ASCI Journal of Management
Vol. 10 No. 1 (September 1980)

Research Note

Fertiliser Storage and Distribution in the 1980s

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This is a study on Storage of Fertilisers undertaken by ASCI for the Union Ministry of Agriculture. After studying the trends in production, supply, and demands for fertilisers over the years, it has provided forecasts of storage requirements and investment needs. It has also provided suggestions for improvement of the existing distribution and storage sysems.

The Problem

During the last three decades chemical fertiliser production and consumption in India have increased by a factor of nearly 80. During 1979–80, the total national consumption was approximately 5.26 million tonnes of nutrients, while the domestic production was close to 3 million tonnes. The balance of the demand was met through buffer stocks and imports.

While in absolute terms the aggregate quantities consumed and produced are very large, India ranked relatively poorly in relation to other developing countries in terms of fertilisers consumption per hectare of the cultivated area. Additionally, a large portion of the present consumption is concentrated in approximately 30 to 40 per cent of the total area cultivated in the country as a whole. Thus, a large portion of the country's cultivable area remains under fertilised. Furthermore, there is a large unrealised irrigation potential which, when realised, would further increase the demand for fertilisers. Finally, given the overall need to increase the agricultural production in the 1980s, it follows that per hectare consumption of fertiliser can be expected to increase appreciably beyond the present levels, necessitating the distribution of still larger quantities in the future.

The distribution of fertilisers is characterised by certain peculiar aspects which arise from the temporal and spatial patterns of fertiliser consumption and production. More particularly, the production of fertilisers is concentrated in large production facilities at about 70 locations in the country. At the same time, the pattern of production is more or less uniform throughout the area with some seasonal decline in the summer months. On the other hand, the fertiliser comsumption points are dispersed throughout the cultivable area of the entire country. Also, fertilisers are applied to the crops not continuously but in three or four short intervals during the planting seasons. These factors necessitate the building-up of inventories and storage of fertilisers at various locations and for different periods during the year.

As the consumption and production of fertilisers can be expected to increase substantially during the next ten years, the distribution of the large quantities would require the criterion of new infrastructural facilities, particularly for storage and transport, as well as the optimal utilisation of the existing facilities. To fulfil these requirements, it would be necessary to estimate the structure of future demand for such facilities and to critically analyse the existing distribution system. We confined our research efforts primarily on the storage aspects. Therefore, the basic objectives of this study, stated briefly, are: (1) to estimate the country-wide storage requirements and investment needs for warehousing fertilisers in the 1980s; and (2) to examine the existing fertiliser distribution and storage systems and practices so as to suggest improvements and modifications for better utilisation of the existing and newly created infrastructural facilities.

The Approach

Storage requirements of fertilisers are related not only to the quantities consumed, produced, and imported, but also to the temporal and spatial patterns of supply and demand. As the first step, therefore, it is necessary to estimate and project the demand and supply patterns for the period of study for disaggregated regions, that is, for the States and the districts. These projected patterns can then be used to estimate disaggregated storage requirements for these regions. The region-wise storage requirements can then be distributed across the States and the districts on the basis of infrastructural availabilities. More specifically, given the pattern of transport of fertilisers which is primarily by rail, the concept of nodal point can be utilised for this disaggregation process. After specifying the quanta and locations of storage facilities at the nodal points and their hinterlands, the next step would be to examine the variety of storage structures and the associated cost in relation to the specific storage requirements for fertilisers. On these basis, an investment programme can be suggested.

The existing organisational and management and control information systems have to be reviewed in terms of their operational efficiency. On the basis of this review, which would bring out the existing constraints and difficulties, and the specification of certain efficiency criteria, it would be possible to make suggestions for improving the overall system of distribution.

The Results

a) Demand Estimates:

State-wise demand forecasts were computed utilising a least squares multiple regression model and time series data. The independent variables incorporated in this model are: cultivable area under irrigation, area under HYV seeds, rain fall, consumption in the preceding period, time trend, and closing stock. This model project the aggregate doubling of fertiliser consumption by 1988–89 to approximately to 11.4 million tonnes of nutrients from the 1979-80 level of 5.26 million tonnes. The highest increases in State-wise consumption can be expected in M P, Maharashtra, Bihar, Gujarat, and West Bengal. The expected increases in the demand for nitrogenous fertilisers are somewhat lower than those for phosphatic and potassic fertilisers.

b) Production and Import Estimates:

The basic difficulty in forecasting the aggregate production arises due to the variations in the rates of production capacity utilisation. It became necessary to conduct a survey of production facilities to obtain reliable estimates of the rates of production capacity utilisation. These data were then combined with production capa-

cities under implementation to estimate the level of domestic production till 1988-89. On this basis, the domestic production of fertilisers is expected to increase by a factor of approximately 2.35 from the 1979–80 level of 7.02 million tonnes. The highest increases in production can be anticipated in Orissa, West Bengal, Madhya Pradesh and Haryana. Between 1980-81 and 1988-89, the production of the phosphatic fertilisers is expected to increase by about 115 per cent, compared to 95 per cent increase for the nitrogenous fertilisers.

The demand and the indigenous supply projections are then utilised to estimate the import needs for the country and the States. It is estimated that in spite of the nearly 135 per cent increase in domestic production the country can be expected to have to import nearly 38 per cent (or 4-38 million tonnes of nutrients) of its consumption requirements in 1988-89. The largest demand for imports among the States can be expected from Uttar Pradesh, Punjab, Karnataka and Madhya Pradesh.

c) Storage Forecasts :

The disaggregated demand and supply forecasts are then used to project the State-wise storage requirements through a stock and flow forecasting model. This model incorporates the peculiar temporal characteristics of fertiliser consumption and production on a disaggregated basis. Certain assumption about the buffer stock requirements and other agro-economic conditions are also incorporated in the model, which generates the maximum stocks of fertilisers for each State which would have to be stored during any particular seasonal interval within the forecast period. On the basis of this stock forecasting model, the total storage capacity of 10.6 million tonnes will be required by 1988-89 for fertiliser distribution. The maximum State-wise storage requirements can be expected from Uttar Pradesh, Punjab, Andhra Pradesh, and Tamil Nadu.

(d) *Nodal Points* :

To disaggregate the State-wise storage requirements, it is necessary to take into account the transport availability, current and potential consumption levels, location of production and import points and administrative factors. On the basis of these criteria, 157 nodal points have been identified across the country. Each nodal point has one or a few districts associated with it as hinterland areas. A nodal point will act as a central receiving and distributing point for the hinterland areas. Among the States, the highest number of nodal points have been located in Uttar Pradesh and Maharashtra.

(e) Investment Needs :

To compute the investment requirements for fertilisers, it is necessary to examine the types of storage structures and the associated costs in relation to locational requirements and expected duration of storage. Once the structural and cost options have been narrowed down and estimates made of the additional storage facilities required in relation to the existing facilities, an appropriate investment programme can be devised. Because of the varieties of cost and structural options and utilisation alternatives involved, this approach projects the maximum aggregate additional storage requirements of 3.8 million tonnes and the minimum additional requirements of 1.1 million tonnes. On the basis of the cost options available and certain assumption about the locational distribution of storage capacities, these additional storage requirements imply the maximum and minimum investment requirements of Rs. 12.41 crores and Rs. 3.29 crores, respectively, by 1988-89. The projections also indicate that given the

adopted methodology of assessing the existing storage facilities, no additional investments for fertiliser storage will be required in Kerala, Haryana, Himachal Pradesh, Jammu and Kashmir, Orissa and the North Eastern regions.

(f) Suggestions for improvement of distribution and storage systems :

After reviewing the existing distribution and storage systems and their organisation, the following principles have been adopted as the criteria for suggesting improvements : (i) the distribution and organisation system should be based on the requirements of the management and control information flows ; (ii) the various distribution operations should be routinised as much as possible, and (iii) transit and storage losses should be minimised. This approach suggests that, first, the organisation for fertiliser distribution should be consolidated and integrated for more effective co-ordinating and planning. It is suggested that a Central Fertliser Co-ordinating Committee be established on a permanent basis to oversee the international, national and inter-State aspects of fertilisers supply, demand and distribution. Similarly, a State Fertiliser Co-ordinating Committee at the State level should be created to co-ordinate and plan intra-States distribution. It is suggested that the staff for these co-ordinating committees come from the existing organisations and agencies so that the organisational and jurisdictional disputes are minimised.

Secondly, it is suggested that the distribution and movement of fertilisers commence as early in the season as possible. The quantities to be moved and distributed should be based on reliable and comparable disaggregated seasonal demand and supply forecasts. The planning and implementation of these operations should be such that the mean forecast quantities demanded by each region can move at least to the nodal point level before the peak season begins. Then it would be necessary to undertake only contingency movements during the peak season. This would enable the distribution system to minimise the disrupting effects of transport and other bottlenecks during the peak season. Thirdly, it is recommended that strict adherance to well established storage and handling practices should be encouraged to reduce the transit and storage losses.

More generally, an attempt should be made to critically analyse the entire system of public distribution through the total system cost approach. □