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SELECTED ARTICLE

Production of Fertilizers in India.

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The principle underlying the use of fertilizers, namely, the necessity of adding plant food to the soil, was understood in a general way even in the early days of civilization. It was only about a century ago, however, that the science of plant nutrition and the requirements of the soil for certain elements, in which it is liable to be deficient, began to be clear as a result of the researches of de Saussure and Liebig on the Continent and Lawes and Gilbert in England. The versatile Lawes was not only one of the most brilliant pathfinders in agricultural science but was also the first manufacturer of a chemical fertilizer, namely superphosphate. Phenomenal progress has since been made in the manufacture of chemical fertilizers in Europe, America and Japan, and today the combined world production in the case of some of the important fertilizers is computed in terms of millions of tons. The fertilizer industry by its effect on the cost of production of sulphuric acid has given a tremendous impetus to the development of the heavy chemical industries. Since the World War of 1914—18 the synthetic manufacture of fertilizers has been greatly developed.

The intelligent use of fertilizers has become an integral part of the agriculture of the advanced countries in Europe, in America and in other parts of the world. This cannot be claimed of India; indeed, until comparatively recently the use of fertilizers by the ryot was insignificant in spite of the field experiments carried out at the different agricultural research stations in this country. The poverty of the ryot was the main impediment. In recent years, however, as a result of a combination of circumstances, including the lowered prices of fertilizers and the systematic propaganda conducted by commercial firms, the use of fertilizers by the cultivator has become considerably in excess of that on tea and coffee estates which were at one time practically the sole consumers of these commodities in India. Even now the consumption by the cultivator represents a small fraction of that which will be possible if the circumstances alter sufficiently so as to make the use of fertilizers general.

Imports and exports. In this article it is proposed to deal briefly with the production of fertilizers in India, but before proceeding to discuss production it will be well to understand the extent to which fertilizers are at present being imported into and exported out of this country. The exports consist almost exclusively of organic fertilizers manufactured from bones and animal and fish refuse which are slow acting and also unpopular in India due to religious prejudice. The imports and exports for 1938—39 are shown below.

Imports

	Tons	Value in rupees
Nitrate of soda	2,137	2,23,891
Sulphate of ammonia	76 748	82,99,126
Muriate of potash	1,829	1,82 606
Superphosphate	6,788	5,65,290
Ammonium phosphate	2,569	3,95,166
Fish manure	2,349	72,538
Other fertilizers	7,032	7,78,757
Total	99,452	105,17,324

Exports

	Tons	Value in rupees
Bones for manurial purposes	15,424	11,84,473
Bone meal	25,072	14,85,764
Fish manure	4,710	3,79,374
Guano	178	19,045
Horn meal	1,007	1,04,833
Sulphate of ammonia	1,313	1,36,455
Other fertilizers	5,546	4,11,341
Totol	53,250	37,21,685

To roughly 100,000 tons of fertilizers which are at present annually imported it is necessary to add approximately 20,000 tons of sulphate of ammonia and 2,000 tons of superphosphate produced in the country and also the amounts of the various indigenous organic manures consumed, before the total approximate consumption of fertilizers in India can be arrived at. When it is considered, however, that the world's present annual production of sulphate of ammonia and superphosphate alone is of the order of 4,000,000 and 15,000,000 tons respectively, the comparative smallness of India's total consumption would be obvious.

Nitrate of potash. The manufacture of nitrate of potash is a very old industry of Northern India. Although potentially a fertilizer of unusual value owing to the presence of both nitrogen and potash in it, the material is not used to a large extent as a fertilizer. This is due partly to its high cost of production as compared with that of other nitrogenous fertilizers, and partly to the fact that it is in demand as a constituent of explosives. As is generally known, it is found in a crude form as an efflorescence in the surface soil where it is formed as a result of the decomposition of nitrogenous organic matter and the bacterial nitrification of the resultant ammonia. In order that nitrate of potash may be formed, potash salts must also be simultaneously available in the soil.

Saltpetre. The crude saltpetre from which nitrate of potash is obtained varies in composition and usually contains a large proportion of sodium chloride. The refining consists in removing impurities including sodium chloride. Crude saltpetre and also the earths from which saltpetre is extracted are used locally as a fertilizer, but the bulk of the meterial is refined into nitrate of potash for purposes of export. The use of the refined material also as a fertilizer is not unknown.

The production of saltpetre is at present on a much smaller scale than it was at the beginning of the nineteenth century when the export amounted to 80,000 tons per annum. The average annual export during recent years has not exceeded 8,000 tons, but presumably the present European war will again stimulate its production and export. A large number of refineries exist in the Punjab, the United Provinces and Bihar for the production of saltpetre.

From the figures given above it will be seen that some 2,000 tons of nitrate of soda is still being imported annually into this country. In the past it has been imported in much larger quantities, but apparently it has in recent years not been able to compete successfully with sulphate of ammonia. The world's entire requirement of nitrate of soda is met from Chile where it is found as a natural deposit, and there is no possibility of its manufacture being undertaken in this country.

Sulphate of ammonia. The most important fertilizer from the point of view of Indian manufacture is undoubtedly sulphate of ammonia. Some 90,000 tons

of this fertilizer are now being consumed annually in the country, and it may confidently be expected that its consumption will continue to increase. Ten years ago the total consumption in India was between 20,000 and 25,000 tons, and the increase by 300 per cent within a decade indicates the rate at which its use is spreading among the cultivators Of recent years, and of course, before the present war started, its price had been considerably lowered and the firms concerned in its sale maintained an organization for propaganda and ready availability of the material. It is not too much to expect that its price will, after the present war is over, be lowered further in order that the use of this fertilizer may be more widespread.

Until the advent of the Haber-Bosch process of synthetic manufacture of ammonia about two decades ago, sulphate of ammonia was produced entirely as a by-product in the manufacture of coal-gas and metallurgical coke. At present the synthetic production probably exceeds the total quantity made as a by-product. The nitrogen present in the coal is given off as ammonia as a result of destructive distillation resorted to in the production of both gas and coke. The gas containing ammonia is first stripped of its tar content and is then conducted through a plant, known as the saturator, which contains sulphuric acid. Sulphate of ammonia is produced as a result of interaction between ammonia gas and sulphuric acid, and this collects as a paste at the bottom of the saturator. The paste is removed, dried and neutralized with sodium carbonate. In India the production of sulphate of ammonia dates back to 1909, and the fertilizer has so far been made practically entirely by coke plants operating in the coal-fields and also by those attached to the iron and steel factories of Bengal and Bihar. It is probably not yet generally known that the Mysore Chemicals and Fertilizers Ltd. are about to place on the market sulphate of ammonia made synthetically at their factory situated in Mysore. This marks an important new development in the production of fertilizers in this country.

The East Indian Railway's coke plant attached to the Railway's collieries in the Giridih coalfield was the first to produce sulphate of ammonia in India. The coke plant was erected in 1909, and for the first six years the acid required for the recovery of ammonia was purchased from Calcutta. In 1915 an acid plant was added which has since supplied the requirements of the sulphate of ammonia plant. The Bengal Iron Company were the next in the field and erected their by-products recovery plant at Kulti in 1915. The Tata Iron and Steel Company at Jamshedpur followed in 1916, and subsequently several other concerns, such as the Loyabad Coking and By-products Recovery Plant in the Jharia coalfield, the Indian Iron and Steel Company near Asansol and the Bararee Coke Co. near Dhanbad, began to produce sulphate of ammonia. It is understood that the newly-founded Steel Corporation of Bengal do not contemplate manufacturing sulphate of ammonia. With the exception of the East Indian Railway Coke Plant and the Bararee Coke Co., all the Indian producers of sulphate of ammonia as a by-product are members of the British Sulphate of Ammonia Federation, and the price of the commodity as sold in India is, therefore, controlled by the Federation. The largest Indian producer is the Tata Iron and Steel Company, and the total production has so far not exceeded 20,000 tons per annum.

Reference has already been made to the Mysore Chemicals and Fertilizers Ltd. This firm proposes to manufacture about 7,000 tons of sulphate of ammonia annually, and the production has probably already been commenced. It is anticipated that practically the entire output of this factory will be consumed in the Mysore State by the sugarcane cultivation and the coffee and tea estates. The factory manufactures sulphuric acid by the contact process and are the first to produce ammonia synthetically in this country. The synthetic process

adopted is known as the 'Chemico' process which is presumably an adaptation of the original Haber-Bosch process worked out in Germany and later adopted by the Imperial Chemical Industries at their works at Billingham. In principle the synthetic production of ammonia consists in combining three volumes of hydrogen with one volume of nitrogen in the presence of a catalyst; in practice, however, the process is a complicated one. Further developments in the manufacture of sulphate of ammonia will presumably be along the lines of synthetic production, but the output from coke plants should also increase as the iron and steel industry expands further.

Phosphate of ammonia. Considerable quantities of calcium cyanamide have in the past been imported into India, but owing to the increasing popularity of sulphate of ammonia its consumption has been on the decline. No cyanamide is produced in this country and none is likely to be produced, although in a note published in 1917 Dr. (later Sir) L. L. Fermor, formerly of the Geological Survey of India, suggested three possible sites for the establishment of this industry in India. A comparatively recent addition to the range of inorganic fertilizers is phosphate of ammonia which is now being imported into this country in substantial quantities. It is produced synthetically and is a double fertilizer in that it supplies both nitrogen and phosphorus to the soil. No attempt has yet been made to produce it in this country, although in view of the recent developments in Mysore there does not seem to be any reason why it cannot be made in India.

Superphosphate. The import of superphosphate has for some years been of the order of 7,000 tons per annum, and some 2,000 tons are manufactured in this country. This fertilizer is produced on a vast scale in different parts of the world, and some years ago when the Tariff Board investigated the position of the heavy chemical industries in this country, it was thought that with suitable protection from the State the manufacture of superphosphate could be developed. The difficulties attending the manufacture of this fertilizer are (1) lack of suitable rock phosphates and (2) the comparatively high cost of production of sulphuric acid in the country. Deposits of phosphates are available in the Trichinopoly district of Madras and in the Singhbhum district of Chota Nagpur, but their high iron content renders them unsuitable for the manufacture of superphosphate. Superphosphate can also be made from bones, and although the latter are plentiful in the country, they can usually be exported to fetch higher prices than are paid for imported rock phosphate. These are some of the factors which have inhibited the development of the superphosphate industry in the country. But the time may yet come when as a result of the double movement of expansion of the heavy chemical industries and increased purchasing power of the ryot a successful superphosphate industry will be established in India.

Only two firms in India have so far seriously attempted to produce superphosphate in this country from crushed bones. One of these, Messrs Dharamsi Morarji Chemical Co. of Bombay, had a comparatively ambitious scheme for production of this fertilizer, but the expectations were not realized. They continued to produce on a small scale for some years and have since abandoned this manufacture. Messrs Parry and Company of Madras are still producing superphosphate at the rate of 2,000 tons per annum, most of which is made from bones.

Basic slag obtained as a by-product of the steel industry is an important phosphatic fertilizer in England and under certain soil conditions has been known to produce remarkable results. The Indian slag is poor in phosphorus and its grinding to the requisite degree of fineness is consequently not considered to be an economic proposition.

Potassic Fertilizers. Potassic fertilizers, mainly in the form of muriate of potash, are in ordinary times imported largely from Germany and Palestine. India does not produce any potassic fertilizer except in the form of nitrate of potash which has already been discussed. Potash salts are present among the beds of rock salt in the Salt Range of the Punjab, and the question of their exploitation for manurial purposes was considered by the members of the Government Salt Department and the Geological Survey of India, but the prospects were thought to be highly doubtful.

Organic Fertilizers. India produces considerable quantities of organic fertilizers at or near Calcutta, Madras, Cawnpore and Karachi. The exact figures for production are not available, but the export figures given earlier in this articles indicate the sales of production. Unsteamed bone-meal is produced in those bone mills which crush bones for gelatine. The portion of the bones which gets powdered in the process of crushing is marked as unsteamed bone-meal. Steamed bone-meal is obtained by steaming bone pieces (usually greasy bones) in digesters under a pressure of 60/75 lb. for 2-3 hours. After drying, the steamed material is crushed to a fine powder. Steamed horn and hoof meal and steamed leather meal (charmon) are produced by the same process as steamed bone-meal. Sterilized animal meal is derived from animal carcasses, etc After skinning, the dead animals are introduced into superheated rotaries and converted into dried pulp which is crushed in disintegrators. Owing to its disagreeable smell, export is difficult and the material is largely used in mixed fertilisers for tea gardens. Fish guano is obtained from the refuse of small fishes which are caught in large numbers in the Sunderbans and on the Malabar coast. This material is also difficult to export and is consumed largely in the country admixed with other fertilizers. All the organic fertilizers mentioned above are produced in substantial quantities in India. Another type of organic fertilizer which is produced in the country and used to a considerable extent by the cultivator is oil-seed cake meals. These are by-products of the oil pressing industry, and those varieties, which are not fit for use as a cattle food, find their way largely into the soil. (*Indian Farming* 1 (1940 : 211).

Ezperiments with Waste Products as Cattle Fodder in Famine Areas.

(From the Principal Information Officer, Government of India).

Investigations have lately been made by a senior worker from the Animal Nutrition Section of the Imperial Veterinary Research Institute at Izatnagar, in some of the famine stricken areas in the Punjab, Rajputana and Sind, to find out what local green roughage, if any, which when added to the agricultural and factory wastes like groundnut husk, rice husk, corn hearts, reed, bajra husks, molasses, etc., locally available, would maintain cattle even in famine conditions. Food experiments, it is understood, with these substances are being undertaken immediately at Izatnagar so that the results may be available at an early date. The chemical analyses of these agricultural and factory wastes do not, it is said compare unfavorably with wheat *bhoosa*, the roughage which is being supplied by Government organisations in these famine areas: These areas, which border the Rajputana desert, happen to have the best breeds of cattle in India. The soil is rich and in normal times crops and fodder grasses grow luxuriously, but no serious effort seems to have been made at conserving roughage for times of scarcity or tapping new sources of cheap fodder supply during famines.

For the last three years there has been no rain, with the result that there has been a complete failure of crops. Majority of the best breeds of cattle in