SYMPOSIUM ON FERTILIZER DEMAND

A Symposium on Fertilizer Demand was held on January 1, 1971 during the 24th Annual Conference of the Society at Madras. Dr. V. Shanmugasundaram, Head of the Department of Economics, University of Madras, presided over the Symposium. Extended summaries of the papers presented and the views expressed by the speakers who participated in the Symposium are given below.

Shri R. Parthasarathi[1] : *Forecasting fertilizer demand*

The term 'fertilizer demand' has come to be the stock-in-trade in all offiicial discussions, business conferences, seminars, symposium etc. on the subject. But, unfortunately, on each one of these occasions, people use it loosely to mean different things. For instance, to the official spokesman, 'fertilizer demand' might mean, usually, a target fixed by the Government with a view to achieving a national objective namely self-sufficiency in food, fiber and to produce targeted levels of export crops. But to economists and marketing persons, the term refers to the proper growth potential for sales in a given period of time. A realiastic forecast of the demand for fertilizers would not be possible if the essential marketing aspects are not taken into account. The analyst may forecast demand in the sense of broad magnitude of the requirements but it is the market represented by the multitude of consumers which finally decides 'effective demand'.

Generally speaking, there are four methods of forecasting the country's total fertilizers requirements taking into account 'need based' considerations. In these methods, no account is taken of the marketing conditions of the future. The Fertilizer Associations of India in their report entitled 'Development of Fertilizer Industry' submitted to the Planning Commission in 1968 have adopted these four methods in forecasting the level of fertilizer requirements during the Fourth Plan period. A range within which the effective demand might be, was attempted in the report. The four methods adopted were (1) Straight line method of forecast based on the production of previous five years, actual distribution of fertilizers assuming compound rate of growth. (2) Population-nutrition method.

1. The Fertilizer Association of India, New Delhi.

(3) Area-crop approach (4). Assuming a 5% growth rate in food grains production, working out the requirements of fertilizers on the basis of norms of yield expressed as a ratio of plant nutrients applied to the grain produced.

Wide disparities between targets set and effective demand in respect of three major nutrients N, P & K were noticed. In order that forecasts are not too much out of line with effective demand, a forecaster need to research deeply into the market forces namely price trends, level of competition, consumers preferences, in-put out-put ratio etc. Other factors that will have to be taken into account relate to institutional and credit facilities, transportation systems and storage capacities. In other words, a systematic approach comprising the entire range of marketing activities should be the basis of fixing targets rather than a 'need based' approach. One has to look into the special characters of the fertilizers market. In first place, the demand for fertilizers is seasonal. This emphasises the need for meticulous planning of movement and storage of material in advance of the seasons. It is roughly estimated that the total offtake of fertilizers in the country may be distributed 60% during Kharif seasons just before the Monsoon start and the remaining 40% during the Rabi and third crop season. The stocking of fertilizers should, however, precede these months by atleast a month or two so as to avoid any bottlenecks in transportation. Thus the proper planning of transportation and storing of the right type of fertilizers at strategic locations is a very important factor in actualisation of demand. The second distinguished feature of the fertilizer market is that the fertilizer demand primarily results from benefit/cost ratio. All forecasts of demand should, therefore, indicate the sustainability of the forecasts from the point of view of benefit/cost ratios as they may exist during the period of the forecast. It may be pointed in this connection that it may be useful to review to what extent the non-availability of credit in the past had restricted actual sales of fertilizers. The third characteristic of fertilizers market is the farmers' attitude towards the use of fertilizers modification etc. Lastly, the changes that are happening in the status and nature of the fertilizer market itself is an important point. The margins of new high analysis products and there where acceptance by farmers have had certain important implications to the future of fertilizer in the country. There will be high competition in the market in the future period.

Main informational gaps in available data make it difficult to forecast demand with any reasonable degree of accuracy. Some of

the major items of information in this connection are :

(*a*) The farmer's rate of adoption of the recommended practices. If the practices actually followed are less than optimal levels, what are the Is it possible to quantify their effects on the demand of inputs, at least as an approximation ?

(*b*) Are there significant deficiencies in marketing facilities (*e.g.* transportation, storage, etc.) which might impede the growth in demand ? What will be the future requirements of transportation and storage facilities if anticipated levels of growth in demand should materialise ?

(*c*) What will be the order of credit available as against needs ? Are there any institutional factors which might impede the growth in demand. If so, is it possible to measure it and take note of it while forecasting ?

(*d*) What will be the effect of growing competition on the future demand for products ?

(*e*) Are there any limitations such as lack of incentives at the dealer levels, motivational problems which stand in the way of increasing fertilizer off-take by farmers ? Is it possible to quantify their effects ?

An integrated study sponsored by U.S.A.I.D. entitled 'Fertilizer Demand and Marketing Study' has been undertaken by the Fertilizer Association of India. This study is being carried out with the cooperation of leading research institutions in the country namely National Council of Applied Economic Research, The Indian Statistical Institute, The Institute of Agricultural Research Statistics and the Indian Agricultural Research Institute. There are four independent segments of study which will be carried out by each one of the institutions separately. These different parts of the study are given below :

(*i*) A study of Marketing and Distribution Facilities—by FAI.

This study is expected to provide—on the basis of a review of the current pattern, organisation and costs of distribution of fertilizers—basic information required by the fertilizer industry for the development of a dynamic market strategy.

(*ii*) A study of the Optimal Demand for Fertilizer – by ISI.

This study is expected to provide information through the use of response curves and agricultural production functions about the theoretical potential market for fertilizer over the next few years and a forecast of probable level of actual demand for fertilizers over the next few years.

(*iii*) A study of the "Use of Fertilizers and the Factors Influencing their Use by Farmers"—by NCAER.

This study is expected to throw light on the factors that influence the decisions of farmers to use fertilizers and will also analyse to what extent they may influence future growth in demand. This study is based on interviewing about 5,000 farm families about fertilizer practices. The interview will be conducted in three rounds for three consecutive years with the sample remaining fixed.

(*iv*) A supplementary study by analysing data available with the I.A.R.S. as a result of that institution's field surveys. This analysis which will aim at measuring the correlative relationships between major inputs used with particular reference to their effects on fertilizer use is expected to support the findings of the NCAER study which is based on survey approach.

These studies might provide useful answers to the missing links in the information chain at least at quantitative basis.

Dr. Daroga Singh[2] : *Demand of fertilizers in India*

The role of fertilizers' use will have to be studied along with other essential inputs. Consumption of various inputs in a given area depends on the stage of agricultural development and technology being used in that area. In a vast country like India, it would be difficult to identify a single factor with respect of which the country could be considered as homogeneous. Under the same set of given conditions, the farmers respond to a given input differently. For example, response of farmers to the application of fertilizers to the wheat crop in Ludhiana District is very much different from that of Aligarh District although the major areas under wheat in the two districts are under irrigation (irrigation being a factor which induces the farmers to use fertilizers). It will, therefore, be desirable to undertake studies

2. Director. I.A.R.S., New Delhi.

for estimation of demand of fertilizers on smaller area basis which are agriculturally homogeneous.

The concept of effective demand may be concerned with the quantity of fertilizers cultivators in a district purchase under alternative sets of cost-benefit relationships and interactions with associated inputs and other factors, if any. Effective demand under this definition is an economic concept that equates the quantity of fertilizers purchased by cultivators in a district each year with the historical benefits obtained from its use. Benefits from the use of fertilizers may be associated with weather, availability of water, crop responses, fertilizer costs, commodity prices and other factors to be determined by certain investigational analysis.

For studying the relationship between fertilizers and other factors such as weather, irrigation, crop responses, prices, technological changes and managerial skill of the cultivators etc., appropriate statistical models will have to be developed and such studies will have to be undertaken for smaller areas which are homogeneous with respect to certain characters. At present, the smallest area in which such studies may be carried out, may be a district for which official data on various aspects are available over a period of time. If the independent variables also change with time, the prediction equation for independent variables will also have to be determined and certain econometric models will have to be followed. For example, while introducing irrigation as a factor in the prediction equation of demand for fertilizers, it will be useful to study the growth rate of irrigation in order to determine the area likely to be irrigated at any furture point of time. Reliable and adequate data are not available in respect of such items as response of fertilizers to individual crops, managerial skill of farmers, crop-wise consumption of fertilizers within the districts etc. Thus, in studying the demand for fertilizers one has to examine critically the present position regarding the availability of data at district level. Before undertaking such a detailed analysis, it would be worthwhile to spend some resources for filling up the gaps in the data.

Most of the studies which have been undertaken by the various agencies for determination of fertilizers demand in future, have confined to mostly few variables and that has been the reason that the estimated demand has always been very much divergent from the actual requirements.

Ewell* in 1969 estimated the amount of fertilisers needed to achieve alternative agricultural production targets by use of an additive model. To achieve a 24 million ton increase in foodgrains in the Fourth Five Year Plan, he deducted an amount attributed to increased irrigation area and to area under high yielding varieties of crops and assumed a constant ratio of foodgrain response for each group of crops per added unit of a mixture of four parts nitrogen, two parts phosphate and one part potash.

It should be noted that this is a linear non-functional relationship with the quantity of fertilizers required to achieve the targeted foodgrain production increase calculated as a residual. It does not consider the effect of interactions or of changes in the rate of application of fertilizers by cultivators in response to possible changes in costs, crop price and other factors.

Similarly, Desai** in 1969 projected demand for nitrogen fertilizer by the use of a two step model that included area under each crop and the rate of application per unit of area in each crop. Two rates of application were assumed; the first based on observed rates for each crop in each State and the second based on the use of nitrogen at near the recommended rate. As background for this approach, Desai had used survey data to analyse factors influencing fertilizer use by cultivators. His cost-benefit proxy was the ratio of the weighted average price of nitrogen in each State in a year to the weighted average price of crops for the previous year. In general, his approach is based on the diffusion rate of growth in demand as reflected by the historical experience of cultivators before the introduction of high yielding varieties.

Many other studies support the concept that shifts to the rate of increase in demand are associated with shifts in costs and benefits of farming. Cost may change as result of adjusment in the combination of inputs such as the introduction of more fertilizer responsive varieties, added irrigation resources, new technologies in the fertilizer industry that reduce the cost of fertilizer nutrients relative to crop prices, improvements in the managerial skills of the cultivators and many unknown factors. Benefits may shift with changes in yield and

* India's Fertilizer Requirements during the 1970s.—A Report to the Ministry of Food, Agriculture, Community Development & Cooperation, Govt. of India, New Delhi. The Ford Foundation, New Delhi.

** Growth of Fertilizer use in Indian Agriculture, Past Trends and Future Demand—Associated Paper No. 24, Cornell University. Ithaca. New York, U.S.A., July 1969.

prices for each crop, adjustment in the cropping pattern, reduction in the cost of inputs, and many other factors. Fertilizer demand increasing factors tend to get concentrated in a consecutive span of years during which cultivators increase their use of nutrients in an attempt to readjust to a shift in the economic optimum rate of application.

The general hypothesis that needs to be tested is that effective demand for fertilizers in any year is the result of accumulated economic benefits cultivators have derived from its use. In theory, the farm should be the basic unit for analysis of economic demand for fertilizers. By considering the economics of farming with this unit, the effect of interactions of all input costs including fertilizers on output values should be given weights. Unfortunately, very little information is at present available regarding the use of other inputs and their interaction with fertilizers. Even information on the response of fertilizer to individual crop is at present available on a limited scale and that also for a few crops. Some economic studies* made on the basis of response data on the cultivators' fields have indicated that at present the use of fertilizers on a large percentage of cultivators' farms does not give very economic return and as a result such farmers get discouraged in using fertilizers. Intensive research is needed in locating the factors why the responses in certain areas are poor.

Shri D. M. Rao[3] : *Forecasting requirements of fertilizer company*

A company requires three types of forecasts—(*i*) Market Demand, (*ii*) Company Demand, and (*iii*) Sales Forecast. Market demand is the possible total volume of sales of product in a given time in a defined area. A forecast of Market demand forms the basis for pre-plant start up operations such as selecting suitable location for plant, type of products and quantity to be manufactured, etc. Company demand is its share of the Market demand and it reflects the possible sales with the existing marketing efforts and normal marketing conditions. The sales forecast is the expected level of company's sales based on chosen maketing plan and assumed environmental conditions.

Forecasting fertilizer demand is beset with many difficulties. A good fertilizer demand forecast requires a very careful and detailed study of the consumption coupled with good judgement by the

* Return from Fertilizers on Farmer's yields, *Indian Journal of Agri. Economics,* Oct.-Dec. 1970 pp. 25-40, by Dr. Daroga Singh etc.

3. Coromandal Fertilizers of India, Secundrabad.

forecasters. The forecasts may be short-term and long-term. For short-term planning, the company needs more accurate estimates broken up minutely into taluk or even smaller areas and the estimates will have to be worked out month wise. In a long term estimate, such detailed break-up is not required.

The methods of forecasting may be broadly grouped into two categories—trend method and area crop method. Under the trend method, a linear, non-linear, semi-logarithmic or logarithmic equation may be used with estimated demand for fertilizers as dependent variable and the time element as the independent variable. This method suffers from a number of drawbacks. It is not of much help to a company which requires more minute and accurate forecasts.

The company requires detailed information to estimate the market demand, company demand and make a sales estimate. For this purpose, they require crop areas by taluks or even smaller regions like a block. Symbolically, the different types of demand may be expressed as given below :

Market demand is ;

$$M_D = \sum_{i=1}^{n} (I_{Ii}\, W_{Ii}\, F_{Ii} + I_{Ni} U_{Ni}\, W_{Ni} + H_{Di} W_{Hi} F_{Hi} + U_{Di} W_{Ui}\, F_{Ui})$$

Company demand is .

$$C_{D_i} = \sum_{i=1}^{n} M_{Di} S_{Mi}$$

Sales forecast is:

$$\begin{aligned} S_D = C_E + \sum_{i=1}^{n} \Big[\Big\{ (I_{Di} - I_{Pi})\, W_{Ii}\, F_{Ii} + (I_{Ni} - I_{Ki})\, U_{Ni}\, W_{Ni} \\ + (H_{Di} - H_{Pi})\, W_{Hi}\, F_{Hi} + (U_{Di}\, U_{Pi})\, W_{Ui}\, F_{Ui} \Big\} S_{Mi} \Big] \\ + (F_D - F_P)\, W_F + (P_D - P_P)\, W_P + R W_R + P_C\, Q_I\, W_C \\ + A_P\, W_A + M_I\, W_M \end{aligned}$$

where :

I_{Di} is irrigated area but does not include areas under HYVs and land brought under irrigation for the first time.

I_{Pi} irrigated area next year.

W_{Ii} is weight for irrigated area. The weight is the average rate of application of N, P_2O_5 and K_2O on the crop. The average rate is not the recommended rate but is an average of farmer practice.

F_{Ii} is the precent area fertilised to the total area irrigated.

I_{Ni} is new areas brought under irrigation.

I_{Ki} is the new area likely to be brought under irrigation next year.

U_{Ni} is the effective utilisation of irrigation water.

W_{Ni} is weight for such newly brought areas under irrigation.

H_{Di} is area under high yielding varieties.

H_{Pi} is the expected area under high yielding varieties next year.

W_{Hi} is the weight for high yielding varieties.The weight is the average rate of application of N, P_2O_5 and K_2O on the crop. The average rate is not the recommended rate of application but is the average of farmers' practice.

F_{Hi} is the per cent area fertilised out of the total area under high yielding varieties.

U_{Di} is unirrigated area.

U_{Pi} is the current estimate of unirrigated area for next year.

W_{Ui} is weight for unirrigated area. The weight is the average rate of application of N, P_2O_5 and K_2O on the crop. The average rate is not the recommended rate but the average of farmers' practice.

F_{Ui} is per cent area fertilised out of the total area.

F_D is the amount of credit allowed when estimating company demand.

F_P is the amount of credit to be allowed next year.

W_F is the weight of credit allowed.

P_D is the company promotional budget used in estimating campany demand.

P_P is the amount proposed to be spent on promotion next year.

W_P is the weight for promotion.

R is the status of rainfall in the year under consideration—below normal, normal and above normal (-1, 0, $+1$).

W_P is the weight for rainfall.

P_C is purchasing capacity of farmers—below normal, normal, above normal (-1, 0, $+1$).

Q_I percentage of farmers whose purchasing capacity is affected in the current year.

W_C is weight for purchasing capacity. A forecaster should be able to place the effect of such increase or decrease in purchasing capacity in quantitative terms.

A_P is price for agricultural commodities expressed as a factor such as -1, 0, $+1$ etc.

W_A is weight expressed as tonnes of product. The forecaster has to take into account such crops as may directly affect product consumption in determining the weights.

M_I is intensity of competitors activity expressed as a factor such as -2, -1, 0, $+1$ etc., depending on the expectations whether competition is very intense, intense, normal or weak as compared to the assessment made at the time of estimating company demand.

W_M is weight for competitors' activities. The forecaster uses his judgement as to the weight to be used in terms of tonnes of product in relation to the factor he is going to use as above.

S_{Mi} is the share of the market for ith crop.

A company sales forecast is arrived at for the year as a whole and then spilt on a monthly basis. This is done on the basis of time of application of the company product on a crop. The forecaster based on the judgement of the proportion of the product that will be applied on each crop and the time when it will be applied, arrives at the sales forecast by months.

If an operational area has to be split into smaller areas than the area for which a sales forecast is made, *i.e.* instead of a district, taluk-wise or blockwise, this again is based on the percentage of area under the crop in each taluk/block to the overall rate of application and other relevant factors.

A company may arrive at a sales forecast by asking its salesmen to give an estimate of sales in the territory in which they operated or by judging the distributors' ability to perform. For estimating sales for a larger area such as State as a whole, the consumption of plant food and the share of market, may also be used.

The companies will not be in a position to gather detailed statistics of different types through surveys. It would be useful if Governmental organisations both at the Centre and the State conduct detailed large scale surveys periodically and follow them by minor surveys. The data that will be of interest to the company from such surveys are average rate of application of fertilizers by crops and by areas according to the irrigated, unirrigated areas and also under high yielding varieties and the percentage of area fertilised under these categories of areas.

Shri J. S. Sharma[4] : *Symposium on demand for fertilizers*

The demand may be looked at from two angles—short term demand and longte rm demand. For formulating the import programme, the Government would require short term forecast of requirements next year or the year after. The fertilizer factories and distributors would also require short term forecasts of demand in the coming one or two years. On the other hand, for formulating long term programmes for increasing production of fertilizers or for fixing targets of agricultural production one would require estimates of consumption or demand over a longer period say 5, 10, 15 or even 20 years.

The essential difference between the two types of demand estimates is with regard to the assumptions made regarding the changes in technology and the constraints operating on consumption. Taking up the second question viz. constraints, it was explained that such constraints as supply of agricultural credit or institutional factors like land reforms might not be wholly or substantially altered in a period of one or two years. The short term forecast can, therefore, assume that these constraints would continue to operate. On the other hand, in framing the long term demand estimates, one could assume that the availability of institutional credit would improve and that some of the tenurial constraints on investment would also be

4. Member-Secretary, National Commission on Agriculture, New Delhi.

removed partially, if not wholly. The major factor influencing short term forecast of demand is the uncertainty of weather. Weather influences the use of fertilizers by the farmers and if the weather is unfavourable the original demand forecast would go wrong. In the short run, the technology also may be taken as given. In the long term demand estimates, assumptions will have to be made regarding the possible changes in technology of agricultural production as well as of fertilizer production. For instance, if an assumption is made that high yielding varieties of rice suitable to coastal paddy areas can be evolved and use extensively by 1973-74 then one set of demand estimates will follow. If on the other hand, an alternative assumption is made that such varieties are not likely to be in wide use in the year 1973-74, another set of estimates will follow.

The spurt in consumption of fertilizers after 1965-66 could be attributed to the introduction of high yielding varieties of wheat and the accelerated minor irrigation programmes including tubewells taken up in North India. A similar spurt in fertilizer consumption might be expected when appropriate rice varieties were evolved.

In the context of change in technology, projections based on past trends would not be appropriate. Even the rates based on fertilizer practices adopted by the farmers during the last two or three years cannot also be applied to a distant future date. Similar changes in consumption patterns may also occur with improvement in fertilizer technology itself. If more efficient ways of absorption of nitrogen by plants could be evolved, the rate of application of fertilizer might go down without affecting productivity.

Another factor which influences fertilizer consumption is the ratio of price of fertilizer to price of output. This, however, could be varied as a deliberate policy measure by the Government through appropriate pricing, taxation and subsidisation policies.

Dr. W.B. Donde :[5] *Methodology for estimation of demand for fertilizers*

Projecting the demand of chemical fertilizers in Indian Agriculture becomes a difficult attempt at the stage of Indian agriculture when significant changes in the case of many factors such as soil

5. Economist, Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi.

chemistry, biology of crop/variety growth, rain fall, agricultural infrastructure, demand for agricultural commodities and economy or benefit cost considerations by cultivators, are under way. The actual level of fertilizer consumption is the product of the area on which fertilizers are used and the dose of fertilizer applied per hectare. The increase in the coverage of area might depend on the diffusion of knowledge of fertilizer use and the output response.

For estimation of demand for fertilizers, two methods are suggested. The first method is that based on marginal approach and diffusion rate. The data required for this purpose are : (*a*) output response to fertilizer use by crops in an area over a period of time, (*b*) the quantity of fertilizer consumed by crops over a period of time and (*c*) the cost of fertilizer use and prices of crops raised over a period of years. Using these data, the economic optimum rate of application of fertilizer may be derived at a level of use where the value of marginal increment in output is equal to the market price of fertilizer or the cost of fertilizer application. This level multiplied by the area under the crop would provide the optimum potential fertilizer demand for that crop in the given area. This can be compared with the actual use in that area. The distance between the optimum calculated demand and the actual demand would show broadly the shortfall in the diffusion of fertilizer use. Thus, for different situations of output response to fertilizers and cost price relationships, there would be different "optima" and "actuals". As a result of the introduction of more fertilizer responsive varieties, rise in the prices of crops or fall in the price/cost of fertilizer use, the "actuals" would be catching with the "optima" which might be moving upwards. For projecting the demand for fertilizers, assumptions would therefore have to be made in respect of future fertilizer response. The rate of diffusion could be estimated on the basis of past trend. The difference between the 'optimum' and the 'actual' would give the demand for fertilizers in the future. Thus the distance between the optimum and the actual would indicate the scope left for fertilizer promotion efforts.

This approach has the difficulty of arriving at the optimum demand under Indian agricultural conditions in which the use of fertilizers is considerably lower than that recommended by the Agricultural Departments. The calculation of associated costs would also make the determination of economic optimum a difficult proposition,

The second approach is that of identifying suitable classificatory variables for grouping the districts and evolving an estimating equation which has independent variables that make an economic sense in the present attitude of cultivators to fertilizers use. The factors that could be identified as influencing consumption of fertilizers and having some economic sense are (*i*) Progressiveness of farmers and productivity of soil which may be represented by the gross value of output, (*ii*) experience of past several years which may be identified as gross value of output and value of fertilizer used per hectare lagged by one year, (*iii*) Changes taking place in the cropping pattern and fertiliser consuming crops over a series of years, (*iv*) irrigated area by crops and (*v*) the rain fall and its variability. Some of these factors could be used as classificatory variables for grouping the districts and others as independent variables explaining the quantity of fertilizer used each year. One way of grouping the districts would be to rank them according to per hectare dose of fertilizer at the beginning and at the end of a period of study. The districts may also be grouped according to the rainfall and its availability or according to dominant crop of the district. As the Indian agriculture gets modernised, the gross value of output and the cost of fertilizers per hectare might become dominant variables determining fertilizer consumption. Till such time, the accumulated experience of the cultivators in respect of fertilizer use, cropping pattern and irrigation intensity might help to predict fertilizer consumption in future more adequately than the benefit-cost relationship.

Dr. V. Shanmugasundaram[6] : *Fertilizers Demand ; A welfare model and its statistical implications*

The basic economic issues that enter in a study of fertilizers demand under a welfare model may be considered in three groups. The first group relates to market forces under conditions of monopolistic competition, sellers market and black market prices. The constraints in this part of the study are in terms of the degree of pure competition, the frigidities from the supplier side which occasion new demand price relationship and the flow of funds. The second group relates to the conditions of social need theory and physical planning. It is not the restricted flow of loanable and disposable funds available for the purchase of fertilizer but the absorbing capacity of land and

6. Professor of Economics, University of Madras, Madras.

the cooperating factors to take care of fertilizer input in the context of assured agricultural commodity demand which is crucial to social demand for fertilizer. The third group is concerned with reconciling the model of welfare economics with fertilizer demand. In this context, the redistributive significance is to be emphasised for increasing agricultural production because the present use of market mechanism has not so far sustained it.

The welfare criteria imply the application of the Compensation Principle and the Theory of Redistribution Justice. The absorption of fertilizers in India is about 3% of the total consumption of fertilizers in the world but the relevant share of the population of India is not of this magnitude in comparison to the world population. In determining the national demand for factor inputs, the axiomatic factors of man—land ratio are, however, taken into account. The agricultural statisticians will have to estimate the measure of the intensity of the use of land without the constraints of fertilizers demand on purely money terms. Such findings on input may well be directly proportional to the pressure of population on land.

With the large amount of data available, it should be possible to construct fertilizer demand functions with welfare axioms.

Shri C. Muthiah[7] : *Effective demand of fertilizer for high yielding variety paddy (A sample study based on field investigations in selected districts)*

Viewed in the context of need based targets set for fertilizer consumption requiring a three-fold increase in consumption from the levels achieved in 1968-69, the steep fall in growth rate witnessed during 1969-70, a year of near normal weather conditions, is disturbing. Even in Tamil Nadu, with its record of high level of fertilizer consumption, the (compound) annual growth rate during the sixties has been only of the order of 15 per cent. The present system of target setting based on planned area under various programmes for different crops and the recommended dosages has led to fixation of unrealistic targets. Various surveys conducted on the High Yielding Varieties Programme, both at the national and local levels, have consistently brought out wide divergence between the recommended

7. Agricultural Economic Research Centre, Madras University, Madras.

dosages and the actual levels of applications of various plant nutrients by the selected farmers. The causes for such divergence brought out by these studies indicate the directions in which certain policy measures could be undertaken to improve and sustain the growth in effective demand for fertilizers. These studies have well established the importance of easy and enough credit facilities at economic rates of interest in the promotion of fertilizer consumption ; more than half the total short-term borrowings of farmers has gone to finance the fertilizer purchases. More research and extension efforts are required to deal with the elements of cautiousness and risk aversion by the farmers suffering from price and yield uncertainties and credit rationing ; the factors responsible for wide scale discounting of extension advice by the farmers need to be gone into in greater detail, if the rate of growth of fertilizer consumption is to be improved and sustained in the crucial years ahead. There is need for urgent measures to mitigate or minimise the uncertainity and loss caused by highly variable yield response on account of the unfavourable environmental conditions facing the HYV rice farmers. The effective level of demand for fertilizers by farmers depends on the (i) technological level, (ii) fertilizer-crop price ratio, and (iii) the timely availability of complementary inputs and services, particularly water, credit and extension services. A simultaneous inprovement on the above three broad categories of variables is bound to raise the level of demand for fertilizers appreciably.

Shri P.D. Khunte[8] : *Influence of single crop on fertilizer demand in Maharashtra*

A study of the consumption of Nitrogen in Maharashtra, during the period 1962-63 to 1969-70, has shown that the application of fertilizer has been mainly confined to sugarcane crop. It was observed that about 65 to 70 percent of total consumption of fertilizer is mainly associated with sugarcane. These was close association of rise in sugarcane area with nitrogen consumption. The coefficient of correlation at district level varied from 0·60 to 0·97. A survey undertaken during 1969 in three Districts having major and minor sugarcane growing areas has also shown that the consumption of Nitrogen is mainly associated with sugarcane.

8. The Fertilizer Corporation of India, Trombay, Bombay.