

Fertilizer crisis

and ways to cope up

S K Rautaray* and Swati Sucharita

ICAR-Indian Institute of Water Management, Bhubaneswar, Odisha 751 023

Fertilizer prices have increased tremendously during the year 2021 and 2022 due to the rising price of inputs, sanctions on Belarus and Russia after start of war, and export restrictions in China. Such price hikes have burdened the economy of India due to a huge subsidy on fertilizers and the need of foreign exchange for import of fertilizers and allied inputs. So, there is a need to incentivize the farmers to use less chemical fertilizers. Some practical ways to reduce the chemical fertilizers include promotion of green manuring in suitable agroecosystems, integration of green manuring and rock phosphate and/or SSP to reduce the use of DAP in paddy crop, recycling of agricultural wastes at farm level using vermicompost, using other sources of fertilizers such as biofertilizers, city compost, cow dung slurry etc and adoption of efficient agronomic practices to reduce the use of chemical fertilizers. Wide scale adoption of these measures will help in reducing the financial burden on the Government of India and keeping the soil, water and air healthy.

Keywords: Biofertilizer, City compost, Green manure, Rice, Rock phosphate, Vermi-compost

GLOBALLY, fertilizer prices increased by about 80% during January–December in the year 2021. Such increase continued in the year 2022 also. There was an increase of 30% in the fertilizer price during January–April in the year 2022. It is expected that fertilizer prices will remain higher for a longer period, unlike the previous such peak that occurred in the year 2008. The increased fertilizer prices are due to surging input costs. For the manufacture of N fertilizer, natural gas is used as primary feedstock in most countries. The prices of natural gas have increased exorbitantly. Besides, increase in input price, the supply disruptions due to sanctions on Belarus and Russia after start of war between Russia and Ukraine are also responsible for this. Export restrictions in China to meet their own domestic demand of fertilizers resulted in low fertilizer availability and subsequent price hike in global market. The urea prices reached an all-time high from \$380/tonne

in April 2021 to \$930/tonne in April 2022 (145% increase). During this period, DAP (Di-ammonium phosphate) prices reached to \$924/tonne from \$555/tonne (66% increase). Such price hikes have crossed the affordable limit of farmers.

There is a huge burden on the Government due to subsidy on fertilizers. The amount of such subsidy was only ₹60 crores in the year 1976–77. It increased to ₹1,38,000 crores in the year 2020–21 and ₹1,62,132 crores in the year 2021–22. For the three-month period during April–June of 2022 only, the subsidy amount crossed ₹2,15,000 crores. There is a steep rise in subsidy amount from the year 2019–20 onwards and it is still continuing. It is not possible to go on increasing the subsidy amount on fertilizers. Also, it is high time to think of minimizing the pollution of soil, water and air due to the use of chemical fertilizers. With this background, the present article

describes some practical solutions to the present fertilizer crisis.

Promotion of green manuring in suitable agroecosystems

Sesbania is a good green manure-cum-cover crop for lowlands and sunhemp (*Crotalaria juncea*) is very promising for this purpose in uplands. Location specific other green manure crops are also available. It was observed that *Sesbania rostrata* as green manure-cum-cover crop for the 6-year study period helped in mean saving of 50.0 kg N, 8.3 kg P_2O_5 and 16.4 kg K_2O /ha. It also enhanced energy efficiency and profitability of lowland rice besides improving the organic carbon, available N, P_2O_5 and K_2O content in soil. Considering the potential cultivated area of *Sesbania* as green manure in about 20 million hectare (Mha) in irrigated and rainfed lowland ecologies, about 1 million tonnes (Mt) N can be saved which corresponds to 8.77% of annual urea production in India.

In addition, about 0.17 Mt of P_2O_5 can be saved which corresponds to 9% P_2O_5 present in DAP produced per annum in India. About 0.328 Mt of K_2O can be saved with this green manure-cum-cover crop which corresponds to 18.7% of the annual muriate of potash (MOP) import. At micro-level, on field basis, green manuring with *Sesbania* has potential to meet 62.5% of N, 3.9% of P and 28.2% of K requirement of an irrigated high yielding variety of paddy in the wet season for Eastern India (80 kg N, 40 kg P_2O_5 and 40 kg K_2O /ha). Considering this, a policy should be developed to promote *Sesbania* green manure by providing an incentive amount of ₹1500/ha to farmers growing this crop which may eventually reduce the burden on the subsidy of fertilizers. Such farmers who get subsidy on green manure may be tagged so that they will not avail the subsidy benefit on chemical fertilizers.



Sesbania green manure crop before the transplanted rice

Integration of green manuring and rock phosphate and/or single super phosphate (SSP) to reduce the use of diammonium phosphate (DAP) in paddy crop

In acidic soils, rock phosphate may be used as phosphorous (P) source and the full dose for the rice crop may be applied to the green manure crop before sowing. In mild acidic soil, the P dose for rice crop may be met from SSP or a combination of rock phosphate and SSP applied to the green manure crop. Green manure incorporation in soil helps in improved P availability in soil. Also, enough time available during the growing and incorporation of green manure helps in converting insoluble and citric acid soluble P to water soluble form. This procedure is hastened with the acidity of soil

and also with organic acid released during decomposition of green manure. Thus, costly DAP can be partly substituted by rock phosphate and SSP.

Recycling of agricultural wastes at farm level using vermicompost

Recycling of agricultural wastes using vermicompost technology at farm level is a practical way of managing agriwaste for meeting the plant nutrient requirement in farming. Our experience with a 1.584 ha farm for three years (2015–16 to 2017–18) revealed that 8.1 tonne vermicompost was produced in 3 batches from 24 tonnes of agriwastes produced within the farm area. Out of 24 tonne agriwaste, 10 tonne could be obtained from fresh cowdung and bedding material using 3 cows and 1 calf. Another 10 tonne waste can be obtained by lopping off young twigs of *Glyricidia* plantation which can be grown as a fence crop boundary of 1 ha farm area. Maize stover, rice stubbles, weeds and other crop residues may provide another 4 tonnes of agriwaste.

The mean nutrient content in vermicompost for the study period was 1.45% N, 0.60% P and 0.76% K. About 8 tonnes of vermicompost can contribute 116 kg N (258 kg urea), 48 kg P (equivalent to 244 kg DAP for P) and 60 kg K (120 kg MOP). A large number of such farms may contribute substantially for meeting their nutrient needs. Providing incentives for promoting such farms will help in achieving stability in fertilizer price and less depending on global fertilizer price. Our experience with such system revealed that growing of green manure crop and complementary



Vermicompost unit



Paddy crop grown using green manure and vermicompost

nutrition with vermicompost at 3 tonnes/ha helped in growing of paddy crop successfully in *kharif* season under shallow lowland.

Other sources of fertilizers

Biofertilizers: Use of *rhizobium* in pulse and leguminous oilseed crops has great scope in reducing N fertilizer. Similarly, *Azotobacter* (a highly aerobic bacteria) is suitable for non-legume upland crops in light textured soils. *Azospirillum* (partially aerobic bacteria) is suitable under partially aerobic soil condition. Inoculation of this bacteria is very effective in C4 crops like sugarcane, sorghum, bajra, maize and fodder grasses. Combination of *Azotobacter* and *Azospirillum* in 1:1 ratio may be applied if needed by the soil conditions. Blue green algae and *Azolla* can be used for lowland rice to save chemical N fertilizer upto 40 kg/ha. Phosphate solubilizers are useful in increasing the availability of native P. Vesicular arbuscular mycorrhizal fungi are mobilizers of native P through a network of mycelia and can be used in upland



Rhizobium inoculation in groundnut improved nodulation and N fixation

soil conditions for crops having extensive root proliferation.

City compost: About 62 Mt of municipal solid wastes are generated annually. For the dual purpose of safe disposal of these

wastes and the role of these wastes in nutrient addition, city composts are produced by state governments. The compost provides major nutrients like nitrogen, phosphorus, potassium, manganese, calcium, magnesium and micronutrients like boron, zinc, molybdenum, iron, etc. Government provides assistance of ₹1500/tonne on sale of city compost which can be used as organic fertilizer by farmers. Government of India provided subsidy on city compost in the year 2016–17 at ₹0.55 thousand crores. It steadily increased to ₹72.98 thousand crores in the year 2020–21.

Cow dung slurry: Biogas slurry is a by-product of anaerobic digestion that contains easily-available nutrients, e.g. considerable amounts of both macro (N, P, K) and micronutrients, which might be a composting amendment to adjust nutrient element ratio and foster the activity of microbial communities. The digested biogas slurry is rich in macro and micro nutrients that provide essential plant nutrients for a longer period. Biogas slurry may be considered as a good quality organic fertilizer for sustainable agriculture.

Efficient fertilizer management to reduce use

Site specific nutrient management by adopting soil test based

fertilizer recommendation and leaf colour chart can avoid overuse of fertilizers. Similarly, fertilizer placement is useful in reducing fertilizer dose in row crops. In rice crop, basal application of fertilizer at last puddling helps in placing the fertilizer in the reduced zone for high use efficiency, especially in medium heavy and heavy soils. Top dressing of N fertilizer at tillering must be timed with first weeding using cono weeder for incorporating urea in the reduced zone for better N use efficiency. However, for light textured soils, more number of split applications of fertilizer helps in increasing the use efficiency. Rice field should be drained to saturation before applying fertilizer and shallow irrigation be given two days after it to maintain a submerged condition. This water management practice is useful for high N use efficiency in rice field. In rice fields with ponded water exceeding 5 cm nano urea may be sprayed over the crop canopy at recommended doses. Use of urea super granules can reduce the use N dose, especially in heavy textured soils under submerged conditions. Other agronomic practices like optimum time of sowing, pest management and crop management improves yield and indirectly enhance fertilizer use efficiency.

SUMMARY

The present fertilizer crisis has forced the researchers, policy makers, extension workers and farmers to reduce the use of chemical fertilizers in agriculture. Rice is grown in about 40 Mha in India and huge quantity of chemical fertilizers is used. For this important crop, *Sesbania* is a good green manure-cum-cover crop under lowlands and sunhemp under uplands. At field level, green manuring with *Sesbania* has potential to meet 62.5% of N, 3.9% of P and 28.2% of K requirement of an irrigated high yielding variety of rice in Eastern India. This practice can be promoted by providing an incentive at ₹1500/ha to farmers. In acidic soils, rock phosphate may be used as P source and the full dose for the rice crop may be applied to the green manure crop. In mild acidic soil, the P dose for rice crop may be met from SSP or a combination of rock phosphate and SSP. Generating vermicompost at farm level and use of other sources such as biofertilizers, city compost and biogas slurry has good potential in substituting the chemical fertilizers. The extension approach should re-orient more towards fertilizer and water saving techniques.

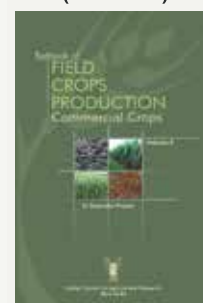
*Corresponding author's e-mail: sachin.rautaray@icar.gov.in

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Krishi Anusandhan Bhavan-I, Pusa, New Delhi 110 012
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