The most neglected threat to public health in China is toxic soil

And fixing it will be hard and costly

3 minutes ago

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TANG DONGHUA, a wiry 47-year-old farmer wearing a Greenpeace T-shirt, smokes a cigarette and gesticulates towards his paddy fields in the hills of southern Hunan province. The leaves of his rice plants poke about a foot above water. Mr Tang says he expects to harvest about one tonne of rice from his plot of a third of a hectare (0.8 acres) near the small village of Shiqiao. There is just one problem: the crop will be poisoned.

Egrets and damselflies chomp lazily on fish and insects in the humid valley below the paddy fields. But just beyond this rural scene lurks something discordant. Mr Tang points to a chimney around 2km away that belches forth white smoke. It belongs to the smelting plant which he blames for bringing pollution into the valley. Cadmium is released during the smelting of ores of iron, lead and copper. It is a heavy metal. If ingested, the liver and kidneys cannot get rid of it from the body, so it accumulates, causing joint and bone disease and, sometimes, cancer.

Hunan province is the country's largest producer of rice—and of cadmium. The local environmental-protection agency took samples of Mr Tang's rice this year and found it contained 50% more cadmium than allowed under Chinese law (whose limits are close to international norms). Yet there are no limits on planting rice in polluted areas in the region, so Mr Tang and his neighbours sell their tainted rice to the local milling company which distributes it throughout southern China. Mr Tang has sued the smelter for polluting his land—a brave act in China, where courts regularly rule in favour of well-connected businesses. His is an extreme case of soil contamination, one of the largest and most neglected problems in the

country.

Soil contamination occurs in most countries with a lot of farmland, heavy industry and mining. In Ukraine, for example, which has all three, about 8% of the land is contaminated. A chemical dump in upstate New York called Love Canal resulted in the poisoning of many residents and the creation of the “superfund”, a federal programme to clean up contaminated soil. But the biggest problems occur in China, the world’s largest producer of food and of heavy industrial commodities such as steel and cement.

China’s smog is notorious. Its concentrations of pollutants—ten or more times the World Health Organisation’s maximum safe level—have put clean air high on the political agenda and led the government to curtail the production and use of coal. Water pollution does not spark as much popular outrage but commands the attention of elites. Wen Jiabao, a former prime minister, once said that water problems threaten “the very survival of the Chinese nation”. China has a vast scheme to divert water from its damp southern provinces to the arid north.

Dishing the dirt

Soil pollution, in contrast, is buried: a poisoned field can look as green and fertile as a healthy one. It is also intractable. With enough effort, it is possible to reduce air or water pollution, though it may take years or decades. By contrast, toxins remain in the soil for centuries, and are hugely expensive to eradicate. It took 21 years and the removal of 1,200 cubic metres of soil to clean up the Love Canal, a site covering just 6.5 hectares.

China’s soil contamination is so great that it cannot adopt such a course (see map). The country is unusual in that it not only has many brownfield sites (contaminated areas near cities that were once used for industry) but large amounts of polluted farmland, too. In 2014 the government published a national soil survey which showed that 16.1% of all soil and 19.4% of farmland was contaminated by organic and inorganic chemical pollutants and by metals such as lead, cadmium and arsenic. That amounts

to roughly 250,000 square kilometres of contaminated soil, equivalent to the arable farmland of Mexico. Cadmium and arsenic were found in 40% of the affected land. Officials say that 35,000 square kilometres of farmland is so polluted that no agriculture should be allowed on it at all.

Stick in the mud

This survey is controversial. Carried out in 2005-13, it was at first classified as a state secret, leading environmentalists to fear that the contamination might be even worse than the government let on. Not everyone, however, is as pessimistic. Chen Tongbin, head of the Institute of Geographic Sciences and Natural Resources Research in Beijing, thinks the figure of 19.4% is too high. Based on local studies, he says 10% is nearer the mark. Even that would be a worrying figure, given that China is trying to feed a fifth of the world's population on a tenth of the world's arable land. The conclusion seems to be that China's soil pollution is widespread and that information about it is disturbingly unreliable.

There are three reasons why the contamination is so extensive. First, China's chemical and fertiliser industries were poorly regulated for decades and the soil still stores the waste that was dumped on it for so many years. In 2015, for example, 10,000 tonnes of toxic waste was discovered under a pig farm in Jiangsu province in the east of China after a businessman proposed plans to build a warehouse on the plot and tested the soil. In 2004 construction workers on the Beijing metro suddenly fell ill when they started tunnelling under a site previously occupied by a pesticide factory.

New environmental regulations have sought to crack down on chemical dumping but they do not seem to do enough. Since 2008 new plants have had to be built in special chemical-industry parks, where oversight is supposed to be stricter. At the end of May, Greenpeace, an environmental NGO, took samples from the wastewater, soil and air of one such park, in Lianyungang in Jiangsu. It discovered 226 different chemicals. Three-quarters of them are not subject to hazardous-chemical regulations in China, 16 are definitely or probably carcinogenic to humans and three are illegal.

Making matters worse is the astonishing "safety" record of the chemical industry. Between January and August 2016, China suffered 232 accidents in chemical factories, such as leaks, fires and explosions—almost one a day. Since around a fifth of these factories are in China's most productive agricultural areas or near rivers used for irrigation, many of the spilled chemicals end up in fields. Chemical factories are not the only culprits. About 150km from Mr Tang's village, in a town called Chenzhou, part of a lead and zinc mine collapsed in 1985, flooding nearby farms with arsenic, a by-product of mining. Arsenic concentrations in the soil were 24 times the legal limit 30 years later.

The second big problem is that land is being poisoned by "sewage irrigation". Wastewater and industrial effluent are used in increasing amounts for irrigation because there is not enough fresh water to go round. In the north of China there is less water available per person than in Saudi Arabia, so farmers use whatever they can get. China produces over 60bn tonnes of sewage a year and in rural areas only 10% of it is treated. Most of the sludge goes into lakes and rivers, and thence onto fields.

A study in 2014 found that 39 out of 55 areas using sewage irrigation were contaminated by cadmium, arsenic and other poisons and that the accumulation of heavy metals in intensively irrigated areas was rising. An earlier study from 2010 found that water along 18% of the length of China's rivers was too polluted for use in agriculture. It is used anyway.

To make matters worse, the soil is bearing the burden of the excess use of fertiliser and pesticide, which has increased as China's demand for grain has risen. Since 1991 pesticide use has more than doubled and the country now uses roughly twice as much per hectare as the worldwide average. Fertiliser use has almost doubled, too. In 2012 a survey by the Institution of Nutrition and Food Safety reported that in 16 provinces 65 pesticides were detected in food, though whether this was the result of overuse by farmers, illegal dumping by factories or some other reason is not clear. The most common pesticides were present in all the main foodstuffs.

Third, soil pollution is affecting more people than it used to because of

economic change and urbanisation. Twenty years ago, most chemical and pesticide plants were built far from cities and although their pollution hurt soil, crops and farmers, it did not directly affect city dwellers. Since then, China has experienced the largest urban expansion the world has ever seen and once-remote factories are now surrounded by houses and shops. As the economy switches from heavy industry to services, many factories are closing down or relocating.

Covering a lot of ground

A case in Changzhou in Jiangsu province showed what can happen next. In early 2016 students at a newly opened campus of the Changzhou Foreign Language School began complaining of headaches, skin rashes and a strange smell. Hundreds fell ill, some with lymphoma. The campus, it turned out, had been built next to a dump owned by three chemical companies that had closed in 2010.

The land had been acquired by the local government and cleaned up by a specialist firm that spread a heavy layer of clay over the top. Alas, the clay leaked. A survey in 2012 found that levels of chlorobenzene, a solvent, were 80,000 times the permitted limit. In May 2016 two NGOs took the chemical companies to court, blaming them for the pollution. The court threw the case out, leaving the plaintiffs with huge costs. As in so many cases, the pollution had been buried for decades but was unearthed by economic change.

The harm caused by soil pollution is as grave as might be expected. Heavy metals are exceptionally bad for food safety and human health. In 2002 China's ministry of agriculture conducted one of the few nationwide food tests to look for such heavy metals; it found that 28% of the rice samples it took had excess lead and 10% had excess cadmium.

In 2015 a survey by Yonglong Lu of the Research Centre for Eco-Environmental Sciences in Beijing and others in *Environment International*, a scientific journal, counted hepatitis A, typhoid and cancers of the digestive tract among the health hazards of eating

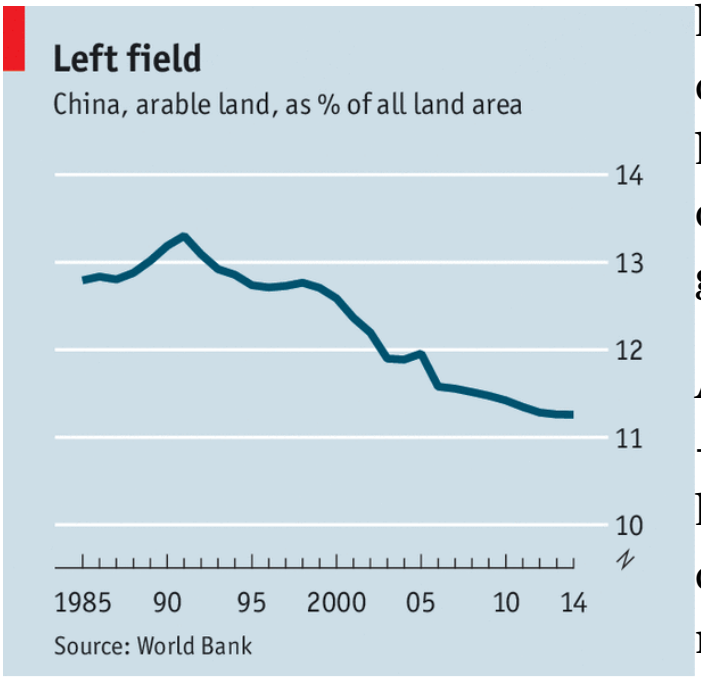
contaminated food. The authors also suggested that there may be a link between soil pollution and China's "cancer villages", 400-450 clusters with unusually high levels of liver, lung, oesophageal and gastric cancers. In 2006 a Chinese environmental NGO took urine samples from 500 residents of Zhuzhou, an area of Hunan province with several such villages; 30% of those tested showed elevated levels of cadmium and 10% needed specialist treatment.

That alone should have rung alarm bells for China's rulers. In addition, several other effects are pushing the problem of polluted soil slowly up the ladder of political concerns. Politicians are becoming increasingly concerned about public opinion. Alarm at reports of cadmium rice and other contaminated foods is growing. Nor do local governments want a repeat of the Changzhou case, which became a public controversy last year.

The law of sod

Politicians also worry about the impact that contamination has on agricultural yields. Poisoned soils are less productive. The ministry of environmental protection said in 2006 that grain yields had fallen by 10m tonnes as a result of soil contamination. It did not specify what period this referred to but in 2006, China's total grain output was just under 500m tonnes, so pollution could have reduced the harvest by 2% below what it might otherwise have been. With the total amount of arable land falling as a result of urbanisation and soil erosion (see chart), China cannot afford to contaminate what is left. The national government is obsessed with feeding China's 1.3bn people and anything that reduces grain yields is a matter of concern.

Lastly, soil contamination adds to the difficulties that local governments face in acquiring land to build on. A large part of local-government finance depends on officials taking over land on the edge of cities (sometimes forcibly) and leasing it to property developers who build the new houses and offices that China requires. Without this moneymaking activity, many provincial and county governments would go bankrupt. In 2014 a working group of the Communist Party revealed that 12 provinces had run out of



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land for construction. So when contamination reduces the amount of land for leasing or forces cities to build on polluted brownfields, it hurts local governments.

As a result, the attitude of authorities —especially the national government— has begun to shift from indifference to concern. In 2011 the environment ministry announced a five-year plan to cut heavy-metal emissions in the worst-affected areas by 15% from what they were in 2007 by the end of 2015. It said that three-quarters of the targets had been met by the end of 2014. That year the legislature stiffened penalties for polluters. Last year the national government issued a ten-point plan that aims to make 90% of contaminated farmland safe by 2020, defines different soil types and lays out steps to be taken to stabilise soil quality for each one. This year the legislature has said it will clarify who is responsible for soil pollution in the past and codify into Chinese law the “polluter pays” principle.

This spate of rulemaking is welcome, but it is only a start. As in many countries, health, food safety, water pollution and soil contamination are all dealt with in China by different regulatory agencies, which do not always co-operate. There has been no nationwide health survey to track the effect of soil contamination. And most of the soil-improvement plans lack teeth because they depend for enforcement on local officials, who are often in cahoots with the local polluters.

Efforts to clean up polluted soil have so far been modest because, without a proper law, it is not clear who should pay for them. China has nothing like America’s “superfund”. Nor could it afford to eradicate contaminants entirely by, say, washing the soil and treating it with bacteria. London did this when preparing the site, formerly an industrial area, for the 2012 Olympic games: it cost £3,000 ($3,900) per cubic metre. Cleaning China’s

250,000 square kilometres to the depth of one metre to the same squeaky-clean standard would in theory cost $1,000 trillion—more than all the wealth in the world. Even a less thorough clean up would cost more than China could afford.

Instead, the country has piecemeal projects. It has tested a method of using chemicals to fix heavy metals in the soil but the results have been disappointing. Researchers also worry about controlling pollution by adding more chemicals. To reduce rice contamination, plant scientists have bred a hybrid variety that absorbs less cadmium. Mr Tang was offered some but rejected it because the yield was low.

The Chinese have experimented with growing willow trees, which absorb cadmium, and poplars, which do the same for lead, to clean up its fields. This works—but the fields cannot be used for crops in the meantime. Typically the treatment of poisoned brownfields consists of spreading layers of clay or concrete over the affected areas, as happened in Changzhou, but this often just pollutes the water table beneath. Gao Shengda, the secretary of the China Environmental Remediation Industry Association, admits that the country lacks the experience and technical skills to stabilise its polluted soils.

Mr Tang calls for assistance

Serf and turf

At the end of May Mr Tang's case came to court. The judge found that the pollution was indeed leaking from the industrial site. He admitted the fields were polluted. But he said that Mr Tang had not proved that one had caused the other and threw out the case. Mr Tang has launched an appeal. While he waits, he and his neighbours trudge back daily to their fields to look after the poisoned rice, which is almost ready for harvest.

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