



AGENCY FOR INTERNATIONAL DEVELOPMENT

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SOME ASPECTS  
OF  
FERTILIZER USE BY SMALL FARMERS

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A REVIEW

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## SOME ASPECTS OF FERTILIZER USE BY SMALL FARMERS: A REVIEW

### Introduction

Assistance programs for fertilizer imports in recent years have had to increasingly contend against the view that such assistance would benefit the rural affluent. The theoretical underpinnings of this view rest on the established fact of uneven distribution of land in less developed countries: that it tends to concentrate social, economic and political power in the hands of affluent farmers; that by virtue of this power, the affluent tend to preempt the meager supply of credit and fertilizer for their own use.<sup>1/</sup> Other farmers, particularly the small farmers, are therefore unlikely to benefit from an increased availability of fertilizer. Empirical support for this view, however, has been mainly "anecdotal"<sup>2/</sup> comprising impressionistic or subjective accounts of field trips in some parts of India.<sup>3/</sup>

Generally, the defense of fertilizer assistance programs has been based on the imperative need for increasing foodgrain production and for maintaining an adequate supply to meet farmer's demand, particularly the requirement of the small farmers. Food output can be raised and income of the poor can be improved by the widespread application of the new agricultural technology of which fertilizer forms an integral part. Inadequate supplies of fertilizer (and indeed all critical inputs) would therefore constrain output and income growth. By and large, input markets, imperfect though these

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<sup>1/</sup> These ideas came to be strongly articulated towards the close of the sixties in the context of the spread of the high yielding seed varieties. See, for instance, Clifton R. Wharton, Jr., "The Green Revolution: Cornucopia or Pandora's Box?" Foreign Affairs, April 1969.

<sup>2/</sup> See, I. J. Smeun, Small Farmers and the Landless in South Asia, World Bank Staff Working Paper No. 300, February 1979.

<sup>3/</sup> For instance, Francine Frankel, India's Green Revolution: Economic Gains and Political Costs, Oxford University Press, Bombay 1971. Also, W. Ladejinsky, "The Green Revolution in Punjab: A Field Trip", Economic and Political Weekly, June 28, 1969.

are in some respects, do function normally - that is, allocate available supplies according to demand. Preemption of the supply of an input like fertilizer by some sections might occur only when the input is in short supply.<sup>4/</sup> It is then that access to fertilizer gets blocked by blackmarketing and exorbitant prices. The worst affected farmers in such situations are invariably the small farmers. Since domestic fertilizer production is insufficient, imports of fertilizer, ensuring a plentiful availability, would thus be essential to enable the smaller farmers to get their due share of fertilizer.

Understandably enough, this line of defense has not satisfied the critics fully. One reason for this dissatisfaction is the

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<sup>4/</sup> This view was strongly articulated by Mellor as early as 1969. Cf. "If the inputs are not available, the benefits are not received. In a situation of scarcity, cultivators with small holdings and with consequently less economic, political and social power are least likely to obtain the inputs. This is likely to prevail even if there are special programs for small farmers. Under such circumstances the high yield varieties can lead to further unnecessary widening of income disparities. Both from the point of view of accelerating overall rates of production growth and from the point of view of helping the small cultivator, the most useful means of dealing with this problem is by making inputs abundantly available. With an easy supply situation small cultivators will normally obtain ample supplies." See, Statement of John W. Mellor in Symposium on Science and Foreign Policy: The Green Revolution (Proceedings before the Subcommittee on National Security Policy and Scientific Developments of the Committee on Foreign Affairs, House of Representatives, Ninety-first Congress, First Session, December 5, 1969. U.S. Government Printing Press, Washington 1970). Reporting on a study of West Godavari, Andhra Pradesh, India, G. Parthasarathy observed, "Inputs were often in short supply. When this occurred, it was the tenants and small farmers who went short." See, International Rice Research Institute, Changes in Rice Farming in Selected Areas of Asia, Los Banos, 1975. See also, K. S. Gill and S. S. Johi, Distribution of Fertilizers in Punjab, Punjab Agricultural University, Ludhiana, 1973.

feeling that the defense sidesteps the entire issue of equity. The concept of equity, however, has never been satisfactorily defined in the context of fertilizer use. Concerns, though not articulated in exact terms, seem to arise from the assumptions that (a) fewer small farmers would use fertilizers; (b) that the distribution of fertilized land would favor the group of large farmers; and (c) that the share of the small farmers in total fertilizer consumption would be exceedingly small. The issues are invariably posed in a narrow "small-vs-large farm" framework - one that completely disregards the existence of farms that are neither large nor small.

To take up the question of shares first, it seems intuitively obvious that equality in this respect cannot be obtained when farm sizes are unequal and the distributions of farms and operated land by farm size are skewed in opposite directions. Fertilizer consumption on a half hectare holding, after all, can never equal the consumption on a ten hectare holding. It seems reasonable to assume that fertilizer use in any given situation must have a relationship with the size of land that is fertilized. Following this line of reasoning further, it would seem that the rationality of farmers implies that they would each be trying to optimize the application of fertilizer under their particular circumstances and that the rates of fertilizer application per unit of land would not vary greatly with size of holding. Since the share of each group of farmers in fertilizer consumption is a product of the rate of fertilizer applied per unit of land and the land fertilized, it may be

expected to follow closely the distribution of fertilized land by farm size. If the fertilized land is unevenly distributed, so would be the shares in fertilizer consumption.

Departures from this close correspondence between the two distributions can occur in two different situations. First, when the input is in short supply in relation to demand, resultant higher prices may easily force those farmers with poorer resource base to use less (if at all) fertilizer per unit of land than others; second, when the smaller farmers tend to use greater quantity of fertilizer than others in order to maximize output from their limited land holding (that is, when they tend to substitute more and more fertilizer for the unavailable land). In either situation, it is the rate of fertilizer application that seems to indicate whether or not fertilizer use is equitable. In the first situation, both the rate of fertilizer use and the share of consumption would be directly lower on the smaller farms, while in the latter, the share would be indeterminate, though the rate of fertilizer use would be distinctly higher on the smaller farms. Stated this way, the equity concept becomes more tractable, and certainly objectively verifiable in terms of data.

The verification is, of course, easier said than done. No study has so far been conducted specifically with the equity issues in view. Mostly, studies were undertaken in response to pressing policy needs of the time to provide, for instance, estimates of fertilizer demand, or fertilizer use by crops,

or estimates of quantities of different kinds of fertilizers (such as urea, ammonium sulphate, etc.) used for different kinds of crops by different groups of farmers and the like. Consequently, the data these studies provide are inadequate for the purpose of estimating variables that are appropriate for the investigation of equity issues. However, under certain simplifying assumptions a few indicators can be derived from them; but generalizations based on these indicators would necessarily be indicative of the directional tendencies rather than conclusive statements.

This review, based on the data from two separate studies, needs to be viewed in this perspective. It is concerned with the development of (a) the distribution of fertilizer users that identifies the direct beneficiaries of fertilizer; (b) the distribution of fertilized land, which shows how the area benefiting from fertilizer is distributed among different groups of fertilizer users; and (c) the distribution of fertilizer consumption indicating the share of each group of fertilizer users in the total fertilizer consumed. It does not claim to settle the issues, but it does marshal available evidence on the directional tendencies underlying the distribution of fertilizer among farmers.\*

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\*Given this focus of the review, several areas of interest will remain outside its purview. One of these is the interregional variations in fertilizer consumption. There has been no substantive change in this regard since the Fertilizer Promotion Project Paper was developed in 1979. A scheme has been initiated recently to subsidize transportation of fertilizer to remote areas, but it is too early to evaluate its impact. Another area of interest left out of this paper is the relationship between agricultural credit and fertilizer use. The extensive literature on this subject was reviewed in "Production Credit and Fertilizer Consumption: A Review of Literature", USAID/India, September 1980. There has been no qualitative change in this area that would call for a fresh look into the question.

The NSS Study

As part of its survey on landholdings conducted in the 26th Round (July 1971 - September 1972), the National Sample Survey (NSS) had collected plotwise data on use of chemical fertilizers for each holding operated by the sample households.<sup>5/</sup> The data related to irrigated and unirrigated crops, the area under each crop treated with different types of fertilizers (urea, ammonium sulphate, superphosphate, mixed fertilizers, and "other fertilizers"), and the quantity and the value of the fertilizers applied. Taking the irrigated and the unirrigated crops together in 1971-72, according to this study, 14.9 million holdings used urea and 4.9 million used ammonium sulphate; the holdings using superphosphate, mixed fertilizer and "other fertilizers" totalled respectively 2.5 million, 3.7 million and 2.5 million. Similar information is available with regard to the area treated with each fertilizer and the quantity and the value of such fertilizer.

Even so, the distributions we are interested in cannot be derived from these data in a straight forward manner. Had the farmers applying different types of fertilizers been mutually exclusive - that is, had each one been using only one fertilizer - a simple addition across fertilizer types and over farm sizes would have yielded the distribution of fertilizer users by farm size. As it is, the additivity principle is not strictly admissible, since some farmers using urea, for instance, apply superphosphate and/or muriate of potash as well. A simple addition across the types of fertilizers and over farm sizes leads, under the circumstances, to double counting. The same problem exists in regard to the

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<sup>5/</sup> National Sample Survey, "Fertilizer Use in Agricultural Holdings: Area Under Crops and Use of Fertilizers in Rural Areas, NSS 26th Round (July 1971 - September 1972)," Sarvekshana, October 1978.

other variables - area fertilized and quantity or value of fertilizers consumed.

Despite this shortcoming, however, the data relating to nitrogenous and mixed fertilizers may be utilized to derive a meaningful profile of fertilizer users. Indian farmers generally prefer to use nitrogenous fertilizers and few rely exclusively on phosphatic or potassic fertilizers. Further, farmers, who want to fertilize land with nitrogen, are most likely to derive all their requirement from one source (such as urea) rather than from multiple sources. In view of these considerations, it seems reasonable to assume that holdings using nitrogenous and mixed fertilizers are mutually exclusive and therefore additive. Since these two types of fertilizers together accounted for more than 80 percent of all fertilizers consumed in 1971-72, this approach would seem to lead to a close approximation to a comprehensive profile of fertilizer users and to the totality of fertilizer use.

Table 1 has been constructed from the data on all crops, irrigated and unirrigated, showing the number of holdings using nitrogenous and mixed fertilizers (column 1), the area treated with these fertilizers (column 3), the rate of application per hectare (column 5) and the total quantity of these fertilizers used (column 6). Each of these items has been grouped by size of holdings, of which there are five. Following conventional usage in India, holdings with less than a hectare of land are taken here to be "marginal" holdings; those with land between one and two hectares, "small" holdings. Following

TABLE 1

USE OF NITROGENOUS AND MIXED FERTILIZER: NUMBER OF HOLDINGS,  
 AREA, RATE OF APPLICATION AND QUANTITY USED, ALL INDIA  
 ALL CROPS, 1971-72

Size of Holdings (hectares)	Number of Holdings using fertilizers (million) (1)	Percent (2)	Area Fertilized with Fertilizers (million ha) (3)	Percent (4)	Rate of Application (kg/ha) (5)	Quantity of Fertilizers Used (000 tons) (6)	Percent (7)
0 - 1	8.849	37.41	3.410	12.62	113.4	386.725	14.12
1 - 2	6.015	25.42	5.265	19.49	98.4	518.038	18.91
2 - 4	4.808	20.32	6.753	25.00	98.4	664.270	24.25
4 - 10	3.208	13.56	8.148	30.17	102.2	832.766	30.40
10 & Above	.666	2.81	3.422	12.67	98.3	396.506	12.28
All Sizes	23.654	100.00	27.006	100.00	---	2738.499	100.00

Source: Sarvekshana, October 1978.

Note: "Fertilizers" include urea, ammonium sulphate and mixed fertilizers.

the same usage, "large" holdings are taken to be those with more than 10 hectares of land, while those with land between 2 and 4 hectares and between 4 and 10 hectares, respectively as "semi-medium" and "medium" farms.

From column 1, we see that 23.6 million holdings used (and were therefore the direct beneficiaries of) fertilizers<sup>6/</sup> in 1971-72; of these 8.6 million were marginal and 6 million were small holdings. Semi-medium and medium users totalled 4.3 and 3.2 million respectively, while large holdings numbered about .66 million. These estimates seem to settle at least one issue: whether fewer small and marginal farmers would be the direct beneficiaries of fertilizers. As these estimates indicate, they are certainly not fewer in number and, relative to other groups of farmers, they are the single largest group of farmers directly benefiting from fertilizer use. The percentage distribution of fertilizer users by farm size is shown in col 2. About 37.4 percent of the users were marginal while 25.4 percent were small farmers and together they comprised about 62.8 percent of all fertilizer users. The large, medium and semi-medium farmers respectively formed 2.8, 13.6 and 20.3 percent.

Column 3 shows that about 27 million hectares were treated with fertilizers in 1971-72, of which 3.4 million were in marginal and 5.3 million were in small holdings; about 6.7 million and 8.1 million hectares treated with fertilizers were

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<sup>6/</sup> Hereafter, in this section, we use "fertilizer" to mean nitrogenous and mixed fertilizer.

in semi-medium and medium holdings, while 3.4 million were in large holdings. The percentage distribution of fertilized area by farm size is shown in col 4. There was no difference between the marginal and large holdings at the two ends of the distribution - about the same proportion of fertilized land was cultivated in these two groups. However, the extent of fertilized land was largest, both in absolute and relative terms, among the medium and the semi-medium holdings.

The rates of application of fertilizer are shown in col 5. The marginal holdings led all other holdings in respect of the quantity of fertilizer used per unit of land (113.4 kg/ha ). The medium holdings ranked next with 102.2 kg/ha. There was no significant difference in respect of the application rate among other holdings. This seems to indicate that access to fertilizer was open to all groups of farmers irrespective of size and that there was no significant barrier to the use of fertilizer. The marginal farmers used greater than the average rate of fertilizer per hectare possibly in order to maximize total output from their small holdings.

Quantity of fertilizers used in col 6 is the product of area fertilized (col 3) and rate of application (col 5). Of the 2.7 million tons of fertilizers consumed, about 327 thousand tons and 513 thousand tons were used in marginal and small holdings respectively. Large holdings used 336 thousand tons while the semi-medium and the medium holdings respectively used 664 thousand and 833 thousand tons. Percentage distribution of fertilizer consumption is shown in col 7. The group

shares of the marginal and the small holdings were greater than that of the large holdings. The largest share, however, accrued to the medium holdings. The share of the small and marginal holdings taken together was slightly greater than their share in the fertilized land.

For reasons noted earlier, these conclusions would seem to be applicable to all fertilizer users. It seems unlikely that the overall patterns of distributions would have been substantially different if phosphate and potassic fertilizers also were taken into account. At the same time, it should not be overlooked that the NSS study related to a period when the High Yielding Varieties Program was at an early stage; fertilizer use was still very limited to a few farmers and to a small proportion of cultivated land. Some deviation from the overall patterns of distribution at a later period when the new technology has had time to cover a significant part of the cultivated land cannot therefore be entirely ruled out. In the following section we turn to examine a recent survey of fertilizer use carried out in 1976-77.

#### The NCAER Study

The National Council of Applied Economic Research (NCAER) carried out a survey of fertilizer use over a period of two years - 1976-76 and 1976-77. The survey was based on a sample of about 22,000 cultivator households in the country. Some of the preliminary estimates relating to 1975-76 were utilized in the preparation of the Fertilizer Promotion

Project Paper.<sup>7/</sup> Recently, data for the year 1976-77 have been released by the NCAER.<sup>8/</sup> This section of the review is based on this latter set of data.

The objective of the NCAER study was to develop estimates of fertilizer demand state by state and for the country as a whole. The survey was designed to measure, within an error margin of  $\pm 5$  percent, the input of fertilizer per unit of land for major crops (irrigated, unirrigated, traditional and modern varieties) in each state. It was not designed to estimate other characteristics, such as the number of holdings or area operated, with the same degree of precision; these aggregate estimates, according to the report, are subject to a greater margin of error. However, the ratio estimates of the study have generally a greater precision, and the study recommends that these ratios be applied to appropriate official records for the estimation of aggregates, such as fertilizer consumption.<sup>9/</sup>

In this section we shall use the ratio estimates of the NCAER in conjunction with the Agricultural census data on number of operational holdings and operated area, to derive the aggregate estimates of fertilizer users, fertilized land and fertilizer consumption.<sup>10/</sup> The focus of the NCAER study was on cultivator households, while the Census was based on retabulation of data

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<sup>7/</sup> NCAER, Fertilizer Demand Study, Interim Report

<sup>8/</sup> NCAER, Fertilizer Demand Study, Final Report

<sup>9/</sup> Interim Report, Volume I

<sup>10/</sup> The reference year for both the NCAER study and the Agricultural Census was 1976-77.

on operational holdings and operated area from village records.<sup>11/</sup> However, the NCAER survey took account of operational holdings as well, using a definition similar to the one used by the Agricultural Census.<sup>12/</sup> This fact, together with the NCAER view that its ratio estimates could be applied to official data for estimation of aggregates, enables us to make conjunctive use of the two sets of data.<sup>13/</sup>

The NCAER estimates of percentages of farms using fertilizer<sup>14/</sup> by farm size and by states are shown in Table 2. These percentages have been generally taken to be the adoption rates in the extensive literature on the green revolution.<sup>15/</sup> As the table indicates, about 45 percent of all Indian farms, irrespective of size, use fertilizer. This is the overall extent of fertilizer adoption.

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<sup>11/</sup> The Agricultural Census data includes institutional operators - cooperative farms, state farms, trusts and corporations - and the area operated by them while the NCAER study does not. While the inclusion of institutional operators may not make much difference in the small categories of farms, it does introduce an upward bias in the aggregate estimates for the large farms, particularly in regard to land fertilized and fertilizer consumed. This limitation needs to be borne in mind throughout this section.

<sup>12/</sup> See, T. K. Roy and H. Y. Siddiqi, "Fertilizer Use in India: Role of Small and Marginal Farmers", Margin, Vol. 12, No. 4.

<sup>13/</sup> Throughout this section we shall use the terms: farms, cultivator households and operational holdings (or simply holdings) interchangeably.

<sup>14/</sup> "Fertilizer", in the NCAER data, refers to plant nutrients N, P and K. In this section, therefore, fertilizer data relate to plant nutrients.

<sup>15/</sup> The ratio between the number of farms using a modern input (such as high yielding varieties of seeds, or fertilizer) and the total number of farms is generally taken to be the adoption rate for that input. See, Michael Schluter and John W. Mellon, "New Seed Varieties and the Small Farm", Economic and Political Weekly, March 25, 1972. Also, Biplab Das Gupta, The New Agrarian Technology and India, McMillan, Delhi, 1980, p. 225.

TABLE 2

-14-

PERCENTAGE OF FARMS USING FERTILIZER  
BY FARM SIZE AND BY STATE, 1976-77

State	Size of Farms (Hectares)					All farms (6)
	Below 1 (1)	1-2 (2)	2-4 (3)	4-10 (4)	10 & Above (5)	
Punjab	71.8	94.4	96.9	98.7	100.0	95.3
Kerala	77.8	96.4	84.6	100.0	--	80.1
Tamil Nadu	67.0	75.1	87.2	89.5	80.6	73.7
Haryana	44.1	57.0	60.5	89.6	95.4	68.6
West Bengal	61.1	64.8	81.9	75.4	100.0	65.7
Gujarat	53.2	55.9	67.4	71.5	75.3	65.0
Andhra Pradesh	44.9	66.5	75.2	75.0	90.0	62.2
All India	36.8	44.8	55.2	55.4	58.8	45.2
Bihar	29.1	55.7	66.4	72.2	90.6	44.9
Uttar Pradesh	30.0	44.4	74.4	76.4	98.7	44.6
Maharashtra	38.7	41.4	38.4	53.0	63.1	43.9
Jammu & Kashmir	47.6	35.1	27.1	25.5	--	40.4
Karnataka	34.4	39.7	39.8	41.2	37.5	38.5
Himachal Pradesh	22.2	46.0	44.8	47.6	100.0	28.8
Rajasthan	13.8	17.6	36.5	34.3	28.4	26.4
Orissa	9.8	26.3	31.9	34.4	60.0	19.8
Madhya Pradesh	9.9	9.8	20.4	19.9	40.6	16.4
Assam	3.9	5.5	8.9	8.2	--	5.3

Source: NCAER, Fertilizer Demand Study, Final Report

The data make it abundantly clear that the extent of adoption varies considerably from state to state. At one end of the spectrum, showing the least adoption, is Assam with barely 5 percent of farms using fertilizer; at the other end is Punjab, where more than 95 percent of the cultivators use fertilizer. The adoption rates are higher than the all-India average in seven states. States ranked by descending order of magnitude of the adoption rate are: Punjab, Kerala, Tamil Nadu, Haryana, West Bengal, Gujarat and Andhra Pradesh. Fertilizer adoption rates are lower than the national average in ten states. These, ranked again in descending order of magnitude of the adoption rate are: Bihar, Uttar Pradesh, Maharashtra, Jammu and Kashmir, Karnataka, Himachal Pradesh, Rajasthan, Orissa, Madhya Pradesh and Assam.

The adoption rates also vary from one size-group of farms to another. Taking the country as a whole, the adoption rates are about 37 percent among marginal holdings, 45 percent among small holdings, 55 percent among both semi-medium and medium holdings and about 59 percent among large holdings. At the state level too, there is a wide variation in the percentage of fertilizer users among different categories of farms. With the exception of Jammu and Kashmir, where this percentage appears to be inversely related to farm size, in all other states it seems to rise with an increase in farm size.

In the literature on the green revolution, these varying adoption rates have been the subject of extensive discussion. Seldom however, if at all, have these rates or percentages

been viewed in the context of the original data. Percentages can sometimes be deceptive; especially when they are derived from different bases or totals, they tend to obscure significant aspects of the original data.<sup>16/</sup>

The percentages of fertilizer users in each farm size-group for India as a whole are shown alongside the data on operational holdings in Table 3. Column 1, showing the number of holdings in each size-category, is extracted from the Agricultural Census of 1976-77. Column 2, showing the percentage of holdings using fertilizer, is brought over from Table 2. The number of fertilizer users in Column 3 is simply the product of Columns 1 and 2.

The percentages in Column 2 show that adoption is positively related to farm size. The percentage of marginal holdings using fertilizer is the smallest (36.8 percent) while that of small holdings is slightly larger (44.8 percent). It increases with the rise in size of farms. In the largest size-group of farms, the percentage of fertilizer users is 60.8 percent. These percentages tend to give the impression that fewer marginal and small farmers use fertilizer compared to large farmers. That this impression is totally incorrect can be observed at once from the data in Column 3. Of the 35 million fertilizer users in India, about 16.4 million are marginal and about 6.6 million are small farmers; 6.4 million are semi-medium and 4.6 million are medium operators. Large farmers using fertilizer total 1.4 million.

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<sup>16/</sup> W. J. Reichman, *Use and Abuse of Statistics*, Pelican. See specially, Chapter 6: "The Persuasive Percentage".

TABLE 3

PERCENTAGE DISTRIBUTION OF FERTILIZER USERS  
BY FARM SIZE, ALL INDIA, 1976-77

Farm Size (hectares)	Number of Holdings (million) (1)	Percentage of holdings using fertilizer (2)	Number of Fertilizer users (million) (3)	Percentage distribution (4)
0-1	44.53	35.8	16.39	46.29
1-2	14.70	44.8	6.59	18.61
2-4	11.64	55.3	6.44	18.19
4-10	8.21	55.4	4.55	12.85
10 & Above	2.44	58.8	1.43	4.03
Total	81.52	45.2	35.40	100.00

Source: Col. 1. From Agricultural Census, 1976-77  
Col. 2. From Table 1, this review

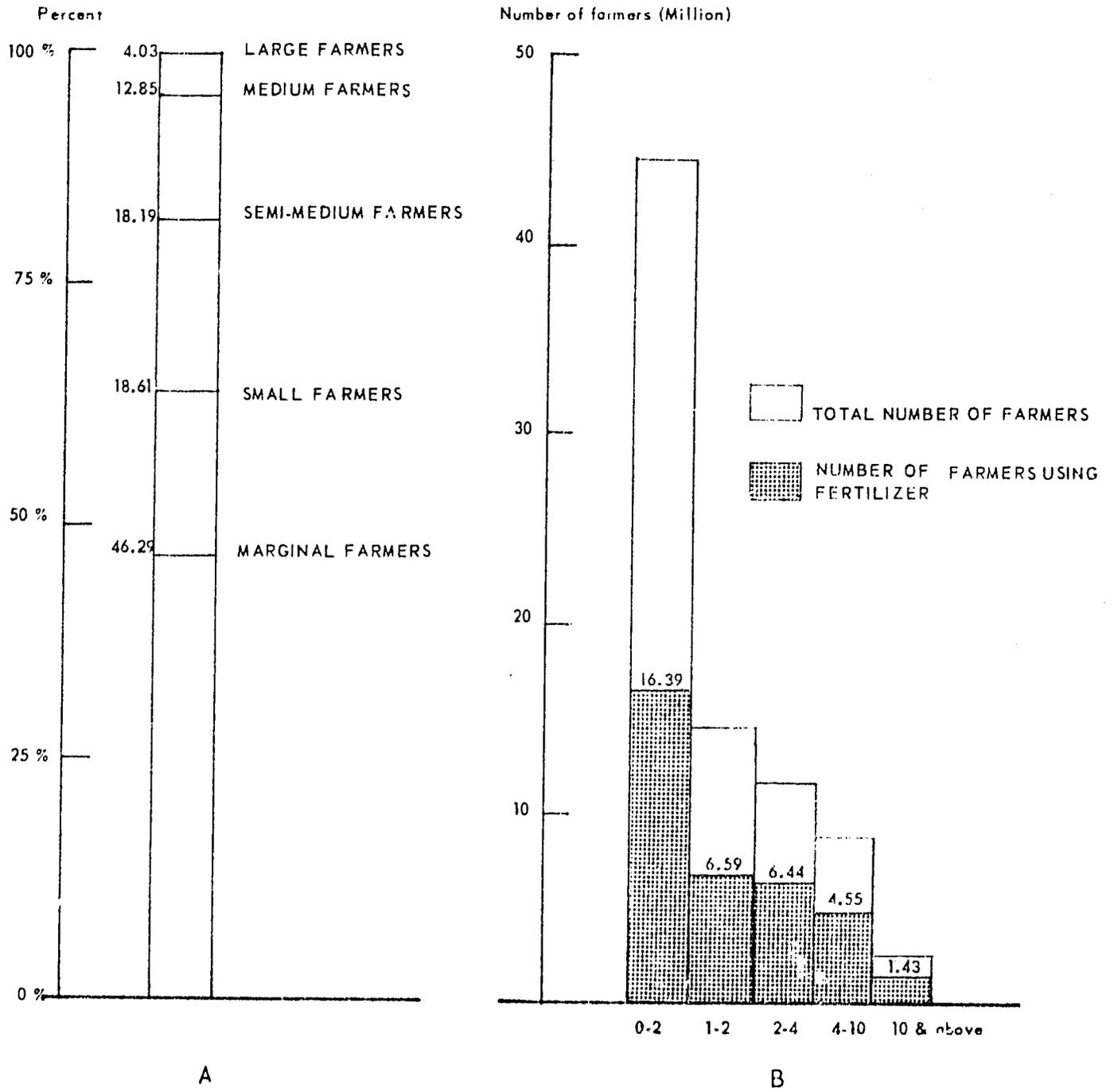
Instead of being fewer, in fact, the marginal and small farmers constitute the largest single group of beneficiaries; and instead of being numerically preponderant, the large farmers using fertilizer form a very small group indeed.

The percentage distribution of fertilizers users, shown in Column 4 represents, in effect, a transformation of the absolute numbers of fertilizer users in each size - class into percentages using a common base - that is, the total number of fertilizer users in the country. The column shows that among all fertilizer users, 46 percent are marginal, 19 percent are small, 18 percent are semi-medium, 13 percent are medium and only 4 percent are large farmers (See Chart I).

Statewise distributions of holdings by farm size are not available yet for 1976-77; hence the percentage distribution of fertilizer users cannot be derived here for the states. However, the distribution obtained here for the country as a whole has a wider generality that covers the states as well. Given the fact that the distribution of operational holdings in the states is similar to the all-India distribution, the marginal and the small farmers would be the predominant group of beneficiaries of fertilizer in all states. The overall pattern of distribution of fertilizer users at the state level would be similar to the national level.

Turning now to the distribution of fertilized land in Table 4, we note that about 56 million hectares, out of a total of 163 million hectares, were fertilized in 1976-77. Data in Column 1 are from the agricultural census while those in Column 2 are from the NCAER

CHART - 1



- A. PERCENTAGE DISTRIBUTION OF FERTILIZER USERS  
(Source: Table 3, Column 4)
- B. NUMBER OF FERTILIZER ADOPTERS  
(Source: Table 3, Columns 1 & 3)

study. Area fertilized by farm size in Column 3 is derived from the first two columns, and its distribution by farm size is shown in Column 4.

Interestingly, only 34 percent of the total cultivated area receives some fertilizer; the rest of the land does not. About 22 percent of this fertilized land is operated in small and marginal units, 26 percent in large holdings and about 52 percent in semi-medium and medium holdings. If cultivation of fertilized land constitutes an advantage, it appears to be neither in favor of the small and the marginal groups of farmers, nor in favor of the large, but almost wholly in favor of the middle group of farmers - the semi-medium and the medium operators.

This conclusion is borne out further by the data in Table 5, which show the distribution of fertilizer consumption by farm size. Column 1 of this table is extracted from the NCAER study while Column 2 showing total fertilizer consumption is derived as a product of the rate of fertilizer per unit of land (Column 1) and area fertilized (Column 3 of Table 4). The distribution of this fertilizer consumption by farm size is shown in Column 3. It will be observed that the large farmers consume about 21 percent of the total fertilizer, whereas the semi-medium and medium holdings consume 51 percent. The marginal holdings consume about 12 percent while the small holdings use 14 percent of the total fertilizer; their combined shares are together greater than the share of the large farmers.

TABLE 4

PERCENTAGE DISTRIBUTION OF FERTILIZED  
LAND BY FARM SIZE, ALL INDIA, 1976-77

Farm Size (hectares)	Area Operated (million ha) (1)	Percentage of area fertilized (2)	Area Fertilized (million ha) (3)	Percentage Distribution (4)
0 - 1	17.50	31.3	5.48	9.77
1 - 2	20.86	32.7	6.82	12.16
2 - 4	32.36	36.1	11.68	20.82
4 - 10	49.60	35.2	17.46	31.13
10 & Above	42.82	34.2	14.64	26.10
Total	163.14	34.4	56.08	100.00

Source: Col. 1 from Agricultural Census, 1976-77  
Col. 2 from NCAER study

TABLE 5

PERCENTAGE DISTRIBUTION OF FERTILIZER  
CONSUMPTION BY FARM SIZE, ALL INDIA, 1976-77

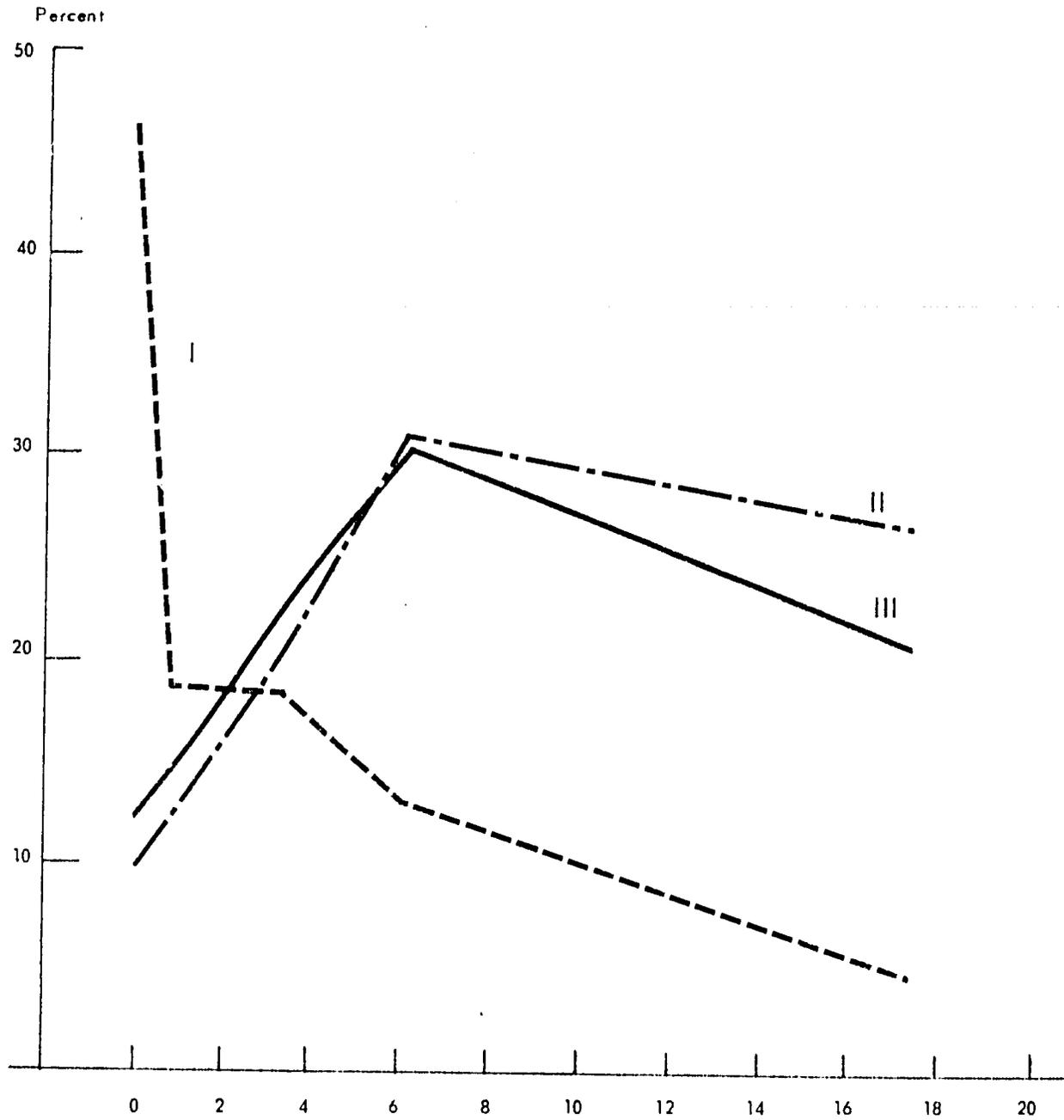
Farm Size (hectares)	Fertilizer input per fertilized hectare (kg) (1)	Total Fertilizer Consumption (000 tons) (2)	Percentage Distribution (3)
0 - 1	92.3	505.804	12.24
1 - 2	85.8	585.156	14.16
2 - 4	80.1	935.568	22.64
4 - 10	71.1	1241.406	30.04
10 & Above	59.0	863.760	20.90
Total	76.4	4131.694	100.00

Source: Col. 1 from NCAER study  
Col. 2 is product of Col. 1 (this table) and Col. 3 of  
Table 4.

That the shares of the marginal and small farmers in the total fertilizer consumption is greater than their respective shares in fertilized land is entirely due to the fact that compared to other farmers, they use a greater quantity of fertilizer per unit of land. Column 1 shows that the rate of fertilizer application is inversely related to farm size. The marginal farmers use about 92 kg/ha of plant nutrients - N, P and K; this rate declines to 86 kg/ha in the group of small holdings and to 80 kg/ha in the case of the semi-medium holdings. There is a further decline to 71 kg/ha in the medium holdings. The large farmers use only 59 kg/ha. It does seem that the small and marginal farmers substitute a greater quantity of fertilizer per unit of land to compensate for their small size of holdings and thus maximize their total output and total income from land. Another conclusion follows from the data. Had there been any serious institutionally or socially generated problem of access to fertilizer, the small and the marginal holdings would not have been able to apply this large quantity (92 kgs and 86 kgs) of plant nutrients per unit of their fertilized land. It does seem that the market for fertilizer, on the whole, and despite possible local aberrations, has not been biased against the small and marginal farmers.

The distribution of fertilizer users, fertilized land and fertilizer consumption (all by farm size) are shown in Chart II. The distribution of fertilizer users shows the preponderance of the marginal and small farmers. The distribution of fertilized land suggests a relatively greater advantage to the

CHART - II



- I DISTRIBUTION OF FERTILIZER USERS BY FARM SIZE
- II DISTRIBUTION OF FERTILIZED LAND BY FARM SIZE
- III DISTRIBUTION OF FERTILIZER CONSUMPTION BY FARM SIZE

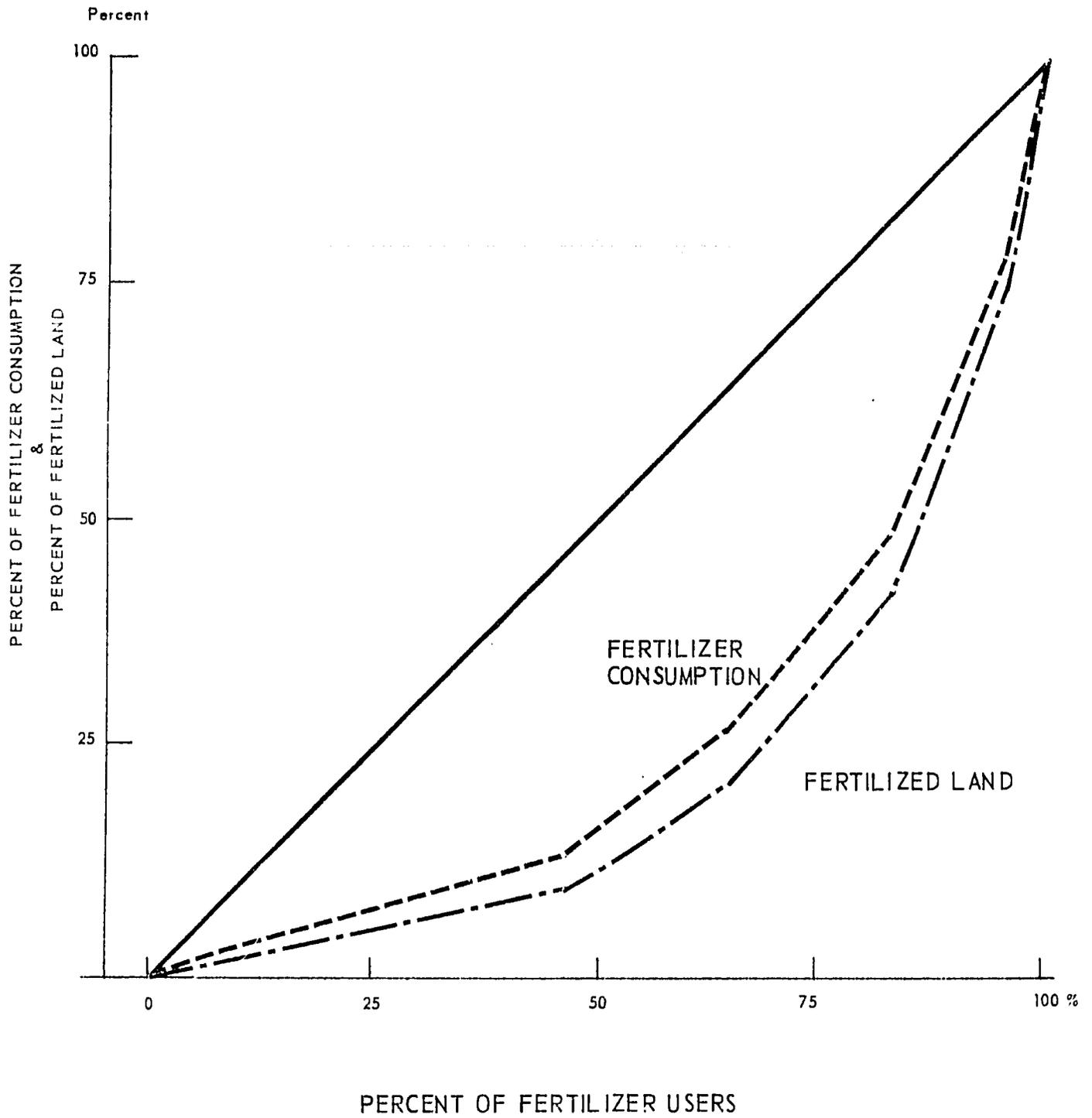
middle groups of farms. The distribution of fertilizer consumption is distinctly better than the distribution of fertilized land, lying as it does above the distribution of fertilized land in the smaller ranges of farm size, and below the distribution of fertilized land in the upper reaches of farm size.

This conclusion is reinforced strongly when the cumulative distributions of fertilized land and fertilizer consumption are plotted in a Lorenz diagram against the distribution of fertilizer users (Chart III). The distribution of fertilizer consumption lies throughout above the distribution of fertilized land, and closer to the diagonal line of equality.

#### Concluding Observations

Comparing the distribution emerging out of the two studies in this exercise, two points of dissimilarity deserve comment. First, in the distribution of fertilized land derived from the NCAER/Census data, land fertilized in the large holdings is about three times as large as that in marginal holdings and more than double the fertilized land in small holdings. This feature of the distribution is not inconsistent with a priori expectations; however, it is not in line with the result derived earlier from the NSS Study. It seems likely that the operators of large holdings were initially slow (the NSS data) to take to fertilizer and the new technology it represents, but over time they came to apply fertilizer to a greater area (NCAER/Census data). Plausible though this explanation is, another factor accounting for a substantial part of this difference must not be overlooked: it is the upward bias in the estimate of fertilized land for large farms due to the

CHART - III



inclusion of institutional operators in Agricultural Census data. The same upward bias has led to the second point of difference relating to the fertilizer share accruing to the large vis-a-vis the small/marginal operators.

Despite this difference, the distribution patterns of fertilizer consumption emerging from the two studies remain basically the same. In the context of the small-vs-large farm debate, it is presumably the combined share of the small and marginal farms that need to be compared with the share accruing to the large farms. Marginal holdings are in reality a subset of small holdings - they have been distinguished from small holdings in this review in deference to the conventional usage in India. If we consider the small and the marginal farms... together as a group, then its share in total fertilizer consumption is greater than that of the large farms. True, the distribution is not symmetrical, but it is not negatively skewed either.

As observed earlier, the narrow focus of the debate (small-vs-large farms) has tended to obscure the fact that the largest share of fertilizer consumption accrues to the group of medium and semi-medium farms - farms that are neither small nor large. This is, however, a consequence of the greater area fertilized by the operators of medium and semi-medium holdings, rather than of a higher rate of fertilizer application. In point of fact, the small and marginal farmers apply fertilizer most intensively to their land, possibly with a view to maximizing output and income from their tiny holdings; and their ability to secure enough fertilizer for this purpose indicates the absence of significant

social and institutional barriers to their access to fertilizer markets.

Development literature suggests that the small farmers generally apply greater quantity of labor input per unit of land in order to maximize output from their tiny holdings. In effect, this amounts to a substitution of human labor with low opportunity cost for a severely limited resource, that is, land. The evidence marshalled here shows that given the availability of a land substituting input, such as fertilizer, small farmers use it intensively for the same reason.

The significance of programs to augment domestic supply of fertilizer is that they ensure an adequate supply of this input, enabling the small farmers to use fertilizer intensively to substitute for land, and thus maximize their output and income. Under conditions of scarcity, it is generally the small farmer who has to go without fertilizer and suffer a reduction in income. Appropriately enough, a major objective of the Indian government's fertilizer policy is to bridge the gap between domestic production and estimate requirement of fertilizer through commercial and/or concessional imports and to maintain an adequate supply at all times. Its recent decision to subsidize transport costs of fertilizer to the block headquarters in remote areas - those not located at the railheads - should be viewed in this perspective. A full scale examination of the Indian government's fertilizer policy is beyond the scope of this review. Various elements of this policy and the instruments adopted to attain the overall objectives

were outlined in the Fertilizer Promotion Project Paper.

The conclusions emerging out of this review may now be summarized as follows: (i) The operators of marginal holdings form the largest group of fertilizer users; the second largest group of fertilizer users is that of small farmers. Taken together, the small and marginal farmers constitute about 65 percent of all fertilizer users. Large farmers using fertilizer constitute about 4 percent of the fertilizer users. (ii) The operators of marginal holdings use fertilizer most intensively, that is, they apply the largest quantity of fertilizer per unit of fertilized land. The rate of fertilizer use is the second highest in the case of small farmers, while it is the lowest for operators of large holdings. (iii) The share of marginal farmers in total fertilizer consumption is the least, while that of the small farmers is the second lowest. Taken singly, the shares of both the small and the marginal farms are smaller than the share accruing to the large farmers, but taking the small and the marginal operators as a single group, its share in total fertilizer consumption is larger than that of the operators of large holdings. (iv) Of all farm groups, the medium farmers consume the largest proportion of fertilizer; together with the semi-medium farms, their share in total fertilizer consumption is more than fifty percent.