Addressing India’s Food Security
Is Phosphorus the Missing Link?

MADHURI NANDA

India relies on higher agricultural productivity to meet the increasing food demands of its growing population. The linkages between phosphorus—the macronutrient—and food security are well established. India, though, has depleting soil fertility, leading to a heavy dependence on the import of phosphorus. The European Union, Australia, and other import-dependent countries have pioneered efforts towards its sustainable use. India has still not made the much-needed shift in focus towards a clear policy on phosphorus. Creating awareness and sensitisation among key stakeholders is essential.

India has surmounting pressure on its existing resources to meet food security targets under agreed Sustainable Development Goals (SDGs) set by the United Nations, which came into effect in January 2016. Sustainable agriculture is integral to meeting these targets. The macronutrient, phosphorus, with its unsubstitutable character, has a critical role to play in Indian agriculture, which is currently being ignored. The silver lining on the horizon, though, is the untapped potential solutions in the form of recovery, as well as better and more efficient use of phosphorus, which could be implemented on a large scale. However, any advancement in research on this topic will result in benefits only if researchers are able to present them in a form that convinces policymakers about phosphorus being a non-renewable and non-substitutable resource for humankind (Scholz et al 2015). As Isaac Asimov acknowledged in 1974, phosphorus would be a “bottleneck” for human existence (Lougheed 2011) and, if unsustainably managed, its absence would wipe away the human race. Are we even aware of this challenge and are we doing our bit as the second-largest consumer of phosphate fertilisers in the world, after China (FAOACFW 2016)?

Significance of Phosphorus

Food production is directly linked to soil conditions, in terms of the soil’s nutrients, moisture, and other edaphic factors. Phosphorus, one of its key macronutrients other than nitrogen and potassium, is an unsubstitutable nutrient in agriculture. Phosphorus is also one of the most abundant minerals in the human body, and constitutes a key component in human DNA and RNA, in addition to its role in the formation of bones and teeth (Childers et al 2011). For plants, its uptake from the soil is critical not just for growth, but also for reproduction, energy production, photosynthesis, and other activities in the plant’s life cycle (Rao 1997). Phosphorus deficiency in soil causes lesser dry weight of leaves and other parts of the plant, thus affecting seed formation and preventing flowering (Atkinson and Davison 1971). Its deficiency also hampers the uptake of other minerals, like nitrogen (Singh and Singh 1968).

Among other macronutrients, it is widely established that phosphorus could be a limiting nutrient for plant growth. As a component of adenosine triphosphate, it is critical for the conversion of light energy to chemical energy during photosynthesis, and contributes to essential nucleic acids and phospholipids, and hence is important not just for plant growth, but also for flower and seed formation (Tisdale et al 1995).

The scientific community has long established the linkage between phosphorus and food security (Adhya 2013; Butler 2009; Childers et al 2011; Cordell et al 2009; Cordell and White 2013; Heckenmueller et al 2014; UNEP 2011; Weikard 2016). With India’s high malnutrition rates, and a high proportion of the population suffering from stunting (38.4%) and 35.7% being underweight (UNICEF et al 2017), it has become important to ensure enhanced agriculture productivity to meet the needs of a growing population. In addition to availability, food security also entails elements of access, stability, and utilisation of food (FAO et al 2014). However, food production still remains most critical, basically, to ensure that adequate food is grown in the region, or imported, to meet the needs of the local population. In this respect, phosphorus has a critical role to play.

A higher cropping intensity denudes the soil of essential nutrients, and an adequate replacement of these nutrients back into the soil is essential. India’s high dependence on chemical fertilisers, with import levels of up to 90%, either as raw material, rock phosphates, or intermediates (Indian Bureau of Mines 2016), leaves the country at huge risk and exposure to volatile international phosphate prices.

Geopolitical Factors

Although the reserves and existing resources of phosphorus in nature are huge, they are, however, controlled by a...
handful of countries—such as Morocco, Western Sahara, China, Algeria, Syria, Russia, and the United States (US)—some of which are deeply conflict-ridden (Jasinski 2016). The world is dependent on them to meet their need for phosphate, and this skewed geographical distribution has a direct impact on the price of phosphorus. This is an area of concern, especially for poorer nations such as those in Africa, who cannot afford fertiliser prices in international markets.

During the global economic crisis of 2008, countries faced soaring food and oil prices, other than the financial crisis. The rising food prices were attributed to declining food production, the diversion of land for crops used to generate biofuels, higher energy prices, and increasing demand from developing countries with rising populations (Mittal 2009). Interestingly, although global food prices increased, India managed to control its food prices; the increase was not as significant here. For instance, prices of cereals increased by only 23% in India over 2005–08, as compared to a global price increase of 150% during that period.

If one were to examine the price fluctuations of phosphate-based fertilisers around the time, it is striking that the price spike in this sector was much more than the rise in food prices. Global phosphate prices increased from $50 per tonne to $430 per tonne, a rise of 760% (Figure 1). Consequently, the Government of India had to deal with a large, sudden rise in its fertiliser subsidy outgo at the same time (Figure 2). Such a rise in phosphate prices directly affects farm inputs, and hence the ability of small and marginal farmers in any developing country to maintain soil fertility.

The politics of access to phosphorus took another turn when China enforced a ban on the export of foodgrains, and subsequently even phosphate fertilisers, in an attempt to minimise the risk to their domestic market from rising international food prices (Yang et al 2008). This provided immediate relief to its domestic market, with a gradual increase in prices, as compared to the international market. Such drastic steps, however, could affect other import-dependent economies, be it India, the European Union (EU), or Australia.

Global and Indian Positions

Various actions have been undertaken worldwide recognising the significance of phosphorus. Developed countries of the EU highlighted—through the Hague Center for Strategic Studies—the EU’s heavy dependence on imports and, hence, the vulnerability of its domestic agriculture and food industry (Ridder et al 2012). Subsequently, the European Sustainable Phosphorus Platform was established in 2013 and, in 2014, the EU identified phosphorus as one of its 20 critical raw materials (Trudeau 2014).

In contrast, however, India is clearly lagging behind, with no formal platform to discuss the country’s vulnerability to the scarcity of phosphorus. The low phosphorus content in Indian soils (98% of the districts have low and medium phosphorus levels), the heavy dependence on fertiliser imports (90%), and the huge subsidy burden of the government make India highly vulnerable. We are aware of the emergent need for increased agricultural production to feed our growing population and meet the targets of hunger and malnutrition under the SDGs. However, are we even prepared to ensure adequate soil fertility to sustain the desired crop production? It is an integral link in making India a food-secure nation.

Conclusions

Our existing policies address the scarcity of phosphorus implicitly, not explicitly. It is still not fully realised that as a scarce and important nutrient, it demands immediate action. For instance, the National Food Security Mission, one
of the missions of the Ministry of Agriculture and Farmers’ Welfare, takes up phosphorus through its inherent objectives of nutrient improvement and soil fertility (DoACFW 2015). On similar lines, the Soil Health Card scheme was launched in India to provide farmers with information on the nutrient conditions of their soils, based on field tests, to recommend the use of fertilisers. The scheme holds great promise (Srinivasarao et al 2013). However, its country-level success remains to be seen.

For the success of existing policies and schemes, stakeholder engagement is an important missing factor, with sporadic research on phosphorus in India. Most of the existing policy directives are not linked with ongoing research on the subject. A convergence of existing research and implementation on the ground needs to be brought into the current framework. It is realised that our lack of awareness and “blindness” towards the significance of phosphorus will not lead us any closer towards our food security targets, for which all stakeholders need to be sensitised. India needs to upscale its research programmes on phosphorus through apt policy interventions. Unless an encouraging environment is made available, India will continue to remain vulnerable to phosphorus scarcity, and food security will remain a mirage for future generations as well.

NOTES

REFERENCES

Obituaries
The EPW has started a section, “Obituaries”, which will note the passing of teachers and researchers in the social sciences and humanities, and social activists who have contributed to a just society.

The announcements will be in the nature of short notices about the work and careers of those who have passed away. Readers could send brief obituaries to edit@epw.in.