding practices for coss bred and non-descripts cows in Kerala

	Brown Swiss Cross Bred				Non-descript			
	Rainy		Summer		Rainy		Summer	
	Existing	Optimal	Existing	Optimal	Existing	Optimal	Existing	Optimal
	(kgs)							
Local grasses	3.08	12.45	2.58	9.72	3.88	6.50	2.30	3.91
Hybrid napier grasses	1.01	--	0.84	--	0.12	--	0.25	2.59
Guinea grass	0.14	--	0.04	--	0.06	--	0.05	--
Others*	0.05	--	0.03	--	0.05	--	0.09	--
Paddy straw	4.14	4.00	4.86	4.00	1.82	3.00	2.18	3.00
Groundnut oilcake	0.16	0.65	0.62	0.59	0.25	0.40	0.31	0.33
Coconut Oil Cake	0.16	--	0.11	--	0.06	--	0.04	--
Gingelly Oilcake	0.14	--	0.15	--	0.05	--	0.03	--
Tamerin seed	0.35	--	0.32	--	0.24	--	0.19	--
Cotton seed	0.04	--	0.04	--	--	--	--	--
Gram	0.03	--	0.02	--	--	--	--	--
Rice bran	0.32	0.30	0.27	0.28	0.22	--	0.23	--
Compound cattle feeds	0.76	0.50	0.72	0.50	0.16	0.10	0.19	0.10
Others**	0.06	--	0.07	--	0.03	--	0.05	--
Feed cost per kg milk	0.70	0.61	0.90	0.68	0.97	1.04	1.10	1.21
Percent change in feed cost in optimal plan	-12.9		-24.4		+7.2		+10	

*includes tapioca residues, plantain leaves etc.
**includes jaggery, rice residue etc

Source: T.P.Gangadharan, Feed economy in Milk production: A probe under New Dairy Farm Technology in Kerala. Industrial Journal of Agricultural Economics, Vol.XXXV No.4, p.38.

Appendix I.

Trends in Livestock Products and Projections to 1990 and 2000.

Data on milk, meat and eggs are available from different sources, but there appears to be some questions on their reliability. Commenting on the data on milk production in 1985, the Jha Committee had observed that 'Inadequacy and unreliability of the available statistics have come in the way of our making as precise an assessment of the progress in milk production enhancement as we would have liked to make". The data on meat and egg production would also invite similar comments. However, to give a rough idea of the trend in the production pattern available information are used.

Milk Production

Estimates of milk production available from the Ministry of Agriculture, Government of India indicate that production of milk in 1984-85 was 38 million tonnes. The targeted milk production for 1990 is 52 million tonnes and for 2000 the target is 65 million tonnes. These estimates for different years are reproduced below:

1/ Govt.of India, Ministry of Agriculture Report of the Evaluation Committee on Operation Flood II (LK Kha Chairman), New Delhi, 1985, p.35.

Year	Production
1971-72	22.5
1980-81	31.5
1981-82	32.9
1982-83	34.6
1983-84	36.3
1984-85	38.0
1989-90(projected)	52.0
2000	65.0

It is generally believed that milk production enhancement activities during the last ten years have accelerated the growth rate and it is expected that the recent trend will continue. A study[1/] on milk production in India during the last 20 years had indicated that the annual compound growth rate for 1964-83 was 2.66% but it was at a much higher rate of 4.13% during 1974-83. When those two growth rates were used, the projected production levels for 2000 were 50.48 million tonnes and 69.03 million tonnes. The projected levels of milk production for 1990 and 2000 are given below:

Basis	Projected milk production	
	1990	2000
	(Million tonnes)	
1964-83 rate	38.69	50.48
1974-83 rate	45.67	69.03

1/ S.P.Singh et.al. An Economic Analysis of Interstate Disparities in Milk Production and Institutional facilities in India, Agricultural Situation in India, January 1986.

According to the Government estimates of milk production the 1990 projected production based on the 20 year growth rate is already achieved. At the same time the 1990 production based on the 10 year growth rate (45.67 million) is below the seventh plan projection of 52 million. Assuming that the trend in milk production during 1974-83 is likely to be maintained it is possible to expect the 1990 production levels to be around 45 million tonnes.

The Government projection of 65 million tonnes for 2000 is below the projections obtained from the 10 year growth rate (69 million tonnes). Assuming that the tempo during the last ten years might decline, it is possible to estimate that milk production in 2000 would be between 60-65 million tonnes.

These estimates are also consistent with the supply projections obtained by the National Commission[1/] on Agriculture (NCA) whose estimates of milk production for 1985 and 2000 were 44.2 million and 64.4 million tonnes respectively. The NCA had also obtained two estimates of demand for milk:

	Estimated demand		Supply
	Low	High	
	(million tonnes)		
1985	33.4	44.2	44.2
2000	49.4	64.4	64.4

1/ Government of India, Ministry of Agriculture and Irrigation Report of the National Commission on Agriculture, Volume III, New Delhi. 1976.

The high estimate of demand is consistant with the supply projections and any shortfall in this demand might lead to an excess production.

Meat: According to the IFPRI study, the 1961-65 average production of meat was 0.626 tonnes and the average production of 1973-77 was 0.726 million tonnes.[1/] The projected supply of meat for 1990 was .868 tonnes and for 2000 it was .982 million tonnes. The projected consumption levels were much ahead of the production levels leaving a sizeable deficit. The IFPRI demand- supply projection for 1990 and 2000 indicated the following levels.

Production		Consumption	Deficit
		(million tonnes)	
1990	.868	1.279	.411
2000	.982	1.965	.883

The production estimates of the National Commission on Agriculture was about double these estimates. Considering the population of various categories of meat producers the NCA estimates were ontained as follows:

1/ J.S. Sharma (1986)

	Meat production		
	1971	1985	2000
	(million tonnes)		
Mutton/goat	0.37	0.60	1.11
Pork and Pork Products	0.05	0.09	0.17
Buffalo meat & beaf	0.18	0.35	0.52
Poultry meat	0.09	0.15	0.30
Total	0.69	1.19	2.10

Aggregate consumer demand for meat was expected to range between 1.1 and 1.4 million tonnes in 1985 and between 1.6 and 2.1 million tonnes in 2000.

Table A.1

Supply - Demand balance of meat from the NCA projection

	Supply	Demand	
		Low	High
		(million tonnes)	
1971	0.69		
1985	1.19	1.05	1.40
2000	2.10	1.57	2.11

Source: National Commission on Agriculture

Eggs

The NCA had estimated that in 1985 production of eg from 177.5 million layers was 15,775 million and the production in 2000 was estimated at 27,882 million from 179.4 million layers. The demand estimates for eggs indicated that the supply was slightly below the high estimate of demand.

Table A-2

Supply - Demand balance of eggs from the NCA Projections

	Supply	Demand	
		Low	High
		(million eggs)	
1971	6,040		
1985	15,775	10,217	15,292
2000	27,882	17,419	28,513

Structural Changes

It is anticipated that the structure of dairying in India might undergo some changes by 2000 A.D. According to the Chairman of the National Dairy Development Board, the estimated production of 65 million tonnes of milk in 2000 A.D. can be achieved by looking after dairy animals better and by putting to practical use certain scientific and technological innovations in feeding, breading, and disease control of the milch stock. Dairying shall continue to be subsidiary or side occupation for most farmers and a major source of income for the landless. The competition between men and animal for land will dictate ever increasing use of crop residues for cows and buffaloes. By 2000 the number of primary societies are expected to be about 100,000 as against 28,000 during mid-eighties.

Improved fowls are expected to produce the bulk of eggs. The distribution of total egg production in 2000 among improved fowl, local (desi) fowl and duck formed the

following pattern:

	Number (million)	Eggs (million)
Improved fowl	136.4	24,552
Local (desi) fowl	35.0	2,450
Duck	8.0	880

Cereal and other feeds

There exists no systematic procedure for estimating changes in feed availability over time. Most of the existing data on feed availability are indirect estimates based on area under fodder crops and forest, food crop yield, and on production of residues and hyproducts of main crops.1/

According to Nair, the main source of growth in feed supply in India during the past has been the increase in crop production, especially of foodgrains and oilseed. The estimates of feed availability from these sources were obtained using the following assumptions:

1. Estimates of roughages are obtained by applying the straw-grain ratio to the estimated production of crops.
2. Estimates of rice, wheat and other bran are obtained by applying the bran content in each grain.
3. The production of oilcake is obtained from the oilcake content of crushed oilseeds after making allowance for export of oilcake.
4. Coarse grain use in cattlefeed was assumed to be 2 per cent of the total grain production.

1/ See Whyte R.O. and Mathur M.L. (1968), ICAR (1954) Central Council of Gosamvardhana (1965) Amble et.al (1865) and K.N.Nair (1985).

The estimates of roughages abd concentrates during the last two decades are available from Table A.3

Based on the FAO data, IFPRI had obtained the trends in cereal feed use of different commodities. These estimates for 1966-1970 and 1976-80 are summarised in Table A.4.

Table A.3

Estimated feed supply in India

Year	Roughages	Concentrates
	(million tonnes)	
1961-66	273.5	12.5
1962-67	272.0	11.5
1963-68	279.0	11.2
1964.69	285.1	12.4
1965-70	293.8	11.5
1966-71	316.8	13.2
1967-72	318.7	13.7
1968-73	323.7	13.6
1969-74	281.5	14.2
1970-75	311.3	15.0
1971-76	317.1	15.0
1972-77	325.7	14.3
1973-78	370.1	15.9
1974-79	385.9	16.6
1975-80	390-1	17.4
1976-81	388.1	16.9
1977-82	384.3	17.8

Source: K.N.Nair,p.A-91

Table A-4

Estimated Cereal Feed Production

	1966-70 average	1976-80 average
	(million tonnes)	
Cereal feed	7.65	10.07
Roots and tubers	0	0
Pulses feed*	0.95	1.10
Groundnut feed	1.37	1.95
Banana and Plantains*	0	0
Total noncereal	2.32	3.05

* Cereal Equivalent
Source: IFPRI

Comparable data are not available from other sources. Though data on production of concentrates of plant origin are available, it is not clearly established as to what proportion of the production is actually used for cattle feed. In 1974 the Committee on Livestock Feeds and Fodder of the Ministry of Agriculture and Irrigation had obtained the following estimates for 1971-72.

The availability of 11 million tonnes estimated for 1971-72 was much lower than the estimated 17.4 million tonnes of concentrates being consumed.[1/] The National Commission had found it difficult to understand the divergence between data on availability and use.

1/ Amble et.al (1965), p.221-35

Table A-5

Availability of Different Feeds Based on Total Production of Foodgrains and Oilseeds; 1971-72

Item	Total Production	Available for feed
	(million tonnes)	
Coarse grain*	24.49	0.49
Edible oilcake**	3.42	2.77
Cotton Seed	1.98	1.78
Rice and wheat bran	4.85	4.68
Pulses by-products	11.09	1.33
		11.05

*Feed availability based on 2 percent coarse grain production

**Availability of edible oilcake depends on conversion rate and export policy of the Government which changes from time to time.

Source: Report of the Committee on Livestock Feeds and Fodders, 1974.

The National Commission on Agriculture had also obtained feed requirements for livestock in 2000. It was visualised that the feed requirement of nondescript cattle differed considerably from the crossbred and improved cattle. Also the fedding requirments changed according to the type of cattle, age group, lactation stage and other such characteristics. The estimated levels of concentrates, green fodder and dry fodder for the projected levels of various categories of animals in 2000 are available in Table.A.6.

On the basis of the concentrate feeds required for livestock feeding in 2000, the requirements of coarse cereal foodgrains have been estimated on the assumption that pigs and poultry rations should contain upto 50 per cent of coarse cereals and other livestock rations should contain, on an average, 25 per cent of coarse cereals. Thus the coarse grain requirement for livestock feed in 2000 is estimated to be 23,90 million tonnes.

Against the requirements of 373 million tonnes of dry fodder the amount of dry fodder available from grain, pulses and oilseed crops is estimated to be 356.8 million tonnes. In 2000 the area under fodder crops was estimated to be 16.50 million hectares including 6.5 million hectares of irrigated land, and the fodder production was estimated at 575.0 million tonnes. In addition to the cultivated green fodder, grazing in forest land, and monscon grasses and tree leaves also would be available. It was estimated that 25 million tonnes of coarse cereal grains would be available for feeding livestock, along with about 52 million tonnes of other ingredients for concentrates (Table A.7).

Thus the availability of concentrate feeds of plant origin in 2000 for feeding livestock is estimated to be short of the estimated requirements by 5.76 million tonnes. It can be further observed that the estimates of 25 million tons of coarse grain available for livestock feed in 2000 may be an over estimate. As pointed out in Table 20, during 1971-72 the coarse grain use for cattlefeed was only 0.49 million tonnes or about 2% of the coarse grain production

Table A-6

Requirements of feeds and fodders for livestock in 2000 AD

Category of Livestock	Requirement of		
	Concentration	Green fodder	Dry fodder
	(million tonnes)		
Cattle			
Males: Working and breeding	6.66	133.3	146.7
Females: Milch and dry			
Nondescript	1.56	38.9	31.2
Improved indegenous	4.82	39.6	24.1
Cross bred	18.97	136.1	41.4
Youngstock			
Crossbred	8.75	58.3	11.7
Others	4.84	48.4	14.5
Buffaloes			
Male working & breeding			
Females milch and dry	2.37	12.7	12.7
nondescript	2.37	23.7	23.7
improved	9.64	64.3	38.5
Young stock	0.70	34.8	13.9
Total for bovines	58.82	590.1	358.4
Improved poultry	8.06		
Improved sheep	6.57	1.6	8.8
Improved goats	4.38		5.8
Improved pigs	4.65	3.1	
Horses and ponies	0.15		
Camels	0.18		
Total	82.81	594.8	373.0

Source: NCA Report, Vol.VII, p.390.

Table A.7

Availability of Concentrate feed of plant origin in 2000 AD for feeding livestock

Source	Quantity (million tonnes)
Coarse cereal grains	25.00
Bran from wheat and rice	5.67
Chunis from pulses	4.38
Oilcakes	42.00
Total	77.05

of 24.5 million tonnes. The NCA estimates of coarse grain production in 2000 is 65 million tonnes and the estimated 25 million tonnes used for cattlefeed would imply that about 40% production is utilised for cattlefeed. Further, on the basis of the production growth during the past, the 65 million tonnes production target itself may be beyond the reach. The 1970-71 level of production (24.5 million tonnes) increased to 32 million tonnes in 1984-85 and the targeted production at the end of the seventh plan (1989/90) is only between 34 to 35 million tonnes, with an estimated annual growth rate between 1.2 to 1.8%. If this growth rate is maintained during the period 1990 to 2000, the level of coarse cereal production in 2000 is unlikely to exceed 40 million tonnes. At this level of production, the projected use of coarse cereals in cattlefeed

would imply that about 62% of production is utilised for cattle feed.

The 1971-72 level of coarse grain use for human consumption was about 24 million tonnes and a very conservative estimates of consumption in 2000 assuming inferior goods status for coarse grain would be around 30 million tonnes. This would leave only about 10 million tonnes of coarse grain production available for cattle feed. Thus the demand supply gap for concentrates would be around 20 million tonnes even if the projected levels of availability of bran, pulses and oilcakes are achieved.[1/]

1/ Here it could be pointed out that the projected level of pulses production in 2000 (35 million tonnes) is also unlikely to be achieved. Against the 1985 projected level of 22 million tonnes, the actual production was only 13 million tonnes and the 1989/90 targeted production is only 16 million tonnes.

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