UNCLASSIFIED
CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) — PART I

Rep

1. PROJECT TITLE

FERTILIZER PROMOTION

(AID Loan No.386-T-226,226A,226B)

2. PROJECT NUMBER: 386-0471

3. MISSION/AID: USAID/INDIA

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 81-6

☒ REGULAR EVALUATION ☒ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES

A. First PRO-AG or Equivalent	B. Final Obligation Expected	C. Final Input Delivery
FY 79	FY 81	FY 82

6. ESTIMATED PROJECT FUNDING

A. Total $ _____

B. U.S. $101,000,000

7. PERIOD COVERED BY EVALUATION

From (month/yr.) 2/80

To (month/yr.) 6/81

Date of Evaluation Review 6/81

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
The project is proceeding satisfactorily:		
Finalize IFB for utilization of $34.4 million loan balance.	William Janssen	12/31/81

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9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS : NONE

- ☐ Project Paper
- ☐ Financial Plan
- ☐ Logical Framework
- ☐ Project Agreement
- ☐ Implementation Plan e.g., CPI Network
- ☐ PIO/T
- ☐ PIO/C
- ☐ PIO/P
- ☐ Other (Specify) _____
- ☐ Other (Specify) _____

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☒ Continue Project Without Change
- B. ☐ Change Project Design and/or ☐ Change Implementation Plan
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

Fletcher E. Riggs, Agriculture Advisor
B. Sen, Agriculture Economist
M.A. Nair, Program Specialist

12. Mission/AID/W Office Director Approval

Signature

Typed Name: Richard M. Brown
Director (Acting)

Date

AID 1330-15 (3-78)

USAID/INDIA

PROJECT EVALUATION SUMMARY (PES) - PART II

FERTILIZER PROMOTION PROJECT (386 - 0471)

13. Summary

The overall fertilizer sub-sector performance has been creditable, in spite of the adverse impact of drought and fertilizer price increases. Fertilizer consumption increases over previous years (1979-80 @ 3%; 1980-81 @ 6%) were less than the Project Paper target of 10% per year. The external factors of drought and fertilizer price increases were the primary factors in this short-fall.

The momentum of fertilizer imports, to which the AID Project was designed to contribute, has been maintained. Imports of 4 million material tons in 1979-80 was increased to 5 million in 1980-81. 222,000 MT of AID financed fertilizer arrived in India during January to March 1981.

Meeting the PP output target of 25 million nutrient tons of consumption over the four year project life will depend on meeting targets set for 1981-82 of 6.6 million and for 1982-83 of 7.6 million.

Penetration of fertilizer into more remote areas took a major leap forward with establishment of a program to subsidize transport of fertilizer to all 5000 block headquarters in the country. In addition the Fertilizer Promotion Program, temporarily held in abeyance due to materials shortages, has been started in 65 selected districts.

A special USAID analysis establishes that small farmers have ready access to fertilizer in the market, use fertilizer more intensively than larger farmers, make profitable use of it, and represent 65% of all fertilizer users.

Studies of Fertilizer Promotion and remote area penetration, proposed to be financed by AID if requested by GOI, were discussed with the Ministry of Agriculture with a final conclusion being not to pursue the studies further.

14. Evaluation Methodology

Project Progress is measured by sub-sector performance since AID fertilizer is co-mingled with other fertilizer and can not be tracked as such. The PP framed AID financed fertilizer (3 to 5% of the total) as a contribution to keeping fertilizer supply lines, overall, as full of fertilizer as possible. Attachment A includes an update of overall fertilizer sub sector performance during 1980-81.

The special analysis of fertilizer access and use by size of farm was motivated by our interest in trying to quantify the situation regarding AID's target group of small and marginal farmers. The conventional wisdom that small farmers are denied access to fertilizer is not supported by the analysis. Details of study design, data sources, etc. are given in Attachment C. The methodology for Benefit-Cost Analysis of Fertilizer Use utilized farm level production response results from the use of fertilizer, combined with fertilizer use data by size of farm. Details are provided in Attachment D.

15. External Factors

One EOPS indicator is to maintain a rate of fertilizer consumption increase of 10 percent per year. This has not happened. Table 1 in Attachment A indicates 1978/79 to 1979/80 growth rate of three percent while for 1979/80 to 1980/81 the rate is six percent. The target for 1981/82 is an 18% increase which would put consumption growth back on the late seventies track.

Two external factors are primarily responsible for the shortfall in consumption. 1979/80 experienced one of the worst droughts in Indian history and substantially reduced the demand for fertilizer. In 1980/81 the monsoon was better but there were still some areas affected by adverse weather. Therefore, the assumption of normal weather has not been met.

In addition, fertilizer prices were raised about 38 percent in June 1980 which, in spite of procurement price increases for foodgrains, did not maintain the assumed "current crop/fertilizer price relationship". The impact of this price increase has not been quantified but it logically would have impacted unfavorably on fertilizer consumption.

In spite of substantial increases in world market prices for fertilizer and ocean freight and heavy demands on FX reserves for petroleum and vegetable oil imports, the GOI has maintained the momentum of its fertilizer imports. During 1980/81 fertilizer imports reached a record level of 5 million MT of material, an increase of 25 percent over 1979/80. Such imports have been a major factor in sustaining fertilizer consumption since domestic production had fallen behind due to shortages of feed stock and outages of electric power.

Our conclusion is that, in spite of not meeting consumption targets, the fertilizer sub-sector performance was highly creditable given the adverse impact of the external factors discussed above.

16. Inputs

There have been no significant problems in relation to fertilizer procurement and shipment. The first tender for $66 million has been completed resulting in 222,000 MT of AID financed fertilizer arriving in India during January to March 1981. See Section 7 and Table 2 in Attachment A.

17. Outputs

Output targets in the log frame are cumulated for the 4 year life of project at 25 million MT of fertilizer nutrient consumption. Nearly 11 million of this target was achieved in 1979/80 and 1980/81. If targets for 1981/82 (6.6 million) and 1982/83 (7.6 million) are met, the overall target will be achieved. (See Table 1 in Annex A and Table 3 Project Paper).

One other output indicator is that additional supply points be established in the "lagging" areas. This would seem to be more than adequately addressed by the block headquarters program discussed in paragraph 18.

The Project Paper discussed two types of studies that might be useful in providing guidance to the fertilizer program. One involved the distribution system for fertilizer and its effectiveness in penetrating remote areas. The other would have analyzed the various fertilizer promotion schemes in use in the country. The Ministry of Agriculture (MOA) developed four study outlines dealing with these subjects and with fertilizer credit. USAID, utilizing a U.S. consultant, reviewed these study proposals with the MOA and decided that, due to methodological deficiencies, the lack of real need for some of the work proposed (See Production Credit and Fertilizer Consumption, USAID/India, September 1980), these studies would not be pursued further.

18. Project Purpose

"Maintain current momentum of fertilizer consumption on an equitable basis".

The first EOPS indicator is to increase fertilizer consumption by 10 percent per year. This target has not been achieved. The impact of external factors is discussed in Paragraph 15. No factors internal to the project impacted unfavorably on achieving this target. In fact, accelerated fertilizer imports helped maintain the rates achieved in spite of domestic production shortfalls.

The second EOPS indicator is an increased growth rate of fertilizer consumption in "lagging" areas as compared to state averages. Quantitative estimates of this indicator have not been made. However, the GOI program for subsidized delivery of fertilizer to every block headquarters sets the stage for more extensive coverage

of fertilizer in India, particularly in remote areas not now being adequately served. In addition to getting the fertilizer to every block headquarters, the GOI has also instructed State Governments to expand and improve the retail distribution network within the block to assure equitable distribution of fertilizer within the block (See Attachment B). This need was emphasized in the Project Paper.

The GOI Intensive Fertilizer Promotion Campaigns (IFPC) and other fertilizer promotion activities to increase fertilizer consumption in lagging areas were described in the PP, and expected to be continued during the life of the project. Industry and other privately sponsored schemes have continued; however, the GOI IFPC was suspended during parts of 1979-80 and 1980-81. Because of constraints on the supply side, it was felt unwise to create the additional demand pressure resulting from the IFPC. The GOI has announced re-establishment of the IFPC for 1981-82 in 65 districts where the potential use of fertilizer is high but consumption is lagging.

The third EOPS indicator is continued participation of small farmers in increased fertilizer consumption. The special analysis in Attachment C provides substantive evidence that small farmers have access to fertilizer in those areas where there is fertilizer. The market, or other factors, do not discriminate against small farmers. What is required then is an area expansion of the market to reach more remote areas. This program is in operation as described above.

The GOI, determined to expand fertilizer consumption by small and marginal farmers, has maintained the fertilizer subsidies in effect for these groups in spite of heavy pressures to reduce subsidies overall. Marginal farmers receive a one-third, and small farmers a one-fourth, reduction in the prices of all fertilizer materials.

19. Goal

The project goal is to increase agricultural output over the 1979-83 period and to increase small farmer incomes:

In 1978-79 agricultural output in India recorded a record level of 131 million MT of food grains. Drought in the following year reduced this to 115 million MT, whereas in 1980/81 output recovered to about 130 million MT. Preliminary projections for 1981/82 are for a record outturn of 135-138 million MT.

20. Beneficiaries

The targeted beneficiaries are small farmers. Attachment C establishes the fact that small farmers do have access to fertilizer on an equitable basis. Attachment D shows that fertilizer is a profitable investment for small farmers. Rates of return from fertilizer use are similar for various farm size groups. Small farmers apply fertilizer more intensively than large farmers, thus increasing the productivity of their small land holdings. There are 35 million farms in India that use fertilizer, and 65% of them are marginal and small farmers, i.e. farm size is two ha. or less.

21. Unplanned Effects

None

22. Lessons Learned

For a fertilizer import project one should make sure they are in a country like India, where fertilizer and general agricultural development policies are keyed to the attainment of project objectives.

23. Special Comments or Remarks

Titles of Attachments

A. Fertilizer Sector Performance - 1980-81.

B. Guidelines for Organizing Delivery of Fertilizer up to Block Headquarters

C. Some Aspects of Fertilizer Use by Small Farmers: A Review

D. Benefit/Cost Analysis of Fertilizer Use.

ATTACHMENT A

FERTILIZER SECTOR PERFORMANCE - 1980-81

This report covers the latest developments on fertilizer consumption, imports, clearance and handling of imported fertilizers, fertilizer distribution and policy decisions for the improved management of the fertilizer sector.

1. Fertilizer Consumption

Fertilizer consumption in 1980-81 is estimated at 5.58 million tonnes of nutrients as against a target of 6.10 million tonnes. Although the estimated consumption is 520,000 tonnes short of the target set for 1980-81, it increased by 320,000 tonnes from 1979-80 and by 460,000 tonnes from 1978-79. Major constraints were adverse weather conditions in several states and to some extent the increase in fertilizer prices.

Imported fertilizer managed through the Pool helped to a great extent in meeting the shortfall in supplies from domestic manufacturers. As against the deficit of 2.126 million tonnes of nutrients required to be met from the Pool during the period from February 1, 1980 to January 31, 1981, allotments from the Pool were made to the extent of 3.039 million tonnes of nutrients which included 912,000 tonnes to cover short-fall in supplies from domestic production.

Despite severe drought conditions in some major states in 1980-81, fertilizer consumption registered an overall increase of 6.1 percent during 1980-81 (3.8 percent during kharif season and 7.5 percent during rabi season) over the previous year. The following table indicates fertilizer consumption during the period from 1975-76 thru 1980-81, and the 1981-82 targets.

TABLE 1 - Consumption of Fertilizers

(million nutrient tonnes)

	N	P	K	N+P+K	Increase over previous year (percent)
1975-76	2.15	0.47	0.28	2.90	
1976-77	2.46	0.63	0.32	3.41	17.6
1977-78	2.91	0.87	0.51	4.29	25.8
1978-79	3.42	1.11	0.59	5.12	19.3
1979-80	3.50	1.15	0.61	5.26	2.7
1980-81	3.71	1.23	0.64	5.58	6.1
1981-82 (Target)	4.40	1.47	0.73	6.60	18.3

Source: Annual Report for 1980-81, Department of Agriculture, Union Ministry of Agriculture, Government of India.

From Table 1, it is evident that fertilizer consumption has been steadily increasing. However, it is equally evident that the rate of fertilizer consumption increase has slackened. If consumption targets are achieved for 1981-82, performance would be comparable to the high growth years in the late '70s'.

2. Imports

During 1980-81 fertilizer imports reached a record level of about 5 million tonnes of product - about 1 million tonnes more than the 1979-80 level - due to shortfall in domestic production.

With the increasing imports, large quantities of fertilizers had to be unloaded and cleared from the ports. During 1980-81, 5.05 million tonnes of imported fertilizer material (about 2.5 million nutrient tonnes) were unloaded at both major and minor ports. This represents an increase of about 19 percent over the total quantity of fertilizers imported and cleared during 1979-80.

To insure prompt and efficient handling of fertilizers at the ports to meet the current and future requirements, certain mechanized unloading devices are being established at Bombay, Haldia and Madras.

3. Penetration of Remote Areas

Until recently, fertilizers were supplied from despatching stations freight prepaid to the rail head destination nearest to the distributors. Out of a total of 5,000 blocks only 2,100 blocks are connected by rail lines. Consequently, movement of fertilizers to the blocks which are not connected by rail lines has to be done by means of transport other than rail in order to insure supplies in these blocks.

Mostly retail outlets are clustered around rail heads, thereby resulting in inadequate availability of fertilizers in remote areas away from the rail heads. Farmers from such remote areas had to travel to distant retail outlets near rail heads to purchase their fertilizers.

In order to assure more equitable distribution of fertilizer, the GOI has taken a major policy decision to introduce a scheme which would enable transportation of fertilizers to all 5,000 block headquarters in the country on government account. Necessary guidelines relating to this scheme were issued to State Governments in October 1980. The guidelines (Attachment B) provide more details about this scheme and include instructions for expansion and improvement of the retail distribution network in each block to assure that fertilizers are equitably distributed within the block.

In the Zonal Meeting held in January, 1981, implementation of this scheme was reviewed, which surfaced certain operational difficulties, primarily a disagreement among the states and fertilizer manufacturers regarding fertilizer rates. In February/March this problem was tackled

state by state and freight rates worked out for each manufacturer and for each Pool agency in each state. These rates are valid through March 1982, at which time they will be reviewed and adjusted as necessary.

The GOI has also issued instructions to all agencies involved to maintain detailed records of fertilizer movement and consumption under this scheme so that fertilizer penetration into remote areas can be measured.

4. Fertilizer Promotion

The GOI Intensive Fertilizer Promotion Campaigns (IFPC) and other fertilizer promotion activities to increase fertilizer consumption in lagging areas were described in the PP, and expected to be continued during the life of the project. Industry and other privately sponsored schemes have continued; however, the GOI IFPC was suspended during parts of 1979-80 and 1980-81. Because of constraints on the supply side, it was felt unwise to create the additional demand pressure resulting from the IFPC. The GOI has announced re-establishment of the IFPC for 1981-82 in 65 districts where the potential use of fertilizer is high but consumption is lagging.

The districts selected reflect potential increases in fertilizer consumption in both rainfed and irrigated areas. Rainfed districts would be those having 750 mm or more of rainfall and five to 30 percent net irrigated area. For districts with good irrigation facilities, those selected for the IFPC would have more than 30 percent of the area sown irrigated and be consuming less than 30 kg of fertilizer per ha. In addition, certain districts consuming more than 75 kg/ha of fertilizer would be selected for special demonstrations to increase the efficiency of fertilizer use.

Execution of the IFPC will be in the hands of the fertilizer manufacturers. Each manufacturer will select 1 - 2 districts in each state in which it operates and be responsible for opening retail points, storage godowns at suitable points, arranging supplies, laying out fertilizer demonstrations on cultivators fields, distribution of leaflets and other training of farmers. Manufacturers will work in close collaboration with district/state authorities. District and block level committees will be constituted to effect this collaboration.

5. Logistics

Logistics play a vital role in insuring that the right type of fertilizers reach the farmers at the right time and place. Transportation of imported and indigenously manufactured fertilizers, handling and storage of imported fertilizers, and fertilizer distribution are the major aspects of logistics.

A. Movement

Until December 1980, due to serious transportation problems, fertilizer movement was comparatively slow. Consequently, stocks continued to pile up at the ports and plants. Movement by rail had, by and large, to be confined to "block rakes" (whole trainloads of fertilizer) for single point destination so far as major ports and production units were concerned. While on the one hand, it has been possible through block rake movement to achieve easier monitoring, reduction in transit time, etc., there were problems at the unloading terminals. With the improvement in the working of the railway, more rail wagons for fertilizer movement are becoming available with the result that stocks at the ports and plants are gradually decreasing.

B. Road Transport Subsidy

Inadequacy of railway wagons resulted in the use of more road transport for fertilizer movement. A temporary road transport subsidy was in operation for moving fertilizers to remote areas under which transport costs were reimbursible for: (a) road movement up to 1,000 km; (b) road movement up to 250 km and then rail movement to destination; (c) rail movement by block rake to destination, then road movement up to 250 km; (d) road movement up to 250 km, then rail movement by block rake, then road movement up to 250 km. This subsidy has now been merged with the equated freight scheme under the program to deliver fertilizer to each block headquarters.

C. Distribution

Earlier, two organizations - the Food Corporation of India, which is a public sector agency and the Indian Potash, Ltd., which is a private agency were given the responsibility for clearance, handling and distribution of imported fertilizers. Now this job has been entrusted to several public and private sector undertakings. This has facilitated quicker clearance and handling of imported fertilizers as well as movement of both imported and indigenously manufactured fertilizers to supply points.

D. Operations Control

The operation of unloading, handling and clearance at the ports and transportation of fertilizers from plants and ports is being regularly monitored through a Control Room established in the Department of Agriculture, Ministry of Agriculture. Ten major grades of fertilizers are currently being distributed. Fertilizers are produced in over 60 plants; imports are arranged in over 30 ports; imported fertilizers are stocked in over 550 godowns in the country. The present manual data processing system is inadequate to cope with the data on increasing magnitude of fertilizer consumption. A

scheme for a computerized data processing system has been proposed in the Sixth Five Year Plan with a view to obtaining reliable data, its prompt retrieval and fast tabulation and storage for future reference. This will assist management in taking decisions quickly on removing bottlenecks in various aspects of fertilizer operations.

6. Prices

The GOI increased the prices of fertilizers by about 38 percent in June 1980 and by 18 percent in July 1981 because of: (a) a steep increase in the prices of petroleum products which constitute the main feedstock of nitrogenous fertilizers, (b) increases in the prices of other raw materials such as imported sulphur, phosphoric acid and rock phosphate, and (c) increases in the cost of imported fertilizers and freight. The effect of the June 1980 increase on fertilizer consumption has not as yet been quantified, although it is generally considered that this price increase was a factor in the disappointing increase in fertilizer consumption in 1980-81. This year's price increase, effected prior to the announcement of the kharif grain prices, will also work against increased fertilizer consumption. This impact will be moderated somewhat by farmers expectations of higher government procurement prices prior to kharif harvest.

7. AID Financed Fertilizer Imports

The following table indicates the status of fertilizer imported under the AID loan. All of this fertilizer has landed, cleared the ports, been bagged and stored. AID fertilizers are a part of the Pool fertilizers and lose their identity after being unloaded and cleared through the port. The Department of Agriculture will distribute a part of AID financed fertilizer to farmers during the 1981 kharif season and the balance during the following rabi season.

The semi-annual Zonal Conferences (January/February and July/August) review the fertilizer requirements and availability situation in respect of each of five zones (North, South, Central, East and West). Fertilizer requirement is determined in terms of crop production targets, and area targets for high yielding varieties. Fertilizer availability in this context means the stocks and production of the indigenous manufacturers located in each sone. The gap between the requirement and the availability of fertilizer in each zone is then planned to be bridged by supplies from the Central Fertilizer Pool which includes AID financed DAP and urea.

Experience has shown that during each crop season, there is a period of a few months or so when the bulk of the fertilizer is consumed. In general, May-July are the peak months during kharif. The peak months of fertilizer use during the rabi season are October, November and December. It is in the peak

months that the gap between requirement and availability of fertilizer is the largest. Consequently the bulk of the imported fertilizer, including that financed by AID, is supplied by the Pool for use during these peak months, although small quantities may be moved from the Pool in other months according to schedules established at the Zonal Conferences.

ARD:M.A.Nair:F.E.Riggs:la:8/21/81

TABLE 2

FERTILIZERS PROCURED UNDER IFB No. MMTC/USAID/I dated Sept. 19, 1980

	Vessel Name	Date of arrival	Port of discharge	Tonnage (MT)	Supplier	C & F Cost	FOB			Agents Commission 1/
							Cost	Freight	Total	
	DAP									
*	Point Susan	Jan 26, 81	Bombay	26,976.730	Phibro Asia	8,717,138.40	-	-	-	27,740.68
*	E. Rutledge	Feb. 28,81	Bombay	4,870.816	Phibro Asia	1,590,102.24	-	-	-	5,090.00
*	Sam Houston	April 7,81	Madras	5,499.206	Phibro Asia	1,795,243.30	-	-	-	5,746.67
*	Stonewall Jackson	Mar.16,81	Bombay	2,598.906	Phibro Asia	848,425.86	-	-	-	2,715.86
*	Button Gwinnett	Feb.18,81	Calcutta	7,064.728	Transammonia	2,471,807.03	-	-	-	-
*	Wiiliam Hooper	Jan.26,81	Bombay	12,710.917	Transammonia	4,447,295.64	-	-	-	-
*	Traveller	Feb.16,81	Navalakhi	20,998.367	Agr. & Industrial	-	4,230,960.97	3,083,610.19	7,314,571.16	5,249.59
*	Thomas Nelson	Feb. 6,81	Marmagoa	10,497.777	Agr. & Industrial	-	2,115,197.09	1,410,901.23	3,526,098.32	2,624.44
*	Columbia	Feb.14,81	Cuddalore	20,935.3624	Inter ore	-	4,281,072.26	3,346,098.97	7,627,171.23	5,233.84
	La Maria	Jan.22,81	New Mangalore	18,188.480	Agricc	4,708,997.47	-	-	-	-
	Hickery	Jan.28,81	Rozi	22,964.302	Agrico	5,945,457.79	-	-	-	-
	Sea Pioneer	Feb.21,81	Karwar	17,694.562	Agrico	4,581,122.10	-	-	-	-
	Pacific Trader	Mar.3,81	Madras	7,060.910	Agrico	1,828,069.60	-	-	-	-

1/ Agent Commission payments were not charged to AID loan funds.

* U.S. Flag Vessels

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Vessel Name	Date of arrival	Port of discharge	Tonnage (MT)	Supplier	C & F Cost	FOB Cost	FOB Freight	FOB Total	Agents Commission
Eastern Friendship	Mar.13,81	Kakinada	13,776.659	Agrico	3,566,777.02	-	-	-	-
TOTAL DAP			191,837.7224		40,500,436.45	-	-	-	-
UREA									
Grace Five	Jan.13,81	Karwar	15,031.507	Agrico	3,806,729.15	-	-	-	-
Pacific Trader	Feb.28,81	Kandla	14,967.350	Agrico	3,790,481.39	-	-	-	-
TOTAL UREA			29,998.857		7,597,210.54	-	-	-	-
GRAND TOTAL			221,836.5794		48,097,646.99	10,627,230.32	7,840,610.39	18,467,840.71	54,401.08

C & F $ 48,097,646.99
FOB
with Freight 18,467,840.71
66,565,487.70

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ANNEXURE -A

ILLUSTRATION FOR WORKING OUT EQUATED FREIGHT (FOR MOVEMENT TO BLOCK HEADQUARTERS) FOR PURPOSES OF DEDUCTION AT SOURCE.

1. Total expenditure on road movement to block headquarters from manufacturer 'M' as per proposed movement programme = q1. d1. r1. + q2. d2. r2+ _____

Where q1 = quantity(tonnes) moved over distance d1(km)

r1 = rate(Rs.per tonne per km) of road freight for distance d1

d1 = Distance between Railway Station r1 and Block B1.

2. Quantities, distance and rate:-

	(q) quantity tonnes	(d) distance Km.	(r) Rate Rs. per tonne per Km.	(Amount qdr. Rs.
	1,000	20	0.50	10,000
	500	50	0.30	7,5000
	100	100	0.25	2,500
Total:	1,600			20,000

3. Total expenditure for movement of 1600 tonnes = 20,000

∴ Equated freight = Rs 20,000 ÷ 1600 = = Rs.12.50 p. ton.

4. Normal Issue price (Urea) at FOR railhead = Rs.1885 per tonne

5. Proposed issue price for block headquarters movement = Rs. 1885 - 12.50 = 1872-50 per tonne

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6. IMPROVEMENT OF THE SCHEME:

Delivery of fertilisers upto block headquarters is a new experiment. The guidelines in the foregoing paras may not cover all situations in all the States. It is, therefore, desirable for the State Govts. to review the progress after the current season, i.e. Rabi 1980-81. In the light of the actual experience and achievement, the Ministry of Agriculture for the improvement and implementation of the scheme.

The State Government may forward their suggestion to

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GUIDELINES FOR ORGANISING DELIVERY OF FERTILISER UPTO BLOCK HEADQUARTERS.

1. INTRODUCTION:

At present the indigenous imported fertilisers are delivered by the manufacturers and Pool handling agencies at rail heads. On the other hand, out of about 5,000 blocks in the country, 2900 blocks are not connected by rail lines. It has resulted in (a) clustering of fertilisers sale points in urban areas and at rail heads (b) inadequate availability of fertilisers in the interior and (c) long distance travel by farmers to get fertilisers. All these factors have adverse effect on the consumption of fertilisers in the blocks, which are away from the rail lines. In order to rectify the position, the Government of India have since decided that fertilisers will be delivered upto Block HeadQuarters. Orders in these regard have already been issued.

2. BLOCK-WISE SUPPLY PLAN:

2.1 Soon after each Zonal Conference, the State Governments would develop their own supply plan for each district (to begin with) and for each block (ultimately). This supply plan would clearly indicate the phasing of supplies from each manufacturer as well as from each of the pool fertilizer handling agencies. In such an exercise, the location of sources of supply,(both indigenous and imported), the lay of the road net-work, location of storage godowns, rake unloading points, etc. would be taken into consideration to arrive at the least cost supply arrangement. Once this plan is ready, it should be finalised in a tripartite Conference of State Government officials, representatives of manufacturers and the pool handling agencies; and copies issued to all concerned including the Inputs Division(4copies), Department of Agriculture & Cooperation, Government of India.

2.2 It might be clarified that it is not necessary to disturb the existing distribution and marketing arrangements of the industry and to insist that each supplier must take fertiliser to each and every block of the State. This will have to be governed

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by the existing marketing set up of each supplier, the need for improvement of the set up consistent with the rationalised marketing zone concept, as well as the cardinal principle of avoiding infructuous criss-cross movement of the same type of fertilisers within the State. It is recognised that creation of such a rationalised pattern would not be a one-shot affair and may have to be achieved in a phased manner over a period of time. In some of the Southern States, certain manufacturers have already a well-developed system of either reaching fertilisers within the blocks or defraying the transport expenses in lieu thereof. In such cases, the status quo may continue, as no further change in the system is really required and the objective of these guidelines already stands realised. However, minimum availability (stock) of fertilisers in each block with or without rail connection, will have to be ensured.

3. FERTILISER RETAIL OUTLETS IN THE BLOCKS:

3.1 The State Governments would identify the retailing infrastructure for each block separately(i) for institutional agencies and (ii) for private dealers. Subject to the overall policies of the State Government, the objective should be that the farmers should have access to distribution system, and the retail outlet should be as uniformally spread out in each block as is possible, consistent with the economic viability criterion.

3.2 The blocks, where private retail net work has to be strengthened, would be identified and steps taken in cooperation with the Industry to establish a retail net work. The State Governments can help the fertiliser manufacturers by identifying suitable entrepreneurs willing to undertake input retailing work in such areas. Effort should be made to see that the retail net work is fairly well-spread out in each panchayat/village jurisdiction in the block and that all the shops do not cluster around the block headquarters only.

3.3 Similarly, the blocks with weak institutional retailing infrastructure, like, cooperatives, Agro-Industries Corporations,

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etc. should also be identified. It is necessary to find out the sources from which these blocks are getting their supplies. Based on this information, systematic plan for strengthening the institutional retail infrastructure should be drawn up and implemented as early as possible.

4. TRANSPORT OF FERTILISERS UPTO BLOCK HEADQUARTERS:

4.1 Institutional Agencies:-

4.1.1 Transportation of fertilisers to block headquarters may take place in one of the following ways:-

(a) From factory/godown/port to the blocks by road only:

(b) By rail(Blocks rake) from factory/port to pre-determined points(single point destination) and from these destination stations by road to the blocks either through buffer godown or directly to the blocks.

(c) By road from factory/port to loading stations, by rail (block rake) to single point destinations and by road to block either through buffer godown or directly.

(d) By rail in individual wagons to different destinations:-
(i) upto block headquarters.
(ii) short of block headquarters.

4.1.2. As regards(a) this movement is normally organised by the manufacturers or pool handling agencies themselves. However, the institutional agencies also take delivery by road ex-factory. This movement is at present taking place and as such delivery by this mode of transportation to the block is consistent with the proposed system. Hence, no special arrangements are required .

4.1.3 As for (b) and (c), transportation upto the single point destinations is arranged by the manufacturers/pool handling agencies at present. Further transportation by road either through intermediate godown or directly to

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the blocks is done either by the manufacturers/pool handling agencies or by institutional agencies, like, Markfed etc. It may not be physically possible or feasible for the manufacturers/pool handling agencies to undertake road transportation upto block headquarters on their own. Institutional agencies will have to perform this function to the extent required, subject to agreed costs being met by the manufacturers/pool handling agencies.

4.1.4 As regards(d), the individual railway wagons may deliver the fertiliser either within the block or short of the block. In the case of the former no road movement would be involved on the manufacturers or pool handling agencies account and therefore, no special dispensation for the meeting the road mileage expenses is required. However, in case the fertiliser has to be unloaded at a rail-head which is away from the block, some road movement would be required. In this case, the guidelines given in para 4.1.3. would be relevant.

4.1.5 Fixation of an equated freight rate for road Transportation to be undertaken by the Institutional agencies.

Fertilisers will now be reached at the cost of the manufacturers/pool handling agencies, etc. on the basis of "FOR block headquarters or any other pre-determined location, in lieu of block headquarters, in special cases" against "FOR rail-head" as used to be the practice so far. It might happen in some cases that the block headquarters is inconveniently located on/or it may not have the requisite infrastructure and the logistical problems of carrying fertiliser to the block headquarter and then distributing it in the villages of the blocks may be too expensive and cumbersome. Instead, there marketing infrastructure and network of road and transportation system may be more convenient and economical from the overall distribution point of view. In such cases, the Agriculture Production Commissioner of the State may after

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careful consideration declare such a place as the notional block headquarter for purpose of fertiliser distribution. It must be added that the Govt. of India expect this number to be very small in each State, and all such cases, with full facts will be reported to the Govt. of India. As explained in para 3.1.3 above, the institutional agencies may have to play a role in the road transportation of this material from rail-heads/godowns, etc. to block headquarters. Normally the institutional agencies should submit reimbursement claims to the Fertiliser Manufacturers/Pool Handling agencies with respect to the fertilisers carried out by them from the rail-head to the block headquarters. However, this system is likely to prove dilatory and involves too much of paper work. Therefore, a simplified system has to be thought of where institutional agencies can get deduction at source towards the equated freight, which they have to incur, while making payments for the purchase of fertilisers from the manufacturers/ pool handling agencies. For working-out the equated freight the following procedure is proposed:-

(i) Ascertain the transportation rates prevalent within the State for different slabs of distances for transportation of different commodities on State Govt. account, such as, food grains, sugar, etc.

(ii) Work out the quantities of fertilisers likely to be moved in different slabs of distances from rail-heads to the block headquarters in different districts:

(iii) Based on these, work out the total expenses on road movement for each slab keeping in view the rates for different slabs of distances;

(iv) Thus work out the total expenditure involved in moving the fertilisers from rail-heads to block headquarters for all the slabs and divide it by total quantity to be moved. This will give the average equated freight for the State for the fertiliser to be moved as explained in para 3.3.3. An illustration is indicated in Annexure-A

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This equated freight rate should be discussed with the manufacturers and the pool handling agencies to see if there is scope for economy any where; and an agreed figure should be decided. In case of an unresolved difference of opinion, the matter may be referred to the Ministry of Agriculture, who in consultation with such agencies as may be required, give their final decision which will be binding on both the parties.

4.2 Private Dealers:

Manufacturers and Pool Handling Agencies (except Food Corporation of India) have their own dealers. The average equated transport rate for delivery upto Block Head Quarter may be mutually decided by them, subject to the ceiling rate to be fixed by the State Government as per paras 4.1.3 and 4.1.5. . In the case of reallottees of the State Governments in the private sector Ex Food Corporation of India, the methodology indicated in paras 4.1.3 and 4.1.5 will apply.

5. MONITORING OF SUPPLY:

In order to ensure that fertilisers are delivered to the block headquarters, it will be necessary for the State Governments, to arrange for close monitoring of the supply of fertilisers. The items to be monitored are indicated below:-

(a) Whether the supply is according to the plan;
(b) If there is any deviation, the reasons for such deviations may be ascertained.
(c) Corrective action for the deviations may be taken;
(d) Whether the institutional agencies are moving fertilisers to blocks as per the agreed plan.
(e) If not, the reasons may be ascertained and the corrective action may be taken.
(f) Whether manufacturers and pool handling agencies are taking adequate steps to strengthen their distribution network in the interior.
(g) Whether institutional agencies are also taking adequate steps to improve the retailing infrastructures in the blocks where their distribution net work is weak. Periodical reports about about the supply may be forwarded to the Ministry of Agriculture.

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A. J. S. Sodhi
Joint Secretary(Inputs)

D.O.No.18-5/77-FA/RM(Pt)
Government of India
Ministry of Agriculture
Deptt. of Agri. & Cooperation

New Delhi, Dated 29th Oct. 1980.

My Dear

The Government of India issued orders for delivery of indigenous fertilisers vide Department of Chemicals and Fertiliser's letter No.4(15)/80-FDA-I dated the 3rd July, 1980 upto Block head-quarters by the indigenous fertiliser manufacturers. Similar order was issued for imported fertilisers vide Department of Agriculture's letter No. 18-5/77-FA/RP.I dated the 28th August, 1980. I had discussed the proposed guidelines for implementing these orders in the last Zonal Conference with a view to effectively ensuring delivery of fertilisers equitably in all blocks of the country irrespective of the distance from nearest rail-head.

2. We have since had detailed discussions with the Department of Chemicals and Fertilisers, Fertiliser Industry Coordination Committee, Fertiliser Association of India and others. In the light of these discussions and in the light of suggestions which emerged in the recent Zonal Conferences, we have formulated the guidelines, which are sent herewith for your information and suitable action. If you visualise any serious problem in implementing the aforesaid orders as per the guidelines, please let me know immediately. Otherwise, the implementation of these guidelines will be reviewed in the next series of Zonal Conferences in January, 1981.

3. I have no doubt that you will be able to spare some time personally to guide and supervise the successful introduction of this scheme which holds the potential of ensuring equitable availability of this critical input in all the blocks of your State.

With kind regards,

Yours sincerely,

(A. J. S. Sodhi)

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SOME ASPECTS OF FERTILIZER USE BY SMALL FARMERS.

A REVIEW

B. SEN

Agricultural Economist

Office of Agriculture and Rural Development

August 1981

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I. 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, these affluent tend to consume the meager supply of credit and fertilizer for their own use.[1/] 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"[2/] comprising impressionistic or subjective accounts of field trips in some parts of India.[3/]

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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1/ 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.

2/ See, I. J. Singh, Small Farmers and the Landless in South Asia, World Bank Staff Working Paper No. 320, February 1979.

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

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are in some respects, to 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.[4/] 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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4/ 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. Johl, Distribution of Fertilizers in Punjab, Punjab Agricultural University, Ludhiana, 1973.

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feeling that the defense sidesteps the central 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

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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, [illegible] 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,

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or estimates of consumption 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 those studies provide are inadequate for the purpose of estimating variables that are appropriate for the investigation of equity issues. However, under certain simplyifying 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 marshall available evidence on the directional tendencies underlying the distribution of fertilizer among farmers.*

*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 evalute 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 qualititative change in this area that would call for a fresh look into the question.

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The NSS Data

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.[5/] 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

5/ 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.

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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

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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)	Percent	Area Fertilized with Fertilizers (million ha)	Percent	Rate of Application (kg/ha)	Quantity of Fertilizers Used (000 tons)	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
0 - 1	8.849	37.41	3.410	12.62	113.1	386/725	[illegible]
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	98.1	664.270	24.25
4 - 10	3.208	13.56	8.148	30.17	102.?	832.706	30.4?
10 & Above	.666	2.81	3.422	12.67	93.?	336.5??	12.??
All Sizes	23.654	100.00	27.006	100.00	---	2736.49?	100.??

Source: Sarvekshana, October 1978.

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

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the data origin. Marginal holdings are those with less than 1.0 hectares of land, while those with land between 1 and 2 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[6/] in 1971-72; of these 8.8 million were marginal and 6 million were small holdings. Semi-medium and medium users totalled 4.9 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

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

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in semi-medium and medium holdings, while 0.6 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 387 thousand tons and 518 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

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shares of the large holdings and the small holdings were greater than that of the large holdings. The highest 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 distribution 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

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Project Paper.[7] Recently, data for the year 1976-77 have been released by the NCAER.[8] 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 ± 5 percent, the level 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.[9]

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.[10] The focus of the NCAER study was on cultivator households, while the Census was based on retabulation of data

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7/ NCAER, Fertilizer Demand Study, Interim Report
8/ NCAER, Fertilizer Demand Study, Final Report
9/ Interim Report, Volume 1
10/ The reference year for both the NCAER study and the Agricultural Census was 1976-77.

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on operational holdings and operated area from village records.[11] However, the NCAER survey took account of operational holdings as well, using a definition similar to the one used by the Agricultural Census.[12] 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.[13]

The NCAER estimates of percentages of farms using fertilizer[14] 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.[15] As the table indicates, about 45 percent of all Indian farms, irrespective of size, use fertilizer. This is the overall extent of fertilizer adoption.

11/ 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.

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

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

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

15/ 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. Mellor, "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.

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

e	Size of Farms (Hectares)					All farms
	Below 1 (1)	1-2 (2)	2-4 (3)	4-10 (4)	10 & Above (5)	(6)
eb	71.3	94.4	96.9	98.7	100.0	95.3
ia	77.8	96.4	84.6	100.0	--	80.1
Nadu	67.0	75.1	87.2	89.5	80.6	73.7	
ra	44.1	87.0	80.5	89.8	95.4	68.6
Bengal	61.1	64.8	81.9	75.4	100.0	65.7
rat	53.2	55.9	67.4	71.5	75.3	65.0
a Pradesh	44.9	66.5	75.2	75.0	90.0	62.2
India	36.8	44.8	55.3	55.4	58.8	45.2
r	29.1	55.7	66.4	72.2	90.6	44.9
Pradesh	30.0	44.4	74.4	76.4	98.7	44.6
ashtra	38.7	41.4	38.4	53.0	63.1	43.9
& Kashmir	47.6	35.1	27.1	25.5	--	40.4
taka	34.4	39.7	39.8	41.2	37.5	38.5
hal Pradesh	22.2	46.0	44.8	47.6	100.0	28.8
sthan	13.8	17.6	36.5	34.3	28.4	26.4
sa	9.8	26.3	31.9	34.4	60.0	19.8
a Pradesh	9.9	9.8	20.4	19.9	40.6	16.4
n	3.9	5.5	8.9	8.2	--	5.3

ce: NCAER, Fertilizer Demand Study, Final Report

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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

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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.[16/]

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 58.8 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.

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

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[illegible] than 1½ 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 2[illegible].6 million holdings used (and were therefore the direct beneficiaries of) fertilizers[6/] in 1971-72; of these 8.5 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

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

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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 387 thousand tons and 518 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

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share of area [illegible] was somewhat 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 distribution 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

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Project Paper.[7] Recently, data for the year 1976-77 have been released by the NCAER.[8] 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 ± 5 percent, the level 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.[9]

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.[10] The focus of the NCAER study was on cultivator households, while the Census was based on retabulation of data

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7/ NCAER, Fertilizer Demand Study, Interim Report
8/ NCAER, Fertilizer Demand Study, Final Report
9/ Interim Report, Volume 1
10/ The reference year for both the NCAER study and the Agricultural Census was 1976-77.

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on operational holdings and operated area from village records.[11] However, the NCAER survey took account of operational holdings as well, using a definition similar to the one used by the Agricultural Census.[12] 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.[13]

The NCAER estimates of percentages of farms using fertilizer[14] 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.[15] As the table indicates, about 45 percent of all Indian farms, irrespective of size, use fertilizer. This is the overall extent of fertilizer adoption.

11/ 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.

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

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

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

15/ 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. Mellor, "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.

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

State	Size of Farms (Hectares)					All farms
	Below 1 (1)	1-2 (2)	2-4 (3)	4-10 (4)	10 & Above (5)	(6)
Punjab	71.3	94.4	96.9	98.7	100.0	95.3
Kerala	77.2	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	87.0	80.5	89.6	95.4	66.6
West Bengal	61.1	64.2	81.9	76.4	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	55.3	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

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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

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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.[16/]

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 58.8 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.

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

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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	36.8	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

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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

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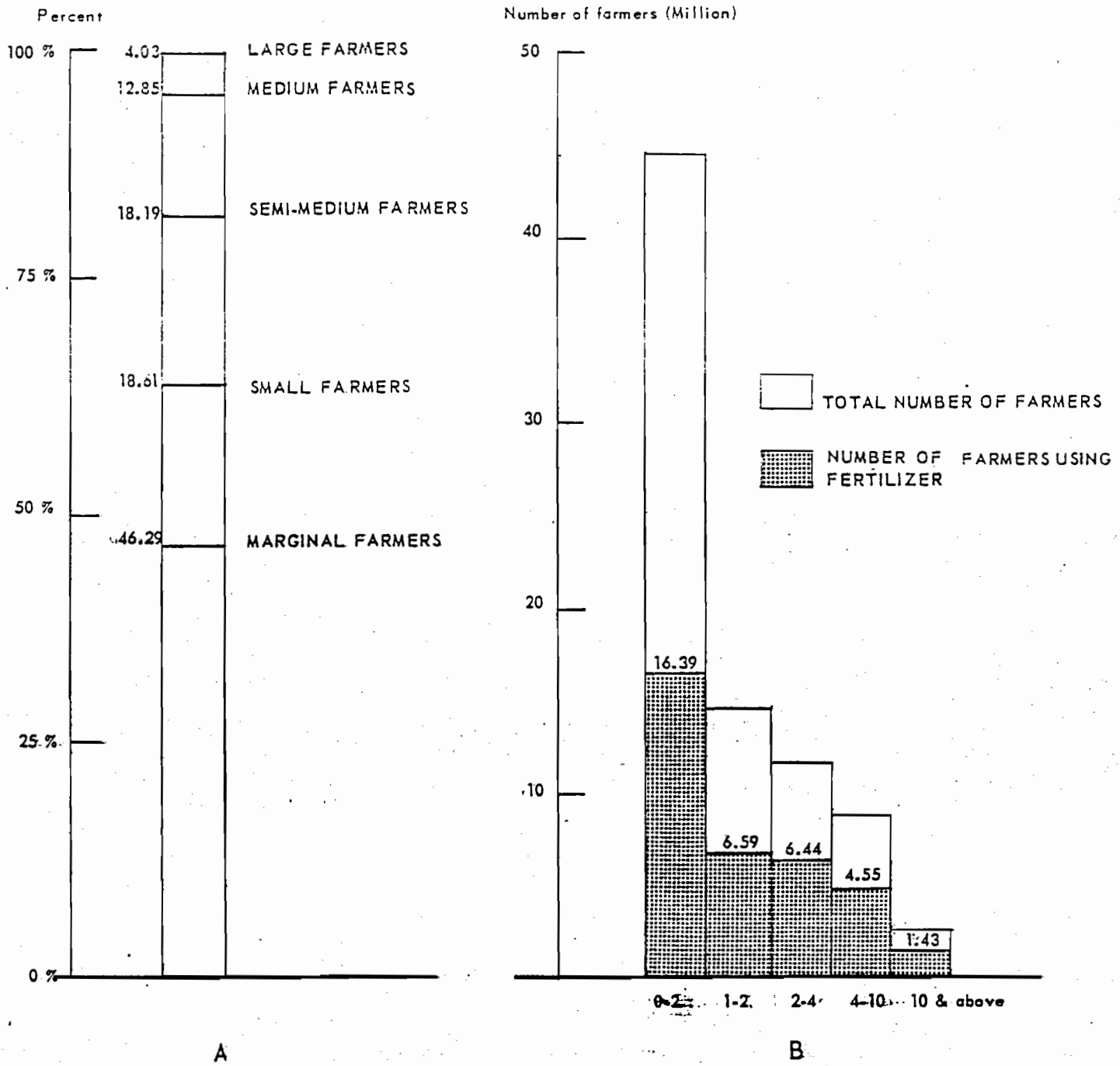
CHART – I



A. PERCENTAGE DISTRIBUTION OF FERTILIZER USERS
(Source: Table 3, Column 4)

B. NUMBER OF FERTILIZER ADOPTERS
(Source: Table 3, Columns 1 & 3)

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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.

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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.

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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.

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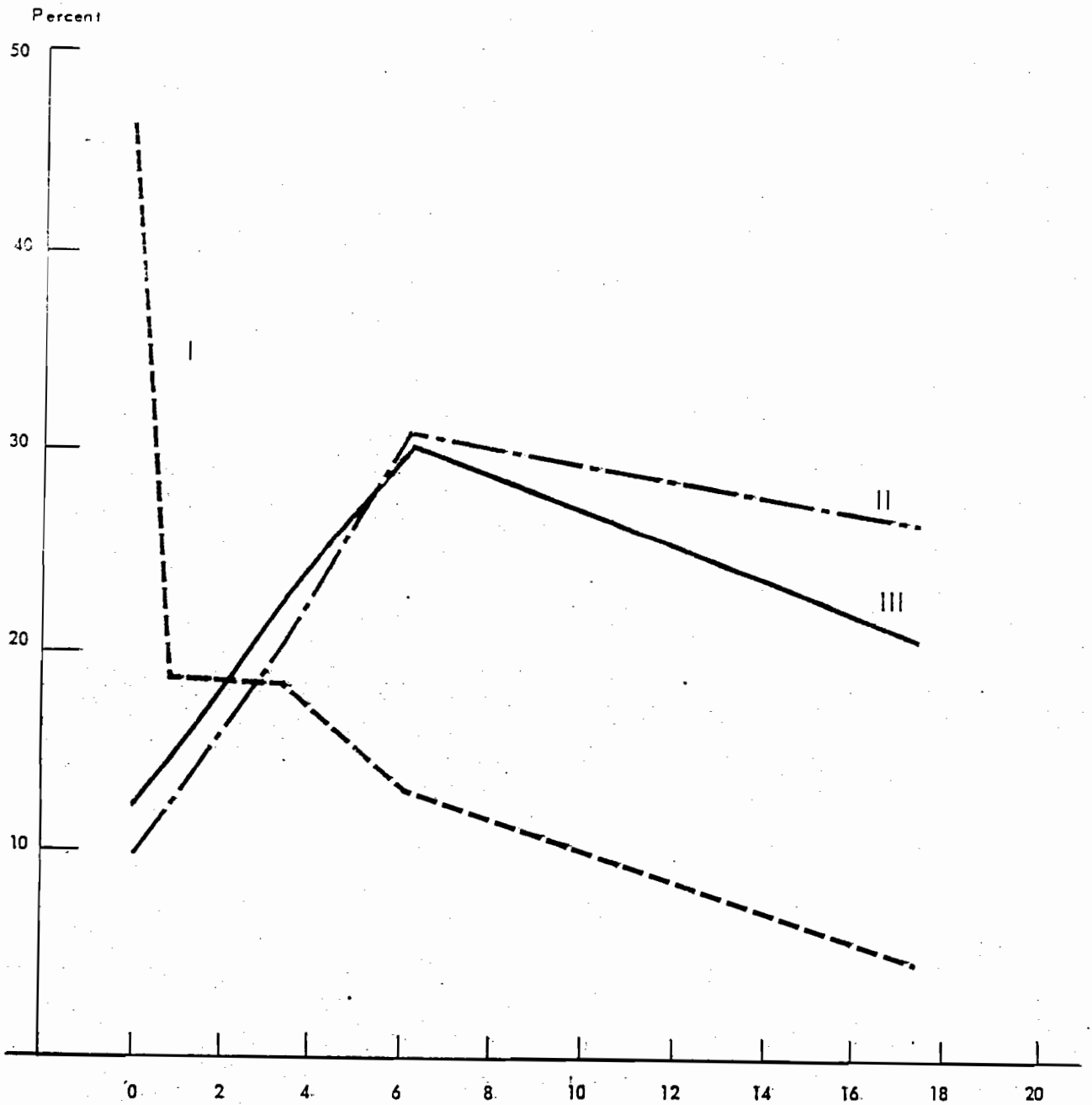
The distribution of fertilizer users, fertilized land and fertilizer consumption (all by farm size) are shown in Chart II. The distribution of fertilizer users shows the preponderance of the marginal and small farmers. The distribution of fertilized land suggests a relatively greater advantage to the

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

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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

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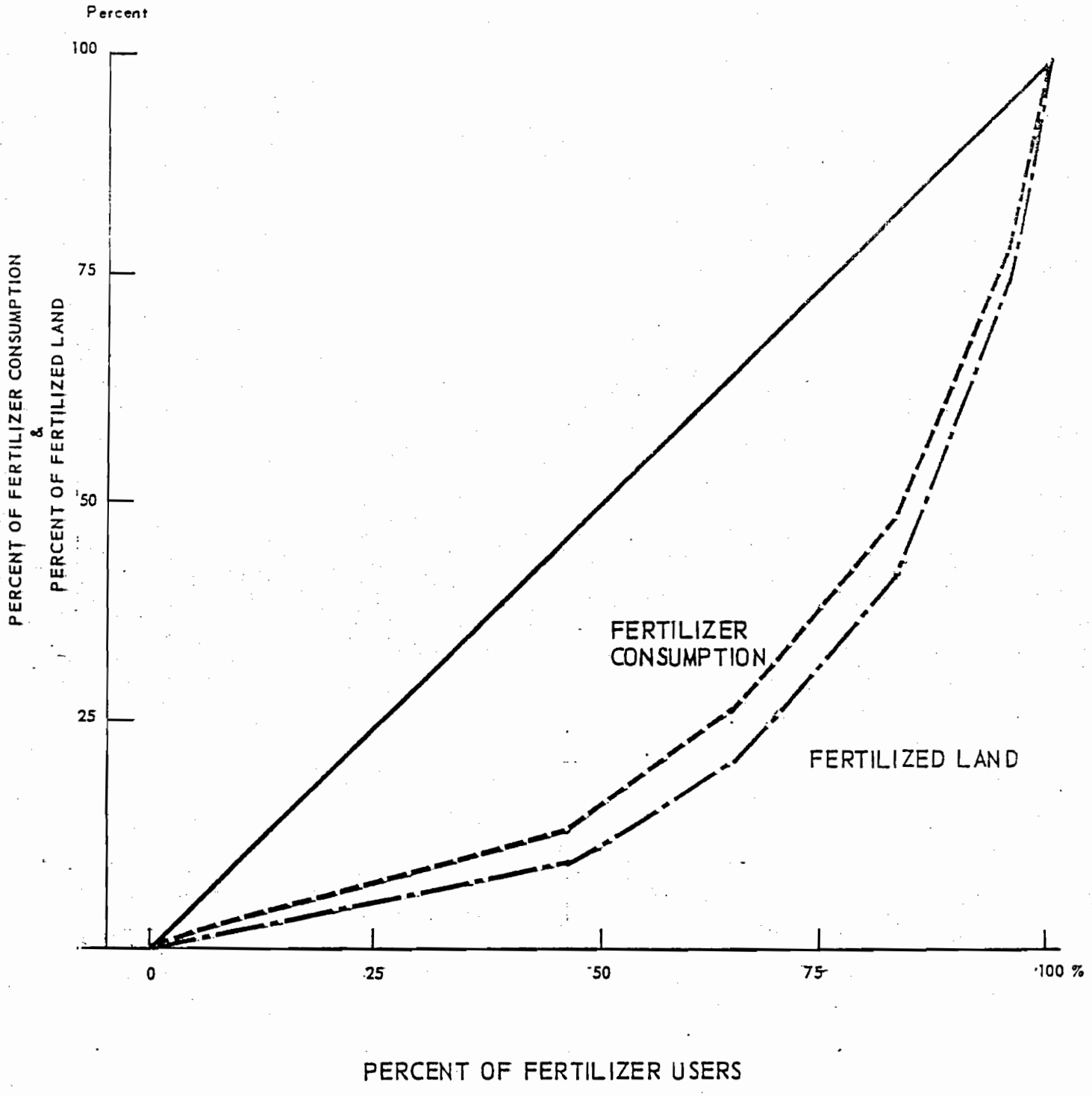
CHART – III


Percent
100
75
50
25
0
25
50
75
100 %
PERCENT OF FERTILIZER CONSUMPTION
&
PERCENT OF FERTILIZED LAND
FERTILIZER CONSUMPTION
FERTILIZED LAND
PERCENT OF FERTILIZER USERS

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 farmers 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.

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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 persepctive. 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

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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.

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ATTACHMENT 'D'

BENEFIT-COST ANALYSIS OF FERTILIZER USE

This review is concerned with a benefit-cost analysis of fertilizer use on farms of different size. The Indian Council of Agricultural Research (ICAR) initiated a program in 1967-68 of Simple Fertilizer Trials (SFT) on cultivators' fields in order to determine the fertilizer requirement of the high yielding crop varieties and to compare the performance of these and the local varieties under different soil and agro-climatic conditions in the country. With more than 15,000 experiments conducted during 1968-71, the program yielded a large body of useful data on fertilizer response.1/

A study of the response data shows that the yield of the same variety varies widely among different agro-climatic zones2/; it varies again from one nutrient to another and from field to field within the same zone, depending upon whether the field is irrigated or unirrigated. Given this wide diversity, it is not meaningful to talk in terms of

1/ The data for this review are obtained from: The Indian Statistical Institute, Optimum Requirement for Fertilizers For The Fifth Plan Period, New Delhi 1974.

2/ The ISI study divided the country into 57 agro-climatic zones. Field data are available for different varieties of wheat, maize, jowar, bajra, paddy, cotton, groundnut and gram separately for irrigated, unirrigated and dryland conditions.

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an aggregate response function. Nor is it feasible, for the purposes of this review to take into account all varieties, all crops and all locations. This review would perforce be selective and illustrative, rather than exhaustive.

For our purposes, we select two irrigated crops (wheat and paddy), two varieties (Kalyansona for wheat and IR-8 for paddy) and two states (Punjab for wheat and Andhra Pradesh for paddy). The varieties chosen are those which have been in extensive use throughout the seventies, and indeed which are still popular with the farmers.

The yield response[3/] of the selected varieties to different doses of N, P and K are shown in Charts I - III separately. Since there is no significant interaction

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3/ The estimated response functions are as follows:

Wheat (Kalyansona):

$$Y = 2326 + 23.030.N - 0.085\ N^2 + 22.140.P - 0.199\ P^2 + 29.800\ K - 0.425\ K^2$$

Paddy (IR-8):

$$Y = 4306 + 13.170\,N - 0.028\ N^2 + 32.440\ P - 0.199\ P^2 + 5.512\ K + 0.0\ K^2$$

where Y is yield per hectare, N is nitrogen, P is phosphate and K is potash

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effect in the data[4/], the response of each nutrient would be taken as additive.

Data on the quantity of fertilizer used by different categories of farmers in Punjab and Andhra Pradesh, for wheat and paddy respectively, have been taken from the NCAER study relating to 1975-76[5/]. Output prices are procurement prices in force in 1975-76 while the nutrient prices have been derived from average fertilizer prices in the same year.[6/] Table 1 shows the average quantity of fertilizer (in terms of nutrients) applied to wheat and paddy in Punjab and Andhra Pradesh respectively by different groups of farmers per unit of land. The table also shows the cost of fertilizer applied per hectare on different size-group of farms.

The next two tables (2 and 3) show the estimated benefit-cost ratios for different farms growing wheat in Punjab and paddy in Andhra Pradesh. In each table, column 1 shows the yields at zero level of fertilizer application, derived from the respective response functions. Average yields per hectare with fertilizer in column 2 are calculated

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4/ See the ISI study
5/ NCAER, Fertilizer Demand Study, Final Report, vols
6/ FAI, Fertilizer Statistics

in terms of the average use of fertilizer (from Table 1) and the respective response functions. The difference between Cols 2 and 1 is average yield due to fertilizer (Col 3). The money value of this yield (using the procurement price) is the average gross benefit per hectare in Col 4. The cost of fertilizer in Col 5 is taken from Table 1. The difference between Cols 4 and 5 is the average net benefit per hectare - net of fertilizer cost - in Col 6. Finally, Col 7 showing the average benefit-cost ratios on a per hectare basis, is derived by dividing Col 4 by Col 5.

The numerical value of the benefit-cost ratio is the highest for the small farmers (1 to 2 hectares) in Punjab, and is the least for the large farmers (10 hectares and above). Among paddy growers in Andhra Pradesh the largest value of the benefit-cost ratio is obtained on the medium and semi-medium group of farmers, cultivating between two and 10 hectares of land; the smallest value of the ratio occurs for the group of small farmers. However, the difference among farmers in terms of the absolute values of the benefit-cost ratio is so small that it would be appropriate to conclude that there is no difference in respect of benefits and cost. All farmers, regardless of size, are reaping equal benefits from fertilizer use.

17 March 1981

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TABLE 1 Fertilizer Application (in terms of nutrients) per Fertilizer Hectare of HYV Wheat (irrigated) in Punjab and Winter Paddy (irrigated) in Andhra Pradesh

(in kg)

Size of Farms (hectares)	N	P	K	Total cost of nutrients (Rs)
		Wheat		
Below 1	91.3	22.0	1.7	517
1 - 2	74.8	23.9	0.8	462
2 - 4	79.0	24.5	1.7	484
4 - 10	75.2	27.2	1.3	486
10 & Above	79.1	33.4	1.0	543
All farms	77.2	27.4	1.3	496
		Paddy		
Below 1	89.1	29.4	--	555
1 - 2	93.3	24.3	4.9	547
2 - 4	75.6	26.3	3.5	486
4 - 10	76.0	28.3	3.2	501
10 & Above	78.0	24.6	6.3	490
All farms	80.1	26.7	3.6	507

Notes: Price of N derived from urea: Rs 4.02/kg
Price of P derived from SSP: Rs 6.68/kg (averaged)
Price of K derived from MOP: Rs. 1.90/kg(averaged)

Source: FAI, Fertilizer Statistics, 1979-80
NCAER, Fertilizer Demand Study, Final Report, vol 9 Table 203: vol 10, Table 47.

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TABLE 2

ESTIMATED PER-HECTARE AVERAGE BENEFITS TO FARMS

IN DIFFERENT FARM-SIZE GROUPS, PUNJAB, 1975-76

Farm Size (Hectares)	Estimated Yields of Wheat			Average Gross Benefit (Rs/ha)	Average Fertilizer Cost (Rs/ha)	Average Net Benefit (Rs/ha)	Average Benefit Cost Ratio
	Without Fertilizer (kg/ha)	With Fertilizer (kg/ha)	Increment in Yields (kg/ha)				
	1	2	3	4	5	6	7
Below 1	2326	4157	1831	1923	517	1406	3.72
1 - 2	2326	4011	1685	1769	462	1307	3.83
2 - 4	2326	4085	1759	1847	484	1363	3.82
4 - 10	2326	4069	1743	1830	486	1344	3.77
10 & above	2326	4061	1735	1822	543	1279	3.36
All farms	2326	4091	1765	1853	496	1357	3.74

Note: Price of wheat per quintal: Rs 105

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TABLE 3

ESTIMATED PER HECTARE AVERAGE BENEFITS TO FARMS

IN DIFFERENT FARM-SIZE GROUPS, ANDHRA PRADESH, 1975-76

Farm Size (Hectares)	Estimated Yields of Paddy			Average Gross Benefit (Rs/ha)	Average Fertilizer Cost (Rs/ha)	Average Net Benefit (Rs/ha)	Average Benefit Cost Ratio
	Without Fertilizer (kg/ha)	With Fertilizer (kg/ha)	Increment in Yields (kg/ha)				
	1	2	3	4	5	6	7
Below 1	4306	6040	1735	1284	555	729	2.31
1 - 2	4306	5991	1685	1247	547	700	2.28
2 - 4	4306	5878	1572	1163	486	677	2.39
4 - 10	4306	5923	1617	1197	501	696	2.39
10 & Above	4306	5881	1575	1165	490	675	2.38
All farms	4306	5927	1621	1199	507	692	2.36

Note: Price of paddy per quintal: Rs 74

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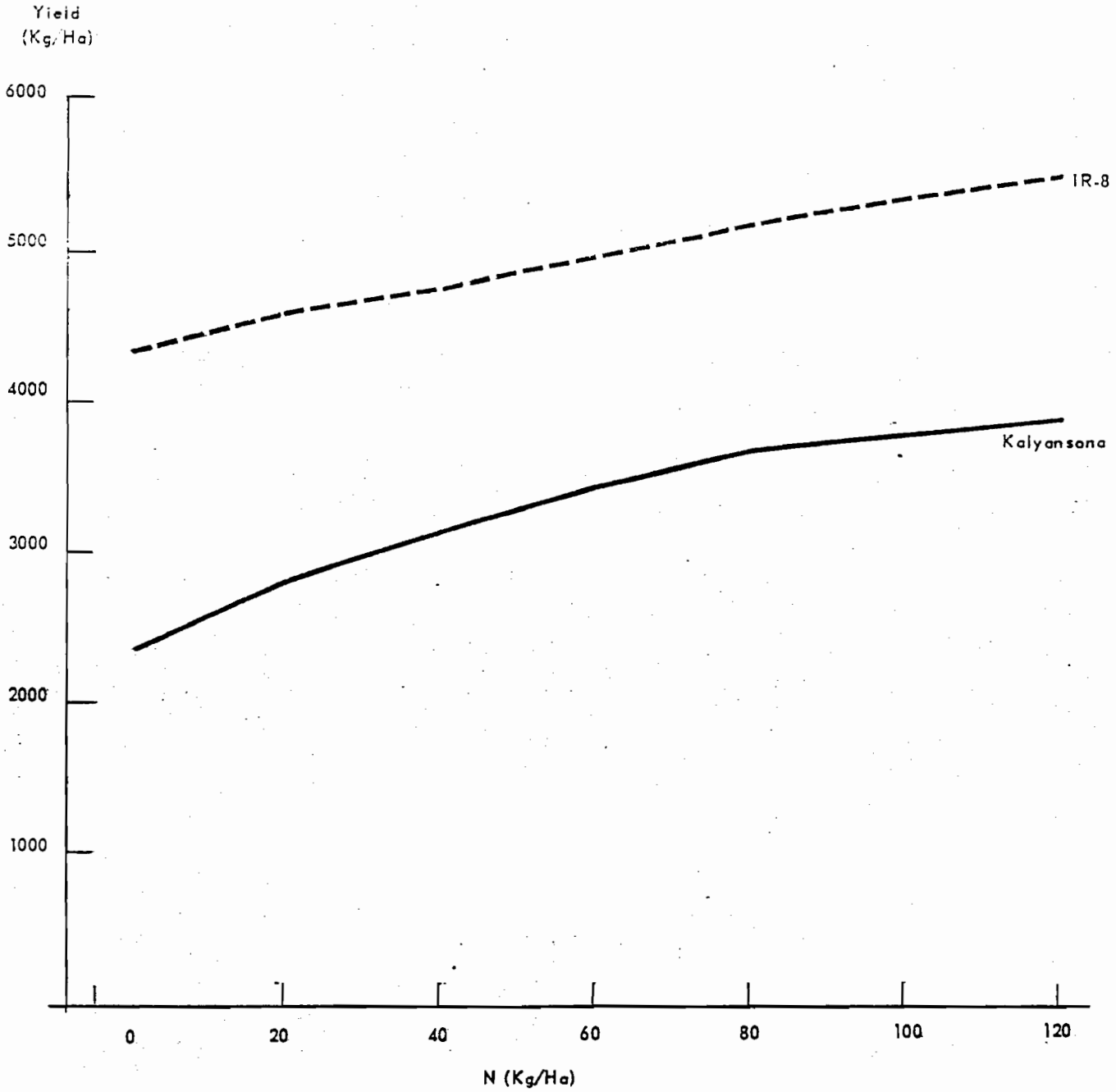
CHART



NITROGEN RESPONSE OF IR-8 PADDY (Irrigated) IN ANDHRA PRADESH AND OF KALYANSONA WHEAT (Irrigated) IN PUNJAB.

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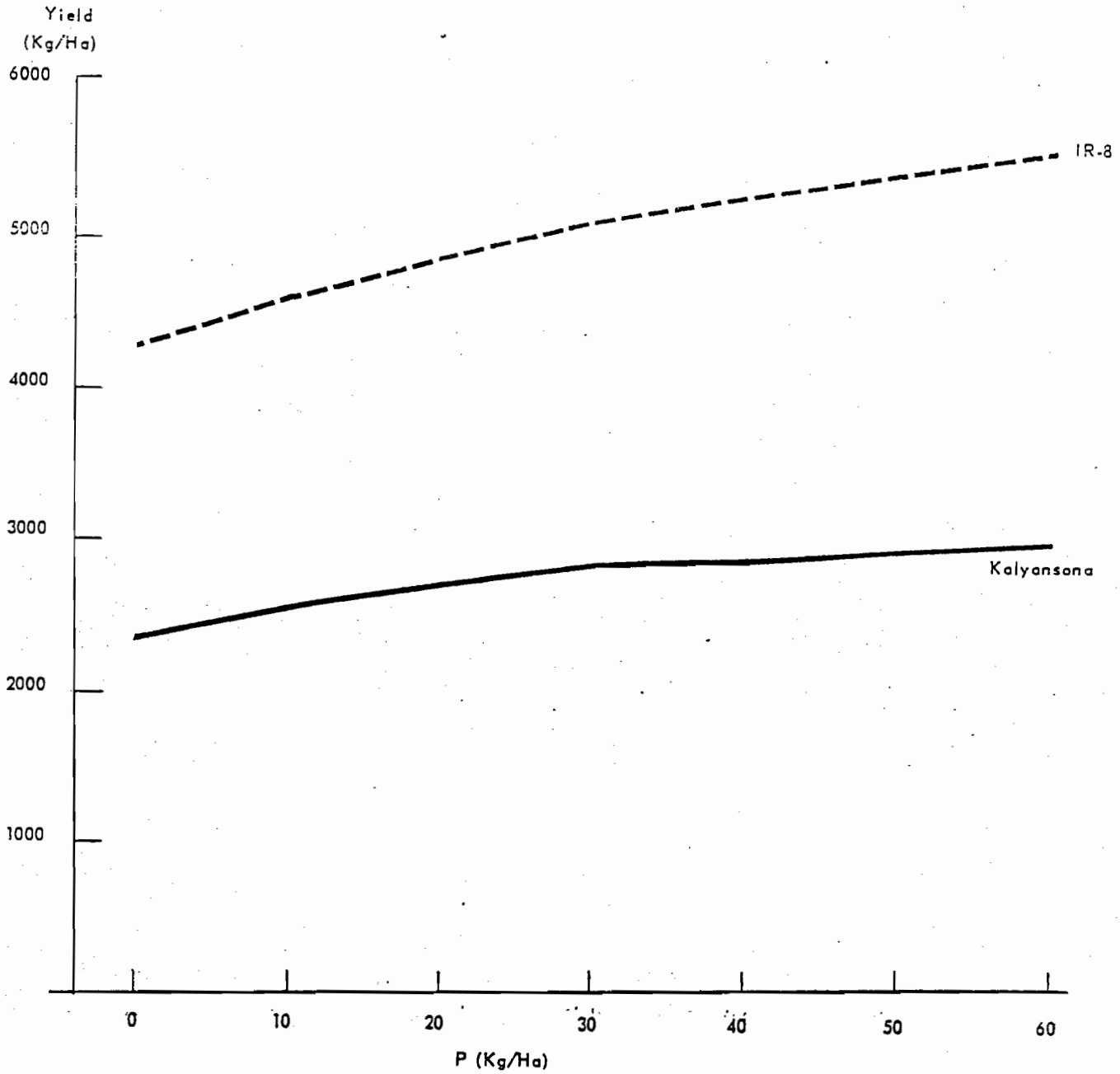

PHOSPHATE RESPONSE OF IR-8 PADDY (irrigated) in ANDHRA PRADESH AND OF KALYANSONA WHEAT (Irrigated) IN PUNJAB.

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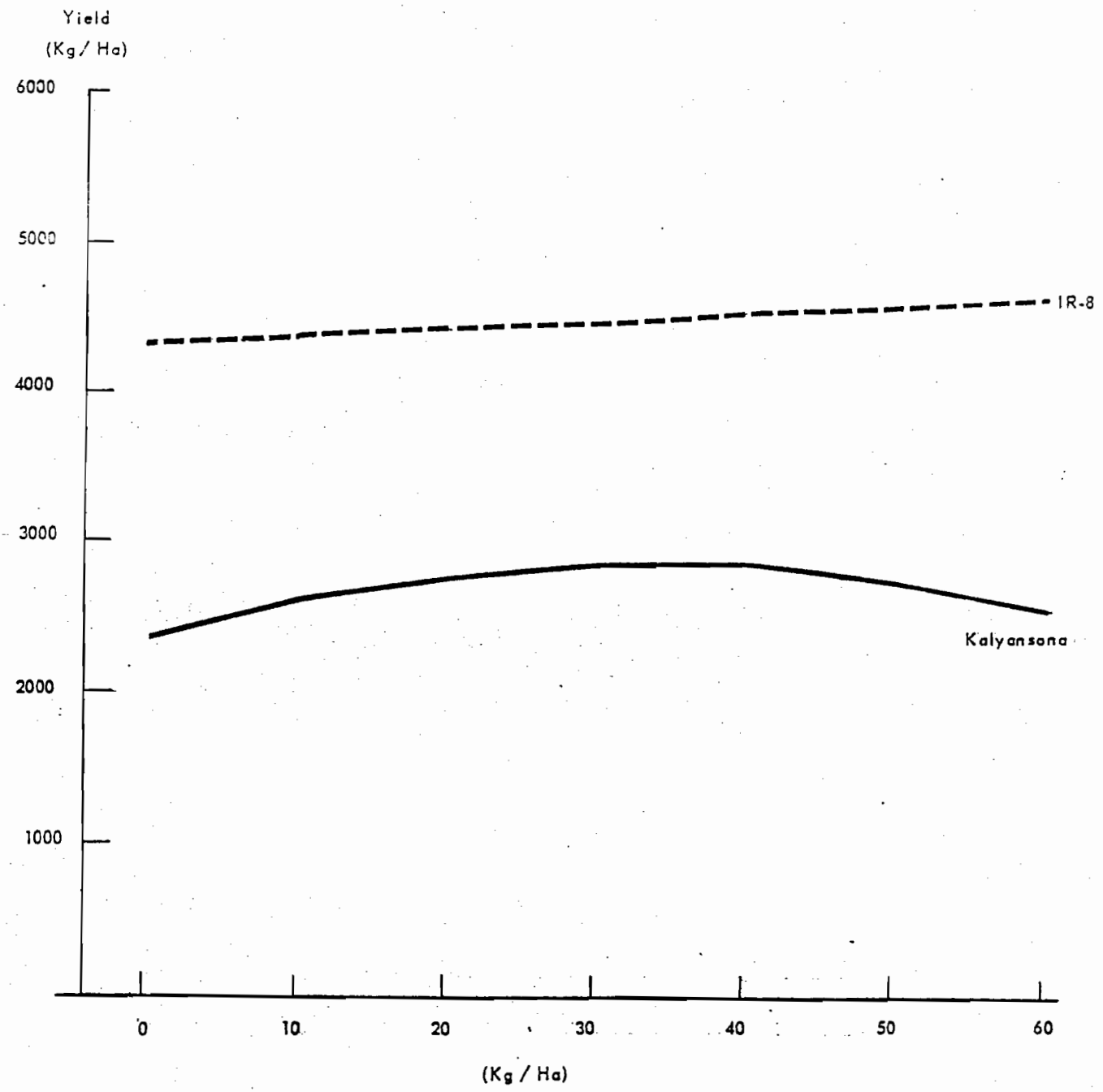

POTASH RESPONSE OF IR-8 PADDY (Irrigated) IN ANDHRA PRADESH AND OF KALYANSONA WHEAT (Irrigated) IN PUNJAB-

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