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Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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SUPPLEMENT

TO THE SECOND WORLD-WIDE STUDY ON THE FERTILIZER INDUSTRY: 1975-2000 *

Prepared by the
Sectoral Studies Section
International Centre for Industrial Studies

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Notes:

A slash between dates (e.g.,1977/78) indicates a crop year.
The use of a hyphen between dates (e.g., 1975-1980) indicates the full period included, including the beginning and end years.

INTRODUCTION

The participants at the Second Consultation Meeting on the Fertilizer Industry, held at Innsbruck, Austria from 6 to 10 November 1978, requested that the "Second World-Wide Study on the Fertilizer Industry: 1975-2000" be updated. In discussing the second study, the participants concentrated mainly on the medium- and long-term forecasts of the demand for fertilizers up to 2000. Some participants felt that such forecasts were not reliable and therefore should be used with caution. It was suggested that different methods to estimate the future fertilizer needs of developing countries be used in the third study on the fertilizer industry, rather than employing projections of demand based on the past and present inadequate levels of consumption. In projecting demand, it was felt that attention should be paid to successful experiences in increasing fertilizer consumption and appraisals of additional sources of plant nutrients.

Taking the above into consideration and the relative proximity of the Third Consultation Meeting on the Fertilizer Industry scheduled for late September 1980 in Sao Paulo, Brazil, it was deemed appropriate to prepare a supplement to the second study at this stage for presentation to the Third Consultation Meeting. This supplement concentrates on the three main nutrients, nitrogen, phosphate and potash; they are analysed at world and regional levels according to the country classification employed by the Food and Agriculture Organization of the United Nations (FAO). The supplement is comprised of an updated descriptive analysis of the current situation between 1978 and 1980, based mainly on FAO sources; a descriptive analysis of the medium-term outlook, based on the latest forecasts from the UNIDO/FAO/World Bank Working Group on Fertilizers; revised long-term projections to the year 2000; and an analysis of plant-capacity implementation.

I. THE CURRENT SITUATION IN THE FERTILIZER INDUSTRY

The aim of this chapter is to present the highlights of the current situation in the fertilizer industry. Two years have elapsed since the "Second World-Wide Study on the Fertilizer Industry: 1975-200" was issued in September 1978. In the main, the factors and trends analysed in the second study remain valid; only the intensity of some varied, such as the increased cost of raw materials, higher plan investment and fluctuating international prices of fertilizers.

A. World consumption of fertilizers

World total consumption of the three main nutrients, nitrogen, phosphate and potash, in 1978/79, according to FAO's latest figures, grew to 106.7 million tons or 7.8 per cent over the previous year. This marked the first real market recovery since the 1974/75 slump, with a growth rate above the 5.9 per cent historical average for 1970-1976.

Preliminary figures for 1979/80 show a nutrient growth of 111.3 million tons or 4.3 per cent over the preceding year. Therefore, 1978/79 stands out as the only good fertilizer year between 1975 and 1980. The The primary cause for this performance were events in the developed countries, mainly in the United States of America, that accounted for about 40 per cent of the variations. Bad weather in the United States and the Union of Soviet Socialist Republics during the crop years 1977/78 and 1979/80, respectively, was responsible for drops in the agricultural output, whereas 1978/79 was a good crop year for the developed countries. However, the developing countries' consumption increased to more than twice the world's growth rate until the crop year 1977/78 and then experienced a very substantial drop to about one half of its previous growth rate in the following two years. Most developing countries either stagnated or had small growth rates, with the exception of the Asian centrally planned economies and the Far East which grew to 17.8 and 13.3 per cent, respectively, in the crop year 1978/79.

The main reasons for the slower growth in consumption within the developing countries were the following: foreign exchange restrictions,

reduced fertilizer supplies due to the scarcity of raw materials, relatively higher prices due to increased production and distribution costs that taxed several government subsidy programmes, less favourable crop-fertilizer price relationships, and a temporary technical incapacity to deliver certain fertilizers and raw materials.

The regional situation of developing countries during the past two years is described, in brief, below:

Africa had a slow growth rate that nearly approached a steady condition, thus reflecting the less favourable economic and foreign exchange situation in this region.

Latin America had a low performance rate in 1978/79, with mixed results in 1979/80. Brazil's marked slowdown in its growth rate and Mexico's stagnant fertilizer demand in 1978/79 played the main role in creating this region's problems.

The Near East experienced a slow growth rate in nitrogenous and potassic fertilizers and a virtual stagnation in phosphate consumption. Turkey's severe economic and foreign exchange problems, which resulted in substantial shortages in fertilizer and fuel supplies, were mainly responsible for the limited performance of this region.

The Far East maintained twice the world's average growth rate during the past two years. The main countries that contributed to this region's performance were India, with around a 25 per cent growth rate in 1978/79 and about 7 per cent in 1979/80 despite the severe drought which affected the country; Indonesia, which had a higher nitrogen consumption caused by the increased use of rice crops; and the Republic of Korea, which presently is slackening consumption due to the translation of higher oil prices into higher fertilizer costs. In general, Asian countries in certain areas seem to be approaching some nutrient saturation ratios, especially with respect to phosphates.

Asian centrally planned countries had even a better performance as a region than the Far East due mainly to the increased agricultural output of the People's Republic of China, despite fertilizer supply problems stemming from the temporary scarcity of raw materials. Currently China's policy is to balance its nitrogen-phosphate-potash (N-P-K) ratios by giving more priority to phosphatic fertilizers than nitrogenous fertilizers. However, China's official consumption figures, released for the first time in late April 1980, do not match those of FAO, mainly

in nitrogen and potash. This situation will be clarified next March at FAO's annual statistical review meeting.

Nevertheless, fertilizer consumption in developing countries still lags far behind consumption in developed countries, both on a per hectare and per capita basis. In 1978/79 the nutrient consumption per hectare in developed countries was 115.2 kg, whereas developing countries consumed 39.3 kg. However, if the Asian centrally planned economies region is discounted since China's figures are being revised, the consumption of developing countries with market economies will shrink to 29.5 kg per hectare.

The developing countries' share in world N-P-K consumption was 23.5 per cent in 1976/77, 26.5 per cent in 1977/78 and 27.4 per cent in 1978/79.

The evolution of fertilizer consumption by region, based on FAO's data up to 1978/79, is given in annexes I(A), (B) and (C) for nitrogenous, phosphatic and potassic fertilizers, respectively. It is shown that in 1978/79, world nitrogenous fertilizer consumption increased by 7.7 per cent to 51.4 million tons of N, phosphatic fertilizer by 8.3 per cent to 30.5 millions tons P_2O_5, and potassic fertilizer by 7.2 per cent to 24.8 million tons K_2O. The corresponding market share of developing countries was 34.8 per cent for N, 25.2 per cent for P_2O_5, and 14.5 per cent for K_2O.

B. World production of fertilizers

1. Evolution of the fertilizer industry since 1977/78

World production of N-P-K fertilizers, according to FAO's most recent data, grew to 112.8 million tons in 1978/79, up 7.3 per cent over 1977/78. However, the corresponding world supply available for strict fertilizer application—discounting losses and technical uses—was 106.4 million tons. This is the highest annual growth rate achieved since 1975/76, when production slackened due to the stock that resulted from apprehensive buying carried out the previous year. The main cause for this performance in quantitative terms was the dynamic recovery of the developed market economies region, which represented 52.6 per cent of the increase in 1978/79, followed by both of the centrally planned economies regions.

The developing countries recorded some decline in their growth rate over 1977/78, mainly due to a quantitative fall in potash. However, if the good performance of the Asian centrally planned economies region were discounted, the remaining developing market economies regions suffered a larger decline stemming from a substantial drop in their phosphate production growth rate—6.7 per cent in 1978/79, down from 19 per cent in the previous two years due to a fall in the Near East—and the closure of the potash mine in the Congo, which produced around 90 per cent of the output of this group of regions.

The developing countries' share of the world production of nutrients was 17.5 per cent in 1978/79. Annex V gives the production of the main nutrients by region. Annexes VI(A), (B) and (C) show the plant capacity developments and production self-sufficiency by nutrient and by region.

(a) Nitrogen

World production of nitrogenous fertilizers grew to 53.8 million tons of N in 1978/79, up 8.9 per cent over the previous year, of which 51.6 million tons were available for agriculture. This increase was the largest in the past five years. The largest quantitative increases came from the developed market economies region—chiefly Western Europe and then North America—that accounted for 40 per cent of the world increase of 4.4 million tons, followed by Asian centrally planned economies with 26.5 per cent.

In the developing market economies region, production in Africa and Latin America increased by 7 per cent, quite below the world average for 1978/79, whereas production in the Near East and the Far East was over 16 per cent.

There were significant problems in several countries. The USSR suffered major setbacks in 1979 due to a severe winter that buckled pipelines and caused interruptions in the natural gas supplies. Further compounding the problems were the cutoff of gas supplies from Iran, thereby forcing gas diversion from other fields, and other temporary technical and logistical difficulties. India had to reduce production due to the lack of feedstock and power, despite the commissioning of several new plants, and it is estimated that the lack of feedstock may force a production cutback equivalent to one third of the domestic demand in 1980. Similar feedstock problems are besetting Turkey and

the Philippines, whereas the Republic of Korea will reduce production in 1980 due to slackening domestic consumption and ever-growing oil prices.

The brighter spots were as follows: Mexico is about to achieve self-sufficiency in ammonia, several idling plants in Western Europe and the United States are coming back on stream as a result of increased fertilizer prices and there is greater production in Indonesia, Iraq and Kuwait.

(b) Phosphate

World production of phosphatic fertilizers grew to 32.5 million tons of P_2O_5 during 1978/79, an increase of 8.3 per cent over the preceding year, of which 30.8 tons were available for agriculture. This growth rate marked a major improvement over that of the preceding five years. As in the case of nitrogen, the developed market economies region was the major quantitative contributor—especially the United States—accounting for 56.5 per cent of the 2.48 million ton increase in world production in 1978/79. The two centrally planned economies regions were the next largest contributors, with about 17 per cent each.

In the developing market economies regions, the Far East increased production during 1978/79 by 23 per cent and Africa followed in magnitude with 17 per cent. However, both Latin America and the Near East suffered an absolute decline due to shortfalls in Mexico and Turkey, respectively, during 1977/78.

The main problems were as follows: The USSR suffered from a severe winter, shortages in sulphur and other temporary technical and logistical difficulties. In general, the available supply to sulphur was tight. In late 1979, the spot market in sulphur almost disappeared as a result of bad weather, accidents and other problems, thereby effectively limiting the phosphate fertilizer output in the larger producing countries. However, this situation is easing up because additional sulphur production is coming on stream in Poland, the USSR, Mexico and Iraq.

An additional problem is created by the decreasing quality of phosphate rock, the effects of which on plant efficiency may require either major de-bottlenecking or new plants that are specifically designed to process lower grade, higher impurity rocks.

The brighter spots are as follows: Mexico is making major invest-

ments in order to achieve production self-sufficiency in a short time. A de-bottlenecking programme is being carried out in the United States in order to accommodate lower grade rocks without affecting the efficiency of plants. India, the Republic of Korea, Brazil, Morocco and Tunisia are enjoying greater production.

(c) Potash

The world production of potassic fertilizers increased to 26.5 million tons of K_2O during 1978/79, but only 2.9 per cent over the preceding year, of which 24.1 million tons were available for agriculture. This growth rate, although a bit higher than the preceding year, was nevertheless lower than that of the prior five years.

The production of potash stems entirely from the developed countries. There are two developing countries that produce potash, namely China and Chile, but their contribution is negligible. The Congo had been the third developing country producing potash, but it closed its potash mine in 1976.

There were several troublesome spots. The USSR experienced a period of bad weather and technical and logistical problems that contrived to slightly reduce absolute output from 1978 to 1980. Canada declared force majeure late in 1979 due to a railway strike and delays in repairing a major bridge in Vancouver, which is the main exit of Canadian potash. Nevertheless, the situation is now back to normal.

The above-mentioned events, as in the case of sulphur, led to the virtual disappearance of the spot market in potash late in 1979 because there was a lack of supply in excess of that reserved for contractual arrangements.

2. Production costs of fertilizers

The second study on the fertilizer industry pointed out the importance of inflation and the location of a plant. They are the main determinants of fertilizer production costs, along with the more conventional factors of product, process and plant size.

Since generalized cost estimates are not likely to be useful, it is essential to compare the conditions and assumptions of at least three types of locations for each product. The first type of location is a site with a fully supporting infrastructure, which normally

occurs in developed countries and in some areas of the more advanced developing countries. The second type is a site with some infrastructure, but it is necessary to provide additional facilities. The third type is a remote location without any infrastructure. The latter two types of locations usually occur in developing countries. Since 1977 the World Bank has been presenting a series of papers on investment and production costs for fertilizers to the FAO Commission on Fertilizers that are based on surveys of projects under implementation around the world. The latest paper, presented in June 1980, gives a picture of the mid-1980 investment and production costs for new plants, giving figures for the main fertilizers in the three types of locations defined above. However, its direct comparison with the second study's production costs, which are based on prices and costs prevailing in 1977, albeit with an inflation factor of 15 per cent through 1980, is likely to be tricky. Serious inflationary pressures and large relative currency changes with respect to the US dollar have made a revision of the cost data in the study difficult.

(a) Nitrogen

In 1979 about 70 per cent of the world's ammonia capacity was based on natural gas, 15 per cent on naphtha, 10 per cent on fuel oil and 5 per cent on coal. However, the oil-price disarray of 1979/80 resulted resulted in disproportionate increases of oil spot prices and, consequently on naphtha and fuel oil prices. This meant that plants based on the two latter feedstocks, mainly in the developed countries of market economies, were no longer competitive. Although some countries, such as India, are endeavouring to use more coal as feedstock, a comparison of prices for ammonia feedstocks indicates that it is favourable to use even more natural gas than naphtha, fuel oil and coal. Figure 1, page 68, of the second study highlights these differences. The representative nitrogenous fertilizer is the gas-based ammonia-urea complex of 1,000 tons per day (t.p.d.) of ammonia and 1,650 t.p.d. urea. Table 1 gives the production cost structure for this complex in the three locations. From this table it can be seen that capital charges, i.e., depreciation, interest and return on investment, are the dominant production component. Therefore, the optimization of plant utilization is essential to maximize profits. In developing countries, lower plant

TABLE 1. ESTIMATED INVESTMENT AND PRODUCTION COSTS FOR UREA
(1980 US$/Metric Ton)

Basis : 1,650 tpd bagged product/1,000 tpd ammonia
Capacity Utilization: 90%
Capacity : 330 days/year
544,500 tons urea/year
Production : 490,050 tons/year

Site	Developed Site	Developed Site	Developing Site (Some Existing Infrastructure)	Developing Site (Remote Location)
Plant Investment US$	US$205 Million	US$205 Million	US$280 Million	US$375 Million
Working Capital US$	US$ 15 Million	US$ 15 Million	US$ 20 Million	US$ 25 Million
Total Investment US$	US$220 Million	US$220 Million	US$300 Million	US$400 Million
Raw Materials	Gas @ $3.0/Mscft	Gas @ $4.5/Mscft	Gas @ $1.5/Mscft	Gas @ $0.8/Mscft
Natural Gas including Fuel and Gas for Steam and Power Generation	105.00	157.50	52.50	28.00
Other Variable Costs US$/Ton	16.00	16.00	16.00	16.00
Fixed Costs US$/Ton	64.09	64.09	82.45	105.72
Production Costs US$/Ton	185.09	237.59	150.95	149.72
Capital Charge (15%) US$/Ton	67.34	67.34	91.83	122.44
Realization Price US$/Ton (ex-factory)	252.43	304.93	242.78	272.16

operation rates outweigh the benefits of cheaper feedstocks and economies of scale.

(b) Phosphate

Currently about 60 per cent of the world's phosphatic fertilizer supply comes from phosphoric acid that is derived from phosphate rock. The representative phosphate fertilizer is the phosphoric acid-diammonium phosphate-triple superphosphate (DAP-TSP) complex of 1,000 t.p.d. phosphoric acid plus a corresponding sulphuric acid plant and a 1,200 t.p.d. granulation plant for DAP or TSP. Generally, granulation plants that make TSP can also make DAP with some additional equipment. Tables 2(a) and 2(b) give the production cost structure of phosphoric acid and DAP plants. The tables show that raw materials account for 60 to 70 per cent of the realization price and 80 per cent for the production costs. This means that access to low-priced raw materials, especially near a rock mine, is the main competitive factor, whereas economies of scale through larger plant sizes are rather marginal.

(c) Potash

Information on potash investment and production costs customarily has been difficult to obtain. The development of large Canadian potash deposits, where conditions are more uniform, has resulted in the availability of more reliable cost data on potash. Canada is generally acknowledged to have the world's lowest potash production costs due to their rich potash seams and the fact that they possess the world's largest and most modern concentration of potash-production capacity.

The representative potash fertilizer is potassium chloride. Table 3 gives the production cost structure for a mine in Canada and a mine in New Mexico in the United States. Each facility comprises underground dry mining and a conventional flotation process to produce fertilizer-grade material. Of the other major producer, the USSR, little is known of its potash mining economies. Consequently, it is assumed that Canada's production costs will be the industry's bellwether.

3. Organic materials

The second study presented an overview of organic materials, such as a complement to chemical fertilizers, its effects on soil fertility and plant nutrition, its evolution in developing countries and the esti-

TABLE 2(a). ESTIMATED INVESTMENT AND PRODUCTION COSTS FOR PHOSPHORIC ACID

(1980 US$/Metric Ton)

Basis : 1,000 tpd (100% P_2O_5)
Capacity Utilization: 90%
Capacity : 330 days/year
330,000 tons/year P_2O_5
Production : 297,000 tons/year

Site	Developed Site	Developing Site (Some Existing Infrastructure)	Developing Site (Remote Location)
Plant Investment US$	US$130 Million	US$200 Million	US$270 Million
Working Capital US$	US$ 17 Million	US$ 18 Million	US$ 21 Million
Total Investment US$	US$147 Million	US$218 Million	US$291 Million
Raw Materials US$/Ton			
Rock Phosphate (3.352 tons at $35/ton)	117.32	117.32	117.32
Sulphur (0.976 tons at $100/ton)	97.60	97.60	97.60
Other Variable Costs US$/Ton	18.00	18.00	18.00
Fixed Costs US$/Ton	58.63	86.92	115.20
Production Costs US$/Ton	291.55	319.84	348.12
Capital Charge (15%) US$/Ton	74.22	110.10	146.97
Realization Price US$/Ton (ex-factory)	365.77	429.94	495.09

For each $1.00/ton increase in rock costs, production costs increase by $3.35/ton P_2O_5.
For each $1.00/ton increase in sulphur costs, production costs increase by $0.98/ton P_2O_5.

TABLE 2(b). ESTIMATED INVESTMENT AND PRODUCTION COSTS FOR DIAMMONIUM PHOSPHATE
(1980 US$/Metric Ton)

Basis : 1,200 tpd bulk product (18-46-0)
Capacity Utilization: 90%
Capacity : 330 days/year
396,000 tons/year DAP
Production : 356,400 tons/year DAP

Site	Developed Site		Developing Site (Some Existing Infrastructure)		Developing Site (Remote Location)	
Plant Investment US$	US$39 Million		US$45 Million		US$47 Million	
Working Capital US$	US$15 Million		US$17 Million		US$19 Million	
Total Investment US$	US$54 Million		US$62 Million		US$66 Million	
Raw Materials US$/Ton	(a)	(b)	(a)	(b)	(a)	(b)
Phosphoric Acid - 0.47 tons P_2O_5	160.29	171.91	184.82	202.07	209.67	232.69
Ammonia - 0.225 NH_3	45.00	45.00	45.00	45.00	45.00	45.00
Other Variable Costs US$/Ton	6.00	6.00	6.00	6.00	6.00	6.00
Fixed Costs US$/Ton	15.91	15.91	17.93	17.93	18.60	18.60
Production Cost US$/Ton	227.20	238.82	253.75	271.00	279.27	302.29
Capital Charge 15% US$/Ton	22.74	22.74	26.10	26.10	27.78	27.78
Realization Price US$/Ton	249.94	261.56	279.85	297.10	307.05	330.07

(a) Based on phosphate rock at $35/ton and sulphur at $100/ton and capital charge of 10%.
(b) Based on phosphate rock at $35/ton and sulphur at $100/ton and capital charge of 15%.

For each $1.00/ton increase in rock costs, production costs increase by $1.58/ton DAP.
For each $1.00/ton increase in sulphur costs, production costs increase by $0.46/ton DAP.
For each $1.00/ton increase in ammonia costs, production costs increase by $2.25/ton DAP.

TABLE 3. ESTIMATED INVESTMENT AND PRODUCTION COSTS FOR POTASH

(1980 US$)

Site	Canada	New Mexico
Capacity stpy	1,500,000	850,000
Capacity metric tpy	1,364,000	773,000
Plant Investment $	285,963,000	131,389,000
Start-up Fees	6,682,000	6,075,000
Subtotal	292,645,000	137,464,000
Contingency (10%)	29,264,000	13,746,000
Total Plant Investment	321,909,000	151,210,000
Working Capital	12,879,000	8,829,000
Total Investment	334,788,000	160,039,000

	Short Ton	Metric Ton	Short Ton	Metric Ton
Operating Cost - Mine	8.59	9.45	16.35	18.00
- Refinery	9.22	10.14	11.92	13.11
Subtotal	17.81	19.59	28.27	31.11
Depreciation (5%)	10.73	11.80	8.90	9.79
Insurance and Local Taxes (1%)	2.15	2.36	1.78	1.96
Subtotal	12.88	14.16	10.68	11.75
Total Production Costs	30.69	33.75	38.95	42.86
(a) Capital Charge (15%)	33.48	36.82	28.24	31.05
Estimated Realization Price Ex-Works at 15% Capital Charge	64.17	70.57	67.19	73.91
(b) Capital Charge (10%)	22.32	24.54	18.83	20.71
Estimated Realization Price Ex-Works at 10% Capital Charge	53.01	58.29	57.78	63.57
Transport and Loading	25.00	27.50		
(c) Estimated fob Realization Price with Capital Charge of 15%	89.17	98.07		
(d) Estimated fob Realization Price with Capital Charge of 10%	78.01	85.79		

mated production cost of a typical city refuse composting plant that produces 45,000 tons per year (t.p.y.) of compost.

Organic materials are receiving increasing attention due to constraints that slow down fertilizer consumption (see section B of Chapter I, that deals with the world production of fertilizers) and the industry's conjunctural problems between fast-rising production and distribution costs, and slower growing fertilizer prices (see conclusion number four of the second study, p. 226. Those factors point out the need to have additional sources of nutrients and to improve the efficiency of use involved in existing sources.

Up to the medium term, the more promising additional sources of nutrients are the following:

- nitrogen-fixation capacities in grains
- organic materials recoverable from wastes at farm and village levels
- organic materials recoverable from municipal refuse, including town and industrial wastes

The first two sources are being assessed by FAO and will be presented as a separate report. With respect to the last source, municipal refuse is generated either in the form of solids or sludges. Solid refuse and stable manure are the basic raw materials for composting, whereas the sludges can be considered as blending materials because their higher moisture and nitrogenous content provide better contions for the composting process. Since composting is the only way to produce soil-conditioning material, the only variation imposed by different wastes is the method and extent of pre-treatment prior to the composting process.

Many organic materials are or have the potential value to be used as a fuel, for animal feeding or as raw materials or ingredients for making other products. Except in special circumstances, most wastes are not produced in sufficient amounts in any one place to justify individual processing. In fact, some wastes are produced only seasonally or at irregular intervals. The physical and chemical nature of wastes vary widely and, as a result, some wastes are difficult to process except in combination with other wastes.

Generally, the only economically recoverable waste that is regularly

produced is municipal refuse from cities. It constitutes the basic raw material for composting, whereas other organic materials are incorporated in controlled amounts in order to facilitate its treatment and to ensure a final compost of a reasonably uniform quality.

The most important difference between developed and developing countries with respect to the characteristics of their urban refuse is that the latter's wastes have often a content of higher humidity, density and organic matter than the former, despite its lower per capita waste production. This factor makes urban refuse-composting more preferable in developing countries, provided that the process is suitably adapted to cope with the higher moisture content. However, there are two main shortcoming involved in the use of urban compost as an additional source of nutrients:

1. The low nutrient content—around 3 per cent of $N\text{-}P_2O_5\text{-}K_2O$ by weight on a dry basis—makes it costly to transport the urban compost beyond 50 or 60 kilometres away from the plant, thus effectively limiting its reach to crops surrounding the city in which the composting plant is located.

2. The amount of economically recoverable municipal refuse from cities in developing countries, at best, can only produce a small fraction of the total nutrient demand of those countries, amounting roughly to between 2 and 4 per cent of current and estimated consumption.

C. International trade of fertilizers

1. Evolution and patterns of fertilizer trade exchanges

World exports of the three nutrients totalled 34 million tons in 1978/79, up 2 per cent over the previous year. The corresponding weight of international trade was 32 per cent of world consumption, which remained fairly steady during the past five years with the exception of 1975/76, when the trade's weight fell to 25 per cent of world consumption. Annex VIII shows the recent import and export evolution by region. From this annex, it can be seen that in 1978/79 the world exports by nutrient were 22 per cent for nitrogen, 25 per cent for phosphates and 60 per cent for potash. The corresponding imports were 36 per cent for nitrogen, 17 per cent for phosphate and 47 per cent for potash.

The above figures show that the interregional trade exchange patterns presented in the second study continued during the past two years,

with the exception of nitrogenous fertilizers.

The trade in nitrogen increased from 18.8 per cent in 1974/75 to 22 per cent in 1978/79, reflecting a deterioration of regional supply in the developing countries. With the exception of the Near East, all of the developing regions stagnated, reversing the past trend of increased regional supply in the developing countries.

The trade in phosphate greatly increased from 17.5 per cent in 1974/75 to 25 per cent in 1978/79, reflecting a growing interdependence between developed and developing countries. This trend indicates an accelerated shift toward the production of phosphate intermediates for trade in rock-producing countries; the United States and Morocco are leading in this regard.

Potash trade remained more stable, increasing from 58.6 per cent in 1974/75 to 60 per cent in 1978/79. This indicates the ever-growing dependence of developing countries upon imports from the developed countries.

In 1978/79, the developed market economies region greatly strengthened its exporting position in all nutrients. This region accounted for 97 per cent of the world's quantitative increase. North America contributed over half of this region's performance in all nutrients, followed by Western Europe.

The developed centrally planned region showed a slight absolute decline in nitrogenous and potassic fertilizers, but only a small increase in phosphatic fertilizers. The developing market economies region showed a fast-growing participation in exports of nitrogenous and phosphatic fertilizers in the last five years, reflecting the entry of a number of developing countries onto the export market. The more notable examples are the Republic of Korea, although as of 1980 it has been reducing urea exports because its naphtha-based industry has become less competitive, Kuwait, Saudi Arabia, Indonesia, Iraq and Qatar. Mexico and the Libyan Arab Jamahiriya are becoming important new entries onto the ammonia export market. The Asian centrally planned region has only a marginal participation in exports.

In 1978/79, the developing countries' share in world exports for all nutrients was 6.2 per cent. Their corresponding share in world imports was 39 per cent. However, if potash were disregarded—in which the developing countries have a negligible share of production,

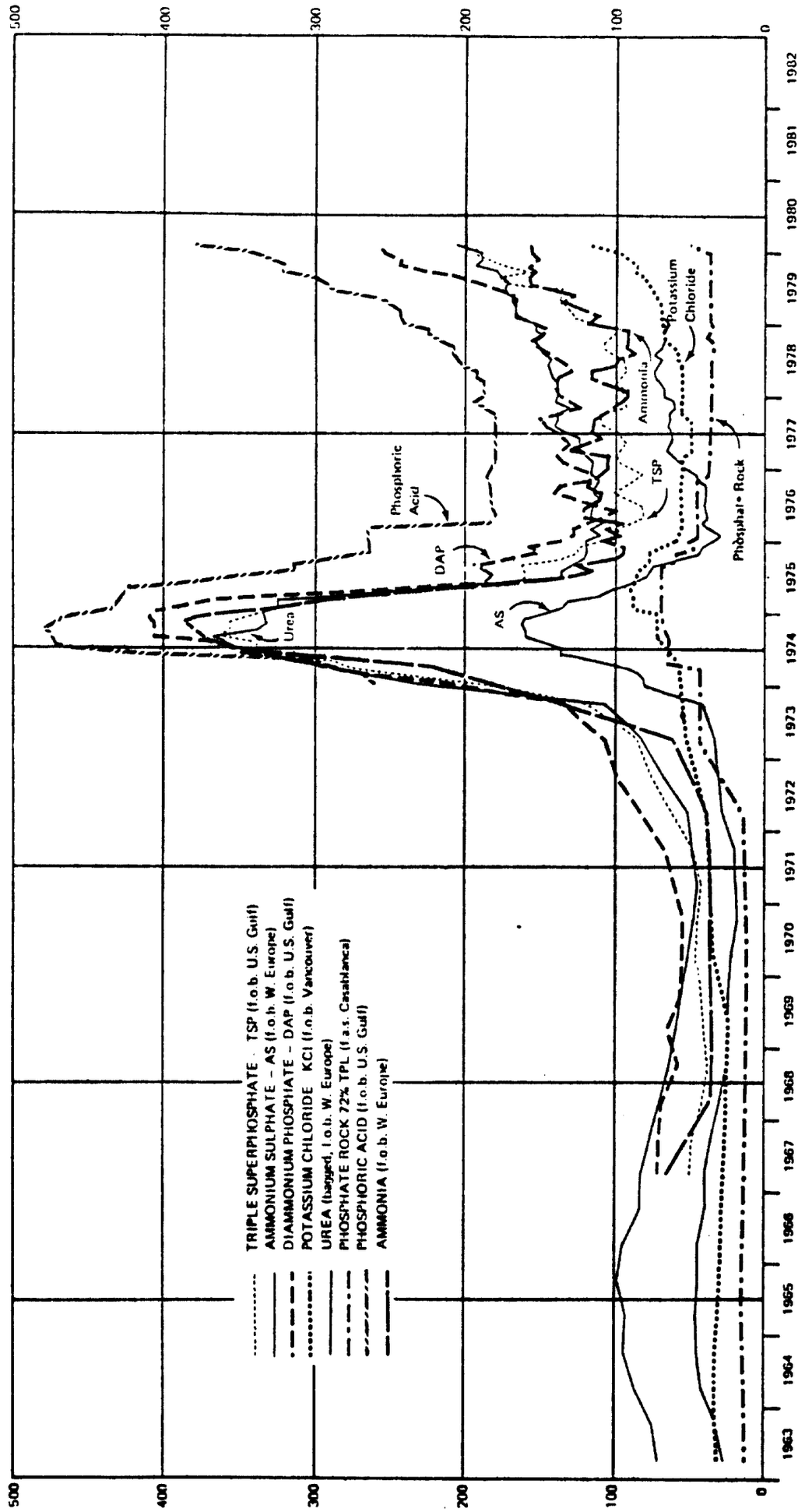
the developing countries' share of nitrogenous and phosphatic imports would be 54 per cent, in spite of substantial increases in their domestic production.

At present the trade in fertilizers is not significantly affected by tariffs or other trade barriers, reflecting their character as essential inputs for agriculture.

2. Fertilizer prices

The second study presented a price-evolution analysis of representative fertilizer products from 1960 to 1977. Graph 1 supplies the corresponding updated prices as of the first quarter of 1980. The prices shown are spot prices and do not fully describe the bulk of the transactions traded at contract prices. Since contract prices are usually unavailable, spot-price trends generally reflect comparable trends of contract prices. From this graph, four periods of evolution can be seen: (1) a period of growing world demand and lagging supplies that induced higher fertilizer prices, which peaked around 1966. (2) technological developments and large economies of scale that reduced production costs and brought down international prices from 1966 until 1970/1, when prices bottomed out. During this period, spot prices were often lower than contract prices. (3) a period, starting in late 1971, during which shortages began to emerge, leading by 1973 to nondelivery of contracts and the forcing of most trade into the spot market. The quadrupling of oil prices late in 1973 and of phosphate rock prices by mid-1974 greatly affected production costs and strained the available supply. The apprehensive buying on the part of some regions in 1974/75 in an attempt to buffer themselves against expected shortages and greatly increased prices led to the large price-increases recorded on Graph 1. (4) a period in which farmer greatly reduced their buying because the price levels of fertilizers produced a very disfavourable cost-benefit ratio. This action brought down prices; the big losers were the dealers and distributors who engaged in apprehensive buying, particularly in the Far East region. Since then prices have fluctuated reflecting the more cautious dealings of buyers and sellers. However, prices rose steadily during 1979, reflecting the large increases in production and distribution costs that the industry no longer was able to absorb through production efficiences as in the past. Nevertheless,

GRAPH 1. EXPORT PRICE TRENDS FOR SELECTED FERTILIZER MATERIALS
(US $ PER TON OF PRODUCT)
CURRENT PRICES



Source: The World Bank, The Fertilizer News Bulletin Number 8 (Washington, D.C., May 1980).

since 1980 prices have softened as sellers grow more apprehensive, mainly over uncertainties in the developed countries.

In general the developing countries have continued to increase their imports of fertilizers and do not appear to have reached a cost-benefit ceiling on fertilizer prices in relation to prices for their exported agricultural commodities. The main constraints on the developing countries are foreign-exchange restrictions and temporary shortages.

II. THE FUTURE OUTLOOK OF THE FERTILIZER INDUSTRY

Most comments from participants at the Second Consultation Meeting on Fertilizers pertained to forecasts on fertilizer demand and production. Therefore the aim of this chapter is to update the medium-term forecasts, to assess the existing yardsticks measuring consumption and production, and to appraise past results and future committments of new plant constructions. The most authoritative and internationally accepted body doing forecasts on fertilizer demand and supply is the UNIDO/FAO/World Bank Working Group on Fertilizers, whose membership includes the feftilizer industry. The composition of the Group, its sources of information and the characteristics of the forecasts have been given on page 128 of the Second Study.

A. The medium-term outlook

The information presented in this heading is primarily that of the Working Group that concentrates on demand forecasts 5 and 10 years ahead, and plant capacity and supply capability estimates up to 5 years ahead. The Group's yearly published reports go from June 1976 to June 1979. The last revision was carried out in May 1980 but it is still unpublished at the time of writing the present supplement. Therefore an analysis of the Group's records of the past four years will shed light on the existing yardsticks measuring consumption in comparison with actual FAO figures and production in terms of plant capacities.

1. The medium-term forecasts to 1984

Concerning demand forecasts, the methodology used by the Group is given on page 128 of the Second Study. As the latest published report gives forecasts up to 1983/84, they have been incorporated in the regional demand tables given in Annex I (a), (b) and (c) for the main nutrients. Annex II shows the corresponding growth rates and market share by nutrient. Nevertheless, comments will be made in comparison with the preliminary figures of the most recent forecast (May 1980) up to 1984/85.

Concerning production forecasts, the methodology used by the Group is given on pages 132-133 of the Second Study. The data presented is based on the more accurate information available on the situation of operating plants, plant closures, and firmly committed projects for the next five years.

Instead of production forecasts the Group presents 5-year forecasts of plant capacity and estimated supply capability according to assumptions and factors described in the methodology. Annex VI (a), (b) and (c) gives the most recent plant capacity committments up to 1984/85 as updated in May 1980 by nutrient and region.

Briefly, the highlights of the medium-term situation are as follows:

(a) Consumption from Annexes I and II, the demand for the main nutrients is as follows:

(i) Nitrogen: The 1980 revised world demand for nitrogen is down by about 3 per cent over the June 1979 forecasts shown in Annex I (a) with the original figure for 1983/84 being reached one year later.

The main changes over the 1979 forecasts, were a substantial downward revision of the developed centrally planned economies region. Far East also shows a decline compensated by a comparable increase in the Asian centrally planned region of about 1 million tons of N by 1983/84.

During the period 1979/80 - 1984/85, the developed countries would increase nitrogen consumption by 7.8 million tons, or 4.2 per cent average annual growth rate. Last year's medium-term estimates were 6.5 million tons and 3.7 per cent respectively.

The developing countries should increase demand by 6.3 million tons or 5.76 per cent average annual growth rate. Last year's estimates were 5.8 million tons and 5.3 per cent respectively.

(ii) Phosphate: The 1980 revised world demand for phosphates remained about the same as last year's forecasts, with only a minor adjustment in both centrally planned regions. During the period 1979/80 - 1984/85, the developed countries would increase consumption by 3.7 million tons or 2.9 per cent average annual growth rate. The developing countries should increase demand by 2.9 million tons, or 5.6 per cent average annual growth rate.

(iii) Potash: Similar to nitrogen, the 1980 revised world demand for potash cut down by 3 per cent on last year's forecast, with almost all the differences coming from a downward adjustment of the developed centrally planned region.

During 1979/80 - 1984/85, the developed countries would increase consumption by 4.1 million tons, or 3.3 per cent average annual growth rate. Last year's medium-term estimates were 4.3 million tons and 3.4 per cent respectively. The developing countries should increase demand by 1.2 million tons, or 5.3 per cent annual growth rate. Last year's estimates were 1.3 million tons and 5.5 per cent respectively.

(b) Productior, from Annex VI (a) to (c) it is seen that during 1979-80 - 1984/85 the developed countries plan to increase capacity by 7 million tons of ammonia, 2.5 million tons of phosphoric acid, and 9.5 million tons of potash. The corresponding increments in the developing countries are 10.4, 3.7 and 1.2 million tons respectively.

The supply/demand balances for individual nutrients are as follows:

(i) Nitrogen: the balance indicates a recovery from the 1979/80 tight situation to reach a comfortable 2 million tons surplus by 1984.

(ii) Phosphate: shows a somewhat stabilized positive balance of around 1 million tons during 1979-1984.

(iii) Potash: its negative balance reflects the shortages faced by this industry during 1979. The 1 million tons deficit is carried forward in 1980 to start diminishing until 1983 where it turns out positive to reach 1 million tons surplus by 1984.

(c) Fertilizer prices, as pointed out in the Second Study, page 131, the fast-growing increases in the production and distribution costs of fertilizers are sharpening a painful dilemma that revolves around future fertilizer prices. On the one hand, the combination of rising equipment costs, high interest rates, fast rising raw material costs, slower technological improvements, out-of-step accounting rules and legal deductions, and limited fertilizer price increases are making it very difficult to modernize existing plants or generate new plant investments.

On the other hand, even the limited fertilizer price increases are putting a great strain on the farmer's purchasing power. The solution would be better crop prices and/or larger Government subsidies, and often a foreign currency component in countries with foreign exchange limitations as is customarily the case in developing countries. This situation is likely to become critical during the medium term and may force a de facto solution if remedial action is not taken in time.

2. The analysis of medium-term fertilizer demand forecasts

This analysis aims at finding out the scores on medium-term demand forecasting, usually up to 5 years ahead. By comparing the relationships between forecasted consumption and actual consumption, a probabilistic estimator can be calculated to correct the optimistic or pessimistic biases built in the person or group of persons doing the forecasting. Hence it becomes a useful feedback tool to the forecasters in order to make the medium-term future more clear or closer to the "actuals" in the future.

The Working Group's forecasts from 1976 to 1979 were correlated with FAO actuals from 1976 to 1978/79. However, a full probabilistic estimate of demand at least by regions for up to 5 years ahead could not be pursued due to lack of adequate numbers of data. The regional figures available are too few too attempt its probabilistic analysis. Consequently, macro-regional aggregates at developed and developing countries level had to be used.

Furthermore, since FAO actuals and the Group's forecasts only correspond to 3 forecasted years ahead, only a limited comparison between them could be made. The above two main shortcomings effectively prevented not only the probabilistic analysis but the preceding detailed statistical analysis as well.

Consequently a preliminary statistical analysis was carried out using as data descriptors the following: as averages the arithmetic mean and mode were calculated, as dispersion the range of maximum deviation in the 2 macro-regions was given.

Annex III gives the three data descriptors on the relationship between forecasted and actual consumption for all three nutrients by macro-regions. The headings of the annex represents the following:

- the arithmetic mean indicates the weighted average of the regions forming each macro-region, according to their respective consumption share.

- the mode shows the value occurring most frequently in the frequency distribution of each macro-region. It points out the most often occurring regional readings of forecast/actual coefficients.
- the range of maximum deviation indicates the outer limits of the regional forecast/actual coefficients. To facilitate interpretation, the limits are given as percentage of actual consumption. It shows the maximum deviation of forecasted over actual consumption at which at least one region was found.

From the interpretation of Annex III, three striking results emerge:

(i) The very good scores achieved by the Group in forecasting at macro-region and world levels the consumption of all nutrients, as given by the arithmetic mean.

(ii) The smaller optimistic biases for nitrogen and potash, and a pessimistic bias for phosphate at macro-region level given by the mean, masks somewhat larger biases at regional level as given by the mode.

(iii) The quite wide range of deviation mainly in the regions comprising the developing countries do require remedial action if better regional demand estimates are desired. Therefore regional demand estimates should be treated with caution although in future, as the Group sharpens its forecasting skills, these difficulties may be overcome.

3. Plant capacity implementation analysis

The plant capacity data presented by the Group has two main characteristics: on the one hand, it records only firmly committed projects for the next five years as it is known at tht time of making the capacity estimations without any data manipulation. On the other hand, with hindsight the Group adjusts yearly the past capacity data when more complete information becomes available. This shortcoming on the completeness of information affects primarily both centrally planned economies regions where data gathering is very difficult and the information obtained contains unknown margins of error.

The following analysis aims at appraising the implementation of firmly committed plants and the medium-term evolution of world capacity for the three main fertilizer intermediates. Its results should enable a more pragmatic assessing of fertilizer production hypotheses for the long-term, and the appraising of obstacles and

resources needed to overcome them in order to increase fertilizer production in the developing countries.

Annex VI (a), (b) and (c) indicates plant capacity developments from 1976 to 1985 by nutrients and regions. The annexes show the implementation part from mid-1976 to mid-1980 and the medium-term plans to 1984/85 to increase capacity to meet the growing consumption of fertilizers.

In order to gain a better insight of the implementation part Annex VII (a), (b) and (c) were prepared. They show the existing capacity by mid-1976, the evolution of incremental capacity including its coefficient of implementation, and the magnitude of the effort done at expanding capacity during the past four years.

From the interpretation of Annexes VI and VII three main results stand out:

(i) Discounting the effects of both centrally planned regions for which projects are incompletely known, the developing countries that planned a doubling of capacity during the past four years, could only achieve 65 per cent of planned capacity for ammonia and less than 50 per cent for phosphoric acid. In potash, the closing of the Congo mine in 1976 left them with a diminished capacity by mid-1980.

The corresponding situation of the developed market economies region was 65 per cent of planned capacity for ammonia, 80 per cent for phosphoric acid, and less than 50 per cent for potash. These results were mainly due to plant closures rather than difficulties in implementing committed plants as was the case for the developing countries.

The situation in both centrally planned economies, that indicate over-implementation of planned capacities, in fact reflects more the incomplete knowledge of all committed projects at the moment of making the forecast.

In quantitative terms during the past four years the developing countries planned to increase capacity in ammonia and phosphoric acid by 2.5 million tons and 0.4 million tons respectively over that of the developed countries. However, the implementation results show that the developing countries ended up lagging behind the developed countries by 2.0 million tons and 2.4 million tons respectively.

(ii) The planned development of capacity in developing countries in the preceding four years, remained about even for ammonia whereas it

showed a decline for phosphoric acid from 1977/78 onwards in relation to the originally planned figures in 1976. However, the actual plant construction, although far below the planned schedule, indicates an improvement from 1978/79 onwards thus showing a two-year lag in implementing a reduced planned capacity programme.

(iii) The medium-term committments to 1985, show that developing countries plan for the next five years a larger capacity increase than that of the preceding four years, mainly in phosphoric acid which actual construction badly lagged behind plans. This situation, on which developing countries are just keeping about even in production self-sufficiency, will require a major co-operative effort if the firmly committed plants are to be actually build at least to 80 per cent of planned capacity, that was the best implementation rate of developed countries during 1976-80.

The new plant construction regional situation of the developing countries is as follows:

Africa: during 1976-80, only one ammonia plant recently came on stream in Algeria whereas in phosphoric acid (where Africa holds about 75 per cent of world rock reserves) Morocco, Tunisia and Algiers stagnated during 1976-79 after Morocco increased capacity by 67 per cent late in 1976 and only recently Tunisia made a 330,000 t.p.y. capacity addition. During 1980-85, in ammonia only Algeria is completing a new plant later to be followed by a first plant in Nigeria. In phosphoric acid, Morocco is completing an 80 per cent expansion of her existing capacity to be followed by a 20 per cent expansion in Tunisia's capacity. The construction programme is 67 per cent larger than the 1976-80 one. Africa's new plant construction programme is very limited in comparison to her known raw materials reserves, particularly in phosphates.

Latin America: during 1976-80, in ammonia only Mexico engaged in a major plant construction programme followed way behind by Brazil and Trinidad and Tobago. During 1979/80 no new ammonia plant came on stream in the region. In phosphoric acid, the region completely stagnated largely due to problems with local phosphate rock in Brazil and Mexico. During 1980-85, in ammonia, Mexico, Brazil and Trinidad and Tobago have a construction programme 77 per cent larger than the 1976-80 one, with Mexico accounting for about 60 per cent of the total expansion.

In phosphoric acid, Mexico is doubling her existing capacity while Brazil is more than trebling it, thus getting closer to Mexico's, the current capacity leader in the region.

Near East: during 1976-1980, in ammonia Iraq emerged as the new capacity leader followed by Egypt whereas Kuwait, the pre-1976 capacity leader, stagnated during this period. In phosphoric acid, the region practically stagnated except for Turkey that increased her pre-1976 capacity by 68 per cent.

During 1980-85, in ammonia Iraq stagnated while Egypt took over as capacity leader. However, the capacity is more evenly distributed among several countries than is the case in any of the other regions, where extreme concentration in few countries is the rule. This reflects the widespread endowment of ammonia raw materials and money in this region. Nevertheless, the plant construction programme is 13 per cent smaller than the 1976-80 one. In phosphoric acid, only Jordan and Iraq appear as new producers with 400,000 t.p.y. each, while the remaining countries have no further committed projects.

The Near East new plant construction programme is very small in comparison to its known large reserves of natural gas for ammonia production.

Far East: during 1976-80, in ammonia India engaged in a very large plant construction programme that increased by 50 per cent its pre-1976 capacity, the largest increase in the developing countries after China. Indonesia, the Republic of Korea and Pakistan lagged way behind. In phosphoric acid, only India almost trebled its pre-1976 capacity and the Republic of Korea doubled it: the remaining countries stagnated largely due to difficulties in assuring larger supplies of phosphate rock and sulphur in favourable conditions.

During 1980-85, in ammonia India has a 56 per cent larger construction programme than in the preceding 1976-80 period, followed way behind by Indonesia, Pakistan and Bangladesh. The Republic of Korea has stopped building naphtha-based ammonia plants in view of their incompetitiveness with gas-based ammonia. The region plans to build 26 per cent more plants than during 1976-80. In phosphoric acid, India is the only country than plans to increase capacity by about 12 per cent less than the 1976-80 period.

The Far East new plant construction programme reflects primarily the need to meet the demand for fertilizers in the Indian sub-continent despite having a less than adequate local raw materials situation compounded by foreign exchange problems. Concerning the Asian centrally planned region, no attempt is made at analysing its situation in view of data uncertainties explained at the beginning of this heading.

Regarding potash capacity in developing countries, besides China only Jordan and Brazil plan to have together 1 million t.p.y. new capacity during 1980-85. This reflects the poor raw material situation of the developing countries.

B. The long-term outlook

In the Second Study, page 137, a brief explanation was given of the various broad categories of forecasting methods. Customarily, demand is projected using any of the forecasting methods mentioned above and their production is estimated according to certain assumptions. In the Second Study demand was projected using trend extrapolations based on regression analysis by the least squares method, complemented by coherence and consistency analyses. It is felt that before moving on to more complex econometric models and/or futures research techniques, a deeper analysis should be carried out on the trend extrapolation method to find out a better application for its results. Generally, trend extrapolations have two main drawbacks:

(i) They implicitly assume that the future will be a repetition of the past. This statement, widely used as a standard answer, masks a deeper and more important factor.

Time series have four main components: trend, cyclic, seasonal and random, of which the most important is the trend component. In this regard the trend is the resultant vector of all the forces permanently acting over the analysed variable, in this case fertilizer consumption. Therefore the resultant trend vector represents the dynamic equilibrium of forces at play in the past and as such has the characteristics of an inertial force. It is in this limited sense that the opening statement above has a meaning, for inertial forces do not tend to change unless the change is forced on to them. The change can be internal (competition between the individual trends forming the resultant trend vector) and/or external (events entering through the random component and endeavouring to become structural features of the resultant trend vector).

For a change to take place, the agents-of-change vectors must contend with the resultant inertial-trend vector at play. The intensity and direction of the first vectors will indicate the effects impacted on the inertial-trend vector in terms of resulting intensity (total fertilizer consumption) and direction (changed growth rates). Therefore defining the inertial-trend vector is essential in order to measure the impact and relative effects on the trend of the new forces expected to play a role in the future. Generally these new forces are presented as hypotheses or assumptions on individual trends and/or on expected events. Consequently the summarily dismission of trend extrapolations

would effectively remove the main inertial element against which the impact of any change can be measured.

(ii) The changing of the long-term projections every time a new medium-term forecast is made. As medium-term forecasts are modified yearly by the Working Group, there are consequently yearly variations of long-term projections. Since no proper planning can be done with long-term targets changing yearly, it is very desirable to have a stabilized long-term reference trend extrapolation curve whose projections remain valid for several years. The reference trend extrapolation projections can then be used as yardsticks against which policy options for change can be tested and measured.

The above two items have shown the importance of defining stabilized inertial-trends of longer-term projections of fertilizer demand by regions.

1. The stabilized long-term reference trend extrapolation analysis

This analysis aims at providing a more stable reference trend relatively free from biases, optimistic or pessimistic, that could retain long-term validity for several years and be of use as trend reference against which policy options can be tested.

Two main series of data exist that could be used for this purpose, that of FAO that gives past explanatory trends, and the UNIDO/FAO/World Bank Working Group on Fertilizers that gives future predictive trends.

From heading 2. of point A., the mainly optimistic medium-term biases will tend to augment as the number of forecasted years increase. Moreover, since the built-in biases are quite different between world/macro-region aggregates, and individual regions, then the different world aggregates (world-only, developed and developing macro-regions, and regional additions) will yield widespread values.

To overcome the above difficulties and to obtain a reference trend extrapolation (that includes past and future trends) valid at regional, macro-region and world levels, the following analysis was carried out:

To gauge the degree of deviation for world and regional levels of aggregation, a comparative analysis of fertilizer demand projections for the year 2000 was made. Annex IV shows the results achieved. When only world totals are projected, the Group's scores in the four exercises done from 1976 to 1979 are about 12 per cent above the FAO-based projections for all nutrients. This result is quite consistent

with the very good medium-term scores of the Group. But when world totals are obtained by adding individual regional projections, then its average deviation is up to around 30 per cent of that obtained using only world totals. This outcome is also consistent with the results of heading 2. point A.

Since the discrepancy of results may be due to statistical biases both on the medium-term forecasts data and the mechanical lead of best-fit regression equations, three additional tests were made:

(i) Trend extrapolations were made based on FAO's past data and the set of medium-term forecasts done by the Group from 1976 to 1979. The yearly forecasts, as expected, showed ups and downs around FAO's actual consumption line from 1976 to 1979. However, a new series constructed on the yearly average of the Group's forecasts between 1976 and 1979 gave a closer approximation to actual consumption than any single medium-term forecast.

(ii) A long-term trend extrapolation stability analysis to 2000 was made by comparing three main series: FAO's based past trend only, the average of the Working Group's forecasts only, and a new series combining FAO's past data with the Group's average forecasts up to 1983/84.

Figures 1 to 3 show the above comparative trends by nutrients.

From the figures it can be seen that the Group's projected series are up to 25 per cent above FAO's, whereas the combined FAO plus Group projections remain up to 10 per cent above FAO's. The new combined series then has the same deviation as the Group's world-only projection shown in Annex IV.

(iii) To find out the long-term stability of the new combined series, a comparative world aggregate analysis was made. Figures 4 to 6 show the comparative world aggregates (world-only, developed and developing macro-regions, and individual regional additions) by nutrient.

The figures show that there is no substantial variation between the three levels of world aggregation, provided that judgement is exercised in aggregating regional "best-fit" equations.

Figures 7 to 13 show examples of the above pitfall where mechanically lead best-fit trend extrapolations often heavily distort the regional trends.

From the above analysis it can be concluded that the new combined series, FAO plus the Group's medium-term average forecasts, provide a stabilized long-term reference trend line.

The corresponding extrapolations by regions to 1990 and 2000 are given in Annexes I (a), (b) and (c) for nitrogen, phosphate and potash respectively.

2. The long-term projections to the year 2000

(a) Consumption. In mid-1979, FAO published a global study[1/] on the development of agricultural output to meet food needs up to the year 2000. The study gave estimates of agricultural input requirements for 90 developing countries included in the developing market economies regions. No estimates were provided either for the Asian centrally planned economies region or the developed countries regions.

By comparing the FAO study estimates for the year 2000 with the stabilized long-term trend extrapolation given in Annex I, a first policy option appraisal may be made.

Table 4 gives the main relevant factors for this comparison. Although the FAO study only presents totals for the three nutrients, they have been disaggregated by using the same individual nutrient share shown in Annex I.

On table 4, FAO estimates for total nutrients in the developing market economies regions is 90 per cent larger than the UNIDO trend-line estimates with 80 per cent of that value coming from the Far East region. This large discrepancy in estimates shows that the Far East is the trouble spot in the developing countries. To meet the food needs of this region, its fertilizer consumption should increase 2.6 times over its inertial trend extrapolation value, whereas the other 3 regions have their food needs and trend estimates of fertilizer consumption within reasonable limits. The situation of the Far East becomes worrysome since this region has difficult foreign exchange problems compounded by a relative lack of raw materials for fertilizer manufacture. Its satisfactory solution will require major efforts from the developed and developing countries alike.

1/ Agriculture: Toward 2000 (FAO, C 79/24, July 1979)

Table 4.

Comparison between FAO and UNIDO fertilizer consumption estimates to the year 2000 for the developing market economies regions.

Region	(millions of metric tons)				Growth rate 1978/2000 (percentage)		
	Total N-P-K	N	P_2O_5	K_2O	N	P_2O_5	K_2O
			FAO estimates				
Africa	5.3	2.2	1.9	1.2	7.0	7.3	8.5
Latin America	18.6	7.5	6.8	4.3	5.1	5.1	4.9
Near East	11.4	7.2	4.0	0.2	6.8	6.5	6.5
Far East	57.6	38.7	11.9	7.0	9.3	8.7	8.8
Total developing market economies	92.9	55.6	24.6	12.7	8.1	7.0	7.0
			UNIDO estimates				
Africa	3.4	1.4	1.2	0.8	4.8	5.1	6.5
Latin America	16.1	6.5	5.9	3.7	4.4	4.4	4.2
Near East	7.1	4.5	2.5	0.1	4.5	4.3	3.2
Far East	22.3	15.0	4.6	2.7	4.7	4.1	4.2
Total developing market economies	48.9	27.4	14.2	7.3	4.6	4.3	4.3

Source: Agriculture: Toward 2000 (FAO estimates) page 79
UNIDO estimates from Annexes I (a), (b) and (c)

(b) Production. The three chief fertilizer intermediates: ammonia, phosphoric acid and potash are, in the main, the foundation of all fertilizers and have adequate regional plant capacity data. Estimating longer-term fertilizer supply has two principal shortcomings:

(i) the choices of fertilizer production involve taking stock from several production systems, a selection of fertilizer products, and a range of policy options from fertilizer raw materials to crops, all of which are country specific.

(ii) The assumptions on fertilizer intermediates are risky to make in view of the problems shown in heading 3. point A, that point out the growing difficulties in implementing plant construction programmes in the developing countries.

Nevertheless, an indicative estimate on the number of ammonia and phosphoric acid plants needed is given below, calculated according to the plant capacity hypotheses of the Second Study, pages 141 to 143. Those hypotheses explore the aim of the developing countries to achieve retional self-sufficiency, if possible.

According to the Second Study, the fertilizer supply capacity factors for regional self-sufficiency are as follows:

- for ammonia, plant capacity is 1.685 times nitrogen demand for developed countries and 1.52 times for developing countries: the ammonia plants are estimated at 1000 t.p.d. of ammonia or 272,000 t.p.y. of nitrogen.
- for phosphoric acid, plant capacity is 1.22 times the effective acid-based phosphate demand for developed countries and 1.29 times for developing countries. The estimated supply from non-phosphoric acid sources: 11.8 million tons for developed countries and 5.1 million tons for developing countries. The phosphoric acid plants are estimated at 1,000 t.p.d. or 330,000 t.p.y. of P_2O_5.

Table 5 on the next page gives the plant capacity estimates for fertilizer intermediates up to the year 2000. It shows the effects that plant capacity hypotheses create on the regional new plant construction programmes for the period 1985/2000. It points out very large imbalances in ammonia, principally in the Far East and the developed countries (mainly the developed centrally planned economies region), where the Far East region, under FAO assumptions, should build eleven new ammonia plants per year during 15 years without having adequate local raw materials and financial resources for such a large undertaking. However, the Near East, with plentiful ammonia feestocks and financial resources, has a very limited plant construction programme.

Concerning phosphoric acid, both Africa and the Near East have, especially the first region, more than adequate raw materials for the plant construction programme. However, Latin America and the Far East have limitations on locally available phosph rock that is reflected in the estimated capacity by the year 2000.

Table 5.

Plant capacity projections for fertilizer intermediates
(millions of metric tons)

Region	Ammonia				Phosphoric acid			
	Capacity to 2000		No.new plants 1985/2000		Capacity to 2000		No.new plants 1985/2000	
	FAO	UNIDO	FAO	UNIDO	FAO	UNIDO	FAO	UNIDO
Developed countries		115.1		144		32.3		17
Developing countries:								
Africa	3.3	2.1	8	3	9.5	4.4	20	5
Latin America	11.4	9.9	18	13	3.6	3.6	5	5
Near East	10.9	6.8	18	3	4.1	2.2	7	1
Far East	58.8	22.8	173	41	2.7	2.7	4	4
Total market economies	84.4	41.6	217	60	19.9	12.9	36	15
Asian centrally planned ec.		22.6		36		1.3		4
Total developing countries		64.3		96		14.2		19
Total world		179.4		240		46.5		36

Source: FAO and UNIDO fertilizer demand estimates of table 4 and Annex I (a) and (b).
Plant capacity forecasts to 1984/85 from Annex VI (a) and (b)

III CONCLUSIONS AND RECOMMENDATIONS

The main conclusions and recommendations to be drawn from the Second Study and the present Supplement are the following:

(i) FAO has shown the urgent need to increase food production with a growing share from fertilized areas. FAO's long-term projections on fertilizer consumption for meeting food needs in the four developing market economies regions compares quite reasonably with the corresponding UNIDO stabilized trend estimates, except for the Far East. The situation in the Far East of unmet fertilizer requirements to produce the food needed by its growing population seems a likely possibility due to raw materials limitations and foreign exchange difficulties. It poses a serious challenge to the world, for this region contains about one quarter of total world popolation.

(ii) The objective of regional self-supply requires a substantial modification on the strong trends which shift intermediate fertilizer production to countries producing plenty of raw materials. Consequently it leads to large imbalances in regional plant construction programmes that are therefore not likely to be implemented. The problem is further aggravated by the low implementation results of firmly committed plants in the developing countries compounded by lower average plant operation rates. Otherwise, more fertilizer plants will be needed through to the year 2000 just to attain the same production targets.

(iii) The current conjunctural problem of fast-rising capital, production and distribution costs and slower growing farmer's incomes and strained Government subsidies affecting future fertilizer prices is becoming ever more critical. Its outcome is uncertain but an unsatisfactory solution may restrict future supply availability at a time when increased fertilizer consumption is needed, especially in the Far East. The alternative of not fertilizing enough may be hunger.

(iv) The need to adequately analyse the meaning and consequences of the aims, problems and trends described above, requires sophisticated forecasting methodologies able to accomodate a number of quantitative and qualitative variables, an in-depth appraisal of current plant construction difficulties in the developing countries, and the full co-operation of all parties concerned.

It is regretable that UNIDO's initial efforts at mustering co-operation failed to draw an adequate response as pointed out in paras. 28 and 29 of the Progress Report on Actions Recommended by the Second Consultation[2/].

(v) The requirements to define and later attain fertilizer consumption and production targets up to the year 2000 are many and need the firm committment of the parties concerned from the very beginning. No country seems to be able to carry out its programmes in isolation based on its own resources alone.

2/ Progress Report on Actions Recommended by the Second Consultation (UNIDO, ID/WG.308/7, 26 June 1980).

Annex I(A). World consumption of nitrogenous fertilizers, by region up to the year 2000 in million m.t. of N.

Year	DEVELOPED COUNTRIES			DEVELOPING COUNTRIES							WORLD TOTAL
	Market Economies	Centrally planned economies	Total	Market economies					Asian centrally planned economies	Total	
				African	L. American	Near East	Far East	Total			
1965/1966	10.8	3.9	14.7	0.1	0.7	0.4	1.1	2.3	1.6	3.9	18.6
1966/1967	12.1	4.5	16.6	0.1	0.8	0.4	1.6	2.9	2.1	5.0	21.6
1967/1968	13.4	5.2	18.6	0.2	0.9	0.5	1.7	3.3	1.9	5.2	23.8
1968/1969	13.8	6.1	19.9	0.2	1.1	0.6	2.2	4.1	2.5	6.6	26.5
1969/1970	14.6	6.6	21.2	0.2	1.2	0.7	2.6	4.7	2.8	7.5	28.7
1970/1971	15.6	7.5	23.1	0.2	1.3	0.8	2.7	5.0	3.5	8.5	31.6
1971/1972	15.8	8.3	24.1	0.3	1.4	0.8	3.1	5.6	3.4	9.0	33.1
1972/1973	16.5	8.9	25.4	0.4	1.6	1.0	3.5	6.5	3.7	10.2	35.6
1973/1974	17.8	9.7	27.5	0.4	1.7	1.2	3.5	6.8	4.4	11.2	38.7
1974/1975	17.1	10.4	27.5	0.4	1.8	1.0	3.4	6.6	4.4	11.0	38.5
1975/1976	19.2	11.5	30.7	0.4	1.9	1.3	3.8	7.4	4.8	12.2	42.9
1976/1977	20.0	11.3	31.3	0.5	2.2	1.5	4.3	8.5	5.2	13.7	45.0
1977/1978	19.8	11.7	31.5	0.5	2.5	1.6	5.0	9.6	6.7	16.3	47.8
1978/1979	21.3	12.2	33.5	0.5	2.5	1.7	5.5	10.1	7.7	17.9	51.4
				Forecast							
1979/1980	21.7	14.1	35.8	0.5	2.9	1.8	6.4	11.6	7.4	19.0	54.8
1980/1981	22.4	15.1	37.5	0.6	3.1	2.0	7.0	12.7	7.8	20.5	58.0
1981/1982	23.1	16.0	39.1	0.6	3.4	2.1	7.8	13.9	8.0	25.9	61.0
1982/1983	24.0	16.8	40.8	0.7	3.6	2.3	8.5	15.1	8.3	23.4	64.2
1983/1984	24.7	17.6	42.3	0.7	3.9	2.5	9.3	16.4	8.5	24.9	67.2
				Projection							
1990/1991	30.8	27.3	58.1	1.1	5.0	3.4	11.3	20.8	11.4	32.2	90.3
1999/2000	37.6	30.7	68.3	1.4	6.5	4.5	15.0	27.4	14.9	42.3	110.6

Source: FAO, UNIDO/FAO/World Bank Working Group on Fertilizers, June 1979 and UNIDO.

Annex I(B). World consumption of phosphorous (P_2O_5) fertilizers, by region up to the year 2000 in million m.t. of P_2O_5

Year	DEVELOPED COUNTRIES			DEVELOPING COUNTRIES							WORLD TOTAL
	Market economies	Centrally planned economies	Total	Market economies					Asian centrally planned economies	Total	
				Africa	L. America	Near East	Far East	Total			
1965/1966	10.5	3.5	14.0	0.1	0.5	0.2	0.4	1.2	0.6	1.8	15.9
1966/1967	11.1	3.8	14.9	0.1	0.5	0.2	0.5	1.3	0.6	1.9	16.8
1967/1968	11.5	4.1	15.6	0.1	0.6	0.2	0.5	1.4	0.6	2.0	17.6
1968/1969	11.9	4.5	16.4	0.2	0.7	0.3	0.8	2.0	0.7	2.7	19.1
1969/1970	12.0	4.8	16.8	0.2	0....	0.3	0.9	2.2	0.8	3.0	19.8
1970/1971	12.4	5.2	17.6	0.2	1.0	0.3	0.8	2.3	1.0	3.3	20.9
1971/1972	12.8	5.6	18.4	0.2	1.0	0.4	1.0	2.6	1.1	3.7	20.1
1972/1973	13.4	5.8	19.2	0.3	1.3	0.4	1.2	3.2	1.2	4.4	23.6
1973/1974	14.1	6.1	20.2	0.3	1.4	0.5	1.3	3.5	1.4	4.9	25.1
1974/1975	11.8	6.9	18.7	0.3	1.7	0.5	1.1	3.6	1.6	5.2	23.9
1975/1976	12.3	7.6	19.9	0.3	1.7	0.7	1.1	3.8	1.5	5.3	25.2
1976/1977	13.4	7.8	21.2	0.4	2.0	0.8	1.3	4.5	1.6	6.1	27.3
1977/1978	13.2	8.1	21.3	0.4	2.2	1.0	1.6	5.2	1.7	6.9	28.2
1978/1979	14.3	8.5	22.8	0.4	2.3	1.0	1.9	5.6	2.1	7.7	30.5
				Forecast							
1979/1980	14.1	9.4	23.5	0.5	2.5	1.0	2.1	6.1	2.1	8.2	31.7
1980/1981	14.4	10.1	24.5	0.5	2.7	1.1	2.3	6.6	2.3	8.9	33.4
1981/1982	14.7	10.8	25.5	0.6	3.0	1.2	2.5	7.3	2.5	9.8	35.3
1982/1983	15.0	11.5	26.5	0.6	3.2	1.3	2.7	7.8	2.7	10.5	37.0
1983/1984	15.3	12.2	27.5	0.6	3.4	1.4	2.9	8.3	2.8	11.1	38.6
				Projection							
1990/1991	15.4	15.1	30.5	0.9	4.4	1.8	3.5	10.6	3.6	14.2	44.7
1999/2000	16.0	19.3	35.3	1.2	5.9	2.5	4.6	14.2	4.7	18.9	54.2

Source: FAO, UNIDO/FAO/World Bank Working Group on Fertilizers, June 1979 and UNIDO.

Annex I(C). World Consumption of potash fertilizers, by region up to the year 2000 in million m.t. of K_2O

Year	DEVELOPED COUNTRIES			DEVELOPING COUNTRIES							WORLD TOTAL
	Market economies	Centrally planned economies	Total	Market economies				Total	Asian centrally planned economies	Total	
				Africa	L. America	Near East	Far East				
1965/1966	7.9	3.4	11.3	0.1	0.3	0.02	0.2	0.6	0.2	0.8	12.1
1966/1967	8.4	3.6	12.0	0.1	0.3	0.01	0.3	0.7	0.2	0.9	12.9
1967/1968	8.9	4.1	13.0	0.1	0.4	0.02	0.3	0.8	0.2	1.0	14.0
1968/1969	9.0	4.4	13.4	0.1	0.5	0.02	0.4	1.0	0.3	1.3	14.7
1969/1970	9.3	4.7	14.0	0.1	0.5	0.02	0.4	1.2	0.3	1.5	15.5
1970/1971	9.9	5.1	15.0	0.1	0.6	0.03	0.5	1.3	0.3	1.6	16.6
1971/1972	10.1	5.6	15.7	0.1	0.6	0.03	0.6	1.5	0.4	1.9	17.6
1972/1973	10.6	6.1	16.7	0.1	0.7	0.04	0.7	1.8	0.4	2.2	18.9
1973/1974	11.5	6.7	18.2	0.1	0.8	0.04	0.8	2.0	0.6	2.6	20.8
1974/1975	10.1	7.1	17.2	0.1	0.9	0.04	0.8	2.1	0.6	2.7	19.9
1975/1976	10.5	8.7	19.2	0.2	0.9	0.04	0.7	1.8	0.4	2.2	21.4
1976/1977	11.6	8.9	20.5	0.2	1.1	0.05	0.8	2.2	0.4	2.6	23.1
1977/1978	11.5	8.6	20.1	0.2	1.4	0.05	0.9	2.6	0.5	3.1	23.2
1978/1979	12.6	8.6	21.2	0.2	1.5	0.05	1.1	2.9	0.7	3.6	24.8
				Forecast							
1979/1980	12.6	9.9	22.5	0.3	1.6	0.06	1.1	3.0	0.6	3.6	26.1
1980/1981	13.0	10.5	23.5	0.3	1.9	0.07	1.2	3.4	0.7	4.1	27.6
1981/1982	13.4	11.1	24.5	0.4	1.9	0.07	1.3	3.6	0.7	4.3	28.8
1982/1983	13.8	11.9	25.7	0.4	2.0	0.08	1.4	3.9	0.8	4.7	30.4
1983/1984	14.3	12.6	26.9	0.4	2.2	0.09	1.5	4.2	0.8	5.0	31.9
				Projection							
1990/1991	16.7	16.5	33.2	0.5	2.8	0.08	1.5	6.1	1.2	7.3	40.5
1999/2000	19.7	21.2	40.9	0.8	3.7	0.10	2.7	7.3	1.5	8.8	49.7

Annex II. Fertilizer Consumption - Share and Growth rate by regions up to the year 2000 (in percentage)

Region	Nitrogenous					Phosphate					Potash				
	Growth rate		Share			Growth rate		Share			Growth rate		Share		
	1979-1984	1984-2000	1979-1980	1984-1985	1999-2000	1979-1984	1984-2000	1979-1980	1984-1985	1999-2000	1979-1984	1984-2000	1979-1980	1984-1985	1999-2000
Developed Countries:															
Market economies	3.1	2.4	39.6	37.2	34.0	1.0	0.4	43.7	39.0	29.5	2.5	2.0	47.1	44.4	39.6
Centrally planned economies	4.7	3.2	26.5	27.0	27.8	4.4	3.0	30.3	32.2	35.6	4.4	3.2	38.8	40.2	42.7
Total developed countries	3.7	2.8	66.0	64.2	61.8	2.4	1.8	74.0	71.2	65.1	3.4	2.6	85.9	84.6	82.3
Developing Countries:															
Africa	5.9	3.8	1.0	1.1	1.3	7.0	3.7	1.5	1.8	2.2	5.9	4.7	1.1	1.2	1.6
Latin America	5.4	3.5	5.2	5.5	5.9	5.5	3.7	8.0	8.9	10.9	6.5	3.5	5.8	6.7	7.4
Near East	5.4	3.7	3.5	3.7	4.1	5.0	4.0	3.4	3.7	4.6	3.7	3.5	0.4	0.4	0.2
Far East	5.9	3.5	11.9	12.6	13.5	5.1	3.6	6.4	7.1	8.5	4.6	4.0	4.3	4.5	5.4
Total Market economies	5.5	3.6	21.6	22.9	24.8	5.4	3.7	19.3	21.5	26.2	5.6	3.8	11.6	12.7	14.6
Asian Central Planned economies	5.1	3.3	12.4	12.9	13.2	5.0	3.5	6.7	7.3	8.7	5.1	3.5	2.5	2.7	3.1
Total developing countries	5.3	3.5	34.0	35.8	38.2	5.3	3.7	26.0	28.8	34.9	5.5	3.7	14.1	15.4	17.7
Total World	4.3	3.0	100.0	100.0	100.0	3.2	2.3	100.0	100.0	100.0	3.7	2.7	100.0	100.0	100.0

Source: Calculated from data in Annexes 1

Annex III. Relationship between forecasted consumption over actual consumption

Forecasted years ahead	Arithmetic mean		Range of maximum deviation (in percentage of actual consumption)		Mode	
	Developed Countries	Developing Countries	Developed Countries	Developing Countries	Developed Countries	Developing Countries
			Nitrogenous			
First year	1.04	0.98	-4 / +12	-22 / +24	1.08	1.04
Second year	1.07	1.03	+1 / +16	-24 / +46	1.06	1.09
Third year	1.06	0.95	0 / +16	-25 / +38	1.06	1.09
Fourth year						
			Phosphate			
First year	0.97	1.00	-12 / 0	-17 / +20	0.98	0.96
Second year	0.98	1.00	-12 / +1	-17 / +27	1.00	0.94
Third year	0.97	0.99	-12 / +2	-9 / +37	0.96	0.92
Fourth year						
			Potash			
First year	1.03	1.08	-7 / +12	-25 / +61	0.96	0.95
Second year	1.04	1.08	-1 / +13	-6 / +56	1.06	0.96
Third year	1.02	1.10	-6 / +14	-20 / +27	1.02	1.22
Fourth year						

Source: Forecasted consumption from the UNIDO/FAO/World Bank Working Group on Fertilizers, from 1976 to 1979.
Actual consumption from FAO.

Annex IV. Comparative fertilizer demand projections for the year 2000 (in million m.t.)

Base year	Based on FAO and Working Group trends	World total only Based on FAO trend	Deviation in (%) (Working Group/FAO)	World total based on regional aggregated trends	Deviation in (%) (regional aggregates/ Working Group)
			Nitrogenous		
1976	108.4		8.6	155.4[a]	43.3
1977	114.0		15.0		
1978	112.0		13.0	145.5[b]	29.9
1979	111.7	99.1	12.7		
			Phosphates		
1976	50.9		(0.5)	72.4[a]	42.2
1977	57.0		11.3		
1978	58.4		14.1	76.2[b]	30.4
1979	59.0	51.2	15.2		
			Potash		
1976	48.9		6.0	63.0[a]	28.8
1977	51.0		10.6		
1978	51.2		11.0	66.9[b]	31.9
1979	50.7	46.1	9.0		

Note: [a] First Draft World-wide Study on the Fertilizer Industry 1975-2000, UNIDO December 1976

[b] Second World-wide Study on the Fertilizer Industry 1975-2000, UNIDO December 1978

Annex V. World production of fertilizers, by region , in million m.t. of nutrient

Region	Nitrogenous				Phosphate				Potash			
	1975/76	1976/77	1977/78	1978/79	1975/76	1976/77	1977/78	1978/79	1975/76	1976/77	1977/78	1978/79
Developed countries												
Market economies	21.7	22.4	23.4	25.1	14.2	15.5	16.2	17.7	11.9	13.2	13.8	14.7
Centrally planned economies	13.5	14.0	14.7	15.3	7.8	8.0	8.4	8.8	11.0	11.5	11.6	11.5
Total developed	35.2	36.4	38.1	40.4	22.0	23.5	24.6	26.5	22.9	24.7	25.4	26.2
Developing countries												
Africa	0.1	0.1	0.2	0.2	0.4	0.4	0.6	0.7	0.3	0.3	0.1	--
Latin America	1.2	1.3	1.3	1.3	1.0	1.3	1.5	1.5	0.01	0.02	0.01	0.01
Near East	1.0	1.0	1.1	1.1	0.6	0.6	0.5	0.5	---	---	---	---
Far East	2.9	3.2	3.6	4.3	0.6	0.8	1.1	1.3	---	---	---	---
Total market economies	5.2	5.6	6.2	7.1	2.6	3.1	3.7	4.0	0.3	0.3	0.1	0.01
Asian centrally planned economies	3.5	4.2	5.1	6.3	1.5	1.6	1.7	2.0	0.2	0.2	0.3	0.3
Total developing	8.7	9.8	11.3	13.4	4.1	4.7	5.4	6.0	0.5	0.5	0.4	0.3
Total world	43.9	46.2	49.4	53.8	26.1	28.2	30.0	32.5	23.4	25.2	25.8	26.5
Available world supply for agriculture	42.2	44.4	47.9	51.6	25.0	26.9	28.4	30.8	21.4	23.1	23.4	24.1

Source: FAO monthly Bulletin of Statistics, March 1980.

Annex VI(A). Plant capacity development and production self-sufficiency in nitrogenous fertilizers

Regions	Plant Capacity, ammonia								Production		
	Capacity in million m.t.			Regional share in (%)			Growth rate in (%)		Self-sufficiency (Prod./consumption)		Growth rate in (%)
	1976/1977	1979/1980	1984/1985	1976/1977	1979/1980	1984/1985	1976-1979/80	1979-1980/85	1976/1977	1978/1979	1976-1978/79
Developed Countries											
Market economies	37.6	38.6	40.2	48.1	39.5	34.9	0.6	0.6	1.1	1.2	5.6
Centrally Planned economies	20.9	30.5	35.9	26.8	31.2	31.2	9.8	2.8	1.2	1.2	4.4
Total	58.5	69.1	76.1	74.9	70.7	66.1	4.2	1.6	1.1	1.2	5.1
Developing Countries											
Africa	0.4	0.6	1.3	0.5	0.7	1.2	14.8	13.7	0.3	0.3	3.3
Latin America	2.8	3.9	6.6	3.6	4.1	5.7	9.3	8.7	0.6	0.5	4.2
Near East	2.0	4.1	6.2	2.6	4.2	5.4	20.3	7.1	0.6	0.8	16.9
Far East	5.7	7.9	11.9	7.3	8.1	10.3	8.1	7.1	0.7	0.8	16.0
Total market economies	10.9	16.7	26.0	14.0	17.1	22.6	11.0	7.6	0.6	0.7	13.2
Asian centrally planned	8.7	11.8	12.9	11.1	12.2	11.3	8.4	1.5	0.8	0.8	21.3
Total	19.6	28.5	38.9	25.1	29.3	33.9	9.9	5.3	0.7	0.7	16.4
World total	78.1	97.6	115.0	100.0	100.0	100.0	5.7	2.6	1.0	1.0	7.7

Source: FAO and UNIDO/FAO/World Bank Working Group on Fertilizers, May 1980.

Annex VI(B). Plant capacity development and production self-sufficiency in phosphate fertilizers

Regions	Plant Capacity, phosphoric acid								Production		
	Capacity in million m.t.			Regional share in (%)			Growth rate in (%)		Self-sufficiency (Prod./consumption)		Growth rate in (%)
	1976/1977	1979/1980	1984/1985	1976/1977	1979/1980	1984/1985	1976/1979/80	1979-1980/85	1976/1977	1978/1979	1976-1978/79
Developed Countries											
Market economies	16.71	17.64	19.20	64.3	59.9	53.8	1.3	1.4	1.1	1.2	6.0
Centrally planned economies	4.97	6.85	7.82	19.1	23.2	21.9	8.3	2.2	1.0	1.0	5.6
Total	21.68	24.49	27.03	83.4	83.1	75.7	3.1	1.6	1.1	1.2	5.9
Developing Countries											
Africa	1.56	1.89	3.04	6.0	6.4	8.5	4.9	3.2	1.1	1.7	24.8
Latin America	0.94	0.94	1.99	3.6	31.9	5.6	--	13.3	0.6	0.7	8.9
Near East	0.65	0.84	1.98	2.5	2.8	5.5	6.6	15.3	0.7	0.5	(12.0)
Far East	1.09	1.23	1.60	4.2	4.2	4.5	3.1	4.5	0.4	0.7	50.6
Total market economies	4.24	4.90	8.61	16.3	16.6	24.1	3.7	9.8	0.6	0.7	17.0
Asian centrally planned	0.07	0.07	0.07	0.3	00.2	0.2	—	—	1.0	0.9	3.9
Total	4.31	4.97	8.68	16.6	16.8	24.3	3.6	12.3	0.7	1.0	13.0
World total	25.99	29.46	35.71	100.0	100.0	100.0	3.2	3.2	1.0	1.0	5.7

Source: FAO and UNIDO/FAO/World Bank Working Group on Fertilizers, May 1980.

Annex VI(C) Plant capacity development and production self-sufficiency in potash fertilizers

Regions	Plant Capacity								Production		
	Capacity in million m.t.			Regional share in (%)			Growth rate in (%)		Self-sufficiency (Prod./consumption)		Growth rate in (%)
	1976/1977	1979/1980	1984/1985	1976/1977	1979/1980	1984/1985	1976-1979/80	1979-1980/85	1976/1977	1978 1979	1976-1978/79
Developed Countries											
Market economies	17.95	18.22	21.56	58.6	55.7	49.6	0.3	2.8	1.2	1.2	5.4
Centrally planned economies	12.35	14.05	20.27	40.3	43.0	46.6	3.2	6.3	1.3	1.3	0.1
Total	30.30	32.27	41.83	98.9	98.7	96.2	1.6	4.4	1.2	1.2	3.0
Developing Countries											
Africa	—	—	—	—	—	—	—	—	1.3	—	—
Latin America	0.03	0.03	0.33	0.1	0.1	0.7	—	—	—	—	—=
Near East	—	—	0.72	—	—	1.7	—	—	—	—	—
Far East	—	—	—	—	—	—	—	—	—	—	—
Total market economies	0.03	0.03	1.05	0.1	0.1	2.4	—	0.3	0.13	0.003	(81.4)
Asian centrally planned	0.32	0.38	0.60	1.0	1.2	1.4	4.4	29.0	0.6	0.4	(1.6)
Total	0.35	0.41	1.65	1.1	1.3	3.8	4.0	26.1	0.23	0.09	(38.1)
World	30.65	32.68	43.48	100.0	100.0	100.0	1.6	4.8	1.0	1.0	2.4

Source: FAO and UNIDO/FAO/World Bank Working Group on Fertilizers, May 1980.

Annex VII(A). The structure of ammonia production capacity by regions, in million m.t. of N.

Regions	Existing capacity 1975/76	Incremental capacity 1976/77 Planned	1979/80 Actual	1977/78 Planned	1979/80 Actual	1978/79 Planned	1979/80 Actual	1979/80 Planned	Actual	Coefficient of capacity implementation 1976 80	1977 80 (actual/planned)	1978 80	1979 80	Coefficient of capacity expansion 1976-1980, (incremental/existing capacity) Planned	Actual
Developed countries:															
Market economies	34.8	6.03	3.8	4.94	1.1	2.43	0.2	0.0	(0.3)	0.63	0.22	0.08	0.0	0.17	0.11
Centrally planned economies	20.3	6.13	10.0	7.53	9.4	6.66	8.4	4.69	4.9	1.63	1.25	1.26	1.04	0.30	0.39
Total developed	55.1	12.16	13.8	12.47	10.5	9.09	8.6	4.69	4.6	1.13	0.84	0.94	0.98	0.22	0.25
Developing countries:															
Africa	0.4	0.66	0.3	0.75	0.3	0.71	0.3	0.33	0.3	0.45	0.40	0.42	0.91	1.65	0.75
Latin America	2.5	1.88	1.4	1.28	1.1	0.35	0.5	0.0	0.0	0.74	0.86	1.42	0.0	0.75	0.56
Near East	1.8	2.54	2.3	2.81	2.2	2.53	1.8	1.14	0.8	0.90	0.78	0.71	0.70	1.41	1.26
Far East	4.7	5.75	3.2	2.82	2.2	2.39	1.9	1.03	0.9	0.56	0.78	0.79	0.87	1.22	0.83
Subtotal	9.4	10.83	7.2	7.66	5.8	5.98	4.5	2.50	2.20	0.66	0.76	0.75	0.88	1.15	0.76
Asian centrally planned	7.3	3.85	4.5	1.88	3.2	1.09	2.4	0.46	1.0	1.17	1.70	2.20	2.17	0.53	0.62
Total	16.7	14.68	11.7	9.54	9.0	7.07	6.9	2.96	3.2	0.79	0.94	0.97	1.08	0.88	0.70
World total	71.8	26.84	25.5	22.01	19.5	16.16	15.5	7.65	7.8	0.95	0.88	0.96	1.02	0.37	0.35

Source: FAO/UNIDO/World Bank Working Group on Fertilizers reports from 1976 to 1980

Notes: - The existing capacity in 1975/76 is that as amended in May 1980
- Actual capacity is the one included in the May 1980 review.
- Planned capacity are the firmly committed plants as recorded by the Group in each year from 1976 onwards.

Annex VII(B) The structure of phosphoric acid production capacity by regions, in million of m.t. of P_2O_5

Regions	Existing capacity 1975/76	Incremental capacity								Coefficient of capacity implementation (actual/planned)				Coefficient of capacity expansion 1976-1980, (Incremental/existing capacity)	
		1976/77 Planned	1979/80 Actual	1977/78 Planned	1979/80 Actual	1978/79 Planned	1979/80 Actual	1979/80 Planned	1979/80 Actual	1976-80	1977-80	1978-80	1979-80	Planned	Actual
Developed countries															
Market economies	15.76	2.45	1.98	0.91	0.93	0.34	0.68	0.69	0.66	0.81	1.02	2.0	0.95	0.15	0.12
Centrally planned economies	4.86	0.67	1.99	0.49	1.88	0.98	0.84	0.63	1.15	2.97	3.83	0.85	1.82	0.13	0.41
Total developed	20.62	3.12	3.97	1.40	2.91	1.32	2.52	1.32	1.81	1.27	2.00	1.91	1.37	0.15	0.19
Developing countries															
Africa	1.19	0.99	0.70	1.06	0.33	0.33	0.33	0.33	0.33	0.78	0.31	1.0	1.0	0.83	0.59
Latin America	0.96	1.06	(0.02)	0.1	0.0	0.0	0.0	0.0	0.0	(0.018)	0.0	0.0	0.0	1.10	(0.02)
Near East	0.58	0.63	0.26	0.35	0.19	0.45	0.19	0.20	0.04	0.41	0.54	0.42	0.20	1.08	0.45
Far East	0.60	0.71	0.63	0.1	0.14	0.05	0.02	0.0	0.0	0.89	1.4	0.4	0.8	1.18	1.05
Sub-total	3.33	3.39	1.57	1.61	0.66	0.83	0.54	0.53	0.37	0.46	0.41	0.65	0.70	1.02	0.47
Asian centrally planned	0.07	0.10	0.0	0.11	0.0	0.11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.42	0.0
Total	3.40	3.49	1.57	1.71	0.66	0.94	0.54	0.53	0.37	0.45	0.38	0.57	0.70	1.02	0.46
World total	23.92	6.61	5.54	3.11	3.47	2.26	3.06	1.85	2.18	0.84	1.11	1.35	1.18	0.27	0.23

Sources: FAO/UNIDO/World Bank Working Group on Fertilizers reports from 1976 to 1980

Notes: - The existing capacity in 1975/76 is that as amended in May 1980
- Actual capacity is the one included in the May 1980 review.
- Planned capacity are the firmly committed plants as recorded by the Group in each year from 1976 onwards

Annex VII(C). The structure of potash production capacity by regions, in million m.t. of K_2O

Regions	Existing capacity 1975/76	Incremental capacity								Coefficient of capacity implementation (actual/planned)				Coefficient of capacity expansion 1976-1980, (Incremental/existing capacity)	
		1976/77		1977/78		1978/79		1979/80		1976-80	1977-80	1978-80	1979-80	Planned	Actual
		Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual						
Developed countries:															
Market economies	17.63	1.34	0.59	0.92	0.27	0.53	0.54	0.46	0.28	0.44	0.29	1.01	0.61	0.07	0.03
Centrally planned economies	11.93	1.45	1.74	2.90	1.64	2.00	1.50	0.90	0.80	1.20	0.56	0.75	0.89	0.12	0.14
Total developed	29.56	2.79	2.33	3.82	1.91	2.53	2.04	1.36	1.08	0.83	0.50	0.80	0.79	0.09	0.08
Developing countries:															
Africa	0.30	0.10	(0.30)	0.0	NA	NA	NA	NA	NA	(3.0)	NA	NA	NA	0.33	(1)
Latin America	0.03	0.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Near East	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0	0.0
Far East	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	0.33	0.16	(0.30)	—	0.0	—	0.0	—	0.0	(1.8)	—	—	—	—	—
Asian centrally planned	0.30	0.0	0.08	0.06	0.06	0.04	0.04	0.02	0.02	0.0	1.0	1.0	1.0	0.0	0.26
Total	0.63	0.16	(0.22)	0.06	0.06	0.04	0.04	0.02	0.02	(1.7)	1.0	1.0	1.0	0.25	(0.35)
World total	30.19	2.95	2.11	3.88	1.97	2.57	2.08	1.38	1.10	0.71	0.50	0.66	0.79	0.09	0.10

Source: FAO/UNIDO/World Bank Working Group on Fertilizers reports from 1976 to 1980

Notes: - The existing capacity in 1975/76 is that as amended in May 1980
- Actual capacity is the one included in the May 1980 review
- Planned capacity are the firmly committed plants as recorded by the Group in each year from 1976 onwards.

Annex VIII World trade in fertilizers, by region, in million of m.t. of nutrient

Region	Imports						Exports					
	N		P_2O_5		K_2O		N		P_2O_5		K_2O	
	1977/78	1978/79	1977/78	1978/79	1977/78	1978/79	1977/78	1978/79	1977/78	1978/79	1977/78	1978/79
Developed countries												
Market economies	4.0	4.7	2.0	2.6	8.9	9.1	6.9	8.2	4.7	5.4	9.7	10.6
Centrally planned economies	0.3	0.3	0.4	0.4	3.0	2.8	2.3	2.3	0.3	0.4	5.2	5.2
Total developed	4.3	5.0	2.4	3.0	11.9	11.9	9.2	10.5	5.0	5.8	14.9	15.8
Developing countries												
Africa	0.4	0.4	0.2	0.2	0.2	0.2	0.01	0.02	0.3	0.3	--	--
Latin America	1.4	1.3	0.8	0.8	1.4	1.5	0.2	0.2	0.1	0.1	0.01	0.01
Near East	0.8	1.0	0.3	0.6	0.05	0.05	0.5	0.7	0.1	0.1	--	--
Far East	1.7	2.4	0.7	0.9	1.1	1.2	0.4	0.4	0.1	0.2	--	--
Total market economies	4.3	5.1	2.0	2.5	2.8	3.0	1.1	1.3	0.6	0.7	0.01	0.01
Asian centrally planned	1.6	1.5	0.1	0.2	0.2	0.4	0.02	0.04	--	--	--	--
Total developing	5.9	6.6	2.1	2.7	3.0	3.4	1.1	1.3	0.6	0.7	0.01	0.01
Total world	10.2	11.6	4.5	5.7	14.9	15.3	10.3	11.8	5.6	6.5	14.9	15.8

Source: FAO Monthly Bulletin of Statistics, March 1980

Figure 1 World consumption of nitrogen, phosphate and potash fertilizers, past and projected long-term projections in million m.t.

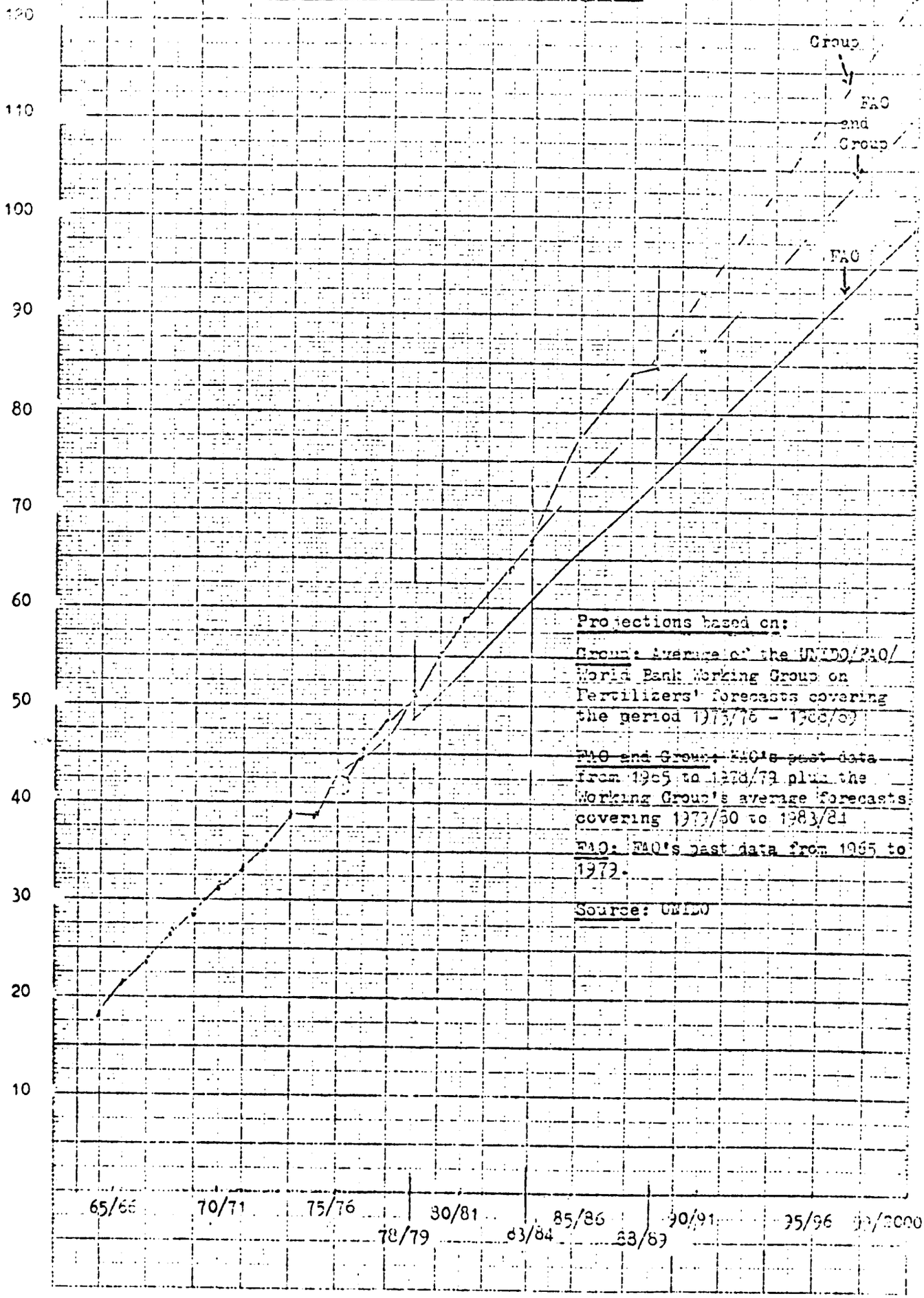


Figure 2 World consumption of phosphate fertilizers, comparative long-term projections in million m.t.

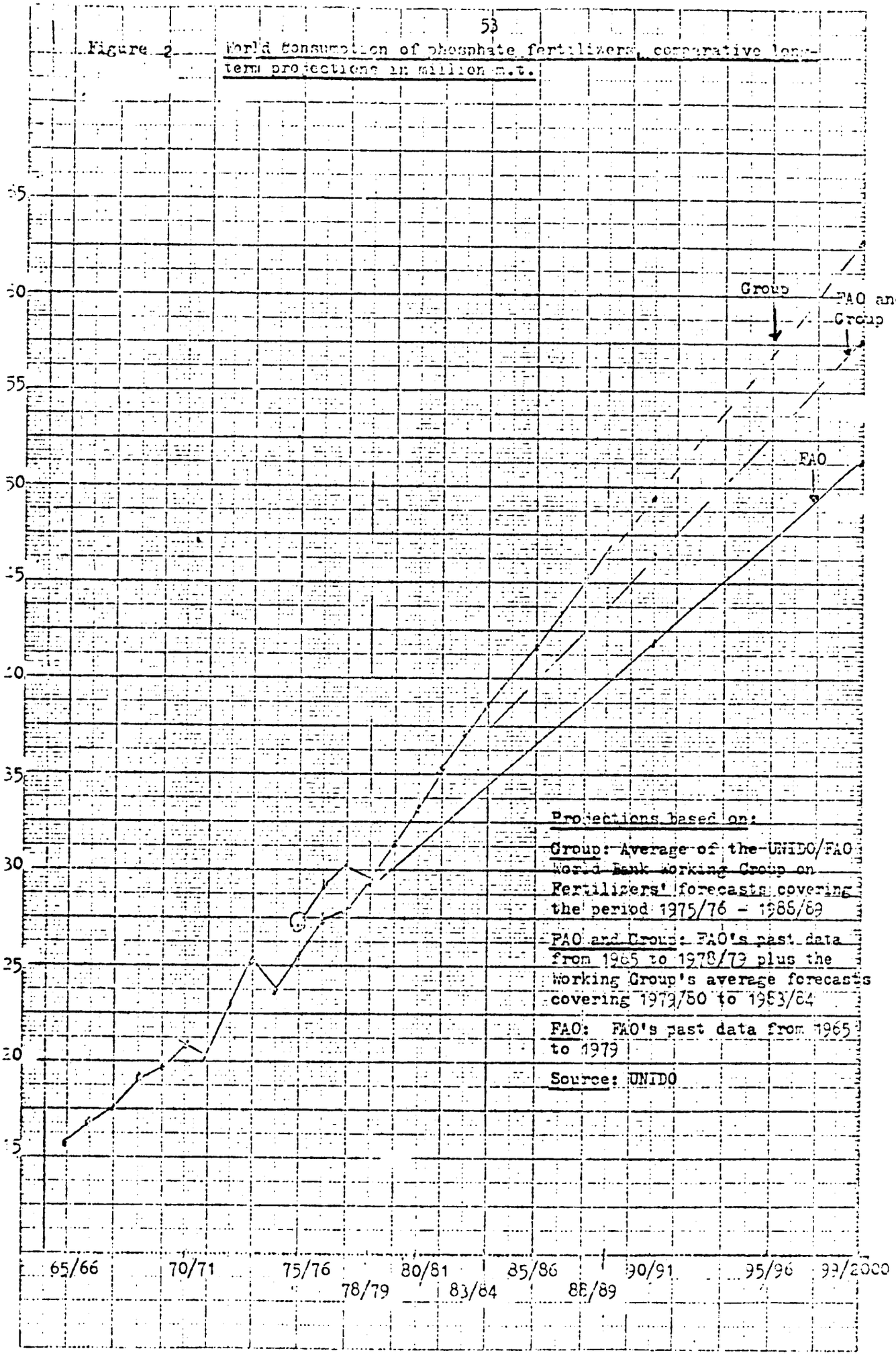


Figure 3 -- World Consumption of Potash Fertilizers, comparative long-term projections in million m.t.

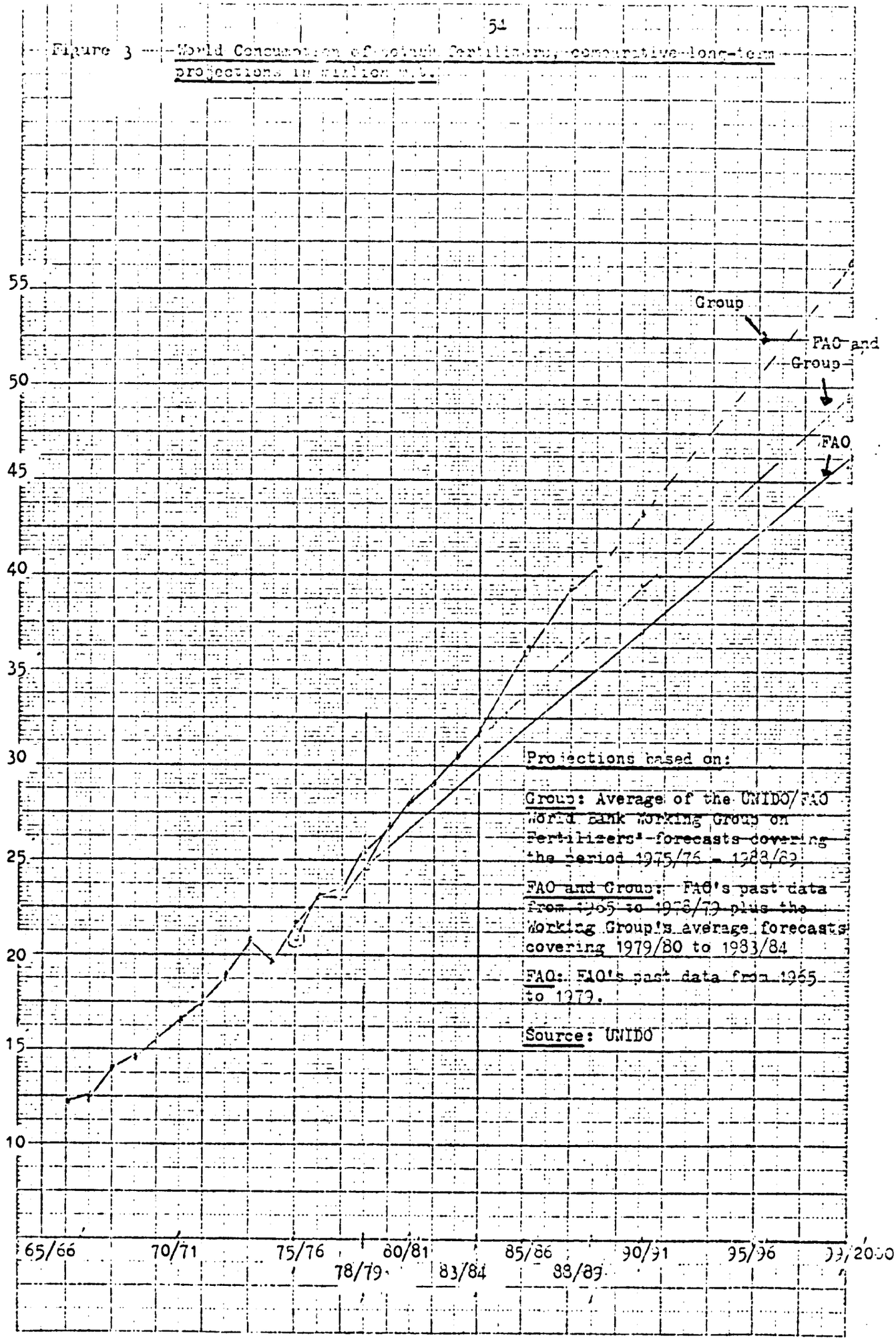


Figure 4 World consumption of nitrogenous fertilizers, comparative regional aggregates for the long-term reference projection in million m.t.

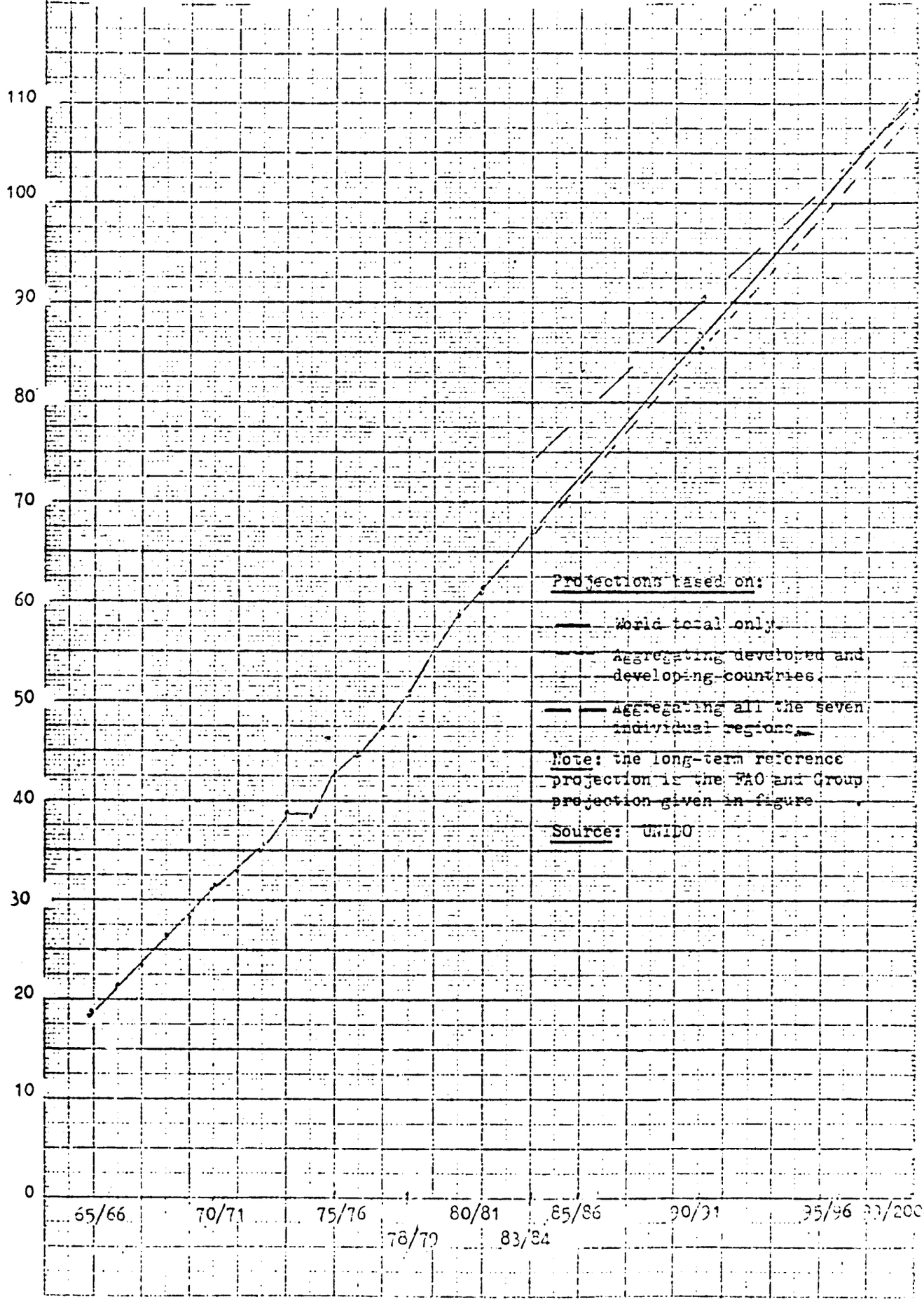


Figure 5 Consumption of phosphate fertilizers, comparative regional aggregates for the long-term reference projection in million m.t.

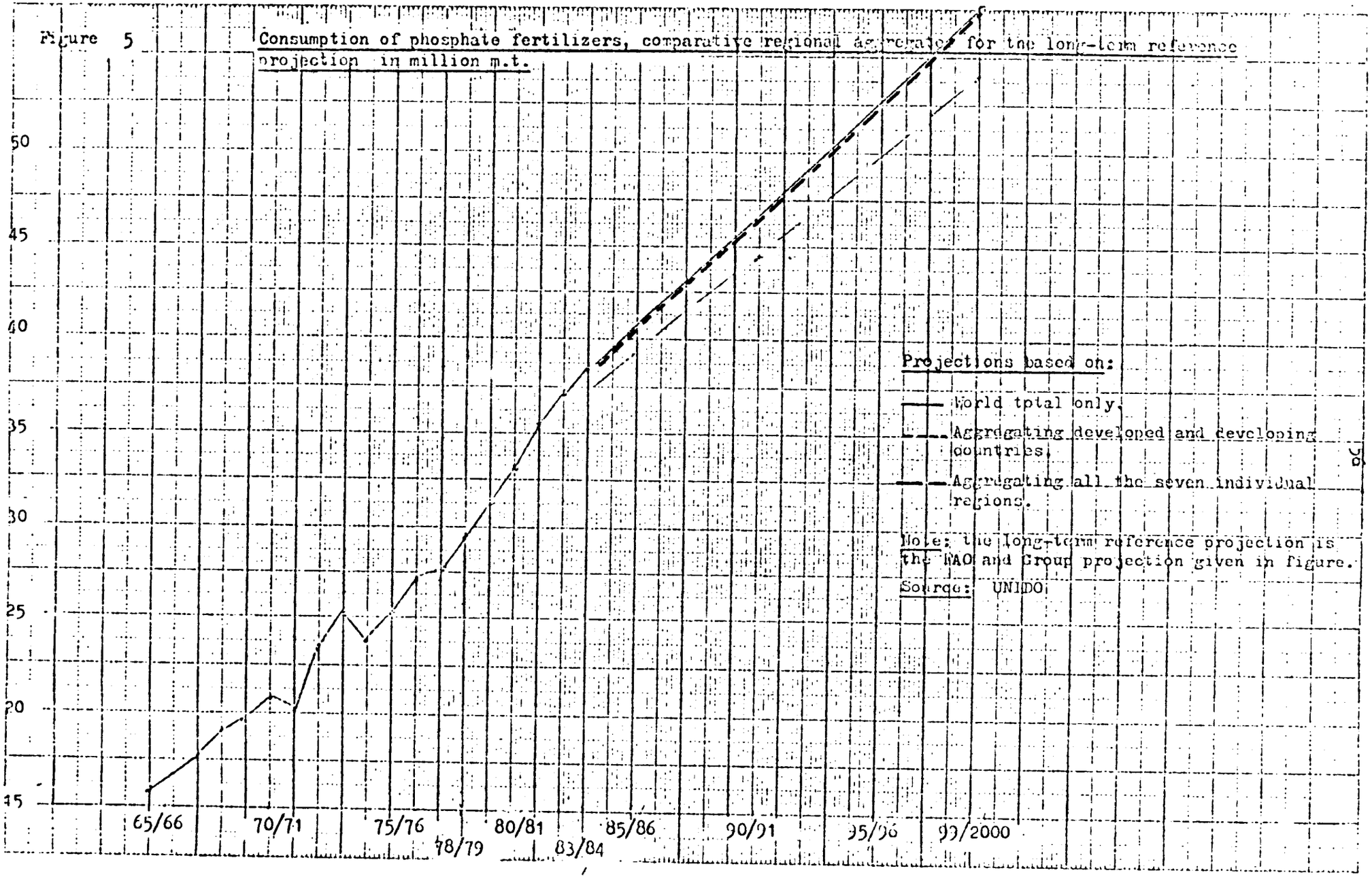


Figure 6 Consumption of potash fertilizers, comparative regional aggregates for the long-term reference projection in million n.t.

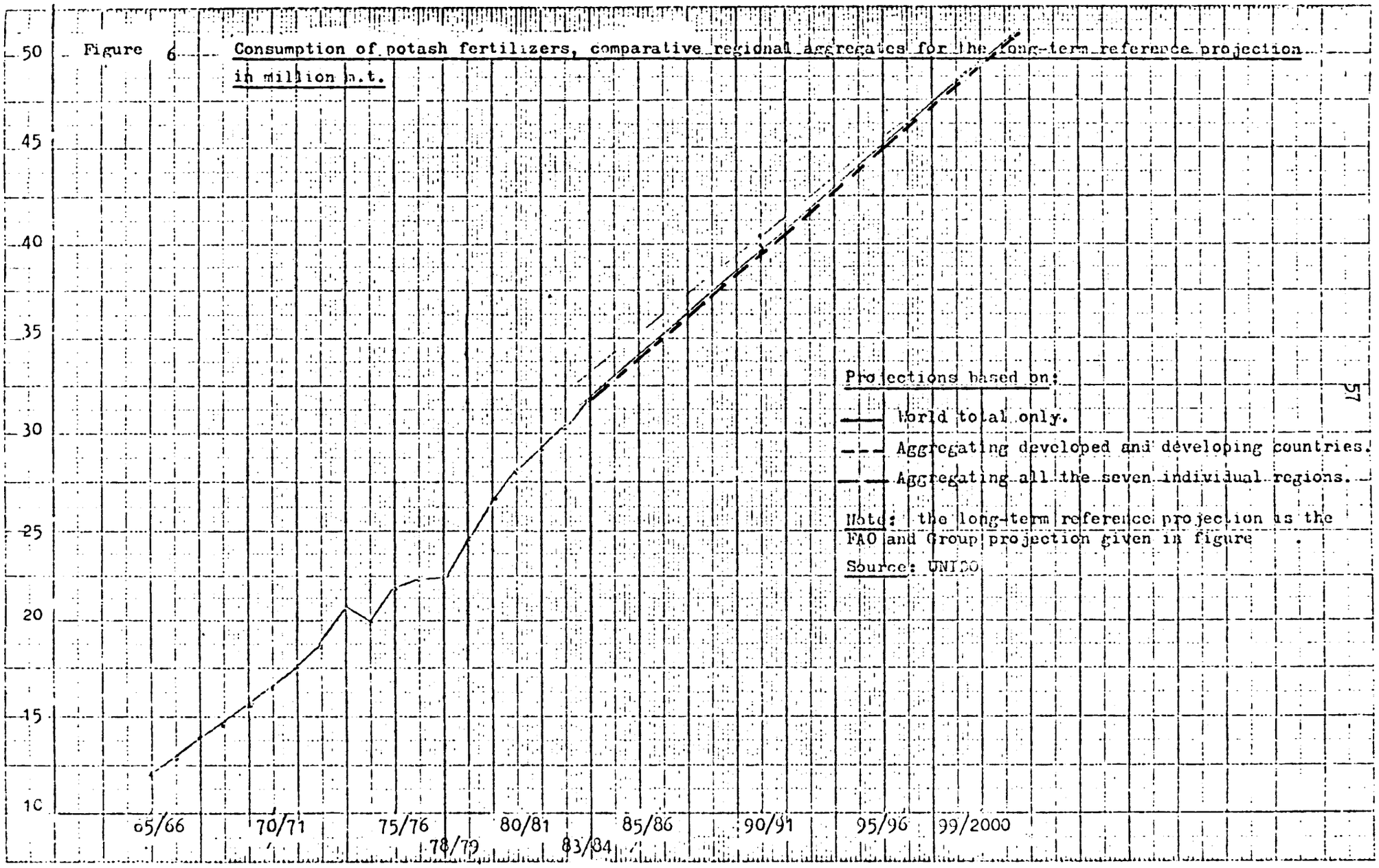
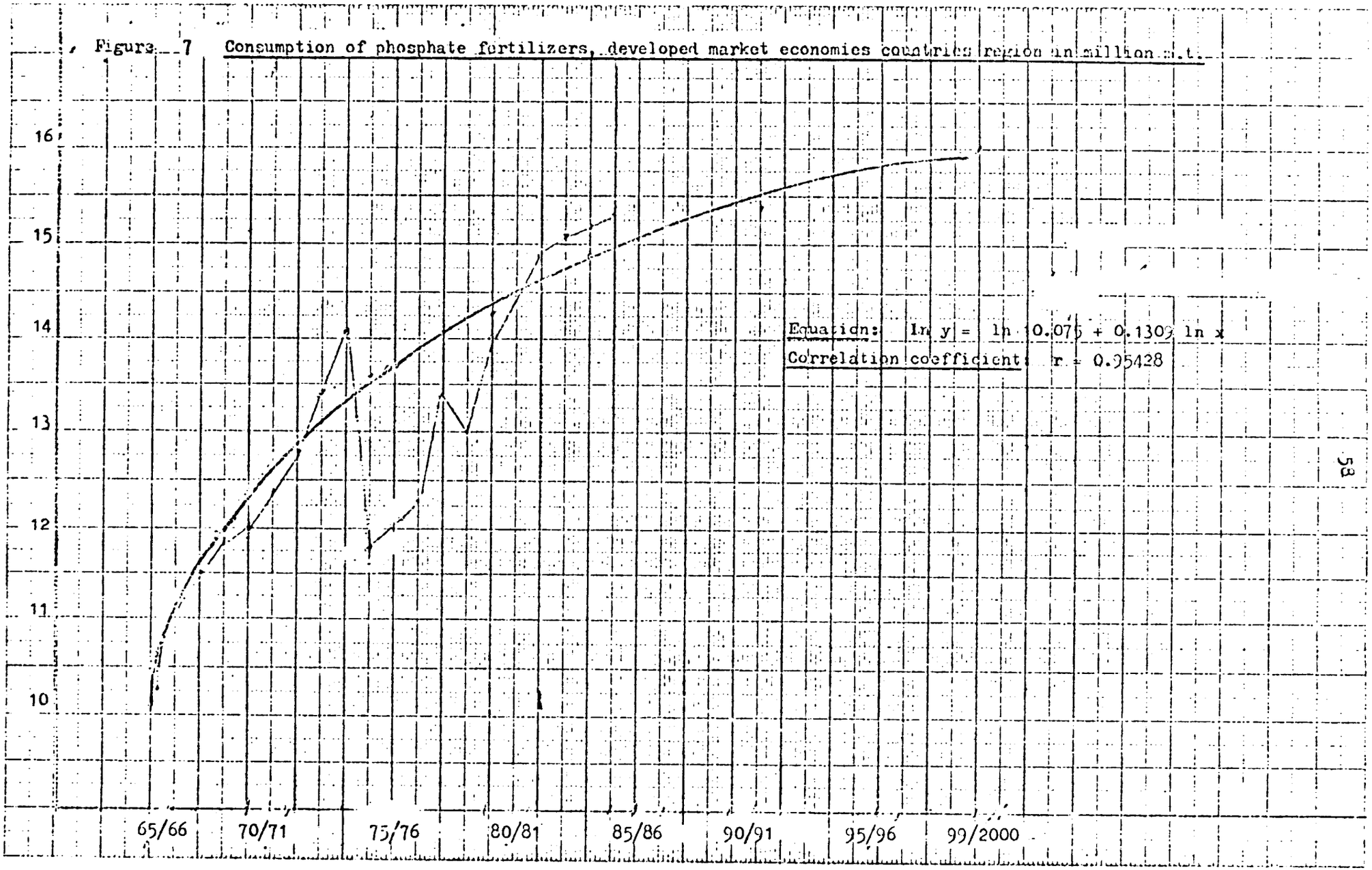
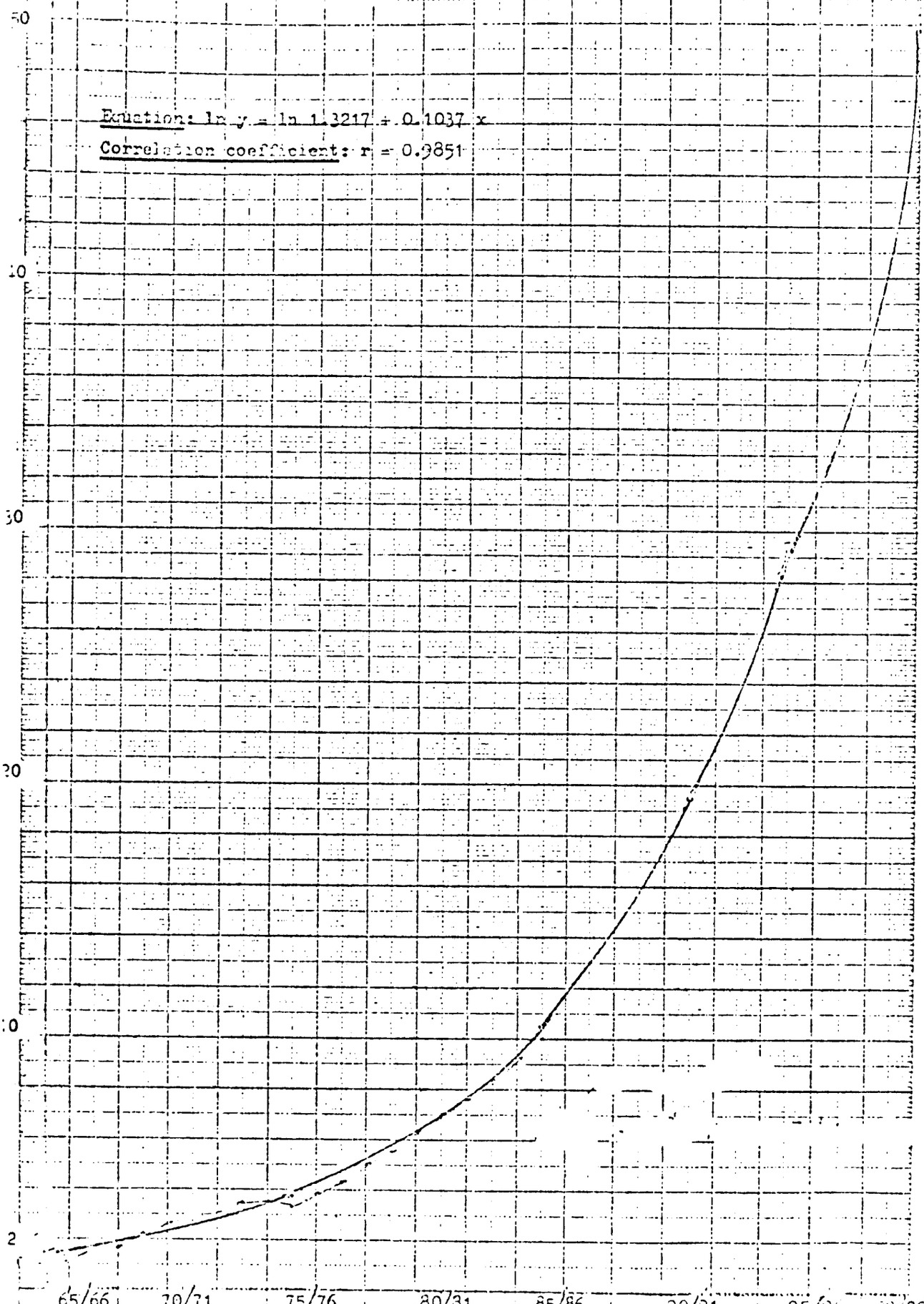


Figure 7 Consumption of phosphate fertilizers, developed market economies countries region in million n.t.



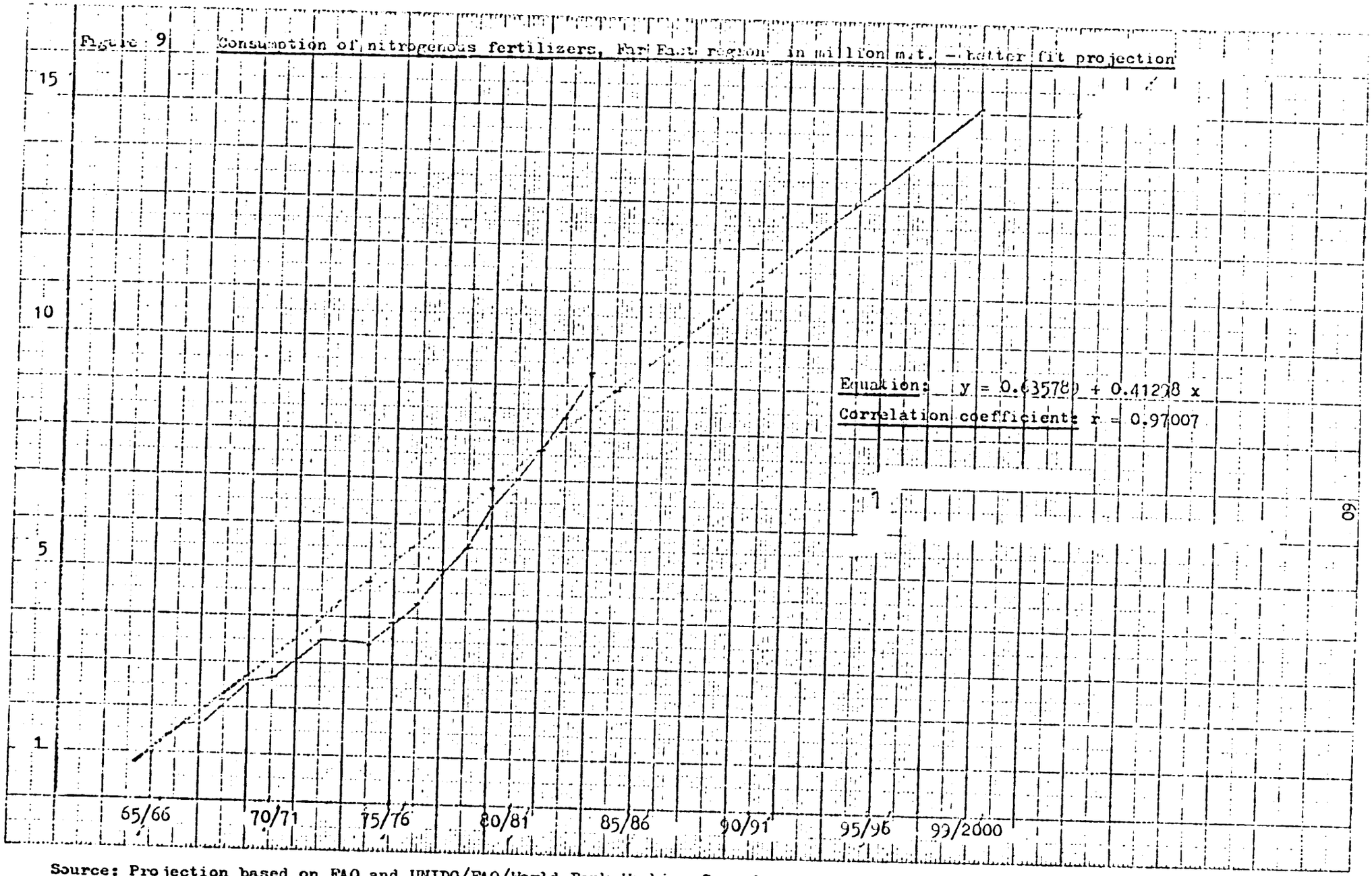
Source: projection based on FAO and UNIDO/FAO/World Bank Working Group's average from 1979 to 1983.

Figure 8 Consumption of nitrogenous fertilizers, Far East region in million m.t.
= best fit projection



Source: Projection based on FAO and UNIDO/FAO/World Bank Working Group's average trend 1979 to 1983.

Figure 9 Consumption of nitrogenous fertilizers, Far East region in million m.t. – better fit projection



Source: Projection based on FAO and UNIDO/FAO/World Bank Working Group's average from 1979 to 1983.

Figure 10 Consumption of phosphate fertilizers, Africa region in million m.t. - best fit projection

Equation: $\ln y = \ln 0.0996 + 0.1070 x$

Correlation coefficient: $r = 0.9706$

Source: Projection based on FAO and UNIDO/FAO/ World Bank Working Group's average from 1979 to 1983

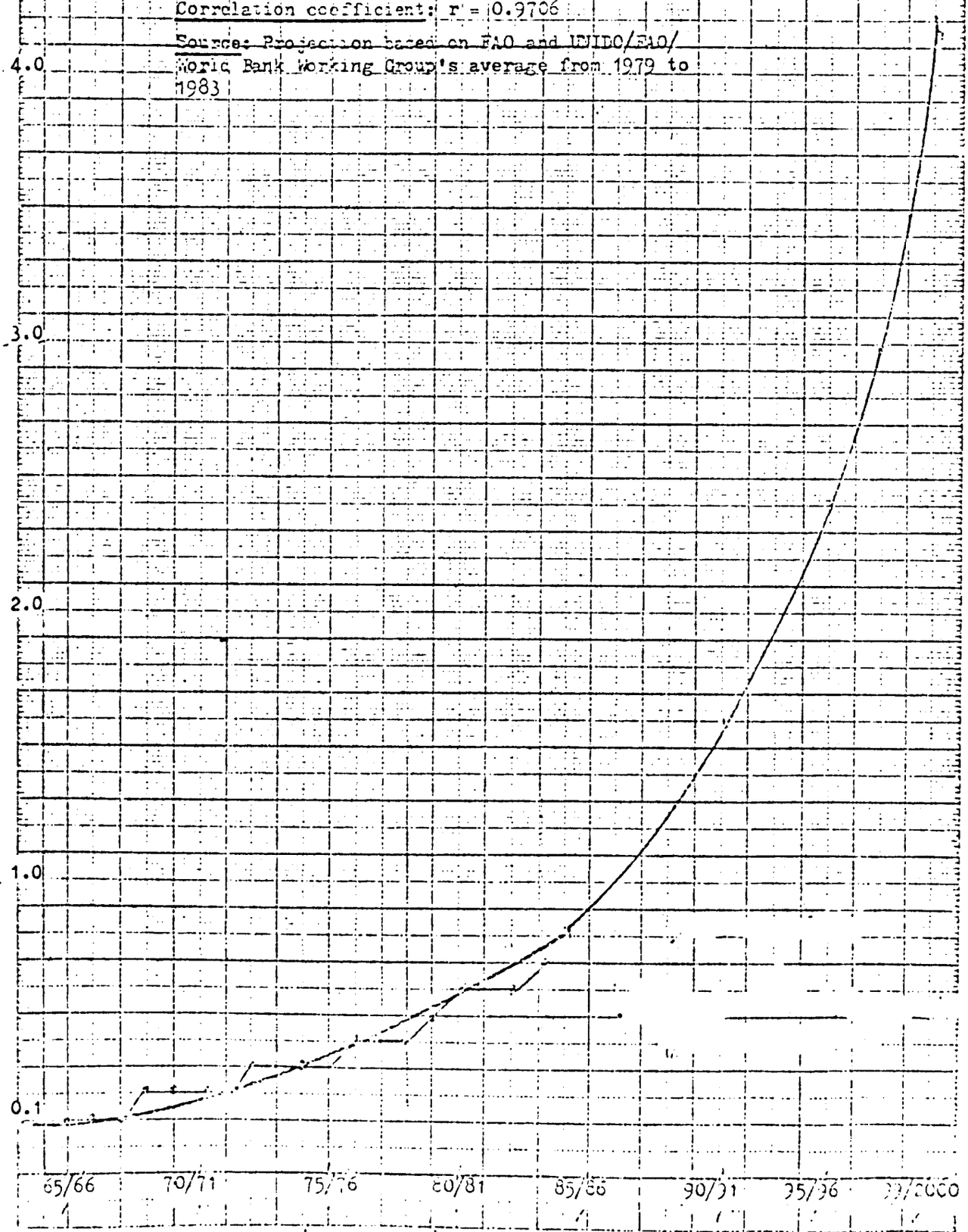
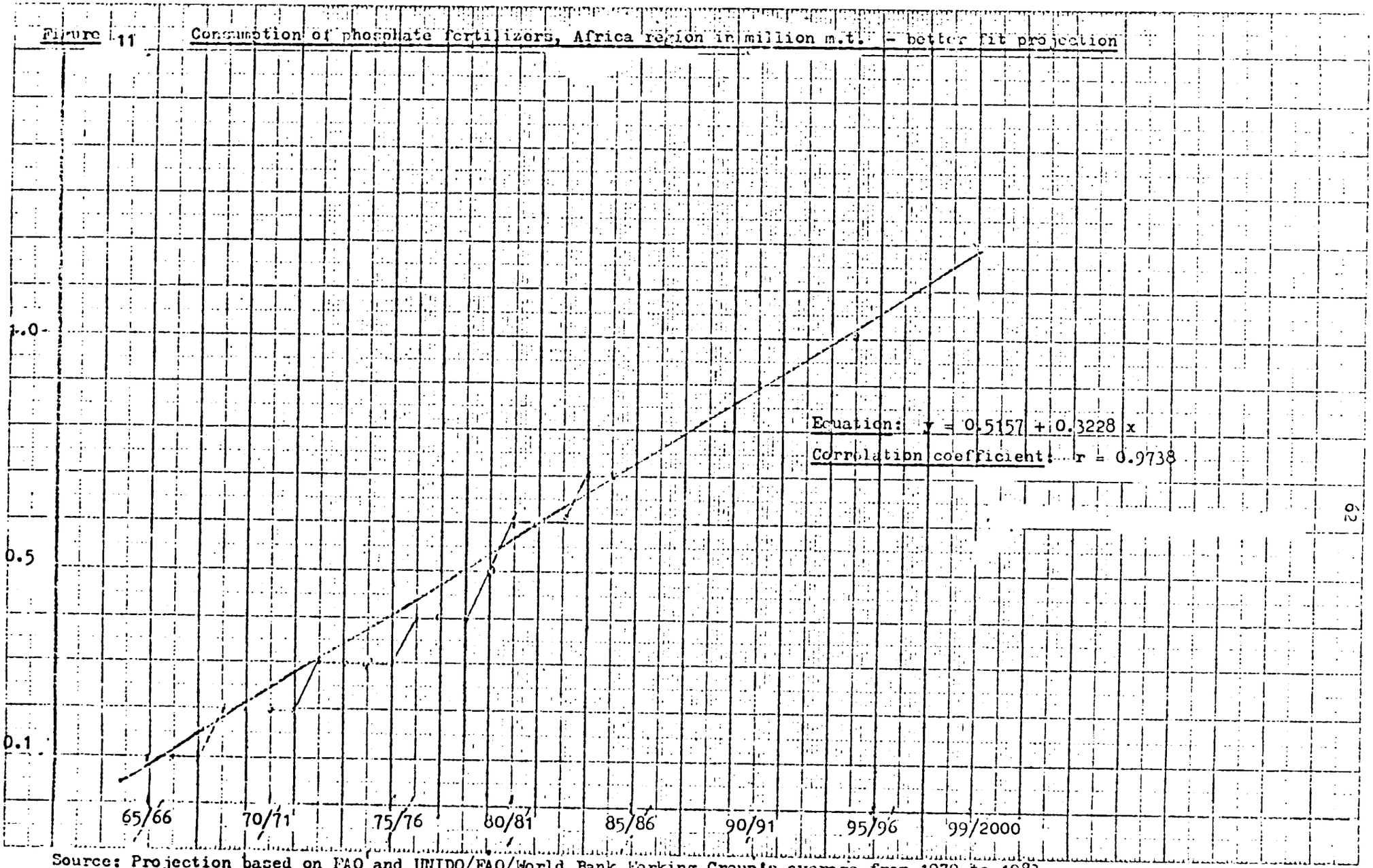
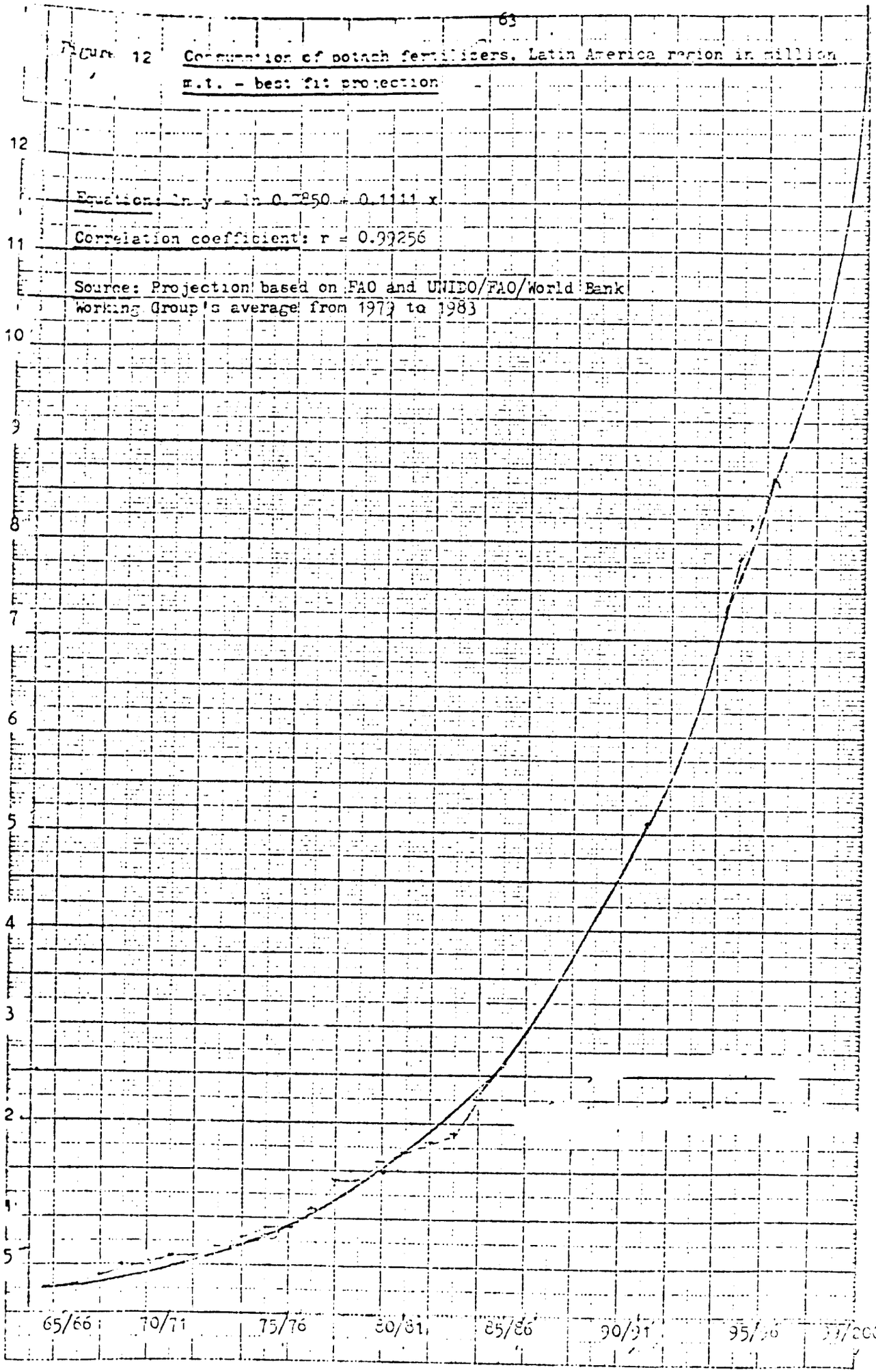


Figure 11 Consumption of phosphate fertilizers, Africa region in million m.t. - better fit projection



Source: Projection based on FAO and UNIDO/FAO/World Bank Working Group's average from 1979 to 1983.

Figure 12 Consumption of potash fertilizers, Latin America region in million m.t. - best fit projection

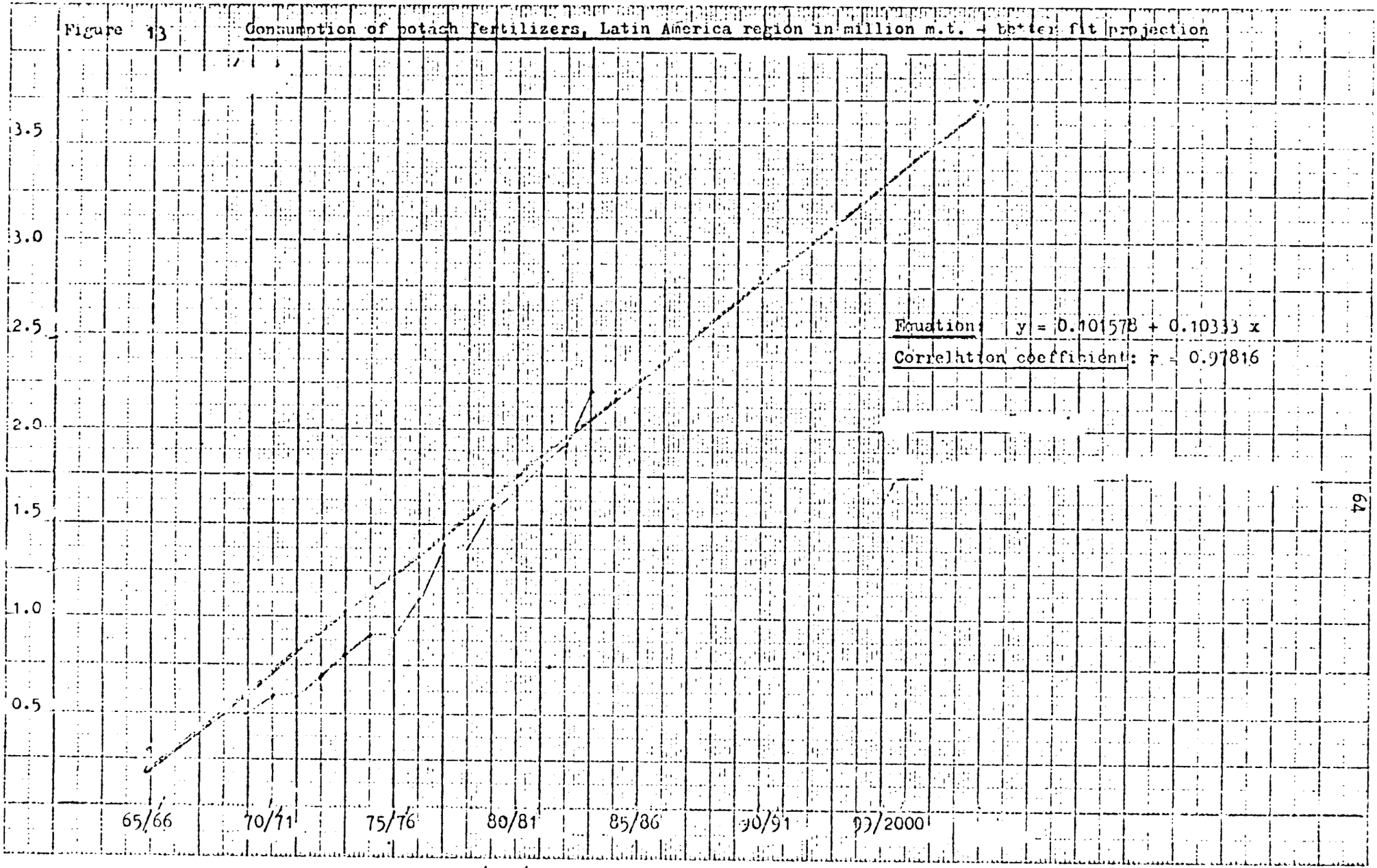


Equation: $\ln y = \ln 0.7850 + 0.1111 x$

Correlation coefficient: r = 0.99256

Source: Projection based on FAO and UNIDO/FAO/World Bank Working Group's average from 1972 to 1983

Figure 13 Consumption of potash fertilizers, Latin America region in million m.t. + better fit projection



Source: Projection based on FAO and UNIDO/FAO/World Bank Working Group's average from 1979 to 1983

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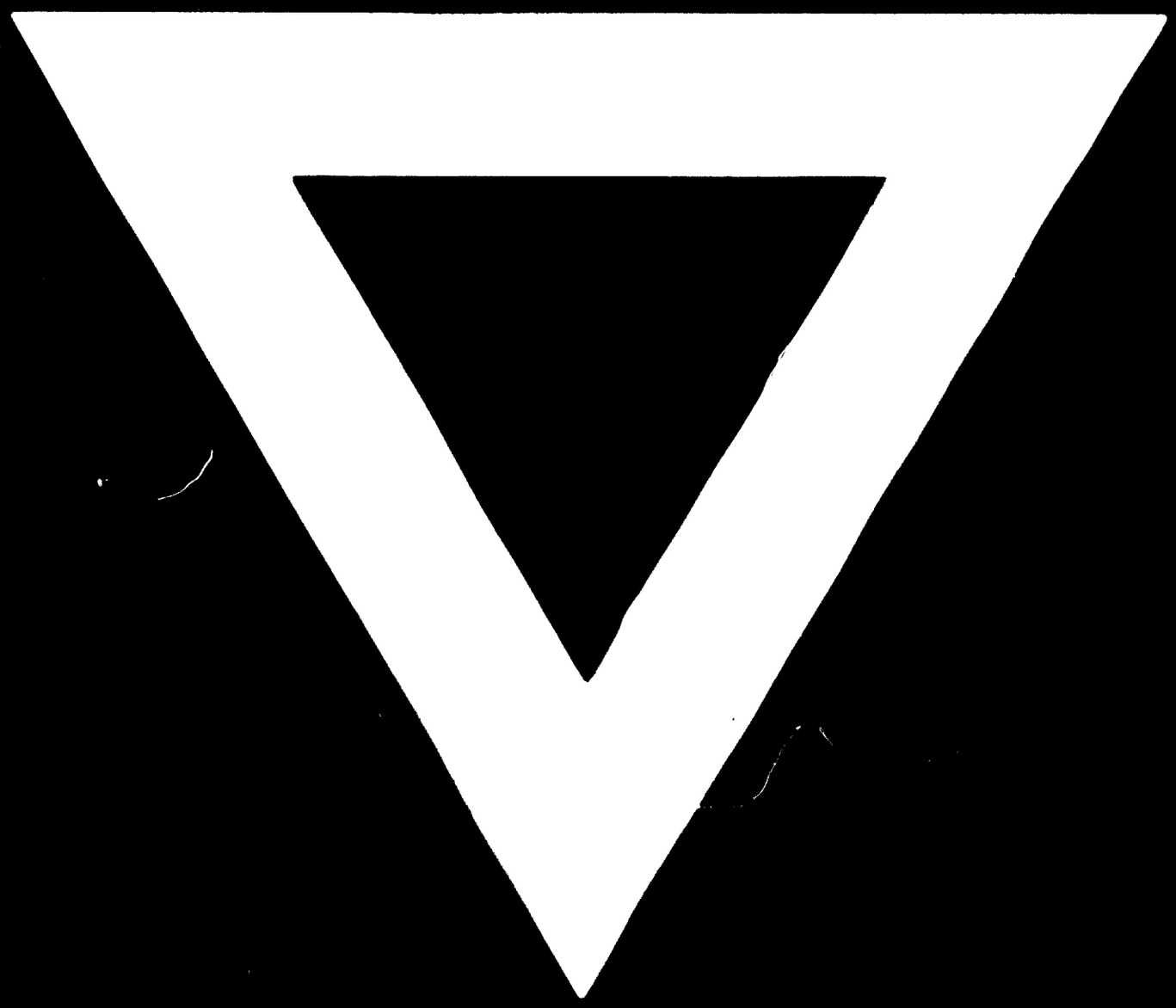

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