Farm Level Storage: Orderly Marketing, the Public Distribution System and Labour Absorption

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Introduction

In most ldcs foodgrain production is marked by weather-inspired fluctuations. This in turn, given the inelastic nature of demand and supply, causes large inter- and intra-year variations in the prices of foodgrains. The seasonal nature of agricultural production and the low holding capacity of producers—due to immediate cash needs as well as to lack of proper storage facilities—results in heavy market arrivals in the immediate post-harvest months which in turn lead to a sharp decline in prices during this period. To tackle this problem effectively, ldcs have often adopted a system of domestic procurement and public distribution of foodgrains, and the maintenance of a buffer stock.

In the context of procurement on behalf of the public distribution system and the operation of the buffer stock, the need to have proper storage facilities requires no emphasis. Crudely, the alternatives are either to depend solely upon large warehouses operated by the public agencies or to improve and/or create additional storage facilities with the farmers. In Part I I shall discuss India's experience of the pros and cons of the two methods of storage from the point of view of economic efficiency.

In Part II I discuss the effectiveness of food loss prevention, labour absorption capacity, capital requirements and social cost-benefits of two techniques of improving farm level storage—improved structures based on suitably modifying the existing structures, and modern structures. For the food technologist a choice between these two would be based on relative food loss-prevention performance but for the farmer, choice of storage structure is determined by a wider range of factors, in which the commonly recognised causes of food loss are often insignificant. These factors include the local cost and availability of raw materials, space availability, security against theft, fire and flood, traditional beliefs about storage location—often reflecting local experience concerning the significance of other loss factors—and consumption patterns. Because of these factors these two techniques cannot be regarded as alternatives in all cases, but there are many situations where they can be.

I Storage: the Two Alternatives

The Indian Government follows a foodgrains price policy designed to ensure a remunerative price to the grower and, at the same time, through a subsidised public distribution system, to take account of the interests of the consumer. To make the price policy operational and effective a public agency, Food Corporation of India (FCI) has been created to undertake support/procurement purchases at a designated price on behalf of the government; these fixed prices are constant throughout the year. The stocks so acquired by this public agency are then distributed through a network of fair price shops in the country.

The success—or otherwise—of the procurement operation depends very largely upon the pattern of surpluses. While regional concentration of surpluses makes it easier for the government to procure large quantities by concentrating only in these surplus pockets, this pattern also results in an inefficient concentration of the workload for the procurement agency during the short period of heavy market arrivals. Moreover, the output of foodgrains has not increased at the same rate in different regions because growth in production over the years has been primarily concentrated only in the existing surplus regions, and thus today India has pockets of large surpluses and pockets deficient in cereals. The public sector agency makes most of its support purchases in these surplus pockets and then transports them to the consuming areas. The faster rate of increase in the foodgrain output of these surplus pockets and a policy of uniform support prices throughout the procurement season has resulted in a shift towards concentration in the pattern of market arrivals which in turn has increased the management problems of the public sector agency.

With the adoption of HYVs on a large scale from the mid-1960s, India's wheat production and, to a lesser extent, rice, increased at a rapid rate, particularly in the surplus producing states of Punjab and Haryana; of the rice consuming states the growth of rice output was highest in Andhra Pradesh. These developments resulted in a quick shift in the pattern of market arrivals.

In the Punjab in 1961-62 only 52.5 per cent of the total market arrivals of wheat fell between April to June (the immediate post-harvest period); in 1970-71 this proportion rose to 70.1, and by 1979-80 to 92.1 per cent. In the case of Haryana it increased from 67 per

Bulletin, 1982, vol 13 no 3, Institute of Development Studies, Sussex

cent in 1970-71 to 94.8 per cent in 1979-80. By contrast, in a state such as Uttar Pradesh where surpluses are only marginal, market arrivals in the immediate post-harvest period increased only slightly—from 54.0 per cent in 1961-62 to 58.3 per cent in 1979-80 (see Table 1).

In the case of rice the proportion of market arrivals during the immediate post-harvest period (October to December) increased in Punjab from 71.6 per cent in 1961-62 to 87.2 per cent in 1970-71 and to 96.5 per cent in 1978-79. In contrast, in West Bengal which is a deficit state, market arrivals during the period October to December remained almost unchanged, reaching 22.1 per cent in 1961-62 and 23.1 per cent in 1978-79 (see Table 2).

This concentration of market arrivals created problems of transportation, handling and storage as markets became choked. The pressure on the marketing system made it difficult for the public agencies to carry out their purchase operations efficiently and to maintain quality effectively. The problem of heavy market arrivals can be alleviated by opening more purchase centres but this leads to further problems of transportation, handling and storage, along with increased overhead costs to be borne by the public agency.

Nevertheless, during the post-harvest months, the number of procurement centres opened by the Food Corporation of India and the Government of Punjab increased from about 200 in 1970-71 to 684 in 1978-79, to 784 in 1979-80 and to 825 in 1980-81. Though the government agencies were thus able to procure more grain from the farmers there remained a major problem: transporting the surplus to the consuming areas. The transport system could not be synchronised with the pattern and volume of procurements and consequently FCI could not move large quantities of grain from Punjab and Haryana to other states. During the period 1976/77 to 1978/79, despite an increase in storage capacity from 16.2 lakh (100,000) tonnes to 22.8 lakh tonnes, involving the use of schools, colleges and other institutional buildings, the FCI had to keep 5.6 lakh tonnes of wheat in the open (as at 1 January 1978). Wheat stored in the open, mostly on makeshift plinths, was exposed to the weather, affecting the quantity and quality of marketable produce and resulting in severe strains in both the public distribution and transport systems. In such a situation it was clearly imperative to consider the possibility of using improved farm-level storage to achieve orderly marketing of produce.

The Agricultural Prices Commission rightly observed in 1979 that

table 1

Percentage distribution of market arrivals of wheat in different states

		period			
state	*year*	*Apr-Jun*	*Jul-Sept*	*Oct-Dec*	*Jan-Mar*
Bihar	1961-62	18.8	28.1	21.9	31.2
	1970-71	40.1	23.0	19.4	17.5
	1979-80	37.5	25.1	23.1	14.3
Haryana	1961-62*				
	1970-71	67.0	21.7	7.3	4.0
	1979-80	94.8	2.6	1.8	0.8
Madhya Pradesh	1961-62	56.0	7.9	17.4	18.7
	1970-71	42.5	8.0	25.8	23.7
	1979-80	44.3	24.7	18.3	12.7
Punjab	1961-62	52.5	22.3	15.6	9.6
	1970-71	70.1	19.6	7.6	2.7
	1979-80	92.1	5.7	1.2	1.0
Rajasthan	1961-62	48.0	15.8	17.7	18.5
	1970-71	51.8	17.9	14.3	16.0
	1979-80	60.7	17.1	12.2	10.0
Uttar Pradesh	1961-62	54.0	14.9	14.6	16.5
	1970-71	43.1	26.5	17.7	12.7
	1979-80	58.3	21.1	11.4	9.2
total	1961-62	51.2	17.1	16.4	15.3
	1970-71	56.8	21.5	12.6	9.1
	1979-80	72.6	13.2	7.6	6.6

*figures not available

> to alleviate this situation, there is a need for the public agencies to open many more primary marketing centres to be able to set up a balance between centralisation of the produce in the main grain markets and decentralisation at the purchase centres. . . . Another solution to this problem lies in developing on-farm storage facilities, which can be promoted by covering the holding costs of storage interest etc.

The above analysis clearly indicates that incentives to farmers to make more prolonged use of farm-level storage, reducing the marked seasonality of market arrivals, would ease public stock management problems. A prior concern would therefore be to improve the quality of farm-level storage, and, in the context of the

public distribution system's need for orderly marketing of produce, such improvements are most urgent in areas where production increases fastest.

II Effectiveness of the Two Techniques

To improve farm level storage two types of programme are possible: (a) propagation of improved structures based on suitable modifications in the existing structures and b) replacement of traditional structures by modern structures. Let us examine the relative merits of the two alternatives. For this purpose we shall rely on the results obtained in the Institute of Development Studies/Indian Grain Storage Institute study [Boxall, Greeley, Tyagi et al 1978] in Andhra Pradesh. In this study the effectiveness of two techniques of loss prevention, viz use of metal bins (modern structure) or use of improved storage structures along with improved practices were evaluated.

Effectiveness in loss prevention

The analysis of the weight loss of paddy in traditional unimproved stores indicated that the weight loss, though varying between different structures, was 4.26 per cent on average. The analysis further revealed that the loss in improved stores was on average 0.62 per cent in the case of the metal bin and 1.02 per cent in the case of the improved *gade.*[1] Although losses in these improved stores, where other recommended practices were properly followed, were significantly lower than the average, for the purpose of the present analysis we shall be using only the average figures, ie in the case of the improved *gade* the estimate of grain saved is 4.26−1.02=3.24 per cent and 4.26−0.62=3.64 per cent for the metal bin. Thus, the metal bins are slightly more effective in loss prevention than the improved structures.

The benefit of better storage is an increase in grain availability. The value of this grain to the economy can be perceived in the following way: if the economy requires one metric ton (1,000 kg) of grain over the storage period, then given a weight loss in storage of 4.26 per cent, 1,044 kg of paddy need to be stored in the beginning of the season; if the storage loss is reduced to 1.02 per cent through the use of an improved *gade,* then the storage requirement to obtain a net availability of 1,000 kg is 1,010 kg. Similarly, through using a metal bin, losses are reduced to 0.62 per cent,

[1]The *gade* is a basket of woven bamboo strips with an average capacity of one ton. It is the predominant storage structure in coastal Andhra Pradesh. The *gade* is vulnerable to rodent attack especially in houses with a poor standard of hygiene and in some outdoor situations. The *gade* may be rodent proofed by standing the basket on a platform. The platform protects the structure from rat attack and ground water damage and this is combined with the use of a fumigant (after mud-coating) to prevent insect infestation.

table 2

Percentage distribution of market arrivals of rice in different states

		period			
state	*year*	*Oct-Dec*	*Jan-Mar*	*Apr-Jun*	*Jul-Sept*
Andhra Pradesh	1961-62	30.9	26.0	26.3	16.8
	1970-71	33.0	31.2	23.7	12.1
	1978-79	26.1	24.0	32.3	17.6
Bihar	1961-62	16.8	26.0	35.7	21.5
	1970-71	24.4	34.9	21.1	19.6
	1978-79	26.1	30.3	22.5	21.1
Haryana	1961-62*				
	1970-71	91.6	7.8	0.5	0.1
	1978-79	94.9	3.8	1.3	neg
Karnataka	1961-62	23.9	34.8	27.5	13.8
	1970-71	25.1	32.5	21.5	20.9
	1978-79	22.6	28.4	27.6	21.4
Kerala	1961-62	13.8	37.1	22.7	26.4
	1970-71	13.3	21.7	36.6	28.4
	1978-79	31.3	22.6	29.9	16.2
Madhya Pradesh	1961-62	23.2	51.0	20.4	5.4
	1970-71	30.9	55.1	10.1	3.9
	1978-79	33.3	43.2	19.7	3.8
Orissa	1961-62	21.7	36.3	29.7	12.3
	1970-71	11.7	50.9	25.4	12.0
	1978-79	23.8	36.9	21.2	18.1
Punjab	1961-62	71.6	26.6	1.8	—
	1970-71	87.2	9.3	2.2	1.3
	1978-79	96.5	3.2	0.2	0.1
Tamil Nadu	1961-62	26.9	31.4	22.2	19.5
	1970-71	20.6	31.6	33.1	14.7
	1978-79	23.0	32.4	25.6	19.0
Uttar Pradesh	1961-62	34.9	47.7	13.1	4.3
	1970-71	40.6	40.5	12.7	6.2
	1978-79	60.6	28.5	7.6	3.3
West Begal	1961-62	22.1	32.7	25.4	19.8
	1970-71	18.1	41.5	25.5	14.9
	1978-79	23.1	31.4	24.2	21.3
total	1961-62	28.6	33.5	23.1	14.8
	1970-71	36.4	32.3	20.4	10.9
	1978-79	50.6	22.9	16.1	10.4

*figures not available

requiring storage of 1,006 kg to ensure the availability of one ton of grain at the end of the storage period. Thus the net grain saved for every metric ton of storage requirement is 34 kg in the case of the improved *gade* and 38 kg in the case of the metal bin.

Labour absorption

The construction of traditional stores, when made from timber, stone, burnt or unburnt bricks or clay, is generally done by village masons, carpenters, potters and blacksmiths. When bamboo baskets such as the *gade* are used (these are very common in the south and east) construction is generally undertaken by low-caste groups who specialise in the manufacture of these baskets near the time of harvest. Other structures, made from straw rope and commonly used by large farmers in the south and east, are constructed by specialist agricultural labourers. The *gade* is woven from bamboo strips and it was estimated that for the construction of a *gade* of one ton capacity, about six man-days are required. The amount of labour required for improving the *gades,* though varied in different regions due to the material used for making the improved platform, on average worked out to about 0.75 man-days per ton. The *gade* has to be freshly mud coated every year and this requires another 0.5 man-days. Thus, putting the life of the *gade* at 15 years, the total labour requirement works out to 14.25 man-days (Table 3).

To construct metal bins, it is estimated that for the one ton capacity about 3.5 man-days are required. In this case, however, no annual repairs are required; at most what is needed is an annual cleaning of the store, involving about an hour of labour time. Thus, over a period of 15 years, the total labour time required for this purpose may be about two days.

From the above, it is evident that in the case of loss prevention through the improved traditional store *(gade)* instead of metal bins, labour absorption of about nine more man-days per ton is possible. The Andhra study indicated that about 57 per cent of *kharif* paddy production and 47.4 per cent of *rabi* paddy production was stored at the farm-level and more than one third of it was stored in the *gades.* On this basis, in Andhra Pradesh alone, at a level of 9 mn tons of paddy production annually, in a period of 15 years, about 13.5 mn man-days of employment could be created through adoption of improved *gades* for prevention of farm level storage losses. Thus, in labour surplus areas, where employment generation is a social necessity, prevention of farm-level storage losses based on improving the existing structure would be a more appropriate programme.

Whether—in the absence of intervention—the rate of displacement would be the same as implied above in situations where the two techniques can be taken as alternatives, would depend upon a variety of demand considerations. Potentially, the social costs of displacement are high, and it is clearly necessary to investigate the effects through case studies, as the potential losers, the basketmakers (and village landless) come from amongst the poorest rural people.

Capital requirement

The capital requirement was estimated at Rs 440.25 in the case of metal bins for one ton of storage capacity. The costs of improvements in the case of *gade,* though varying in sample villages, was Rs 70.80 on average for one ton of storage capacity. The initial construction cost of the basic unimproved *gade* was found to be remarkably uniform across the sample villages and was priced at two kg of paddy for every 40 kg of

table 3

Labour absorption and capital costs of improved storage

items	*units*	*metal bins*	*improved gade*
1. loss	percentage	0.62	1.02
2. grain saved per ton	kilogrammes	38	34
3. labour requirements in construction and improvement	man-days	3.50	6.75
4. labour requirements (over 15 years) for cleaning, repairs etc	man-days	2.00	7.50
5. total labour requirements (3+4)	man-days	5.50	14.25
6. initial capital costs	(rupees)	440.72	120.80

capacity. The farm-gate price of paddy in Andhra Pradesh during 1975-76 was on average Rs 1.00 per kg and thus for one ton of capacity, the price of the *gade* worked out at Rs 50. Thus, the total initial cost of the improved *gade* worked out to Rs 120.80.

Social benefits

The accounting ratio (to convert market prices into social prices) for rice for Andhra Pradesh has been worked out by Lal [1974] at 1.037. Thus the accounting values of savings of 3.4 and 3.8 kg of paddy per quintal (100 kg) stored in 1975-76 work out to Rs 3.525 and Rs 3.941 respectively. These values are then adjusted to take account of their distribution between different economic classes by using income distribution weights [see Boxall et al 1978:110-14]. The annual value of social benefits of improved storage of one quintal of paddy for both the metal bin and the improved *gade* are presented in Table 4. The annual benefits (Table 4) of Rs 4.13 and Rs 3.69 respectively for metal bins and improved *gades* (Rs 6.24 and Rs 5.58 if pro-poor extension programmes operate) give a present value of discounted social benefits from improved storage of one quintal of paddy of Rs 29.71 for metal bins and Rs 26.56 for improved *gade* (Rs 44.91 and Rs 40.16 if the pro-poor proramme operates) on the assumption that the benefits are received each year for 15 years.

Social costs

The present value of social costs of improved storage for one quintal of paddy was estimated at Rs 26.17 in the case of the metal bin and Rs 17.61 in the case of the improved *gade;* ie the cost of the *gade* is only 67 per cent of the cost of the metal bin. Moreover, this estimate is based on the assumption that a new *gade* is purchased when the improved platform is built, which may not always be true in practice. Since it is impossible to ascribe any realistic probability value to this, we have assumed that this additional cost will be incurred in all cases. Further, it is possible that upon the introduction of either the improved *gade* or the metal bin, an old structure will be discarded which will have some positive value as scrap. Thus in many circumstances, our cost estimates will over-state, albeit slightly, true costs.

Cost-benefit ratios

The social cost-benefit ratios of improved storage by metal bins and improved *gades* are presented in Table 5 under three different assumptions regarding the distributional impact of an extension programme (in the first case no income weights are used and the second and third cases correspond to the two given in Table 4).

The ratios, with returns over the life of the improvement varying between 8 per cent and 128 per cent depending on technique and distribution, are very encouraging. Even with the relatively low loss levels from the sample store results, high rates of return are possible. Social cost-benefit ratios are designed so that any project with a positive ratio is socially desirable, but clearly the ratios are extremely sensitive to the

table 4

Social benefits from improved storage

size group of operational holding (hectares)	*per capita income*	*income weight*	*distribution of benefit*				*social benefit*			
			a		*b*		*a*		*b*	
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
less than 0.01	414	5.10	0.12	0.11	0.394	0.35	0.61	0.56	2.01	1.79
0.01 to 3.00	499	2.90	0.87	0.77	1.182	1.06	2.52	2.23	3.43	3.07
above 3.00	1,017	0.34	2.95	2.65	2.364	2.12	1.00	0.90	0.80	0.72
total (rupees)			3.94	3.53	3.94	3.53	4.13	3.69	6.24	5.58

Notes: columns 4, 6, 8 and 10 refer to metal bin use and columns 5, 7, 9 and 11 to improved gade use.

The benefits are for one year's improved storage of one quintal of paddy (100 kg). In case a) we assume that the distribution between size groups is in accordance with each size group's contribution to the total quantity stored at farm level, ie 3:22:75. In case b) we assume that an extension programme would be so organised as to concentrate slightly more on poorer households—although still only 10 per cent of the total grain in store covered by the programme would be with the landless as the ratio assumed is 10:30:60.

table 5

Social cost benefit ratios of improved storage by metal bins and improved gades

type of benefits	*method of improvement*	*social cost**	*social benefit**	*ratio*
A. without giving differential weightage to benefits accruing to different income groups	metal bin	26.17	28.35	1:1.08
	improved gade	17.61	25.37	1:1.44
B. with income distributional weights and benefits distributed between groups in proportion to quantity stored	metal bin	26.17	29.71	1:1.14
	improved gade	17.61	26.56	1:1.51
C. with income distributional weights and benefits distributed in favour of poor	metal bin	26.17	44.91	1:1.72
	improved gade	17.61	40.16	1:2.28

*for one quintal of paddy (1 quintal=100 kg)

Notes: the length of life of the metal bin is uncertain. The cost-benefit ratios if one assumes 20 and 25 years' of useful life are given below for each case:

	20	25
case A	1:1.18	1:1.23
case B	1:1.23	1:1.28
case C	1:1.80	1:1.83

Whilst not producing ratios as favourable as the improved gade with 15 years of life, these alternative assumptions do make a marked difference and, given the uncertainty over expected life, the figures in the table proper should be regarded as a minimum.

assumptions about distributional impact and its valuation; even slight modification, as in cases B and C, leads to substantially increased benefits.

Conclusion

On the basis of the above analysis, it could be concluded that the setting up of large warehouses operated by public agencies cannot alone solve the problems arising from rapid expansion of output of agricultural produce. To achieve orderly marketing of produce, programmes for improving farm storage facilities are necessary. The empirical evidence suggests that in labour surplus countries programmes based on improving traditional storage structures would be most economical on both a private and social analysis.

References

Agricultural Prices Commission, 1979, *Report on price policy for wheat for the 1979-80 crop,* Department of Agriculture, Government of India

Boxall, R. A., Martin Greeley, D. S. Tyagi, et al, 1978, 'Prevention of farm-level foodgrain storage losses in India: a social cost-benefit analysis', *Research Report,* IDS, Sussex

Lal, Deepak, 1974, 'Agricultural output conversion factors', *Technical Paper* 13, Planning Commission, New Delhi