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India: The Emerging Challenges

Essays in Honour of Prof V K R V Rao

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Foodgrain Sector: Growth, Equity and Market Intervention

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Introduction

The reciprocal relationship between foodgrain and labour markets and between foodgrain and other product markets are important in understanding the development process. The interdependency between the markets often results in simultaneous shifts in supply and demand curves in the foodgrain market. For instance, an upward shift in the foodgrain supply curve leads to an upward shift in the labour demand curve which in turn shifts up the foodgrain demand curve. The magnitude of interdependency depends on the one hand on employment-output elasticity, and on the other on the income elasticity of demand for foodgrains of the poor. Evidence also suggests that foodgrain price is a major determinant of nominal wage levels in agriculture and the urban informal sectors. The price of labour may not fall below a certain minimum determined by the cost of subsistence and hence, the labour supply curve tends to be elastic at the subsistence wage rate determined by the foodgrain price. People would be willing to starve rather than work unless the energy expended in the physical labour is compensated by the energy provided by food (Seckler, 1982). Clark and Haswell in their survey of agricultural wage rates in the subsistence economies observed that rural labour, however poor, will not do a day's work for less than the equivalent of 3 Kgs grain.

The interdependency between grain and other product markets operates through the foodgrain price effect. Since foodgrain takes a major share in the budget of the poor, a fall in foodgrain price leaves a higher margin for other items, and results in demand buoyancy in the markets catering to the poor (Radhakrishna, 1978).

Clearly, in India the most ideal situation is the one in which labour

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demand outpaces labour supply, and foodgrain supply outpaces foodgrain demand. In the Indian economy, the first condition is being violated while the second condition is being fulfilled. The potential adverse consequences of labour market failure on the foodgrain market have been, to some extent, offset by the growing size of buffer stocks as well as by the declining size of grain imports. This paper confines itself to the macro performance of the foodgrain sector of the Indian economy. It also analyses the effects of government intervention in the foodgrain market, and in particular, the effects of the liberalisation policy.

The Foodgrain Economy

Growth

India adopted a combination of policy measures to stimulate foodgrain supply in the post-independence period. While irrigation has been emphasised throughout, technology received emphasis only after the mid-sixties. India has taken advantage of the biological innovation in High Yielding Varieties (HYV) and has adopted a new strategy known as the Green Revolution.

These have produced commendable results in foodgrain production, which increased from 63 million tonnes (*mt*) per annum in 1951–55 to 139 *mt* in 1981–85 (Table 1). Irrigation was the most important source of foodgrain output growth. Seckler and Sampath (1985) have attributed one-half to two-thirds of the increase in foodgrain production directly to irrigation. Studies on the comparative performance of the agricultural sector between pre- and post-Green Revolution periods have brought out several striking features. First, the two periods differ in their sources of agricultural growth. The first period relied heavily on the expansion of cropped area, while the second period relied on yield improvements. Since the yield improvements could not fully compensate for the decline in the contribution of cropped area, the growth rate of foodgrain production declined, though marginally, from 2.88 per cent per annum during 1950–65 to 2.81 per cent per annum during 1966–85 (Hanumantha Rao *et al.*, 1988). In the case of non-foodgrain crops, both area and yield contributed to their growth. Market forces seem to have favoured their area expansion (Rao and Deshpande, 1986). Secondly, in the post-Green Revolution period, wheat experienced an acceleration in its output growth whereas most of the other crops experienced deceleration.

TABLE 1

Foodgrain Output, Imports, Procurement, Government Supply and Availability

	1951–55	*1956–60*	*1961–65*	*1966–70*	*1971–75*	*1976–80*	*1981–85*
1. Gross Foodgrains Output (mt)	63.09	72.87	83.02	87.03	103.02	120.04	138.50
2. Annual Availability							
Net (mt)	57.59	66.82	77.86	81.86	93.16	104.27	120.30
Per capita (Kg)	152.70	160.80	168.40	158.70	156.00	161.40	166.30
3. Government Availability (mt) (Annual average)							
Opening stock	1.43	0.94	2.20	2.94	4.60	15.86	14.81
Purchases	2.19	0.79	1.45	5.67	8.03	11.79	16.55
Net Imports	2.42	3.43	5.07	6.40	3.56	–0.08	1.67
Total	6.04	5.16	8.72	15.01	16.19	27.57	33.04
4. Government Supplies (mt) (Annual average)	4.64	3.84	6.45	11.14	10.17	11.55	14.55
5. Ratio of Opening Stock to Gross Output (%)	2.27	1.30	2.65	3.38	4.47	13.21	10.72
6. Ratio of Net Imports to Gross Output (%)	3.84	4.71	6.10	7.36	3.45	–0.06	1.21

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

The annual growth rate of wheat output increased from 4 per cent during the pre-Green Revolution period to 6.4 per cent during the post-Green Revolution period; but rice and coarse cereals recorded a decline in growth rate from 3.4 per cent and 2.2 per cent to 2.6 per cent and 0.85 per cent respectively. Comparatively favourable returns for wheat appear to have helped in stimulating the wheat output (Rao and Deshpande, 1986).

Thirdly, crop output tended to be more sensitive to rainfall in the post-Green Revolution period: it was estimated that a 1 per cent decline in rainfall from normal was associated with 0.17 per cent and 0.41 per cent decline in output in the pre- and post-Green Revolution periods respectively (Hanumantha Rao, *et al.*, 1988). This is significant since crop failures occur three to four times in a decade, affecting the exchange entitlements of the poor. Fourthly, agricultural growth has tended to widen inter-regional disaparities. Punjab, Haryana, Uttar Pradesh, Andhra Pradesh and Maharashtra, with a share of about 20 per cent of India's poor, accounted for 68 per cent of the incremental output in foodgrains in the post-HYV period, whereas Bihar, Orissa, West Bengal, Assam and Madhya Pradesh, with a share of about 38 per cent of India's poor, accounted for 17 per cent of incremental output.

Cereal Demand

The rate of increase in aggregate demand for cereals ($\dot{Q}$) of any income group can be expressed as (see Radhakrishna, 1978).

$$\dot{Q} = \eta\dot{y} + (1 - \eta)r + \epsilon\dot{p} - (\eta + \epsilon)\dot{\pi}$$

where y stands for total expenditure in nominal terms, p for cereal price, π for price of other items, r for population growth rate, η for expenditure elasticity of cereals, ϵ for price elasticity of cereals and dot over a variable for its rate of change. The term $\eta\,\dot{y}$ shows the demand growth due to an increase in nominal total expenditure and $(1 - \eta)\,r$ shows the demand expansion due to population growth.

The above demand expression can also be written as

$$\dot{q} = \eta\,(\dot{y} - \dot{\pi} - r) + \epsilon(\dot{p} - \dot{\pi})$$

where $\dot{q}$ is the rate of growth of per capita consumption of cereals,

i.e., $\dot{q} = Q - r$. The term $\dot{p} - \dot{\pi}$ shows the rate of change in the relative cereal price. Assuming that $\dot{\pi}$ approximates the change in consumer price index, $\dot{y} - \dot{\pi} - r$ can be taken to stand for rate of growth of per capita of real expenditure.

The implications of the demand parameter estimates given in Table 2 are illuminating. For the lowest-income group, the expenditure elasticity being close to unity, given the cereal price, aggregate demand is determined mainly by purchasing power. On the other hand, for the highest-income group, expenditure elasticity is close to zero and hence population growth rate plays a crucial role in determining the aggregate demand for cereals. Thus, population growth rate has no role to play in determining the cereal demand

TABLE 2

Total Expenditure, Own Price and Cross Price Elasticities of Demand for Cereals

Expenditure Group	*Elasticities*		
	Total Expenditure	*Own Price*	*Cross Price*
		Rural	
I Very poor	0.811	–0.678	–0.133
II Moderately poor	0.519	–0.438	–0.081
III Middle	0.283	–0.237	–0.046
IV Rich	0.169	–0.201	0.032
All Rural	0.405	–0.357	–0.048
		Urban	
I Very poor	0.883	–0.575	–0.308
II Moderately poor	0.361	–0.242	–0.119
III Middle	0.070	–0.099	0.029
IV Rich	0.067	–0.071	0.004
All Urban	0.223	–0.173	–0.050
All India	0.364	–0.315	–0.049

Note: 1. Persons below 75 per cent of the poverty line (Z) are defined as very poor, persons between 75 per cent of Z and Z as moderately poor, persons between Z and 150 per cent of Z as middle group and above 150 per cent of Z as rich. Rs 100.86 at 1983 price for rural and Rs 116.37 at 1983 prices for urban areas are taken to be the poverty lines.

2. These are based on the Linear Expenditure System estimated for each group from the National Sample Survery data of the rounds between 1969–70 and 1983.

Source: Radhakrishna and Ravi (1988).

of the poor, whereas purchasing power becomes passive in determining the aggregate demand of the rich. In the case of middle-income groups, both the factors influence the aggregate demand. Given the per capita expenditure, any redistribution of income leading to reduction in inequality would increase the demand for cereals. The direct price elasticity of demand for cereals in absolute terms is much lower for the rich as compared to the poor—implying that the effect of price adjustments is more in the lower-income groups.

Tables 3 and 4 present the changes in cereal consumption, relative prices of cereals and real expenditure. During the period 1951–56 to 1981–86, in real terms per capita cereal consumption increased at an annual rate of 0.57 per cent while per capita total expenditure increased by 1.34 per cent. In the post-Green Revolution period, i.e., 1965–70 to 1981–86, the per capita expenditure increased at an annual rate of 1.31 per cent and relative price of cereal declined by 2 per cent. Simple arithmetic would show that aggregate cereal demand would have increased by 3.25 per cent and per capita cereal demand by 0.92 per cent in the absence of changes in expenditure inequalities and tastes. These growth rates are much higher than the observed growth rates, i.e., 2.66 per cent of aggregate demand and 0.39 per cent of per capita demand. It is worth observing that the estimated demand comes closer to the growth rate of cereal production (3.07 per cent). The observed slow growth of cereal demand could arise either due to adverse income distributional shifts between and within rural and urban sectors or taste changes in favour of non-cereal items. The data gaps do not permit us to identify the key factor.

2. *Supply–Demand Foodgrain Balances*

Foodgrain production has increased at a sufficiently rapid pace and the policy goal of self-sufficiency was almost met by the late 1970s. The net annual imports of foodgrains which averaged 6.4 *mt* in 1956–70 declined to 1.7 *mt* in 1981–85 (Table 1). Consequently, the ratio of net imports to gross output declined from 7.36 per cent to 1.21 per cent. The government increased its foodgrain stock from a low level of 0.94 *mt* constituting 1.30 per cent of gross output in 1956–60 to 14.8 *mt* constituting 10.70 per cent of gross output in 1981–85.

How is this fairly good production performance related to consumption? The per capita availability of foodgrains improved steadily

TABLE 3
Per Capita Monthly Expenditure and Annual Growth Rates

	Per Capita Monthly Expenditure at 1960–61 prices							*Annual Growth Rate Between*	
	1951–55	*1956–60*	*1961–65*	*1966–70*	*1971–75*	*1976–80*	*1981–85*	*1951–55 to 1981–85*	*1966–70 to 1981–85*
1. Cereals	5.74	6.01	6.36	6.42	6.53	6.47	6.81	0.57	0.39
2. Other food	6.73	6.90	7.38	7.41	7.38	7.75	8.48	0.77	0.91
3. Clothing	1.24	1.47	1.66	2.02	2.32	2.88	3.34	3.36	3.43
4. Fuel & light	0.98	0.93	0.98	1.11	0.91	0.91	1.03	0.15	–0.48
5. Other non-food	5.11	5.68	6.60	7.37	7.74	8.53	9.92	2.23	2.00
Total Expenditure	19.81	20.99	22.97	24.32	24.86	26.55	29.57	1.34	1.31

Source: National Accounts Statistics.

TABLE 4

Commodity Group Price Indices and Annual Growth Rates

		Price Indices (1960–61 : 1.00)					*Annual Growth Rate Between 1966–70 and 1981–85*
		1961–65	*1966–70*	*1971–75*	*1976–80*	*1981–85*	
1.	Cereals	1.09	1.83	2.49	3.08	4.20	5.69
2.	Non-Cereal items	1.12	1.58	2.21	3.13	4.80	7.70
2.1	Other food	1.15	1.82	2.70	3.66	5.63	7.82
2.2	Clothing	1.05	1.26	1.81	2.69	3.85	7.73
2.3	Fuel & light	1.12	1.51	2.06	3.28	5.94	9.56
2.4	Other non-food	1.10	1.41	1.88	2.79	4.27	7.67
	All Commodities	1.11	1.63	2.26	3.12	4.72	7.34

Note: Implicit Price indices are derived from the Expenditure in Current and Constant Prices as given in National Account Statistics.
Source: National Accounts Statistics.

from 153 kg/annum in 1951–55 to 168 kg/annum in 1961–65 and then declined. However, the declining trend was reversed during 1976–80 and the per capita availability reached 166 kg/annum during 1981–85. Although gross output levels were much higher in 1981–85 compared to 1961–65, increases in population and food stock building and falling imports have resulted in more or less the same level of per capita annual availability in both the periods.

How does the per capita availability level of 166 kg/annum observed during 1981–85 compare with nutritional requirements? Following the Planning Commission's recommendation of a daily energy requirement of 2,400 Kcal per capita for rural areas and 2,100 Kcal for urban areas and assuming that 70 per cent of the energy comes from foodgrains, the per capita foodgrain requirement works out to 172 kg per annum. It is evident that at the aggregate level, India is near self-sufficiency in foodgrains. However, the problem of under-nutrition exists and arises due to inequalities in income distribution.

Our analysis suggests that among the three major sources of demand, the expansion of government stocks and net exports are closer to the policy goals, while the expansion of consumer demand falls short of expectations. The expansion of aggregate foodgrain consumption which is very close to population growth has fallen short of the supply expansion.

Market Intervention

Issues

The post-Green Revolution period marks the initiation of a comprehensive long-term national procurement-cum-public distribution policy. It has come to include tiered pricing, zonal restrictions on the grain movements between states, zonal procurement and distribution, maintenance of buffer stocks, and substantial central government subsidies on food and fertilisers. The Food Corporation of India (FCI), established in 1965, has been performing the functions of procurement, storage, movement and distribution of grains at the national level.

The annual procurement of foodgrains went up from 2.2 *mt* in 1951–55 to 16.5 *mt* in 1981–85 and presently it accounts for about 10 per cent of the foodgrain production. Public distribution rose from 4.6 *mt* in 1951–55 to 14.5 *mt* in 1981–85 accounting for 15 per cent

of the present net availability. The central government expenditure on subsidies has increased phenomenally in the recent past. In 1985–86, the central government incurred an expenditure of Rs 16.5 billion on food subsidy and Rs 22.5 billion on fertiliser subsidy; and these two together accounted for 6.8 per cent of the central government's expenditure and 75 per cent central subsidies.

The interesting questions relating to market intervention are: what are the benefits and costs associated with a procurement-cum-rationing policy? Which sections gain and which sections lose as a result of this intervention policy? Answers to the above questions may vary across states because of India's regional diversity and the decentralisation of its policy arrangements. We have tried to assess the impact of the rice procurement-cum-rationing policy upon the economy of Andhra Pradesh, a moderately rice surplus state.

Rice Market Intervention Policy in Andhra Pradesh

The Government of Andhra Pradesh operates the rice procurement policy through millers levy. This runs in conjunction with the procurement activities of the Food Corporation of India. In 1985–86, private sector millers bore a 50 per cent levy. The procurement was then split giving one unit to the FCI and half a unit to the Andhra Pradesh State Civil Supplies Corporation (APSCSC). In return for their contribution, the millers were permitted to dispose of half a unit of the levy-free rice within the state, and to sell one unit anywhere in the country at the prevailing free market zonal prices. Rice procurement level has increased rapidly after the introduction of the 'two-rupee-a-kilo' rice scheme in December 1982. The rice scheme provides a ration of 5 kg per month per person with a ceiling of 25 kgs per family, to all families with an annual income of less than Rs 6,000. Subsidised rice is being supplied to over ten million households comprising 70 per cent of the total households. In 1985–86 the scheme resulted in a subsidy of Rs 2,097 million (Rs 780 million borne by the central government and Rs 1,317 million by the state government).

Policy effects

We have made use of a systematically constructed model given in the Appendix for evaluating the welfare effects of the intervention policy. In the model, rice prices are determined in markets through a combination of government intervention and basic market forces.

The model specifies aggregate market demand as a function of open market price of rice, ration price, the volume of ration and its distribution across the classes. The aggregate supply is accounted for by the open market supply, rice procured by the FCI and APSCSC, and exports. The aggregate supply is specified to be a function of producer price which is determined by the weighted price received by the miller. Policy effects are traced through the shifts in aggregate demand and supply functions. The following four policy changes are considered:

P(1) FCI procures additional 1 *mt* 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 to 2.6 *mt* from Andhra Pradesh and ration supply from 2.15 *mt* to 3.15 *mt*.

P(2) 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.

P(3) The government withdraws from procurement and public distribution of rice and imports from abroad are allowed without any restrictions.

P(4) The government adopts a policy of self-sufficiency at the state level, i.e., rice market functions under autarky and withdraws from procurement and public distribution of rice.

We have taken 1985–86 as the bare scenario, and evaluated the effects of the four policies using the model given in the appendix. In the present analysis, the bottom 40 per cent of rural population is treated as rural poor, the next 30 per cent as rural middle class and the top 30 per cent as rural rich class. Likewise, the urban population has been classified into three classes. The poor and the middle class of both the regions are covered by the rationing scheme in Andhra Pradesh. The ration quantity supplied in the base year (2.15 *mt*) is more than the total contribution of the Centre to the PDS (1 *mt*) and state's procurement (0.88 *mt*). We have assumed that the balance (0.27 *mt*) has come from previous stocks and treated it as an exogenous variable in the model. The results are given in Tables 5, 6 and 7.

TABLE 5

Equilibrium Values under Different Policy Changes

Item	*Base Year Scenario*	*P(1)*	*P(2)*	*P(3)*	*P(4)*
Q_S	9.365	9.352	10.078	8.692	8.055
Q_M	5.277	4.264	6.983	7.717	8.055
Q_E	1.600	1.600	3.095	0.975	—
Q_F	1.608	2.608	—	—	—
Q_G	0.880	0.880	—	—	—
Q_R	2.150	3.150	—	—	—
Q_D	7.427	7.414	6.983	7.717	8.055
$\bar{p}$	2910	2900	3450	2400	1920
p_M	3020	3150	3450	2400	1920
p_E	3450	3450	3450	2400	—
p_F	2280	2280	—	—	—
p_G	2420	2420	—	—	—
PR	27.252	27.121	34.769	20.861	15.466

Note: 1. Quantities are in million tonnes, prices in Rs per tonne and producers'/millers' revenue (RP) in Rs billion.

2. Q_S : Aggregate domestic supply
   Q_M : Supply in open market
   Q_E : Rice Exported to other states
   Q_F : FCI procurement
   Q_G : State Government procurement
   Q_R : Rice distributed through PDS
   Q_D : Aggregate domestic demand
   $\bar{p}$ = Weighted price received by millers
   p_M = Wholesale open-market price
   p_E = Export price of rice
   p_F = FCI procurement price
   p_G = State Government negotiated price
   PR = Producers' revenue

It is pertinent to emphasise that changes in welfare levels given in Table 6 cannot be aggregated across classes without using welfare weights. However, welfare comparison of alternative policies for a given class is possible. Hence, in Table 6 a row-wise comparison is meaningful but column-wise is not.

The effects of P(1) in which 1 *mt* of rice is procured by the FCI and is distributed to the poor and middle classes at Rs 2 per kg involving an additional ration supply of 24.51 kg per person per year are illuminating. Rice output, producer price and producers/

TABLE 6

Welfare Changes compared to Base Year Scenario

Classes	*Base Year Scenario*			*Changes in Real Expenditure (Rs/annum/person)*			
	No. of persons (in million)	*Per Capita Expenditure (Rs/annum)*	*Per Capita Expenditure plus Income Gain Due to Rationing (Rs/annum)*	*P(1)*	*P(2)*	*P(3)*	*P(4)*
Rural							
Poor	17.5	717	771	23	– 70	– 15	23
Middle	13.1	1244	1305	21	– 25	– 69	– 89
Rich	13.1	2233	2233	–25	102	– 61	–133
Urban							
Poor	5.9	1288	1356	22	–128	38	145
Middle	4.3	2315	2392	22	–155	54	194
Rich	4.3	4338	4338	–22	– 73	111	199

TABLE 7

Rice Consumption Levels under Various Policies

Classes	*Base Year scenario*	*Per Capita Consumption of Rice (kg/annum)*			
		P(1)	*P(2)*	*P(3)*	*P(4)*
RURAL					
Poor	84.71	86.90	71.57	88.92	103.24
Middle	123.64	124.43	121.57	120.40	119.45
Rich	158.87	157.05	160.42	160.15	160.91
URBAN					
Poor	145.97	146.32	125.65	164.03	195.08
Middle	170.63	168.11	154.07	194.39	227.61
Rich	143.43	142.13	139.80	150.47	159.51

millers revenue remain more or less the same as those of the base scenario. But a highly progressive welfare transfer takes place: the poor gain substantially, while the rich lose. It is worth observing that the real income gain to the target group (Rs 21–23 per person per annum) is slightly lower than the nominal income gain (Rs 28 per person per annum). This is due to the rise in the open market price. We observed earlier that the supply of 2.15 *mt* of rice through PDS involved a total subsidy of Rs 2,097 million (centre and state). We can assume that the government expenditure on subsidy in implementing P(1) is Rs 975 million approximately. The other costs in implementing this policy are: welfare loss of Rs 328 million to the rural urban rich. On the other hand, the benefits 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, the government and the rich consumers are bearing the costs in order to raise the welfare levels of the poor.

Let use consider the inter-state trade liberalisation policy P(2). While computing the effects, it is assumed that there is no change in the export price. If procurement and public distribution are withdrawn and inter-state trade is liberalised, the export of rice from Andhra Pradesh to other states increases by 1.5 *mt* and the open market price in Andhra Pradesh increases by 14 per cent and adjusts to the level of the export price. Consequently producer price increases by 19 per cent. Farmers respond positively to the price rise and increase their output by 7.6 per cent. The net result is an increase in producers/millers revenue by Rs 7,517 million (28 per cent). Assuming that input costs account for 36 per cent of this revenue, the net gain accruing to producers/millers comes to Rs 4,811 million. The government (centre and state) also gains through a reduction in its expenditure on subsidy. Thus the total gain works out to be Rs 6,908 million. On the other hand, this policy has a negative effect of welfare loss to all classes barring the rural rich. The poor experience a decline in their real expenditure to the extent of Rs 70 per person per annum in the rural areas and Rs 128 per person per annum in the urban areas.

In P(3), liberalisation is extended further in the sense that all the restrictions on imports and exports of rice are removed. We assume that this policy results in the prevalence of a border price in all rice markets of India which is lower than the procurement price but

higher than the ration price. As expected, this policy leads to a price fall in the rice market of Andhra Pradesh. Consequently, rice production in Andhra Pradesh declines by 0.67 *mt* (7 per cent) and producer revenue by Rs 6,391 million (4 per cent). The welfare effects of the policy differ between rural and urban areas. All the rural classes experience reduction in their real incomes. On the other hand, the urban consumers gain due to the fall in the open market price. Of course, the rich gain more than proportionately due to their higher dependence on the open market. Since the border price is higher than the ration price, the urban poor lose due to the withdrawal of rationing which, however, is more than compensated by their gain due to the fall in the open market price. 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 budget constraint, it may aggravate the foreign exchange constraint. The domestic economy will also be exposed to the uncertainties in the world rice market. Moreover, the market infrastructure already built up for procurement and public distribution system may not permit drastic changes. This policy, if extended to all other agricultural commodities, may result in a fall in the incomes of the agricultural producers and, hence, sharpen the rural-urban disparities.

Under autarky, P(4), both rice output and producer price decline substantially 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 producer revenue declines from Rs 27 billion in the base scenario to Rs 15 billion. The welfare effects of this policy are more or less similar to those of P(3): all the urban classes gain but the rural middle and rich classes lose. The government expenditure on subsidies will be reduced by Rs 2,097 million because of its withdrawal from procurement-cum-public distribution. However, in contrast to P(3), the rural poor do not lose, in fact they gain marginally. It is worth observing that this policy, if adopted by surplus states, may adversely affect the consumers in the deficit states. Thus, this type of intervention leads to a conflict of interest between surplus and deficit states and between rural and urban classes.

Concluding Observations

The analysis contained in the paper brings out two striking features on the Indian foodgrain economy: the growth of foodgrain production

remained constant at 2.8 per cent per annum despite the Green Revolution and the per capita availability of foodgrains remained at 166 kg. even though the per capita real total expenditure recorded an annual rate of growth of 1.3 per cent. The apparent paradox can be resolved by hypothesising either adverse income distributional shifts or changes in tastes on the demand side.

It is worth observing that if the cereal production increases at the historical rate of growth of about 3 per cent per annum, the additional production can be absorbed only if the incomes of the poor increase rapidly, since the possibility for further increasing the level of government foodgrain stock is getting exhausted. Alternatively, the procurement-cum-public distribution activity would have to be expanded in order to prevent the cereal price decline.

The paper has also analysed the welfare effects of rice market intervention in Andhra Pradesh. A comparison between the existing situation and the postulated outcome in the event of complete abolition of the zones, withdrawal of rationing and international trade restrictions indicates that producers and the rural classes would lose and the bulk of the gains would accrue to the urban classes and, among them, progressively more to the rich. This policy shift would also result in an outflow of foreign exchange due to an increase in imports.

The Andhra Pradesh case study demonstrates how the procurement-cum-rationing policy can improve the welfare levels of the poor without affecting producer incentives. The cost of the policy would have to be shared by the government and rich consumers not covered by rationing. The extent of welfare gain to the poor depends on proper targeting of the PDS. A major drawback of the procurement-cum-rationing policy is that it tends to increase the amount of subsidy over time and this may aggravate the budgetary constraint. In the long run, there is no alternative to shifting up the supply curve and simultaneously improving the purchasing power of the poor, which implies strengthening the interdependencies between foodgrain and labour markets.

Appendix

Model

A dual model has been designed to trace the effects of intervention policies on production, consumption and welfare levels of

various segments of population. The model incorporates all the essential features of the existing public distribution policies such as procurement through imposition of millers' levy and the distribution of the same to the selected target group at a subsidised rate. The model can also be used to examine the effects of changes in inter-state trade policies.

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 Linear Expenditure System (LES). 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 price can be taken as the income gain to the consumer due to ration. 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:

$$p_1 q_{1k} = c_{1k} p_1 + b_{1k}\left[y_k + q_{Rk}(p_1 - p_{Rk}) - \sum_j c_{jk} p_j\right] \quad (1)$$

where q_{ik} is the per capita consumption of i th item by the k th class with i = 1 for rice, p_i is the price of i th commodity with p_1 = the price of rice in the open market, y_k is the per capita total expenditure of the k th class and b and c are parameters.

The aggregate demand (Q_D) is given by:

$$P_1 Q_D = \sum_k C_{1k} p_1 + \sum_k b_{1k}\left[Y_k + Q_{Rk}(p_1 - p_{Rk}) - \sum_j C_{jk} p_j\right] \quad (2)$$

where $Q_d = \sum_k n_k q_{1k}$, $Q_{Rk} = \sum_k n_k q_{Rk}$, $Y_k = \sum_k n_k y_k$

$C_{jk} = \Sigma n_k C_{jk}$ and n_k is the number of persons in the k*th* class.

The total market demand, i.e., purchases from ration shop plus those from the open market is a function of open market price, ration price, volume of ration and its distribution across the classes.

Supply Function

Using the notation given in Table 3, the supply utilisation can be expressed as

$$Q_S = Q_M + Q_F + Q_G + Q_E \quad (3)$$

The supply function is given by

$$Q_S = f(p_p) = F(\bar{p}) \quad (4)$$

Since whole of the rice procured by the APSCSC and a proportion (Θ) of the rice procured by the FCI are distributed through fair price and ration shops, we have

$$Q_R = Q_G + \Theta Q_F \quad (5)$$

It may be noted that Θ varies from year to year depending on the central government's policy in the context of nation-wide supply-demand situation.

The millers' revenue (R) and weighted price ($\bar{P}$) are given by

$$R = p_M Q_M + p_E Q_E + p_F Q_F + p_G Q_G \quad (6)$$

$$\bar{P} = R/Q_S \quad (7)$$

Market Integration

For linking supply and demand functions, we need to establish a relationship on the one hand, between retail price (p_1) and whole sale 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:

$$\frac{dp_1}{p_1} = \frac{dp_M}{p_M} \quad (8)$$

$$\frac{dp_p}{p_p} = \frac{d\bar{p}}{\bar{p}} \quad (9)$$

(8) implies that rates of change in the open market wholesale and retail prices are equal and (9) implies that the rate of change in producers' price equals to the rate of change in the weighted price received by the miller.

Policy Effects

At equilibrium $Q_D = Q_S$ and 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 (j = F, G, E) on market supply and demand are given by

$$\frac{\partial Q_S}{\partial Q_j} = \frac{1}{Q_S}\frac{\partial Q_S}{\partial \bar{p}}\left[1+\alpha\left(1-\frac{p_M}{\bar{p}}\right)\right]^{-1}\left[(p_j - p_M) + Q_M\frac{\partial p_M}{\partial Q_j}\right]-1 \quad (10)$$

$$\frac{\partial Q_D}{\partial Q_j} = \sum_k (C_{1k} + b_{1k}Q_{Rk} - b_{1k}C_{1k} - Q_{1k})\frac{1}{p_M}\frac{\partial p_M}{\partial Q_j} \quad (11)$$

where α is the supply elasticity i.e. $\alpha = \frac{p_p}{Q_S}\cdot\frac{\partial Q_S}{\partial p_p} = \frac{\bar{p}}{Q_S}\cdot\frac{\partial Q_S}{\partial \bar{p}}$

Equating and solving the above two equations we obtain the rate of change in open-market price.

Effects on $\bar{p}$ is given by:

$$\frac{\partial \bar{p}}{\partial Q_j} = \frac{1}{Q_S}\left[1+\alpha\left(1-\frac{pM}{\bar{p}}\right)\right]^{-1}\left[(p_j - p_M) + Q_M\frac{\partial p_M}{\partial Q_j}\right] \quad (12)$$

Effect of Ration

$$\frac{\partial Q_S}{\partial Q_R} = \frac{\alpha}{\bar{p}}\left[1+\left(1-\frac{p_M}{\bar{p}}\right)\right]^{-1}\left(Q_M p_M\right)\left(\frac{1}{p_M}\frac{\partial p_M}{\partial Q_R}\right) \quad (13)$$

$$\frac{\partial Q_D}{\partial Q_R} = \sum\left[C_{1k} + b_{1k}Q_{Rk} - C_{1k}b_{1k} - Q_{1k}\right]\frac{1}{p_1}\frac{\partial p_1}{\partial Q_R} + \sum\frac{(p_1 - p_{Rk})}{p_1}b_{1k}\frac{\partial Q_{Rk}}{\partial Q_R} \quad (14)$$

(13) and (14) can be solved for $\frac{1}{p_M}\frac{\partial p_M}{\partial Q_R} = \frac{1}{p_1}\frac{\partial p_1}{\partial Q_R}$

Measurement of Welfare Changes

Suppose a consumer with income (total expenditure) y and ration quantity of q_R given at p_R by the government faces market with prices $p_1, p_2, \ldots, p_n$. His equilibrium quantities will be given by

equation (1). Using indirect utility function of the LES, the utility levels can be worked out.

Let y^t, q_R^t, p^t, (t = 0,1) be the values of the variables before and after a policy change. The utility levels can be expressed as:

$$u^t = y^t + q_R^t(p_i^t - p_R^t) - \sum_j c_j p_j^t \prod_{i=1}^{n}\left(\frac{b_i}{p_i^t}\right)^{b_i} \quad (15)$$

(t = 0, 1)

The change in welfare level from u^0 to u^1 can be expressed 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 utility level equivalent to the utility level of u^1 i.e. y^{01} is equivalent income in base year prices corresponding to y^1 It can be shown that

$$y^{01} = c_j p_j^0 - I\sum c_j p_j^1 + I\left[y^1 + q_R^1(p_i^1 - p_R^1)\right] \quad (16)$$

where $I = \prod_{i=1}^{n}\left(\frac{p_1^0}{P_i^1}\right)^{b_i}$

Change in consumers welfare (dw) in terms of base year prices is given by:

$$dW = y^{01} - \left[y^0 + q_R^0(p_1^0 - p_R^0)\right]. \quad (17)$$

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. However, the feedback effects can be incorporated in the above formulations with a few alterations.

Let s_k be the share of rice crop in the income of the k th class. Assuming that the rate of change in production is uniform across all the rural classes and that the total expenditure is a fixed proportion of income of each class and can vary between the classes, the effects of Q_j and Q_R on aggregate demand are given by:

$$\frac{\partial Q_D}{\partial Q_j} = \sum_k\left[C_k + b_{1k}Q_{kR} - b_{1k}C_{1k} - Q_{1k}\right]\frac{1}{p_1}\frac{\partial p_1}{\partial Q_j} +$$

$$+ \sum_k b_{1k} \frac{\partial Y_k}{\partial Q_j} \frac{1}{p_1} \tag{18}$$

$$\frac{\partial Q_D}{\partial Q_R} = \sum_k \left[C_{1k} + b_{1k} Q_{Rk} - b_{1k} C_{1k} - Q_{1k} \right] \frac{1}{p_1} \frac{\partial p_1}{\partial Q_R} + \sum_k \frac{(p_1 - p_{Rk})}{p_1} . b_{1k} . \frac{\partial Q_{Rk}}{\partial Q_R} + \sum_k \frac{b_{1k}}{p_1} . \frac{\partial Y_k}{\partial Q_R} \tag{19}$$

$$\frac{1}{Y_k} \frac{\partial Y_k}{\partial Q_j} = s_k \left(\frac{1}{p_p} . \frac{\partial p_p}{\partial Q_j} + \frac{1}{Q_s} . \frac{\partial Q_s}{\partial Q_j} \right) \tag{20}$$

$j = F, G, E, R$

The effects on aggregate supply will be same as those obtained earlier. Substituting (20) in (18) and (19) and using them in place of (11) and (14) and following the rest of the model including the welfare sub-model, we can obtain the policy effects.

The parameter estimates of the supply-demand functions have been estimated from time-series data and the results are available in Radhakrishna and Indrakant (1988). The policy effects given in the text incorporates farm income feedback effects on demand.

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