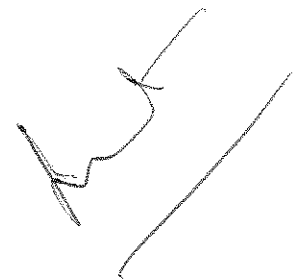


**EVALUATING RICE MARKET  
INTERVENTION POLICIES**

**Some Asian Examples**





Dr. S. Indrakant  
READER IN ECONOMICS  
Osmania University  
HYDERABAD-500 007.

*S. Indrakant  
Prof. of Economics  
Osmania University  
Hydr. 500 007.*

**EVALUATING RICE MARKET  
INTERVENTION POLICIES:  
SOME ASIAN EXAMPLES**

Published by

ASIAN DEVELOPMENT BANK

1985

## CONTENTS

### FOREWORD

I. OVERVIEW	1
J. Keith Johnson	
II. KOREA	37
Kwang-Sik Myoung and Jung-Hwan Lee	
III. MALAYSIA	91
Mokhtar Tamin and Sahathavan Meyanathan	
IV. BANGLADESH	151
Akhlaqur Rahman and Wahiduddin Mahmud	
V. INDIA	237
R. Radhakrishna and S. Indrakant	
VI. PRINCIPLES, ISSUES, THEMES AND LESSONS	323
C. Peter Timmer	

**V. Effects of Rice Market Intervention  
Policies in India:  
The Case of Andhra Pradesh**

**R. Radhakrishna  
and  
S. Indrakant**

Centre for Economic and Social Studies, Begumpet, Hyderabad.

Acknowledgement is made of the assistance of Dr. P. Ashok Kumar,  
Dr. V. Surendar, Dr. K. Hanumantha Rao, Mr. K.S. Reddy,  
Mr. S. Sudhakar Reddy and Mr. G.K. Mitra.

238

239

## TABLE OF CONTENTS

<b>Introduction</b>	245
<b>Background of Public Intervention in the Foodgrain Market</b>	246
Evolution of Foodgrains Policy	246
Foodgrain Market Intervention in India	251
Overview	251
Policy goals and policy instruments	253
Support, procurement and issue prices	253
Procurement agencies and methods	254
Public Distribution System (PDS)	255
Government stock operations	256
Import policy	257
<b>Market Intervention in the Foodgrain Market of Andhra Pradesh</b>	258
Overview	258
Procurement of Rice (Mechanisms, Volume and Prices)	259
Public Distribution System in Andhra Pradesh	263
Subsidies	265
Rice subsidy	265
Fertilizer subsidy	267
<b>Rice Marketing in Andhra Pradesh</b>	268
Rice Marketing Channels	268
Market regulation and market arrivals	270
Seasonality in Prices	270
Millers Margin	273
Retailers Margin	279
Spatial Market Integration	282

240

<b>The Effects of Government Intervention in the Rice Market of Andhra Pradesh</b>	284
Introduction	284
Model	285
Demand for rice in the presence of PDS	285
Supply function	287
Market integration	288
Policy effects	288
Welfare Implications of Policy Changes	290
Incorporation of farm income feedback effects	290
Policy effects	292
<b>Appendix V.1 Demand Model for Rice</b>	306
<b>Appendix V.2 Rice Supply Function for Andhra Pradesh</b>	312
<b>Appendix V.3 Estimation of Rice Production, Price and Consumption in 1985/86</b>	315
<b>Footnotes</b>	318
<b>References</b>	320

241

### Tables, Charts and Figures

Table V.1	Gross Output, Government Procurement, Net Availability and Government Supplies of all Foodgrains and Rice from 1951-1983, All India	248
V.2	Government Operations in Foodgrains and Rice Markets from 1951-1983, All India	249
V.3	Central Government Food and Fertilizer Subsidies	252
V.4	Issue Price and Cost per Ton of Rice Incurred by FCI	256
V.5	Cost of Carrying Buffer Stocks of FCI	257
V.6	Procurement and Prices of Rice in Andhra Pradesh	262
V.7	Government Supplies and Domestic Consumption of Rice in Andhra Pradesh	263
V.8	Prices of Rice at Various Levels Under PDS in Andhra Pradesh: 1986/87	265
V.9	Rice Subsidy (Central and State Governments) 1980/81 to 1985/86	266
V.10	Fertilizer Subsidy in Andhra Pradesh	268
V.11	Number of Agricultural Market Committees and Regulated Markets in Andhra Pradesh	272
V.12	Rice Production and Market Arrivals in Andhra Pradesh	272
V.13	Seasonal Price Indices for Rice in Andhra Pradesh	276
V.14	Seasonal Price Functions	277

242

243

V.15	Purchases and Sales of Sample Rice Millers, 1985/86	277
V.16	Distributive Shares in Rice Marketing of Sample Mills, 1985/86	278
V.17	Prices in Andhra Pradesh, 1970/71-1985/86	280
V.18	Inter Market Correlation Coefficients for Selected Markets in Andhra Pradesh, Monthly Rice Wholesale Prices	282
Table V.19	Equilibrium Values Under Different Policy Changes, Variant A	295
V.20	Equilibrium Values Under Different Policy Changes, Variant B	296
V.21	Welfare Changes Compared to Base Year Scenario, Variant A	297
V.22	Welfare Changes Compared to Base Year Scenario, Variant B	298
V.23	Rice Consumption Levels Under Various Policies, Variant A	299
V.24	Rice Consumption Levels Under Various Policies, Variant B	300
V.25	LES Parameters Estimates: Andhra Pradesh (Rural)	309
V.26	LES Parameters Estimates: Andhra Pradesh (Urban)	310
V.27	Price and Expenditure Elasticities for Rice	311
V.28	Parameter Estimates of Rice Supply Function	314
V.29	Per Capita Monthly Consumption of Rice in 1977/78	316

V.30	Parameters of Log-normal Distribution	316
V.31	Share of Rice Crop in the Incomes of Rural Households	317
Chart V.1	Major Rice Marketing Channels in Andhra Pradesh	271
V.2	Distribution of Paddy and Rice Wholesale Price Reporting Centers in Andhra Pradesh	283
Figure V.1	Production, Procurement, Public Distribution and Market Arrivals During 1970-1986	260
V.2	Seasonal Price Indices for Rice in Andhra Pradesh	275
V.3	Prices of Rice in Andhra Pradesh, 1970-1986	281
V.4	Rice Market Under Autarky	304

244

245

## INTRODUCTION

Foodgrain policy is of overriding concern to policymakers of India for a number of reasons. The foodgrain sector provides sustenance to a large section of the population and poverty levels are very sensitive to the variations in its production and price levels. Its uneven development often results in conflicting interests between surplus and deficit states. The magnitude of the supply-demand elasticities are such that even a small supply-demand gap can generate forces of destabilization, and their effects are not confined to the original market but spread outwards to other markets.

Since the social outcome of a freely competitive market may not always be desirable, a policy of extensive government involvement in the grain market has become established in India. Foodgrain prices are determined in markets through a combination of government interventions and basic market forces. The major policy goals spelt out in the official documents are: self-sufficiency in foodgrains, reduction of hunger among the poor, availability of foodgrains to consumers at reasonable prices, price stability, and ensuring adequate returns to farmers. Policy makers reconcile the conflicting interests of various socioeconomic groups in their policy formulations by means of food and input subsidies.

Central and state governments participate in the design and implementation of foodgrain policy. The relative roles of the two tiers of government vary among the various components of the policy. The central government plays a key role in the buffer stock operation and in the control of external and internal trade between the states. Since foodgrain surpluses are concentrated in a few states, central government also plays a crucial role in reconciling the conflicting interests of the surplus and deficit states. The central policy takes into consideration the existence of local institutions and allows a major degree of freedom for each state to formulate its own policy. Given the broad parameters of the central policy, the state formulates its own policy to fulfill its own specific objectives. Consequently, the mode of procurement and the extent of public distribution of food grains vary substantially among the states. Any analysis of the effects of market intervention in a state has to take cognizance of central and state policies and the institutional network through which the policies operate.

This paper analyzes the nature of market interventions in the grain market of India and assesses the impact of the rice procurement and distribution policies on the economy of Andhra Pradesh.<sup>1</sup> A dual model has been formulated for analyzing price formation in the rice market of Andhra Pradesh. The model has been specified so as to assess the policy effects on the rice economy and on the welfare levels of consumers, divided into six expenditure classes. The first section analyzes the foodgrain price policy in



India and the next provides the specific details on its operations with respect to rice in Andhra Pradesh. The structure of the rice market in Andhra Pradesh is then analyzed in the following section, and the policy intervention effects in the last section.

## BACKGROUND OF PUBLIC INTERVENTION IN THE FOODGRAIN MARKET

### Evolution of Foodgrains Policy

Policy intervention in the foodgrain market was virtually absent till 1943 and free market forces were allowed to determine the prices of foodgrains. Both internal and external forces often placed the economy in crisis. The consequences of the crises were severe since the nutrition intake levels of the poor were low even in normal periods. Weak integration of sub-markets frustrated the market adjustments causing local foodgrain shortages even though there was no shortage at the global level. Disruption of imports and the internal transport system during World War II resulted in a near collapse of the free market system and led to the Bengal famine in 1943. The situation was further worsened by the restrictions imposed by the surplus provincial governments on the movements of foodgrains outside their jurisdictions. The Foodgrain Policy Committee of 1943 favored government intervention in the foodgrain market and suggested a system in which a central government agency would participate in the procurement and distribution of foodgrains parallel to the private trade. It assigned a major role to the central government in food management as it perceived potential conflicts of interest between surplus and deficit provinces in the procurement and distribution of foodgrains. The Committee also suggested a number of controls on private trade and the creation of a central reserve of foodgrains. The above suggestions were made on the premise that private trade would function efficiently in a normal period but in periods of drought and crop failure, the profit motive would lead them to hoard supplies and earn abnormal profits. The government introduced administrative controls, monopoly procurement and public distribution during 1943-1947. In the initial years, government activities were confined mainly to importing grains and distributing them through ration shops rather than procuring them from the domestic supply. Grain imports of 2 million tons (mt) per annum contributed a major share to the rationing requirements. Over the subsequent two decades, policies frequently shifted between loose and tight controls on the domestic grain market. The only durable policy was the control on grain imports which did not permit external trade on private account.<sup>2</sup>

During the early years after independence, the Foodgrain Policy Committee of 1947, influenced partly by the prevailing political preferences for liberal policies and partly by the favorable grain supply position, recommended complete decontrol. The above recommendation was implemented in 1947 and was reversed a year later in the face of rising prices caused by grain shortages. There was a shift in the policy preference for tightening controls. In fact the Foodgrains Procurement Committee of 1950 recommended government monopoly over the trade in grains.

The cycle of decontrol and recontrol was again repeated in the mid-1950s. Two years of good harvest and low grain prices in the world market in the early 1950s had an impact on Indian policy: trade was liberalized from 1952 to 1955. Grain supply bottlenecks started showing up from 1955. Foodgrain production which stood at 72 million tons in 1954 declined to 69 million tons in 1956 and further to 67 million tons in 1958. The grain economy showed destabilizing tendencies and foodgrain prices rose by 11 per cent per annum during 1956-1958. Responding to the destabilizing situation, the government on one hand gave up the liberal policy on the domestic front by imposing tight controls on private trade and by increasing its involvement in the grain trade. On the other hand it allowed imports to increase. The above policy changes had no significant effect on the share of government supplies in total foodgrain availability: the ratio of government supplies to total grain availability was 8 per cent in 1951-1955, 5.8 per cent in 1956-1960 and 8.3 per cent in 1960-1965 (Table V.1). Similarly policy effects on procurement were also minimal: foodgrain procurement per annum averaged 2.2 million tons in 1951-1955, 0.8 million tons in 1956-1960 and 1.4 million tons in 1961-1965 (Table V.2). However, the policy shift from the goal of foodgrain self-sufficiency in favor of subsidized PL-480 wheat imports from the United States had an effect on imports. Foodgrain imports, which recorded a declining trend during 1951-1955, started rising from 1956. Total foodgrain imports per annum, which averaged 2.4 million tons per annum in 1950-1955 and 3.4 million tons in 1956-1960, rose to 5.1 million tons in 1960-1965. Wheat accounted for a major portion of grain imports and its share showed a rising trend. The share of wheat in foodgrain imports increased from 66 per cent in 1950-1955 to 85 per cent in 1956-1960 and 89 per cent in 1960-1965. Imported wheat and rice procured from the domestic supply were utilized for distribution in the cities. It may be emphasized that many economists did not favor PL-480 wheat imports as it was felt that its price-depressing effects would adversely affect the incentives of producers.

Heavy imports and good harvests in 1960-1962 stabilized grain prices. Policies were extended to include support prices for stabilizing farm incomes. However, the price stability was short-lived; grain prices rose again at an

Table V.1: Gross Output, Government Procurement, Net Availability and Government Supplies of all Foodgrains and Rice from 1951 to 1983 — All India

Calendar Years	Average Annual Gross Output (million tons)			Ratio of Procurement to Gross Output (per cent)			Average Annual Net Availability (million tons)			Average Annual Government Supplies (million tons)			Ratio of Government Supplies to Net Availability (per cent)	
	Food-grains	Rice	Total	Food-grains	Rice	Total	Food-grains	Rice	Total	Food-grains	Rice	Total	Food-grains	Rice
1951-55	63.09	25.06	2.19	1.51	3.47	6.04	57.59	23.58	4.64	NA	8.05	NA		
1956-60	72.87	29.85	0.79	0.63	1.08	2.09	66.82	28.00	3.84	1.06*	5.75	3.79*		
1961-65	83.02	35.97	1.45	1.20	1.74	3.33	77.86	33.87	6.45	1.78	8.29	5.25		
1966-70	87.03	35.77	5.67	3.18	6.52	8.88	81.86	33.24	11.14	3.38	13.61	10.16		
1971-75	103.02	41.63	8.03	3.60	7.80	8.65	93.16	38.36	10.17	3.38	10.92	8.80		
1976-80	120.04	47.89	11.79	5.43	9.82	11.33	104.27	43.34	11.55	4.31	11.07	9.95		
1981-83 (P)	130.41	51.12	14.65	6.95	11.23	13.60	114.99	47.79	14.67	7.28	12.76	15.22		

\* Refers to the average of the four year period, 1957-1960.

P Stands for provisional figures and NA for Not Available.

Source: Various issues of Bulletin on Food Statistics, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

Table V.2: Government Operations in Foodgrains and Rice Markets from 1951 to 1983 — All India (million tons)

Calendar Years	Annual Average of						Ratio of Opening stock to Gross Output		Ratio of Net Imports to Gross Output	
	Opening Stock <sup>1</sup>	Purchases <sup>2</sup>	Net Imports <sup>3</sup>	Total <sup>4</sup>	Government Supplies	Gross Output	Opening stock to Gross Output	Net Imports to Gross Output		
<b>FOODGRAINS</b>										
1951-55	1.43	2.19	2.42	6.04	4.64	63.09	2.27	3.84		
1956-60	0.94	0.79	3.43	5.16	3.84	72.87	1.30	4.71		
1961-65	2.20	1.45	5.07	8.72	6.45	83.02	2.65	6.10		
1966-70	2.94	5.67	6.40	15.01	11.14	87.03	3.38	7.36		
1971-75	4.60	8.03	3.56	16.19	10.17	103.02	4.47	3.45		
1976-80	15.86	11.79	-0.08	27.57	11.55	120.04	13.21	-0.06		
1981-83	12.00	14.65	2.09	28.74	14.67	130.41	9.20	1.60		
<b>RICE</b>										
1951-55	0.69	1.51	0.49	2.69	NA	25.06	2.77	1.97		
1956-60	0.42	0.63	0.49	1.54	1.06*	29.85	1.41	1.62		
1961-65	0.68	1.20	0.54	2.42	1.78	35.97	1.89	1.49		
1966-70	0.93	3.18	0.46	4.57	3.38	35.77	2.59	1.29		
1971-75	1.65	3.60	0.07	5.32	3.38	41.63	3.95	0.18		
1976-80	6.27	5.43	-0.14	11.56	4.31	47.89	13.09	-0.30		
1981-83	6.07	6.95	-0.13	12.89	7.28	51.12	11.87	-0.24		

\* Refers to the average of the four year period, 1957-1960.

Note: 1/ + 2/ + 3/ = 4/

Source: Various issues of Bulletin on Food Statistics, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

annual rate of 17 per cent during 1963-1967. In fact, grain prices increased by 27 per cent in 1964. The phenomenal increase in grain prices hurt the poorer sections. This called for a long term foodgrain policy. It was realized that if controls are to be successful, adequate preparations before enforcement are necessary and the state must build up sizeable stocks of grain. It was also accepted that no government can afford to ignore the food requirements issue.

Foodgrain policy mainly comprised short term measures recommended by ad hoc committees prior to 1965. Because of frequent policy changes like loose and tight controls on the foodgrain market, no permanent administrative structures could be built for implementing the policies. By 1965 strong political preferences existed for price stabilization, elimination of hunger and strong government involvement in grain markets to curb the speculative activities of traders.

The year 1965 can be taken as the point of departure for foodgrain policy. Single state zones were introduced for rice and restrictions were placed on grain movements out of surplus states. Restrictions were imposed even on movements out of surplus districts within a state. Policymakers felt that the zone policy would depress market prices in surplus states and hence would facilitate procurement operations. The central government started the practice of assigning procurement targets to each surplus state on the basis of an assessment of nationwide needs. The states chose their own procurement methods. The central government would sell foodgrains to state governments for their public distribution system (PDS) at concessional rates. The zone policy allowed the play of supply-demand factors in determining the open market price within each state given the policy parameters of the central and state governments. Perhaps the observed increase in the interstate price dispersion could be partly attributed to this policy.

The Food Corporation of India (FCI) was established in 1965 to secure a strategic and commanding position for the public sector in the foodgrain trade. The Corporation was expected to act as a countervailing force to the speculative activities of the private traders. The Government of India had also transferred the functions of procurement, storage and distribution to the Corporation heretofore performed by its department of food in several states. Since then, the Corporation has been undertaking the purchase, storage, movement and distribution of food at the national level. It has also been handling all imported grain and its distribution.

The Foodgrain Policy Committee of 1967 suggested the contents of an integrated food policy to ensure equitable distribution at reasonable prices. The Committee expressed concern about PL-480 wheat imports acting as a disincentive to producers and favored self-reliance. It was suggested that an internal buffer stock of at least 4 million tons be built initially from

imports in order to stabilize foodgrain availability and prices. The above suggestions influenced subsequent policy formulation.

Over the years, the role of government and its agencies in procurement and public distribution has also expanded. Annual procurement has gone up to 15-18 million tons, which accounts for more than 10 per cent of foodgrain production and 25 per cent of the marketed surplus. Public distribution has gone up from a range of 8 to 11 million tons in the 1970s to about 13 to 16 million tons in the 1980s. It is to be emphasized that the PDS covers mainly urban areas and leaves out rural areas except in some states such as Kerala and Andhra Pradesh.

Implementation of policies for achieving national foodgrain self-sufficiency, price stabilization and supply of foodgrains to the poor at affordable prices has resulted in a variety of subsidies. The major ones include: food, fertilizer, irrigation and electricity. The central government expenditure on subsidies has increased phenomenally since the mid-1970s (Table V.3). In 1985/86, the central government incurred an expenditure of Rs. 16,500 million on food subsidy and Rs. 20,500 million on fertilizer subsidy; and these two together accounted for 6.8 per cent of the central government's expenditure. The food and fertilizer subsidies also account for 75 per cent of central government subsidies.

### **Foodgrain Market Intervention in India**

*Overview.* A policy of extensive government intervention exists and a fairly self-sufficient infrastructure has been built to administer the policy. In general terms, the central feature is that a specified portion of grain output from producers or traders must be sold to the government at a procurement price fixed by the government on the basis of the yearly recommendations made by the Agricultural Price Commission (APC), recently renamed the Bureau of Agricultural Costs and Price (BACP). The recommendations of the BACP are influenced by factors like cost of production, the previous year's open market price and the size of the harvest. Procurement policy is implemented by the Food Corporation of India (FCI) with help from the states. State governments can choose the procurement mode (producer levy/trader levy or pre-emptive purchase) and with or without zoning and can change the price offered to farmers if they consider such a price change is desirable. In periods of good harvest, the government is prepared to buy whatever quantities are offered by farmers. Much of the procured output will be supplied to the states at an issue price for meeting their public distribution commitments and a part of the procured output is used for building buffer stocks. A fairly extended public distribution network exists to distribute foodgrains at subsidized prices. The PDS in practice

Table V.3: Central Government Food and Fertilizer Subsidies  
(Rs. in millions)

Year	Central Government Expenditure on			Total Subsidies	% of Food and Fertilizer Subsidies in Central Government Expenditure	% of Food and Fertilizer Subsidies in Total Subsidies
	Food Subsidy	Fertilizer Subsidy	Food Subsidy + Fertilizer Subsidy			
1971/72	470	NA	470	1,400	0.70	34
1972/73	1,170	NA	1,170	2,050	1.49	57
1973/74	2,510	NA	2,510	3,610	3.09	70
1974/75	2,950	NA	2,950	4,190	3.01	70
1975/76	2,500	NA	2,500	4,700	2.08	53
1976/77	5,060	600	5,660	9,470	4.30	60
1977/78	4,800	2,600	7,460	12,870	4.98	58
1978/79	5,700	3,420	9,120	14,750	5.15	62
1979/80	6,000	6,030	12,030	18,210	6.50	66
1980/81	6,500	5,050	11,550	19,120	5.13	60
1981/82	7,000	3,750	10,750	19,460	4.23	55
1982/83	7,100	6,050	13,150	23,040	4.31	57
1983/84	8,350	10,480	18,830	28,910	5.23	65
1984/85	11,000	18,320	29,320	44,220	6.68	66
1985/86	16,500	20,500	37,000	49,210	6.81	75

Sources: Various issues of Indian Economic Statistics, Department of Economics, Ministry of Finance, Government of India, Statistics Central Budget for 1985/86, 1986/87.

Note: Data on fertilizer subsidy prior to 1976/77 are not available and hence expenditure on total subsidies do not include fertilizer subsidy.

is very complex and varies between states. The commitment to the public distribution system in some states, such as Andhra Pradesh, is more than the quota received from the central pool. The additional requirements are met by state procurement.

*Policy goals and policy instruments.* The agricultural policy goals spelt out in official documents can be grouped under the following headings:

- Self-sufficiency in foodgrains
- Reduction of hunger among the poor
- Availability of foodgrains to consumers at reasonable prices
- Equitable distribution of foodgrains between regions
- Price stability
- Adequate returns to farmers

It has been much easier to reach an agreement on the policy goals of national self-sufficiency and reduction of hunger among the poor than to reach an agreement on other goals. Over the years, the objectives outlined above have figured in policy documents but their relative emphasis has been changing with the prevailing economic situation. Policymakers have to reconcile the conflicting interests of various socioeconomic groups and regions in their policy formulations, and this sets limits to policy goals and restricts the choice of policy instruments. For instance, in the formulation of the inter-regional equity goal policymakers cannot ignore the reality of federal relations. Central government intervention in the foodgrain trade is desired for fulfilling most of the objectives. In India, very few states are surplus in grains; the majority are grain deficit states. In the absence of intervention by the central government, the surplus states may monopolize the grains trade and take advantage of the situation. Similarly, government expenditure incurred on subsidies of essential commodities supplied to the poor may cut development expenditure. Subsidies are inevitable, even if there is high growth, since this is unlikely to raise the incomes of a vast majority of the poor substantially within a short period.

The following are the important instruments used in India to realize the policy goals:

- Support, procurement and issue prices
- Procurement and public distribution of foodgrains
- Controls on internal trade
- Buffer stock operations
- Imports

*Support, procurement and issue prices.* The Agricultural Price Commission recommends procurement prices every year, based on its price policy,

and thus strikes a balance between the interests of producers and consumers. It is generally agreed that the procurement price should be as close as possible to the long term equilibrium price that would prevail in the absence of government intervention. Hence, it should cover the full costs of production including the imputed value of family labor. Although in theory it is possible to define the long term equilibrium price in a precise manner, there are numerous problems in estimating it. In a country as large and heterogeneous as India, the cost of production varies between regions and between categories of farmers, and this limits the use of cost as a guide to national policymaking. For instance, it is striking to note the cost differences between the technologically more advanced Punjab state and the other states. The cost per ton of paddy is lower by around 30 per cent in Punjab than in Andhra Pradesh because of higher yields in Punjab (Subba Rao 1982).

In the last 15 years there has been a spurt in the production of wheat and rice in some of the northern states. Among the southern states there is a spurt in production of rice in Andhra Pradesh. This has resulted in concentrations of surpluses in a few states. This has compelled the government to go in for very large-scale purchases under the price support policy to avoid a crash in prices which would act as a disincentive to producers. The producers in the surplus states voluntarily supply the grain at the minimum support price while in deficit states government machinery has to play an active role in procuring grains. Consequently, in surplus districts the quantity purchased by the government will be more than their procurement targets. It is observed that in the recent past a major portion of the procured quantity has been voluntarily supplied by the producers of the surplus districts. Prior to 1973/74, the government differentiated between support and procurement prices but discontinued it thereafter. The Agricultural Price Commission announces the procurement prices at the time of sowing and revises them at the time of harvest.

The Agricultural Price Commission's recommendations on the level of procurement prices are published in its reports issued twice a year. The Minister of Agriculture and the other members of the Cabinet and the states' Chief Ministers discuss the recommendations and arrive at the prices to be implemented. The procurement prices are closer to those demanded by the Chief Ministers who represent the interests of rich farmers producing surpluses (Alain de Janvry and K. Subba Rao, 1983). As a result, the procurement prices for wheat and rice are generally higher than those recommended by the Commission. (Raj Krishna and Raychaudhuri 1980).

*Procurement agencies and methods.* There are two procurement agencies in each state: FCI (an agency of the central government) and the state government agency. The state governments are free to choose procurement arrangements which will be adopted by the FCI and also to purchase

additional quantities of grains. Hence there is no uniformity in the procurement methods among the states. In general, the predominantly adopted procurement methods in the past include purchases from the open market and compulsory levies on traders/millers. Government agencies have been purchasing large quantities of wheat from the open market in northern states. A major advantage of this method is that procurement costs incurred by the government are lower compared to other methods. However, the method is effective only when the crop is very good. In the periods of crop failure, the government is generally late in perceiving the situation and the private traders who operate close to the producing areas will buy large quantities immediately after the harvest.

A levy on traders/millers is the most popular method of procurement. In this system the trader/miller shares a portion of his grains with the government at a fixed price — the share is being decided by the government taking into consideration the size of the marketable surplus, open market prices, the grain stocks carried over from the previous year and the commitments of the public distribution system. The government takes a fixed proportion of the supplies passing through the trader/miller at fixed prices and the balance is allowed to be sold to anyone at any price he likes. The trader/miller himself decides what price he has to pay to the farmer in the market.

*Public Distribution System (PDS).* The Public Distribution System (PDS) has three major components: Issue Price, Quantity Issued and Coverage of PDS. The issue price is fixed at two stages. The central government issues grain from the central pool to the states, at a uniform price for all states. The state government adds sales tax, price equalization fund, different surcharges and an additional subsidy to arrive at the sale price in the ration shop, i.e. the price at which grain is supplied to consumers through fair price shops (FPS) and ration shops. The sale price in ration shops varies among states due to inter-state differences in tax rates and retail distribution costs. It is lower than the free market price. Generally, the sale price in ration shops in a deficit state is substantially lower than its open market retail price. The issue price fixed by the central government is lower than the government's cost (Table V.4).

The quantity distributed by central government for PDS during 1981-1983 formed 13 per cent of the domestic net availability of foodgrains and 15 per cent of net availability of rice (Table V.1). Some limitations of the PDS have often been mentioned. While the public distribution system has been able to meet the requirements of the urban population to some extent, it has not succeeded in covering the rural poor. Moreover, some of the poorest sections of the urban population have also not been covered.

Table V.4: Issue Price and Cost per Ton of Rice Incurred by FCI  
(Rs. per ton)

Issue Prices and Costs	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
1. Procurement Price of Rice	1,715	1,968	2,079	2,236	2,337	2,416
2. Procurement Cost of Rice	100	95	99	111	173	152
3. Border Price (CIF)	2,050	2,260	2,036	2,454	NA	NA
4. Cost of Public Distribution	290	379	439	469	519	532
5. Total Cost (1+2+4)	2,106	2,442	2,617	2,816	3,029	3,100
6. Issue Price	1,620- 1,770	1,870	2,000	2,000- 2,280	2,200- 2,290	2,290- 2,430
7. Central Government Subsidy	340	429	534	667	749	773

Source: Annual Reports of FCI and Monthly Statistics of the Foreign Trade of India.

*Government stock operations.* The government utilizes stock operation as a policy instrument to even out the effects of fluctuations in agricultural production. Normally inventory operations carried out by private traders are likely to smoothen the impact of fluctuating production on availability of foodgrain and its price. But past evidence shows the ineffectiveness of private trade to even out the fluctuations. Numerous government committees have suggested that government operations of stock should protect the interests of producers and consumers.

The FCI acts as the government agency for handling stocks. The stocks maintained by the Food Corporation of India can be divided into: (1) buffer stocks and (2) operational stocks. The operational stocks are intended to keep the public distribution system going in a manner which would smoothen the inter-regional and intra-seasonal price variations. The stocks with the FCI were around 16 million tons in 1985/86. The handling of stocks of this magnitude has its own problems. The FCI had a storage capacity of 12 million tons in 1985/86 and hence stocking over and above this capacity will force the FCI to hire some godowns. The carrying stock of buffer stocks is estimated to be Rs. 465 per ton in 1985/86 (Table V.5) which accounts for around 20 per cent of the rice procurement price. It is argued that FCI costs are higher than those incurred by cooperatives and private agencies due to administrative expenses (K. Subba Rao, 1978). It is also recognized

that the role of the FCI should not be evaluated on the basis of costs alone, since it is being used as a policy instrument to ensure inter-regional and interpersonal equity in foodgrain intake.

Table V.5: Cost of Carrying Buffer Stocks of FCI  
(Rs./ton)

Various Costs	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
Handling expenses	16	25	27	28	26	29
Storage charges	83	98	93	92	89	102
Interest	182	222	233	221	258	285
Administrative overheads	16	18	22	21	24	21
Storage shortages	43	53	47	37	22	27
Freight					7	
Transit shortages					2	
Total	340	416	422	399	428	464

Source: Annual Reports of Food Corporation of India (FCI).

There is some ambiguity about the exact quantum of stocks needed for the purpose of buffer stocking. Targets recommended by the various government committees have varied from 1 million tons (Foodgrains Policy Committee of 1948) to 12 million tons (Technical Group of the Department of Food, 1975/76). In addition, they have recommended 4 million tons of grains for operational stocks (Technical Group of the Department of Food, 1975/76). Thus they have suggested a stock of around 16 million tons of foodgrain. However, the above targets have been mostly inoperative. The actual amount stocked has no relation to policy recommendations and has been influenced by domestic production and imports. It appears that most of the committees have rationalized the actual stocks as desirable stocks.

*Import policy.* The acceptance of national self-sufficiency as a major policy goal has made the role of imports less important. There has been appreciable reduction in the absolute and the relative size of imports

during the last three decades (Table V.2). The use of imports as an alternative to buffer stocks has recently been suggested by a few policy analysts. However, the price advantage has not been compared with the storage costs. It should be recognized that although the border price is low, foreign exchange shortages may not permit sizeable imports. Besides, without making corrections for distortions in other markets, any grain liberalization may adversely affect the incentives of the producers. Dependency on a border price which is not free from uncertainties may also give rise to destabilization tendencies.

## MARKET INTERVENTION IN THE FOODGRAIN MARKET OF ANDHRA PRADESH

### Overview

Andhra Pradesh is one of the major rice surplus states in India. Its production of rice in 1985/86 is estimated around 9.4 million tons, of which 2-3 million tons are exported by public and private agencies. Although there are no firm estimates on the magnitude of interstate trade in rice, the share of Andhra Pradesh in the total volume of rice trade can be taken as 15-20 per cent. Exports by private traders are mostly to four states viz., Kerala, Tamil Nadu, Maharashtra and West Bengal, where rice prices are higher than the open market price in Andhra Pradesh. The total quantum of exports by private agencies is influenced by the open market prices prevailing in the other states. Field investigations have revealed that the market signals are very effective in influencing rice millers/traders with regard to the choice of external markets.<sup>4</sup>

Central and state governments' intervention in input and output markets of the state's rice economy is widespread. Intervention in the input market takes the form of a fertilizer price subsidy provided by the central government and an indirect subsidy on electricity and water given by the state government. The latter two subsidies arise as their tariff rates are lower than their costs. Intervention in the product market takes the form of procurement, movement, storage and distribution of rice by central and state government agencies. In 1985/86, FCI (central government agency) procured from millers 1.6 million tons at procurement prices ranging from Rs. 2,353-2,479 per ton depending on the quality and issued 1.1 million tons to the state government for its PDS at issue prices ranging from Rs. 2,170-2,850 per ton depending on the quality. The balance is retained for the central pool. In 1985/86 the Andhra Pradesh State Civil Supplies Corporation (APSCSC) procured from millers 0.8 million tons at negotiated

prices ranging between Rs. 2,433 and 2,559 per ton. The state government distributes rice at subsidized prices to economically weaker sections under its two-rupees-a-kilo rice scheme.

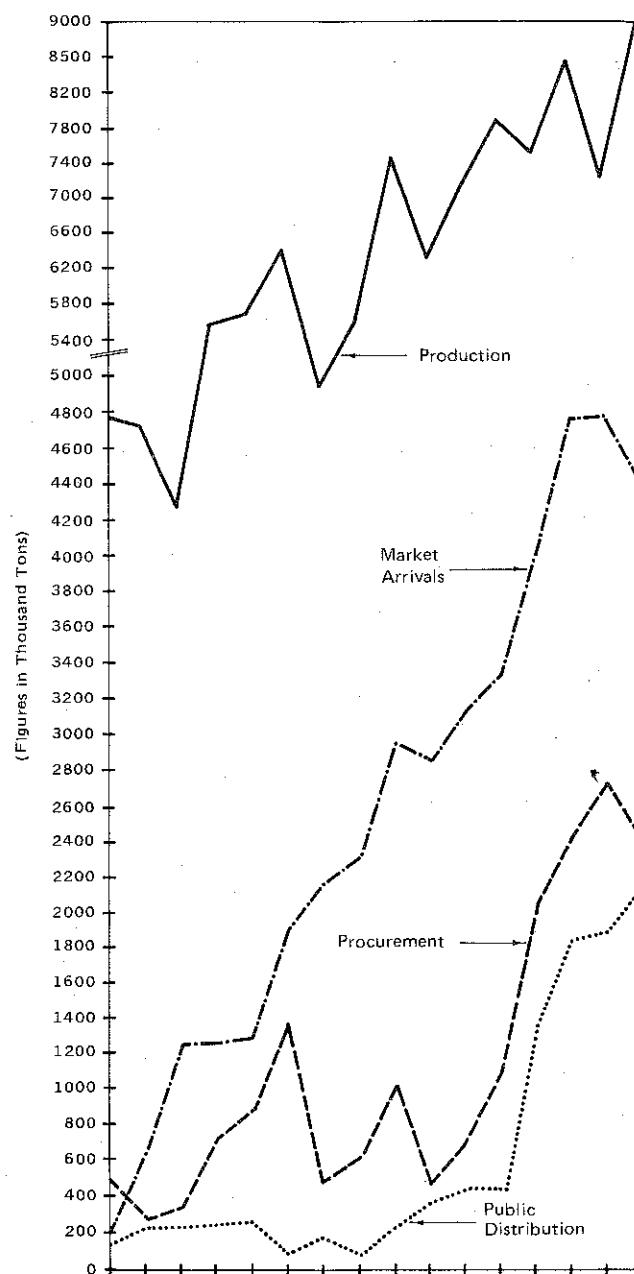
### Procurement of Rice (Mechanisms, Volume and Prices).

The Government of Andhra Pradesh introduced a compulsory levy on producers for the first time in 1965/66 and entrusted the Food Corporation of India with the responsibility of undertaking procurement directly from producers. Soon after the introduction, several alterations were made during 1965/66 in the producers' levy scheme. The scheme was abandoned after a trial of barely four months. Neither of the objectives of the scheme could be fulfilled nor could the procurement target be realized. The main reason for the failure of this scheme was that there was no advance preparation for its implementation.

In 1968/69, the Government of Andhra Pradesh imposed a compulsory levy on all traditional sheller and huller-cum-sheller mills as well as modern rice mills operating in the private and cooperative sectors.<sup>5</sup> All the huller mills and some of the non-trading huller-cum-sheller mills were excluded from the purview of the compulsory levy. The exact proportion of the levy varied from time to time, depending on the public procurement target and crop situation in a particular year. The procurement policy in 1985/86 was that the millers were required to give one unit to the FCI as a levy and half a unit to the Andhra Pradesh Civil Supplies Corporation Ltd (APSCSC), at a negotiated price. Only then were they permitted to sell half a unit of levy-free rice within the state and one unit anywhere in the country.<sup>6</sup> So far as cooperatives are concerned, the mill levy was 25 per cent and they were eligible for 75 per cent of levy-free sales. The cooperatives who did not wish to avail this facility, could sell to the APSCSC at the negotiated price.

Trends in procurement, procurement-output ratio, and procurement-market arrivals ratio are tabulated in Table V.6. It can be seen that the procurement has risen from a very modest level of 0.3-0.5 million tons, accounting for hardly 6-10 per cent of the rice output in 1970-1973 to a large amount of 2.4-2.7 million tons, accounting for 28-40 per cent of production in 1983-1986 (Figure V.1). The extent of procurement in the early 1980s was substantially higher than that of all India. There was a phenomenal jump in the quantity of procurement in 1982-83 on account of the introduction of a new welfare scheme. It is worth observing that the recent addition to rice procurement is mainly accounted for by the APSCSC. FCI and APSCSC together purchased 50-60 per cent of the volume of rice entering the regulated markets in 1982-1986.

Figure V.1: Production, Procurement, Public Distribution and Market Arrivals During 1970-1986



It can be hypothesized that the volume of rice procurement ( $q_p$ ) depends on level of rice output ( $q$ ) and the level of procurement price ( $p_p$ ) in relation to the open market price ( $p_M$ ). The two-rupees-a-kilo rice scheme might have influenced the procurement in 1982-1986. The following equation has been estimated for 1970-1971 to 1985-1986.

$$q_p = -421 + 0.18q - 54.23 \left(\frac{p_p}{p_M}\right) + 1356 D$$

(2.26)      (0.05)      (6.35)

$$R^2 = 0.90$$

$$DW = 1.66$$

D = Dummy, 0 for 1970/71 to 1981/82, and 1 thereafter.

(Figures in brackets are t-ratios.  $q_p$  and  $q$  are measures in '000 tons)

The equation fares well and the estimated coefficients have expected signs. The coefficient of price ratio is not significant and the coefficients of output and period Dummy are highly significant. It can be inferred from the estimated equations that 1 mt additional production of rice results in 0.18 mt of procurement. The procurement-output elasticity is therefore about three. As expected the two-rupee-a-kilo rice scheme has a significant effect on procurement; it resulted in an additional procurement of 1.36 mt.

Time series data on procurement prices fixed by the central government are presented in Table V.6. It shows that procurement price as a ratio of wholesale price in the open market varies between 0.6 to 0.86; and generally lower values were found in years in which rice production levels were low. Usually, the procurement price is lower than the full cost of production including the imputed value of family resources. Consequently state governments offer additional (bonus) amounts to make the procurement price attractive to producers. Raj Krishna and Raychaudhuri (1980) estimated the additional benefit offered by the Government of Andhra Pradesh as 3 per cent of the procurement price during 1966/67 to 1976/77. However, this practice of giving a bonus is not currently in vogue.

The APSCSC purchases from rice millers additional requirements of nearly 1 mt over and above the quantities supplied by the FCI for its PDS at a negotiated price. Procurement price is taken as the basis while determining the negotiated price. In addition, the APSCSC takes into consideration the available information on anticipated production of foodgrain and the price situation. Based on these two, the APSCSC, usually in the first week of October every year, prepares proposals for purchase of rice during both kharif and rabi seasons and places them before the state government; the Sub-Committee of the Cabinet then convenes a meeting of all the representatives of millers in the state for the purpose of negotiating the price.



The negotiated price is fixed by the government based on the consensus at the meeting. Usually the miller would agree to the following arrangement:

- (i) one unit of rice to be supplied to FCI at the procurement price fixed for that year;
- (ii) half a unit of rice to be supplied to the APSCSC at the negotiated price;
- (iii) subject to (i) and (ii), the District Collector permits the miller to sell half a unit of rice within the state at any price; and
- (iv) one unit of rice within the country at any price.

Table V.6: Procurement and Prices of Rice in Andhra Pradesh

Year	Volume of procurement (million tons)	Proportion of procurement to gross output (%)	Procurement price <sup>1</sup>	Procurement price as a % of wholesale price <sup>2</sup>
1970/71	0.47	9.81	940.5	85.76
1971/72	0.27	5.72	940.5	77.82
1972/73	0.33	7.75	971.0	63.67
1973/74	0.70	12.54	1,199.9	71.08
1974/75	0.89	15.61	1,311.1	61.84
1975/76	1.38	21.40	1,360.0	83.01
1976/77	0.48	9.74	1,380.0	79.51
1977/78	0.61	11.51	1,380.0	79.10
1978/79	1.04	14.00	1,500.0	90.36
1979/80	0.47	7.45	1,562.5	85.32
1980/81	0.70	9.99	1,715.0	78.27
1981/82	1.10	13.98	1,968.0	80.52
1982/83	2.00	26.08	2,078.5	79.96
1983/84	2.42	27.53	2,236.0	79.82
1984/85	2.74	37.95	2,337.0	84.52
1985/86	2.48	28.29	2,416.0	80.86

1 Refers to procurement of Fine variety.

2 Wholesale prices are weighted prices of Sort I and Sort II varieties of rice taken in the ratio of 32:68.

Sources:

1. Various issues of season and crop reports, Bureau of Economics and Statistics, Government of Andhra Pradesh.
2. Annual Reports of FCI.
3. Various issues of Bulletin on Food Statistics, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

The state government has no direct control over the price at which the miller sells one and a half units of rice within and outside the state, but it indirectly influences the level of demand through the ration shops. The negotiated price and its basis of fixation vary from year to year. It is usually a little higher than the procurement price but very much lower than the open market price. For instance, the negotiated prices per ton of rice fixed for the year 1984/85 was Rs. 100 and for 1985/86 was Rs. 80 higher than procurement prices for all varieties of rice. The following shows the procurement price and the negotiated price of rice for the year 1985/86:

Variety	Procurement Price (Rs./ton)	Negotiated Price (Rs./ton)
Common	2353	2433
Fine	2416	2496
Superfine	2479	2559

Public Distribution System in Andhra Pradesh

Time series data on the quantity of rice supplied by the government under PDS in Andhra Pradesh are presented in Table V.7. The table shows that the quantity distributed under the PDS was at a low level till 1977/78.

Table V.7: Government Supplies and Domestic Consumption of Rice in Andhra Pradesh

Year	Government Supply (million tons)	Domestic Consumption (million tons)	Ratio of Government Supply to Consumption (%)
1970/71	0.12		
1971/72	0.23	4.78	4.81
1972/73	0.23	4.50	5.11
1973/74	0.24	5.27	4.55
1974/75	0.25		
1975/76	0.08		
1976/77	0.17		
1977/78	0.08	6.57	1.22
1978/79	0.23		
1979/80	0.37		
1980/81	0.42		
1981/82	0.44		
1982/83	1.37		
1983/84	1.87		
1984/85	1.89		
1985/86	2.15	7.46	28.86

Sources: For Government Supplies: Bulletin of Food Statistics and Andhra Pradesh State Civil Supplies Corporation. Domestic Consumption: Estimated from National Sample Survey Reports.

In 1978, the share of government supplies in domestic consumption was 1.22 per cent. This was followed by a steady rise in government supplies interrupted by a marked step in 1982-83. In 1985/86, the ratio of government supplies to domestic consumption of rice rose to 28.86 per cent. The sudden increase in government supplies is due to the introduction of the two-rupee-a-kilo rice scheme in December 1982. It is useful to discuss in detail the new scheme.

The two-rupee-a-kilo scheme is applicable to families with annual income of less than Rs. 6,000. These families have been categorized as 'green card holders', and the rest as 'yellow card holders'. The scheme provides 5 kg per month per person subject to a ceiling of 25 kgs per month per family. This is done through a network of 232,063 fair price shops covering 27,221 villages and towns. In 1984/85 nearly 13.3 million households comprising 70 per cent of the total households were covered by the scheme. The state government also assists the rest of the population by making rice available through Fair Price Shops to households having annual income of more than Rs. 6,000 at Rs. 2.65 to 2.70 per kg. The following illustrates the magnitude of distribution, and the breakdown by income of the scheme:

Number of cards in circulation in 1985 (families in millions)	Urban	Rural	Total
a) Green card holders (families having annual income of Rs. 6000/- and below)	214	803	1,017
b) Yellow card holders (families having annual income above Rs. 6000/- per annum)	138	175	313
c) Total card holders	352	978	1330

The total requirement of rice to be supplied through the public distribution system in Andhra Pradesh was nearly 2 million tons per annum in 1984/85. Against this requirement, 1.0 million tons was available from the central pool and 1.0 million tons was purchased by the APSCSC from millers at negotiated prices. On account of the scheme, in addition to the

expenditure incurred by the FCI in providing 1 million tons at subsidized prices to the state government, the state government spent Rs. 958 millions in 1983/84, Rs. 1,371 millions in 1984/85 and Rs. 1,317 millions in 1985/86.<sup>7</sup> The price of rice at various levels under PDS in Andhra Pradesh is shown in Table V.8.

Table V.8: **Prices of Rice at Various Levels under PDS in Andhra Pradesh: 1986/87 (Rs/Ton)**

Levels	Common	Fine	Super Fine
I. FCI Issue Price	2,390.0	2,510.0	2,660.0
II. APSCS Issue Price to FPS <sup>1</sup>			
Urban Dealers	1,884.3		
— Rural <sup>2</sup>	1,926.2		
III. FPS Issue Price to:			
a) Green card holders <sup>3</sup>	2,000.0	2,000.0	2,000.0
b) Yellow card holders <sup>4</sup> of			
1. Hyderabad	2,650.0	2,650.0	2,650.0
2. Vijayawada, and Visakhapatnam	2,750.0	2,750.0	2,750.0

Source: Andhra Pradesh State Civil Supplies Corporation.

Note: FPS: 1. Fair Price Shops

2. Door Delivery

3. Families with annual income less than Rs. 6,000.

4. Families with annual income more than Rs. 6,000.

### Subsidies

*Rice Subsidy.* The central government gives a subsidy on rice to the Food Corporation of India (FCI) which in turn passes it on to consumers. The extent of the central subsidy accruing to the people of Andhra Pradesh depends on the quantum of rice allotted to Andhra Pradesh from the central pool and the rate of subsidy per ton. Since direct estimates on the extent of the central subsidy accruing to Andhra Pradesh are not available, they have been estimated using:

$$SRA_t = RA_t \times SR_t$$

Where RA = quantum of rice allotted to Andhra Pradesh from the central pool;  
 SR = subsidy per quintal of rice;  
 SRA = amount of subsidy accruing to Andhra Pradesh, and  
 t = time

The estimates are given in Table V.9. The extent of the central subsidy on rice accruing to Andhra Pradesh increased from Rs. 125 millions in 1980/81 to Rs. 780 millions in 1985/86, registering a compound growth rate of 44 per cent. The volume of rice issued increased at an annual rate of 22 per cent while the rate of increase in the per quintal subsidy is 18 per cent per annum.

Table V.9: **Rice Subsidy (Central and State Governments):**  
1980/81 to 1985/86

Year	Central Government			State Government subsidy (Rs. in millions)	Total Food subsidy (Rs. in millions)
	Subsidy per ton (in Rs.)	Quantity distributed through PDS ('000 tons)	Total subsidy (Rs. in millions)		
1980/81	340	368	125		125
1981/82	429	417	179		179
1982/83	534	436	233	40	273
1983/84	667	1,103	736	958	1,694
1984/85	749	1,008	755	1,371	2,126
1985/86	773	1,009	780	1,317	2,097

Note: Quantities distributed through PDS are provided for calendar years.

Sources: Column 2 : Various Annual Reports of Food Corporation of India, New Delhi.

Column 3 : APSCSC

Column 5 : Various Annual Budget Reports of the Government of Andhra Pradesh.

In addition to the central subsidy, the Andhra Pradesh government gives a rice subsidy to the Andhra Pradesh Civil Supplies Corporation which

in turn passes it on to consumers. Irrespective of the costs involved in procurement, distribution etc., the Corporation sells rice to consumers (green card holders) at a fixed rate of Rs. 2 per kg. The difference between costs involved and realized value is borne by the Government of Andhra Pradesh. The state government spent Rs. 1,371 millions in 1984/85 and Rs. 1,317 millions in 1985/86.

A figure of Rs. 2097 millions is obtained for 1985/86 by adding the central and state governments' expenditures on the rice subsidy which works out to be Rs. 1,108 per ton. Only at the price of Rs. 3,108 per ton could the Public Distribution System have supplied rice without any subsidy. This price is slightly higher by Rs. 88 per ton than the open market price in Andhra Pradesh (Rs. 3,020) but lower by Rs. 342 per ton than the export price (Rs. 3,450).

*Fertilizer subsidy.* A fertilizer subsidy is given by the central government. In the absence of data on the rate of subsidy for different varieties of fertilizers, the extent of the central subsidy accruing to Andhra Pradesh has been estimated using the function:

$$SFA_t = SF_t \times \frac{FA_t}{F_t}$$

Where SF = total fertilizer subsidy given by the central government;

FA = consumption of fertilizers in Andhra Pradesh;

F = total consumption of fertilizers in India, and

SFA = amount of subsidy accruing to Andhra Pradesh.

The estimates are presented in Table V.10. The Table shows that the fertilizer subsidy accruing to Andhra Pradesh has substantially increased from Rs. 530 million in 1980/81 to Rs. 2,460 million in 1985/86. The price advantage due to fertilizer subsidy accruing to rice producers is also shown in the same table. The price advantage increased from 4 per cent in 1976/77 to 33 per cent in 1984/85.

Table V.10: Fertilizer Subsidy in Andhra Pradesh

Year	Extent of <sup>1</sup> Fertilizer Subsidy Accruing to Andhra Pradesh (Rs. in million)	Estimated <sup>2</sup> Fertilizer Subsidy per Hectare of Area Under Rice (in Rs.)	Average Price of Fertilizer		
			With Subsidy (Rs./kg)	Without <sup>3</sup> Subsidy (Rs./kg)	Percentage difference
1976/77	71	13.07	4.04	4.22	4.26
1977/78	324	58.27	3.71	4.33	14.31
1978/79	404	60.59	3.47	4.13	15.98
1979/80	514	93.78	3.84	4.33	22.86
1980/81	528	94.75	4.46	5.38	17.10
1981/82	405	66.76	5.19	5.81	10.67
1982/83	655	109.96	5.41	6.35	14.80
1983/84	1,235	189.08	5.05	6.41	21.21
1984/85	2,460	550.32	4.97	7.48	33.55

Notes: 1. Worked out on the basis of proportion of fertilizer consumption in Andhra Pradesh to total consumption of fertilizer in India.  
 2. Assumptions used are: (a) that fertilizer is used only for irrigated crops, (b) fertilizer consumption is distributed according to the proportion of irrigated area under different crops.  
 3. Weighted average price of ammonium sulphate, urea, calcium ammonium nitrate, ammonium phosphate, single super phosphate and muriate of potash. Weight is based on the share of each type of fertilizer in the total supply.

## RICE MARKETING IN ANDHRA PRADESH

### Rice Marketing Channels

A chain of intermediaries perform the task of collecting paddy from the widely scattered producers and also take care of activities like processing, storing and transporting it to ultimate consumers. The markets are characterized by the participation of private, cooperative and public (FCI and APSCSC) marketing agencies. The cooperative marketing and processing societies function as competitors to private trade and thus protect the interests of growers. While cooperative marketing of rice is dormant in Andhra Pradesh, the other two agencies dominate the paddy/rice trade.

The estimates compiled by V.T. Raju (1976) on market surplus of rice in Andhra Pradesh show that 60 per cent of paddy output is sold by the farmers, retaining 20 per cent for home consumption, and the remaining 20 per cent is meant for seeds and for payment of wages and rent in kind. Subba Rao (1978) estimates that 30 to 70 per cent of paddy sales (the proportion depending on the region) take place in the village itself. The rest of the marketed surplus is sold by the farmers to millers and wholesale traders. In all, there are three types of transactions between producers and millers:

- Producer sells his produce at the market yard through a commission agent either in open auction or in a tender system.
- Producer sells directly at the premises of the mill.
- Producer sells through his village broker. In this case the buyer has to transport the produce from the village.

Trading rice millers purchase paddy either at the market yard or directly from the producers and process it and dispose of the rice. In our field study in 1985/86, it was observed that the millers sold rice through four channels in the following proportions:

- 37 per cent was contributed to the FCI under the Central Government Levy Scheme at the procurement price of Rs. 2,280 per ton of raw rice and Rs. 2,430 per ton of parboiled rice.<sup>8</sup>
- 18 per cent was contributed to the Andhra Pradesh State Civil Supplies Corporation at the negotiated price of Rs. 2,420 per ton of raw rice.
- 12 per cent was sold in the domestic open market within Andhra Pradesh at a price of Rs. 3,020 per ton.
- 33 per cent was sold in open market outside the State of Andhra Pradesh at an average price of Rs. 3,390 per ton for raw rice and Rs. 3,600 per ton of parboiled rice. This portion of raw/parboiled rice was sold mainly in the states of Tamil Nadu, Kerala, Maharashtra and West Bengal. Millers normally sell to big wholesale traders of rice through brokers.

When a wholesaler purchases paddy from the producers, he processes it in the non-trading rice mills. The wholesalers, like trading rice millers,

have to contribute to the FCI and Civil Supplies Corporation. Wholesalers who fulfill all obligations get permits to sell rice in the open market within and outside the state. The role of wholesalers in surplus and deficit areas of the state differs. In surplus areas, the wholesaler purchases paddy, processes it in the non-trading rice mills, and sells directly to the retailer within that market. Wholesalers in deficit areas purchase rice from the trading millers of surplus areas and supply rice to the deficit market.

The various combinations of middlemen linking the producer with the ultimate consumer constitute several marketing channels (Chart V.1). The presence of large numbers of traders/wholesalers, the participation of public marketing agencies, and the observance of market regulations appears to give rise to near competitive conditions in the private paddy/rice markets of Andhra Pradesh.

*Market regulation and market arrivals.* Andhra Pradesh is one of the few states with a good coverage of regulated markets. All transactions within a radius of 20 kms from the market yard come under the purview of the regulated market.

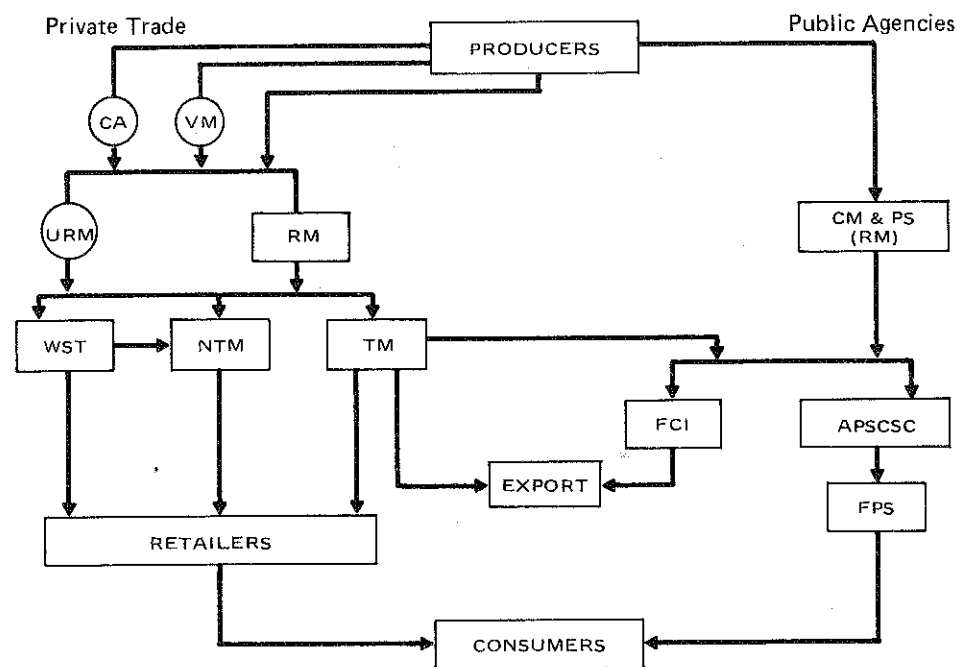
In order to ensure effective implementation of regulatory measures, agricultural marketing committees (AMC) are constituted with representatives of farmers, traders, officials and non-officials. The data on the number of regulated markets and agricultural marketing committees in Andhra Pradesh, during 1970/71 to 1986/87 are furnished in Table V.11. It can be seen that the number of regulated markets have more than doubled and the number of markets per marketing committee increased from 2.7 in 1970/71 to 3.5 in 1986/87. This also indicates the increase in the activities of agricultural marketing committees.

One of the consequences of enlarging the regulation network is the increase in market arrivals. Table V.12 gives the data on production and arrivals of rice in regulated markets in the state from 1970 to 1986. It is evident from the table that while production has hardly doubled, the market arrivals have almost trebled. The percentage of output marketed increased over time and is about 50 per cent in 1985/86. The phenomenal increase during 1982-1986 could be due to the government policy of increased public distribution. The assured supply of rice to the rural population through the public distribution system (PDS) might have led to this steep rise in market arrivals. It is interesting to note that the share of market arrivals in output increased in 1984/85 even though it was agriculturally a bad year.

### Seasonality in Prices

Table V.13 presents the seasonal price indices computed from monthly data from April 1956 to August 1986 for wholesale prices of paddy and

Chart V.1: Major Rice Marketing Channels in Andhra Pradesh



CA : Commission Agent  
 VM : Village Merchant  
 URM : Unregulated Market  
 WST : Wholesale Trader  
 NTM : Non-Trading Mills  
 TM : Trading Mills

CM & PS : Co-operative Marketing and Processing Societies  
 FCI : Food Corporation of India  
 APSCSC : Andhra Pradesh State Civil Supplies Corporation  
 FPS : Fair Price Shops

Table V.11: Number of Agricultural Market Committees and Regulated Markets in Andhra Pradesh

Year	Number of Agricultural Market Committees	Regulated Markets
1970/71	103	277
1971/72	113	296
1972/73	114	308
1973/74	116	348
1974/75	116	348
1975/76	131	381
1976/77	196	477
1977/78	203	504
1978/79	203	536
1979/80	207	560
1980/81	211	569
1981/82	215	588
1982/83	218	591
1983/84	221	599
1984/85	230	599
1985/86	231	601
1986/87	233	810

Source: Directorate of Marketing, Hyderabad.

Table V.12: Rice Production and Market Arrivals in Andhra Pradesh ('000) tons

Year	Rice production	Rice market arrivals	% of market arrivals to production
1970/71	4,786	1,590	33
1971/72	4,717	1,308	27
1972/73	4,256	1,249	29
1973/74	5,583	1,256	22
1974/75	5,700	1,303	22
1975/76	6,541	1,888	29
1976/77	4,929	2,162	43
1977/78	5,604	2,319	41
1978/79	7,432	2,966	39
1979/80	6,304	2,847	45
1980/81	7,011	3,133	44
1981/82	7,868	3,370	42
1982/83	7,671	4,007	52
1983/84	8,567	4,765	56
1984/85	7,081*	4,571	65
1985/86	8,766*	4,425	50

\* Estimated from supply functions

Source: For market arrivals: Directorate of Marketing, Hyderabad.

rice, and from January 1969 to December 1985 for retail prices of rice.<sup>9</sup> The seasonal price movements are consistent with market arrivals: prices tend to fall in the post harvest period (October-February) and rise in the lean period (Figure V.2). The variations in seasonal price indices are more in respect of paddy than rice. It is also observed that variations in retail prices are low.

The likely gains that accrue to a trader from buffer stock operations can be computed from the seasonal price indices. The trader's revenue would be at a maximum if he buys in April when prices are lowest and sells in October for Sort I, and in September for Sort II, when prices are highest. The revenue works out to be 9.35 per cent of the price for Sort I, and 6.19 per cent for Sort II. When the wholesale monthly average prices of 1985/86 are multiplied by the above estimates, we get the revenue per ton from buffer stock operations. They are: Rs. 301 for Sort I and Rs. 188 for Sort II. FCI incurred an expenditure of Rs. 465 per ton per annum for buffer stock operations. While the revenue from stocking Sort I rice for six months is higher than the storage costs (i.e. Rs. 232/ton/6 months), the revenue from stocking Sort II is slightly lower than the storage costs (Rs. 194/ton/6 months).

The seasonalities can be represented by the following functional form:

$$S_m = a + bm + cm^2$$

Where  $S_m$  is the seasonal price index in the  $m^{\text{th}}$  month.

$m = 1$  for October, ... , 12 for September

We have estimated the seasonal price index function with the data given in Table V.14. The function gives a satisfactory fit. The signs of the estimated coefficients are meaningful. Since prices fall during October-February and start rising after February, we observe  $b > 0$  and  $c > 0$ .

### Millers Margin

Suppose the linear production function can describe the production process of a rice mill. The price equation for a ton of rice is given by:

$$q_M P_M + q_F P_F + q_G P_G + q_E P_E + V = a_p p_p + \sum_j a_j p_j + \Pi + T = C + \Pi \quad (1)$$

- Where:  $q_M$  : quantity of rice sold in open market at price  $p_M$
- $q_F$  : quantity of rice sold to the FCI at price  $p_F$
- $q_G$  : quantity of rice sold to the APSCSC (state government) at price  $p_G$
- $q_E$  : quantity of rice sold in external markets at price  $P_e$
- $V$  : value of by-products
- $p_p$  : price of paddy
- $a_p$  : paddy input requirement for producing one ton of rice
- $a_j$  :  $j^{\text{th}}$  input (other than paddy) used in producing one ton of rice
- $p_j$  : price of  $j^{\text{th}}$  input
- $\Pi$  : profit per ton of rice
- $T$  : tax and depreciation per ton of rice
- $C$  : processing cost including taxes and depreciation
- $q$  :  $q_M + q_F + q_G + q_E$

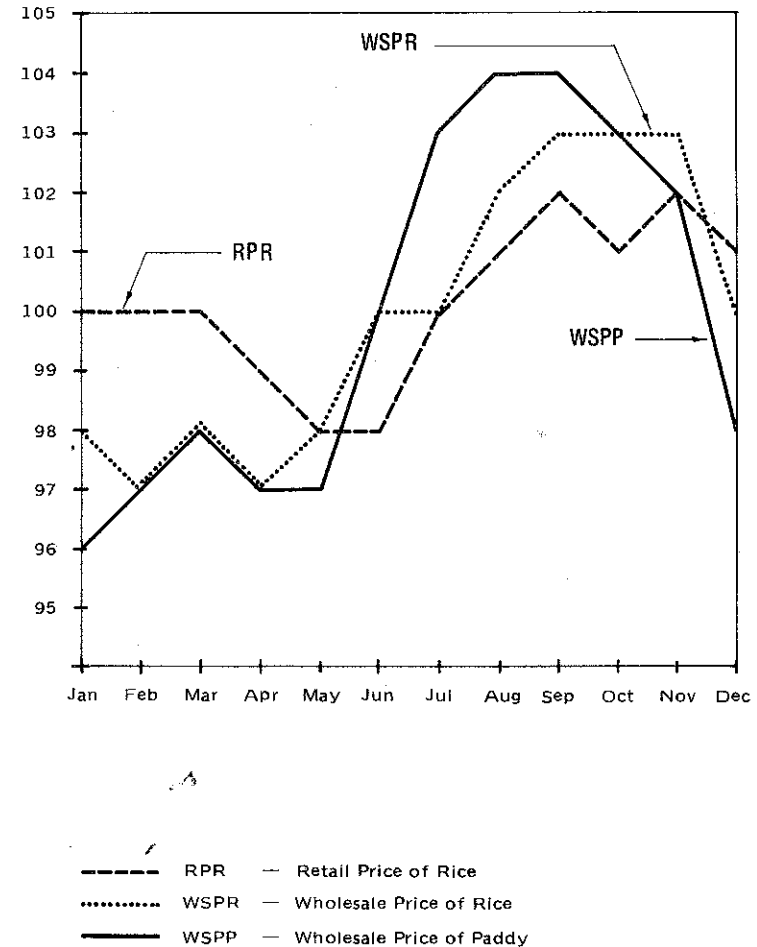
In (1),  $\sum_{j=1} q_j p_j$  is the weighted average price per ton realized by the miller ( $\bar{p}$ ). Hypothesizing that the miller retains a profit margin ( $m$ ) on price ( $p$ ) and solving for  $p_p$  we obtain:

$$p_p = \frac{1}{a_p} \left[ (1 - m) \bar{p} - \sum_{j=1} a_j p_j - T + V \right] \quad (2)$$

In equation (2)  $p_p$  is a linear function of  $p$ . The field study revealed that the intercept term of equation (2) is relatively small and hence the  $p_p \approx p$  result will be used in the next section.

The various components of equation (1) have been derived from data on a sample of 58 mills located in the districts of Nalgonda and

Figure V.2: Seasonal Price Indices for Rice in Andhra Pradesh



Mahaboobnagar of Andhra Pradesh.<sup>10</sup> The total transactions of all the sample mills including the prices realized by the millers in various marketing channels are presented in Table V.15 for the period 1985/86. It may be noted that the rice mills installed additional processes for producing par-boiled rice for which there is a lot of demand in external markets.

The open market price net of transport cost for parboiled rice sold in external market is higher by Rs. 1,170 per ton i.e. 48 per cent than the FCI's procurement price ( $p_F$ ). Similarly the open market price of rice in Andhra Pradesh is higher by Rs. 740 per ton i.e. 30 per cent more than the procurement price ( $p_F$ ). The difference between the prices of parboiled

Table V.13: Seasonal Price Indices for Rice in Andhra Pradesh

Month	Sort I			Sort II		
	WSPP	WSPR	RPR	WSPP	WSPR	RPR
January	95	99	102	96	98	100
February	95	97	100	97	97	100
March	97	97	98	98	98	100
April	96	96	96	97	97	99
May	98	97	96	97	98	98
June	100	100	98	100	100	98
July	103	102	100	103	100	100
August	104	103	101	104	102	101
September	105	103	102	104	103	102
October	105	105	102	103	103	101
November	104	103	103	102	103	102
December	98	102	103	98	100	101
Coefficient of variation (%)	3.8	2.7	2.3	3.0	2.2	1.3

Note: WSPP = Wholesale Price of Paddy  
WSPR = Wholesale Price of Rice  
RPR = Retail Price of Rice

Table V.14: Seasonal Price Functions

Dependent Variable	Estimated a	Regression b	Coefficients c	R <sup>2</sup>
1. Wholesale Paddy Sort I	108.22	-3.96 (6.20)	0.32 (6.7)	0.84
2. Wholesale Rice Sort I	108.66	-3.48 (8.69)	0.26 (8.67)	0.89
3. Retail Rice Sort I	106.37	-2.29 (4.05)	0.16 (3.71)	0.66
4. Wholesale Paddy Sort II	105.68	-2.96 (6.24)	0.25 (7.05)	0.86
5. Wholesale Rice Sort II	105.68	-2.58 (8.02)	0.20 (8.34)	0.89
6. Retail Rice Sort II	103.32	-1.30 (4.29)	0.09 (4.17)	0.67

Note: Functional form is  $Y = a + bm + cm^2$ .

Figures in the brackets are 't' values.

m = 1 for October, ..., m = 12 for September.

Table V.15: Purchases and Sales of Sample Rice Millers 1985/86

Item	Quantity ('000 T)	Value (Rs. in million)	Price Ton (Rs.)
1. Total paddy purchases from farmers <sup>1</sup>	260.3	417.8	1,605
2. Sales of rice and its products			
(i) Parboiled			
FCI	46.2	112.2	2,430
Open Markets in other states	49.6	178.5	3,600
(ii) Raw rice			
FCI	15.5	35.3	2,280
APSCSC	32.4	78.5	2,420
Open market in the state	19.9	60.2	3,020
Open market in other states	8.2	27.8	3,390
(iii) By-products <sup>2</sup>		69.8	

Notes:

1 Inclusive of transport cost and handling charges paid by producer up to the market yard and commission to the agent in the yard (1 per cent of sale value).

2 Includes value of broken rice.

Source: Sample Survey of Rice Milling Industry in Andhra Pradesh, Centre for Economic and Social Studies, Hyderabad.



and raw rice works out to be Rs. 150 per ton in the case of the procurement price and Rs. 210 per ton in terms of the prices prevailing in external markets. It is worth observing that the export price for raw rice ( $p_E$ ) is 12.3 per cent higher than the open market price in Andhra Pradesh ( $p_M$ ). Simple arithmetic would show that miller would obtain 18.5 per cent more revenue if controls on his sales are lifted provided the export price is not affected by the additional exports from Andhra Pradesh due to trade liberalization.

Table V.15 reveals that millers contribute 55 per cent of the milled rice to FCI and APSCSC, which is less than the contribution they are required to make. According to procurement policy the millers are required to contribute 75 per cent to FCI and APSCSC. The difference is mainly due to the manner in which the policy is implemented. Interestingly, the volume of rice exported by the millers was almost equal their rice contribution to FCI i.e.  $q_E = q_F$ ; and sales to APSCSC were half of sales to FCI i.e.  $q_G = 1/2 q_F$ , as required by policy.

The distributive shares in rice marketing are presented in Table V.16.

Table V.16: **Distributive Shares in Rice Marketing of Sample Mills 1985/86**

Item	Value (Rs. in millions)	Share (%)
1. Producer revenue	417.8	74.3
2. Miller's return	562.3	100.0
a) Rice	497.6	
b) By-products	64.7	
3. Miller's gross margin	144.5	25.7
4. Processing costs	41.3	7.3
5. Miller's net margin	103.2	18.4

Note: Processing cost also includes taxes and depreciation but excludes interest on working and fixed capital.

Source: Sample Survey of Rice Milling Industry in Andhra Pradesh, Centre for Economic and Social Studies, Hyderabad.

The cost and profit per ton of rice are given below:

1. Processing cost including taxes and depreciation and excluding interest on productive capital per ton of rice	(C) =	Rs. 178
2. Profit per ton of rice	(II) =	Rs. 647
3. Miller's average price per ton	( $\bar{p}$ ) =	Rs. 2,910
4. Profit margin (2 ÷ 3)	(m) =	0.2231

From the survey data the following equation has been estimated:

$$p_p = 0.5179 \bar{p} + 103$$

The elasticity of paddy price with respect to millers weighted price therefore works out to be 0.94.

*Retailers margin.* The above analysis is confined to the relation between the miller's average price ( $\bar{p}$ ) and the paddy producers' price  $p_p$ . The relation between the open market price of rice in the wholesale market ( $p_m$ ) and the retail price of rice ( $p_r$ ) has been estimated for Andhra Pradesh with the monthly data for the period 1970/71 - 1985/86 available for two varieties of rice (see for annual price movements Table V.17 and Figure V.3).<sup>11</sup> The estimated equations for two varieties of rice, namely for Sort I and Sort II, are given below:

Rice: Sort I

$$\ln p_r = -0.277 + 1.065 \ln P_m$$

(118.96)       $R^2 = 0.98$   
DW = 0.74

Rice: Sort II

$$\ln p_r = -0.124 + 1.034 \ln P_m$$

(111.39)       $R^2 = 0.98$   
DW = 1.74

(Figures in parenthesis are t-values)

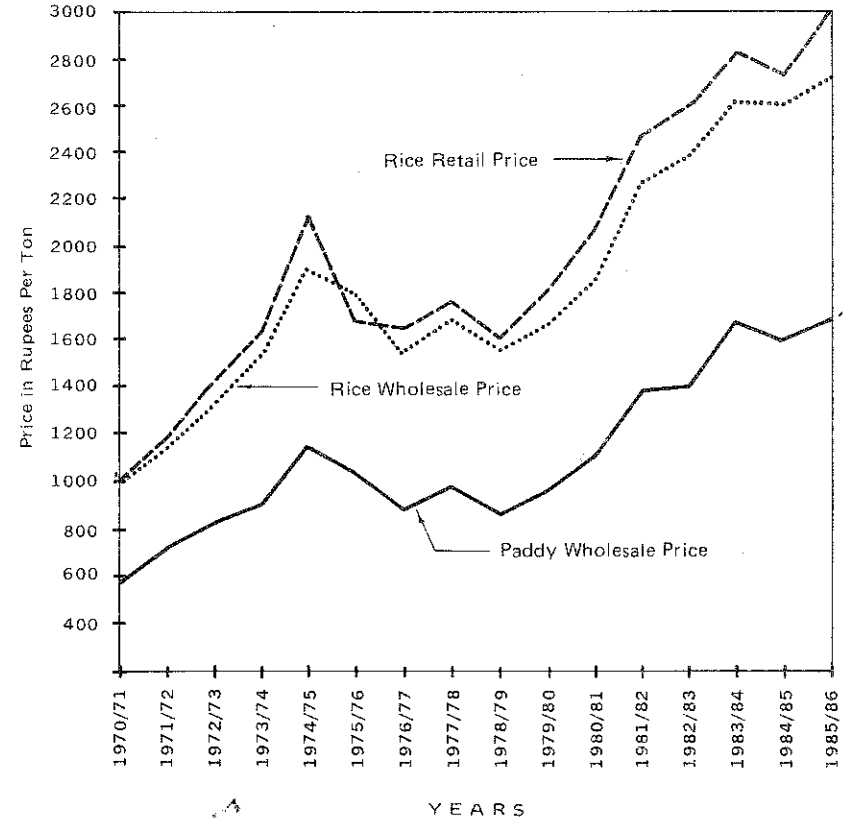
The estimated equation for Sort II turned out to be highly satisfactory. The first equation is not free from auto-correlation. It can be read from the second equation that a 10 per cent increase in the open market wholesale price of rice results in 10.3 per cent increase in retail price of

Table V.17: Prices in Andhra Pradesh 1970/71 - 1985/86

Year	Paddy Wholesale Price (Rs./Ton)		Rice Wholesale Price (Rs./Ton)		Rice Retail Price (Rs./Ton)	
	Year ending March		Year ending March		July - June	
	Sort I	Sort II	Sort I	Sort II	Sort I	Sort II
1970/71	697	575	1201	1003	1170	1000
1971/72	813	726	1328	1158	1410	1180
1972/73	931	829	1518	1323	1630	1400
1973/74	1031	911	1735	1523	1840	1620
1974/75	1319	1158	2180	1913	2370	2100
1975/76	1206	1041	2104	1794	2060	1690
1976/77	1045	895	1790	1544	1980	1660
1977/78	1152	982	1975	1692	2110	1770
1978/79	1041	877	1851	1559	2000	1620
1979/80	1126	969	1956	1670	2170	1820
1980/81	1324	1118	2234	1863	2470	2080
1981/82	1552	1386	2605	2281	2810	2470
1982/83	1591	1400	2691	2389	3030	2610
1983/84	1786	1585	3021	2628	3450	2830
1984/85	1754	1506	3047	2613	3390	2750
1985/86	1805	1585	3221	2722	3740	3010

Sources: Various issues of Season and Crop Reports of Andhra Pradesh and Statistical Abstract of Andhra Pradesh, Bureau of Economics and Statistics, Hyderabad.

Figure V.3: Prices of Rice in Andhra Pradesh 1979-1986



rice. The geometric average of the ratio of monthly retail price to monthly wholesale price during 1970/71 - 1985/86 works out to 1.16 for Sort I and 1.18 for Sort II. Thus the retail traders' gross margin in the consumer price of rice is in the range of 16-18 per cent.

*Spatial Market Integration*

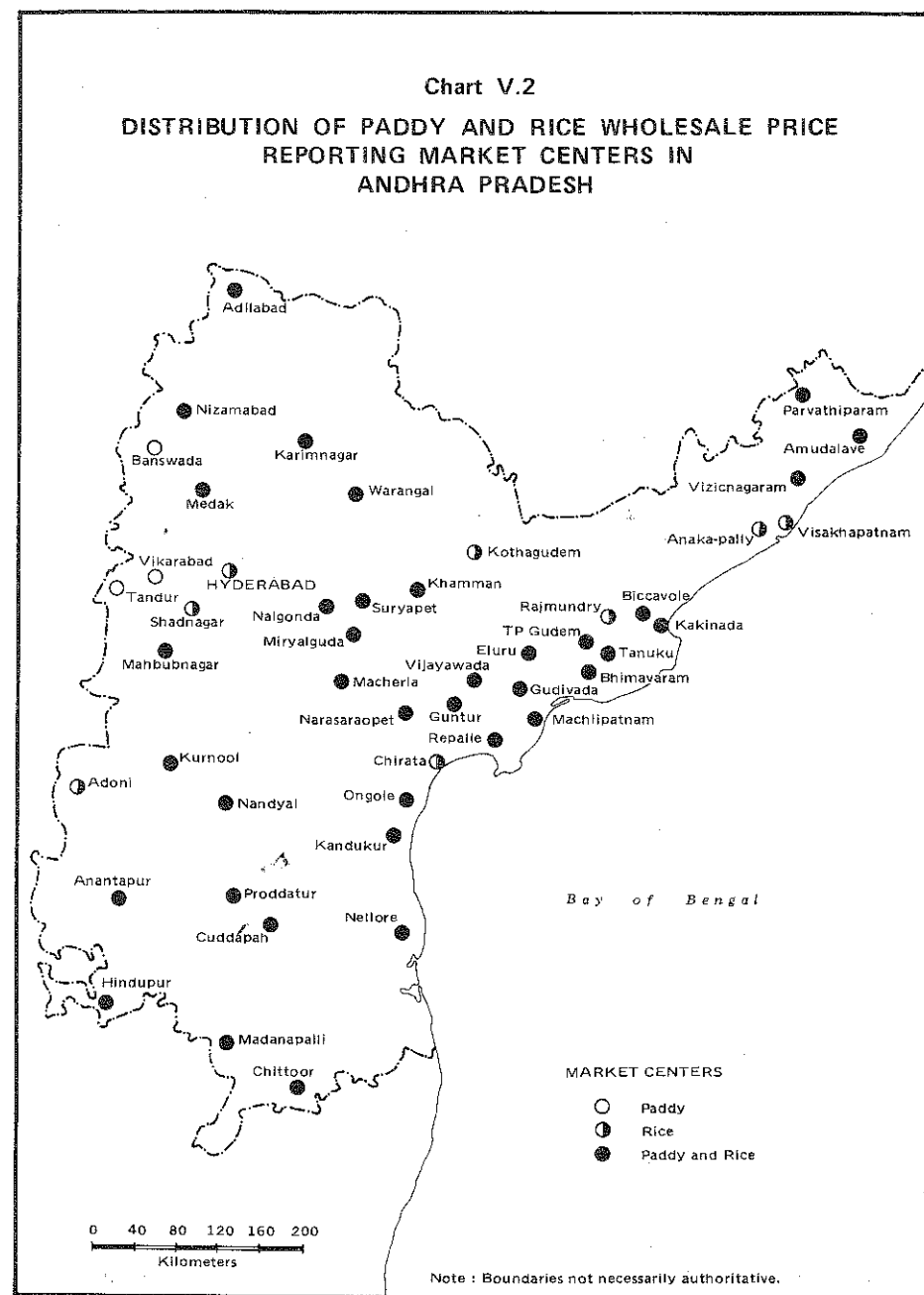
The rice market is characterized by a multi-tier structure with primary, secondary and regional markets functioning at various levels of spatial hierarchy. A sizeable number of regulated markets, i.e. 563, are scattered over the entire state. Primary markets deal with paddy transactions and act as feeders to millers located near secondary and regional markets. The rice trade within the state and exports from the state are handled by secondary and regional markets. Moreover, most of the rice mills are scattered in these centers.

The central government has established marketing departments with field staff to collect information on rice from 50 important regulated markets (see Chart V.2) and 47 market committees. Daily and weekly prices of paddy and rice are broadcast by the nearest All India Radio station. Millers and wholesalers have their own network for obtaining information on daily prices prevailing in various markets.

Table V.18: **Inter-Market Correlation Coefficients for Selected Markets in Andhra Pradesh Monthly Rice Wholesale Prices**

	Nizamabad	Hyderabad	Kakinada	Eluru	Vijayawada	Nellore
Nizamabad	1.00					
Hyderabad	0.97	1.00				
Kakinada	0.97	0.97	1.00			
Eluru	0.97	0.97	0.98	1.00		
Vijayawada	0.97	0.97	0.98	0.99	1.00	
Nellore	0.96	0.96	0.96	0.97	0.97	1.00

Note: The correlation coefficients refer to Sort II variety Period: July 1961-June 1986.



While there are no restrictions on paddy movements between districts within the state, the inter-district rice trade is controlled in order to implement procurement policy. In this arrangement, inter-district price variations also influence the volume of paddy trade. This makes the inter-district price variations in paddy/rice depend on transport costs. In Andhra Pradesh millers also purchase paddy from far-off districts.

The inter-market integration has been examined for selected markets by computing correlation coefficients based on time series data on monthly prices (Table V.18). The correlation coefficients are high, ranging between 0.96 to 0.98. Since correlation is a weak measure, no firm conclusions can be drawn.

## THE EFFECTS OF GOVERNMENT INTERVENTION IN THE RICE MARKET OF ANDHRA PRADESH

### Introduction

The intervention policies in the rice market adopted in Andhra Pradesh are bound to have significant effects as the rice sector is a key sector in the region's economy. On the consumption side, the major issues are concerned with the impact on the welfare of various classes. When the rice price increases, the welfare impact will vary according to how much rice each class consumes. For a given price rise, poor families tend to experience a greater loss in welfare than rich families. Under rationing, a consumer will gain by the quantity of ration multiplied by the difference between the open market price and the ration price. However, a consumer will also lose due to a rise in the open market price. An assessment of welfare changes has to take both into consideration.

On the supply side, the major issues are concerned with the impact of intervention on rice output. While rice producers under a producers/millers levy will experience a loss in their revenue because the procurement price is lower than the market price, they gain to the extent that the open market price rises due to intervention. The total effect depends on the extent of price rise in the open market. Economists do not agree on the magnitude of the total effect (see Y. Hayami et. al., 1982).

The present section seeks to analyze the price and welfare consequences of policy interventions in Andhra Pradesh. The closed economy assumption is adopted and quantity restrictions are imposed on exports/imports. It is also assumed that the government uses levy quotas on the millers, and distributes a part of the procured rice to distinct classes at differential ration prices, and per capita ration supply varies among the classes. The analysis also abstracts from the market imperfections and hence the millers get

normal profits and the price change is passed on to producers. In the model specified below, aggregate demand for rice depends on: open market price of rice, which is an endogenous variable, and ration quantity and its distribution among the classes, and the ration prices. The aggregate supply in the market depends on the weighted average of open market price, procurement price and export price.

### Model

*Demand for rice in the presence of PDS.* We assume that the economy consists of distinct classes and their consumption patterns can be described by a Linear Expenditure System (LES). Let:

$q_{ik}$  = Per capita consumption of rice by the  $k^{\text{th}}$  class with  
 $i = 1$  for rice.

$p_i$  = Price of  $i^{\text{th}}$  commodity with  $p_1$  = price of rice in the open market

$y_k$  = Per capita total expenditure of the  $k^{\text{th}}$  class

$b_k$  = Marginal budget share of rice by the  $k^{\text{th}}$  class

$q_{Rk}$  = Per capita rice ration given to the  $k^{\text{th}}$  class

$p_{Rk}$  = Ration price of rice for the  $k^{\text{th}}$  class

$C_{ik}$  = Committed quantity of  $i^{\text{th}}$  commodity

$n_k$  = Population of the  $k^{\text{th}}$  class

$Q_{1k}$  = Aggregate consumption of rice by the  $k^{\text{th}}$  class i.e.  
 $Q_{1k} = n_k q_{1k}$

$Y_k$  = Aggregate total expenditure of the  $k^{\text{th}}$  class  
i.e.  $Y_k = n_k y_k$

$\bar{C}_{ik} = n_k C_{ik}$

$Q_{Rk} = n_k q_{Rk}$

$Q_R = \sum Q_{Rk}$

The consumer demand function for rice in the absence of ration is given by:

$$P_1 q_{1k} = C_1 P_1 + b_{1k} (Y_k - \sum_j C_{jk} P_j) \quad (1)$$

Suppose the  $k^{th}$  class is given a ration of  $q_{Rk}$  units of rice at a price of  $P_{Rk}$ . The ration quantity multiplied by the difference between the open market price and ration can be taken as the income gain to the consumer due to rationing. This has a limitation when the consumer does not buy the full quota in which case the income gain will be equal to the quantity lifted multiplied by the price difference. These problems do not arise in our case since the ration quota is always less than the actual requirement of rice. The consumer demand function under rationing is given by:

$$P_1 q_{1k} = C_1 P_1 + b_{1k} \left[ (Y_{1k} + q_{Rk} (P_1 - P_{Rk}) - \sum_j C_{jk} P_j) \right] \quad (2)$$

The  $k^{th}$  class demand for rice is given by: —

$$P_1 Q_{1k} = \bar{C}_{1k} P_1 + b_{1k} \left[ (Y_k + Q_{Rk} (P_1 - P_{Rk}) - \sum_j \bar{C}_{jk} P_j) \right] \quad (3)$$

Market demand is given by: —

$$P_1 Q_{1k} = \sum_k \bar{C}_{1k} P_1 + \sum_k b_{1k} \left[ (Y_k + Q_{Rk} (P_1 - P_{Rk}) - \sum_j \bar{C}_{jk} P_j) \right] \quad (4)$$

The total market demand, i.e. purchases from ration shop plus those from open market, is a function of open market price, ration price, volume of ration and its distribution across the classes. The effect of change in ration quantity  $Q_R$  on market demand is given by:

$$\frac{\partial Q_D}{\partial Q_R} = \sum_k \left[ \bar{C}_{1k} + b_{1k} Q_{Rk} - \bar{C}_{1k} b_{1k} - Q_{1k} \right] \frac{1}{P_1} \frac{\partial P_1}{\partial Q_R} + \sum_k \left[ \frac{P_1 - P_{Rk}}{P_1} b_{1k} \frac{\partial Q_{Rk}}{\partial Q_R} \right] \quad (5)$$

In (5),  $\frac{\partial Q_{Rk}}{\partial Q_R}$ , i.e. the additional ration accruing to the

$k^{th}$  class due to one unit increase in total ration ( $Q_R$ ), depends on PDS policy.

The effect of any change in exogeneous variable, say  $Q_j$  (exports/ procurement), on the aggregate demand is given by

$$\frac{\partial Q_D}{\partial Q_j} = \sum_k \left[ \bar{C}_{1k} + b_{1k} Q_{Rk} - \bar{C}_{1k} b_{1k} - Q_{1k} \right] \frac{1}{P_1} \frac{\partial P_1}{\partial Q_j} \quad (6)$$

*Supply function.* Let:

$Q_S$  = Total supply of rice from domestic production

$Q_M$  = Supply of rice in open market

$Q_F$  = Quantity on rice procured by the FCI

$Q_G$  = Quantity of rice procured by the APSCSC

$Q_E$  = Quantity of rice exported

$P_M$  = Open market wholesale price of rice

$P_F$  = Procurement price of rice paid by the FCI

$P_G$  = Procurement price of rice paid by the APSCSC

$P_E$  = Export price of rice

$P_p$  = Producers' price

$P$  = Weighted price received by the miller

$$= \text{Supply elasticity, i.e. } \frac{\bar{P}_p}{Q_s} \frac{\partial Q_s}{\partial P_p} = \frac{\bar{P}}{Q_s} \frac{\partial Q_s}{\partial P}$$

The aggregate supply consists of:

$$Q_S = Q_M + Q_F + Q_G + Q_E \quad (7)$$

The supply function is given by

$$Q_S = f(P_p) = F(\bar{P}) \quad (8)$$

Since the whole of the rice procured by the APSCSC and a proportion ( $\theta$ ) of the rice procured by the FCI are distributed through fair price and ration shops, we have  $Q_R = Q_G + \theta Q_F$ . (9)

It may be noted that  $\theta$  varies from year to year depending on the central government's policy in the context of the nationwide supply-demand situation.

The millers' revenue (R) and weighted price (p) are given by

$$R = P_M Q_M + P_E Q_E + P_F Q_F + P_G Q_G \quad (10)$$

$$\bar{p} = R/Q_S \quad (11)$$

*Market integration.* For linking supply and demand functions, we need to establish a relationship on the one hand, between retail price ( $p_1$ ) and wholesale price ( $p_M$ ) of the open market and, on the other hand, between the producers' price ( $p_p$ ) and millers' weighted price ( $\bar{p}$ ). For policy analysis, the following simplifying assumptions are made:

$$\frac{dp_1}{p_1} = \frac{dp_M}{p_M} \quad (12)$$

$$\frac{dp_p}{p_p} = \frac{dp}{p} \quad (13)$$

(12) implies that rates of change in the open market wholesale and retail prices are equal and (13) implies that the rate of change in producers' price equals the rate of change in the weighted price received by the miller. The empirical evidence given in the previous section shows the approximate validity of the above assumptions.

*Policy effects.* At equilibrium  $Q_D = Q_S$  equilibrium is ensured by changes in the open market price. Policy effects can be traced through the shifts in aggregate demand and supply functions. The policy effect on the open market price can be determined by equating the changes in supply and demand from the initial equilibrium position. Initially, we assume away the feedback effect of changes in farm income on demand and relax it later.

The partial effects of a change in  $Q_j$  on market supply and demand are given by:

$$\frac{\partial Q_S}{\partial Q_j} = \frac{1}{Q_S} \frac{\partial Q_S}{\partial \bar{p}} \left[ 1 + \alpha \left( 1 - \frac{P_M}{\bar{p}} \right) \right]^{-1} \left[ (P_j - P_M) + Q_M \frac{\partial P_M}{\partial Q_j} \right] - 1$$

$$\frac{\partial Q_D}{\partial Q_j} = \sum_k \left[ \bar{c}_{1k} + b_{1k} Q_{Rk} - \bar{c}_{1k} b_{1k} - Q_{1k} \right] \frac{1}{P_M} \frac{\partial P_M}{\partial Q_j} \quad (14)$$

Equating and solving the above two equations we obtain: —

$$\frac{1}{P_M} \frac{\partial P_M}{\partial Q_j} = \frac{1}{P_1} \frac{\partial P_1}{\partial Q_j} \quad (15)$$

Effects on p is given by: —

$$\frac{\partial Q_p}{\partial Q_j} = \frac{1}{Q} \left[ 1 + \alpha \left( 1 - \frac{P_M}{\bar{p}} \right) \right]^{-1} (P_j - P_M) + Q_M \frac{\partial P_M}{\partial Q_j} \quad (16)$$

The effects of rationing are given by:

$$\frac{\partial Q_S}{\partial Q_R} = \frac{\alpha}{\bar{p}} \left[ 1 + \left( 1 - \frac{P_M}{\bar{p}} \right) \right]^{-1} (Q_M P_M) + \left[ \frac{1}{P_M} \frac{\partial P_M}{\partial Q_R} \right] \quad (17)$$

$$\begin{aligned} \frac{\partial Q_D}{\partial Q_R} = & \sum \left[ \bar{c}_{1k} + b_{1k} Q_{Rk} - \bar{c}_{1k} b_{1k} - Q_{1k} \right] \frac{1}{P_1} \frac{\partial P_1}{\partial Q_R} \\ & + \sum_k \left[ \frac{P_1 - P_{Rk}}{P_1} b_{1k} \frac{\partial Q_{Rk}}{\partial Q_R} \right] \quad (18) \end{aligned}$$

(17) and (18) can be solved for  $\frac{1}{P_M} \frac{P_1}{Q_R} (= \frac{1}{P_1} \frac{1}{Q_R})$

*Welfare Implications of Policy Changes*

Suppose a consumer with income (total expenditure)  $y$  and ration quantity of rice  $q_R$  given at  $p_R$  by the government faces a market with prices  $p_1, p_2, \dots, p_n$ . His equilibrium quantities will be given by equation (2). Using an indirect utility function consistent with the LES, his welfare level in the base year is given by: —

$$u^0 = \left[ y^0 + q_R^0 (p_1^0 - p_R^0) - \sum C_j p_j^0 \right] \prod_{i=1}^n \left[ \frac{b_i}{p_i^0} \right]^{b_i} \quad (19)$$

Let  $y^1, q_R^1, p^1$  be the new values after a policy change. Consumer's new welfare level is given by: —

$$u^1 = \left[ y^1 + q_R^1 (p_1^1 - p_R^1) - \sum C_j p_j^1 \right] \prod_{i=1}^n \left[ \frac{b_i}{p_i^1} \right]^{b_i} \quad (20)$$

We propose to express the change in welfare level from  $u^0$  to  $u^1$  in terms of income at base year prices i.e.  $p^0$ . Let  $y_{01}$  be the income (total expenditure) which gives at the base year prices a utility level equivalent to the utility level of  $u^1$ , i.e.  $y_{01}$  is the equivalent income in base year prices corresponding to  $y_1$ . It can be shown: —

$$y_{01} = \sum_j C_j p_j^0 - I \sum_j C_j p_j^1 + I \left[ y^1 + q_R^1 (p_1^1 - p_R^1) \right] \quad (21)$$

where  $I = \prod_{i=1}^n \left[ \frac{p_i^0}{p_i^1} \right]$

Change in consumers' welfare in terms of base year prices is given by:

$$W = y_{01} - y^0 + q_R^0 (p_1^0 - p_R^0) \quad (22)$$

*Incorporation of farm income feedback effects.* The policy effects derived earlier do not incorporate the feedback effects of farm income on aggregate demand. The changes in the price and production of rice also

indirectly influence the demand through changes in producers income. We shall try to incorporate the feedback effects. Let: —

- $Z_k$  = Income of the  $k^{th}$  class
- $Z_{ok}$  = Income of the  $k^{th}$  class other than income from the rice crop
- $s_k$  = Share of income from the rice crop in the aggregate income of the  $k^{th}$  class
- $\pi_k$  = Share of cultivators in the gross output of rice belonging to the  $k^{th}$  class.

Income of the  $k^{th}$  class is given by: —

$$Z_k' = \pi_k p_p Q_k + Z_{ok} \quad (23)$$

It can be shown that: —

$$\frac{1}{Z_k} \frac{\partial Z_k}{\partial Q_j} = s_k \left[ \frac{1}{p_p} \frac{\partial p_p}{\partial Q_j} + \frac{1}{Q_k} \frac{\partial Q_k}{\partial Q_j} \right] \quad (24)$$

In the demand function, the explanatory variable is total expenditure  $Y_k$ . Assuming that consumption forms a fixed proportion of income for each class, we obtain: —

$$\frac{1}{Y_k} \frac{\partial Y_k}{\partial Q_j} = \frac{1}{Z_k} \frac{\partial Z_k}{\partial Q_j} \quad (25)$$

We assume that output changes are uniform across all classes, i.e.

$$\frac{1}{Q_k} \frac{\partial Q_k}{\partial Q_j} = \frac{1}{Q} \frac{\partial Q}{\partial Q_j}$$

Effects of  $Q_j$  and  $Q_k$  on aggregate demand are given by: —

$$\frac{\partial Q_1}{\partial Q_j} = \sum_k \left[ \bar{c}_{1k} + b_{1k} Q_{Rk} - c_{1k} b_{1k} - Q_{1k} \right] \frac{1}{P_1} \frac{\partial p_1}{\partial Q_j} + \sum_k \left[ b_{1k} \frac{\partial Q_{Rk}}{\partial Q_R} \frac{1}{P_1} \right] \quad (26)$$

$$\frac{\partial Q_1}{\partial Q_R} = \sum_k \left[ \bar{c}_{1k} + b_{1k} Q_{Rk} - c_{1k} b_{1k} - Q_{1k} \right] \frac{1}{P_1} \frac{\partial p_1}{\partial Q_R} + \sum_k \left[ \frac{P_1 - P_{Rk}}{P_1} b_{1k} \frac{\partial Q_{Rk}}{\partial Q_R} \right] + \sum_k \left[ \frac{b_{1k}}{P_1} \frac{\partial Y_k}{\partial Q_R} \right] \quad (27)$$

The effects on aggregate supply will be the same as those obtained earlier. By using (26) and (27) in place of (5) and (6) and following the rest of the model including the welfare sub-model, we can obtain the policy effects.

*Policy effects.* The effects of policy changes have been analyzed using the comparative static approach given in the model described earlier. The parameter estimates of the supply-demand functions are given in the appendices. All these policies are centered around government procurement and rationing. The observed position in 1985/86 has been assumed to be the equilibrium position obtained under the then existing policy interventions. The following policies were in vogue in 1985/86:

- A. FCI procured 1.6 million tons of rice from millers at a procurement price of Rs.2280 per ton and contributed 1.0 million tons to the state's PDS.
- B. APSCSC procured 0.88 million tons of rice at a negotiated price of Rs.2420 per ton.
- C. PDS supplied 2.15 million tons of rice at Rs.2 per kg (retail) to the bottom 70 per cent of the households.

- D. Exports were restricted to 1.6 million tons.
- E. Government (central + state) expended Rs. 975 million on the rice subsidy.

The values of the various variables of the model for 1985/86 were as follows (see Appendix V.3):

1. Rice production of the region ( $Q_S$ ): 9.36 million tons
2. Open market supply ( $Q_M$ ): 5.28 million tons
3. Ration supply ( $Q_R$ ): 2.15 million tons
4. Domestic consumption ( $Q_D$ ): 7.43 million tons
5. Exports ( $Q_E$ ): 1.6 million tons
6. Wholesale price of rice in the open market ( $P_M$ ): Rs. 3,020 per ton
7. Producers'/Millers' weighted average price of rice ( $\bar{P}$ ): Rs. 2,910 per ton
8. Producers'/Millers' revenue from rice ( $PR$ ): Rs. 27.252 billion.

It can be seen that the ration quantity (2.15 million tons) is more than the total contribution of the central government to the PDS (1.0 million tons) and the state's procurement (0.88 million tons). We have assumed that the balance (0.27 million tons) has come from previous stocks and treated it as an exogenous variable in our model. We have also assumed that the entire ration has been received by the target group.

Taking 1985/86 as the reference scenario, we have estimated the effects of policy change on: domestic rice production, open market price of rice, millers'/producers' revenue, i.e. revenue accruing to millers, a part of which will be passed on to producers and welfare levels of different strata of population. The following six policy changes are considered:

- P(1) : FCI procures 1 million tons without any alterations in other policies.
- P(2) : FCI raises ration quota given to the PDS by 1.0 million tons, i.e. total ration supply increases from 2.15 mt to 3.15 million tons. It is assumed that the FCI provides the additional ration supply from its own stock and does not increase its earlier volume of procurement of rice, i.e. FCI procurement remains at 1.6 million tons.
- P(3) : FCI procures an additional 1.0 million tons of rice from Andhra Pradesh and supplies it to the PDS which distributes



it among the poor and middle classes at a price of Rs.2 per kg. This increases FCI procurement from 1.6 to 2.6 million tons from Andhra Pradesh.

- (P4) : Procurement and public distribution are withdrawn and traders are allowed to export to other states in India without any restrictions. However, rice trade outside India is not permitted.
- (P5) : Central and State governments withdraw from procurement and public distribution of rice, and imports from abroad are allowed without any intervention.
- (P6) : State government adopts the policy of preventing interstate trade, i.e. rice market functions under autarky.

In the above six policies, P(1), P(2) and P(3) deviate moderately from the existing framework and policies P(4), P(5) and P(6) deviate substantially. P(3) bears similarity with the existing two-rupee-a-kilo rice scheme in which 2.15 million tons of rice are supplied to the poor and middle classes. Within each policy, two variants have been considered. In variant A, the changes in producers' income are assumed to have no effect on the rice demand. In variant B, the effect of change in producers income on rice demand has been considered.

Using the parameter estimates of supply-demand functions, the model has been solved for policy effects. Many policies were simultaneously in vogue in the base year. Hence, while studying the impact of a policy change, other policies have not been altered. Results are presented in Tables V.19 to V.24. It is pertinent to emphasize that changes in welfare levels given in Tables V.21 and V.22 cannot be aggregated across classes without using welfare weights. However, welfare comparison of alternative policies for a given class is possible. Hence, in Tables V.21 and V.22, row-wise comparison is possible but not column-wise. The differences between equilibrium values of macro variables under variant A and B are only marginal (Tables V.19 and V.20). As regards welfare transfer, there are differences between the two variants. Since variant B is more meaningful, we have confined our discussion to the results of variant B.

The effects of additional procurement ( P(1) ) is first taken up for discussion. Procurement of 1.0 million tons by the FCI increases substantially the open market price (25%) as well as the producers' price (10%). Farmers react positively to the price rise and increase rice production by 0.40 million tons (4%). Therefore, 40% of the additional procurement can be met from the output expansion. It can be seen that the quantity supplied

Table V.19: Equilibrium Values under Different Policy Changes, Variant A

Item	Base Year	P(1)	P(2)	P(3)	P(4)	P(5)	P(6)
	Scenario						
Q <sub>S</sub>	9.365	9.708	8.969	9.352	10.078	8.692	8.295
Q <sub>M</sub>	5.277	4.620	4.881	4.264	6.802	7.962	8.295
Q <sub>E</sub>	1.600	1.600	1.600	1.600	3.276	0.730	—
Q <sub>F</sub>	1.608	2.608	1.608	2.608	—	—	—
Q <sub>G</sub>	0.880	0.880	0.880	0.880	—	—	—
Q <sub>R</sub>	2.150	2.150	3.150	3.150	—	—	—
Q <sub>D</sub>	7.427	6.770	8.031	7.414	6.802	7.962	8.295
$\bar{P}$	2,910	3,170	2,610	2,900	3,450	2,400	2,100
P <sub>M</sub>	3,020	3,710	2,470	3,160	3,450	2,400	2,100
P <sub>E</sub>	3,450	3,450	3,450	3,450	3,450	2,400	—
P <sub>F</sub>	2,280	2,280	2,280	2,280	—	—	—
P <sub>G</sub>	2,420	2,420	2,420	2,420	—	—	—
PR	27.930	30.774	23.409	27.121	34.769	20.861	17.420

- Notes: 1. Quantities are in million tons, prices in Rs. per ton and producers'/millers' revenues (PR) in Rs. billion.
2. Variant A: Farm income feedback effects on demand are not considered.

in the open market does not fall by 1.0 million tons but by 0.60 million tons. The price rise and output expansion increase the producers' revenue by Rs. 4.08 billion (15%). Though P(1) induces output growth, it adversely affects the consumers' welfare (Tables V.21 and V.22) and rice consumption levels (Tables V.23 and V.24). Real total expenditure declines by: Rs. 13/person/annum for the rural poor; Rs. 67/person/annum for the urban poor; Rs. 31/person/annum for the rural rich and; Rs. 129/person/annum for the urban rich. It is worth observing that though procurement increases the producers'/ millers' revenue, the welfare and rice intake levels of the middle and rich rural classes decline. This is because nearly one-third

of the increase in revenue goes for meeting input costs and the remaining is shared by millers and farmers. It is observed that the increase in total expenditure is inadequate to compensate for the increase in the cost of rice intake.

Additional supply of ration by the FCI from its own sources (P(2)) depresses prices and domestic production: open market price declines by 21%, producers' price by 12% and domestic production by 5%. Consequently, producers experience a loss of revenue to the extent of RS.4.46 billion (16%). It is interesting to note that the extent of price fall due to

Table V.20: Equilibrium Values under Different Policy Changes, Variant B

Item	Base Year Scenario	P(1)	P(2)	P(3)	P(4)	P(5)	P(6)
Q <sub>S</sub>	9.365	9.761	8.903	9.352	10.078	8.692	8.055
Q <sub>M</sub>	5.277	4.673	4.815	4.264	6.983	7.717	8.055
Q <sub>E</sub>	1.600	1.600	1.600	1.600	3.095	0.975	—
Q <sub>F</sub>	1.608	2.608	1.608	2.608	—	—	—
Q <sub>G</sub>	0.880	0.880	0.880	0.880	—	—	—
Q <sub>R</sub>	2.150	2.150	3.150	3.150	—	—	—
Q <sub>D</sub>	7.427	6.823	7.965	7.414	6.983	7.717	8.055
P	2,910	3,210	2,560	2,900	3,450	2,400	1,920
P <sub>M</sub>	3,020	3,790	2,380	3,150	3,450	2,400	1,920
P <sub>E</sub>	3,450	3,450	3,450	3,450	3,450	2,400	—
P <sub>F</sub>	2,280	2,280	2,280	2,280	—	—	—
P <sub>G</sub>	2,420	2,420	2,420	2,420	—	—	—
PR	27.930	31.333	22.792	27.121	34.769	20.861	15.466

- Notes: 1. Quantities are in million tons, prices in Rs. per ton and producers'/millers' revenue (PR) in Rs. billion.  
2. Variant B: Farm income feedback effects on demand are taken into account.

Table V.21: Welfare Changes Compared to Base Year Scenario, Variant A

Classes	Base year scenario		Changes in real expenditure (Rs./annum/person)					
	No. of persons (in millions)	Per Capita Expenditure (Rs./annum)	P(1)	P(2)	P(3)	P(4)	P(5)	P(6)
Rural								
Poor	17.5	717	-19	33	23	-84	1	34
Middle	13.1	1,244	-49	59	22	-114	21	63
Rich	13.1	2,233	-113	97	-24	-71	110	168
Urban								
Poor	5.9	1,288	-61	83	22	-128	38	101
Middle	4.3	2,315	-85	103	21	-155	54	126
Rich	4.3	4,338	-116	97	-24	-73	111	165

Note: Variant A: Farm income feedback effects on demand are not considered.

Table V.22: Welfare Changes Compared to Base Year Scenario, Variant B

Classes	Base year scenario		Changes in real expenditure (Rs./annum/person)						
	No. of persons (in millions)	Per Capita Expenditure (Rs./annum)	Per Capita Expenditure plus income gain due to rationing	P(1)	P(2)	P(3)	P(4)	P(5)	P(6)
Rural									
Poor	17.5	717	771	-13	24	23	-70	-15	23
Middle	13.1	1,244	1,305	-6	-3	21	-25	-69	-89
Rich	13.1	2,233	2,233	-31	-10	-25	102	-61	-133
Urban									
Poor	5.9	1,288	1,356	-67	92	22	-128	38	145
Middle	4.3	2,315	2,392	-93	116	22	-155	54	194
Rich	4.3	4,338	4,338	-129	113	-22	-73	111	199

Note: Variant B: Farm income feedback effects on demand are taken into account.

Table V.23: Rice Consumption Levels under Various Policies, Variant A

Class	Base year scenario	Per capita annual consumption of rice (Kg/annum)					
		P(1)	P(2)	P(3)	P(4)	P(5)	P(6)
Rural							
Poor	84.71	70.40	96.02	86.83	69.63	91.53	101.82
Middle	123.64	120.14	128.73	124.46	116.94	126.70	131.03
Rich	158.87	151.32	167.91	157.08	153.86	169.03	176.14
Urban							
Poor	145.97	129.79	167.86	146.13	125.65	164.23	181.39
Middle	170.63	151.86	194.18	167.88	154.07	194.39	213.04
Rich	143.43	138.16	149.68	142.12	139.80	150.47	155.48

Note: Variant A: Farm income feedback effects on demand are not considered.

Table V.24: Rice Consumption Levels under Various Policies, Variant B

Classes	Base year scenario	Per capita consumption of rice (Kg/annum)					
		P(1)	P(2)	P(3)	P(4)	P(5)	P(6)
Rural							
Poor	84.71	77.18	95.71	86.90	71.57	88.92	103.24
Middle	123.64	121.96	125.08	124.43	121.57	120.40	119.45
Rich	158.87	154.14	162.89	157.05	160.42	160.15	160.91
Urban							
Poor	145.97	128.24	171.70	146.32	125.65	164.03	195.08
Middle	170.63	150.19	198.51	168.11	154.07	194.39	227.61
Rich	143.43	137.86	151.08	142.13	139.80	150.47	159.51

Note: Variant B: Farm income feedback effects on demand are taken into account.

additional supply of ration is slightly less in magnitude than the price rise due to procurement. As expected, the price fall also results in a cut in the open market supply by 0.46 million tons. However, the increase in the ration supply more than offsets the fall in the market supply. Notable is the fact that the FCI supply of 1 million tons from other sources results in a net addition of only 0.54 million tons to the total domestic demand. P(2) results in welfare improvements for all classes other than the middle and rich rural classes. The middle and rich rural classes experience a loss in total welfare in spite of a marginal increase in the consumption of rice. The adverse impact of price decline on their income leads to a cut in the consumption of other items.

The results of the effects of the above two policy changes (P(1), P(2)) taken together, help in commenting on the existing operations of the FCI. FCI procures from surplus states and supplies to deficit states. It can be inferred that this operation will have a positive effect on rice production in the surplus state and a negative effect on rice production in the deficit state. On the other hand, it increases the open market price in the surplus state and depresses it in the deficit state. Thereby, it improves (reduces) the welfare levels of most of the consumers in the deficit (surplus) state. For any evaluation of FCI operations, one has to compare the cost of subsidy with the net welfare gains.

One can consider the following interesting hypothetical case. Suppose two states (X and Y) are identical in all respects, with the same base year scenarios, and let the FCI procure 1 million tons from X and supply it to the PDS of Y. It can be seen that the total rice output of X and Y and total producers' revenue more or less remain at the base year scenario levels. However, changes occur in the welfare levels. All classes in X lose; and all the urban classes and the rural poor gain while the middle and rich rural classes lose in Y. On the whole, the poor as a group (X and Y put together) gain and the rich as a group lose.

In (P(3)), 1 million tons of rice is procured by the FCI and is distributed to the poor and middle class at Rs 2/kg involving a ration supply of 24.51 Kg/person/annum. The effects of P(3) are illuminating. Rice output, producers' price and producers revenue are the same as those of the base scenario. However, an interesting outcome of this policy is a highly progressive welfare transfer: Poor and middle classes substantially gain, while the rich lose. It is worth observing that the real income/expenditure gain to the target group (Rs. 21-23/person/annum) is slightly lower than the nominal income gain (Rs. 28/person/annum). The real gains are lower than the nominal gains due to the price rise in the open market. We observed earlier that the supply of 2.15 million tons of rice through PDS involved a subsidy of Rs. 2097 million by the government (Central + State). We

can assume that government expenditure on subsidy in implementing P(3) is Rs. 975 million approximately. The other costs in implementing it are: welfare losses of Rs. 328 million incurred by the rural rich and Rs. 97 million by the urban rich. The benefits from P(3) include: welfare gain of Rs. 403 million to the rural poor, Rs. 129 million to the urban poor, Rs. 276 million to the rural middle class and Rs. 97 million to the urban middle class. Thus, in the FCI's procurement-cum-rationing policy, government and rich consumers incur the costs involved in raising the welfare levels of the poor.

Let us consider the interstate trade liberalization policy P(4). It should be noted that while computing the effects, it is assumed that there is no change in export price. When procurement and public distribution are withdrawn and inter-state trade is liberalized, export of rice from Andhra Pradesh to other states increases by 1.5 million tons. The open market price in Andhra Pradesh increases by 14 per cent and adjusts to the level of the export price. Consequently, the producers' price increases by 19 per cent. Farmers respond positively to the price rise and increase their rice output by 7.6 per cent. Consequently, producers'/millers' revenue increases by Rs. 6,839 million (24 per cent). Assuming that input costs account from 36 per cent of this revenue, the gain in net income accruing to producers/millers works out to be Rs. 4,377 million. Another gain accruing to the government (central + state) is a reduction in its expenditure on subsidy to the extent of Rs. 2,097 million. Thus the total gain works out to be Rs. 6,474 million. On the other hand, a negative aspect of this policy is that all the classes barring the rural rich experience welfare loss. The poor experience a decline in their real expenditure to the extent of Rs. 70/person/annum in the rural area and Rs. 128/person/annum in the urban area.

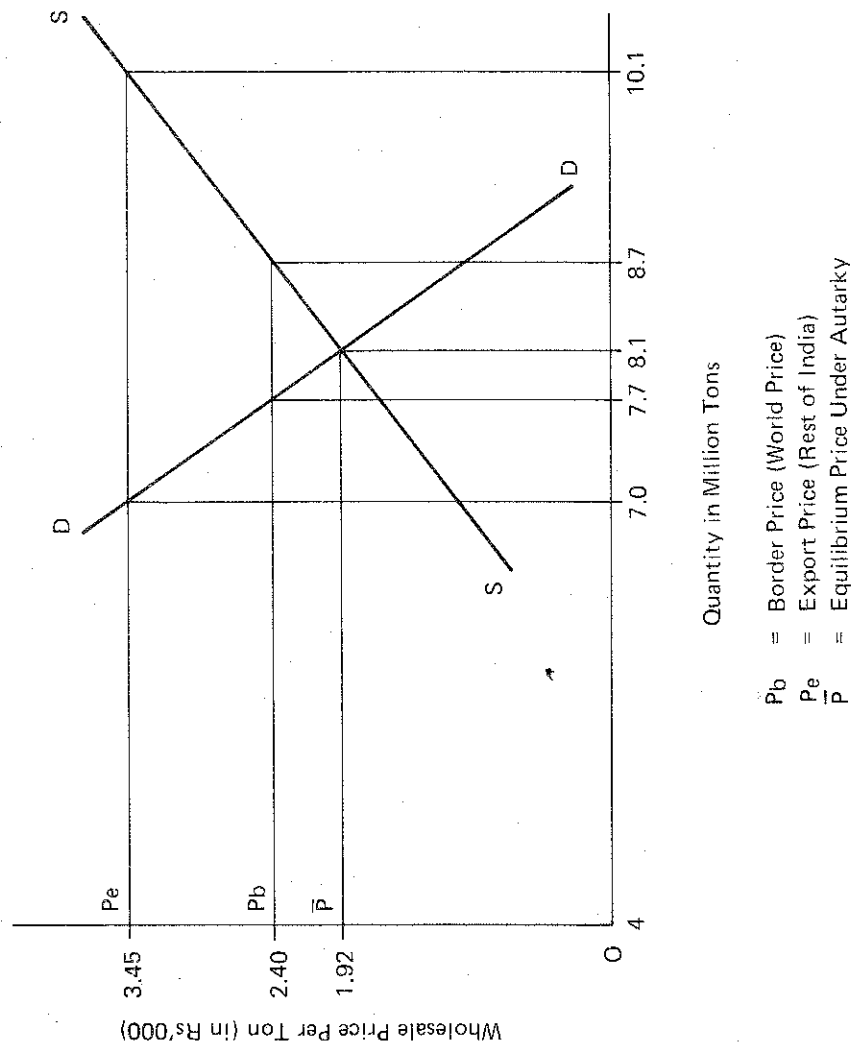
In (P(5)) liberalization is extended further and all the restrictions on imports and exports of rice are lifted. We assume that as a result of this policy, the border price prevails in all rice markets of India. As expected, this policy leads to a price fall in the rice market of Andhra Pradesh. Consequently, rice output in Andhra Pradesh declines by 0.67 million tons (7%) and producers' revenue by Rs. 7,069 million (25%) the welfare effects of the policy vary between rural and urban areas. All the rural classes lose and all the urban classes gain. The rural consumers lose because of the reduction in their incomes. The urban consumers gain because of the price fall in the open market. It can be seen that among the urban classes, the rich gain proportionately more. This is principally due to the fact that their dependency on the open market is more. Since the ration price is lower than the border price in the base scenario, the urban poor lose due to the withdrawal of rationing. However, they also gain from the price fall in the open market. This policy reduces government expenditure on subsidies by Rs. 2,097 million.

Under autarky (P(6)), both rice output and producers' price decline substantially (see Figure V.4) and the equilibrium price is lower than the border price. This is due to the fact that Andhra Pradesh is a rice surplus state. The producers' revenue declines from Rs. 28 billion in the base scenario to Rs. 15 billion. The welfare effects of this policy are more or less similar to those of P(5): all the urban classes gain and the rural middle and rich classes lose. However, in contrast to P(5): the rural poor do not lose and gain marginally. As in the case of P(5), this policy also results in a cut in the government expenditure on subsidies by Rs. 2,097 million. It is worth observing that this policy, if adopted by surplus states, may adversely affect consumers in the deficit states. Hence, this policy intervention leads to a conflict of interests between surplus and deficit states and between rural and urban classes.

What emerges from these alternative scenarios is that the liberal trade policy (removal of import and export restrictions) has a depressing effect on rice output as well as producers' revenue. While it improves the welfare levels of the urban consumers, it affects the rural classes adversely. It is conceivable that the adverse effects of this policy can be offset by the use of the resources released, due to the fall in rice production, in more productive channels. It is an empirical question as to what extent substitution possibilities exist. A nationwide consequence of this policy is an increase in rice imports since the domestic price is higher than the border price. Though this policy may ease the government budget constraint, it may aggravate the existing foreign exchange constraint. The uncertainties in the world rice market may also impose additional strains on the domestic economy. Moreover, the market infrastructure already built for procurement and the public distribution system may not permit drastic changes. If this policy is extended to all other agricultural commodities, it may result in a fall in the incomes of the agricultural producers and hence sharpen rural-urban disparities. However, moderate liberalization combined with other policies may have a favorable effect.

The procurement-cum-rationing policy can improve the welfare levels of the poor and it can also be employed for transferring welfare from the rich to the poor. The extent of welfare gain depends on the appropriate choice of the target group. The 'two rupee-a-kilo' rice scheme covers the bottom 70 per cent of the population of which 40 per cent may be treated as poor. It can easily be shown that the aggregate welfare gain from the scheme can be increased substantially by adopting a discriminatory policy between the lowest 40 per cent and next 30 per cent. It is possible to improve the aggregate welfare without involving additional expenditure on rice subsidy by mere transfer of a part of the ration presently enjoyed by the non-poor to the poor.

Figure V.4: Rice Market Under Autarky



Market intervention by the government is justified so long as the social outcome of the free market is not desirable and the government places a high premium on income redistribution. The justification for intervention will be further reinforced if the other direct policies are comparatively less effective in augmenting the incomes of the poor. A major drawback of the procurement-cum-levy policy is that it tends to increase the amount of subsidy over time and this may result in a cut in the development expenditure of the government. Given the targeted improvements in welfare levels at the national level, it is possible to work out the optimum combination of procurement-cum-levy and trade liberalization policies. Even in the existing procurement-cum-levy policy, scope may exist for improvement in defining the target group, price fixation, etc. However, in the long run, there is no alternative other than shifting up the supply curve and improving the purchasing power of the poor.

## APPENDIX V.1

## Demand Model for Rice

The Linear Expenditure System (LES) has been widely used for the analysis of Indian consumption patterns (R. Radhakrishna and K. N. Murty, 1980). The LES has two limitations: it gives rise to linear income effects and its associated utility function is additive. The limitation of linear income effects has been overcome in Indian studies by the use of piece-wise LES and the limitation of additivity has been overcome by the use of the Nasse model, an extended version of the LES (K. N. Murty and R. Radhakrishna, 1981). It is observed that the LES results are closer to those of the Nasse model. Moreover, some of the flexible systems fitted to Indian data were found to violate convexity conditions. An added advantage with the LES as compared to other demand systems is that its indirect utility function can be utilized for welfare comparisons. The above considerations as well as data availability have led us to choose the piece-wise LES.

## Model

The LES is given by:

$$v_i = p_i q_i = c_i p_i + b_i \left( y - \sum_{j=1}^n c_j p_j \right) + u_i \quad (1)$$

with: —

$$\sum_{i=1}^n b_i = 1$$

$$E(u) = 0$$

$$E(u u^1) = \Omega \otimes 1 \quad (i = 1, \dots, n)$$

where  $q_i$  represents the quantity of  $i^{\text{th}}$  commodity consumed;  $p_i$  is the price of  $i^{\text{th}}$  commodity and  $y$  is the total expenditure such that  $y = \sum_{i=1}^n v_i$ . The

$b$ 's and the  $c$ 's are the parameters of the system. The  $b$ 's are the marginal budget shares and the  $c$ 's are sometimes interpreted as committed quantities. This interpretation is only suggestive and it is not always possible to

do so, particularly when  $c_i$  is negative. A negative  $c_i$  is not inconsistent with the theory. The associated utility function of the LES is given by

$$u(q) = \prod_{i=1}^n (q_i - c_i)^{b_i}$$

The fulfillment of the second order condition of equilibrium requires that  $b_i > 0$ , i.e., no inferior goods and  $Y > \sum_j c_j p_j$ . Since it can be derived from a utility function, it satisfies the theoretical properties viz., adding up, homogeneity and symmetry of the Slutsky substitution matrix. However, the LES has a few limitations. Since the underlying utility function is additive, it becomes an unrealistic specification when we deal with a finer level of commodity aggregation. This specification, besides not allowing inferior goods, imposes too strong a specification on price effects. Nevertheless, this may not pose a problem for broad groups of consumption.

For commodity  $i$ , the income elasticity  $\eta_{i0}$ , own price elasticity  $\eta_{ii}$  and cross price elasticity with respect to  $j^{\text{th}}$  price  $\eta_{ij}$  are given: —

$$\eta_{i0} = b_i / w_i, \text{ where } w_i = p_i q_i / y$$

$$\eta_{ii} = -1 + (1 - b_i) c_i / q_i \quad (2)$$

$$\eta_{ij} = -b_i p_j c_j / p_i q_i \quad (i \neq j)$$

## Data and Estimation

The LES has been estimated from the time series of cross-section data on consumer expenditure published in the reports of the National Sample Survey Organization (NSSO) for four rounds (years). The NSSO reports provide for 12/13 expenditure classes of per capita monthly expenditure on various items including rice. In order to overcome the unattractive property of linear income effects implied by the LES model, the NSSO expenditure classes have been stratified into three groups separately for rural and urban areas. The first group corresponds to the lowest 40 per cent of the population (poor class), the second to the next 30 per cent (middle class) and the third to the top 30 per cent (rich class).

We have adopted the following four commodity classifications: rice ( $q_1$ ); other cereals ( $q_2$ ); other food ( $q_3$ ); and other non-food ( $q_4$ ). Price indices for the four broad commodity groups with 1961/62 as base have been constructed from retail prices of individual items. The LES has been estimated for each group by using non-linear estimation method (see R. Radhakrishna and K. N. Murty, 1980). The total squared correlation coefficient between the observed and the predicted expenditure ( $R^2$ ) have also been computed for examining goodness of fit.

### Results

The estimates of the LES parameter are presented in Tables V.25 and V.26. It can be seen that the LES gives a reasonably good fit. The estimates of the b parameter possess the expected signs.

The estimates of b reveal that the rural poor devote 45 per cent of their additional expenditure to rice and only 21 per cent to non-food items. Rural rich, on the other hand, spend nearly 53 per cent of their additional expenditure on non-food items and only 14 per cent on rice. More or less similar patterns are observed in urban areas. It is interesting to observe that the rural-urban differences are less pronounced than the inter-class differences.

Expenditure and price elasticities have been computed for rice in mean levels for 1985/86. The expenditure elasticity is very high for rural poor (1.4) and low for urban rich (0.24). The direct price elasticities range between -0.82 to -0.43 in rural areas and between -0.79 to 0.33 in urban areas. These are in line with other results reported for India (R. Radhakrishna and K. N. Murty, 1980). Generally, elasticities are higher in magnitude for the poor. The elasticity estimates for the state as a whole have been estimated by taking a weighted average of class specific elasticities (Table V.27).

Table V.25: LES Parameters Estimates: Andhra Pradesh, Rural

Classes/ Items Sl. No.	POOR			MIDDLE			RICH		
	b	c	R <sup>2</sup>	b	c	R <sup>2</sup>	b	c	R <sup>2</sup>
1. Rice	.4477 (.0184)	2.0096 (.5643)	.9681	.1838 (.0369)	6.8977 (.7375)	.9616	.1375 (.0241)	8.3589 (.7622)	.9536
2. Other cereals	.0661 (.0250)	1.9250 (.1114)	.6439	.0108 (.0260)	1.9217 (.1224)	.7937	.0092 (.0199)	1.8735 (.1146)	.5712
3. Other food	.2819 (.0091)	1.3784 (.2942)	.9857	.3415 (.0198)	4.3801 (1.0630)	.9892	.3200 (.0170)	6.4319 (1.3963)	.9830
4. Nonfood	.2043	1.5750 (.2673)	.9489	.4638	4.5824 (1.7594)	.9894	.5333	8.7232 (2.8431)	.9886
5. Overall			.9437			.9759			.9722

Note: Figures in parantheses are approximate standard errors.



Table V.26: LES Parameters Estimates: Andhra Pradesh, Urban

Classes/ Items Sl. No.	POOR			MIDDLE			RICH		
	b	c	R <sup>2</sup>	b	c	R <sup>2</sup>	b	c	R <sup>2</sup>
1. Rice	.3803 (.0193)	3.8331 (.8953)	.9610	.1564 (.0420)	4.7444 (.9923)	.9655	.0288 (.0142)	8.0961 (.6192)	.9690
2. Other cereals	.0454 (.0245)	.8408 (.1459)	.0989	.0153 (.0137)	.6736 (.2316)	.7966	.0076 (.0044)	.9574 (.1633)	.8658
3. Other Food	.3285 (.0204)	2.7490 (.6879)	.9453	.4429 (.0264)	-1.4448 (1.6595)	.9918	.4202 (.0271)	.5598 (6.8109)	.9727
4. Nonfood	.2458	2.2241 (.5756)	.9346	.3853	-5.449 (2.5437)	.9593	.5434 (10.069)	4.6720 (10.069)	.9715
5. Overall			.9246			.9733			.9716

Note: Figures in parantheses are approximate standard errors.

Table V.27: Price and Expenditure Elasticities for Rice, at 1985/86 Prices

Class	Price Elasticity	Expenditure/Elasticity
RURAL		
Poor	-.8241	1.3848
Middle	-.4297	.6025
Rich	-.4478	.5984
All*	-.5431	.8108
URBAN		
Poor	-.7907	1.0749
Middle	-.7087	.6265
Rich	-.3359	.2406
All*	-.6311	.6815
Rural*		
Urban	-.5698	.7716

\* Obtained by using:  $\eta = \sum s_k \eta_k$  where  $S_k$  is the share of  $k^{\text{th}}$  class in rice consumption of the entire population (rural/urban/Andhra Pradesh).

## APPENDIX V.2

## Rice Supply Function for Andhra Pradesh

There is a large body of literature available on acreage response to price for different crops in various regions and places. Raj Krishna and G. S. Raychaudhuri (1980) discuss the elasticities of rice and wheat crops. The acreage elasticity estimates for rice establish the positive response of acreage to price and show a good deal of interstate variations. Cummings (1975) using an identical model fitted to time series data for the period 1949-1969 has estimated the elasticity for rice to be 0.48 for Andhra Pradesh and -0.14 for Kerala. The available literature also suggests that estimates are more sensitive to the choice and specification of explanatory variables, and the level of data reliability rather than to functional form.

While most of the studies were confined to acreage response, only a few studies have been reported on output response (Raj Krishna, 1980; J. R. Behrman and K.N. Murty, 1983; S.L. Bapna and Rao, 1984). The available estimates on the price elasticity of rice output range between 0.30 and 0.48. However, they do not provide a separate estimate for Andhra Pradesh. We have attempted to estimate the supply function for Andhra Pradesh for the post HYV-period using the latest available data (1967/68 to 1984/85, i.e., 18 years).

We have specified the supply function as:

$$\ln Q_t = B_0 + B_1 \ln \frac{P_{Rt-1}}{P_{Ft-1}} + B_2 \ln \frac{P_{St-1}}{P_{Rt-1}} + B_3 \ln W_t \\ + B_4 H + B_5 \ln R + B_6 D_1 + B_7 D_2$$

- where QR : Rice output in tons  
 $P_R$  : Price of rice per quintal (i.e.  $10^{-1}$  ton)  
 $P_S$  : Price of sugar cane per quintal  
 $P_F$  : Price of fertilizer per quintal  
 $W$  : Real wage rate of the agricultural laborer  
 $H$  : Proportion of rice area under HYV technology  
 $D_1$  : Dummy variable takes 1 for every bad crop years viz., 1972/73, 1976/77, 1977/78, 1984/85 and 0 for the rest  
 $D_2$  : Dummy variable takes 1 for very good crop years viz., 1973/74, 1978/79, 1980/81, 1981/82 and 1983/84 and 0 for the rest.  
 $R$  : Rainfall

The estimated supply function is presented in Table V.28. The estimated functions give a good fit:  $R^2$  ranges between 0.95 to 0.97. The estimated coefficients possess the expected signs. Rice price has a positive effect on rice output, while the prices of competing crops viz., sugarcane have a negative effect. The price elasticity of rice output is taken as 0.41 as given by equation (3) in our analysis. This estimate falls within the range of earlier estimates.

Table V.28: Parameter Estimates of Rice Supply Function

S. No.	Constant	Functional form: Log linear									
		$P_{Rt-1}$	$P_{St-1}$	$W_t$	$H_t$	$R_t$	$D_1$	$D_2$	$R^2$	DW	
1.	21.570	0.632** (4.56)	-0.055 (0.68)	1.560** (7.55)	—	—	-0.074 (1.25)	0.194** (3.45)	0.86	1.82	
2.	21.070	0.630** (4.38)	-0.034 (0.35)	1.533** (6.85)	—	0.073 (0.41)	-0.064 (0.98)	0.176* (2.43)	0.85	1.87	
3.	18.470	0.408** (3.89)	-0.005 (0.08)	1.081** (6.08)	0.103** (4.19)	0.152 (1.33)	-0.123* (2.82)	0.092 (1.85)	0.94	2.16	

Note: Figures in parentheses are t-values

\* Significant at 95 per cent level of confidence

\*\* Significant at 99 per cent level of confidence

## APPENDIX V.3

## Estimation of Rice Production, Price and Consumption in 1985/86

*Rice Production*

Dependable official data on rice production are available up to 1983/84. The model supply function yields an estimate of 8.8 million tons gross rice production in 1985/86. This marginally falls short of the estimate of net production arrived by adding net exports to domestic consumption, which works out to be 9.4 million tons. We have accepted the latter estimate as it has been observed by an official committee that the area under paddy is underestimated to the extent of 10%.

*Rice Exports*

Estimates of exports have been arrived at in an indirect manner. The government gives export permits to millers equal to the quantity of rice they contribute to the FCI. Since the export price is higher than the domestic price, millers generally export all the rice for which they receive permits. Sample surveys of rice mills also confirm the above observation.

*Wholesale Prices of Rice*

We have derived procurement, negotiated, open market and export prices from the data of a sample survey of mills. The export price of raw rice is obtained from the parboiled rice price by deducting the FCI allowance for the difference in procurement prices.

*Border Price*

The import price (CIF) of rice for the year 1983/84 was available in the FCI reports. Taking it as the base, and using the time-series data on world prices given in IBRD Report 814/86, Vol. I, October 1986, p. 29, we have estimated the figures for 1985/86. To this we have added the distribution cost of rice given in the FCI Report to arrive at the border price.

*Consumption of Rice*

The latest year for which class specific consumption data on rice are available is 1977/78, although consumption data for broad commodity

groups are available for 1983. The available estimates for 1977/78 are reproduced below:

Table V.29: **Per Capita Monthly Consumption of Rice in 1977/78**

	Rural			Urban		
	Expenditure (in Rs.)	Quantity (in kg)	Implicit Price (per kg)	Expenditure (in Rs.)	Quantity (in kg)	Implicit Price (per kg)
Poor (Bottom 40%)	13.06	7.46	1.75	17.47	9.34	1.97
Middle (Next 30%)	20.71	11.46	1.81	22.19	11.43	1.94
Rich (Top 30%)	27.22	14.81	1.84	23.57	11.75	2.01
All	19.61	10.86	1.81	20.71	10.69	1.94

The estimates of class specific consumption levels for rice in 1985/86 have been projected on the basis of a lognormal expenditure distribution and the LES parameter estimates (see Appendix V.1). The lognormal distribution has been fitted to the available consumption distribution in 1983. The parameters have been updated for the year 1985/86 using past time series data on consumer expenditure and income series. The parameter estimates of the lognormal distribution for 1985/86 are given below:

Table V.30: **Parameters of Log-normal Distribution, (1985/86)**

Item	Rural	Urban
$\hat{\mu}$	7.0505	7.6657
$\hat{\lambda}$	.5337	.5705

On the basis of parameter estimates of the lognormal distribution, class specific mean level expenditures for 1985/86 have been estimated. Making use of the estimated mean level per capita expenditures and the LES estimates, consumption of rice by the various classes have been derived.

#### *Share of rice crop in the incomes of rural households*

A field survey of six villages in Nalgonda district of Andhra Pradesh conducted by the Department of Economics, Osmania University, Hyderabad in 1981 enabled us to estimate the share of agricultural crop income in rural household incomes. We have adjusted these shares using the share of rice crop income in the total agricultural income estimated for Andhra Pradesh in 1981. The shares given below therefore can serve as rough estimates.

Table V.31: **Share of Rice Crop in the Incomes of Rural Households**

Classes	Percentage share
Poor (Bottom 40%)	8
Middle (Next 30%)	28
Rich (Top 30%)	30

## Footnotes

- 1 Andhra Pradesh is one of the largest states of India with a population of 53.5 million in 1981 and an area of 275,068 sq. km. Agriculture accounts for around 50 per cent of the state's income and provides a livelihood for 70 per cent of the population. Rice is a major crop, grown in 29 per cent of the gross cropped area (12.21 million hectares).
- 2 See for a discussion on evolution of food policy in India: R.M. Chopra (1981), W.K. Olsen (1984).
- 3 A useful discussion on the foodgrain buffer stock operation in India is contained in Raj Krishna and Ajay Chibber (1984).
- 4 The traders are equipped with adequate infrastructure to observe the daily movements in various rice markets in India.
- 5 The rice milling industry in Andhra Pradesh is composed of mills with varying technologies and capacities. They may be classified as: traditional hullers-shellers, and modern rice mills. Hullers and shellers, which come under the purview of non-trading mills, undertake custom milling only and statutorily are not permitted to sell rice in the open market. Hullers-shellers which come under the purview of trading mills buy paddy, process it and sell rice in the open market.
- 6 The millers are required to contribute to the FCI 50 per cent of the milled quantity. In actual practice, millers' contribution is less than 50 per cent of the milled quantity. This is primarily due to the fact that the targets of procurement for the millers are decided before the milling season by the state government on the basis of an assessment of the likely quantity that will be milled, and the assessment often has a downward bias.
- 7 The ruling party in the state, which is different from the one at the center, included the scheme in its election manifesto in 1982. Since it had promised to provide rice to the poor at Rs. 2 per kg, it has been maintaining the price for the last three years although the FCI has been raising the issue price.
- 8 FCI pays Rs.150 per ton more for parboiled rice than for raw rice in order to meet the additional cost involved in parboiling. In Andhra Pradesh parboiling is done only for exports. In our analysis we have converted the export price of parboiled rice into a price for raw rice by deducting Rs.150 per ton from the export price of parboiled rice.
- 9 Moving average method has been employed for computing the seasonal price indices.
- 10 The Centre for Economic and Social Studies conducted a sample survey of 58 rice mills in Andhra Pradesh during 1986/87 and collected information on technology, milling capacity, processing costs and output disposal and prices received for the year 1985/86.
- 11 Retail and wholesale price data on rice are available for two varieties viz: Sort I and Sort II. The correlation between the price movements of Sort I and Sort II is very high.

## References

- Alain de Janvry and Subba Rao K., 1983, *Agricultural Price Policy and Income Distribution in India*, Oxford University Press, New Delhi.
- Andhra Pradesh Annual Budget Reports, various issues.
- Andhra Pradesh State Civil Supplies Corporation, National Sample Survey Reports.
- Bapna, S.L. 1980, *Aggregate Supply Response of Crops in a Developing Region*, Sultan Chand & Sons, New Delhi.
- Bapna, S.L. and Rao, K.R., 1984, *Forecasting Crop Output: Use of a Predictive Model for Kharif Foodgrains in India*, Oxford and IBH Publishing Company, New Delhi.
- Behrman, J.R. and Murty, K.N., 1983, *Scenario Analysis of Indian Semi-Arid Tropical Crop Markets*, Economics Program Progress Report No. 52, International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Hyderabad — 502 324, A.P. India.
- Bureau of Economics and Statistics, Hyderabad, *Season and Crop Reports of Andhra Pradesh*, various issues.
- Bureau of Economics and Statistics, *Statistical Abstract of Andhra Pradesh*, various issues.
- Centre for Economic and Social Studies, Hyderabad, *Sample Survey of Rice Milling Industry in Andhra Pradesh*.
- Chopra R.N., 1981, *Evolution of Food Policy in India*, Macmillan, New Delhi.
- Cummings, J.T., 1975, *The Supply Responsiveness of Indian Farmers in the Post-Independence Period: Major Cereals and Cash Crops*, *Indian Journal of Agricultural Economics*, Vol.30, No. 1.
- Directorate of Marketing, Hyderabad.
- Food Corporation of India, *Annual Reports*, various issues.
- Government of India, Ministry of Agriculture, Directorate of Economics and Statistics, *Bulletin on Food Statistics*, various issues.
- Government of India, Ministry of Finance, Department of Economics, *Indian Economic Statistics*, various issues.
- Hayami, Y., Subba Rao, K. and Keijiro Otsuka, 1982, *Efficiency and Equity in the Producer Levy of India*, *American Journal of Agricultural Economics*, Vol.64, No.4.
- Monthly Statistics of the Foreign Trade of India, various issues.
- Murty, K.N. and Radhakrishna, R. 1981, *Agricultural Prices, Income Distribution and Demand Patterns in a low-income country* in Robert E. Kalman and J. Martinez (eds), *Computer Applications in Food Production and Agricultural Engineering*, North-Holland Publishing Company.
- Olsen, W.K., 1984, *Seasonality, Transaction Patterns and Real Incomes of Indian Village Foodgrain Markets*, Hartford College, Oxford (mimeo).
- Radhakrishna, R. and Murty, K.N., 1980, *Models of Complete Expenditure Systems for India*, Working Paper 80-98, International Institute for Applied Systems Analysis, A-2361 Luxumberg, Austria.
- Raj Krishna and Raychaudhuri, G. S., 1980, *Some Aspects of Wheat and Rice Price Policy in India*, World Bank Staff Working Paper No. 381.
- Raj Krishna and Ajay Chibber, 1984, *Policy Modelling of a Dual Grain Market: The Case of Wheat in India*, International Food Policy Research Institute, Washington.
- Raju, V.T., 1976, *Market Surplus of Farm Products in India*, Economics Program, International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad 500 016 A.P., India.
- Subba Rao, K., 1978, *Rice Marketing System and Compulsory Levies in Andhra Pradesh*, Allied Publishers, New Delhi.
- Subba Rao, K., 1982, *Food Production, Prices and Income Distribution: A Review of Recent Trends in India*, University of Santa Cruz (mimeo).