

It is projected that India will need to grow its agricultural output 12% to feed its people in 2020. Much of this has to come by growing more on the same amount of land. This land, however, is weakening and withering, reports M Rajshekhar

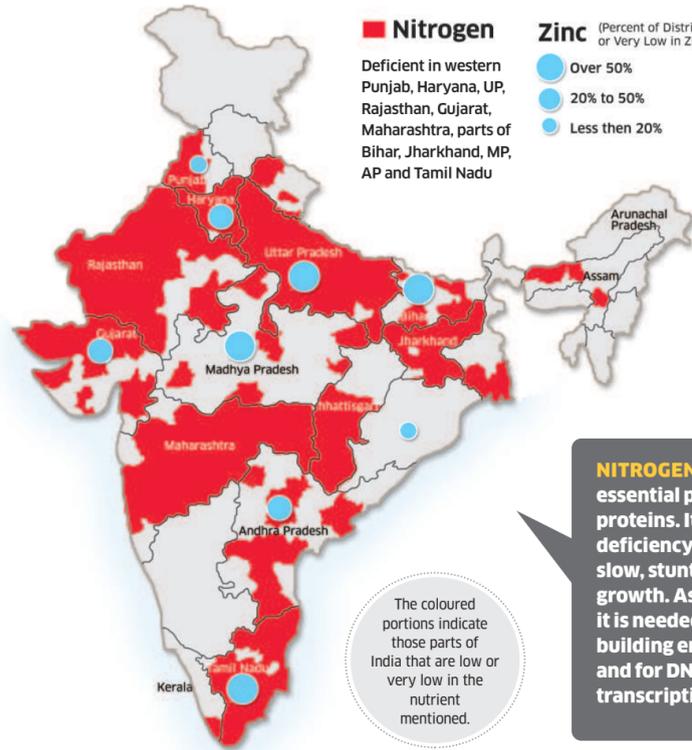
India's Soil Crisis

India's Ailing Agricultural Fields...

Large parts of India are deficient in three or more critical nutrients. If it is not nutrients, they are being carried away by wind and water

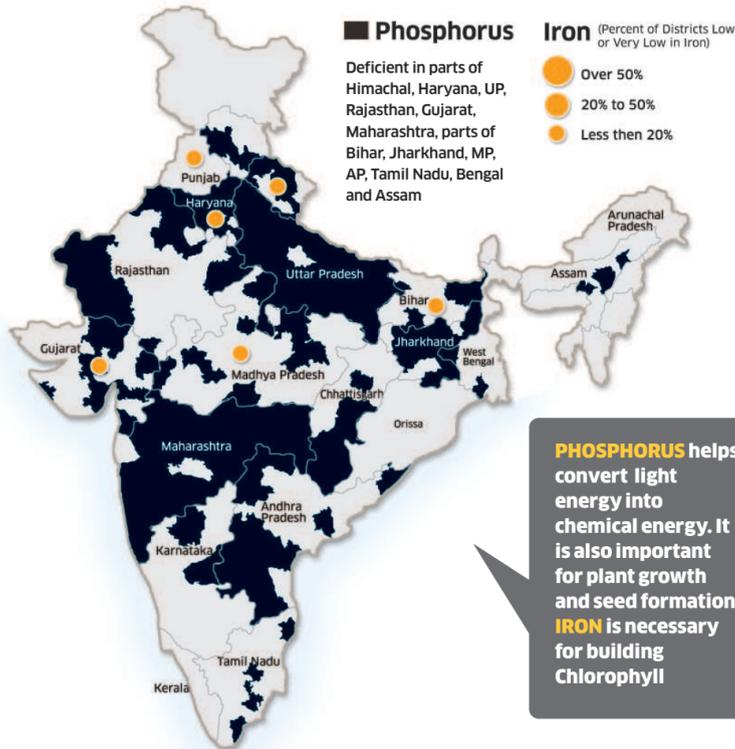


Soils in Punjab, Haryana, UP and Bihar, which produce 50% of our grains and feed 40% of our population, are seeing multiple nutrient deficiencies



NITROGEN is an essential part of all proteins. Its deficiency results in slow, stunted plant growth. As for **ZINC**, it is needed for building enzymes and for DNA transcription

The coloured portions indicate those parts of India that are low or very low in the nutrient mentioned.



PHOSPHORUS helps convert light energy into chemical energy. It is also important for plant growth and seed formation. **IRON** is necessary for building Chlorophyll

In his fields, Badhia Naval Singh, a farmer tilling 8 bighas of land in the Bagli tehsil in Madhya Pradesh, has been seeing something strange for a while now. Earlier, if he pulled out a tuft of grass, he would see earthworms. "Ab woh dikha bandh ho gaye hain (they don't show up any longer)," says the 45-year-old. Also, he says, when he ploughed earlier, the soil would break into soft crumbs and fall along the long furrows the plough left behind. Now, the soil is harder and the plough uproots a succession of large clods — dheplas, in local parlance — from the earth.

The changing nature of soils — for the worse — is a refrain with farmers in these parts, even across the country. Ishwar Lal of Pandutaki village nearby does not see as many birds or frogs around his fields as before. Near Bhopal, farmers say traditional vegetable crops do not grow in their fields any longer. Across the country, farmers say yields drop if they don't add more fertiliser every year.

These anecdotes suggest dramatic changes in Indian soils in about 40 years. They mirror

vation. Of this, about 100 million hectares — or 70% — is heading down a path where it will be incapable of supporting farming.

What is going wrong? Farmers are making the soil work more, growing two or more crops a year, instead of one. This unplanned fertilization is exacerbating nutrient shortages and changing soils' chemical composition. Levels of organic carbon in soil are dropping across the country, making soils more vulnerable to erosion and possibly resulting in the number of earthworms falling.

Not only are these excesses and imbalances reducing the productivity and life of soils, they are now starting to show up in our bodies. For, if the soils are deficient in some nutrients, so are the food crops grown on them. Pharma companies, says a senior scientist at Bhopal's Indian Institute of Soil Science (IISS), have consequently started adding Zinc, Copper, Selenium, Chromium, etc, to fortify their vitamin tablets.

NUTRITIONAL CRISIS

In June, IISS uploaded maps of 18 states that show nutrient deficiency district by district. The maps paint a scary picture. Large parts of India are deficient in two or more critical nutrients. Areas like the Indo-Gangetic plains — Punjab, Haryana, Uttar Pradesh and Bihar — which produce nearly 50% of our grains and feed about 40% of our population — are seeing multiple deficiencies.

Why is this happening? In the past, farmers used to plough the stalks left standing on the field after the harvest, coudung, etc, back into the soil. This ensured that nutrients taken out of the soil were replenished. The green revolution, which started in the sixties, changed all that. High-yielding crop varieties need more water and nutrients — which span from macronutrients like Nitrogen and Phosphorus to micro-nutrients like Copper and Boron.

However, due to imbalanced fertiliser use, hardly any of these nutrient cycles are being completed. Farmers today use a lot of Urea (Nitrogen), some Potassium and Phosphorus, but not much else. Further, they choose fertilizers more by affordability and availability than what the soils need.

Apart from retarding growth in yields, this unbalanced use has also damaged soils. Too much urea, for instance, turns soils acidic. The ICAR report estimates that 6.98 million hectares, or 2% of India's total geographical area, have acidic soils. These are mostly in North East India, south Chhattisgarh and Kerala. Another 6.7 million hectares are salt-affected.

In the absence of historical data on nutrients, the degree of decline cannot be ascertained. The irrefutable point is that these soils are increasingly incapable of supporting agriculture.

CARBON DEBIT

In Bagli, Kishore Lal Singh says the soil in his fields is changing from "bareek" (fine) to "kadak" (hard). In healthy soils, crop residues transformed by earthworms and other soil fauna into soft and spongy organic matter

called humus (or organic carbon). This soaks up water, creates an environment where soil fauna like earthworms thrive, and binds the soil's three constituents: sand, silt and clay. Without humus, the soils compress and harden.

It also contains organic carbon, the other nutrient cycle not being completed today. Farmers, in a hurry to plant the next crop, burn their fields to clear stalks left standing after the harvest. Cow dung is scarcer. That's partly because, with mechanisation, fewer households now need bullocks. The decline of grazing grounds has meant only households large enough to afford fodder can keep milch animals. "The recommended amount of farmyard manure is 5-10 tonnes per hectare," says Y Muralidharudu, the project coordinator for the soil testing

programme at IISS. But, in India, farmers add anywhere between zero to five tons. Poorer farmers, says PS Vijay Shankar, an activist with Samaj Pragati Sahyog, a NGO working with dryland farmers near Indore, sell manure instead of ploughing it into their fields. Or, they use dried dung as fuel.

The outcomes are predictable. DLN Rao, project coordinator for the All India Network Project on Soil Biodiversity-Biofertilizers at Bhopal's IISS, estimates that humus depletion in the top 0-15 cms is nearly 50%, although it can be occasionally as high as 60-70% in some soil types. There is, he adds, 10-20% loss in the 15-100 cms below that top layer.

As humus falls, properties of the soil change. For example, its ability to absorb water reduces, resulting in erosion. The ICAR report estimates that a total of 126 M ha is suffering from various degrees of water erosion. Of this, 0.68 million hectares are seeing "severe", "very severe" and "extremely severe" erosion. Another 0.2 million hectares is seeing "moderately severe" erosion. Wind erosion is more. The report estimates that "very severe and severe wind erosion occur in 16% of India's total geographical area."

Both these processes contribute to desertification — soil turning into a desert. About 81 million hectares of India, or 25% of it, is seeing desertification, says a 2009 Isro paper titled 'Desertification/Land degradation status mapping of India'.

Between unbalanced fertilisation and the drop in humus, anecdotal information suggests that the number of earthworms and other soil insects is falling.

FIXING INDIA'S SOILS Both the 10th and 11th Plan documents allude to our weakening soils. However, it is a crisis that we are just starting to deal with. One of the few exceptions is the government's switch to Nutrient-based Subsidy. As a response to growing micro-nutrient shortages, it falls short. Partly because the price signals it sends out about the nutrients to use are national while the shortages are local. Partly because the government has de-

controlled prices of P and K while holding on to prices of N. As a result, every time P and K prices soar, farmers dump more urea than other fertilisers. And partly because it doesn't extend the subsidy to organic manure or to all 20 micronutrients — it only covers Boron and Zinc.

Research itself is lacking. The research fraternity has focused on increasing yields. In the process, other aspects of agriculture have been ignored. We do not have baseline data about nutrient concentrations — The quantum of deficiency in these maps has been calculated by gauging the minimum concentration of a nutrient required (for that soil type) for above normal yields.

The IISS data, as shown in the maps, was derived from samples collected by soil-testing labs. But macronutrient deficiency has been mapped for only 18-odd states. In the case of micronutrients, we know their concentration in even fewer states. Then, some of this data is very old.

Now, with the help of a Rs 10 crore project from the Agriculture Ministry, is IISS methodically surveying nutrient deficiency across India. "The idea is to cover 10% of villages in every district, collecting samples from the fields of six farmers from each village, including small, medium and large ones," says Muralidharudu.

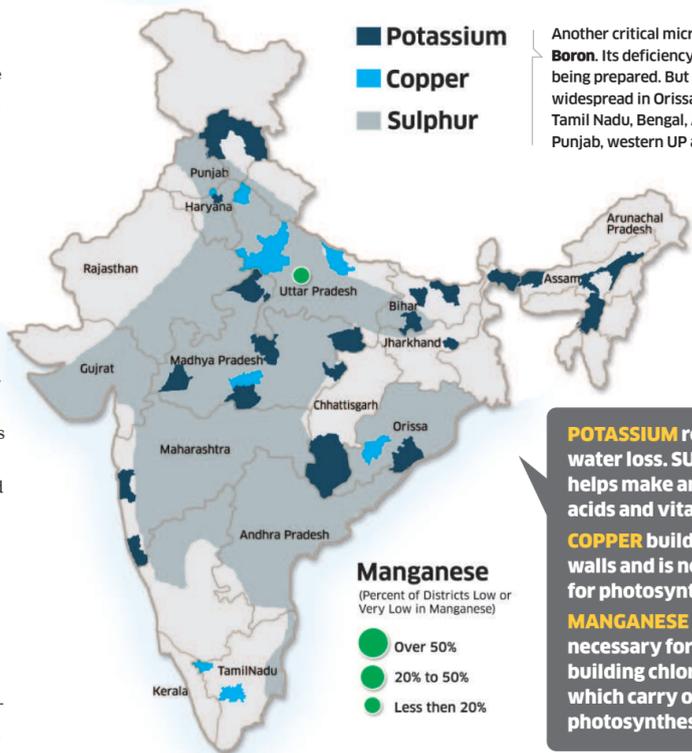
The government is also starting other studies. Like one, led by the National Centre for Organic Farming, Ghaziabad, to assess microbial population and activity in the soil.

Some of the states are doing interesting work, though. Gujarat and Tamil Nadu are setting up more soil testing labs. It is an example the rest of India needs to follow. "India has 115 million land holdings, but our labs cannot process more than 8 million soil samples in a year," says Muralidharudu. "It will take us 15 years, at this rate, to tell every farmer what his soil needs."

That said, it will take more than balanced fertilization to fix India's soils. Says IP Abrol, the chairperson of the Working Group providing inputs to the 12th plan on natural resource management and rainfed farming, "The larger question is about the soils' physical condition — can they support the hydrological cycle? And for that, you need humus and soil biota."

Indeed, field studies at IISS and elsewhere suggest earthworm populations, organic carbon levels and yields are the highest when a combination of balanced fertilization and farmyard manure is used. But India doesn't have enough cow dung. Organic waste can be used instead of cow dung, but we need to figure out better ways to segregate organic and inorganic waste, and to get it across to fields.

Here, Andhra might have an answer. As a part of its organic farming drive, the state is helping farmers set up composting pits where agricultural and household wastes can decompose into manure that is then ploughed back into the soil. Apart from that, it is handing out soil health cards to its farmers. Such solutions need to be encouraged. Or the country will find itself contemplating Malthus.

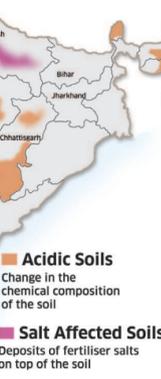


Another critical micronutrient is Boron. Its deficiency map is still being prepared. But shortages are widespread in Orissa, Andhra, Tamil Nadu, Bengal, Assam, Punjab, western UP and Haryana

POTASSIUM reduces water loss. **SULPHUR** helps make amino acids and vitamins. **COPPER** builds cell walls and is needed for photosynthesis. **MANGANESE** is necessary for building chloroplasts, which carry out photosynthesis

SOURCE: INDIAN INSTITUTE OF SOIL SCIENCE, BHOPAL

The changing chemical composition of soils



similar developments elsewhere in the world. In China, for instance, a two year study by its Ministry of Water Resources, concluded that wind and water erosion threaten 17% of its land, portending a 40% drop in its food production in the next 50 years.

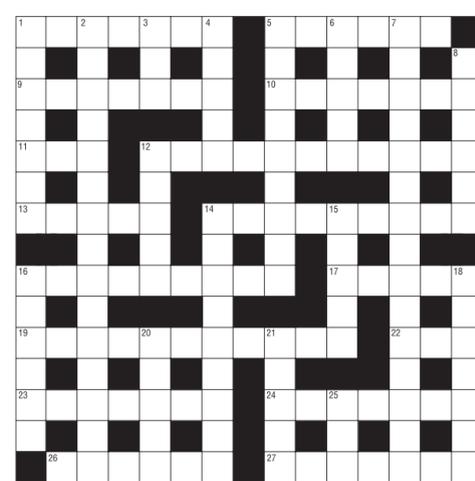
India is no different. Our cereal production in 2008-09 was 234 million tons. In a presentation made to the Planning Commission, Ramesh Chand, the head of the National Centre for Agricultural Economics and Policy Research, estimates that by 2021, cereal demand will rise to 262 million tons.

Given that the supply of agricultural land is not going to rise, this jump has to come from enhanced productivity. But India's agricultural soils are in deep trouble.

According to "Degraded and Waste Lands of India", a report by the Indian Council for Agricultural Research (ICAR) and the National Academy for Agricultural Sciences, about 141 million hectares of our total geographical area of about 328.2 million hectares is under culti-

Crossword

4336



- 27 Outfit lazily refusing to bend this way (7)
- DOWN**
- 1 Loving to be deprived of electoral rights? (7)
- 2 Where a rise is possible if one gets going (4,2,3,6)
- 3 No time for smart signal (3)
- 4 Mild disapproval expressed otherwise by one giving instruction (5)
- 5 Keep complaining of the pain (5-4)
- 6 Free to be a BBC non-starter (5)
- 7 Hanging poor Ted Heal for evading duties (8,3,4)
- 8 Seize a fragment (6)
- 12 Funny one to get depressed within certain limits (5)
- 14 Wish happiness to embrace disabled who have done no wrong (9)
- 15 Burns initially set up as fool to get money (5)
- 16 Take a great stand and risk it being a hanging matter (6)
- 18 Light out in line the proper way (7)
- 20 Capital place to get plastered? (5)
- 21 Take place of dog after business upturn (5)
- 25 What fun to be back in Covent Garden! (3)

- ACROSS**
- 1 It falls short of what's clever around this place in France (7)
- 5 Beers said to cause harm (6)
- 9 Rough man finally protected by a girl (7)
- 10 Vital amendment to article by European (7)
- 11 One thing and another (3)
- 12 Bear the burden of being influential (5,6)
- 13 Same again, please! (5)
- 14 Support magistrates without being in government (4-5)
- 16 Fruit of challenge thrown down by the inexperienced (9)
- 17 Bill reaches eminence when he takes part (5)
- 19 Using profanity gives Bush so ample reason to be put out (11)
- 22 Urge to produce new life (3)
- 23 Give approval to poor Rose at last (7)
- 24 Right about clergyman showing the last shall be first (7)
- 26 Borrowing is needed repeatedly in an emergency (6)

Solution to 4335
ACROSS: 1 Film company, 9 Paragon, 10 Rapture, 11 Dog, 12 Alimony, 13 Amalgam, 14 Yen, 15 Kicks, 17 Sunny, 18 Pririt, 20 Birch, 22 Hat, 24 Initial, 25 Barrage, 26 Leo, 27 Outline, 28 Spotted, 29 Ransom money.
DOWN: 1 Foreign minister, 2 Logbook, 3 Candy, 4 Merganser, 5 Appears, 6 Young and healthy, 7 Apiary, 8 Seemly, 16 Caballero, 18 Prison, 19 Tuition, 21 Harpoon, 23 Trendy, 25 Bosom.
The Daily Mail

Dilbert

by S Adams

