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FERTILIZERS IN AFRICA

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I. LONG-TERM TREND OF WORLD FERTILIZER CONSUMPTION

1. The commercial fertilizer industry had its beginning more than a hundred years ago but the really significant impact of fertilizers has been since the Second World War.
2. From the figures below (Table 1) it will be seen that world consumption rose from about 1.9 million metric tons around the beginning of this century to about 3.1 million tons just before the First World War.

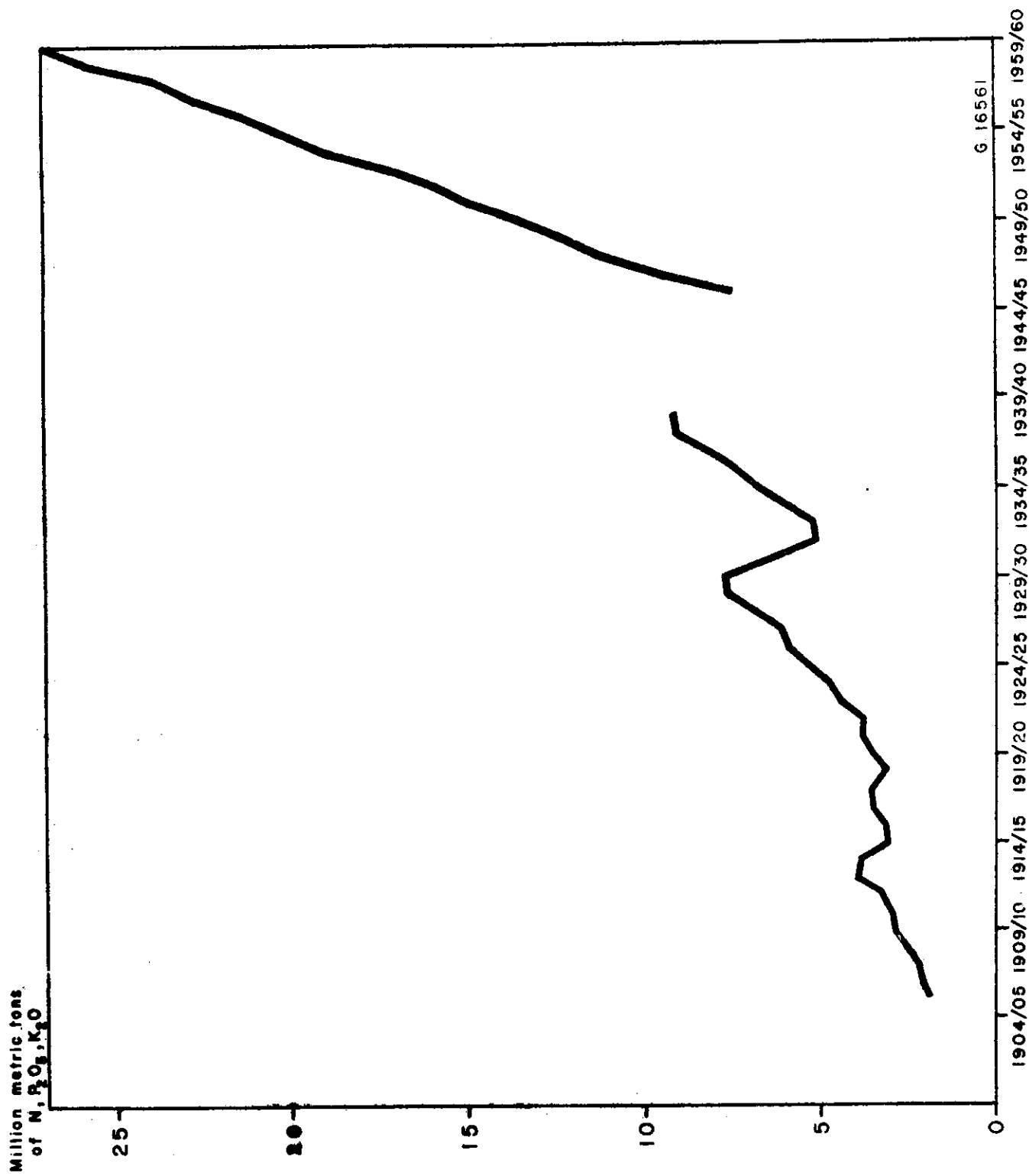
TABLE 1

World fertilizers consumption
(1'000 metric tons N, P₂O₅, K₂O)

Year	Fertilizers			Total
	Nitrogenous	Phosphate	Potash	
1905/1906	366	1,047	515	1,928
1910/1911	623	1,513	914	3,050
1915/1916	770	1,549	809	3,128
1920/1921	779	1,941	1,141	3,861
1925/1926	1,183	2,951	1,843	5,977
1929/1930	1,797	3,538	2,384	7,719
1931/1932	1,237	2,403	1,508	5,148
1938/1939	2,670	3,637	2,904	9,211
1945/1946	2,025	3,375	2,100	7,500
1950/1951	4,191	6,208	4,514	14,913
1955/1956	6,630	7,840	6,830	21,300
1959/1960	9,220	9,530	8,380	27,130
1960/1961	10,010	9,970	8,540	28,520

Source: Monthly bulletin of agricultural economics and statistics, 1a -
Volume 11, No.2 of February 1962 p.1-3; 1 b. Volume 12, April 1963.
Fertilizers. An annual review of world production, consumption
and trade, FAO, 1961.

FIGURE 1 - WORLD FERTILIZER CONSUMPTION
1905/06 - 1959/60



3. Before the world economic depression the consumption of fertilizers was as high as 7.7 million metric tons but the consumption showed a sharp decline during the early thirties, caught up again after 1931-1932 and rose above a level of 9 million tons in 1938-1939.
4. During the Second World War, world consumption had fallen (except in North America where consumption had increased 60 per cent) to a level of 7.5 million tons in 1945-1946. This year was, however, the starting point of accelerated growth of fertilizer consumption, leading to an increase of 280 per cent in 15 years (260 per cent in 14 years from 1945 to 1959).
5. From 1905-1920, more than half of the fertilizer used was phosphate, but nitrogenous fertilizers show the greatest increase after the Second World War and gain the absolute majority in 1960-1961.
6. The proportion of consumption of different kinds of fertilizers was in 1960: 100N; 100P₂O₅; 85K₂O.
7. The distribution of fertilizer consumption and distribution of post-war increase by regions are shown in Table 2.

TABLE 2

World fertilizer consumption by regions
(¹000 metric tons of plant nutrients)

Region	1937/38	1945/46	1949/50	1954/55	1959/60	Percentage increase over			Increase in Thousand metric tons over 14 year 1945-1946 1959-1960
						1938/1939		1945/1946	
						1949/50	1959/60	1959/60	
World	9,200	7,500	13,497	20,260	27,130	47	195	262	19,630
Europe (Excl. USSR)	5,050	3,287	6,269	9,039	12,607	24	149	285	9,320
W. Europe	4,650	3,157	5,200	7,399	9,991	-	-	-	6,834
E. Europe ^{a/}	300	130 ^{b/}	1,069 ^{c/}	1,640	2,616	-	-	-	2,486
USSR	700	680 ^{d/}	1,025 ^{d/}	1,718	2,340	44	234	244	1,660
N. America	1,700	2,672	4,024	5,887	7,130	136	319	167	4,458
Latin America	100	154	225	481	840	125	740	446	686
Near East	100	48	133	206	250	33	150	421	202
Far East ^{e/}	1,000	86	1,014	1,748	2,530	1	153	2,842	2,444
Oceania	400	373	507	722	840	27	110	125	467
Africa ^{f/}	150	200	300	459	593	100	295	197	393

Source: Monthly bulletin of agricultural economics and statistics, 1a - Volume 11, No.2 of February 1962 p.1-3; 1b volume 12, April 1963.

Fertilizers and economic development, F.W. Parker, FAO, February 1962.

^{a/} Includes Bulgaria, Czechoslovakia, Eastern Germany, Hungary, Poland, Yugoslavia. In 1945-1946, the figures of Eastern Germany are included in those of Germany (Western Germany).

^{b/} Czechoslovakia and Poland.

^{c/} Excluding Bulgaria.

^{d/} Estimate. ^{e/} Excluding Mainland China.

^{f/} All data changed up to level given in table 4 for 1954-1955 and 1959-1960 and according to other sources:

Fertilizers, A. World Report on Production and consumption, Food and Agriculture Organization, August 1951.

An annual review of world production and consumption of fertilizers, FAO, 1954.

8. All regions shared in the post-war increase of fertilizer consumption but the share of the less developed countries was extremely low.

TABLE 3

The percentage share of post-war increase
of fertilizer consumption by regions

<u>Region - Country</u>	<u>Percentage share</u>
Europe and USSR	56.0
North America	22.7
Japan, Taiwan and S.Korea	12.4
Latin America, Near East and Africa	4.5
Oceania	2.4
Africa	2.0

9. Of 19.6 million additional metric tons of plant nutrients, 17.9 million tons were used in the more advanced regions and only 1.6 million tons in less developed regions. In the latter almost two-thirds of the people of the world live. This means that an average use of fertilizers in more developed countries was, in 1959-1960, about 25 kilos of plant nutrients per capita and only 1.3 kilos in less developed countries.

II. PRODUCTION, CONSUMPTION AND TRADE IN FERTILIZERS IN AFRICA 1954-1955-1960-61

10. Africa takes a very small part in world fertilizers consumption and still less in world fertilizer output.

TABLE 4

Production, consumption and trade in fertilizers in Africa1954-1955 - 1960-1961(1000 metric tons of N, P_2O_5, K_2O)

Specification	1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61
Output	214	250	276	277	313	330	372
Consumption	459	481	489	580	621	593	717
Percentage of world output	1.0	1.1	1.2	1.1	1.2	1.2	1.3
Percentage of world consumption	2.3	2.3	2.2	2.4	2.4	2.2	2.5
Exports, gross	34	41	45	51	54	54	56
Imports, gross	268	276	269	349	376	297	381
Exports - Imports	-234	-235	-224	-298	-322	-243	-325

Sources: Fertilizers, An annual review of world production, consumption and trade, FAO, 1961.

Makonnen Alemayehu, Chemicals and Fertilizers, first draft, Economic Commission for Africa, 27 September 1962.

11. In the period of 1944/1945 - 1960/1961, the percentage of African fertilizer output did not exceed 1.3 per cent of the world output. As the consumption of fertilizers is larger than the output, considerable amounts of fertilizers must be imported from other countries. The difference between gross export and gross import shows the tendency to growth year by year.

12. The average consumption of fertilizer in Africa is the smallest in the world, per head and per area.

TABLE 5

Fertilizer consumption in relation to agricultural land
arable land and total population in 1959/1960

Continent	Number of total population per hectare of arable land	Average consumption in kg NPK per 1 hectare of	
		Agricultural land ^{a/}	Arable land ^{b/}
Europe (excluding USSR)	2.7	54.5	81.9
USSR	1.0	4.0	10.6
North & Central America	1.0	12.3	29.2
South America	1.9	1.2	6.1
Asia (excl. Mainland China and North Korea)	2.9	4.7	8.4
Oceania	0.5	1.8	29.9
Africa	1.1	0.7	2.5

Source: Fertilizers, An annual review of world production, consumption and trade, FAO, 1961 - p.16, Table 15.

13. There is extremely low potash fertilizer consumption in Africa. Recently, the whole amount of this kind of fertilizer does not exceed a hundred thousand metric tons.

a/ "Agricultural land" or "Agricultural area" includes, according to FAO census definitions, "arable land and land under permanent crops" and "permanent meadows and pastures".

b/ "Arable land and land under permanent crops" includes land under crops (double-cropped areas are counted only once), land temporarily fallow, temporary meadows for mowing or pasture, land under market and kitchen gardens and land under fruit trees, vines, shrubs and rubber plantations.

TABLE 6

Production, consumption and trade in potash fertilizers in Africa
('000 metric tons)

Specification	1954/55	1955/56	1956/57	1957/58	1958/59	1959/60	1960/61
Output	1	1	1	-	-	-	-
Consumption	63	61	53	71	82	84	94
Percentage of world output	-	-	-	-	-	-	-
Percentage of world consumption	1.0	0.9	0.7	1.0	1.0	1.0	1.1
Exports, gross	-	-	-	-	-	-	-
Imports, gross	62	64	61	76	84	85	94
Exports-Imports	-62	-64	-61	-76	-84	-85	-94

Sources: Fertilizers, An annual review of world production, consumption and trade, FAO, 1961.

Makonnen Alemayehu, Chemicals and Fertilizers, first draft, Economic Commission for Africa, 27 September 1962.

14. As shown in Table 6, Africa produces no potash fertilizer. Potash is said to exist in the Congo (Brazzaville), Gabon, Ethiopia and Tunisia.^{1/} Whether the deposits of this salt in the Congo, Gabon and Tunisia are worthy of exploitation is not known yet. A potash refining plant in Ethiopia (Dallol) is planned to begin production in 1964. This plant will be able to give a yearly output of 300,000 metric tons of K_2O which would be more than three times the 1960-1961 total African consumption.

15. As to phosphate fertilizers the situation with respect to production is slightly better. Africa produces a certain amount and even exports small quantities.

^{1/} Makonnen Alemayehu, Chemicals and Fertilizers, first draft, Economic Commission for Africa, 27 September 1962.

TABLE 7

Production, consumption and trade in phosphate fertilizers in Africa
(thousand metric tons)

Specification	1954/'55	1955/'56	1956/'57	1957/'58	1958/'59	1959/'60	1960/'61
Output	187	211	235	229	258	270	300
Consumption	210	217	234	249	246	280	316
Percentage of world output	2.4	2.6	2.8	2.7	2.8	2.8	3.0
Percentage of world consumption	2.8	2.8	2.8	2.9	2.7	2.9	3.2
Exports, gross	34	41	45	51	54	54	56
Imports, gross	47	47	46	61	55	44	54
Exports-Imports	-13	-6	-1	-10	+1	+10	+2

Sources: Fertilizers, An annual review of world production, consumption and trade, FAO, 1961.

Makonnen Alemayehu, Chemicals and Fertilizers, first draft, Economic Commission for Africa, 27 September 1962.

16. If the small consumption of potash is covered only by imports, the consumption of phosphate is based on domestic production of Africa. African international trade in phosphate fertilizers has reached a balance recently.

17. Phosphate fertilizers are produced by the following countries in Africa: Republic of South Africa, an average of about 122,000 metric tons for the period 1944/1945-1959/1960; Tunisia, 41,000 tons and in 1959/1960 more than 60,000 tons; UAR 22,500 tons; Algeria, about 18,000 tons; Morocco, about 15,000 tons; Rhodesia and Nyasaland about 12,000 tons; and very small amounts, 3,000 tons, for other countries.^{1/} As a rule the producing countries are the consumers.

^{1/} According to West Africa No.2413, 5 Oct.1963 p.1137 Togo produces calcium phosphate. From September to December 1957 51070 tons, were mined and exported. Total exports in 1962 were 197,460 tons first grade, 81 per cent. The total for the first six months of 1963 was 214,930 tons (462,320 tons of raw phosphate). It is estimated that 0.5 million tons could be exported during 1963.

18. The consumption of nitrogenous fertilizers is as large as that of phosphates, but the African output of these plant nutrients is rather small.

TABLE 8

Production, consumption and trade in nitrogenous fertilizers in Africa
('000 metric tons)

Specification	1954/'55	1955/'56	19556/'57	1957/'58	1958/'59	1959/'60	1960/'61
Output	26	38	40	48	55	60	72
Consumption	186	203	202	260	293	229	307
Percentage of world output	0.4	0.5	0.5	0.6	0.6	0.6	0.7
Percentage of world consumption	3.0	3.1	2.8	3.3	3.3	2.5	3.1
Exports, gross	-	-	-	-	-	-	-
Imports, gross	159	165	162	212	237	168	233
Exports-Imports	-159	-165	-162	-212	-237	-168	-233

Sources: Fertilizers, An annual review of world production, consumption and trade, FAO, 1961.

Makonnen Alemayehu, Chemicals and Fertilizers, first draft, Economic Commission for Africa, 27 September 1962.

19. The producing countries are only two: the UAR, average 30,400 metric tons, (recently about 40); and the Republic of South Africa, 14,000 tons, (in 1959-1960:- 21,000).

20. The average consumption of fertilizers in Africa is not only very low as shown above, but concentrated in a few countries. Neglecting the relatively small amount of fertilizer used in the Freedom from Hunger Fertilizer Programme in Ghana, Nigeria, Senegal and Morocco, the only countries which use significant amounts are, the UAR, the Republic of South Africa, Algeria, Morocco, Tunisia, Rhodesia and Nyasaland and Mauritius.

21. These seven countries use on the average about 90 per cent of the African nitrogenous fertilizer consumption, 94 per cent of phosphates, and 86 per cent of potash. Only two countries, the Republic of South Africa and the UAR, used in 1959-1960, 61 per cent of the total African consumption.

22. For these reasons one cannot speak meaningfully of fertilizer consumption in Africa. One can only speak of the consumption of fertilizers in a few specific countries and of the utilization of fertilizers by commercial plantations in some countries or by European farmers in others.

III. THE RESPONSE OF PLANT PRODUCTION TO FERTILIZERS IN SOME COUNTRIES OF THE WORLD AND AFRICA

23. In some more advanced economies after more than a hundred years of experimentation with NPK fertilizers, further experiments are still being carried out to ascertain how to use these fertilizers to the best advantage. In most parts of the African continent, experimental work with fertilizers during the past 35 years has also begun to show promising results. In comparison with those obtained after a hundred years of experimentation in western Europe, progress in Africa is of course, extremely limited but nevertheless encouraging. But it must be noted that the experiments in Africa have been carried out mostly in experimental stations which in most cases are located on more fertile soil, and before proper soil maps, if any, were available.

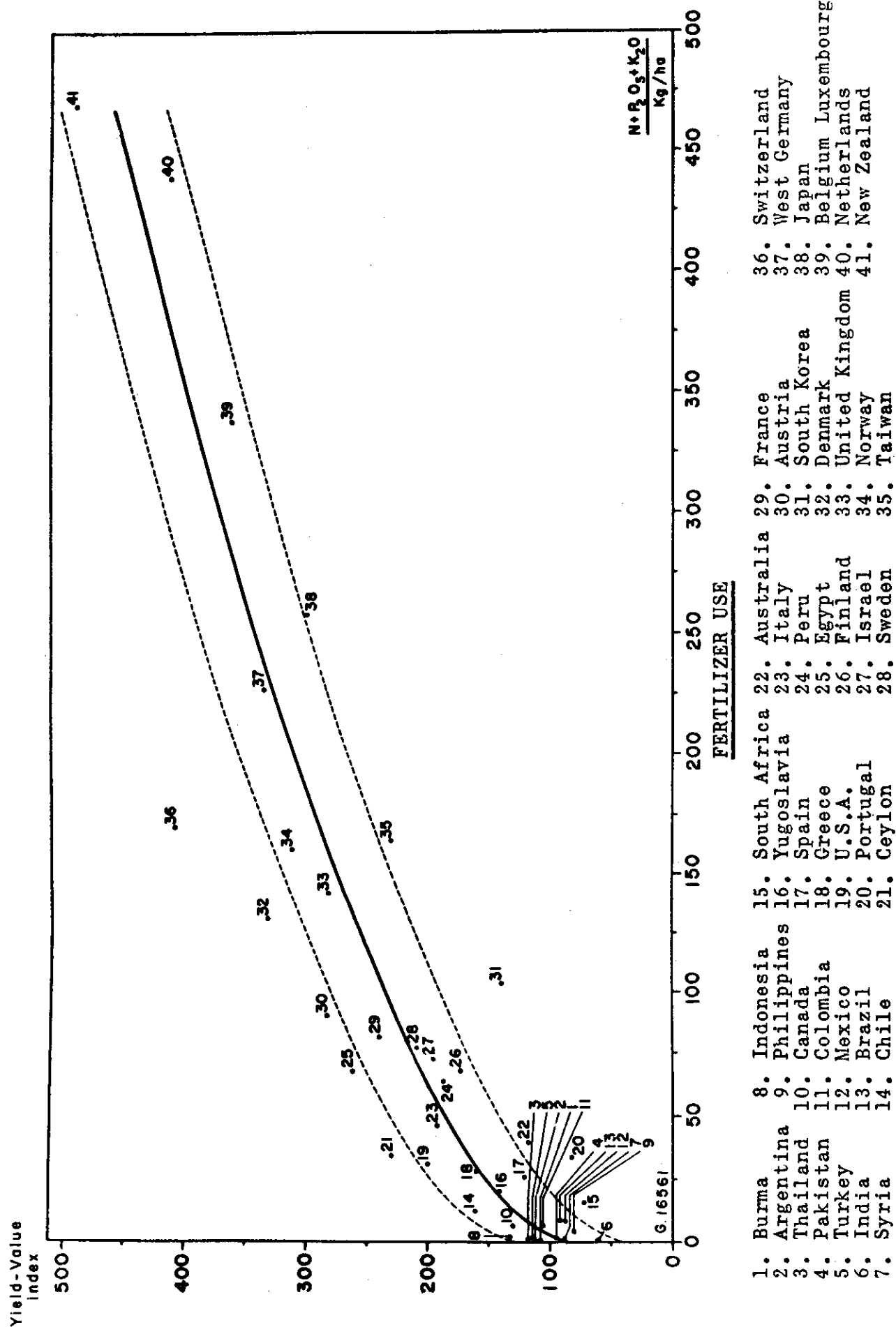
24. Taking the above into consideration as well as the facts that except in the north and south of Africa, the use of fertilizers has been negligible even where rainfall is adequate, one has to be very cautious in the use of the results obtained in experimental stations.

25. Recently the FAO Freedom from Hunger Campaign Fertilizer Programme has started to operate in some countries of Africa, namely in Nigeria, Ghana, Togo, Dahomey, Senegal in West Africa, and Morocco in north Africa. The complete results of trials will not be available until 1966. But the partial findings in response to fertilizers are at present very promising. Let us first, however, examine the general experience and knowledge in terms of the correlation between crops and the use of fertilizers.

26. Fertilizer has become an important factor in the increase of agricultural production in recent years but as shown above, the distribution of its use among continents and countries is very diverse and even now it is used only on a small percentage of the world's crop land.

27. Forty-one countries have been chosen which use significant amounts of fertilizers and give in their statistics indispensable data concerning

FIGURE 2 - CURVE OF AVERAGE RELATIONSHIP BETWEEN FERTILIZER USE AND VALUE INDEX OF CROP PRODUCTION
(per arable hectare 41 countries, 1956-58) ^a



^a-Source: (4)

yield levels of several crops. The correlation between fertilizer use and yield-value index^{1/} of crop production is very useful, because it shows that:

- (a) The countries which use the larger quantities of fertilizers have very high yields.
- (b) The countries which use very small quantities of fertilizers have very low yields and none of these countries has obtained significantly higher yields without the increase of fertilizer use. When countries with particularly low yield levels want to raise them, plans to increase their use of fertilizers from the present low level might anticipate higher yields along the lines indicated by the slope of the curve in figure 2.
- (c) The divergence of some cases (for instance values higher than the range of plus 45 index points from the curve of average relationship are shown for five countries: Ceylon, Austria, Denmark, Switzerland, Egypt; and five show lower values: Portugal, South Africa, Australia, Korea and Taiwan) reflects the influence of other factors which contribute to production in any country and indicates the necessity of improvement in all of them, not only the increase in use of fertilizer.

28. As figure 2 indicates, there is a very wide range of yield-value index among the countries. This cannot be explained by differences in physical limitations. An analysis concerning grain yields has been made by FAO for the period 1956 - 1958 for 40 countries.^{2/} The range of average grain yields varied from 664 Kg/ha to about 3,633 Kg/ha (Table 9).

1/ See: Crop production levels and fertilizer use, Moyle S. Williams and John W. Couston, Fertilizer Programme, Freedom from Hunger Campaign, FAO, Rome, 1962.

The index was developed for each country as follows:

- (a) Total production of the crop for the three years 1956-1958 was multiplied by FAO regional price weights (The price weights are based on wheat = 100 and were expressed as a percentage of the price in the region). The production aggregates for the three years for all crops used were added.
- (b) The total hectares of crops were added for the same three-year period.
- (c) The production aggregates were divided by the total hectares of crops.

2/ Op. cit.

TABLE 9

Range of average grain yields in 40 countries
(average for 1956-1958 in Kg/ha)

Range Kg/ha	Number of countries
500 - 999	6
1000 - 1499	17
1500 - 1999	2
2000 - 2499	6
2500 - 2999	5
3000 and over	4
Total	<u>40</u>

Source: Crop production levels and fertilizer use, Moyle S. Williams and John W. Couston, Fertilizer Programme, Freedom from Hunger Campaign, FAO, Rome, 1962.

29. Variations are related to the stage of agricultural and economic development and to the application of such modern methods of crop production as:

- Improved crop varieties;
- Control of weeds, pests and diseases;
- Conservation and controlled use of water;
- Improved cultural methods including crop rotation;
- Increased use of fertilizers.

Very important are also:

- Improved agrarian structure;
- Relatively favourable economic conditions;
- Greater attention to farm management;
- Effective extension services.

30. The most important point is the contribution to agricultural production and economic development which can be expected from fertilizers when their use is combined with other practices.

31. Some experiences elsewhere give the answer to this question. For instance the calculations made for India show that fertilizers (organic and chemical) contributed about 41 per cent of the increase in food grain production during the second five-year plan ending in 1961.

TABLE 10

India: Sources of increased food grain production
Second five-year plan (1956-1961)

Source	Per cent of increase attributable to this source
Fertilizer (organic and inorganic)	41
Irrigation	27
Improved seeds	13
Double-cropping (due in part to irrigation)	10
Land reclamation, other practices	9
	<u>100</u>

Source: Crop production levels and fertilizer use, Moyle S. Williams and John W. Couston, Fertilizer Programme, Freedom from Hunger Campaign, FAO, Rome, 1962.

The percentage attributions above are, of course, only rough estimation.

32. Indian policy for the third five-year plan, based partly on the above results, assumes that increased fertilizer usage will contribute again nearly 40 per cent of the expected 28 million tons increase in food grain production.

33. The second example comes from the United States of America in the period 1940-1955.

FIGURE 3 - RELATIONSHIP BETWEEN YIELD OF PADDY AND FERTILIZER USED (NUTRIENT)
IN PERIOD 1930-1959 (BY 3 YEAR AVERAGES) - TAIWAN - 2

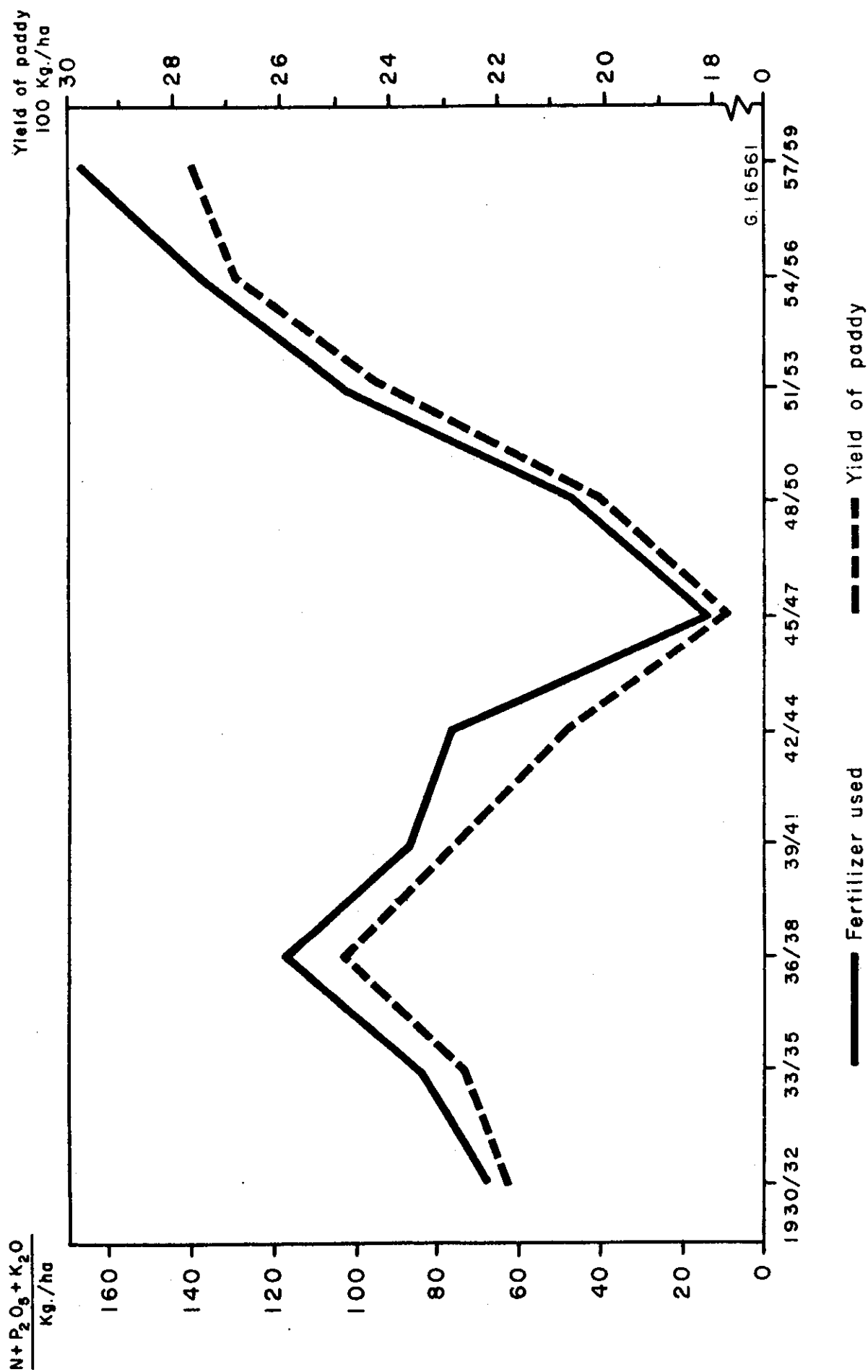


TABLE 11

United States: Sources of changes in crop production per acre
Second World War and 1940/1941 to 1955

Source	Percentage of total
Fertilizer	56
Weather	21
Hybrid maize	11
Irrigation	7
Other	42
Total	137
Shifts in crop acreage	-37
	100

Source: Crop production levels and fertilizer use, Moyle S. Williams and John W. Couston, Fertilizer Programme, Freedom from Hunger Campaign, FAO, Rome, 1962.

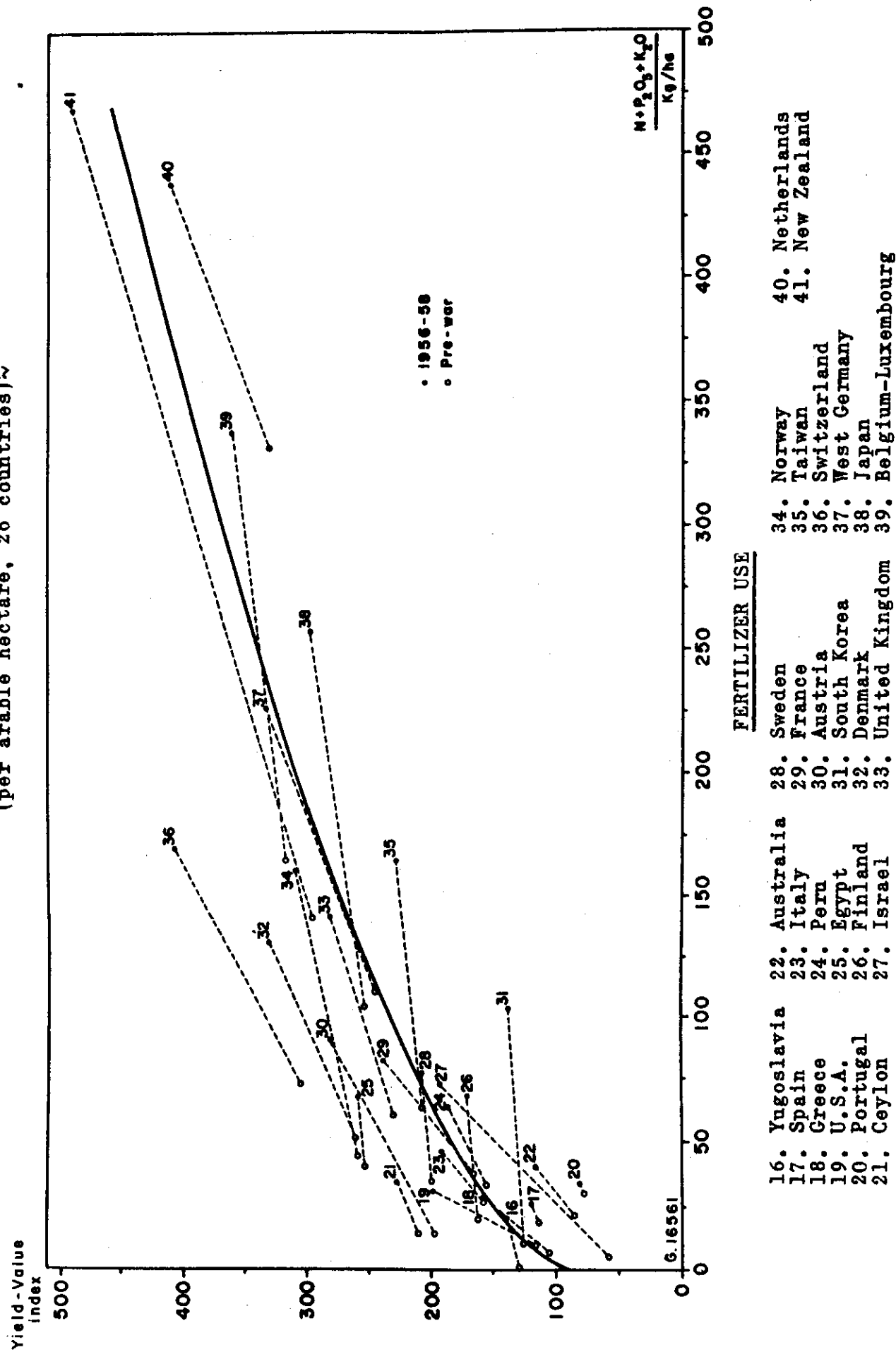
34. It is significant that once obtained, levels of yields are not stable and fall when the amounts of plant nutrients decrease. The drastic fall of paddy yields in Taiwan during the Second World War (Shown on figure 3) indicates the importance of fertilizer use. Similar results were noticed in Japan.

35. The range of the contribution of fertilizers to increased plant production differs from country to country. It depends, first of all, on the levels of fertilizer usage and yield levels: the share is largest when the level of yields is highest.

36. On the other hand, the response of production due to fertilizers is greatest when the initial yield levels are lowest. This means that each further amount of fertilizers gives smaller increases in production and the first application of fertilizers brings the greatest effect. This is very important for many countries in Africa. It is already shown in figure 2, and even more in figure 4.

37. The further increase of fertilizer use brought the best results in those countries which used smaller amounts of fertilizers and the least results in those countries which used greater amounts of fertilizers. There are exceptions.

FIGURE 4 - CURVE OF AVERAGE RELATIONSHIP BETWEEN FERTILIZER USE AND VALUE INDEX OF CROP PRODUCTION
1956-58, COMPARED WITH PRE-WAR
(per arable hectare, 26 countries)



Source: (4)

38. Nevertheless, some countries in the very high ranges both of yield and of fertilizer use, have experienced good responses to fertilizers. For example France, the United Kingdom, Belgium and the Netherlands in the last twenty years have obtained from 4.7 (Belgium) to 18.0 (France) kilos of grains from one kilo of fertilizer mixture. These data are obtained by dividing the entire increase in grain production by the increased amount of fertilizer. This means that all benefits which should be attributed to other factors are included as responses to fertilizers only. One can term this gross response. Net response may be about half of the gross response.^{1/}

TABLE 12

Grain yields and fertilizer consumption in four countries
pre-war and 1956-1958

Specification	France	United Kingdom	Belgium	Netherlands
<u>Grain yield</u>				
100 kilos per hectare				
Pre-war	14.9	21.1	24.1	27.2
1956-1958	22.8	28.0	32.2	33.1
<u>Fertilizer use</u>				
Kilos per hectare				
Pre-war	37.2	59.4	177.9	336.6
1956-1958	80.9	141.2	349.3	438.6
<u>Increases</u>				
Yield (100 Kg/ha)	7.9	6.9	8.1	5.9
Fertilizer (Kg/ha)	43.7	81.8	171.4	102.0
<u>Response (Kg/Kg)</u>				
Grain/unit fertilizer	18.0	8.4	4.7	5.8

Source: Fertilizers and economic development, F.W. Parker, FAO, February 1962.

1/ The Economic position of fertilizer use in the United States, Agriculture Information Bulletin No.202, United States Department of Agriculture, Agricultural Research Service.
Agriculture Information Bulletin No.202 of the United States states that "it can be estimated tentatively that at 1954 average rates of application, from 35 to 40 per cent of the increase in yield of all crops and pasture over the yield when no fertilizer is applied may be attributed to fertilizer" (p.10).

39. Similar data are not available for the countries of Africa. Some, however, were obtained mostly from experimental stations and are examined below.

40. In Egypt experiments by Gracie and Khatil (6) showed that average responses to ordinary superphosphate applied at the rate of 238 kg per hectare were (per kg of P_2O_5):

Perseem (<i>Trifolium alexandrum</i>)	- 42 kg
Beans	6 kg
Rice in husk	9 kg

With twice that application, that is, with 476 kg/ha of superphosphate, average responses were (per kg of P_2O_5)

Wheat	1.3 kg
Barley	1.3 kg
Maize	1.0 kg

41. In Basutoland, there exists a general deficiency in all soils. This is particularly marked in the foothills and lowlands. Although the mountain soils are extremely fertile, they suffer from a phosphate shortage after a few years of cropping (10). According to H. Greene (6) responses to phosphorus were (per kg of P_2O_5)

Sorghum	13 - 20 kg
Maize	10 - 12 kg

In 29 well designed, factorial experiments in Northern Rhodesia (6) the average response to 242 kg/ha of ammonium sulphate was about 65 kg of dry grain per kg of N.

42. On the hilly, sandy soil of Ukiriguru (Tanganyika) (11) most soil treatments bring handsome rewards. There have been high responses to phosphorus applications. In most seasons, there have been valuable nitrogen-phosphorous interactions. The heavier dressings of phosphorus with top-dressed nitrogen, allowing for variations in application, have given average responses of the order of 560 kg seed cotton per hectare per season. This tends to be slightly better than the responses to 15 tons/ha of cattle manure applied once in every three seasons, but without the long continuing residual benefits.

43. The results of many years trials gathered by Augladette (12) from four countries, namely, Senegal, Niger, Upper Volta and Madagascar are shown in Table 13.

TABLE 13

The response to fertilizers in Senegal, Niger, Upper Volta and Madagascar

Plant	Number of trials	Response: per	kg of crops kg of fert.	N:P:K:	Return in \$ per \$1 of input	
		Average	extremes		Gross	Net
Groundnuts	9	7.8	3.4 - 11.4	1:3:1	3.2	2.2
Paddy	9	6.5	3.0 - 9.0	1:2:1	1.4	0.4
Sorhum	7	13.5	6.4 - 17.6	1:1:0.5	2.8	1.8
Millet	4	9.5	7.0 - 12.0	1:1:0.25	1.4	0.4

Source: L'utilisation des engrains outre-mer, par A. Augladette, Extrait de Marchés Tropicaux du Monde.

44. In the forest and coastal savannah region of West Africa annual food crops have responded to nitrogen and phosphorus (6). Lack of nitrogen develops after some years of cropping, and is not evident when forest is first cleared for cultivation. For the savannah region of west Africa phosphorus and nitrogen are the main needs. In trials on peasant farm in Ghana (6) intensively cropped soils receiving 126 kg/ha superphosphate gave 61 per cent response on groundnuts and 52 per cent on cereals.

45. This confirm D. Stephens's contention (13) in his summary that single superphosphate and ammonium sulphate are the fertilizers indicated for general use in Ghana, especially in the savannah zone where the residual effects of the former were large.

46. C.S. Ofori (14) describes experiments conducted on 158 as follow up of previous work starting from 1949 in five growing districts in Ghana. These trials give the following results:

- (a) The largest response to any one nutrient was that due to nitrogen applied even at such a low rate as 11 lbs N/acre.
- (b) Response to phosphorus alone has not been very high even though soils from trial sites are low in available phosphorous content. In combination with nitrogen, high increases in yield were obtained especially in the Oda district where soil ph was 5.8.
- (c) Very low response, or in some cases depression in yield was obtained when potash was applied alone at the rate of 36 lbs K_2O /acre. Increase in yield was high, however, where this nutrient was applied together with N and P.
- (d) Application of complete fertilizers, NPK on maize in peasant farms, could yield a profit of over £G7 per acre in most districts.

47. According to R.K. Djokoto (15) in Ghana \$1 US are dollar worth of fertilizer gives the following value increases in US dollars:

Crop	No. of trials	Gross value response	Net value response
Maize	11	5.4	4.4
Groundnuts	12	1.8	0.8

48. J.W. Couston confirms also in his two preliminary reports for Ghana and Nigeria, good or very good economic responses in crops to application of fertilizers in trials established with in the framework of FFHC Fertilizer Programme in West Africa (16,17).

49. The above results of field trials are promising and permit the hope that a larger use of fertilizer might result in an increased production in the future.

50. The following, however, must be taken in is account:

- (a) Experimental data from field trials must be discounted slightly, if we want to transfer them on the average farms;
- (b) There are costs of extension services and others associated with the fertilizer application;
- (c) Considerably more real costs, mostly labour are not counted here.

IV. HOW TO GET FARMERS TO USE FERTILIZERS IN AFRICA

51. The shifting cultivation prevalent in most African countries means that only part of potentially agricultural land is cultivated. As long as the number of people is small this amount of land is sufficient to supply enough food, but if the density of population increases and the amount of required food exceeds the possibilities of the supply of it, the surface of cultivated land has to be enlarged. This means that the proportion of time under cultivation to time under bush fallow has to be increased. However in this case there is not enough time to restore sufficient amounts of plant nutrients in the soil. Table 14 shows the amounts of plant nutrients and of vegetable matter contained in regenerated forest vegetation after various periods of growth.

TABLE 14

Plant nutrients and vegetable matter in
secondary forest vegetation

Age in years	Nutrients			Production of vegetable matter (dry)
	Nitrogen	Phosphorus	Potassium	
	<u>Kgs. per hectare</u>			<u>tons/ha</u>
2	190	22	169	20
5	570	32	420	112
8	580	35	670	153
18	700	108	820	700

Source: Efficient Use of Fertilisers, FAO Agricultural Studies edited by Vladimir Ignatieff and Harold J. Page, Rome 1958, p.160 Table 18.

52. The figures in Table 14, taken from experiments at Yangambi (The Congo), show that the longer the land rests under bush-fallow, the greater the quantity of plant nutrients will be restored and made available. Of course the amount of nutrients really available for

plants are smaller, because when the vegetation is removed by clearing and burning, most of the nitrogen is irretrievably lost, and a large part of the phosphorus and potassium in the ash is liable to be washed away before it can be absorbed in the soil.

53. Despite the extent of the losses, the amounts of nutrients remaining soon after the land is cleared, are usually sufficient for the first few seasons. However, after these first few years, the longer cultivation continues, the smaller the yields. In this way the production from an increase in acreage (as a result of shortening the fallow period) is countered by lowered yields per acre and soil exhaustion. The decline in fertility thus establishes a vicious circle of poverty.

54. It has been estimated that shifting cultivation, even with improved methods of forest and bush fallow, is justifiable only so long as the population density does not exceed 50 per square kilometres.^{1/} For higher population densities, some means must be found of eliminating forest fallow and of utilizing the land more productively. This means that shifting cultivation must be changed to a fixed farming system as a result of population density increase.

55. In this case, of course, many factors have to be taken into account, but one of the most important is fertilizers. Additional amount of plant nutrients of various kinds - manure, green manure, commercial fertilizers - must be applied to obtain the higher yields needed to increase and improve human consumption. Fertilizers will be required not only to raise yields rapidly and to get maximum results from improved varieties and other practices applied, but also in order to prevent further deterioration of soil fertility. There are many areas of tropical Africa, of course where increasing population density is not yet important. But settlement of these relatively more isolated regions would be very expensive and would provide no solution to problems of raising productivity or conserving the soil in the more populated areas.

^{1/} Efficient Use of Fertilizers, FAO Agricultural Studies by Vladimir Ignatieff and Harold J. Page, Rome 1958.

56. The required amounts of the fertilizers depend on the food requirement. According to the FAO assumptions, Africa's population will grow from 208 millions in 1958 to 283 millions in 1980 and 421 millions in 2000. Present food supply in Africa is insufficient in comparison to the biological requirements, particularly as far as animal proteins are concerned. FAO assumes for Africa two level targets, lower (1980) and higher (2000) for calories and animal proteins. All these assumptions are shown on the Table 15.

TABLE 15

Projected growth of the Africa's population
and targets for calories and animal proteins consumption^a

Specification	1958	1980	2000
Population: millions	208	283	421
index	100	136	202
Consumption:			
Calories <u>per capita</u>			
per day	2,360	2,400	2,450
index	100	102	104
Animal proteins			
<u>g. per capita</u>			
per day	11	15	20
index	100	136	182
Total food needs			
index	100	174	259

^aSources: Fertilizers and Economic Development, F.W. Parker, FAO, February 1962.

J.W. Couston, Marketing and Development Studies, Ghana: Preliminary Report, FAO, FFHC Fertilizer Programme, December 1962.

57. If we know the index of food needs, we can roughly assume that the total agricultural production must increase in proportion to these. If we have got the required total agricultural production level, for instance in 1980, we can come back to the curves on figures 2 or 4 and estimate the quantity of fertilizers required.

58. This has been done by FAO for the less developed regions (Asia and Far East, Near East, Africa, Latin America). Fertilizer requirements for such countries of Africa for which data are available were calculated from the curves of figures 2 or 4 (in Africa; Egypt and South Africa). Fertilizer requirements for other countries, for which crop yield value data were not available were estimated using rates of fertilizer use comparable with that calculated for similar countries. The result is shown below.^{1/}

Food supply index	Fertilizer consumption million tons plant nutrients	
	1959/60	1980
174	0.6	8.6

The estimate was done on the assumption that the area under cultivation will be constant. An expansion of this area could reduce the requirement about 20 per cent, that means to a level of 7.0 million tons.

59. If we consider that world fertilizer consumption has increased since 1944/1945 to 1959/1960 from about 7 million tons of about 27 million tons, the implied required increase of fertilizer consumption in Africa from 0.6 to 7.0 - 8.6 million tons in 20 years does not seem to be impossible. But if we consider the factors limiting use of fertilizers by the farmers in Africa these levels of fertilizer use will be really very difficult to reach.

^{1/} Fertilizers and Economic development, F.W. Parker, FAO, February 1962.

60. These factors can be listed as follows:

1. High cost of fertilizers. Transport charges represent a large proportion of the total cost of fertilizers. It could be only reduced by bulk handling which could not be justified at the present rate of usage.
2. The low value of many crops grown in Africa. Most of the non-export crops of the Region have a very low cash value and although most crops show marked responses to fertilizer application the increases obtained are not large enough to pay for the fertilizer applied at present price levels.
3. The relatively low standard of crop husbandry for most crops. Fertilizers are not a substitute for good farming; rather they must be regarded as an integral part of good farming practise.
4. Very low basic yields of some crops, particularly food crops. Production of new varieties by the plant breeder could gradually result in an increase in basic yields.
5. The additional labour requirements in applying fertilizer at a busy time of the year. Adoption of fertilizer seed drill by mixed farmers could reduce the labour requirements involved in application of fertilizers.
6. Reluctance on the part of farmers to accept new techniques. This can be expected to be gradually overcome by education and propaganda.
7. The lack of information on the kinds and amounts of fertilizer needed and methods of application in specific circumstances.
8. The lack of adequate supplies of fertilizers and inadequate distribution system.
9. The existing tenure systems that tend to discourage the economic use of fertilizers.
10. The lack of adequate seed, disease and insect control measures, and other practises needed for the potential from fertilizers to be realized.

61. All these impediments, obstacles and troubles will have to be overcome if fertilizer use is to be more common in Africa.

62. In this connexion government action is necessarily very important. The following policies are particularly most important and possibly required if modern agricultural methods are to be used to increase agricultural production:

1. Provision for greatly expanded research and extension services for information to cultivators and assistance in applying improved methods.
2. The development of an effective pricing and distribution system for farm products and farm supplies, needed in order to enable farmers to profit from the use of modern methods.
3. The development of a system of adequate farm credit for cultivators with some protection against uncontrollable risks, such as severe drought in some regions.