# To Make Fertilisers Pay

**A Gupta**

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**AGRICULTURAL** production can be raised by bringing more land under cultivation or by increasing the productivity of land. It is natural that the scope for increasing output by extending cultivation will be inereasing-Jy limited. So the principal reliance has to be placed on raising productivity by better cultural practices *and* by qualitative and quantitative improvements -m application of inputs other than land in farming.

Climatic conditions and soil characteristics are two most important factors in crop production which «« e to an extent outside human control. As far as soil conditions are concerned, some basic modifications are possible by the addition of nutrients, but characteristics such as mineral make-up, texture and structure of the soils are practically immutable. The effort to obtain higher yields is largely one of finding out which physical factors are controllable, are limiting crop growth under given conditions of climate and soil. The prime requisite for judicious action is thus knowledge of the soil. Characteristics such as the quantity of available nutrient, the soil structure and texture are essential knowledge on which the technical planning of agriculture depends. Unfortunately, in our country with an available cultivable area of 37.62 crore acres, there are only 32 soil analysis laboratories. This is absolutely inadequate. We must have at least one soil analysis laboratory in every district and the data collected should be used to compile a soil map. With this knowledge of soil conditions, farmers should be advised on the use of appropriate nutrients to be used. The soil analysis laboratories can be modestly equipped for only a few thousand rupees each.

The spectacular increases in crop yields shown in Table 1 were obtained as a result of carefully planned experiments in which the primary nutrients, nitrogen, phosphorus, and potassium, were applied in a large number of combinations. The yields shown represent the response to the most favourable combination of the three nutrients. In fact the relationships between the concentrations of different nutrients in the soil and their uptake by the plant are quite complex. Fortunately, however, plants can make good growth under a rather wide range of conditions if enough of each nutrients is available. Some soils arc seriously deficient in one or more elements, but a great number of soils furnish ail nutrients at a relatively low rate. However, if conditions change so that the crop yield increases, the soil that once supplied balanced nutrients at a low level of nutrient supply may become deficient in some elements. Among the nutrient elements, potassium, calcium, and magnesium, it. is not unusual to find that the decrease in the absorption of one nutrient will be roughly compensated for by an increase in the absorption of other nutrients so that the total equivalents of nutrient cations present in the plant tissue will remain approximately constant.

This however does not always occur. Many types of plants absorb potassium much more readily than calcium or magnesium, conversely some legumes absorb calcium as readily as potassium. Calcium uptake, at least with some kinds of plants, is helped by boron. Molybdenum uptake is favoured by phosphate and depreseed by sulphate. Zinc deficiencies induced by phosphate have been noted. Excess of availabie iron can induce manganese deficiency, and excess manganese can induce iron deficiency and can retard uptake of calcium if the supply of calcium is low in the soil. The application of one or more plant nutrients may thus accentuate the deficiency of another. For example, when nitrogen and phosphorus fertilisers are added without potassium to a soil poor in available potassium, the plants in the resulting larger crop will contain a smaller percentage of potassium and show more pronounced signs of potassium deficiency.

Because of the low level of nearly

**Table 1 : Effect of Fertiliser on Yields of Selected Crops**

| | Crop | Duration of Experiment | Fertiliser ($N + P_2O_5 + K_2O$) | Yield/ha on Checks | Yield/ha on Fertiliser | Increase (*Per cent*) |
|---|---|---|---|---|---|---|
| | | Years | kg/ha | | kilograms | |
| India | Tea | 10 | 135 | 591 | 1134 | *92* |
| Germany | Hay | 10 | 240 | 3560 | 8740 | *146* |
| India | Tapioca | 1 | 370 | 8510 | 25310 | *197* |
| Tanganyika | Pigeon pea | 1 | 210 (+manure) | 581 | 1840 | *217* |
| United States | Wheat | 4 | 200 | 659 | 2285 | *247* |
| Puerto Rico | Sugar cane | 5 | 400 | 9856 | 41216 | *318* |

*Source:* "The State of Food and Agriculture 1963", F A O , Rome.

all piant nutrients in soils of the humid tropics, many such examples may be found of nutrient imbalance brought on by applying only two or three nutrients.

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Many soils are deficient in two or more nutrients. In such cases the addition of one nutrient may produce little or no increase in yield, but the addition of all the deficient nutrients produces a relatively large increase. An example is quoted in the FAO's "State of Food and Agriculture in 1963**. In an experiment in Ceylon potatoes were grown on a soil deficient in both nitrogen and phosphorus, A dressing of phosphorus by itself increased the yield by about 4,200 kg/ha; a dressing of nitrogen and phosphorus together increased the yield by over 9,000 kg/ha. When the response to one nutrient is increased by the application of a second, there is said to be a positive interaction between them. In general, it is true that the nutrient element present in relative minimum is the one which limits crop production and that larger application of other nutrients do not compensate for the deficiency of an essential nutrient.

The forms in which fertilisers are consumed provide many contrasts in usage. Consumption of high-analysis liquid fertilisers for direct application to the soil continues to increase rapidly in the United States. In the year 1953-54 such liquid fertilisers, mainly anhydrous ammonia, accounted for 800,000 tons, or 53 per cent of the total nitrogen production of the United States.

Consumption of nitrogen solutions is increasing also in the USSR, Denmark, the German Federal Republic, Czechoslovakia, Taiwan, Israel and Poland. Increasing interest is also being shown in the consumption of urea. japan and the United States are by far the largest consumers of fertiliser-grade urea, followed by the Republic of Korea, India, Mexico, and Sudan.

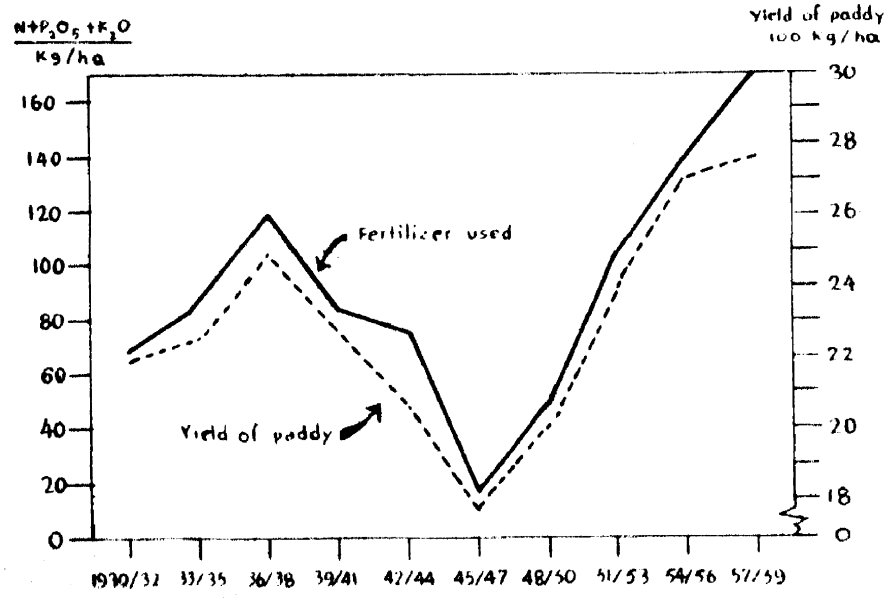
### Fertiliser Use and Paddy Yield

In the phosphatic group, single superphosphate is still the most popular fretiiiser, but the proportion of concentrated superphosphate is rapidly increasing in Europe, North America and in the Far East, at the expense of single superphosphate and basic slag. In the German Federal Republic, France, and Belgium, however, more phosphorus is consumed as basic flag than in any other form because of the availability of large quantities of this material from the operations of the steel industry. Basic slag, which in 1905-06 provided almost 40 per cent of the world's total consumption of phosphate fertilisers, now provides only 15 per cent.

As for potash fertilisers, the dominance of muriate is world-wide, and in accordance with the trend toward greater concentration the share of higher grade, more highly refined muriate has shown a progressive gain over the lower grades.

The growing popularity of complex fertilisers, particularly in Europe and in the United States, has been a feature of the period.

An instance of the relationship between fertiliser use and yield of paddy is illustrated in the figure below which relates to Taiwan. An interesting feature is that the yield-fertiliser input relationship is as close for an increase in fertiliser use as it is for a decrease which occurred in the war years between 1939 and 1945. In India, according to one estimate, increased fertiliser use was responsible for 4.6 million tons of the increase of 11.2 million tons in food production in the Second Five Year Plan. Such estimates are necessarily imprecise, yet the contribution of fertilisers to higher yields is difficult to over-stress.




The total area under cereals is 22.4 crore acres in India; of this 8.36 crore acres under rice, 3.33 crore acres wheat, 4.3 crore acres under jowar, 2.7 crore acres under bajra, 1.1 crore acres under maize, 0.58 crore acres under ragi, 0.83 crore acres under barley and 1.1 crore acres under other small millets. Plant nutrients removed by different crops on an average are given in Table 2.

In India, the soil is deficit in ail the three basic nutrients, $N_2$, $P_20$. and $K^2$ O. Very positive responses have been recorded in experiments with nitrogen and phosphorous both for food crops as well as cash crops. We have therefore relied mainly on these two plant nutrients till now. Potassium fertilisers are very expensive and are not available in our country; they are used now mainly for cash crops like tea, tobacco, etc. A correct choice of nutrient is very important for the maximum benefit to be derived from the land.

In India experiments show that the yield of paddy can be almost doubled by the use of proper nutrients. In one such experiment the yield without fertilisers was 1468 kg per hectare; with 28 kg of nitrogen per hectare the yield went up to 507 kg; by using 54 kg of nitrogen per hectare, the yield increased to 671 kg. On the other hand, when both nitrogen and phosphorous were used — 54 kg of nitrogen and 22.4 kg of $P^2$ $O^5$ the yield on the same land rose to 1123 kg.

To get the most; benefit out of the

Table 2 : Nutrients Removed by Different Crops

| Crops | Nutrients Removed (in lb/acres) | | |
|---|---|---|---|
| | N | $P_2O_5$ | $K_2O$ |
| Paddy | 73 | 21 | 110 |
| Wheat | 52 | 26 | 60 |
| Jowar | 46 | 16 | 77 |
| Bajra | 25 | 10 | 90 |
| Maize | 120 | 42 | 93 |
| Barley | 48 | 26 | 112 |

application of fertilisers, attention has to be paid to other factors such as the time of application, the mode of application and the moisture content of the soil. A disproportionate combination of different nutrients actually reduces productivity. The strict proportions are, however, governed by local conditions and so we come back to the crucial importance of detailed study of soil conditions covering the whole country.