CHEMICAL FERTILIZERS--WORLD SITUATION AND U. S. POSITION WITH PARTICULAR REFERENCE TO NITROGEN

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MR. MASSELMAN: Gentlemen, we started the series of lectures on resources with grains and we are winding it up with fertilizer. I think that is quite appropriate, because you can't produce much grain if you don't have the proper amount and the proper kind of fertilizer. Those of you who are studying that problem know that there are certain angles that you are considering in this problem. I am sure that the speaker can reveal some of the aspects of the problem with more clarity than you could get from me or out of the books and literature that you have on the subject.

Mr. Porter has been with the Department of Agriculture for many years. Prior to that he was actively engaged in the fertilizer industry in this country. He is at present an alternate member for the United States on the Fertilizer Committee of the International Emergency Food Council, which is affiliated with and reports to the Food and Agriculture Organization of the United Nations. Gentlemen, it gives me great pleasure to introduce Mr. Porter.

MR. PORTER: Gentlemen, it is quite an honor for me to have this opportunity to appear before you, and also a pleasure. I appreciate the gracious introductory remarks. I am in the position of a pinch hitter for Mr. Finn, who is delayed on matters of state in Europe. I am hopeful, however, that what I have to give to you will at least provide some information or indicate points that would lead you to further exploration along the lines which will probably be developed this afternoon in the seminar.

The basic topic for this discussion relates particularly to the position of the United States with respect to chemical fertilizers, both as to present and future aspects. In this we are concerned primarily with the major plant food elements--nitrogen, phosphate, and potash--and to a less degree with the so-called minor elements, such as manganese, magnesium, boron, zinc, sulphur, and so on. Calcuim, or lime as it is popularly known, should have special mention since this element is not only required for plant growth but is widely used as a soil amendment. On a broad field we should keep in mind that wise use of fertilizers gives recognition to appropriate nitrogen-phosphate-potash soil and crop needs, collectively as well as individually. In appraising the present and future position of the United States, it will perhaps be well to examine the world situation at least to provide a background. In one of the Food and Agriculture Committee's reports this statement is made, and I think

it sums up the whole situation: "The outstanding characteristic of the world fertilizer situation today is the phenomenal demand."

Of the three major plant foods, nitrogen presents the most acute supply problem. For phosphates, the production and demand situation is more nearly in balance than is the case of nitrogen. It is believed that world capacity to produce phosphate rock is reasonably adequate to meet demands. Inability to maintain processing facilities at capacity levels, together with transportation troubles, may cause regional and local shortages of soluble phosphates from time to time. With respect to potash, world production and requirements also are approaching a balance. Assuming continued maximum production in France, Germany, the United States, and Spain, potash does not present a too difficult problem. It should be pointed out, however, that in the prewar years, the source of the largest exportable supply was Eastern Germany; and achieving a net world balance in potash would require greater accessions from that source that are now available.

Largely because supply and demand more nearly match, there is no international allocation control on either phosphate or potash. Nitrogen because of its relative scarcity, has been continued under such control through the International Emergency Food Committee; and such control is in effect for the 1948-1949 fiscal year. It seems appropriate, therefore, to discuss the nitrogen picture; first, as to international aspects and secondly, as to the situation in the United States.

Because of the importance of the nitrogen problem, the Council of the Food and Agriculture Organization of the United Nations requested the Fertilizer Committee of the International Emergency Food Committee to prepare a special report on the subject. In order to obtain basic information as to the production and utilization of chemical nitrogen, and plans for increased facilities, questionnaires were sent to some 66 countries covering the period 1947-1948 through 1950-51. As of 29 September 1948, replies have been received from 51 countries, representing a substantial part of the nitrogen-producing countries. Your speaker had the privilege of studying these replies, the statistical tabulations relating thereto, and to serve as a member of a special task group which was selected to prepare the report. Hence, what is here presented on the world nitrogen picture is recent information. The data have heretofore not been available. However, it should be emphasized that the information on which this portion of our discussion is based has not been released for publication. Also the tables which are being made available at this time for reference are restricted to governmental use. For the record it should be mentioned that the tabular material has been supplied through the courtesy of the secretariat of the Fertilizer Committee of IEFC. Pending official release, it is requested that these data be held solely for use within agencies of the Government. Th

following numbered sections of this paper are in essence extracts from the draft of the Committee Report.

1. The first has to do with the requirements for nitrogenous fertilizers. This is on a world-wide basis. Practically all countries reported increasing requirements through 1950 and 1951. The totals submitted increase from 3.57 million metric tons in 1947 and 1948, to 4.81 million metric tons for 1950-1951. I might say parenthetically that these requirements have increased as the years go on. The quantity of nitrogenous fertilizers available for consumption in 1948-49 increased from 2.75 million metric tons nitrogen to 3.08 million metric tons nitrogen. For the years 1949-50 and 1950-51 the indicated deficit between stated requirements and reported availabilities is approximately 900,000 metric tons annually. Although the deficit during these years is borne by all countries, the heaviest impact falls upon most of the countries without significant indigenous production. China and the Far Eastern countries might be cited as examples. A summary of the total reported requirements is as follows, in thousands of metric tons nitrogen:

Nitrogen Fertilizer	1947-48	1948-49	1949-50	1950-51
Stated requirements	3,570	4,176	4,497	4,813
Estimated availabilities	2,728 a/	3,058	3,568	3,957

a/ apparent consumption.

The bulk of nitrogenous fertilizers required for the period 1947-48 through 1950-51--this again is based upon the replies to the questionnaires--is intended for the production of basic foods. The reports indicate that about 33 percent will be used for cereals, 12 percent for rice, and 14 percent for root crops. The quantity of nitrogen desired for pasture and forage crops increases from 8.4 percent of the total in 1947-48 to 12.6 in 1950-51, in line with announced programs to increase indigenous production of animal protein as well as conservation measured for grassland. Fiber crops and tobacco account for only 5 and 1.5 percent respectively of the total annual stated requirements of the nations reporting.

Of the countries which have reported nonagricultural requirements for nitrogen, exclusive of military use, very few indicate large requirements. The total for all countries reporting amounts of only about 15 percent as much as the total requirements for nitrogenous fertilizers. By far the largest reported industrial requirement of nitrogen is for the United States.

2. Production of Nitrogenous Fertilizers--production estimates for the reporting countries indicate that by 1950-51 the total planned output will amount to 3.96 million metric tons nitrogen. The increase in production for the same countries above prewar and 1948-49 level amounts to 99.4 and 29.4 percent respectively. The rate of increase varies considerably by period, and the pattern of distribution has change radically from that prevailing prior to World War I. North American production, which in 1938-39 accounted for less than 15 percent of the world total, excluding USSR, increased to 34 percent of the total by 1948-49. Relatively little additional commercial expansion is expected for the next few years under present plans. However, some of the other countries have indicated fairly material increases in capacity.

As you perhaps know, nitrogen from South America is in the form of natural nitrates from Chile. Production in South America has been increasing, but at a rate considerably slower than the average for the world. Asiatic production in 1948-49 is only about 91.5 percent of the prewar production for the same countries; a very large increase, primarily in Japan, is planned for by 1950-51. The reported 1948-49 European production is about 24 percent greater than prewar, with the greatest increase in Belgium and in the United Kingdom. For 1950-51 the anticipated European production is 39 percent above current levels, reflecting the expansion programs of most countries in that area. A table showing the estimated prewar and postwar production of the various geographic areas in thousands of metric tons nitrogen follows:

Estimated Prewar and Postwar Production of Nitrogen

	1938-39	1948-49	1950-51
	(Thousand metric tons of nitrogen)		
North America	289.8	1,044.2	1,131.0
South America	244.5	301.6	303.4
Europe	1,165.2	1,443.3	2,011.8
Asia	279.9	256.4	496.5
Australia	5.3	12.2	13.9
Reported total	1,984.7	3,057.7	3,956.6

The shift in areas of production of nitrogenous fertilizers has been accompanied by a change in the distribution of the types of materials produced. Most of the current total production increase since 1938-39 has been in the form of ammonium nitrate, calcium nitrate, and anhydrous ammonia and ammoniating solutions. As a consequence, in relation to the total supply the production of ammonium sulphates fell from

44 percent of the total in 1938-39 to 34.8 percent in 1948-49. During this decade the production of cyanamide has decreased slightly and that of sodium nitrate increased. The anticipated total increase in total nitrogenous fertilizer production for 1950-51 is accompanied by a projected rise in production of ammonium sulphates and calcium nitrates and some indicated decrease in the production of ammonium nitrate fertilizer.

3. Capacity for Producing Nitrogenous Fertilizers--operating capacity for nitrogen for fertilizer is reported at 3.4 million metric tons nitrogen in 1947-48 and 3.6 million metric tons nitrogen for 1948-49, as compared with 2.1 million metric tons nitrogen for the same countries in 1938-39, or prior to the war. The total reported for 1950-51 is 4.2 million metric tons nitrogen. Part of this reported increase in capacity will come from construction of new plants or additions to existing plants and part from rebuilding and rehabilitation of other plants and equipment, all this increase was during the period covered by the survey, that is, up to 1950-51. The over-all ratio of production to reported capacity will have increased from 80.8 percent in 1947-48 to 84.4 percent in 1948-49 and 95.1 percent in 1950-51. The production difficulties reported as now preventing the attainment of capacity output of nitrogen for fertilizer are reported to be the necessity for using badly worn equipment, in some cases the lack of repair materials, shortage of electric power which is important to production, coking coals, miscellaneous raw materials, and in some cases labor. There is also the problem of internal transportation, which among other things relates to boxcars as well as the pressure tank car supply.

4. Relationship between Requirements and Supply.--The planned rise in production of inorganic nitrogenous fertilizers from 1948-49 to 1950-51 in the exporting countries is at a lower rate than for the world as a whole, due to the fact that Chile and the United Kingdom plan no significant increase in production. The total exportable surplus from all exporting countries increases at a lower rate than production, largely because of the increasing domestic requirements. This increased production has never been able to close the gap. If total production of nitrogenous fertilizers meets expectations in the next two years and consumption of indigenous production is at the level reported, net importing countries will require supplies amounting to approximately 4.9 million metric tons in terms of nitrogen for 1949-50 and for 1950-51, against an available exportable surplus, including U.S. Ordnance production, of only about one million metric tons for each year. In other words, there is a continuing deficit at the level of about 900,000 metric tons annually.

I mentioned previously that nitrogen is under international allocation. Even with the assistance given by this planned method of distribution, which increased export availability above the levels desired

by some of the producing countries and attempted to distribute as fairly as possible the supplies available, it has not been possible to effect an equitable distribution throughout the world of fertilizer nitrogen. However, the allocation did improve the distribution to some of the countries which perhaps were in worse bargaining positions. Part of the difficulty arises from the change in structure of the international distribution of fertilizers since before the war and the increasing monetary problems accompanying all international trade. There has also been another aspect, and that is the increased demand for specific types of material, particularly ammonium sulphate for use in the Far East and Africa, especially for rice production.

The planned increased production in Europe and the Western Hemisphere by 1950-51 will amount, to about 90 percent of the requirement of these areas and their dependent overseas territories and Africa, assuming free trade according to prewar patterns. Sharply increased requirements in all Asia, coupled with the loss of North Korea and Manchuria as major sources of supply, intensify the problem in the Far East, since total production, although increasing, will be less than one-half of the requirements stated for that area. Almost all the planned production in Asia is reported for Japan; and although the level of production in that country by 1950-51 is expected to go far toward meeting its own requirements and those of South Korea, the problem of meeting requirements of China, Formosa, India, and Pakistan still remain In addition, as I indicated, the rice-growing countries have a strong preference for nitrogen in the form of ammonium sulphate; so that as to nitrogen in non-nitrate form, the export availabilities are not readily available for shipment to the Far Eastern countries.

5. Some Conclusions Arrived at in the Committee Report.--In appraising the potential balance between supply and demand of nitrogenou fertilizer, a brief review of the causes for the increase in world requirements will clarify conditions somewhat. Three forces for the increased requirements are operative. It is well to distinguish between them.

The first is of a fundamental character, operating at all times, namely, the increasing demand for foodstuffs, due to the increase in world population, of course, and having the universal objective of attaining a higher accomplishment in meeting nutritional standards. The second arises from the high farm income and favorable financial structur in a number of countries. The third comprises educational activities in the farm field which have resulted in increased fertilizer usage in many countries and which conceivably present a potential influence leading to greater use in other countries. As a result of these forces, which are admittedly not equal, there is likely to be a more intensive and widespread use of fertilizers to increase crop yields as well as to maintain and improve soil fertility.

At present, the favorable price level for agricultural products throughout the world and the ability of countries to finance shipments have made aggregate effective demand closely approximate total requirements submitted by the countries. Should farm prices rise above present levels, it is conceivable that the deficit between demand and estimated supplies would tend to be even greater than now.

It should be emphasized that the estimates of both requirements and production of chemical nitrogenous fertilizers reported by the 51 countries reflect the anticipation of continued favorable price levels and financial conditions. Should the present level of farm prices not be maintained, it is reasonable to assume that the requirements or effective demand will be lower than stated by the committee. In the event of a generally lower price level, including lower prices for fertilizers, it may be anticipated that production of nitrogenous fertilizers will not increase to the goal previously indicated. Lower farm prices may result in a lower expenditure for fertilizers, including nitrogenous materials, but not necessarily in the consumption of comparably reduced quantities. In the event that by 1950-51, farm prices and the financial conditions throughout the world should be substantially less favorable than now, it appears likely from the data submitted that the effective demand will be at least as great as the projected supply available, and no surplus is foreseen within the period covered by the particular inquiry. (At this point we end the extracts from the report.)

With that background, let us look at the situation here at home, paying special attention to nitrogen.

Prewar the average annual consumption of nitrogen for fertilizer in the United States and its possessions was about 337,000 metric tons N, and industrial use was about one-half that, or some 115,000 metric tons. Agricultural and industrial nitrogen requirements of the United States for the period covered by the IEFC Fertilizer Committee Report are:

U.S. Nitrogen Requirements (excluding munitions)	Metric Tons N			
	1947-48	1948-49	1949-50	1950-51
Agricultural	817,000	907,000	998,000	1,089,000
Industrial	376,000	390,000	399,000	408,000
	1,193,000	1,297,000	1,397,000	1,497,000

I should like to mention particularly that these figures do not include any direct military requirements, and would like to refer particularly to the estimate for the years 1949-50 and 1950-51, since, in the light of current conditions, it appears that the requirement figure for 1949-50 may be appropriately applicable also to this year or 1948-49. This conclusion is also borne out by statements that come from trade sources.

The projected production of fertilizer N in 1949-50 in the United States is estimated at 653,000 metric tons N. That is exclusive of industrial take. To meet the stated requirement for fertilizer would require imports of 345,000 metric tons and no civilian exports. For 1950-51 the estimated domestic production of nitrogen for fertilizer is approximately 658,000 metric tons, slightly higher than the previous year. It would require imports of better than 400,000 metric tons to meet the stated requirements. During recent years the average annual imports of fertilizer nitrogen into the United States have been about 175,000 to 180,000 metric tons.

For the present, production of synthetic ammonia at plants operated by or for the Department of the Army, with the exception of some 50,000 metric tons being supplied to the civilian economy, is being utilized for the fertilizer program in the Occupied Areas. According to information which has been made available to the IEFC, estimated production at Army facilities is expected to be as follows:

	Metric Tons N			
	1947-48	1948-49	1949-50	1950-51
U.S. Ordnance Plant Production	210,000	220,000	260,000	260,000

As indicated previously, the Army production is essentially for export to the Occupied Areas. For 1948-49 the Army has supplied 50 percent of the commercial exports of 55,000 metric tons N from the United States. United States private industry is furnishing the other half, or about 27,500 metric tons N. The Army has also supplied 10 percent of its output of anhydrous ammonia to domestic plants for conversion to nitrogenous fertilizer materials.

As to answering some of the questions which were furnished us, the first one is: "(a) What is the present position of the United States in chemical fertilizer?"--for the moment we will consider nitrogen--and "(b) What changes may be anticipated upon termination of the Army export program and the Foreign Assistance Act?" I will divide that question into two parts.

In answer to part one, even with the contribution being made by the Army, the United States is currently short in meeting requirements for fertilizer nitrogen by some 150,000 metric tons, based upon retained indigenous production of 585,000 metric tons and imports of 180,000 metric tons. This deficit continues until 1949-50 and is somewhat greater for 1950-51. To meet this deficit, imports would have to be achieved at approximately double the present rate, or even perhaps three times, or other sources will need to be found. In other words--and this is in part an answer to the second segment of the question--it looks as though a substantial part of the capacity of the plants in the Army's fertilizer program could be used effectively to meet the domestic shortage as and when the Army export program should materially decrease or cease and the Foreign Aid Program terminate. In such an event, consideration should be given to geographical distribution of ammonia-producing plants in the United States and the relative need of certain areas for near-at-hand availability of primary nitrogen or primary ammonia. Also, in any such conversion, study should be given to providing integrated equipment to produce finished nitrogenous fertilizers at plants selected for such a program. Private operation of these plants, for a number of reasons, would be desirable. In this connection, reference is made to the action taken some months ago with respect to the leasing of the Cactus Ordnance Works, with a provision that auxiliary converting facilities be provided to produce processed fertilizer.

In approaching question two, "What problems are involved in maintaining an adequate supply of fertilizers in case of increased demand for chemicals?" we will continue to give major consideration to nitrogen in general. The question has some implication that it refers to problems which might arise as a result of an emergency. This in turn would probably necessitate maximum production of agricultural products, requiring in turn a high level of input of nitrogen to the soil, let us assume the 1950-51 level as a minimum, coupled with balanced supplies of phosphate and potash.

About all I can do here is to raise a number of problems which may come to mind, based in part upon experiences which occurred during the last World War. First to be mentioned is the matter of present and potential high-pressure synthesis capacity within the United States and the extent to which this capacity would be utilized for ammonia, methanol, and other products, all of that considered in the light of the essential need for maintaining a high level of nitrogen for crop production. Within the ammonia field would be the problem not only of adequately supplying material needed for fertilizer, but the industrial requirements and military needs.

Another problem would involve transportation, rail and highway, and facilities for that purpose, especially pressure tank cars--there was a lot of headache at one time on that one item--particularly if any large-scale dispersion of production of certain materials is requir One significant factor is that approximately 260,000 metric tons of nitrogen in the form of ammoniating solutions and anhydrous ammonia is now being used in the fertilizer industry in the United States. This represents about one-third of the nitrogen now being taken for fertiliz All of this moves in tank cars, most of them pressure cars.

A third problem to be suggested relates to imports and sources, and the accessibility of such supplies from the standpoint of physical availability and transportation. As an illustration you might refer to sodium nitrate from Chile.

A fourth problem or factor would relate to the utilization of ammonia plants now operated for the Army fertilizer program, and the expansions now under way, which might or might not provide material for domestic or civilian fertilizer use.

There are a number of other problems which could be mentioned. What we are intending to convey, as perhaps will be recognized, is the very complex question involved. There are a number of interlocking features, and I don't intend at this time to try to answer them. But there is one that deserves, in the speaker's mind, most careful analysis and appraisal.

To this point nitrogen, because of its short supply, should be given the major emphasis. Phosphates and potash, of course, are also necessary. It might be well to give a brief statement as to the United States position in those two materials.

For the fiscal year 1947-48, estimated supplies of phosphates for United States agriculture were in the neighborhood of 1,800,000 metric tons available phosphoric acid expressed as P_2O_5. Domestic production accounted for most of this. Both imports and exports are insignificant in relation to the U.S. supply as a whole. During 1948-49 it is expected that U.S. agriculture will have available some 1,900,(metric tons P_2O_5.

Potash for use in the United States during 1947-48 amounted to about 835,000 metric tons K_2O basis, obtained largely from domestic production. Imports were about 22,000 metric tons K_2O, and exports, chiefly to Western Hemisphere countries, about 55,000 metric tons K_2O. The estimate for U.S. supplies of potash during 1948-49 comprises about 920,000 metric tons K_2O, about 10 percent higher availability than last year, and reflects increased production from domestic producers who during recent years have made substantial enlargements to plant capacity

The third question, "What are the long-range aspects of the use of chemical fertilizers on land use, land productivity, and the cost of agricultural production?" is one that would require a much longer period of discussion than is available at the moment. I want to just hit some of the highlights and give you a few brief extracts.

This question has been studied by the Department of Agriculture and other agencies. There are numerous bulletins on the topic as a whole. I might mention for one, USDA Miscellaneous Publication 595. I am quoting from a section of that publication that is devoted to the suggested use of fertilizer in the United States:

"These suggested shifts in use of fertilizer represent a movement toward more stable farming systems. Used in combination with other practices, they would result in restoration of soil fertility lost during wartime cropping, and would maintain fertility at higher levels. There would be more emphasis on use of fertilizers for improvement and maintenance of soil resources. This means a capital investment, as well as an annual expense that must be met from current income. Over a period of years, and when used in conjunction with the acreage pattern and practices suggested, it means lower-cost production, and ability to provide the abundance of the food most needed for general improvement in nutrition and health for more people. If lower-cost production is reflected in prices of farm products, more people can consume more of the products that represent higher levels of living. This, in turn, enlarges the market outlet for farm products.

"The suggested increase in use of fertilizers would be in keeping with an expanding economy. It is analogous to maintaining an abundance of low-cost production in the industrial phase of the economy, in order that a high level of employment may be maintained, and that the total output may be consumed at prices commensurate with its cost. The level of soil fertility is also a matter of public concern, and the role of fertilizer must be considered carefully in educational and other programs pertaining to this problem.

"The answer to the general problem of increased production--here we are referring to critical production--resulting from technological improvement lies partly in the fact that if the improvement actually results in lower costs per unit, farmers can accept lower prices without sacrifice of income. In fact, with lower costs per unit and more units of product to sell, the farmers who adopt improved practices have considerable defense against the impact of lower prices. But the Nation's welfare requires encouragement of progress in reducing costs of agricultural production and maintaining soil fertility, even though countermeasures will be needed to help those who are at some disadvantage at the moment in adopting these improved methods."

I shall leave for the record a brief list of selected references on the topic in general, together with a supply of the tables referred to previously, which were made available by the secretariat of the Fertilizer Committee.

I thank you very much, gentlemen.

MR. MASSELMAN: Considering the fact that we will have a seminar this afternoon with quite a formidable battery of five panel members, questions will be heard then.

Thank you, Mr. Porter.

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