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*Commentary*

# Agriculture requires both natural and artificial fertilisers

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## INTRODUCTION

A fertiliser, often known as a fertiliser, is a natural or synthetic ingredient that is applied to soil or plant tissues to deliver nutrients to the plants. Liming materials and other non-nutrient soil amendments do not require fertilisers. Fertilizer occurs in a range of natural and synthetic forms. Fertilization in most current agricultural techniques concentrates on three key macro nutrients: Nitrogen (N), Phosphorus (P), and Potassium (K), with the addition of micronutrient supplements such as rock dust on occasion. Farmers use a range of methods to apply these fertilizers, including dry, pelletized, and liquid application procedures, as well as big agricultural equipment and hand-tool approaches.

Compost, animal dung, human manure, mined minerals, crop rotations, and residues of human-nature enterprises were all used as fertilisers in the past (*i.e.* Blood meal from slaughtered animals or trash from the fish processing industry). However, with improvements in plant nutrition in the 19$^{th}$ century, an agricultural sector centred on synthetically manufactured fertilisers arose. This shift was critical in altering the global food system, allowing for larger-scale industrial agriculture and higher crop yields. Nitrogen-fixing chemical techniques, such as the Haber process around the turn of the century, were aided by increased manufacturing capacity generated during World War II, resulting in a surge in nitrogen fertilizer use. Increased nitrogen fertilizer consumption (800 percent rise between 1961 and 2019) was a major trend in the latter part of the twentieth century. As part of the so-called "Green Revolution," improved productivity of traditional food systems (by more than 30% per capita) was a critical component.

For thousands of years, farmers have been concerned with soil fertility management. Minerals or manure were used by Egyptians, Romans, Babylonians, and early Germans to increase the productivity of their fields. Plant nutrition research predates the work of German scientist Justus von Liebig, but his name is frequently referenced. Justus von Liebig's conclusions were quickly disproved by Nicolas Théodore de Saussure and his scientific colleagues at the time. There existed a complicated scientific knowledge of plant nutrition, with a focus on humus and organo-mineral interactions that was consistent with more recent discoveries beginning in 1990. Carl Ludwig Sprenger and Hermann Hellriegel were two prominent scientists on whom Justus von Liebig drew. 'Knowledge' in this field Erosion occurred, fueled in part by the blending of economics and research. In 1837, an English entrepreneur named John Bennet Lawes began experimenting on the effects of different manures on plants growing in pots, and a year or two later, the tests were expanded to include field crops. One immediate result was that he patented manure made by processing phosphates with sulfuric acid in 1842, establishing the artificial manure business for the first time. He enlisted the help of Joseph Henry Gilbert the next year, and the two collaborated on agricultural studies at the Institute of Arable Crops Research. In the early days of nitrogen-based fertilizer manufacture, the Birkeland–Eyde method was one of the competing industrial techniques. This method was used to convert atmospheric Nitrogen ($N_2$) to Nitric acid ($HNO_3$), which is one of numerous chemical reactions known as nitrogen fixation. Nitric acid was produced, which was subsequently employed as a source of Nitrate ($NO_3$).

At Norway, a factory based on the method was established with the construction of big hydroelectric power plants in Rjukan and Notodden. The Haber and Ostwald processes rose to prominence in the 1910's and 1920's. From Methane ($CH_4$) (natural gas) gas and molecular Nitrogen ($N_2$) in the air, the Haber process creates Ammonia ($NH_3$). The Haber

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process produces ammonia, which is then transformed to Nitric acid ($HNO_3$) in the Ostwald process. Nitrogen production plants that had been cranked up for war-time bomb making were repurposed for agricultural use after WWII. Synthetic nitrogen fertilizer consumption has continuously grown over the previous 50 years, nearly doubling to a present pace of 100 million tons of nitrogen per year. Synthetic nitrogen fertilizer production has aided global population increase greatly; it is believed that about half of the world's population is now nourished as a result of synthetic nitrogen fertilizer use. Phosphate fertilizer consumption has grown as well, from 9 million tons per year in 1960 to 40 million tons per year in 2000. A maize crop generating 6–9 tons of grain per hectare (2.5 acres) requires 31–50 kilograms (68–110 lb.) of phosphate fertilizer, but soybean crops only need 20–25 kilos per hectare. Yara International is the world's largest nitrogen-based fertilizer manufacturer.