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Agenda item IX/4

FINANCIAL IMPLICATIONS OF MEETING THE FUTURE FERTILIZER NEEDS OF DEVELOPING COUNTRIES UP TO 1980 1/

by

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World Bank Group 2/

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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

ABBREVIATIONS

All N and P_2O_5 quantities, prices etc. relate only to fertilizer, and not to industrial products.

MT	=	metric tons
MTD	=	metric tons per stream day
MTY	=	metric tons per year
$	=	U.S. Dollars or equivalent
IBRD	=	International Bank for Reconstruction and Development (World Bank)
IFC	=	International Finance Corporation
IDA	=	International Development Association
UNIDO	=	United Nations Industrial Development Organization
FAO	=	Food and Agriculture Organization of the United Nations

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CONTENTS

I. INTRODUCTION

1. This paper has three main objectives: the first one being to update and establish fertilizer consumption and demand forecasts up to 1980 specifically for developing countries; the second one being to transform these quantities into terms of money which would be needed for future imports of finished fertilizers and raw materials, as well as for investments, and the third objective is to discuss sources for these funds. The last point mentioned inherently includes the problem of profitability of fertilizer ventures as well as economic considerations. The paper does not, however, focus on socio-economic aspects of establishing or expanding a fertilizer industry, nor does it endeavor to re-assess the relationship between fertilizer application and agricultural development.

II. FORECASTS UP TO 1980 FOR CONSUMPTION AND PRODUCTION

A. The Overall Picture for Fertilizer Consumption and Production

2. Based on UNIDO's fertilizer demand and production projections up to 1980,[1] and taking into consideration the market knowledge for those countries for which more recent information was available within the World Bank Group, the overall picture may be presented as follows:

1/ UNIDO Symposium Paper ID/WG 99/4 of August 6, 1971, Tables X, XI and XII, prepared by R. Ewell.

TABLE I[1]

Overall Consumption and Production Forecast of N and P_2O_5 (in million MT)

	N fertilizer			P_2O_5 fertilizers		
	1969/70	1980	Expected Increase	1969	1980	Increase
Consumption						
Industrialized Countries[2]	20.8	39.8	19.0	14.8	27.3	12.5
Developing Countries [3]	7.7	19.9	12.2	3.7	9.1	5.4
World Total	28.5	59.7	31.2	18.5	36.4	17.9
Production						
Industrialized Countries[2]	25.4	43.3	17.9	15.9	29.2	13.3
Developing Countries [3]	4.2	16.4	12.2	2.9	7.8	4.9
World Total	29.6	59.7	30.1	18.8	37.0	18.2

Details and basic assumptions from which this table has been derived are given in the sections on N-and P_2O_5 fertilizers in this paper; generally a more balanced consumption-demand pattern than that which we presently have has been assumed, although rational and conscious planning have not been the major characteristics in the past of the world's fertilizer industry.

3. The real growth as a function of time in many sectors of economy and industry may be described by an S-shaped curve (Figure 1A) which follows an exponential formula. This curve may be split into three almost linear sections, as indicated by dotted portions of the curve, and in two curved sections as indicated by double lines.

1/ In the following tables and text, "imports" mean net imports, if not stated otherwise.

2/ including USSR and all Eastern European countries.

3/ including Socialist Asia.

In the early years of fertilizer application in any country, increase is slow. and after farmer education and other market preparation, including the creation of necessary infrastructure and the like, a sharp increase can often be observed, followed by a more linear high growth rate. With approaching the optimum consumption -- also determined by a decreasing benefit/cost ratio -- the curve is flattening out.

4. When studying a specific country, and over a limited period of time, such market forecasts based on regression analysis are often described by trend curves such as the Gompertz curve, Pearl-Read or logistic curve, modified exponential curve and logarithmic parabola. If, however, a multitude of countries in various stages of development are being summed up, like we do in this paper with some 60 developing countries contributing to fertilizer consumption and about half of them involved in production, all sorts of growth curves for both consumption and production are encountered as indicated in Figure 1B. Obviously by a mere coincidence, the overall result of this intermingling of different growth rates is an almost linear increase both in forecasted consumption and production for all developing countries, as shown in Figure 2 and Figure 3. Consumption in the 11 years between 1969/70 and 1980 increases for N by 159%, or about 10% per annum and for P_2O_5 by about 143%, or about 8.5% per annum compound.

5. Figure 2 shows, for illustrative purposes only, the consumption and production forecast under simplified and extreme assumptions: no investment in new production facilities would be made at all, (leaving the production at the 1969/70 level) with two alternatives: either a remaining, or an increasing consumption according to the growth rate as applied in Table I. The balance between production and consumption would then either remain at the present level which would almost certainly make the food problem unsolvable, or in the case of a growing consumption as

forecasted, the developing nations would have to import per annum (net) about 16 million MTY of N by 1980 (about half of the 1971 total world production) and 6 million MTY of P_2O_5. These imports would probably cost a total of about $3 billion in foreign exchange per year at the end of this decade, not even counting potash imports. Although such auspices may stipulate the phantasy of fertilizer sales organizations, we cannot be as unrealistic as to assume that either bilateral or multilateral funds could ever be provided to such an extent for just one sector of the economy. Hence, when aiming at foreign exchange savings as one of the prime objectives of development aid, and at fostering interregional trade among developing countries, fertilizer production capability must be implemented at a faster pace than in the past.

6. Figure 3 shows the impact of investment activity in both the N and P_2O_5 sector, as will be suggested and explained in this paper, on net import requirements under the same consumption alternatives. The first alternative of a constant level consumption and considerable production buildup would arithmetically yield a surplus higher than the consumption which admittedly is an unrealistic case. With the second alternative of a growing consumption, the gap in nitrogen supply would remain at about the 1969 level with 3.5 million MTY of N, but at a 2.6-fold consumption increase over the 1969 level, and the phosphatic fertilizer import requirements would still increase from about 0.9 to about 1.3 million MTY of P_2O_5, with a substantial 1.4-fold increase in consumption in the 11-year period involved. By the end of the decade, about 17% of the N demand, and 14% of P_2O_5 consumption would have to be imported into developing countries.

7. In Figures 4 and 5, this outcome has been transformed into a simplified overview over the long range impact of growth in consumption and production of N and P_2O_5 on the requirements of money for imports. In N-fertilizer, the 1980 net

balance would amount to between minus $2 billion and plus $1.1 billion with a target of minus $460 million, and in P_2O_5 fertilizer, between minus $800 million and plus $530 million with a target of minus $170 million. Although none of the extreme cases may develop, they do indicate some remote chances of what could happen.

8. Investment in fertilizer plants in developing countries, therefore, is a must if we assume that:

- the forecasted consumption growth in developing countries is considered realistic and necessary to achieve the targeted food production, and
- the capital outlay for fertilizer imports should be kept on the actual order of magnitude.

This rather simplified but instructive overview illustrates that the investment activity in the fertilizer sector as outlined in this paper would achieve nothing more than to keep the N-balance up to 1980 in developing countries at about the 1970 level, and prevent the P_2O_5 balance from dramatic increases -- and in summary -- would still require about the same overall annual imports for N and P_2O_5 of about $600 million similar to the 1969/70 figure.

B. Country Classification and Regional Breakdown for Consumption and Production 1/

9. For the purpose of better classification, the developing countries may be classified into 6 categories according to their actual and future fertilizer consumption and production. Table II denominates such a classification comprising more than 120 developing countries.

10. Since the objective of this paper is mainly concerned with the order of magnitude of the financial implications of meeting the future fertilizer demand,

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1/ This paragraph has been added for clarification reasons after the Conference in New Delhi and is based on additional work done by the author in cooperation with M.C. Verghese (UNIDO), R. Ewell, and J. Couston (F.A.O.).

CLASSIFICATION OF LDC ACCORDING TO FERTILIZER PRODUCTION AND CONSUMPTION

CATEGORY:	1	2	3	4	5	6
Probable Demand (1980) '000 MT of N (P_2O_5)/yr.	Very Small <3	Small -20	Medium 20-100 N 60(P_2O_5)	Large >120 N > 80(P_2O_5)	Small or Moderate	Small 20-60
Production	None	None	None	Mostly Existing	Existing or Potential	Small Existing
Proposal for Action Up to 1980 1/	Imports Continuei	Mixing Plants	Satellite Plants	Large Plant (s) for NH_3 and/or H_3PO_4	Surplus Producers for Export	None
	MARKET & INFRASTRUCTURE development primarily					
Number of Countries 1/ N/P_2O_5	48/55	12/23	19/10	22/13	15/16	7/4

1/ Regional Projects not considered.

all developing countries with "very small" and "small" existing and potential consumption have not been evaluated in this paper. There are also 11 countries classified as "Category 6" which have small actual and future consumption, but do have small production units for either N or P_2O_5 fertilizers; for simplification reasons, these have also been left aside in this paper. This leaves for consideration 56 countries for the N-sector, and 39 countries for the P_2O_5-sector, with an aggregate consumption of about 18.7 million MTY of N and 7.3 million MTY of P_2O_5 by 1980 which is more than 80% of the consumption in all developing countries. When estimating finished fertilizer import costs, though, the overall net requirements, regardless of this classification, have been applied. This classification does not include some countries which are considered to be "developing countries" according to DAC definition such as S. European countries, but does include Socialist Asia and South Africa.

11. The breakdown of consumption in the various categories of countries is shown in Table III A:

TABLE III A

Summary of N and P_2O_5 Consumption in Countries According to Classification
(in million MTY)

	N		P_2O_5	
	1969	1980	1969	1980
Category 1, 2, 6	0.19	0.38	0.20	0.50
Category 3	0.44	0.88	0.20	0.50
Category 4	6.86	17.60	1.93	5.27
Category 5	0.12	0.25	0.62	1.52
Subtotal	7.61	19.11	2.95	7.80
Total LDC	7.7	19.9	3.75	9.10

Countries which have been classified into either Category 3, 4, or 5 have been listed in Table III B:

TABLE III B

Countries with Moderate to Large Potential Fertilizer Consumption, and/or Production

	N and P_2O_5	N Only	P_2O_5 Only
Asia, Middle East:	Burma China (PR) India Indonesia N. & S. Korea Malaysia Pakistan Philippines Thailand Turkey N & S. Vietnam Iran	Cyprus Lebanon China (T) Ceylon Abu Dhabi Bahrein Brunei Kuwait Qatar S. Arabia Singapore	Iraq Israel Jordan
Africa:	Algeria Kenya Gabon Egypt Morocco Tunisia S. Africa	Cameroon Maruitius Sudan Rhodesia Libya Nigeria	Senegal Togo Uganda
Latin America:	Brazil Colombia Cuba Argentina Chile Uruguay Ecuador Mexico Peru	Central American Common Market Dominican Republic Jamaica Panama Neth. Antilles Trinidad/Tobago Venezuela	Martinique/Guadalupe
DAC Europe:	N O T C L A S S I F I E D		

12. The regional breakdown of future consumption indicates that by far the largest consumption of both N and P_2O_5 fertilizers will continue to be in Asia, including Middle Eastern countries followed by Latin America and Africa. Based on the

forecast as outlined in the Sections on N and P_2O_5 below, such a breakdown for 1980 is as follows (Category 3, 4 and 5 countries only):

TABLE IV

Expected Regional Distribution of Consumption by 1980 in Category 3, 4 and 5 Countries (in million MTY)

	N	P_2O_5
Asia	13.3	3.9
Middle East	1.0	.5
Africa	1.3	1.1
Latin America	3.1	1.8
Total Category 3, 4 and 5	18.7	7.3
Total LDC Forecast	19.9	9.1

C. Problems in Forecasting of Recurring Costs, and of Investment Costs Required to Meet the Consumption

1. Recurring Costs

13. Recurring or annual costs for meeting the demand as outlined in the previous chapters consist of all direct costs involved in purchasing, by the developing countries, finished fertilizers, raw materials and intermediates, spare parts, chemicals, etc. They do not in this context include repayments of loans, nor interest payments, nor transfer of profits. These costs are considered separately in the sections in this paper dealing with financing of new fertilizer industry projects. Major problems in forecasting such costs are the future prices of

finished fertilizers, freight costs, and prices for feedstocks such as petroleum and fractions thereof, natural gas, coal, rock phosphate, and sulphur. These problems will be discussed separately in the following sections on the N and P_2O_5 fertilizer sectors.

2. A Special Word on Freight Costs

14. Freight costs constitute a major part of the total expenditures for the supply of finished fertilizers and feedstocks.[1/] N-fertilizer, like urea, requires the shipment of about 2 tons of product for each ton of N, and for raw materials plus fuel, for producing N-fertilizer, only about 1 ton per ton of N has to be moved to the factory. Therefore, in the N-sector, freight costs are more important for shipping finished products. It is the other way around for the phosphate fertilizer industry, namely, for every ton of P_2O_5, one must also move about 2 tons of product (in phosphoric acid and TSP) but as much as about 4.5 tons per ton of P_2O_5 when producing fertilizers from rock and sulphur.

15. Any judgement of whether local production or imports of finished fertilizers is of greater benefit for a developing country will continue to be dependent on freight rates because the differences in freight of say $5 per ton of phosphate rock is equivalent to about $18 per ton of P_2O_5 and would be by far more important than differences in yield, or in consumption figures, though all processes would likewise suffer or benefit from freight rate changes. In recent years, shipments in bulk or in bags virtually across the world cost between $3.50 and $17.00 per ton depending on the tonnage; from a few thousand up to 40,000 tons per load are moved in fertilizer trade. The difference in freight rates, for instance for phosphate rock movements to India, from nearby Aqaba, or from Morocco, was only between $6-8 per ton. Freight rates from Morocco to China and from Florida to Korea were about $12 per metric ton early in 1970, compared to $23 a year before.

1/ The total world output of the fertilizer industry was about 200 million tons gross weight in 1969/70.

In recent years, freight cost for bagged products, for instance from the U.S. to India and Indonesia, and from Northern Europe to P.R. China, were prevailing at a low rate of between U.S. $12 and $16 per MT. Since at least 50% of USAID financed cargo must be shipped on U.S. flag vessels if available, and costs for that range between $45 and $65 per MT of bagged material, average freight cost may be much higher, but these must be considered as a reality in the present day "trade-by-aid" pattern; and these higher costs could also serve as a hint at what freight costs could be in the future once the present "low" will have been passed through. These recent events illustrate the vagaries of the tramp shipping market, and the difficulty of predicting trends in freight rates. Although Japanese projections predicted as early as 1971 that there would be a continuing boom in shipping, freight rates declined sharply. Even though the size of ships have been increased, enabling them to break even at lower rates, this will probably not outweigh the continuing increase in seamen's wages, port charges, fuel prices, and shipbuilding costs. A 200,000 ton ship costing about $13 million in 1967 is now said to be priced at more than $28 million to be delivered in 1973-74, and in addition , interest on credits for shipbuilding are now about 7% per annum compared to 5.5% per annum previously. The increase up to 1980 of shipments for the fertilizer sector in developing countries may be on the order of 60 million MTY which would require -- with 5 journeys per ship and year -- 60 new 200,000 ton vessels costing about $2 billion. Average and peak rates vary so much that any forecast to be undertaken for a 10 year period is merely a guess. This fact makes economic judgements even more difficult since these are based on cif prices for competing imports.

16. In addition to freight rate charges, port charges might vary considerably also. In Trinidad for instance, port charges for fertilizers have increased within one year from $7.50 to $12.50 per ton.

17. The purpose of this excursion is mainly to put the various components of a total cost calculation into the right perspective, and to warn against faking an exactness in such estimates which just cannot be achieved.

3. Investment Costs

18. Another serious problem in forecasting the costs for meeting future fertilizer demand is the estimate of total investment costs required for adding the production capability as proposed in this paper. The following are some general remarks which apply to all sectors of the fertilizer industry. This problem is a five-fold one:

a) to arrive at a reasonable forecast for the degree of utilization of existing and new plants in developing countries;

b) to determine the direct ("battery limits") plant costs based on nominal capacities and on actual prices, and to adjust these to conditions in developing countries;

c) to include all necessary additional physical investment which is needed to put any new factory into efficient operation;

d) to estimate other costs such as for credit facilities, subsidies, market development, and farmer education, and finally,

e) all cost items then have to be corrected for cost escalation and changes in the values of currencies involved.

19. Although many fertilizer projects in developing countries have been carried out in the past, only recently the so-called "new generation" of large N-fertiliz[er] plants based on ammonia plants with about 600 MTD ammonia capacity and more, using steam driven centrifugal compressors on so-called energy-independent design[s] have been introduced and a very few -- not more than 10, as of the end of 1971 -- have completed erection.[1/] Therefore, our knowledge about specific and total cost

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1/ In Mexico-Pemex; in India-Cochin, Madras and Durgapur; in Algeria-Arzew; in Kuwait-KPC; in Pakistan-Dawood-Hercules; in Spain-Calvo Sotelo.

of implementing such projects is still limited. The degrees of utilization can only be guessed. Although any such centrifugal type ammonia plant has a certain minimum utilization _if_ it runs, there is no indication whatsoever of a downtime factor to be assumed in developing countries, but also is not in highly industrialized countries; experience with this type of plants has often been, and still is, discouraging with regard to downtime.

20. Direct, or "battery limits," investment costs, on the other hand, may be estimated, depending on the type of project and the country, within reasonable limits of accuracy of say ± 10 or ± 20% of costs based on 1971 costs, provided that the country's investment criteria are well known.

21. Large phosphatic fertilizer or phosphoric acid complexes with capacities around 100,000 MTY of P_2O_5 and more, have been built in an even smaller number than ammonia plants1/ but their direct plant investment cost may, within the same limits of accuracy, be estimated at 1971 prices and the degree of utilization is quite good and easier to estimate than it is for ammonia plants.

22. Quite generally, fertilizer plants, as most other industrial projects, cost much more to implement than they have been estimated to cost, with virtually no exception in the World Bank's and IFC's experience.

23. Another obstacle when estimating the total funds needed for developing the fertilizer sector in any country is the need for funds other than those for the fertilizer manufacturing facilities. Our experience shows that the most grave mistakes are made in enumerating, and cost estimating, the "surroundings" of fertilizer projects.

24. _Figure 6_ presents an overview of major sectors in which investment capital and recurring expenses will have to be provided for the implementation of any

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1/ for example, in Mexico-FFM; in India-Madras; in Tunisia-ICM; in Israel-HAIFA.

fertilizer program enumerating the major sectors of the economy which are involved, namely, besides the fertilizer industry, mining, transportation (including rail, roads, trucks and railcars, ports, coastal barges and pipelines), mechanical/engineering inudstry, distribution and marketing of fertilizers as well as of agricultural products (in one word - agriculture), education and training, public utilities (including ecological facilities), housing, and last but not least, banking. In many, even recent, feasibility studies, most of these areas have not been given proper consideration, although the necessity of investing in sectors other than the fertilizer industry is apparent and generally well known.

25. Of course, the efforts and the amounts of money needed depend on the general economic status in a country, and on the physical and human resources available. Therefore, no generalized figures can be derived for the costs to be outlayed for creating such an "environment." Many authors, agencies, governmental bodies and others, have endeavored to quantify the problem of how to estimate such costs and efforts as related to the requirements for the fertilizer industry as such, but only scarce and rather dubious data have been guessed. This paper again does not intend to quantify those "offsites needs" but rather to highlight its importance and put it into the right perspective as compared to industrial investment, and to the total flow of aid to developing countries. Most mistakes in cost estimating are being made due to the fact that we forget important items rather than in estimating their costs.

26. As a first approximate for taking costs of marketing into account, a major sector which invariably needs large capital support -- although this broad field needs to be defined -- it has been suggested that one dollar be invested in

marketing for each dollar that is invested in fertilizer plants. This guess-figure of course does not include other money-consuming items mentioned in Figure 6 such as public utilities, feedstock and fertilizer transport including rail facilities, ports and barges, credit, and money which is sometimes needed to subsidize fertilizer application and imports. As said before, there is not even a general guess-figure for these sectors, and furthermore, such infrastructure costs benefit all sectors of the economy and it seems to me therefore that any allocation of how much costs would be due to the fertilizer sector, is wild guess work.

27. Not only the amount, but also the type of financing needed for implementing fertilizer programs will be influenced by such additional fund requirements. Whilst the fertilizer industry in many countries could be implemented with the inclusion, or even dominant role, of private investors, this is not the case for almost all of the other sectors involved (possibly with the exception of some mining ventures for oil and gas, for rock phosphate, sulphur and potash). Furthermore, the overall success of fertilizer plants very much depends on the extent to which infrastructure, in its broader sense, may or may not be already available. Governmental activity seems to be an indispensable requirement in order to create healthy grounds for the fertilizer sector, especially so in the lesser developed countries. We could also state that with increasing development, the share of private activity and capital in the fertilizer sector is likely to increase.

28. Figure 6 is also supposed to emphasize the fact that each project in the fertilizer industry implies many other projects in other sectors of the economy, and those may become real pitfalls (and pitholes) as far as money needs are concerned. In the past, this consideration has been, and still is, a stepchild

of both individual fertilizer project feasibility, and of sector studies, probably because such "side projects" are less glamorous than an impressive manufacturing facility is.

29. In addition to the problem of estimating direct costs of plants and of surrounding facilities at present day prices, and mostly those based or costs in industrialized countries, distorting factors must be evaluated such as import duties on equipment which may even vary during construction time, which, if it happens, may cause changes in the financial plans. Another problem is the contigency allowance for unknown and changing financial burdens such as duties and taxes, floating interest rates, provision for possible devaluation or revaluation, and for floating of the currency of the country in which the plant is to be built, or from which the equipment is expected to be supplied. This is usually called the "dollar gap" which is an important issue when putting together financial arrangements, including credits and loans from various countries. Finally, the old fashioned inflation factor -- which is now more fancily referred to as "cost escalation" -- adds to the problem of estimating costs.

30. We are trying to develop in IFC a method of better forecasting total investment costs with the objective of giving probability indications of the size of over-and underrunning a most probable investment cost estimate. But even with such a degree of sophistication, we should not expect a better than a plus or minus 10% estimate in single projects. When forecasting financial needs for many countries, for a whole sector like the fertilizer industry, the pluses and minuses may either iron out or add up which is what I was hoping for when I prepared this paper.

31. Keeping this selection of major problems in mind, any sophisticated optimization study on various cases on nitrogenous and phosphatic fertilizer

needs in developing countries may probably not lead any further than the simplified forecast presented herewith.

III. THE NITROGENOUS FERTILIZERS SECTOR

A. Competitiveness of N Fertilizer Production Versus Imports

32. Although the problem of competitiveness does not seem to be incorporated in the subject of this paper, its basic philosophy is supporting the forecast of production which in turn underlies most financial forecasts given in this paper. The question of whether it is "better" to produce N-fertilizer or to import, already implies another question -- namely, what is the meaning of "better?" You will always find a beneficiary -- but when implementing the fertilizer sector in developing countries, this beneficiary should primarily not be a fertilizer exporter from an industrialized country. Speaking with relation to the experience with projects evaluated by the World Bank/IFC Group, the emphasis on which to focus attention for each project not only varies from country to country, but it also changes with the passing of time. New and additional yardsticks continue to be introduced into any project and sector evaluation, such as the impact on ecology, transfer of technology, labor intensity of the industry, duty protection issues, and the like.

33. Priorities between projects in any given developing country must be set by the Government as well as by lending institutions; a fertilizer project may rank higher within the context of the overall economy and agricultural development, than if a mere comparison of financial and economic data would be made for judging a new project and comparing this with return on investments in other projects which may compete with respect to receiving scarce foreign exchange funds.

As stated in UNIDO's Paper's conclusion,[1] "most of the measures.....in the fertilizer field will have.....a beneficial influence on the national economy far beyond the fertilizer field (transport, reduced import of food, export of agricultural products, food processing industries, etc.)." This being mentioned, the mere comparison in terms of financial and economic benefit still must be done.

34. N-fertilizer production is relevant virtually only for countries classified in Group 4, 5 or 6 (see Table II).

35. Generally, in most "Group 4" and "Group 6" countries production costs are higher than they are in developed countries, and even in "Group 5" countries which are based on favorable raw material and energy supply, these advantages are mostly offset by inherent odds against a profitable production in developing countries.

36. Among the most important problems facing the fertilizer industry as a whole in developing countries which was analyzed in another UNIDO paper[2] and supported by our own experience in many countries, the following seems to be surmounting issues affecting the competitiveness:

- high cost of producing fertilizers (high raw material cost, too small plants, and shortage of qualified personnel);
- inadequate supply of feedstock and spare parts;
- high cost of new fertilizer plants (imported and indigenous equipment) including cost for providing infrastructure, and high process royalty and technical assistance costs, and
- shortage of foreign and local capital;

1/ Symposium Paper ID/WG 99/4

2/ ID/WG99/84, August 6, 1971.

Since most issues have been discussed in great detail in a number of recent papers, this paper only focuses on two highlights in the N-fertilizer sector: the first one is the production cost and cost ex plant and cost of imports, in relation to the price to the farmer for urea in India (as an example). Similar relations exist in most other Group 4 countries (see Figure 7). If we include the "excise duty" (or sales tax), the farmer pays about one-third more than the price what the producing company receives ex-factory for their product. The price to the farmer is usually fixed by the Government and via the benefit/cost ratio, largely affects the farmers' willingness to use fertilizers and therefore, determines the consumption of fertilizers. In this example, if we subtract from the retail price, all cost items which have to be spent, the margin which is left for return on capital -- if any -- is lower than the prevailing opportunity cost of capital in India. This is not a very satisfactory result, and it may hopefully not -- as it is now -- remain representative of the nitrogenous fertilizer industry in developing countries. In any case, and in most developing countries, it seems to be increasingly difficult to make up a profit of $20 per MT of N which would be about considered a reasonable return. Some Governments suspect that there are big profits in this sector because they argue quite convincingly, why do private companies still apply for licenses to produce fertilizers?

37. From Figure 7 and other information, the following rounded figures are taken (in $/MT of N):

	With Imported Urea	Locally Produced Urea (ex plant)
C.I.F. Price		
Total cost	130-160	220 at official exchange rate of 7.50 Rs = $1. 150 at a "shadow rate" of 12 Rs = $1.
F.E. portion	125-155	75

The sales tax of about $22/MT of N in this case has been deducted because it is an arbitrary figure which is entirely under Government control. Local production could therefore be considered "competitive" depending on which consideration one chooses: total financial cost (price), cost at shadow rates, or FE costs only.

38. If the plant were not fully utilized, costs would go up by about $20/MT of N with a 85% utilization which is even high compared to the overall fertiliz industry efficiency in some developing countries of 60 or 70% only, and profits, if any, would fall well below any reasonable minimum. Therefore, the degree of plant utilization is one of the most stringent problems encountered in this industry. Figure 8 shows the effect of utilizing a plant based on 330 stream days per year = 100%, between 85% and 110% of capacity. The figures clearly prove how important debottlenecking and plant improvement is, as well as it shows the need for reducing downtime. The degree of utilization is also determined by those lost stream days per year related to outside reasons such as powe and water supply, feedstock supply, lack of spare parts, etc., as mentioned abov With a high degree of utilization in modern size plants, with cutting down in al of the cost items, and with competitive naphtha or natural gas prices (Indonesia Pakistan, Arab Gulf States, Algeria), production of N-fertilizer in developing countries could be, or could be made to be competitive; at any rate, in terms of foreign exchange. In many cases, cooperation among developing countries by increasing trade in liquid ammonia, could probably reduce the cost of N fertilis to levels comparable to those with products imported from industrialized countri but regrettably such cooperation is not very likely to be established in due cou

B. Additional N-Fertilizer Production

39. The forecast and proposal as made in this paper calls for implementing additional annual nitrogen production capability from 1969 to 1975 of about 7 million MT in LDC plus 5.3 million MT in the second 5-year period on a total of 12.2 million MT. As can be seen in Figures 2 and 3, this would achieve only the goal that with the forecasted consumption of about 14 million MT of N in 1975, and about 20 million in 1980, the gap between N-fertilizer production and consumption in all developing countries would remain up to 1980 at about the 1969/70 level of 3.5 million MTY. These proposed figures are based on the consumption forecast as given in Table V which is an updated and revised version of UNIDO's Table X as presented in the Symposium Paper, ID/WG 99/4.

40. If UNIDO's figures were to be used, for example, the apparent surplus of production over consumption would increase in the World from 1.85 over 2.3 to 3.6 million MTY of N (1969-75-80). This paper suggests that we (a) assume no such surplus, and (b) that a reasonable distribution be established between industrialized and developing countries of additional production capability. The definition of what is "reasonable" of course, is entirely subjective and voluntary.

41. Based on the "best guess" consumption forecast and the actual (1969/70) production in both developed and developing areas, I have arrived at arithmetically required additional N-fertilizer production capability as detailed in Table V, which also considers other information (TVA in C & EN July 5, 1971, and NITREX forecasts).

42. If we assume that a "standard capacity" in developing countries will be 180 and 270 thousand MTY of N in the first and second half of this decade, and with a 71% utilization to achieve self-sufficiency, then about 78 plants (1969-75) plus 30 plants (1975-80), or a total of 108 N-fertilizer

TABLE V

Required Additional N-Fertilizer Production Capability/1

(All figures in million MT of N per year)

	Actual 1969 Production					1969-75		1975-80		1969-80
	Rated Capacity	% Utili-zation	Actual Prod.	Consump-tion	Deficit(-) Surplus(+)	Consump-tion 1975	Additional Production Needed 1969-75	Consump-tion 1980	Additional Production Needed 1975-80	Total Addi-tional Prod. Needed
Developed Areas	36.9	69	25.4	20.8	+4.6	30.0/2	4.6	39.8/3	9.8	14.4
LDC	8.0	52.5	4.2	7.7	-3.5	14.2	10.0	19.9	5.7	15.7
World Total	44.9	66	29.6	28.5/4	+1.1	44.2/6	14.6	59.7/5	15.5	30.1

/1 Based on this paper's assumptions and proposals

/2 Based on a NITREX forecast:

Western Europe	9.5
Eastern Europe, including USSR	9.8
USA, Canada	9.9
Japan and Oceania	1.5
Total	30.7
- LDC in Europe	.7
Developed Countries	30.0

/3 Estimate based on the 1975 forecast

/4 Actual World total consumption in 1970 was 30.65 million MT

/5 UNIDO forecast 68.4 (Ewell)

/6 NITREX [illegible]

plants would have to be implemented in all developing countries during the 1969-80 period which would be an average of 13 plants per year in the first part of this decade and 6 plants in the second half of this decade. I believe that it is not realistic to expect such a high construction activity compared to what is actually going on. It makes more sense to first boost existing plant capacity, both in industrialized as well as in developing countries to a higher degree of utilization, which requires much less capital than the construction of grass roots facilities. Table VI gives underlying assumptions as to the plant capacity and its utilization, and specific costs.

43. After a number of alternative estimates and assumptions made, I have finally arrived at the following proposal with regard to implementation of additional N fertilizer production capability and its cost and regional distribution. (Table VII).

44. The figures for production increase in industrialized countries have been calculated as the forecasted world consumption, minus proposed production in developing countries, which results in an added production capability of 10.2 million MTY of N or about 40% of the developed region's 1969/70 production.

45. To increase production in industrialized countries between 1969 and 1975 from 25.4 to 33.06 million MTY with an installed capacity of 36.9 million MTY of N, only the average utilization would have to be boosted from 69% in 1969/70 to 90% in 1975 with no new plants needed, and practically no investment.

46. From 1975 to 1980, a further increase to full (100%) utilization of the (1969/70) capacity has been assumed, plus the erection of 25 additional plants of the 1,500 MT ammonia plant size, which may also be accomplished by an equivalent replacement of obsolete and small plants by modern, large size factories. If this proposal were realized, the developing nations would then have the following share of world production and consumption in N-fertilizers (in % of world total):

/6 NITREX forecast: 42.9; UNIDO: 48.7 (Ewell)

TABLE VI

Plant Capacities and Specific Investment Costs Assumed

	Actual	1969-75	1975-80
		Average Plant Capacity (in '000 MTY of N)	
LDC		180	270
Developed		1/	410
		Average Utilization in %	
LDC	52.5	71	78
Developed	69	90	100
		Specific Costs in U.S. $ per MTY of N	
LDC			
debottlenecking		150 2/	-
new capacity		400	325
Developed			250

1/ (no investment proposed)
2/ in an actual case in India of debottlenecking, including expansion, about $250/MTY of N have been estimated (1971 basis).

Table VII

Proposed Regional Distribution and Estimated Investment Cost for Additional N Fertilizer Capacity up to 1980

Area	1969 Prod. (Mill. MT/y)	1969 Cons. (Mill. MT/y)	1975 Prod. (Mill. MT/y)	1975 Cons. (Mill. MT/y)	1975 Plants Added	1975 Total Cost ($ million)	1975 FE ($ million)	1980 Prod. (Mill. MT/y)	1980 Cons. (Mill. MT/y)	1980 Plants Added	1980 Total Cost ($ million)	1980 F[illegible] ($ millio[illegible])
Asia	2.0		5.56	5.9	16	1,249	[illegible]85	8.36	8.5	11	952	42[illegible]
Africa	.4		.89	1.3	2	146	131	1.29	1.8	2	133	10[illegible]
Latin Am.	.8		2.10	2.4	6	445	267	3.40	3.6	5	472	23[illegible]
S. Asia	1.0		2.59	4.6	7	561	393	3.39	6.0	2	214	12[illegible]
Total LDC	4.2	7.7	11.14	14.2	31	2,401	1,476	16.44	19.90	20	1,771	89[illegible]
Developed	25.4	20.8	33.06	30.0	0	0	0	43.26	39.8	25	2,830	2,83[illegible]
World	29.6	28.5	44.2	44.2	31	2,401	1,476	59.7	59.7	45	4,601	3,72[illegible]

	1969	1975	1980
% of Production	14.2	25.2	27.6
% of Consumption	27.0	32.2	33.4

which shows that their share in production would come closer to their share in world consumption.

47. Although the implementation up to 1975 of 31 new large plants appears at least at first glance to be unachievable, a detailed study of the investment activity indicates that this number of N-fertilizer plants could be implemented -- early 1972, at least 20 N-fertilizer plants were in various stages of implimentation -- but with a smaller than average capacity equivalent to about 650 MT ammonia per stream day. Since no plant could be in operation by 1975, for which at least financing and government approval has been secured by now (January 1972), there will be a gap of some plants, and a bigger gap (compared to the Table VII proposal) in required capacity. On the other hand, industrialized countries have not stalled investment activity in the N-fertilizer field but will continue to increase capacity although mostly in connection with modernization and replacement of obsolete plants. Therefore, investment activity during the first half of this decade is likely to shift towards industrialized countries, and heavier activity is expected in the latter half to make possible the 51-new-plant-goal in developing countries by 1980 as given in Table VIII. By then, transfer of technology specifically of ammonia plant operation will have reached a higher level than that which is now present, so as to assure a reasonable degree of plant utilization of at least 80% (based on 330 stream days/year = 100%). Furthermore, more fertilizer exporting countries may have realized that in a few years time, chances of exports of basic products such as fertilizers to developing countries may be disappearing in favor of production -- possibly in cooperation with companies from developing countries -- of fertilizers at more favorable locations with regard to raw material supply, freight

costs, and markets. Due to the proposed moderate development of the N-fertilizer sector in developing countries, and provided that production and consumption develop as outlined, imports will remain at about the 1969/70 level of 3.5 million MTY of N.

48. As a summary, production capability in the world for N-fertilizers is about 30 million MTY of N, for which about 76 new plants -- in addition to debottlenecking of existing units -- would be needed. In developing countries, 51 plants would be installed at total costs of about U.S. $4.1 billion with a $2.4 billion foreign exchange portion. The regional distribution pattern can be seen in Table VIII:

TABLE VIII

Added Production Capability of N-Fertilizer, up to 1980

Area	1969 Product. Actual	1969 Rated Capacity	Added 1970-1980 Capability	Added 1970-1980 Plant Number	Added 1970-1980 Cost Total (U.S. $ millio	Added 1970-1980 FE
Asia	2.0	3.8	6.36	27	2,201	1,114
Africa	.4	.8	.89	4	279	237
Latin America	.8	1.6	2.60	11	917	503
South America	1.0	1.8	2.39	9	775	521
Total LDC	4.2	8.0	12.24	51	4,172	2,375
Developed	25.4	36.9	17.86	25	2,830	2,830
World	29.6	44.9	30.10	76	7,002	5,205

49. The average utilization of installed N capacity in developing countries would be 77.6% in 1980, leaving an additional 4.72 million MTY of N as an unutilized capacity which by 1980 might be equivalent to a 4-year consumption increase.

50. The N-fertilizer production, consumption, and trade as derived from the assumptions and considerations given above, are graphically illustrated in Figure

Evidentally trade in liquid ammonia does not show, at least up to the year 1980, any significant role in the overall picture, but it may cause confusion when evaluating production-consumption statistics since counting twice for liquid ammonia in a producer and in a consumer country is not excluded; FAO has taken this issue up.

C. Future Import Requirements

51. The future import requirements in the N-fertilizer sector are made up from straight and complex finished fertilizers, feedstocks, and spare parts, chemicals and other smaller items.

52. These requirements are all calculated with the figures on consumption and production as outlined in the previous sections of this paper, assuming for developing countries a production increase from 4.2 (1969) over 11.14 (1975) to 16.44 million MTY of N. Some further estimates and assumptions have to be established as given in Table IX:

TABLE IX

Import Requirements for the N-Fertilizer Sector

Product	Price cif $/MT	1969/70 Quantity Million MTY	1969/70 Cost $ Million	1975 Cost $ Million	1980 Cost $ Million
Finished Fertilizer-N (gross)	130 (FE)	4.4	572	580	593
Hydrocarbon Feedstock	20 (FE)	2.84	57	170	251
Other feedstock	10 (LC)	1.9	(19)	(22)	(24)
Liquid ammonia	40 (FE)	.42	17	45	44
Spare Parts, Catalyst	5 (FE) 1/	-	21	56	82
Total Gross Import (FE)			667	851	970

1/ $5/MT of N produced.

53. A major crystal ball question is, of course the prediction of future prices of finished N-fertilizers (on a free trade basis). Consistent with what has been used in Figure 7, imported N-fertilizer is expected to cost between $130 and $160 per MT of N in urea, and for purposes of this estimate up to 1980 an average CIF price of $130 for any developing country has been assumed at a constant 1970-dollar price value.

54. Hydrocarbon feedstock is needed at a rate of about 0.9 MT per MT of N and 75% of total N is assumed to be based on hydrocarbons (natural gas, naphtha, fuel oil and refinery gas). The hydrocarbon quantity in 1969, therefore, is calculated as 0.9 x 0.75 x 4.2 = 2.84 million MTY. 15% of total N-production may be based on coal, lignite, etc., consuming 3 MT of such solid feedstock per MT of N. Prices per MT of coal range at about $2 (South Africa), $5 (India), $15 (Zambia) and $20 (Europe). By 1980, only a few countries may still use solid feedstocks; figures in brackets are estimated N-capacities in million MT of N which are expected to be based on coal, lignite, etc: India (0.8), China (1.0?), South Africa (0.2), totalling not more than 2.4 million MTY of N which is 15% of total forecasted production in developing countries.

55. 10% of total N production is forecasted to be on imported ammonia. At this time, it is still an open question as to whether and to what extent purchased liquid ammonia will be traded as a major feedstock for fertilizer production. Only a few such contracts have been signed -- such as Kuwait/Turkey and Iran/India. In order for one to arrive at a best-guess figure for 1980, a minimum of 8 plants, each 800 MTD ammonia capacity, may be expected to operate yielding about 1.8 million MTY of N. As a maximum, not more than 15 plant units of 1,200 MTD should be on stream by 1980, yielding 3.3 million MTY of N. If we subtract the estimated consumption in this group of countries (Category 5) by 1980 of about 0.3 million MTY, then the net export of N, mostly as liquid ammonia, may be on the

order of 2.2 million MTY. Half of this is assumed to be exported to industrialised countries, the other half to developing countries (for which imported ammonia is a foreign exchange item as well.

56. Most developing countries will continue to import spare parts, catalyst and chemicals etc., which amount to foreign exchange costs of about $5/MT of N produced for the entire production.

57. The total of recurring costs for importing finished fertilisers and raw materials would, under this assumption, increase from about $670 million in 1969 to $970 million per annum in 1980.

Export Earnings

58. Although a detailed survey has not been undertaken, N-fertiliser and ammonia total exports from Group 5 countries are expected to amount to the following using a $70 MT of N average fob price between ammonia and finished fertilisers (urea):

	1969	1975	1980
Quantity (million MT of N)	0.5	1.0	2.2
$ million/year	35	70	220

IV. THE PHOSPHATE FERTILIZER SECTOR

A. The Pattern of Production, Consumption, and Trade

59. Based on FAO statistics and on OECD and UNIDO's forecasts, Table X gives the estimate of consumption, and proposed distribution of production for P_2O_5 fertilizers up to 1980. The "philosophy" behind this table is the following:

- the apparent surplus of production over consumption in the world will range between about 0.3 and 0.6 million MTY of P_2O_5;
- production forecasts have been voluntarily reduced to a lower level for W. Europe and for USA/Canada, compared to what UNIDO and other sources had forecasted, because with their figures, world surplus would have reached 2.0 million MTY of P_2O_5 by 1980;
- "production" includes all solid phosphatic fertilizers for local consumption and for export, but excludes phosphoric acid production for export (which appears in the data for phosphatic fertilizer production in the importing country);
- Western Europe does not include DAC countries (Spain, Greece, Yugoslavia, Cyprus) and not Turkey.

60. All of the countries linked in Table X, are classified in Categories 3, 4, or 5. "Rest of ECAFE" covers Philippines (64), Thailand (45), Burma (17), Malaysia (16) and S. Vietnam (28) -- figures in brackets are P_2O_5 consumption in 1969/70; Kenya (19) is the main African country left; in the Middle East, Israel (14) and Iraq (4) contribute to the area's consumption. The "rest of Latin America" comprises Uruguay (30), El Salvador (17), Ecuador (13), Peru (10), Costa Rica (10), and Martinique (11). China (P.R.) had a consumption of 510 in 1969/70.

61. At present, phosphatic fertilizers are being supplied to LDCs either in the form of finished products (TSP, DAP/MAP, or NPK formulations), or as raw materials (rock phosphate, sulphur), whilst trade in phosphoric acid is still negligible, and elemental phosphorus lost ground due to the recent sulphur price drop. This picture probably will change during this decade by shifting towards a larger share of indigenous production of phosphatic fertilisers in developing countries

TABLE X

Production and Consumption of Phosphatic Fertilizers
('000 MT P_2O_5/y)

Developed Countries	1969/70 Prod.	1969/70 Cons.	1969/70 Balance	1975/76 Prod.	1975/76 Cons.	1975/76 Balance	1980/81 Prod.	1980/81 Cons.	1980/81 Balance
W. Europe	4,920	4,405	+515	5,870	5,450	+ 420	6,655	6,300	+ 355
E. Europe	1,880	2,105	-225	3,400	4,000	- 600	4,500	5,500	-1,000
USSR	2,070	1,915	+155	3,600	3,000	+ 600	5,000	4,000	+1,000
USA/Canada	5,170	4,495	+675	7,900	6,500	+1,400	10,000	8,500	+1,000
Japan	745	690	+ 55	900	900	0	1,000	1,000	0
Oceania	1,120	1,170	- 50	1,600	1,600	0	2,000	2,000	0
Total	15,905	14,780	1,125	23,270	21,450	+1,820	29,155	27,300	+1,855
Asia - ECAFE									
India	225	315	- 90	550	800	- 250	800	1,300	- 500
Pakistan	-	50	- 50	75	200	- 125	150	300	- 150
S. Korea	145	130	+ 15	100	250	- 150	140	350	- 210
Indonesia	0	41	- 41	0	75	- 75	100	100	0
Taiwan	45	40	+ 5	70	75	- 5	100	100	0
Iran	0	30	- 30	30	30	0	60	50	+ 10
Rest ECAFE	35	190	- 155	100	350	- 250	200	500	- 300
Turkey	45	170	- 125	60	300	- 240	100	400	- 300
Rest M.E.	45	50	- 5	40	75	- 35	50	100	- 50
Asia Subtotal	540	1,016	- 476	1,025	2,155	-1,130	1,700	3,200	-1,500
[illegible]C (Europe) less Turkey	720	780	- 60	900	1,050	- 150	1,050	1,200	- 150
Africa									
Egypt	60	50	+ 10	125	70	+ 55	200	90	+ 110
S. Africa	310	260	+ 50	400	400	0	500	520	- 20
Morocco	125	40	+ 85	325	30	+ 295	700	40	+ 660
Algeria	15	40	- 25	120	30	+ 90	300	40	+ 260
Tunisia	140)	20)	+ 100	200)	270)	+ 85	220)	410)	+ 360
Rest Africa	90)	110)		155)			350)		
Africa total	740	520	+ 220	1,325	800	+ 525	2,270	1,100	+1,170
Latin America									
Mexico	115	120	- 5	300	300	0	500	450	+ 50
Brazil	120	235	- 115	250	375	- 125	400	500	- 100
Cuba	5	115	- 110	35	220	- 185	50	325	- 275
Argentina	0	25	- 25	25	50	- 25	50	75	- 25
Colombia	10	55	- 45	25	85	- 60	50	125	- 75
Chile	5	85	- 80	35	175	- 140	50	225	- 175
Rest L.A.	25	135	- 110	130	295	- 165	200	400	- 200
Latin Amer. total	280	770	- 490	800	1,500	- 700	1,300	2,100	- 800
Socialist Asia	610	615	- 5	1,100	1,100	0	1,500	1,500	0
[illegible]C Total	2,890	3,701	- 811	5,150	6,605	-1,455	7,820	9,100	-1,280
World Total	18,795	18,481	+ 314	28,420	28,055	+ 365	36,975	36,400	+ 575

based on phosphate rock and either sulphur, or nitric acid, and to a minor extent, using phosphoric acid and (or) MAP as intermediates. There are virtually four ways of supplying phosphatic fertilizers as shown in Figure 10:

- Case A: straight imports of finished fertilizers,
- Case B: Indigenous production based on phosphate rock and sulphur
- Case C: "Satellite Plants" based on purchased phosphoric acid
- Case D: Indigenous production of nitrophosphates

Out of the total P_2O_5 consumption of about 9.1 million MTY expected by 1980, only about 0.5 million MTY are probably consumed in Category 1, 2, and 6 countries; if we exclude the about 50 countries with less than about 3,000 MTY of P_2O_5 consumption by 1980, 23 countries (group 1 and 2) will continue to import finished fertilizers, or may install dry blending plants. The 4 countries classified in Category 6 with small consumption and small production would probably be better off with satellite-type plants.

62. Phosphoric fertilizer consumption, as shown with Table II will be concentrated on Category 4 and 5 countries1/ (72% of total LDC P_2O_5 consumption in 1969/70, and 68% in 1980), whilst the consumption of phosphoric acid for satellite plants (Category 3) is expected to increase from about 0.2 to about 0.5 million MTY of P_2O_5. But even some of the group 4 countries with large P_2O_5 consumption may be better advised to at least partially rely on phosphoric acid imports rather than to shoot for full indigenous production as long as they have to import feedstocks anyway.

1/ Category 4 includes 13 countries with a total of about 1.9 million MTY of P_2O_5 consumption in 1969, growing to about 5.3 million MTY in 1980. Each of these countries has a forecasted consumption by 1980 of more than 100,000 MTY of P_2O_5. Out of the 16 countries with actual or potential phosphatic surplus production (group 5) only 6 are expected to have by 1980 a substantial indigenous consumption of more than 80,000 MTY of P_2O_5, but their total 1980 consumption is expected to be 1.5 million MTY with South Africa contributing about 40% of this figure.

B. Imports Versus Local Production

1. Comparison of Various Cases

63. Cases A, B, and C will now be compared as to their relative competitiveness with regard to imports versus local production. Case D on nitrophosphates has only limited importance and has been left out in this study. Tables XI and XII give all basic figures used in these computations. These tables do not necessarily reflect actual contract prices since these are quite often distorted by tied bilateral aid, barter, and other arrangements. Instead, this comparison has been made on the basis of either production of fertilizers in areas of phosphate rock and/or sulphur surplus, or of producing in developing countries which have to import one or both feedstocks (where applicable). With regard to sea freight, we are on very unsafe grounds as discussed in the paragraph on freight costs (see Section II-C).

64. Another factor which affects the comparison is the different plant capacity assumed for those plants operating for export, and those in consumer countries: in Case A, capacities between 100,000 up to 370,000 MTY of P_2O_5 and in Cases B and C, 70,000-100,000 MTY, have been used, both of which seem to be realistic although not satisfactory for the B and C cases: at least by 1980, some countries (P.R. China, India, North and South Korea, Pakistan, Turkey, Brazil, Cuba, Chile) classified into Category 4, would justify large phosphate fertilizer plants with 200,000 and more MTY of P_2O_5 capacity.

65. Figures 11 through 14 show the results for DAP as an example of this evaluation for three areas which are most important for this sector: Asia, Europe (DAC-countries), and Latin America. Africa has not been mentioned here, since only Kenya and Rhodesia will have a considerable P_2O_5 consumption, but other countries (Tunisia, Morocco, Senegal, Togo, Uganda) are clearly actual or potential surplus producers (Category 5).

TABLE XI: PHOSPHORIC ACID COSTS IN LDC: CASE B AND C

IMPORTS VERSUS LOCAL PRODUCTION

Country/Area	Assumed Plant Capacity '000 MT P_2O_5/y	$/MT P_2O_5 Produced in 54% Phosphoric Acid: Phosphate Costs	Sulphur Costs	Raw material costs	Fixed + Other Variable Costs4/	10% return on total Investment	Ex Plant "Price"	Sea Freight in $/MT P_2O_5 9/: To Asia (India): Raw Mat.	Acid	Total	To EEC Europe: Raw Mat.	Acid	Total	To Latin America: Raw Mat.	Acid	Total	$/MT P2O5 CIF-prices 5/ (Landed Cost) Total)= FL) 54% Clarified Acid: India	EEC Europe	Latin America	F.L. Portion
Case C Production in and Export from Phosphate or Sulphur Surplus Areas: 1/																				
Florida	270	26	21	47	28.5	11.5	87	0	29	34	0	21	21	0	14	14	116	108	101	
Mexico	370	28	20	48	[illegible]	7	101	5	26	36	5	22	27	5	14	19	127 6/	123	115	
Morocco	325	24.5	21	45.5	36	15.5	97	2.5	24	32	2.5	12	15	2.5	19	22	121	109	116	
Tunisia	120	22	24	46	40	18	95 7/	3	26	34	3	13	16	3	20	23	133	108 7/	127	
Iran/Aqaba	100 (270)	30	23	53	30.7	13.3	97	3	15	23	-	-	-	-	-	-	112	-	-	
Case B Production in Sulphur Deficit Countries/Areas 2/																				
Asia (India)	100-120	52-72 3/ (30)	28	83-100 3/ (58)	48	26	157-172 (132)	30-52 (5)	-	30-52 (5)	-	-	-	-	-	-	157-174 8/ (132)	-	-	92-112 (likely 105)
EEC Europe incl. Turkey	100	33-36	24	57-60	40	20	120	-	-	-	8	-	8	-	-	-	-	128	-	67-70 (likely 70)
Latin America (Brazil)	100	59	24	83	44	22	149	-	-	-	-	-	-	43	-	43	-	-	149	95

Note: The above footnotes are explained on the attached sheet.

Remarks to Table XI

Basic Assumptions:

- 90% utilization of plant capacity;
- figures taken from OECD-Study (May 1971), and from various project studies

1. Comparable figures are expected for other group 5 - countries such as: Isrel, Algeria, Senegal, Togo, Egypt.

2. The India example may be considered representative for other countries in the ECAFE region; for South and East African consumer countries, no adequate information was yet available.

3. Depending on rock phosphate source (52 from Middle East; 69 from Morocco and 61 from Florida, with Suez Canal closed); in brackets: cost if local rock phosphate (Udaipur) would be used.

4. Includes cost of clarifying phosphoric acid; 10% depreciation, 4% maintenance, 2% overhead, 1% tax = 17% of fixed capital employed.

5. CIF prices do not include handling and port charges which may add about \$3 - \$5 per MT P_2O_5. Import duty on imported phosphoric acid is for example 40% on cif prices into India.

6. Actual contracts range between \$124and \$131 CIF depending on ship size.

7. Actual contracts with customers in Europe range within cif prices of \$107 - 112/MT t P_2O_5.

As shown in the table, exporters may even sacrifice part of the normally expected minimum return with a view to future plant expansion.

8. Production costs for projects in India have been estimated at about \$160/MT P_2O_5.

9. In the late 1970's, a decrease of sea freight may be possible with larger ships, coming into service, and possibly increasing shipments of higher concentrated (super-phosphoric) acid.

TABLE XIX: PHOSPHATIC FERTILIZER SUPPLY TO LDC: IMPORTS "VERSUS" LOCAL PRODUCTION —

EXAMPLE DAP(18-46-0) BASED ON PURCHASED AMMONIA, AND ON IMPORTED OR LOCALLY PRODUCED PHOS ACID

	Country/Area	Plant Capacity '000MT P_2O_5/Y (Acid)	$/MT P_2O_5 in Phos Acid (2)		Transformation Cost $/MT P_2O_5 (3)	$/MT P_2O_5 FOB Price Bagged DAP	Allocated Sea Freight (1) $/MT P_2O_5 to Asia (4)	to DAC Europe	to Latin America	$/MT P_2O_5 CIF Cost for Bagged DAP Asia	DAC Europe	Latin America
Case A												
Production of DAP in these areas	Florida	270	81		6	87	(40)11	7	8(30)	(127) 98	94	(117) 95
	Mexico	370	95		8	103	(40)11	7	8(30)	(143)114	110	(133)111
	Morocco (5)	325	91		9	100	12	5	6	112	105	106
	Tunisia	120	89		9	98	13	6	7	111	104	105
	Iran/Aqaba	100 (270)	91		10	101	7	-	-	108	-	-
(Arithmetic) Average:			90		8	98				(135)109	104	(125)104
Case B			Total	F.E.								
Based on imported rock and sulphur	Asia (India)	90	151-168	101	10(FE-4)					161/178 (FE-105)		
	DAC Europe including Turkey	100	122	66	8(FE-3)						130(FE-69)	
	Latin America (Brazil)	70	143	91	9(FE-5)							152(FE-96)
Case C												
DAP production based on imported phos acid	Asia	90	(6) 116-137		(7) 8(FE-3)					124/145 (FE-119/140)		
	DAC Europe	100	(6) 112-127		(7) 6(FE-2)						118/133 (FE-114-129)	
	Latin America	70	(6) 105-131		(7) 7(FE-4)							112/138 (FE-108/135)

(1) Ammonia is considered a transient item, carrying a proportionate part of freight, transformation cost etc. (18/64 = 28%; 72% of total cost allocated to P_2O_5).
(2) About $6 subtracted from ex-plant "prices" in Table XI, to take care of costs for concentrating and clarifying acid.
(3) About one third each for fixed-variable costs, bags, and return on investment.
(4) Suez closed; average rate on non-U.S. vessels; to India, China, Indonesia; shipment under U.S. flag: costs in brackets.
(5) MAP project is under close evaluation.
(6) $4/MT P_2O_5 added for port charges and handling.
(7) Transformation cost reduced by $2/MT P_2O_5 to account for savings due to use of clarified/concentrated acid.

66. <u>Asia</u>: (Figure 11) Finished fertilizer imports are expected to continue to be cheaper (cif price $126/MT P_2O_5) than local production, even when shipped by U.S. vessels; however, when comparing foreign exchange costs, indigenous production could appear to be competitive, and be cheaper than when imports were loaded with high freight costs. The freight portion in all three cases is between about 10% and 40% of the total costs of finished fertilizers, with Case B being affected mostly by up-or-downward trends of freight rates. Only a case-by-case study can yield an optimum solution, as has been shown for India where Case B (Cochin II and Konkan) may be justified as well as Case C (Madras and Zuari).

67. <u>Europe</u> (including Turkey): (Figure 12) All three cases are quite similar when one compares total costs, and expected CIF prices, but foreign exchange costs favor indigenous production based on rock and sulphur, which is due to the proximity of rock phosphate sources. Phos acid based plants don't look attractive for this area, but again, some cases with partial use of imported acid for instance for TSP production may offer advantages such as lower capital outlay.

68. <u>Latin America</u>: (Figure 13) A total of about 1.1 million MTY of P_2O_5 would by 1980 be consumed in Category 4 countries (Brasil, Colombia, Cuba, Chile), plus about 0.3 million MTY in other Latin American countries, and consumption forecasts indicate that local production could be considered as being "Competitive" in all of the Category 4 countries, plus in Central America if a regional cooperation there could be arranged. Though, Mexico probably offers cheaper phosphoric acid than could be produced in other Latin American countries, as shown on this graph, although the foreign exchange cost comparison favors local production. Again, all three ways can be considered depending on the individual case, and the development of freight costs which in average for Latin America account for almost one-third of total costs when production is based on rock phosphate and sulphur.

69. As a summary, Figure 14 shows the relative merits of producing phosphatic fertilizers in the three areas, either based on rock phosphate plus sulphur (Case B) or imported phosphoric acid (Case C). As a "yardstick", the expected range has been shown of cif import prices between about \$108 and \$140 per MT P_2O_5, which represents Case A. When comparing total costs, indigenous production in Asia and Latin America (when based on imported rock and sulphur) are expected to be considerably higher than the cost for imported fertilizer. In addition, the inherent risk of changing freight costs, influences this way of procuring phosphate fertilizer much more than in other cases. For Southern Europe, local production in both cases may be competitive with imports. When comparing foreign exchange costs only, production based on rock phosphate and sulphur, in all areas seem to be favored as against imports.

70. Phosphoric acid based "Satellite" plants look quite favorable for all three areas even from a total cost point of view. Future freight cost as determined by the development of phosphoric acid ships and terminals is the important factor.

2. Phosphoric Acid Trade

71. During the decade 1970/80, due to the coming on stream of export oriented phosphoric acid plants in surplus areas, the fertilizer industry will increase the use of phosphoric acid (and MAP) as intermediates. Although by 1980 the quantities involved and traded among developing countries probably do not exceed about 10% of total P_2O_5 fertilizer consumed, phosphoric acid -- as discussed in T. Gans' UNIDO conference paper -- may enable some countries with small P_2O_5 consumption, to implement satellite plants for producing phosphatic fertilizers, with smaller capacities than if they were based on phosphate rock.

72. Category 5 includes 16 countries which are considered potential phosphoric acid producers, but as of the end of 1971, there were only four producers of

phosphoric acid for export (FFM-Mexico, Israel, SHAPUR-Iran, ICM-Tunisia), with a combined capacity of about 750,000 MTY of P_2O_5, but probably Israel's phosphoric acid due to its high purity and high price, may not be traded for fertilizer manufacturing. By 1975, one or two more producers (ANNABA-Algeria, OCP-Morocco) will be in operation adding between about 225,000 and 425,000 MTY of P_2O_5 capacity. Other projects and expansions will by 1980/81 increase capacity for trade phosphoric acid, to about 1.5 million MTY of P_2O_5 which still is small compared to world P_2O_5 fertilizer capacity of 28.5 million MTY in 1975, and 37.0 as forecasted for 1980.

73. Figure 15 shows the probable trade in phosphoric acid in 1975 and in 1980. Presumably, any additional large project would not substantially contribute to the 1975 production if it were not now (January 1972) already at least under preliminary consideration. For 1980/81, additional production capability has been assumed at about 600,000 MTY P_2O_5 which is equivalent to two large 1,000 MTD P_2O_5 phosphoric acid plants.

74. With untied aid, producer countries could trade phosphoric acid (and/or MAP) with other developing countries. Candidate countries which are said to negotiate phosphoric acid contracts, are among others, Brasil (100), Colombia (75), South Korea (210), Thailand (120) and Greece (80), with a total of about 600,000 MTY of P_2O_5 based on the apparent consumption-production gap in 1980 as given in brackets. Other countries suitable for phosphoric acid based satellite plants, may be the 10 countries as listed in Category 3, with a total expected P_2O_5 consumption in 1980, of about 0.5 million MTY.

C. Future Import Requirements for the P_2O_5 Fertilizer Sector

75. The total costs for supplying phosphatic fertilisers are made up from:

- costs for imported finished fertilisers, minus revenue from exports of finished fertilizer, and phosphoric acid.
- costs for rock phosphate,
- costs for sulphur;
- costs for spare parts, etc.

1. Net Costs of Importing Finished Phosphatic Fertiliser

76. First of all, a realistic future import price to developing countries for phosphatic fertilisers must be established. Some sources (OECD) expect a high price of \$145/MT P_2O_5 in either TSP or DAP, but recent developments and actual deliveries -- in spite of some general upward trends -- do not indicate that such a high "premium" must be paid over what a "reasonable" long-term price, defined as "production cost in favorable surplus areas, plus 10% return on investment," has been estimated to be, namely between \$103 and \$111/MT P_2O_5. This figure, of course, is linked to rock phosphate and sulphur prices, but any change in these feedstock prices would move the total production cost proportiona[te] both in case of importing finished fertilisers, and indigenous production, and would therefore virtually not change the conclusions. With cif costs to any developing country, between \$72 and \$90 per MT of DAP, and an assumed N-value of \$130/MT of N in fertilizer one arrives at a price range of between \$106 and \$145 per MT P_2O_5 in bagged fertilizer, or an arithmetic average of \$125/MT P_2O_5 which figure has been used for these comparisons. With shipments made on U.S. flag vessels, however, cif prices would go up by about \$25/MT P_2O_5. Total imports to developing countries during the period up to 1980 would be composed of 50% DAP and NPK, 30% TSP, and 20% nitro-phosphate, in terms of P_2O_5 contents.

77. For calculating net costs of imports, revenues from fertilizer exports must be deducted. Prices over the next decade have, for comparison reasons, been assumed at $90/MT P_2O_5 in TSP and in phosphoric acid both fob N. Africa, with freight costs for the acid of between $12 and $25 per MT P_2O_5 (N. Africa-Europe and Mexico-India, respectively); see Tables XI and XII.

2. Rock Phosphate Import Costs

78. Prices for phosphate rock are forecasted as follows:

TABLE XIII

	Grade 1/	US$/MT P_2O_5 cif prices 1970-1980			
Source	% P_2O_5	DAC Europe	Asia	L. America	fob.
Florida	33	33.2	53.6		19.0
Morocco	33.6	31.2	59.5		22.3
Tunisia	30.2	29.8	-		26.6
Span. Sahara	34	30.6	46.3		18.4
Egypt	33	-	40.0		26.8
Average 2/	33	31	50	35	22
Freight Portion 3/	--	9	19	16	--

1/ Although prices depend on the "utilisation value," and not only on P_2O_5 contents, for comparison reasons, the arithmatic average of prices per unit P_2O_5 has been applied.

2/ Based on the expected "leader price" in the respective area; prices for Asia based on forecasts for India.

3/ Based on about 50% shipments on US flag vessels.

79. The following costs for producing finished phosphatic fertilizers will recur annually, with P_2O_5 consumption in phosphate rock estimated about 8% higher than P_2O_5 production in finished fertilizer.

TABLE XIV

	Price $/MT P_2O_5	Ph. Rock quantity (MTY P_2O_5) 1969/70	1975/70	1980/81
DAC Europe	31	778	972	1,134
Africa	23	799	1,512	2,452
L. America	35	302	864	1,404
Soc. Asia	50	659	1,188	1,620
Asia	50	584	1,107	1,836
Total		3,122	5,643	8,446
+ Phos Acid Production		0	416	648
Total		3,122	6,059	9,094
Total Net CIF Costs in $ million/Y:		115.2	219.5	328.4

3. Sulphur Import Costs

80. The price of sulphur is a typical commodity market price rather than one based on production costs; during the 1960's, sulphur prices fluctuated considerably due to temporary slight surpluses or shortages, with variations of -$8 and +$22 per ton in relation to the average price of $28/t fob Gulf. In 1975, sulphur production forecasted at 58-60 million MTY would exceed the expected demand of 52-54 million MTY sulphur prices are expected to remain at or around the present level with the following examples (as of 1971):

TABLE XV

Country	Prices in US$/MT fob	CIF South and North Africa	CIF India	CIF L. America
Canada	15	23	27	25
Gulf of Mexico	23	30	39	28
Poland	18	24	29	-
Lacq (France)	15	21	26	-
Average1/		25-27	28-30	25-28

1/ J. Lastowiecki (UNIDO paper 99/34) has forecasted, up to 1980 a sulphur price range of between $18 and $22 per ton f.o.b. depending on the quantity of the lot, the kind (quality) of sulphur, and country of destination.

81. Total cost for sulphur imports have been estimated at an average consumption of 0.65 MT of sulphur per MT of P_2O_5 consumed in rock phosphate:

TABLE XVI

Country	'000 MTY of Sulphur 1969/70	1975/76	1980/81
Europe DAC	496	631	737
Africa	510	981	1,594
L. America	193	561	917
Soc. Asia	420	771	1,053
Asia	373	718	1,193
Total	1,992	3,662	5,434
+ Phos Acid Production	0	273	421
Total Quantity	1,992	3,935	5,915
Total CIF Costs:	54.3	106.7	160.4

4. Total Recurring Costs

82. In addition to finished fertilizers and feedstock, spare parts and other items will continue to be imported at a rate of about \$4/MT P_2O_5 produced (as a guess-figure).

83. Total costs are, therefore, as follows:

TABLE XVII

	1969/70	1975	1980
	(in U.S. \$ million/Y)		
Rock Phosphate	115.2	219.5	328.4
Sulphur	54.3	106.7	160.4
Finished Fertilisers	229.3	381.5	465.9
Spare parts etc.	12.4	24.4	36.4
Total Gross Imports	411.2	732.1	991.1
Fertilizer Export	50.4	81.0	132.3
Phosphoric Acid Export	0	34.7	54.0
Total Exports	50.4	115.7	186.3
Net Import Costs	360.7	616.3	805.7

Therefore, contributions from exports to LDC's total phosphatic fertiliser balance would be decreasing from about 8.8% of gross imports in 1969, to only 8.1% in 1980.

D. Proposed Pattern for Additional P_2O_5 Production up to 1980

Additional Production Capability Needed

84. If world production of P_2O_5 fertilizers would be increased from about 18.8 in 1969, over 28.4 in 1975, to 37.0 million MTY of P_2O_5 in 1980, in an 11-year period, production capability amounting to about 18.2 million MTY would have to be added, or about double the world's 1969/70 capacity with a 6.4% per annum compounded growth rate which is in line with the expected consumption increase. The following Table XVIII lists the required additional production capability up to 1980, broken down as suggested in this paper, for developed and developing countries.

85. In the developed countries, capacity increase at 95% plant utilization would be:

7.75 million MTY P_2O_5 from 1969-75, and
6.20 million MTY P_2O_5 from 1975-80

with direct plant investment for phosphatic fertilizer plants based on phosphate rock and sulphur, including "usual" offsites costing about $200/MTY of P_2O_5.

86. In all developing countries, installed capacity would be increased (at 80% utilization) by:

2.9 million MTY P_2O_5 from 1969-75, and
3.3 million MTY P_2O_5 from 1975-80.

87. The specific average investment cost ranges between about $120 and $295 per MTY of installed P_2O_5 capacity, depending on the type and size of plant, with capacities ranging probably between 50,000 and 300,000 MTY. The weighted average specific investment costs, including phosphoric acid plants, turns out to be about $220 per MTY of production capability (80% utilized capacity). Table XIX contains the figures used for preparing estimates on number and

TABLE XVIII

Required Additional P_2O_5 Fertiliser Production Capability
(in '000' MTY of P_2O_5 per year)

	1969 Actual Production	1969 Consumption	1969 - 1975 Consumption 1975	1969 - 1975 Additional Production	1975 - 1980 Consumption 1980	1975 - 1980 Additional Productio[n]
Developed Countries	15,905	14,780	21,450	5,545 needed 7,365 proposed	27,300	5,850 need[ed]
LDC:						
Asia ECAFE	540	1,016	2,155		3,200	
DAC Europe	720	780	1,050		1,200	
Africa	740	520	800		1,100	
Latin America	280	770	1,500		2,100	
Socialist Asia	610	615	1,100		1,500	
LDC Total	2,890	3,701	6,605	3,715 needed 2,335 proposed	9,100	2,495 need[ed] 2,670 prop[osed]
World Total	18,795	18,481	28,055	9,700	36,400	8,555

TABLE XIX

Direct Investment Cost for Implementing Additional Production Capability in Developing Countries

	Production Increase		Assumed Plant Capacity		Number of New Plants /4		Specific Investment Costs		Direct Investment Costs (Total)	
	1969-1975	1975-1980	1969-1975	1975-1980	1969-1975	1975-1980	Total /1	F.E. /1	1969-1975	1975-1980
	'000'MTY P_2O_5		'000'MTY P_2O_5				\$/MTY P_2O_5		\$ Million/y	
Phosphoric Acid Production	910	590	200	300	6	2 /2	172	123	156.5	101.5
Finished Fertilizers										
1. DAP/NPK from Rock and Sulphur	643	952	115	180	7	6	295	180	189.7	272.0
2. DAP/NPK from Phosphoric Acid	525	400	50	70	13	7	120	72	63.0	45.0
3. TSP from Rock and Sulphur	701	798	70	130	13	8	240	144	168.2	186.7
4. Nitrophosphate	466	520	75	90	8	7	250 /3	150	116.5	130.0
Total for Finished Fertilizers	2,335	2,670			41	28			537.4 /5	633.7 /5
Fertilizers Plus Phosphoric Acid	3,245	3,260			47	30			693.9 /6	735.2 /6

/1 Direct Plant Cost, including offsites plus working capital; 60% F.E. portion. Production Capability 80% of rated capacity. For Phosphoric Acid Investment, \$36/MTY P_2O_5 has been added for ships and terminals.

/2 Plus Plant Expansions.

/3 Starting from ammonia and rock; for a 23-23-0 product, or equivalent. rounded up.

/4 At 80% utilization of recommended plant capacity; rounded up.

/5 Foreign Exchange Portion: 322 and 380.

/6 Foreign Exchange Portion: 479 and 482.

costs of additional phosphate fertilizer plants, and Figure 16 illustrates the results. All investment cost figures base on "constant dollars" as of 1971. The average size of finished fertilizer plants would increase from 57,000 to 93,000 MTY of P_2O_5, and the average total direct investment cost per plant would grow from about $13 million in the 1969-75 period to about $23 million in the latter half of this decade.

88. The regional breakdown of the number and cost of plants is given in Table XX, indicating that a major part of the required investment activity in developing countries in the 1969-1975 period is already under way.

TABLE XX

Additional Plant Capacity
1969-1975

	Finished Fertilizer Additional Production '000 MTY			Capability of Additional Projects Needed '000 MTY
	Forecast 1969-75	Capability 1/	Number	
Asia, ECAFE	485	485	7	-
DAC Europe	180	+280	6	-100
Africa	660	160	5	500
Latin America	520	280	5	240
Socialist Asia	490	?	?	490
Middle East/Turkey	-	400	7	-400
LDC Total 1/	2,335	+1,605	30	730

1/ Including 6 phosphoric acid projects for export

89. The outlook for the remaining 5-year period, up to 1980, shows that at least 30 more plants would have to be implemented primarily in Asia (ECAFE), Africa (for export), and Latin America.

90. Figure 17 illustrates the regional distribution of the proposed investment activity in developing countries, and the average amount of foreign exchange which may be needed to be invested.

91. The addition of 165 plants which are proposed and would be needed to add about 20 million MTY of P_2O_5 capacity in the world, means about doubling the world's 18.8 million MTY actual 1969/70 production. Compared to the about 300 existing phosphate fertilizer plants throughout the world, the addition in 11 years of more than half that number seems highly challenging. For instance, the World Bank/IFC Group has contributed and is at present involved in at least 10 new phosphatic fertilizer projects (Cochin II, Morocco, SIES, Zuari, Ultrafertil, Konkan, NPK Engrais, and others) which represent a total investment of at least $300 million, and an actual or requested IDA/IBRD/IFC contribution of about $100 million. Such projects, therefore, should be prepared and implemented at a greater pace.

V. THE POTASH FERTILIZER SECTOR[1]

92. This sector in this paper is not handled in such great depth as are the N and P_2O_5 sectors. One reason for this is that potash consumption will remain small compared to the other nutrients, although in certain areas and with certain crops, more potash needs to be applied, especially increased dosage of other nutrients. There will also be only marginal investment activity in developing countries, as explained below.

93. Many studies have been undertaken on the availability of potash, especially when in 1969/70 the prices dropped and the Canadians exported potash at less than $15 per ton ex-mine. The production capacity of 20-25 million MTY is by far in excess over the actual (1970) production of about 15 million MTY of K_2O, which

1/ See A. von Peter's UNIDO Paper - 99/35, July 1971.

compares to a forecasted consumption increase in developing countries from 1.6 million MTY in 1970 to 3.7 million MTY until 1980. Some new or expansion investment may be done in potash mining in some of the developing countries with potash deposits, such as Spain, Israel, Chile, Peru, Brasil, Jordan, the Congo, Ethiopia, Morocco and West Pakistan, and total potash capacity could reach between 2 and 3 million MTY of K_2O which would cover about the demand increase or more in developing countries and open up additional trade possibilities. Export earnings stemming from potash have not been taken into account; the total production of Israel, Spain and the Congo amounted to only about 1 million MTY equivalent to a fob value of not more than $30 million a year in 1970.

94. The costs of net potash import into developing countries based on a cif price of $40 per ton of potash with 60% K_2O probably go from $133 in 1975 to $189 million per year in 1980. Even potash specialists don't pretend to know whether the depressed actual prices will prevail or even go lower, or may return to their past level which was for a while almost double of what it is now.

VI. TOTAL COSTS FOR MEETING THE FERTILIZER DEMAND UP TO 1980

A. Total Recurring Costs in Foreign Exchange

1. Direct Recurring Costs

95. Adding up the recurring costs for the N and P_2O_5 sector and potash supply, the total for all developing countries up to 1980 are estimated as follows:

TABLE XXI

Total Direct Annual Costs
(in $ million/y, foreign exchange)

	1969	1975	1980
N Fertilizer Sector (Gross Import)	667	851	970
P_2O_5 Fertilizer Sector (Gross Import)	411	732	991
K_2O Import	72	133	189
Total Gross Import	1,150	1,716	2,150
Export Earnings			
N Sector	35	70	220
P_2O_5 Sector	50	116	186
K_2O Sector	not	considered	
Total Export Earnings	85	186	406
NET IMPORT REQUIREMENTS (F.E.)	1,065	1,530	1,744

96. Figure 18 illustrates the net import costs for all developing countries, but excludes spare parts, running royalties and other minor import items. The doubling of costs from 1969 to 1980 should be compared with a 2-1/2-fold increase in total nutrient consumption during the same period (from 13.1 million MTY to 32.7 million MTY of N + P_2O_5 + K_2O). The larger chunk of net annual costs obviously will shift from the N to the P_2O_5 sector.

2. Indirect Recurring Foreign Exchange Costs

97. Besides costs for fertilisers and feedstocks and those items which are directly related to fertiliser production, the running costs must be paid for high yielding seeds, for pesticides, training of operating and sales personnel,

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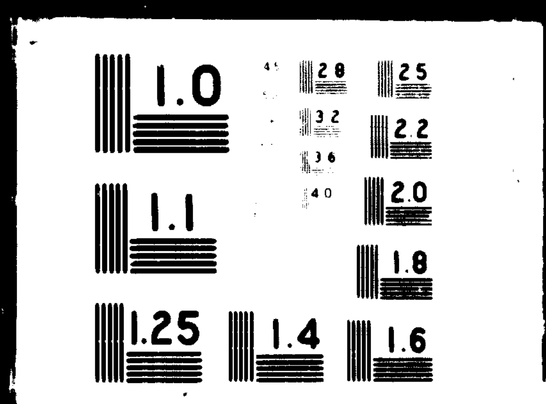

expatriate expenses for management and technical assistance, and last but not least, annual costs of extending credit to farmers, cooperatives and small banks. Some of these expenses are in foreign exchange. Most of these indirect costs ought to be allocated to other areas of the economy, mostly to the agricultural sector. Subsidies given to farmers for buying fertilizers are another item to be covered under this headline; such subsidies are a worldwide practice: for instance, in the United Kingdom in 1970, about $24 million was allocated to such subsidies. In Senegal, subsidies must secure an attractive cost/benefit ratio if the peanut price falls in order to keep the farmers interested in using fertilizers. Other examples are plentiful including EEC countries, and not limited to developing countries.

98. I have not been able to derive from available information an educated guess of how much these recurring costs for all developing countries may amount to, and probably it would need a medium-sized university to work out such figures. Since the objective of this paper is primarily the foreign exchange rather than local currency problem, these costs have not been assessed. Undoubtedly, this should be an objective of further study aiming at a differentiation between the components of indirect recurring costs.

B. Investment Funds Needed up to 1980

1. Total Direct Plant Costs

99. Adding up the investment activity for the nitrogenous and phosphatic fertilizer industry, we arrive at the following figures as given in Table XII and which are illustrated in Figure 19.

100. The 1969/70 production capability (-- all following figures in million MTY --) in developing countries, of about 4.2 N and 2.9 P_2O_5 will step up gradually to a

final of 16.4 N and 9.4 P_2O_5, and direct plant costs for both sectors to be added will probably amount to a total of $5.6 billion for all developing countries, including a 60% foreign exchange component of about $3.4 billion.

2. Indirect Investment Costs

101. In many project appraisals which we have received in the World Bank-IFC Group, no adequate consideration has been given to the indirect costs which are require to be financed before the project as such could be a financial success, as well as a benefit to the country. Although I have endeavored to estimate these costs, I have given up, after a number of attempts, since there is no specific figure per ton of nutrient or the like which could be used for an overall forecast which is the task of this paper. Indirect investment costs are much more a matter of a case-by-case evaluation, but as an overall guess, for each dollar invested in a fertilizer plant, at least one -- maybe two -- dollars would have to be spent in other areas which are often not even closely linked to the fertilizer sector.

102. Figure 6 illustrates most of the areas in which investment funds will be needed in addition to those for the fertilizer industry:

(a) Supply of Feedstocks to the fertilizer industry. Some examples with recent projects in the nitrogenous fertilizer sector are: to secure the naphtha supply, which may require refinery expansion (India) and naphtha barges (Zuari), or natural gas pipelines may have to be built (Shahpur, Kuwait, Sonatrach, Dawood,Pusri) or even new gas wells may have to be drilled (Pusri, Dawood);

TABLE XXII

Investment Activity Costs as Proposed up to 1980

	Period 1969 - 1975				Period 1975 - 1980				Total Period 1969 - 1980	
	Added Capability mill.MTY	Number of Plants	Funds Needed $'000 Total	FE	Added Capacity mill.MTY	Number of Plants	Funds Needed $'000 Total	FE	Funds Needed $ million Total	FE
Nitrogen Fertilizer										
LDCs	6.94	31	2,401	1,476	5.3	20	1,771	899	4.17	2.38
Developed Areas	7.66	0	-	-	10.2	25	2,830	2,830	2.83	2.83
World	14.60	31	2,401	1,476	15.5	45	4,601	3,729	7.00	5.21
Phosphatic Fertilizer										
LDCs 1/	3.25	47	694	479	3.26	30	735	482	1.43	0.96
Developed Areas 2/	7.37	60	1,551	1,551	5.89	28	1,300	1,300	2.85	2.85
World 1/	10.62	107	2,245	2,030	9.15	58	2,035	1,782	4.28	3.81

1/ Including phosphoric acid plants (6 + 2 = 8 from 1969-1980).

2/ Production from phosphate rock and sulphur and partly based on imported acid.

fuel oil tank cars may be needed (Nangal project) or railroad cars to transport coal (Zambia; India: Talcher, Ramagundam), and coal mines may have to be started or expanded (Thapar Project). In the phosphatic fertilizer field, although existing phosphate rock mining needs not be expanded to meet future demade, in some countries like Tunisia, beneficiation plants will probably be nedessary; for export purposes, phosphate rock mines may have to be developed and expanded in Senegal, Egypt, Peru and other countries, and in India, exploration and mining the Udaipur phosphates should become one of the major future investments in the fertilizer sector. Also, new rail lines, marshalling yards, and ports may have to be built or extended in order to get rock phosphate to the fertilizer plant (Tunisia, Morocco), or to the export harbors.

For sulphur and potash, although no direct investment may be needed to create new capacity, funds may well be requested to secure continuous and sustained supply, with emphasis on transporting and storage.

(b) Transportation is a most important sector which is relevant to fertilizer transport to godowns and farmers. Quite often, the number of boxcars and locomotives needed to move fertilizers into consumer areas has been grossly underestimated and therefore, financing has not been secured for badly needed transportation facilities. Even coastal barges for fertilizer shipment may have to be financed in some cases (Pusri). The IIFCO project in India may be needing an additional investment of at least $30 for each MT of N shipped, in order to transport ammonia from the ammonia to the fertilizer plant.

(c) Distributing and warehousing eats up almost every amount of money, but in most cases, it may prove highly profitable to pour money into such a pithole. Examples where this has been done are Ultrafertil (Brazil), and projects in India are also beginning to invest heavily into this sector. In a project in Turkey, we insisted on providing adequate funds for distributing the products of the factory, and so did we again in the case of Pusri.

(d) Utilities is another area in which financing may have to be secured before or parallel to fertilizer projects. The problem of power has been mentioned so often in the UNIDO questionnaire with regard to problems facing the fertilizer industry that no doubt should be left about the necessity of investments in order to secure power supply, and make it more reliable with the objective of reducing the many power failures and voltage dips in almost all of the developing countries (as it happens in New York during summer months). The costs of each day shutdown will increase in the plants with ever-growing capacities. The same applies to water supply. Sea water desalination in Kuwait caused high costs and trouble. IFC is involved in an Indian project, the startup of which may be delayed due to the tardy completion of water supply facilities which in turn may be caused by a shortage of local currency.

(e) Costs for housing, site preparation (Madras, Shahpur), and ecological facilities may need further quantities of money which often are forgotten when project feasibility studies are undertaken.

(f) Cost of Planning and Engineering may have to be financed as well, not only as an integrated part of any one project, but also as an item of a country's overhead cost. Planning and Engineering, for instance, is estimated to cost up to $50/MT of new N capacity which sums up to $500 million to be spent in this decade; this item as a foreign exchange graveyard deserves a closer look although such high figures may be liked by engineering contractors.

(g) In Category 1 and 2 countries, even when importing finished or semi-finished fertilizers, investment would be needed for bulk blending or mixing plants. Although such plants cost only a few hundred thousand dollars each, or even less, the total may sum up to many millions of dollars for all countries concerned, which still would not substantially change the overall picture.

VII. FINANCING OF TOTAL COSTS

A. The Magnitude of the Problem

103. The financing of recurring expenditures amounting to between about $1.1 and $1.7 billion per annum constitutes by far the larger chunk of total financing needed which is forecasted to increase between 1969 and 1980 from about $1.4 to $2.0 billion.

104. As a comparison, world chemical production in developing countries is expected to increase from $3.37 billion in 1960, to $9.50 billion in 1970, and to $19.1-21.8 billion in 1980, which represents a share of about 6% of world total

chemical production in 1970, increasing by 1980 to about 7.5%. This fits into the picture well for fertilizer imports of $1.1 and $1.7 billion in 1969 and 1980 respectively.

105. Various ways have been used for the financing of such commodities, and will continue to be used as described below with "aid by trade" and "aid by tied credit" being the more important means of financing.

106. The financing of recurring expenditures is likewise required for all six categories of countries, but the largest portion, of course, will be needed in Category 3 and 4 countries.

107. The financing of investment capital for the developing countries' fertilizer industry is estimated to require about $5.6 billion up to 1980 with a $3.34 billion foreign exchange component in eleven years.

108. For comparison reasons, worldwide investment in the chemical industry was over $11 billion in 1968 with $8.75 billion invested in non-communist countries. The overall worldwide growth in chemical investment is about 8% per annum. The worldwide capital investment for new plants and equipment by 20 U.S. chemical companies totalled in 1970 about $2.7 billion which would be about 5-1/2 times the capital which is estimated to be needed for direct plant investment per annum in the fertilizer industry in all developing countries. Developing countries in Latin America, Asia, and Africa account for only 6% of the investment in the chemical industry (about $0.7 billion in 1968); this value is expected to increase to over 7.5% in 1980 at which time it may reach $1.9 billion per annum for total investment in the chemical industry compared to the fertilizer sector direct plant investment of about $0.6 billion per annum (1980) with a $0.28 billion foreign exchange portion. The fertilizer industry's direct investment, hence, would account for about 30% of the total chemical industry's investment, the remainder primarily flowing into the petrochemical sector.

109. In total figures, developing countries are expected to require an investment of about $17 billion in the chemical industry over the period 1968-1980, compared to $5.6 billion total investment in the fertilizer industry. The regional breakdown is estimated as follows ($ billion total):

	Total Chemical Industry 1968-1980	Fertilizer Industry 1969-1980
Latin America	11.0	
Asia, Middle East	3.0	
Africa	2.0	
Other	1.0	
Total	17.0	5.6 (Direct)

110. The financing of investment capital will be concentrated on in Category 3, 4 and 5 countries.

B. Financing of Imports of Fertilizers and Feedstocks

111. Total foreign exchange funds needed in all developing countries to meet recurring (annual) expenditures are increasing from about $1.1 billion in 1970 to $1.5 billion in 1975, and $1.7 billion in 1980. These figures cover the purchase of finished fertilizers, feedstock and spare parts for local production.

112. Other authors and agencies have arrived at figures different from these. For example, USAID (Gleason) estimated in 1969 that in 1975 about $1.5 billion per annum would be required for fertilizer imports alone (probably excluding Socialist Asia). The Thirty-Seventh Report of the ACC of the U.N. Economic and Social Council in May 1971 cites the Indicative World Plan according to which in Asia, $2.4 billion at 1962 prices would be the total fertilizer requirement in 1975. These estimates again differ greatly, but at least they are in the same order of magnitude although obviously derived from more optimistic fertilizer "demand" figures other than those given in this paper.

113. Costs for other commodities which need to be imported in order to sustain operations, or to guarantee a success of the direct plant investment, have not yet been assessed. A special word, though, needs to be said about spare parts and chemicals and catalyst imports. Quite frequently its timely provision is hampered by administrative obstacles, quite apart from the lack of foreign exchange funds, and subsequently causes shutdowns of plants. World Bank/IFC has therefore suggested that developing countries should endeavor to establish either spare part pools, or lift the limits up to which plant management is entitled to directly order spares, or to even create a "spare part foreign exchange fund" restricted in its use to that very purpose. What use does a $70 million investment make if a lacking $10,000 part causes the plant to shut down with losses of multiples of this amount per day in foreign exchange benefits which were counte on when the plant was conceived.

114. Four ways have been used for procurement and financing of fertilizers and other commodities, and most probably these ways will remain the prevailing methods to be used in the fertilizer sector during this decade:

1. Grants
2. "Aid by Trade"
3. Aid by Credit -- (a) bilateral tied aid; (b) bilateral untied aid; (c) multilateral aid and
4. Regular payments in cash.

Grants

115. There is no argument from a financial point of view against fertilizer supply as a grant but only about $9 million annually (except Socialist countries) has reportedly been granted during the 1966-1969 period. These grants, as most grants, are not always given without the donor expecting from the recipient some recognitio often in the political field. Furthermore, some deliveries were of such a bad quality (for instance, high biuret contents in urea and low P_2O_5 solubility in TSP) that the reputation of fertilizers was damaged. Also, if unsuitable types

of fertilizers are given away from surplus stockpiles, it may hurt the agricultural extension work in developing countries. Therefore, one should not say "never look a gift horse in the mouth." Grants cost the donor countries often less than is apparent due to the higher prices used in valuing and publicly announcing such grants and due to the fact that the donor country's industry benefits from keeping their wheels turning. The financing of $1.5 billion a year will probably not benefit very much from grants.

"Aid by Trade"

116. Eastern Bloc countries are (mostly on a bilateral basis) exporting to developing countries with government procurement organization, a state trading system based on bilateral clearings. Such a fertilizer trade is usually planned well ahead and according to Mr. Boudewijn of Nitrex, has proven to be quite successful in the last two years in India, Pakistan, Ceylon, Egypt and in Latin America and other areas. Since these supplies have been, and may probably continue to be on a "balanced trade" basis which offers outlets for consumer and industrial goods produced in developing countries, and payments are due in non-convertible currencies, this part of the financing requirements for fertilizer needs is difficult to estimate at least as far as convertible foreign exchange is concerned, however, it should range in the hundreds of millions of dollars (equivalent). Payment and trade balance offer intangible advantages to developing countries which are not being offered by most Western industrialized countries. With some simplification: Eastern countries offer "AID BY TRADE" and Western countries offer "AID BY CREDIT."

117. Many discussions, frequently distoring the facts, have concentrated on the issue of "tied aid versus untied aid." The overall picture indeed so far is governed by merely one method of financing, namely: tied aid which includes supplier credits.

118. Although incomplete, recent investigations by OECD show that in the three years from 1966 through 1968, out of a total aid for financing fertilizer imports into a number of developing countries of between \$164 and \$235 million per annum, more than 80% was channeled through tied aid which figure also implies the often higher cif prices used in this trade. These amounts compare to a total of \$1,530 million which is forecasted to be needed in 1975/76 to import fertilizers and feedstocks, out of which a good portion will be needed for Socialist Asia.

119. Now if one endeavors to calculate the real cost to a developing country for imports of fertilizers financed by the various kinds of aid, tied or untied, and compared to "Aid by Trade," the answer is without a doubt in the economic rather than in the financial field. Input/output information is not even sufficiently available for the actual status especially on the "Aid by Trade" aspect, and less likely would any attempt prove successful when projecting up to 1980.

120. The following three graphs illustrate three cases of financing fertilizer and raw material deliveries to "recipient" countries: cash payments, tied bilateral aid, and untied aid.

121. In Figure 20, the money flow for the payment of one ton of DAP against cash payments has been shown with the freight and tax implications which increase the \$60 fob price to a \$70 delivered price. The economic cost of the foreign exchange needed would have to be assessed with a view to the terms of payment. Generally, prices under free-trade conditions, which are underlying these examples, should be substantially below prices which have to be paid under tied-aid agreements as shown in Figure 21: for each ton of fertilizer which is purchased under tied aid contracts, the price to the recipient country appears much higher (\$80 for example) than what is reported to be the actual "free trade world market price." High freight costs which are an intrinsic part of some tied aid arrangements, are part of such higher costs. However, the impact of interest rates and

repayment schedules may well be such that increased nominal costs by tied aid are often offset by the concessional terms granted and the recipient country, therefore, would actually repay less than the $80 debt.[1] One can argue that towards the end of long maturity periods each dollar repaid is worth less than it was when the fertilizer was purchased. This is the inflationary side of the medal. One can also argue that if the donor country would let the credit earn interest instead of giving it to a developing country for fertilizer purchases, it would accumulate interest, and interest on interest. In any case, there is a gross aid component involved and its gross value is reduced by the subsidy which is indirectly given to the donor country's fertilizer and shipping industry as shown on this graph. This is indeed a rather complex and touchy matter and I am referring its discussion to economists of both sides.

122. Graph 22 shows that the Pearson Commission recommended that the "Partners of Development" should aim at granting untied aid, in which case the advantage of a free market price would be combined with cheap credits as well as including a "true aid" component derived from concessional terms. "Untied" also relates to the way of shipping of fertilizers which is supplied under this type of aid. This graph shows that it is second best (after grants) for recipient countries, and also second best (after cash payment) for donor countries; both being apparent at least on paper.

C. The Financing of Investment Capital

1. The Various Sectors which Need Capital

123. According to the country classification as given in Table II, there are various sectors which will be asking for investment capital. In Category 1 and 2 countries, investments need to be made in marketing and infrastructure, and

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1/ USA, UK and Japanese aid have been given with 0-3% interest rate, 18-50 years maturity, including up to a 10-year grace period.

probably -- to a minor extent -- in dry blending plants. Although comparatively small amounts of money are required, the countries involved belong mostly to the non-industrial and industrializing countries in which capital resources are very scarce. Therefore, outside assistance, even for financing mostly local costs, will be needed. In order to implement satellite plants in Category 3 countries, larger sums of capital must be provided, as well as for Category 6 countries with existing small plants and too small markets to justify economically-sized plants. Investment capital should also focus on further market development to prepare for later installation of satellite type, or full size fertilizer plants. The largest amounts of capital will be needed to finance full-scale N and P_2O_5 fertilizer plants, either for local demand or for export, or for both purposes (Category 4 and 5 countries). In all of these groups, additional "indirect" investment funds, as explained in Figure 6, may be needed.

TABLE XXIII

Application and Sources of Funds

Category	What is to be Financed?	Sources of Funds (examples)
1 and 6	Infrastructure, marketing	Government, IBRD[1/]
2	Infrastructure, marketing	Government, IBRD
	Dry blending plants	Local development banks, suppliers credits
3	Satellite plants	Regional banks, IFC and other multilateral institutions, bilateral aid, suppliers credits
4 and 5	Full size fertilizer plants	IBRD, IFC, Regional Banks, bilateral aid, private companies, suppliers credits

1/ "IBRD" includes IDA where appropriate

2. Capital Resources and Flow of Aid

124. Although the investment as proposed for the fertilizer sector in developing countries is only a fraction of total industrial financing required, its provision is specifically difficult due to its close links to the parallel financing in other sectors of the economy, as has been outlined in Figure 6.

125. Capital resources are insufficient in developing countries and they are difficult to attract for fertilizer investment. Only in the more industrialized countries (which mostly belong to Category 4 and 5), capital has accumulated within the industrial sector, and therefore, financing from depreciation is beginning to play a role. But the largest share may continue to originate from domestic (public or private) savings. Local financial institutions mobilize private savings some of which would be available for the fertilizer sector because the public has a better regard for profits in the fertilizer industry than those that presently exist. Therefore short and long-term securities can be used to finance private fertilizer ventures in the more advanced of the developing nations.

126. Last but not least, foreign private investment and loans have made and could continue to make substantial contributions towards financing direct plant investments. Other foreign resources of capital include multilateral and bilateral institutions.

127. Figure 23 compares the annual recurring costs and average annual investment costs as forecasted for the fertilizer sector up to 1980 with the net flow of financial resources received by developing countries up to 1970, derived from "Trends in Developing Countries," published in 1971 by the World Bank Group. Although figures are not quite comparable because the countries included are different, this graph illustrates the considerable relative importance of the fertilizer sector. If the net flow to developing countries were to remain at

the 1970 level, the sector would grow to about 20% of total net flow and by 1969/70 even surpassed the total net flow from multilateral agencies.

128. This portion of total net capital flow which had arrived at about $1.5 billion by 1970, including $770 million from the World Bank Group, is compared -- see Figure 24 -- with the direct fertilizer plant investment, and to give an idea only, with the annual need for indirect investment capital. Again, this comparison lacks exact comparability since the fertilizer sector figures include some 20% of the funds which may flow into socialist countries who are not included in the net flow from multilateral agencies.[1/]

129. The World Bank Group, as an indication for what could be done during the next few years, would be able to contribute to the fertilizer and chemical sector between about $60 and $100 million annually which would be up to about 20% of this sector's total need. In other words, the World Bank/IFC might probably finance the equivalent of one or two large fertilizer projects per annum. As another example, the Asian Development Bank lent $390 million in 1970 to 15 countries in 59 loans, including one fertilizer project.

3. Indirect Plant Investment Financing

130. With regard to the financing of projects, we must again differentiate betwe direct and indirect plant investment. An essential proposal which I should like to repeat here with regard to indirect investment is to relieve fertilizer projects of the burden of also having to finance parts or all of infrastructure, marketing, railroad, etc., but instead to look out for other, if possible, cheape sources of money. If, with the commitment of building a fertilizer complex, tho absolutely vital "side" investments will not be added in time due to missing fin ancial arrangements, the success of the core project is endangered. Therefore,

1/ The foreign exchange component of projected direct plant investment would add about [illegible] billion (including Socialist Asia) to the about $60 billion external public debt outstanding of 80 LDCs (excluding Socialist Asia) -- see Figure 25.

any commitment in a factory should be tied to a binding commitment by the host government or others to put up the funds, and other resources such as manpower, to create the environment necessary for a successful fertilizer industry.

131. Some countries have been able to reduce the cost of infrastructure for the fertilizer industry by developing sites and "surroundings." The advantages of geographic concentration of the fertilizer and other industry has, however, caused ecological problems and therefore, fertilizer manufacturers may be burdened with high "social" costs in this sector, or may have to spread out into their market areas -- even with higher feedstock transportation costs -- so as to prevent such costly environmental investments.

132. For financing this type of an investment, long term loans are the most suitable source of finance and virtually the same sources as mentioned below (4b) under "Loan Financing" may be tapped.

4. Direct Plant Investment

a. Profitability of Fertilizer Industry in Developing Countries

133. Fertilizer plants are getting bigger and bigger, quite often with the questionable reasoning of "economy of size." Costs per plant are also increasing in terms of specific costs, since ever larger capacities do not result in sufficient economy of scale to outweigh the worldwide cost escalation, especially so in the equipment and construction field, and to equalize higher costs involved in the increasing use of local engineering and procurement. The cost of these services grows faster than the 3-4% average dollar inflation around the world, and they make up a good portion of total investment in fertilizer projects.

134. As shown before, the average direct investment costs per fertilizer plant in developing countries are expected to further increase in the 1970-1980 decade:

nitrogenous fertilizer plants may cost up to $100 million and phosphate plants up to $60 million, or even more.

135. To justify any investments in such large entities, the question of profitability, or return on investment in fertilizer plants in developing countries cannot be disregarded. Virtually three factors influence the purely financial judgement, stripped of any economic considerations, of whether or not a fertilizer plant may be considered profitable and would therefore be able to attract investment capital:

- the opportunity cost of money in the country;
- the interest rate to be paid on the loan portion of the investment as a weighed average of all loans for that project, and
- the debt/equity ratio, and the expected return on the equity

All direct plant investment is assumed to be bound to a production company, and this will for financial purposes, require equity capital as well as loan capital These various "sorts" of money are illustrated in Figure 26 which is an actual example of how to finance a $75 million fertilizer project, either in a private company or in a government-owned company. One needs to provide both local and foreign currency to purchase all goods and services needed for the project's implementation.

136. The expected return on invested capital is a figure which should include the risk involved, future developments, etc., and fixing its minimum value will be a matter of management or government judgement, how this return should compare to the opportunity cost of money in that country, and whether one should look for other than this fertilizer project to invest a given amount of money. This view

neglects any economic consideration such as foreign exchange savings by reducing imports, but instead, it simply assumes that in any country, money has its "opportunity cost," at which rate it could earn profits -- as straight interest on a bank, or as an investment in an enterprise.

137. In fertilizer companies, like in other industries, a long term debt-equity ratio of about 60:40 is considered a sound basis of financing,[1] and might be used for estimating the expected profit on the equity portion: at a given interest rate of say 10% per annum, and an assumed opportunity cost of money of 16% per annum which is the expected minimum overall yield, or return on total capital invested, the profit on the equity should at least be 25% per annum. This as we all know is not at all easy to achieve -- if possible at all -- in any fertilizer plant in the world. Profits have been low, or non-existent in recent years, and international competition in both finished fertilizer and feedstock and intermediates seems to continue to be keeping down profits.

138. With regard to profitability, experience with fertilizer projects in developing countries are specifically discouraging. Three main reasons may be held responsible for this fact:

- the plants which were built many years ago and which are now producing at a sustained level are either too small or use obsolete processes, or both, or suffer from low utilisation;
- the plants built more recently are still in a stage of early operations with a high financial load or small production preventing them from profit making, and
- the generally depressed price situation of this industry in the world.

1/ In the basic chemical industry in the U.S., long term debt ratio in 1969 was only 29.2% compared to 60% as mentioned here.

139. Some examples from A to Z are: Azot Sanayi (Turkey), Banda Shahpur (Iran), ESFAC (Philippines), FACT and FCI (India), Fertisa (Peru), KFC (Kuwait), Mersin (Turkey), NPK Engrais (Tunisia), Sies (Senegal), Ultrafertil (Brazil) and Zambia's Nitrogen Industry. This low profitability if allowed to prevail would seriously hamper the development of a sound financial basis and might even endanger the repayment of loan capital.

b. Loan Financing

140. There are basically six sources of loan financing:

- the government's own resources in local and foreign currency;
- bilateral loans from foreign governments (AID, KFW);
- international sources (IBRD, IDA, IFC, Interamerican Development Bank, Asian Development Bank, and others);
- private local and foreign banks;
- suppliers credits and
- private companies who also invest in the same project's equity.

Most governments have made, and continue to make capital available for constructi of new plants as well as infrastructure projects connected with those programs. A substantial amount of money which governments have fixed with existing investments necessitates them to sustain the projects and to improve them, which again needs money.

141. Governments also have undertaken the job of providing loan money from multilateral and bilateral sources and have tied up themselves in such long-term agreements so as not to leave too much leeway for future activity -- which is grave now that the projects get bigger and the amounts of money needed grow beyond wha has already been spent.

142. In some instances the government not only had difficulties in providing the foreign exchange portion of financing, but also in supplying the local currency at the time it was needed (Turkey - Mersin; Indonesia - Petrokimia; India - Zuari and others). Foreign exchange will continue to be more difficult to supply from the government's own resources, except those who have access to funds, and/or give highest priority to fertilizer projects either as an import substitutor (India, Pakistan, Turkey) or as a foreign exchange earner (Morocco, Saudi Arabia, Algeria, Tunisia, Iran, Venezeula, and Mexico).

143. Bilateral loans from foreign governments are available from industrialized countries with the objective of assisting that country's engineering and supplier firms in getting contracts in a highly competitive market -- that means -- the government subsidizes exports from its own country. The often ambiguous nature of such credits should be watched as in the case of fertilizer import financing.

144. The role of <u>international financing agencies</u> has been dealt with in separate papers at the Delhi Conference, namely Cottrell's paper on "World Bank Experience in Financing Fertilizer Projects in IDCs," and Carmignani's paper on "The Role of the World Bank Group in Assistance to Fertilizer Production in LDCs - Economic Aspects." Furthermore, most of the other institutions have reported about what they have done or intend to do in this field.

145. The World Bank Group in summary has lent to or has taken participation in twelve fertilizer projects in ten different countries with a total commitment of $170 million, through mid-1971. This seems low in relation to the total future needs. One must realize that the total cost of these twelve projects exceeds $500 million which is quite a substantial amount of investment, also compared to future needs in this sector.

146. A most complex example of mixed multi-and bilateral financing is the Pusri urea expansion project in Indonesia, with thee sources of funds being involved,

namely, two multilateral (IDA and ADB) and one bilateral (Japan) sources. The experience in these negotiations led to the rule of thumb: the problems with financing increase with the square of the number of financial institutions involved. Thus, in the case mentioned, one would encounter nine times as many problems as were encountered in a straight two-way financing provided by one source only.

147. Suppliers credits which are mostly guaranteed by the supplier country's government play an important role but they usually carry either a high interest rate with short maturities, or due to restricted competition, they involve high price plant equipment and services.

148. With respect to tied and untied aid, the cheapest loan money such as IDA and USAID credits, has a 40-50 year maturity and carries only a nominal service charge of 3/4 of 1%. Such moeny can only be given to governments which relend it to the fertilizer company on commercial terms prevailing in that country.

c. Equity Financing, and the Ownership Structure of Fertilizer Ventures

149. Equity or risk capital is scarce in most developing countries. Usually the foreign exchange portion is harder to come by than local money but this latter statement is increasingly misleading with the ever larger sums in local currency required for fertilizer projects. Therefore, sources of equity even in local currency may be difficult to find although for instance in India, share issues for fertilizer projects had been oversubscribed within a few days. International organizations and regional and bilateral institutions and banks can also provide such capital, for instance, IFC, DEG, ADELA, PICA, SIFIDA, East African Development Bank, African Development Bank, and International Investment Corporation for Yugoslavia. Semi-private development banks such as ICICI and TSKB have also

invested in the equity of fertilizer projects. In some cases, government guarantees are required, but IFC, for instance, makes equity investments without government guarantees. Generally one might say that equity contribution is equivalent to ownership.

150. Figure 27 shows the ownership structure of the fertilizer industry in a number of developing countries. The groups and bodies involved are:

- governments and private companies in developing and in industrialized countries, and
- multi- and bilateral equity investors such as IFC.

The list of companies with government participation is an overwhelming one when compared to the much smaller list of privately owned and operated fertilizer plants. The graph names a few of them in Tunisia, Senegal, India, Pakistan, Brazil and Peru.

151. I presume that in the future the relative share of privately owned and operated plants or those with major private capital involvement would tend to decrease further if no remedies are taken by governments to attract private capital -- provided governments have included this task in their programs. As of 1970/71, the total risk capital invested by private firms in the fertilizer industry in developing nations may be on the order of $50 million.

d. Partnership with Foreign Private Investors

152. The experience with private foreign investment is discouraging so far. Only a few fertilizer companies in developing countries are profitable. The added risk involved in a sector which is as dependent on infrastructure, government action, weather, etc. as is the fertilizer industry, does not help to create

an investment euphoria in the private fertilizer sector. Furthermore, the growing size of fertilizer plants requires up to $100 million or even more for one single fertilizer complex. These amounts of money simply are not attracted from foreign private sources, if long payout periods increase the risk inherent in any foreign investment. But there are reasons beyond purely financial considerations, such as:

- the non-transferability of funds previously generated in the country, often linked to the blocking by local governments of investments in other than the "core" industries;
- the need to maintain a market position, and
- to get a foothold in the agricultural market which may foster other sales (such as pesticides, plastics) -- and all which might still attract investments by private companies.

153. In all other cases, incentives in the form of "fringe benefits" may be necessary; such "benefits" may also reduce the long-term risk involved in a flat equity participation by returning a part of the long term investment within a period of three or four years after that investment has been made. "Temptors" could be, and have been in various instances:

- technical assistance and management contracts;
- know-how and process license contracts;
- delivery of catalysts, and
- chances to supply fertilizers during the seeding program under a "most-favored-supplier" clause.

In addition, if the fertilizer company owns, or participates in, an engineering firm, this might give some additional profit potential. Figure 28 illustrates such partnership relations, in terms of "units." A participation has been assumed of a Company A originating in an industrialized country, of 25% in the equity of a fertilizer Company B in a developing country. Other also voluntary assumptions made are:

- a seeding program covers four years with altogether 80% of annual sales of Company B which are estimated at 80 units, and a profit of 2 units (which is 6% of sales) resulting from these sales;
- return on investment starts six years after the equity investment has been made and is expected to be 10% on equity (not discounted);
- technical assistance, license, and know-how contracts will yield some profits to Company A besides such intangible benefits as keeping planning staff at work during low workload times in the home country;
- risks are assumed to be involved in the transfer of profits, for example, re-and de-valuation or floating of currencies;
- engineering costs total about 15% of investment, and the risk involved in this business such as guaranteeing performance, etc., is limited to 50% of an engineering (fixed) fee of 5% of total investment with profits of this part of the transaction including net profits from equipment supply (minus risk insurance, and other capital cost), amounting to 5% of total investment.

154. Apparently there are three types of such participations with a profit and risk potential:

(a) a flat participation of A in B; profit potential is limited to an assumed flow of "1" unit per annum and with a risk element, only 3/4 units per annum may be returned, giving a payout time of about 13 years plus 4 profit-free years after the investment has been made, or about 17 years, which is not considered attractive.

(b) with all of the tangible and intangible fringe benefits mentioned, the calculation might result in a 9-year payout period, and

(c) even with the inclusion of the engineering and supply business, total payout period would still be about 7 years after the initial investment.

155. These assumptions are merely guesses and this graph is only meant to illustrate the implications and complications and ways of thinking behind some fertilizer investments. It is, hence, of no use to do cash flow calculations which, of course, may lead to an entirely different picture -- darker or lighter, depending on the case, and the man who has to prepare and make the decision.

156. A considerable amount of attracting devices would have to be put forward in order to entice about $3.3 billion in foreign exchange up to 1980. Even if only 10% of this amount would flow into private sector fertilizer plants with a 40% equity portion, about $130 million would be needed which is more than 2-1/2 fold the risk capital which is estimated to have been invested by private foreign investors as mentioned above.

VIII. CONCLUSIONS AND RECOMMENDATIONS

157. The conclusions of this paper should not be to show up the big problems involved in meeting the future fertilizer needs of developing countries. Everyone in this industry knows about that, although I may have provided you with some updated and additional figures which more clearly show the magnitude of the problem.

158. I am obliged to indicate ways of how to solve some of these problems. I don't dare mark one problem as being a major one and naming the other as being a minor problem because this situation may change from day to day and from country to country.

159. The question is whether a program of implementing about 130 new fertilizer plants within a decade is a doable proposal. My answer is yes, it should be. The total number of fertilizer plants as of July 1969 was estimated by the British Sulphur Corporation to be:

640 ammonia plants
400 nitric acid plants
280 phosphoric acid plants and
1,500 fertilizer product plants

Although this impressive number has been implemented over more than a half a century, we have much more efficient and well organised engineering firms today who should be able to handle more than this number of plants, especially so when also drawing upon the increasing availability of engineering skills in the developing countries themselves.

160. My <u>first</u> proposal is based on the overwhelming importance of <u>indirect</u> investments needed to make the fertilizer application a success. I therefore propose that a comprehensive study be initiated for estimating such indirect

costs, which have to be financed up to 1980, specifically in marketing. It seems mandatory that these funds must be separated and allocated to various sectors other than fertilizer in which they may play an even more important role such as in agriculture, petroleum & mining, railroads, site development and ecology. I believe that we may somewhat relax on the fertilizer factory building activity although this may require considerable effort, but much more effort undoubtedly will be required in the distribution and marketing fields, including establishing or improving credit facilities.

161. I further believe that it is to the benefit of all Partners in Development that implementing capacity for export purposes should be, if at all, concentrated in developing countries with adequate resources who may earn foreign exchange. This second proposal aims therefore at fostering trade in fertilizers among developing nations, rather than selling these goods from industrialized countries on whatever the terms are. Even if this suggestion probably will not work, it should still be said over and over again.

162. I am in favor of untying international aid, specifically in financing investment capital, and I strongly believe in the advantages of international competitive bidding rather than using bilateral tied sources. I know of a case in which a nitrogen fertilizer plant with less than 100 tons per day ammonia capacity was priced at about $25 million. My proposal number three, therefore, is that all information about real investment cost should be gathered and forwarded to interested parties, so as to give a better picture about reasonable plant and equipment costs and prices which in turn would be facilitated by standardizing fertilizer plant types and capacities.

163. My fourth recommendation is then to ease the workload for both planners and bidders by choosing standard sizes and types of plants. The present

generation of ammonia plants may already be considered as being a standard size in the 600-750 ton per day capacity range. A good example for such "standardization" is FCI with 4 plants being built at virtually the same capacity and layout. Urea standard single train plants crystallize around the 1,000-1,200 MTD mark. I suggest that developing countries, together with interested organizations and engineering firms, now settle on the next size range for ammonia and urea and also for phosphatic fertilizer units.

164. My fifth amendment is connected with using local sources of services and supply. Whilst I am personally against overdoing local involvement in too early a stage of development, I feel strongly about relocating part of the engineering company's work into such developing countries in which a major demand for fertilizer engineering work exists, or may be expected. Although this procedure has already started with some success, including partnership arrangements, it could improve substantially. The cost of engineering which constitutes a considerable part of the total capital requirement could then shift into the local currency sector, besides the training effect ("transfer of technology") and the creation of new jobs. As a task in the late 1970's, I consider it important to make local engineering groups in major developing countries capable of handling complete projects and call upon the more experienced engineering companies in industrialized nations and licensors to handle only basic design or basic engineering and overall supervision.

165. The sixth suggestion concerns the high portion of freight rates as I have shown to be indicative of the fertilizer industry whether you produce it locally or import finished products. Therefore, the requirements of shipping capacity should be evaluated in great detail up to 1980 and recommendations for types and

and sizes of ships to be built or used by developing countries worked out, specifically for the fertilizer industry which would include phosphoric acid and maybe molten sulphur transport facilities, as well as bulk carriers for urea, DAP/MAP, and other intermediates.

166. Another conclusion and suggestion -- number seven -- is connected with economic considerations involved in planning the fertilizer industry. It always is a problem to determine the C & F values of fertilizers and feedstocks under the so-called free trade conditions. It would be helpful if a kind of standardized hypothetical price calculation could be made up for favorable locations for nitrogenous and phosphatic fertilizer plants which should include reasonable profits, and to have this hypothetical fob price as a basis for comparison and for establishing protection required when evaluating the merits of any new project in any country. Even with this instrument, one would still have the big fluctuations in freight rates which determine C & F prices and therefore the competitive position of a new project.

167. My last proposal, number eight, is to find an answer to a simple question: who is setting priorities for fertilizer projects in developing countries which compete in a limited international money market? And - how can the setting up of projects which are "uneconomic" both from the financial as well as from the economic points of view be avoided?

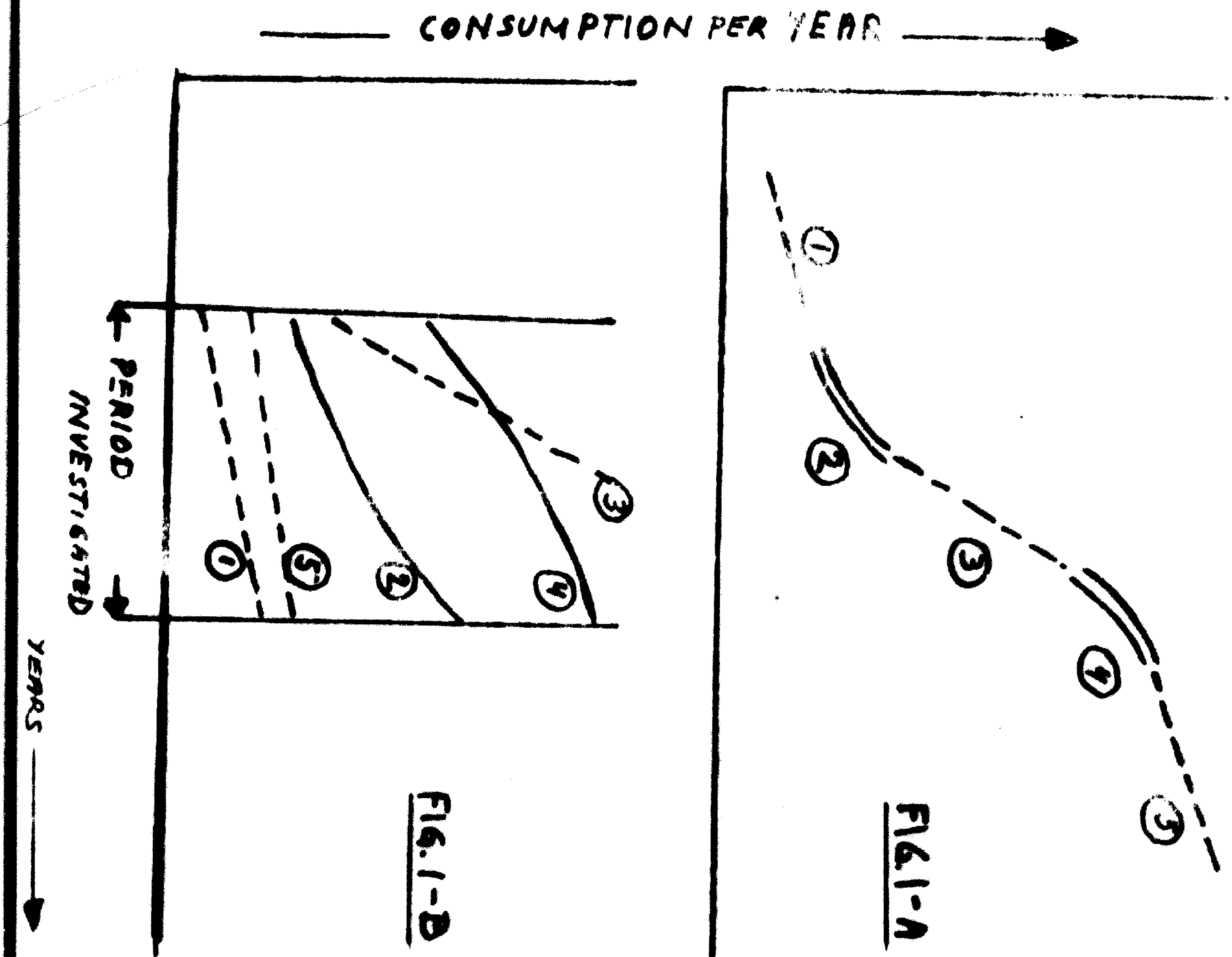

FIGURE 1: FORECASTING OF CONSUMPTION

1-A Complete sample history of consumption increase from starting to use fertilisers, to near maximum, in 5 sections.

1-B Possible overlapping of the 5 sections if a multitude of countries is being investigated, and resulting in a coincidental linear growth.

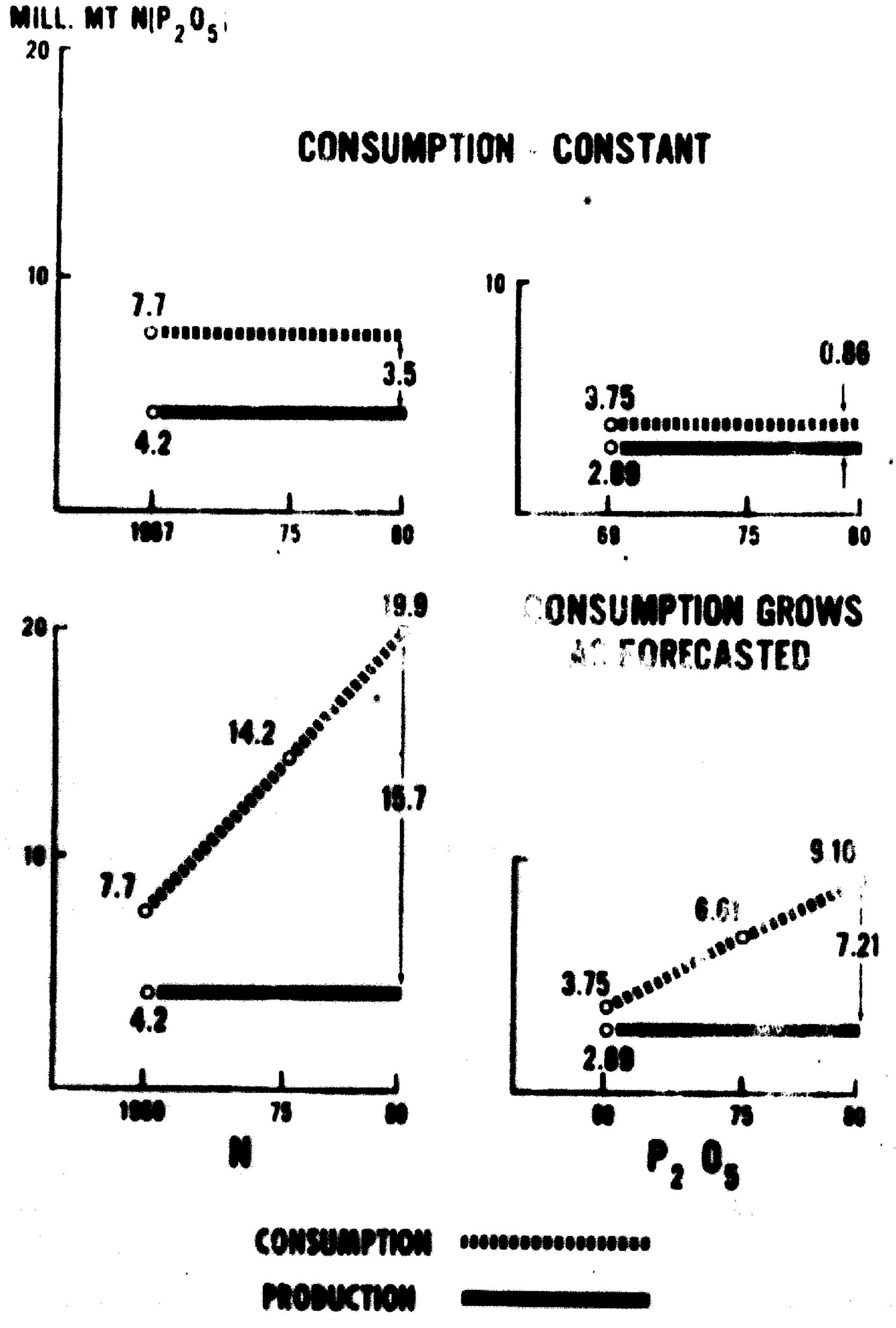

FIGURE 2: CONSUMPTION & PRODUCTION FORECAST 1970-1980

NO ADDITIONAL INVESTMENT

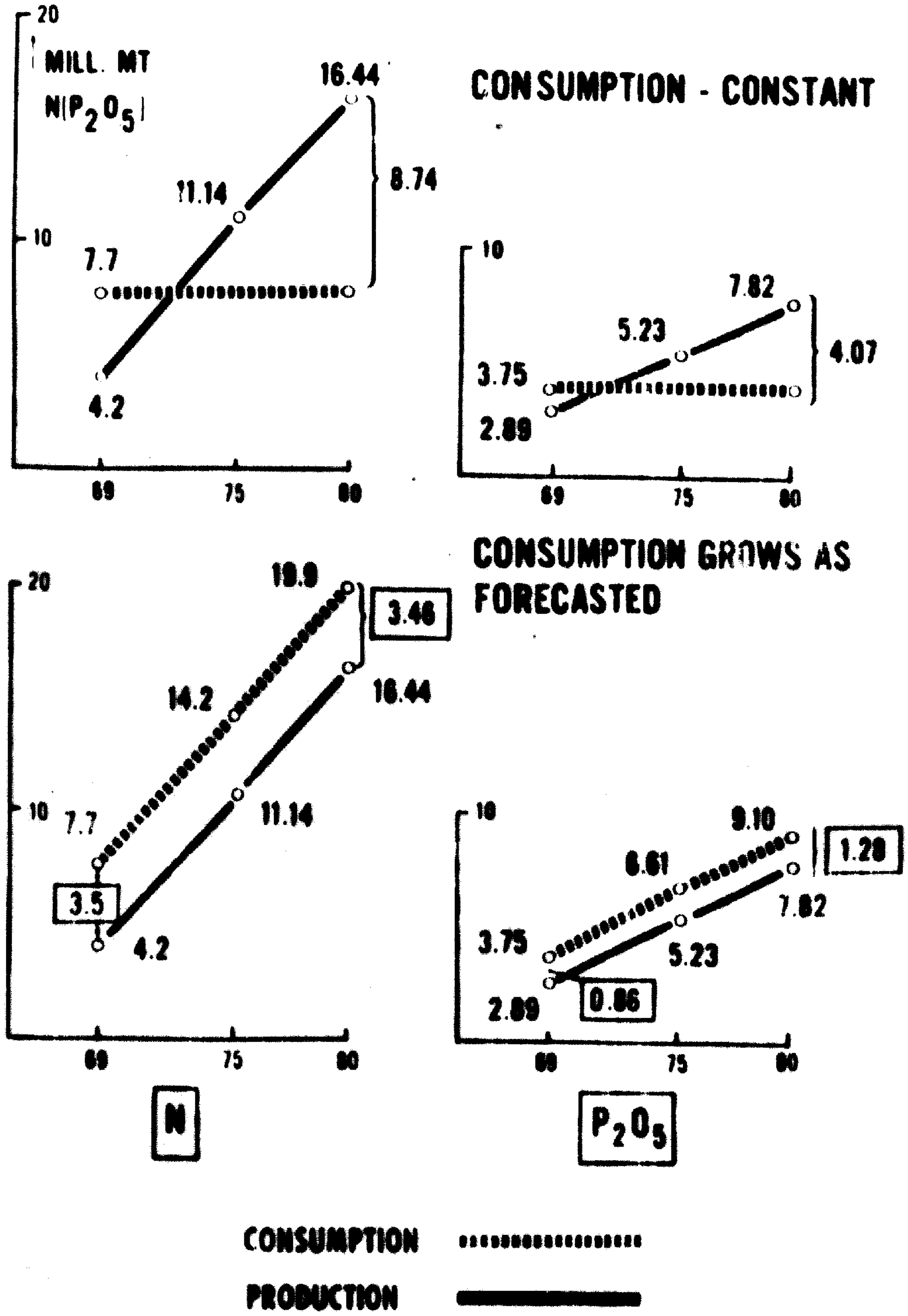

FIGURE 3: CONSUMPTION & PRODUCTION FORECAST 1970-1980

ADDITIONAL INVESTMENT AS PROPOSED

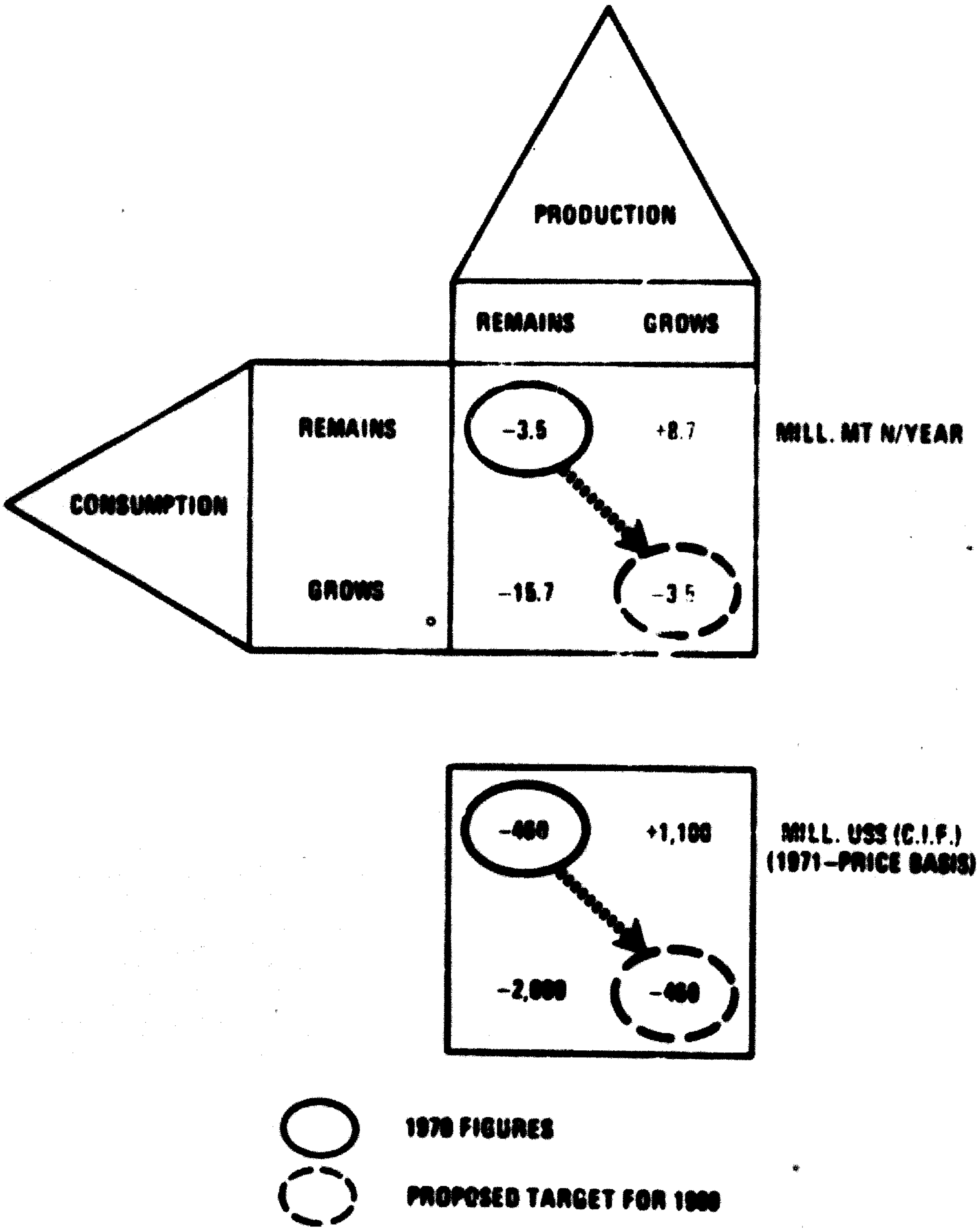

FIGURE 4: GAP IN FERTILIZER - N IN ALL LDC IN 1980

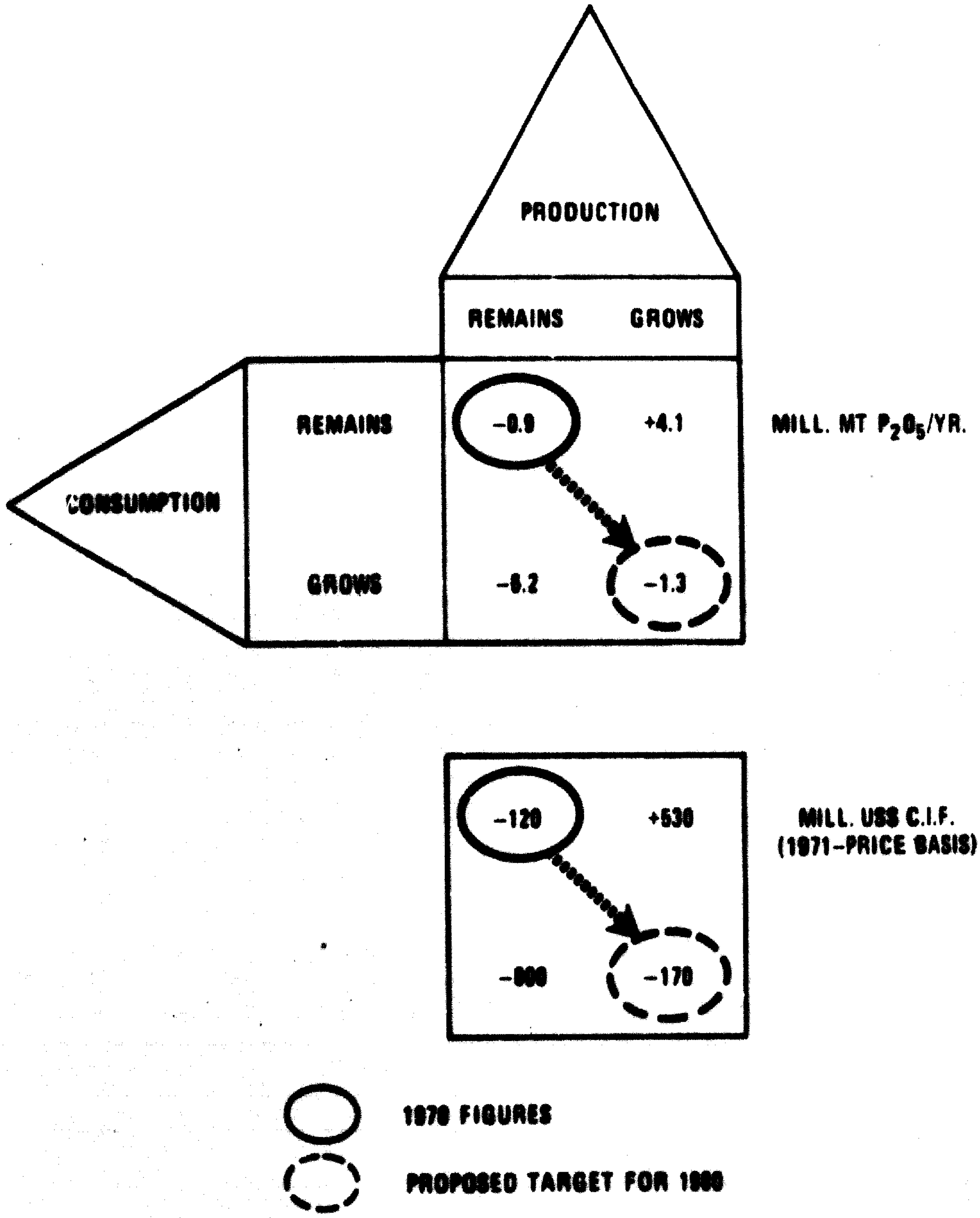

FIGURE 5: GAP IN FERTILIZER - P_2O_5 IN ALL LDC IN 1980

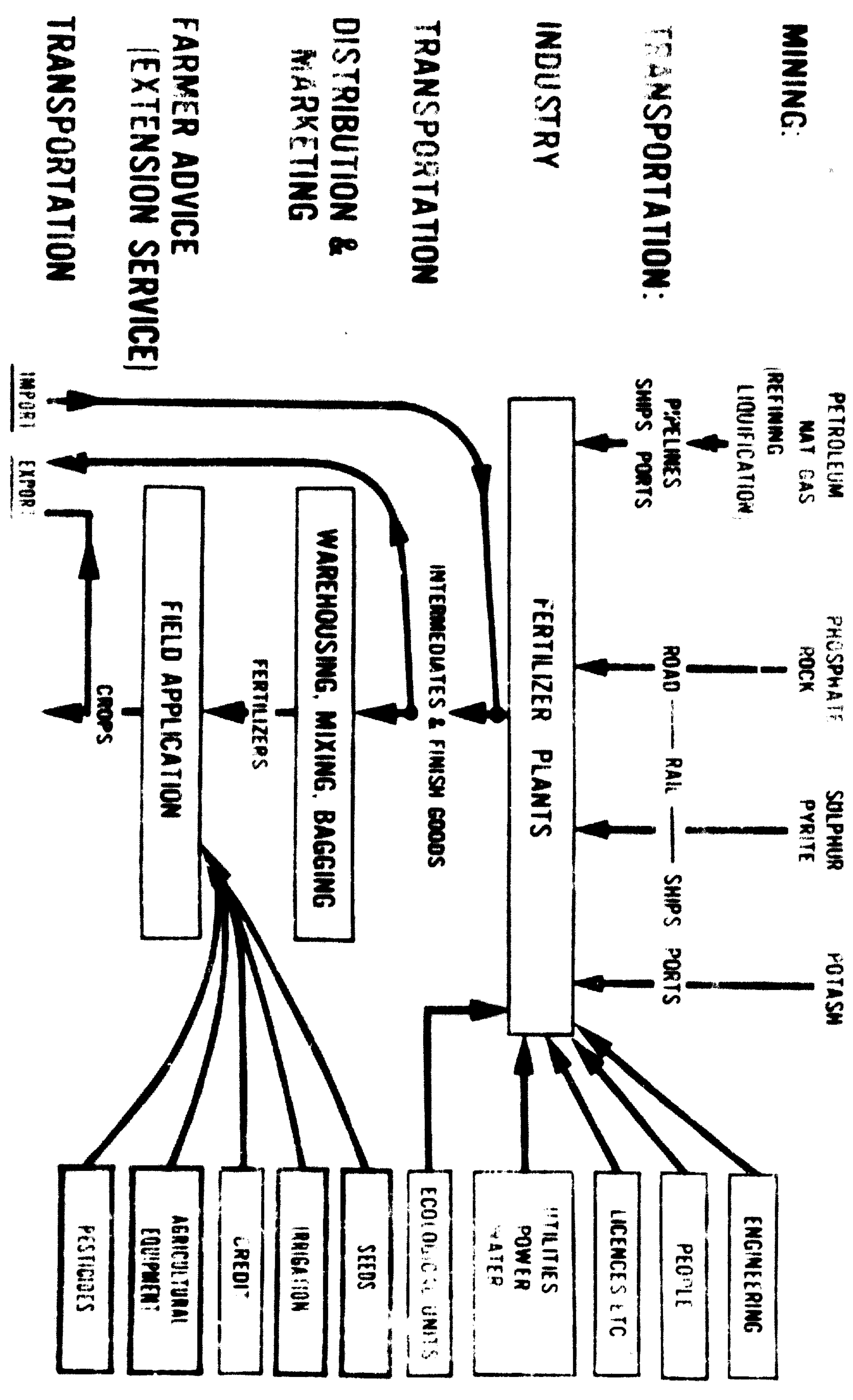

FIGURE 6: SECTORS IN WHICH INVESTMENT CAPITAL IS NEEDED FOR MEETING LDC'S FUTURE FERTILIZER REQUIREMENTS

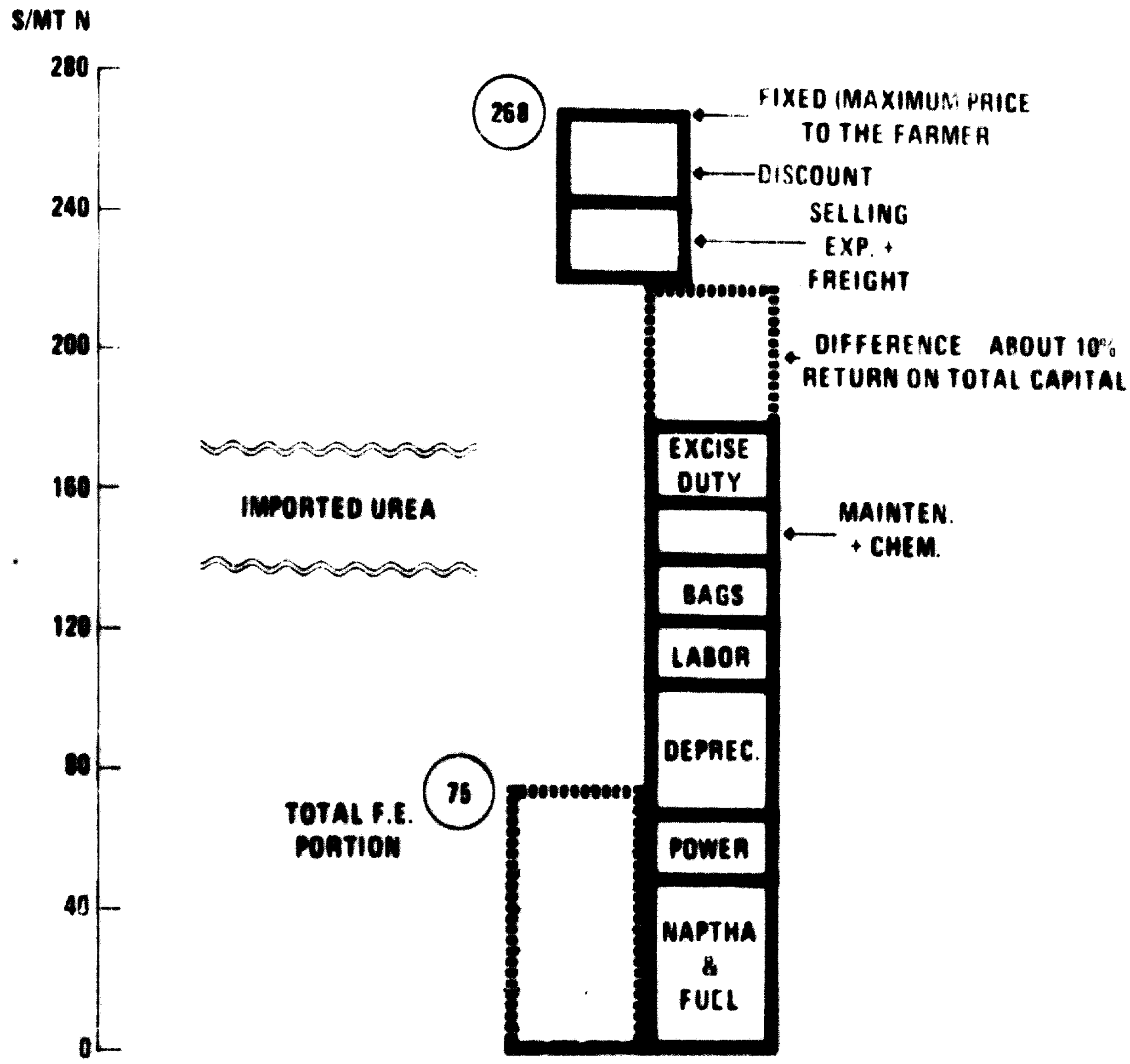

FIGURE 7: N-FERTILIZER PRODUCTION COST AND PRICE TO THE FARMER IN AN LDC

EXAMPLE: UREA IN INDIA 1971

		LOST PRODUCTION		
LOST STREAM DAYS/YR.	% UTILIZ.	'000 MT N/YR.	INVESTMENT VALUE US$ MILL.	RECURRING LOSS US$ MILL./YR.
50	85	30	13.5	4.5
34	[illegible]	21	9.5	3.2
17	95	10	4.5	1.5
±0	100	±0	0	0
+35	110	+21	+9.5	+ 3.2

FIGURE 8: A CASE FOR DEBOTTLENECKING AND PLANT IMPROVEMENT

EXAMPLE: 450,000 MT UREA/YR;

BASIS : 330 STREAM DAYS/YR.

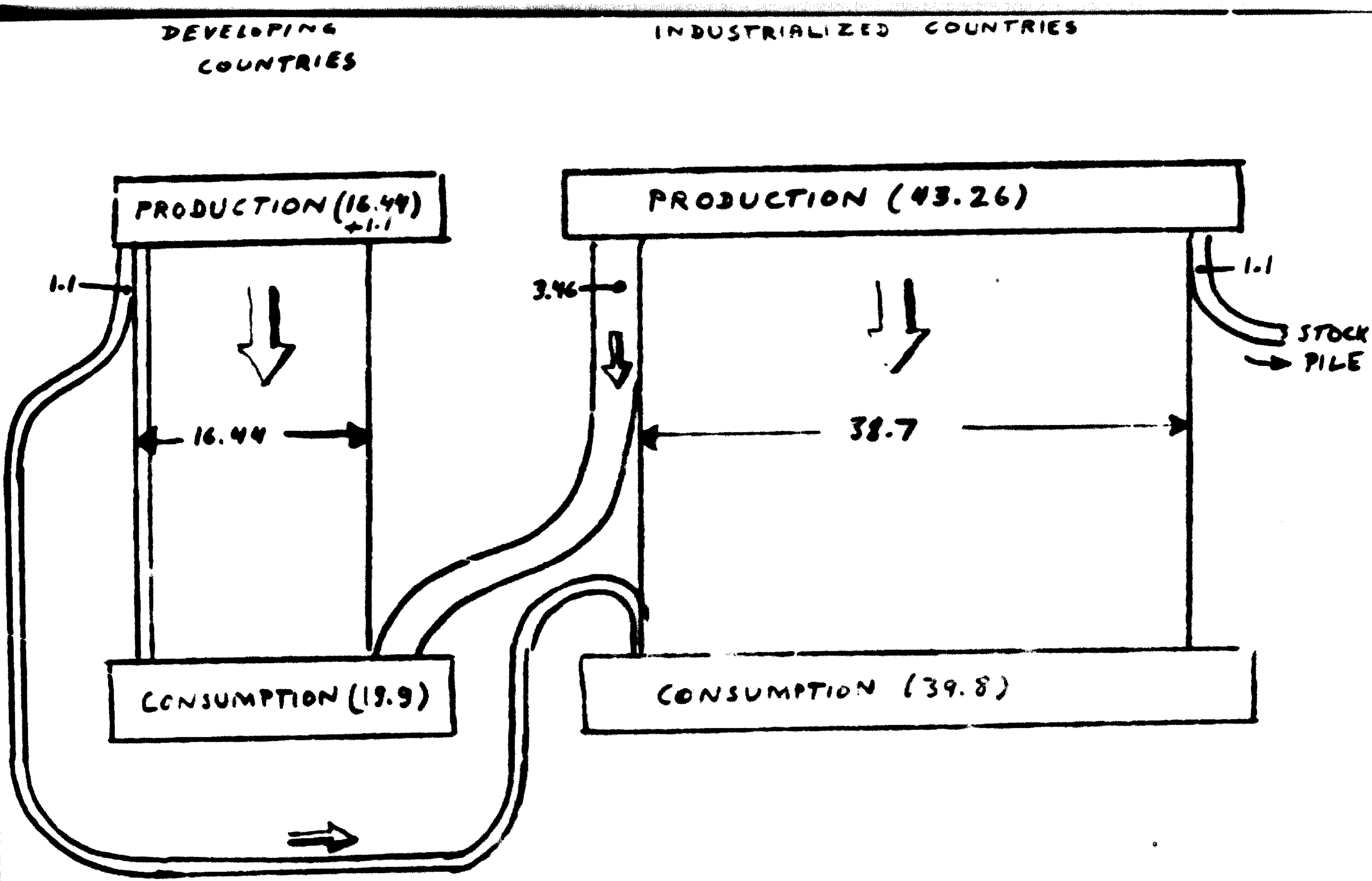

FIGURE 9: N-FERTILIZER SITUATION 1980 (MILL. MTY OF N)

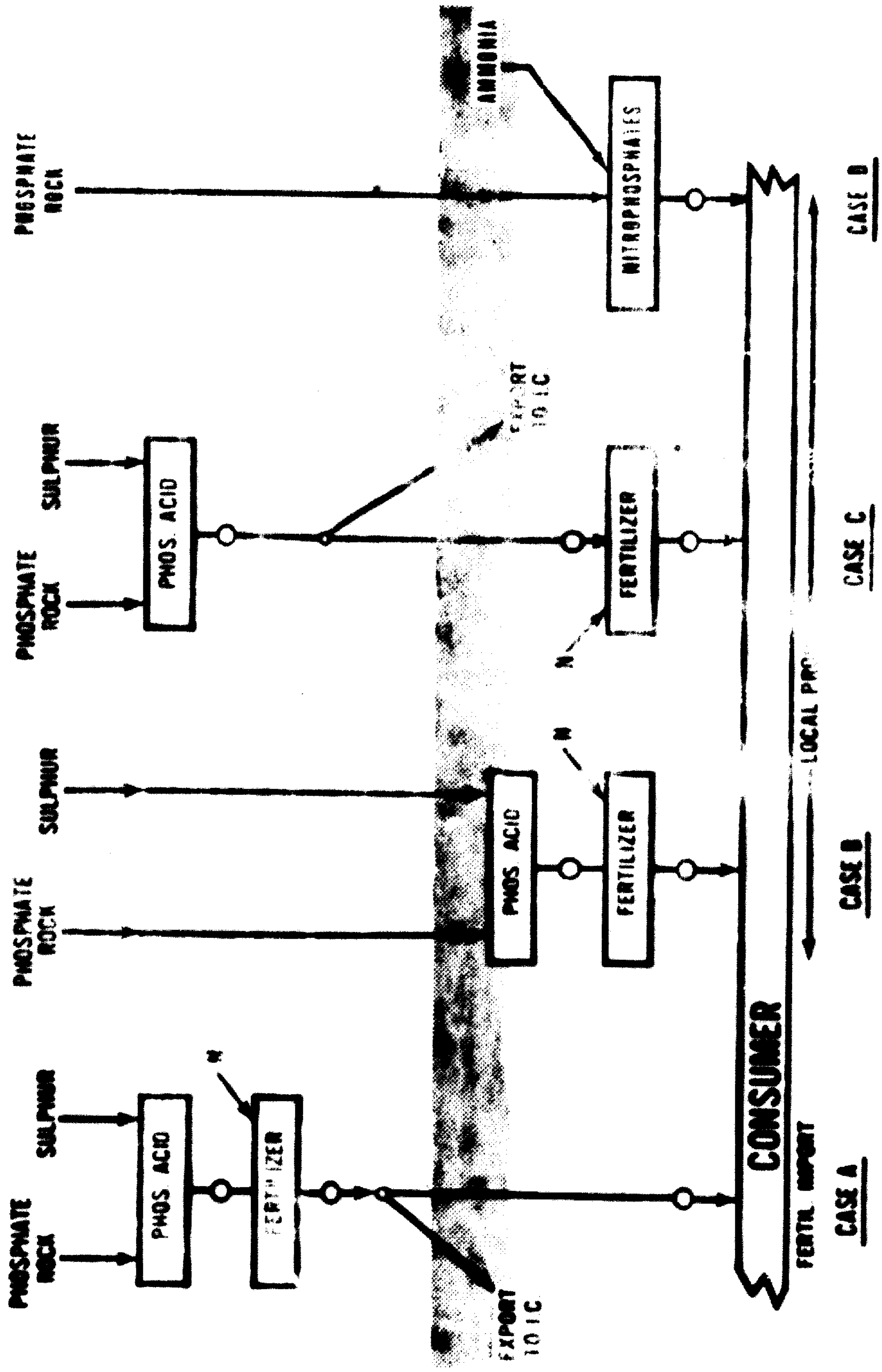

FIGURE 10: 4 CASES FOR SUPPLYING PHOSPHATIC FERTILIZER TO LDC

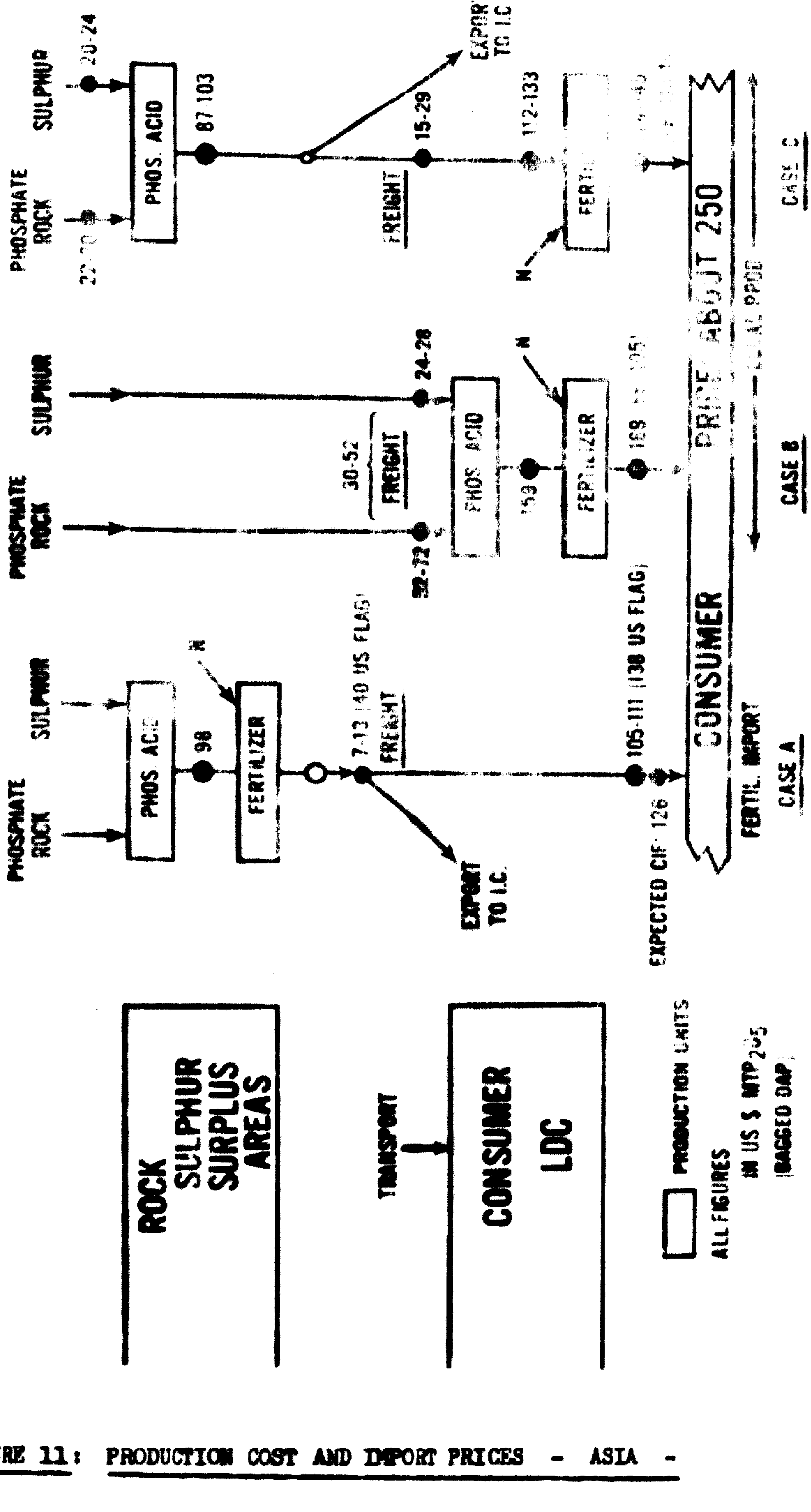

FIGURE 11: PRODUCTION COST AND IMPORT PRICES - ASIA -

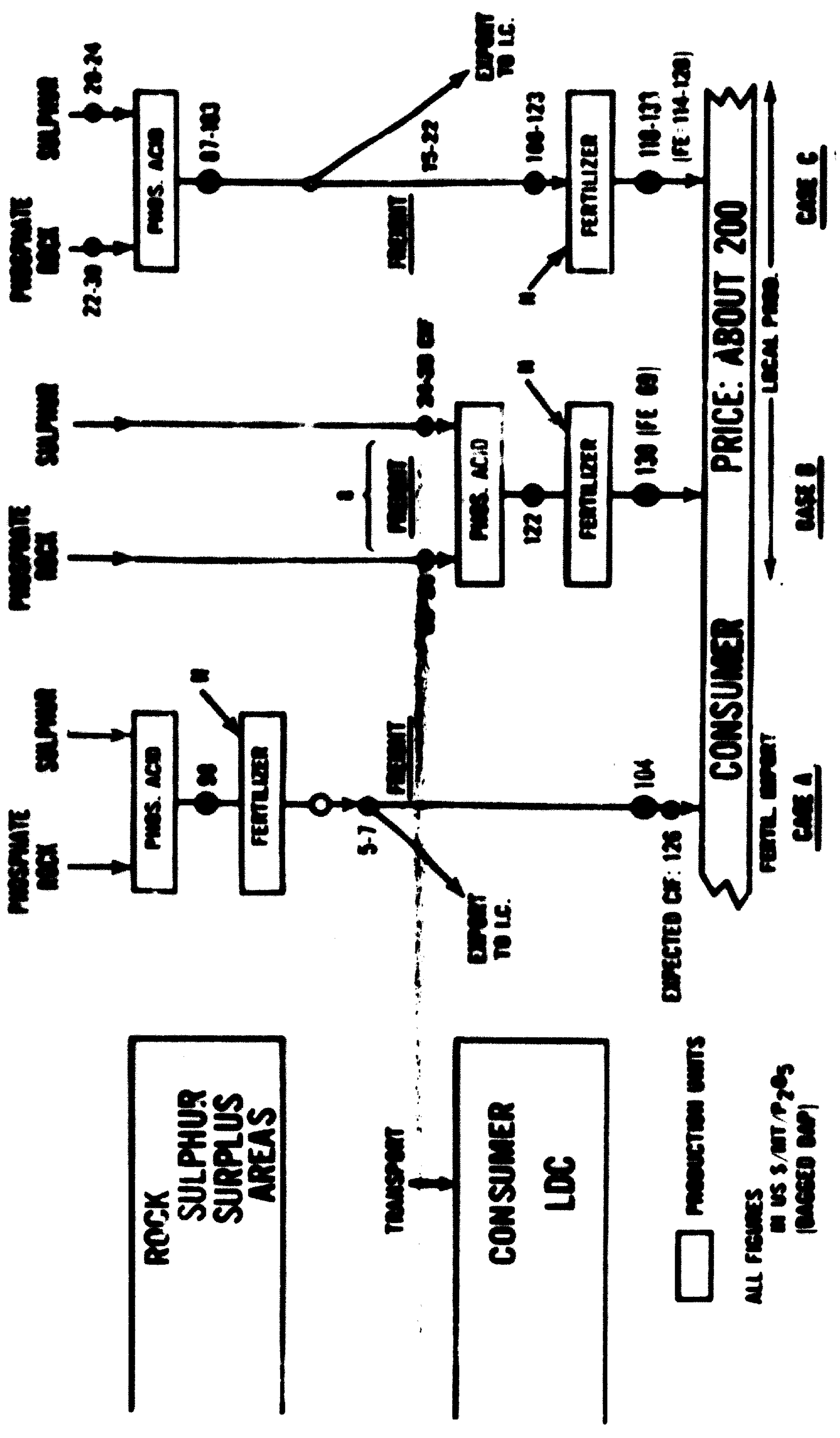

FIGURE 12: PRODUCTION COST AND IMPORT PRICES - EUROPE -

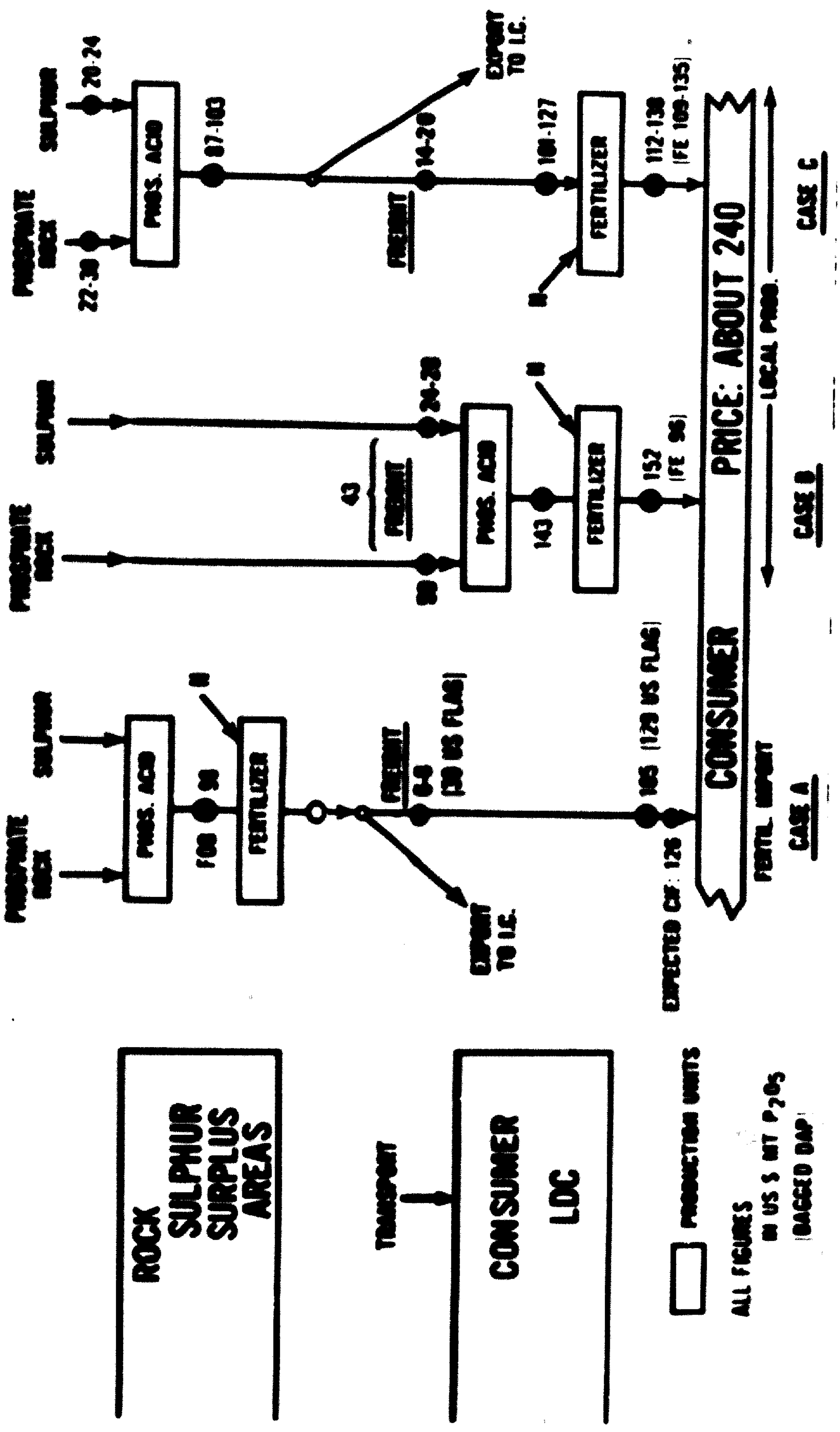

FIGURE 13: PRODUCTION COST AND IMPORT PRICES - LATIN AMERICA -

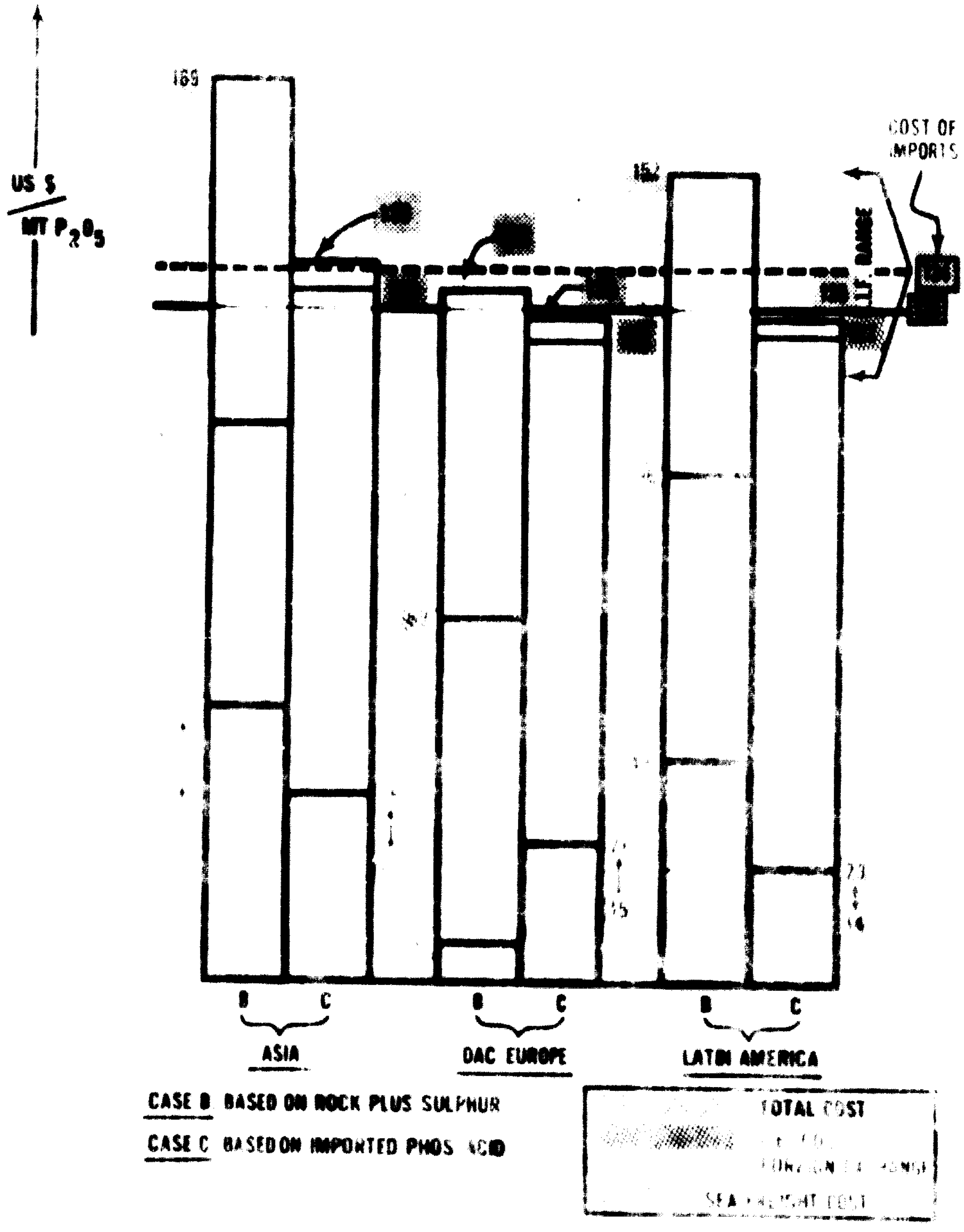

FIGURE 11: COST OF IMPORTING VERSUS LOCAL PRODUCTION OF PHOSPHATIC FERTILIZERS IN LDC, AND IMPORTANCE OF SEA FREIGHT COST

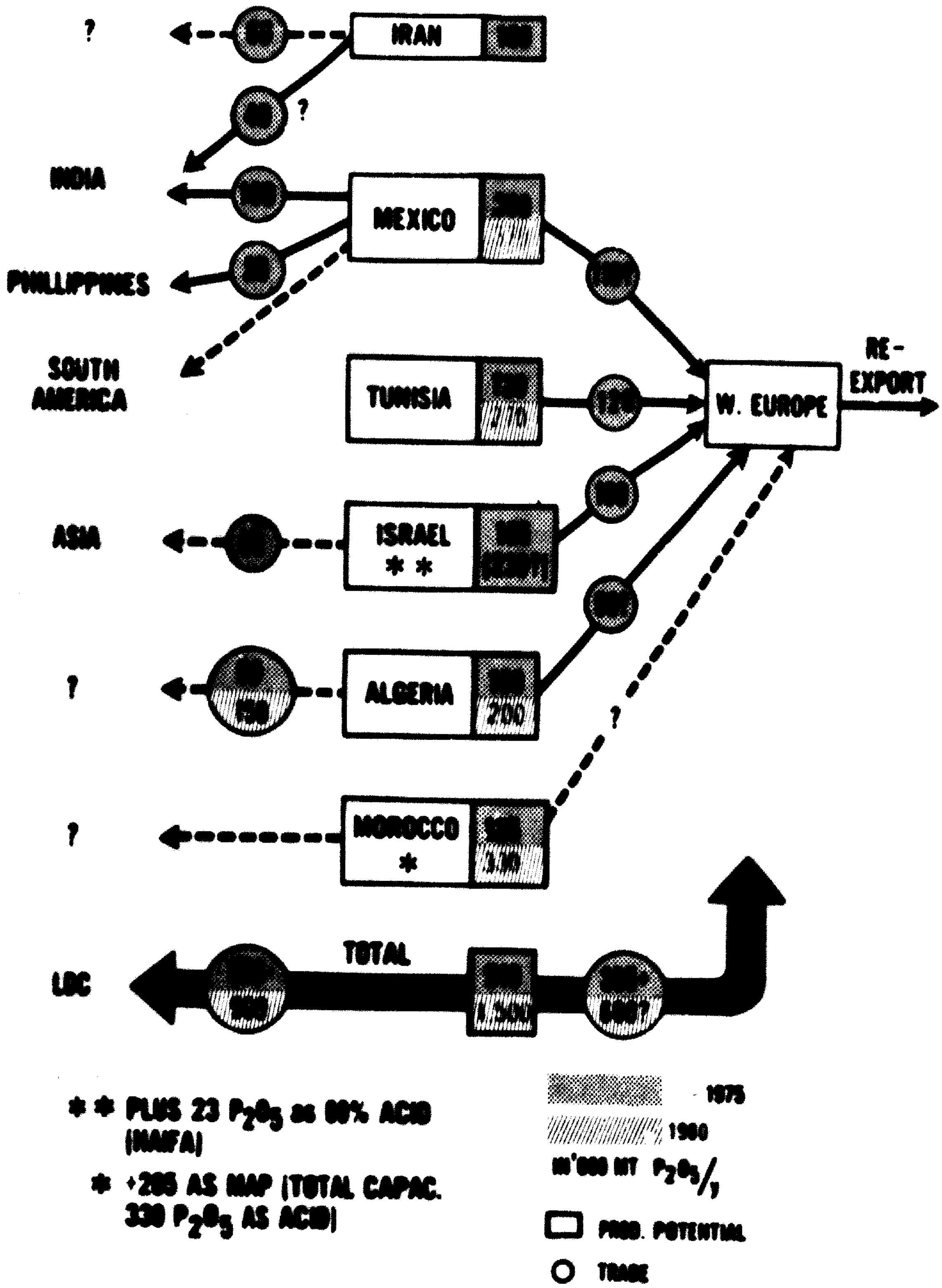

FIGURE 15: PHOSPHORIC ACID TRADE FORECAST

1975 AND 1980

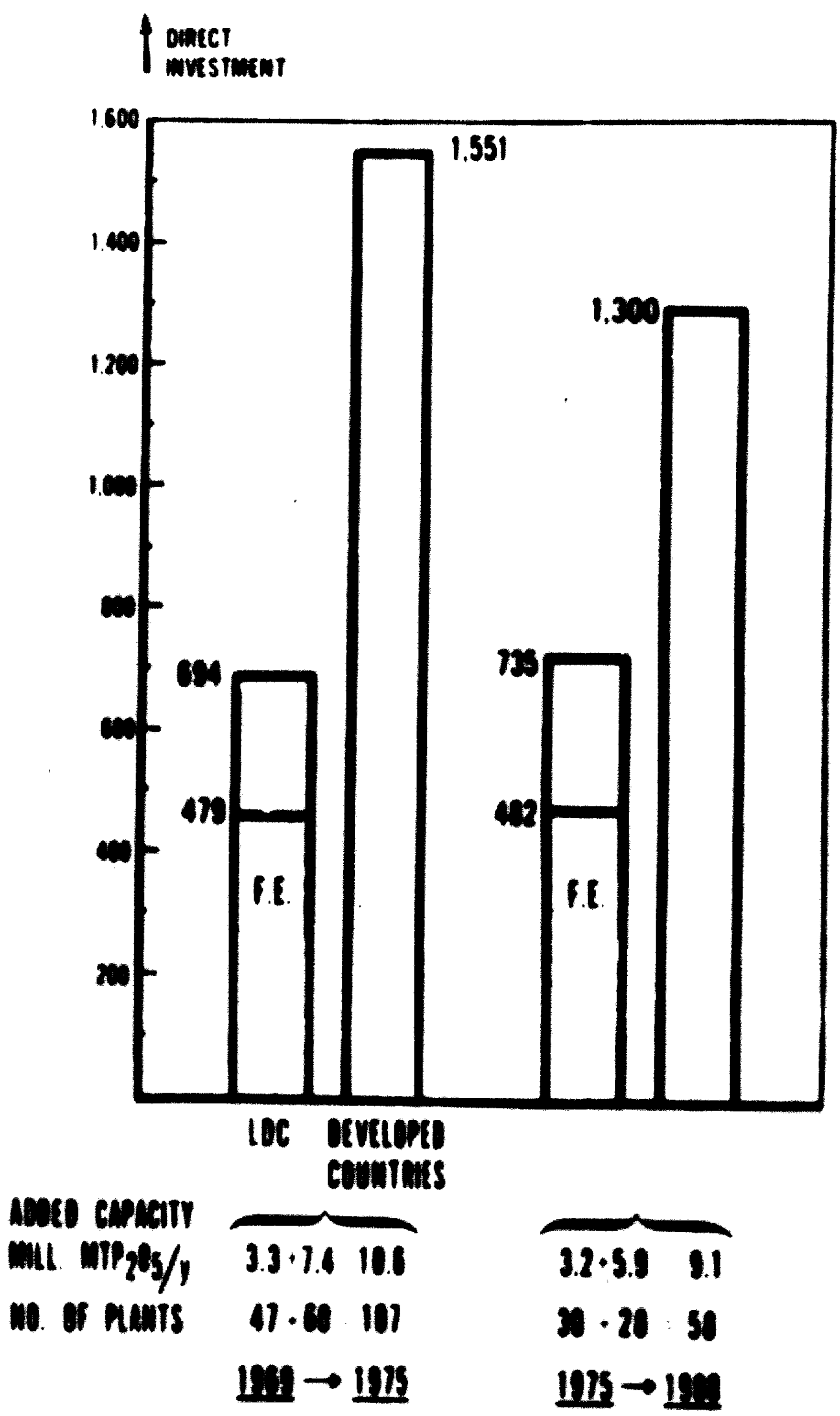

FIGURE 16: DIRECT INVESTMENT COST IN PHOSPHATIC FERTILIZER INDUSTRY

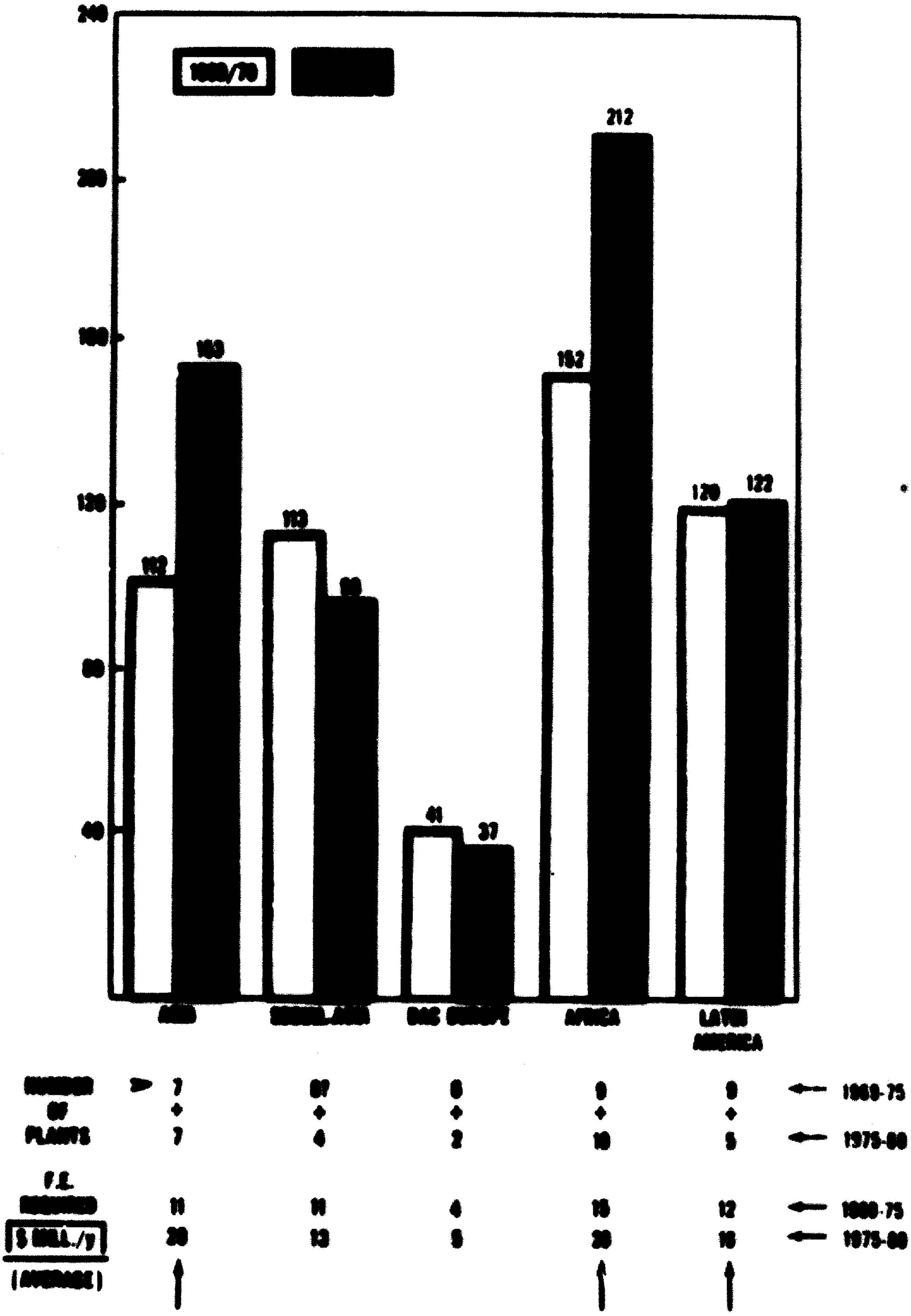

FIGURE 17: REGIONAL DISTRIBUTION OF EXPECTED INVESTMENT IN PHOSPHATIC FERTILIZER PLANTS

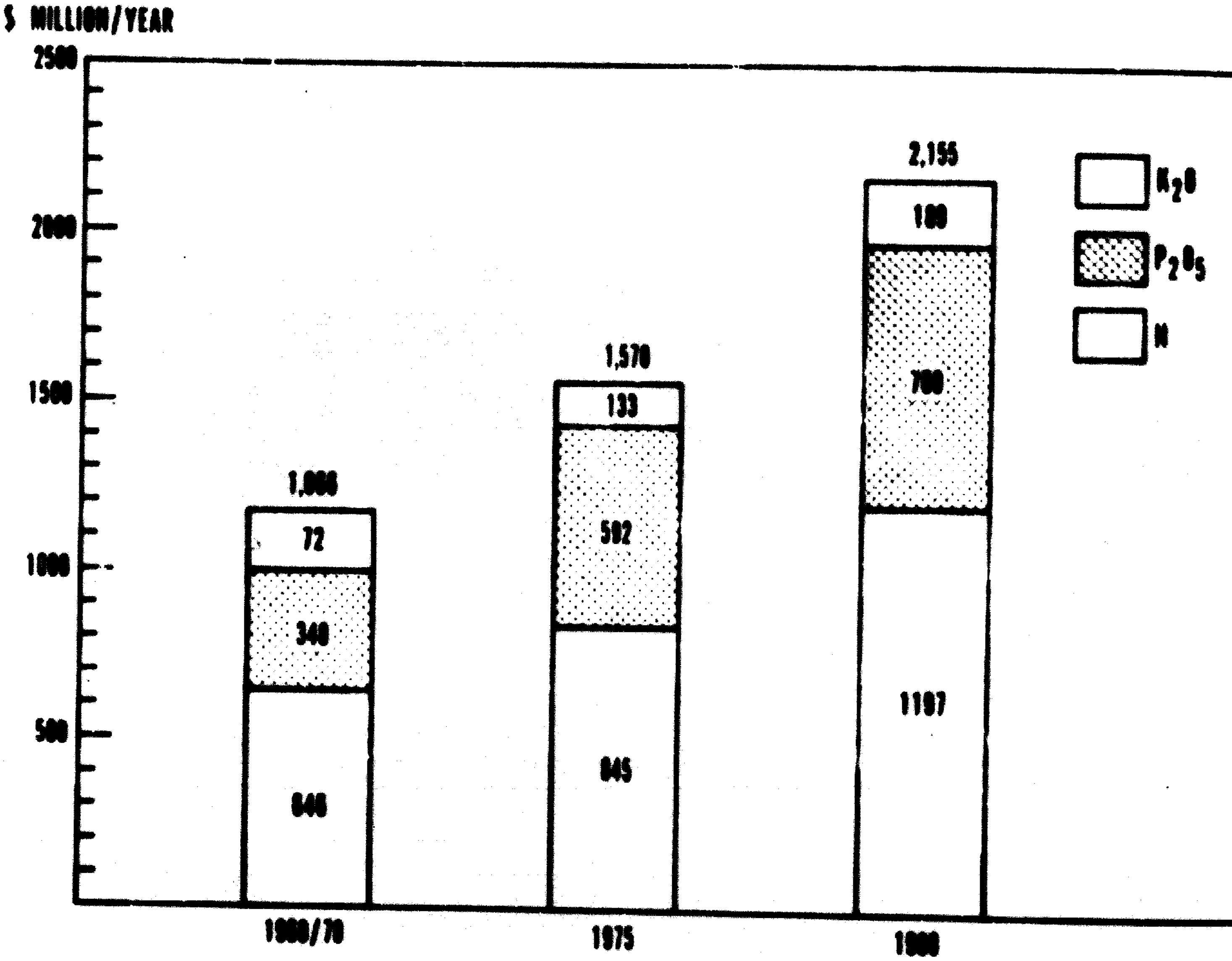

FIGURE 18: FINISHED FERTILIZER AND FEEDSTOCK IMPORTS

FORECASTED TOTAL C.I.F VALUE

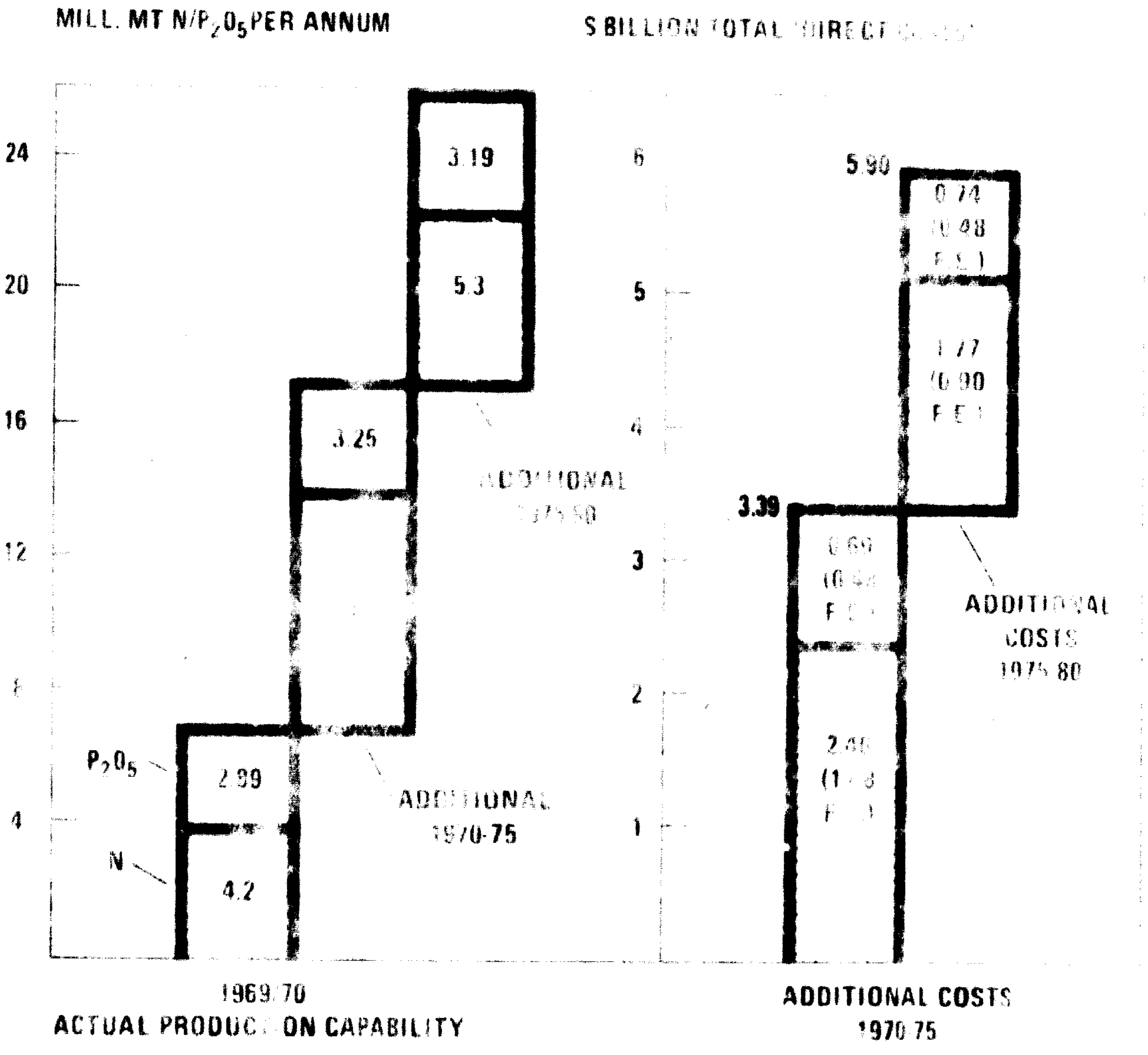

FIGURE 19: OVERVIEW: ADDED PRODUCTION CAPABILITY FOR N AND P_2O_5 FERTILIZERS IN LDC UP TO 1980/81 AND DIRECT COSTS OF ITS IMPLEMENTATION

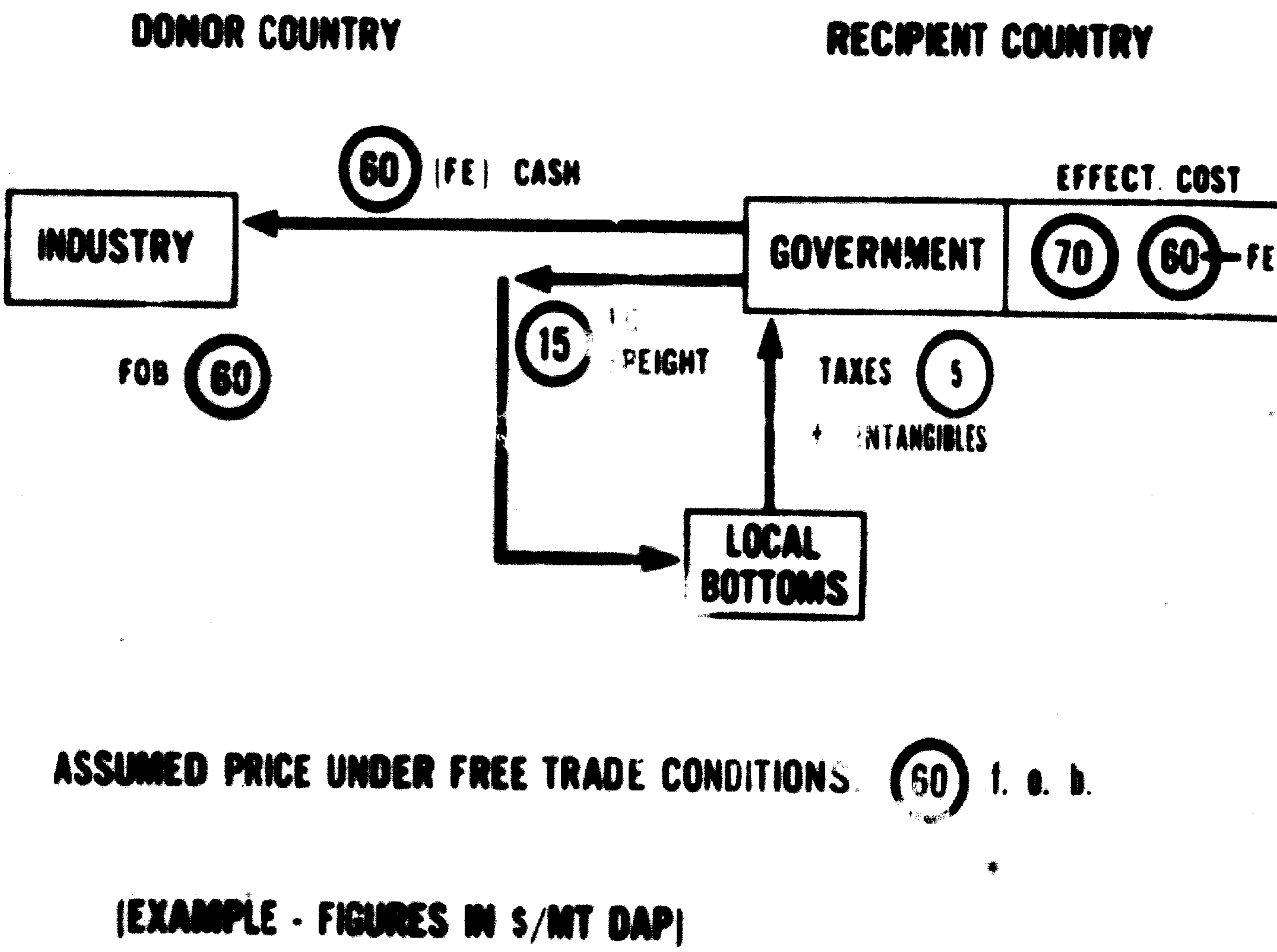

FIGURE 20: NO AID-CASH PAYMENT CLEARING

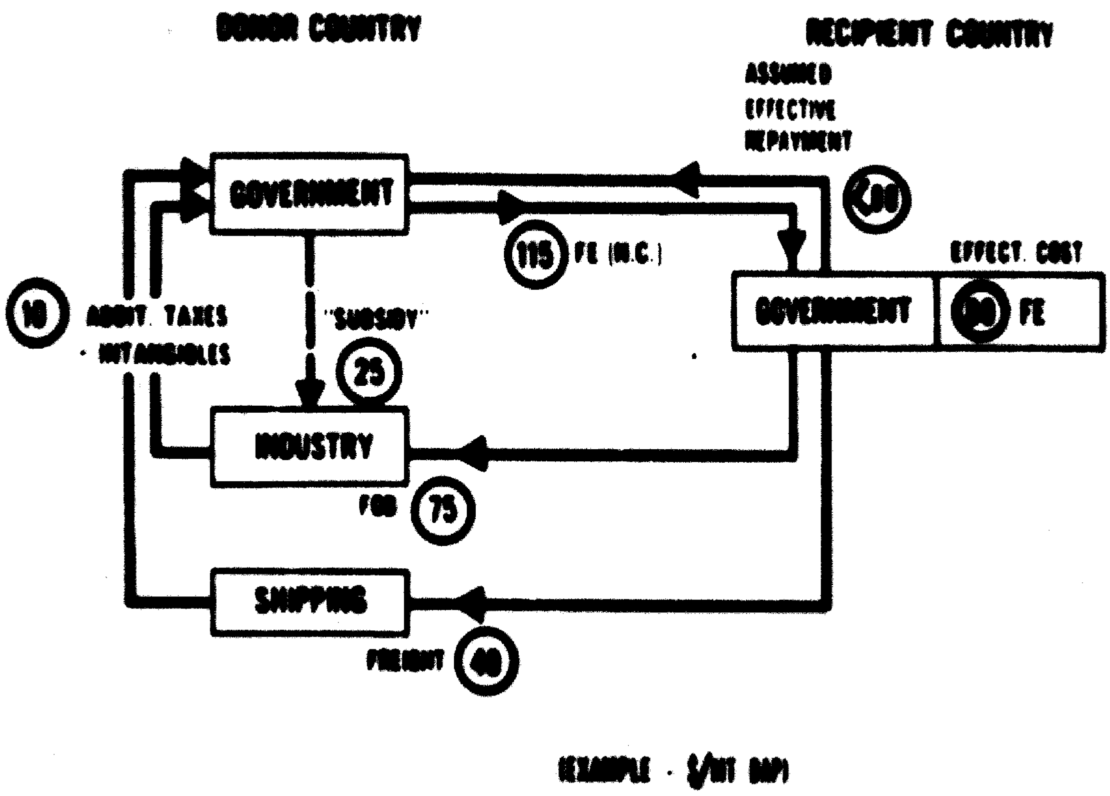

FIGURE 21: TIED BILATERAL AID-NON CONVERTIBLE FUNDS, CONCESSIONAL TERMS

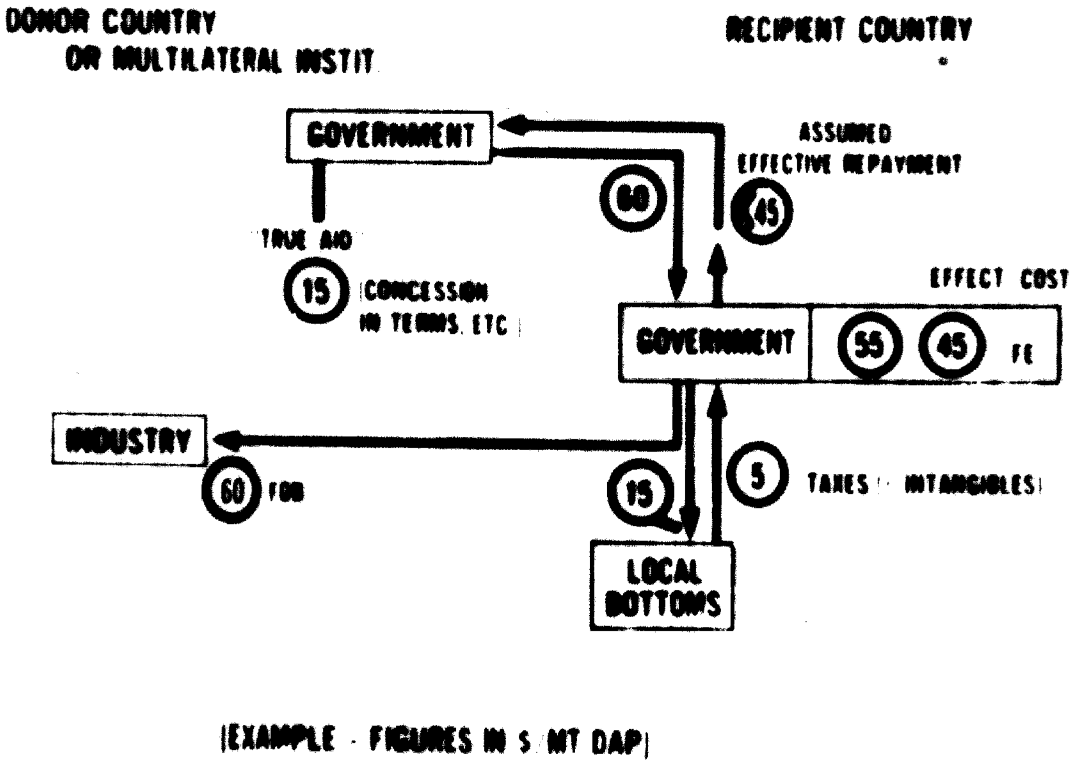

FIGURE 22: UNTIED AID-CONVERTIBLE FUNDS, CONCESSIONAL TERMS

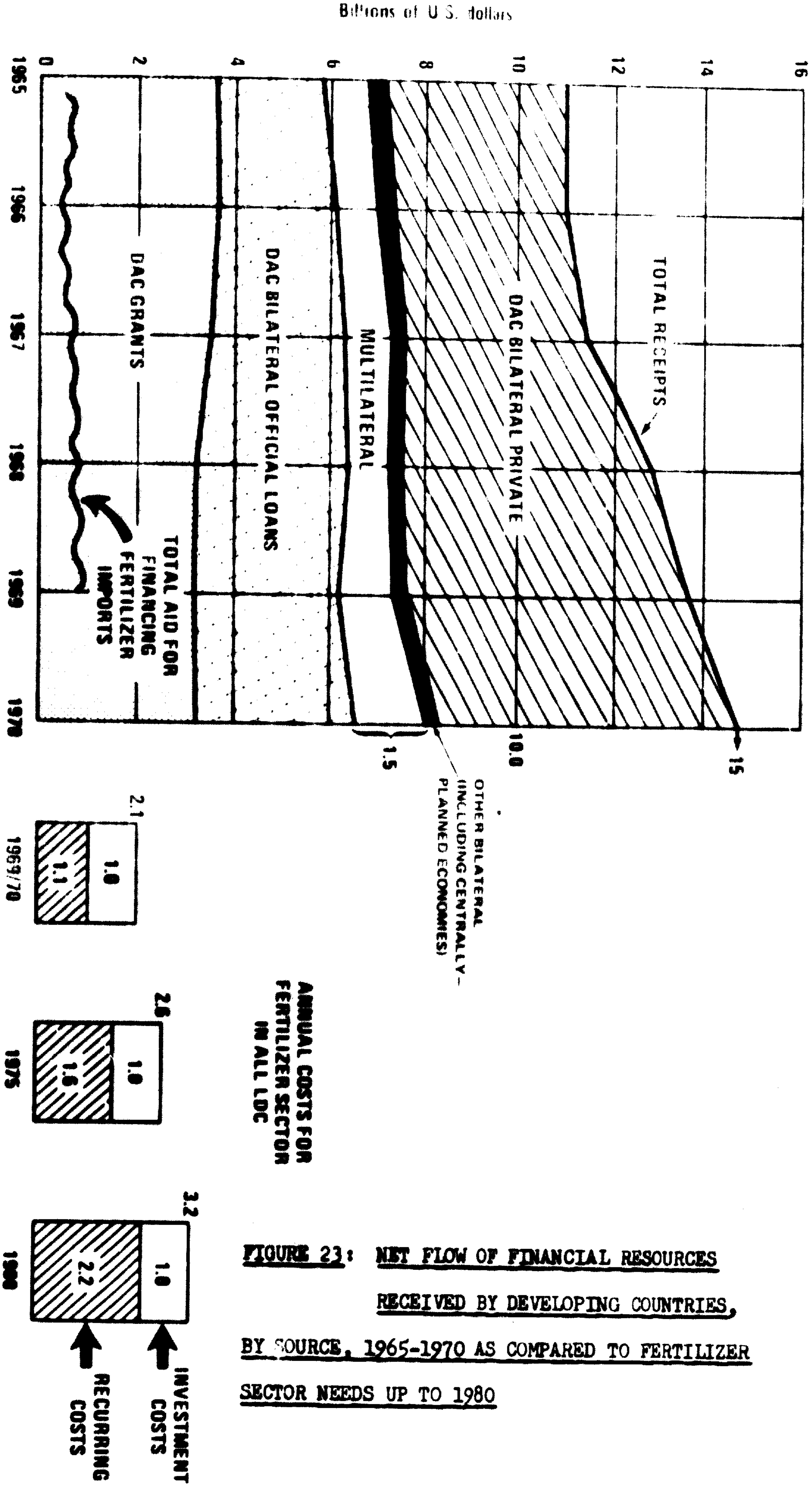

FIGURE 23: NET FLOW OF FINANCIAL RESOURCES RECEIVED BY DEVELOPING COUNTRIES, BY SOURCE, 1965-1970 AS COMPARED TO FERTILIZER SECTOR NEEDS UP TO 1980

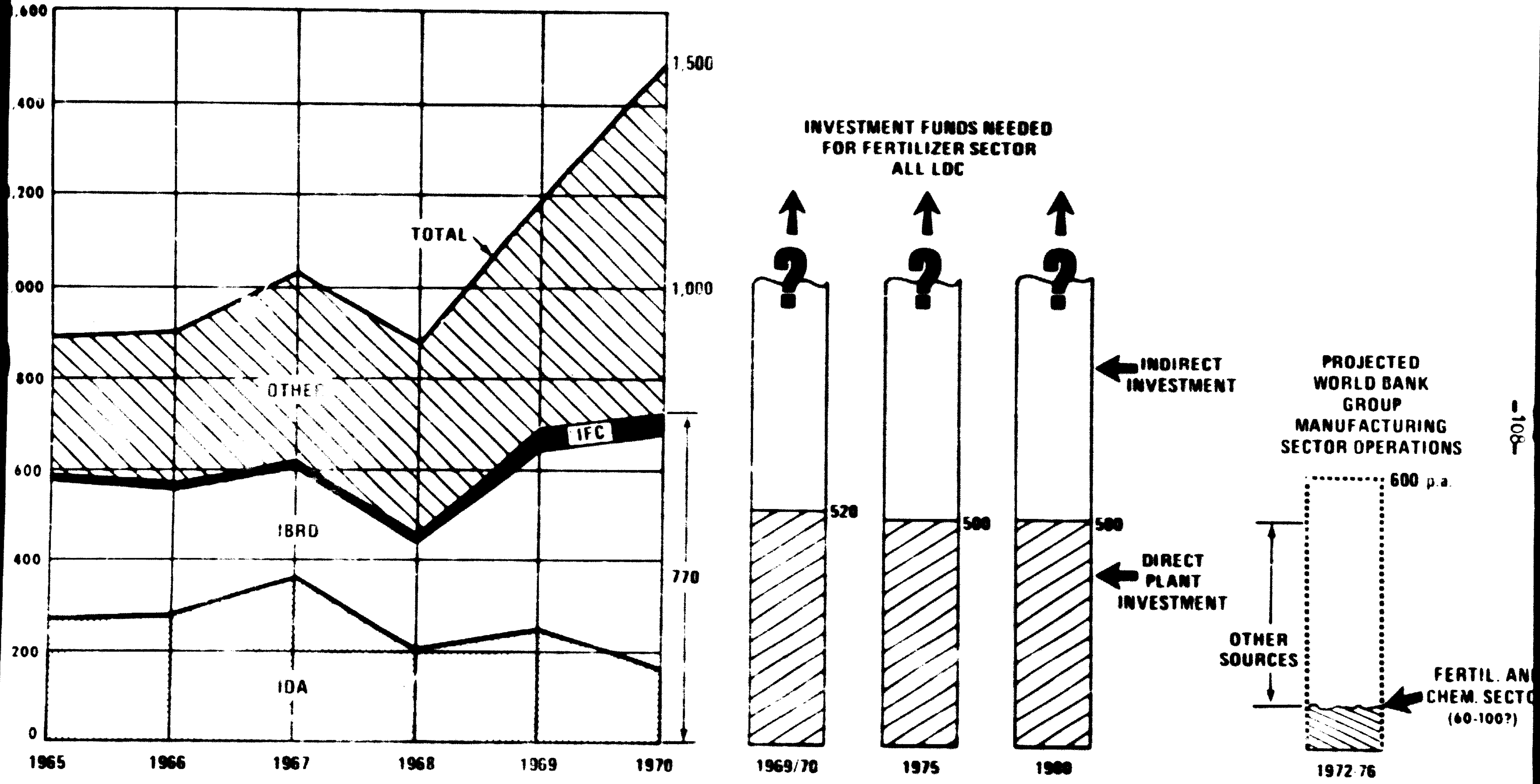

FIGURE 24: **NET FLOW OF FINANCIAL RESOURCES FROM MULTILATERAL AGENCIES TO DEVELOPING COUNTRIES, 1965-1970, AS COMPARED TO FERTILIZER SECTOR NEEDS ... 1980**

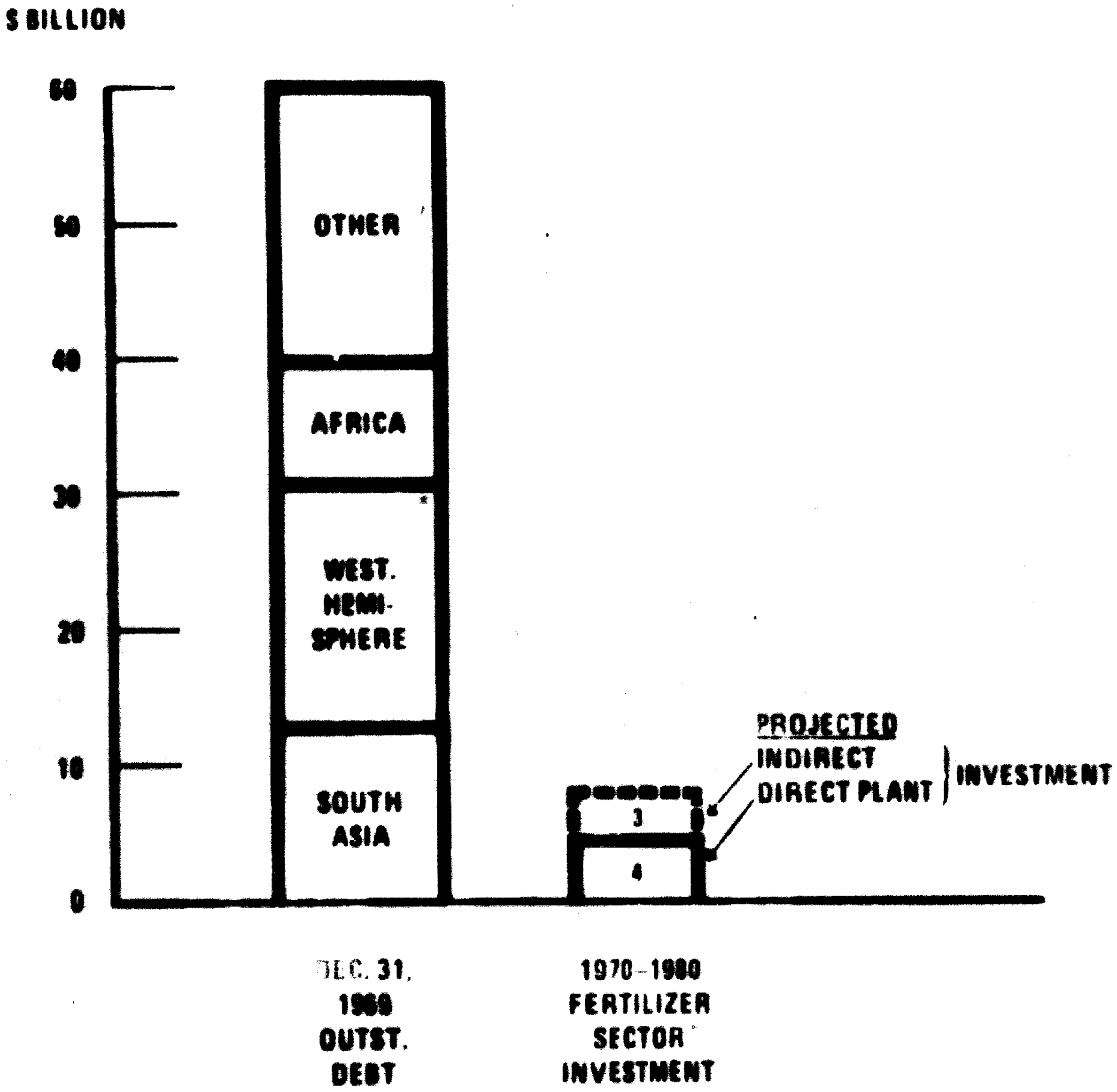

FIGURE 25: EXTERNAL PUBLIC DEBT OUTSTANDING OF 80 LDC, AS COMPARED TO PROJECTED F.E. INVESTMENT IN FERTILIZER SECTOR

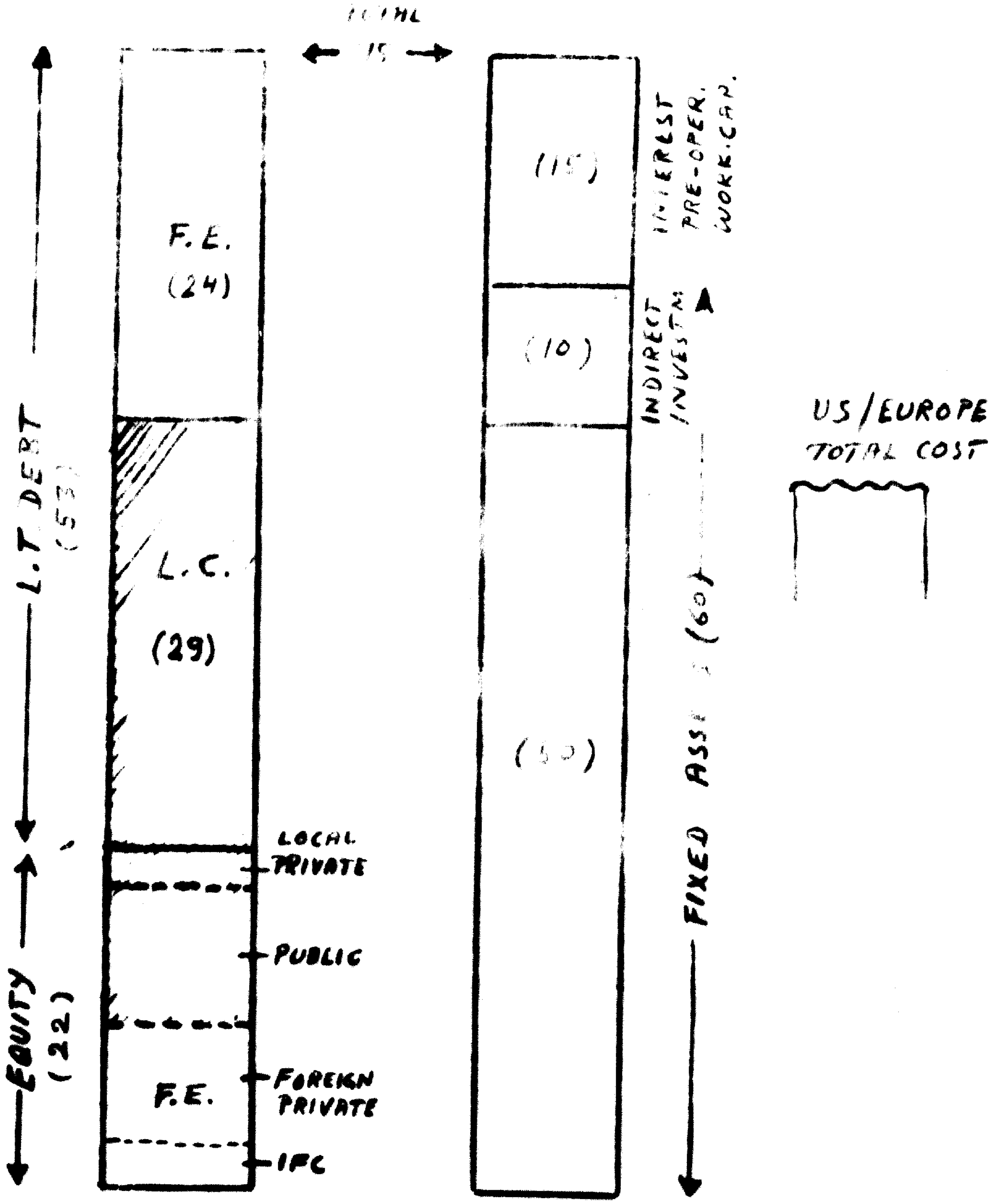

FIG. 26: FINANCING OF A PRIVATE FERTILIZER PROJECT

FIGURES IN $MILLION

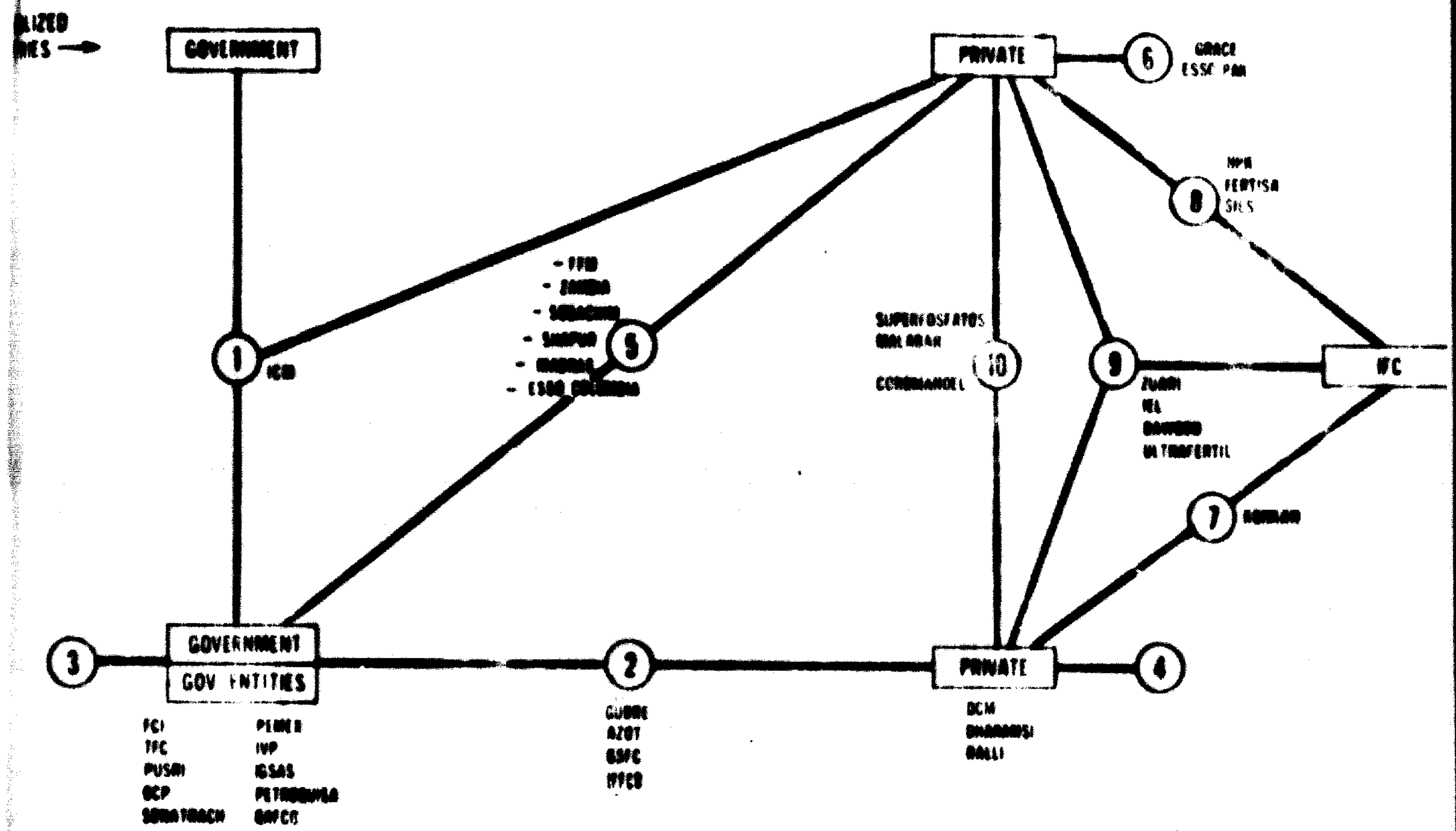

FIGURE 27: OWNERSHIP STRUCTURE OF FERTILIZER INDUSTRY IN LDC

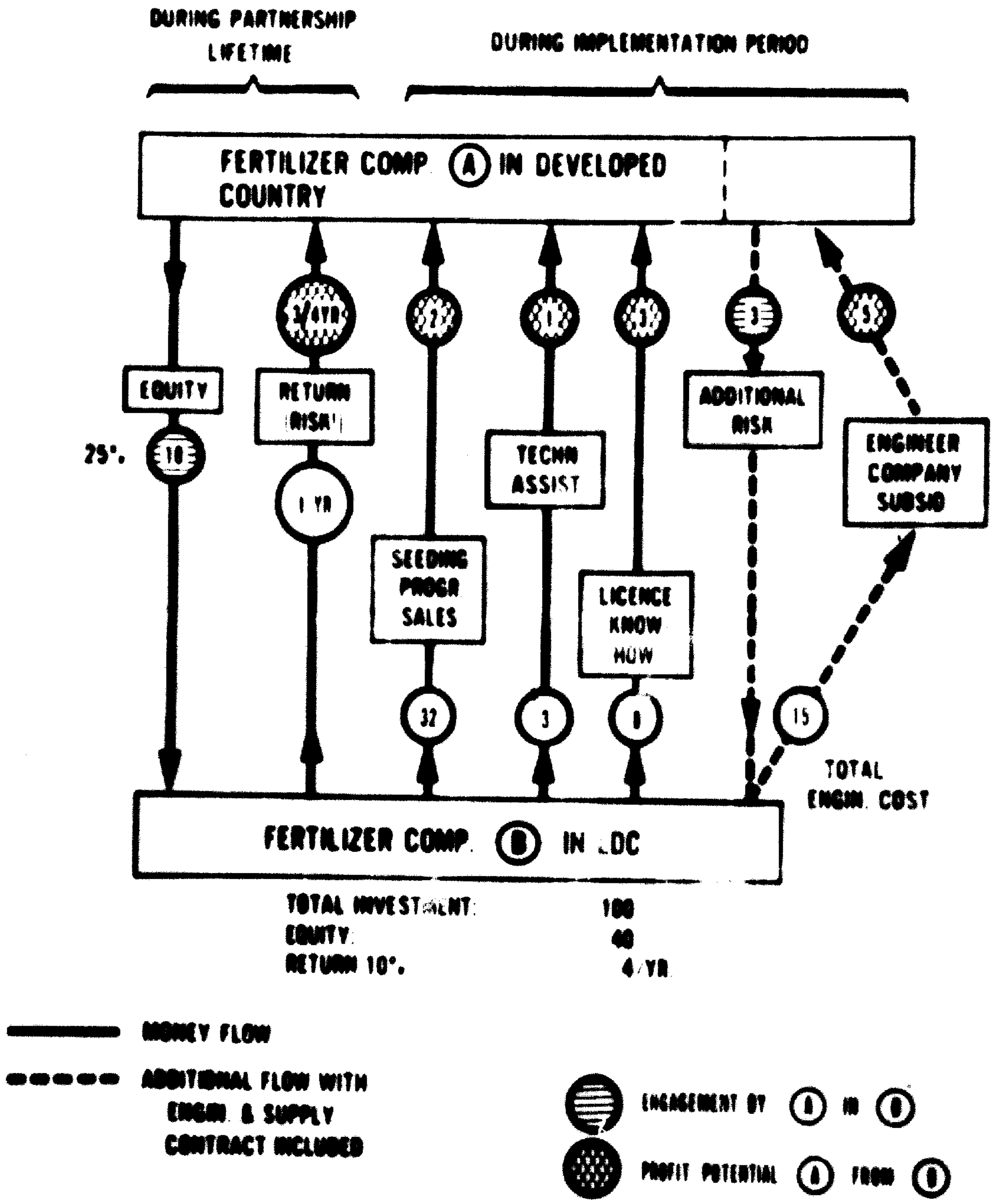

FIGURE 28: PARTNERSHIP ISSUES BETWEEN FERTILIZER COMPANIES IN DEVELOPED & DEVELOPING COUNTRIES

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