ENVIRONMENTAL IMPACT ON LAND CONDITION & CHALLENGES FROM CHINA'S INDUSTRIAL EXPANSION

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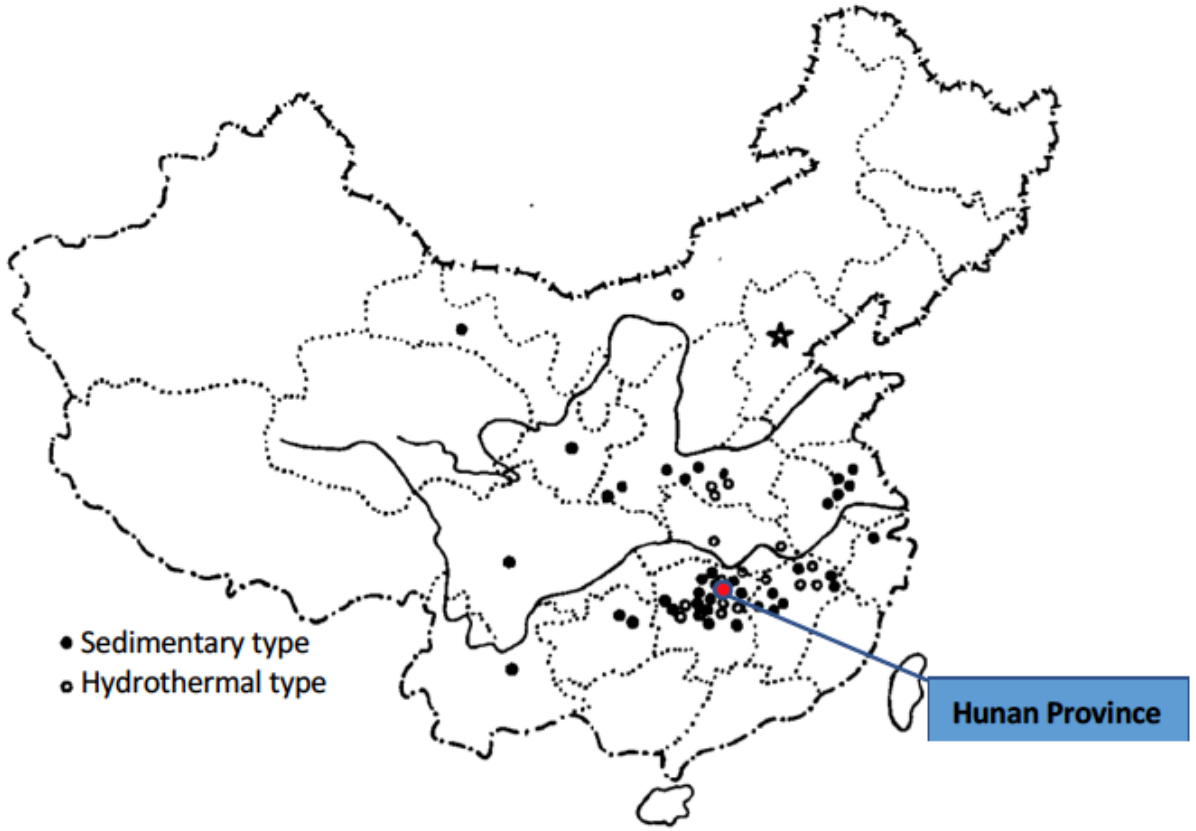
The sketch map showing the distribution of sepiolite deposits in China (according to Li & Zhang 1999)



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Environmental quality in China

- Three decades + of rapid industrialisation and poor management of manufacturing processes, transport and power production
- High profile focus on air pollution - regulatory reform **has** already benefited air quality in some locations
- Soil quality challenges – diverse and uncontrolled industrial development, multiple diffuse and point pollution sources

Findings from a soil survey of China

- 2014 publication of soil survey data
- >16% samples exceed threshold values
  - Collected from industrial, development zones, mining areas, arable, waste water irrigation, transport structures
  - ~ 20% of farmland exceed soil quality standards
  - 3 million Ha polluted
  - 2.5% of all land unfit for agriculture
- Contaminants
  - Metals – e.g. Cd, Ni, As, Cu, Hg, Pb, Cr, Zn
  - Persistent Organic Pollutants (POPS) hexachlorocyclohexane-HCH; dichlorophenyl trichloroethane-DDT
  - Other organic pollutants (polycyclic aromatic hydrocarbons-PAHs)

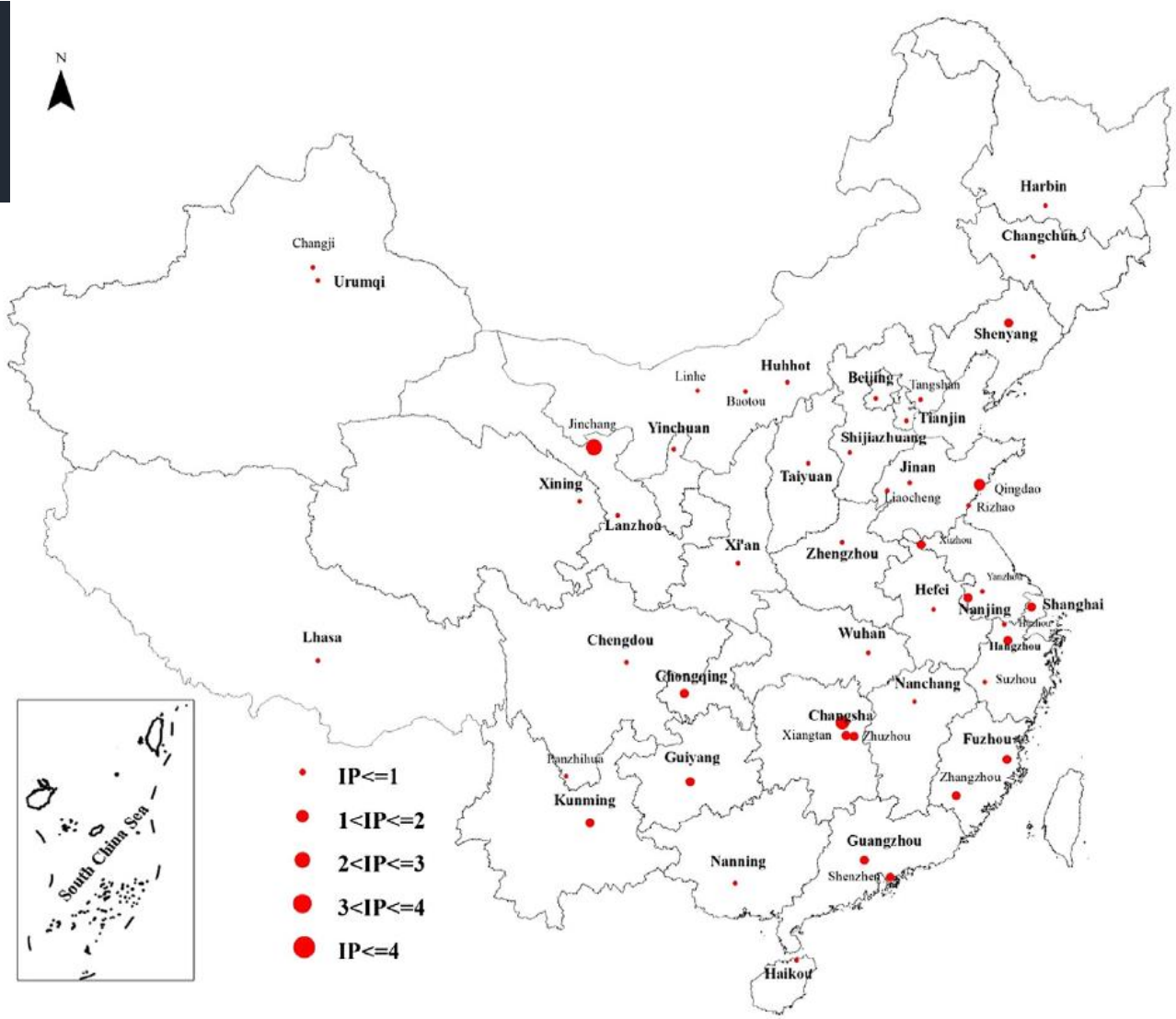
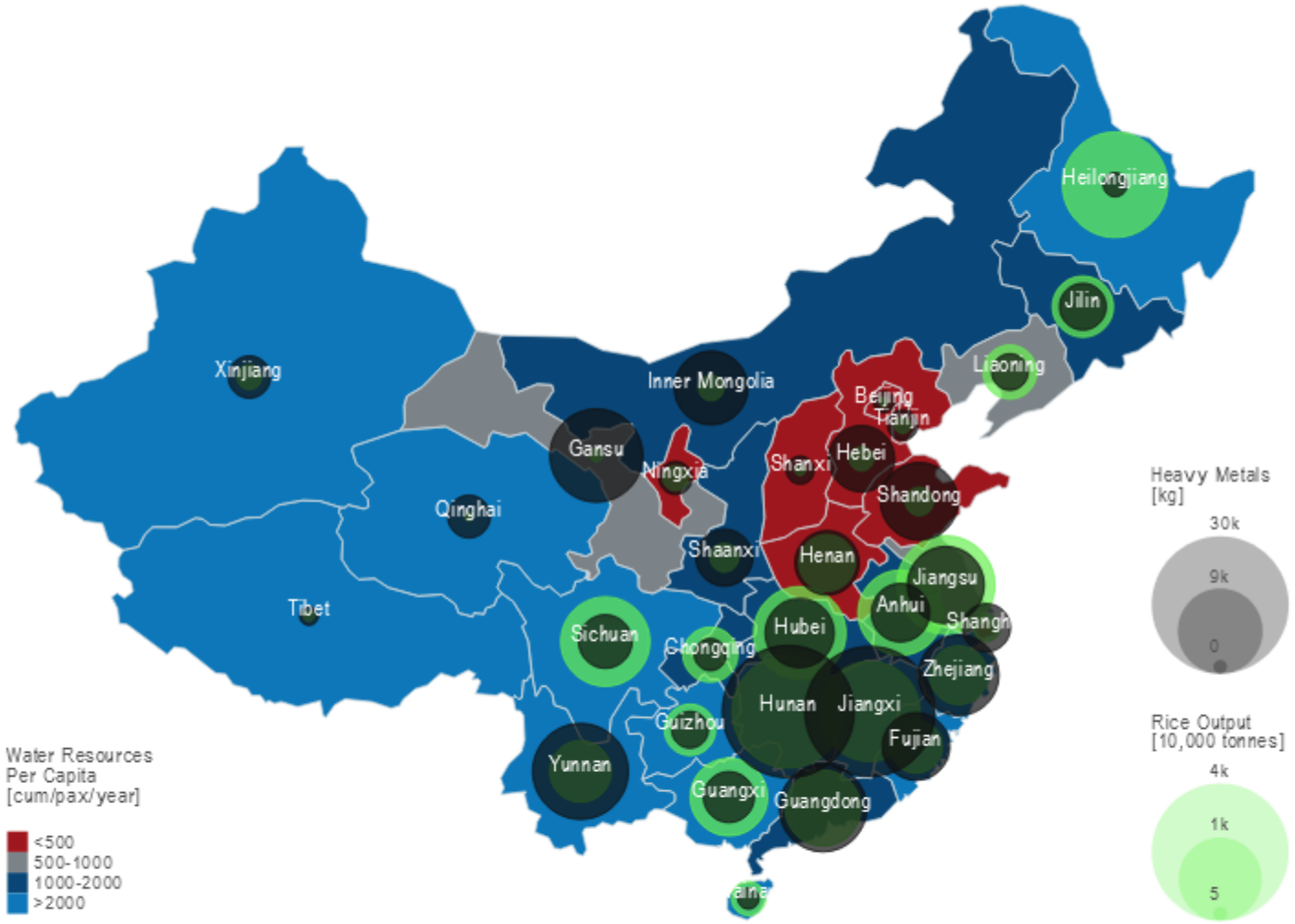


Fig. 4. Heavy metal pollution in urban soils of 48 cities in China.

Teng et al, 2014, Environment International, v69 p177

Heavy metal discharge threatens China's food safety



Click here to select what to show on the map

Hg Mercury	Pb Lead	Cd Cadnium	Rice
Cr Chromium	As Arsenic	All	Wheat

Heavy metals can stay in the soil for a long time and are difficult to clean up. The problem is when crops absorb the heavy metals and in turn these crops are ingested by humans.

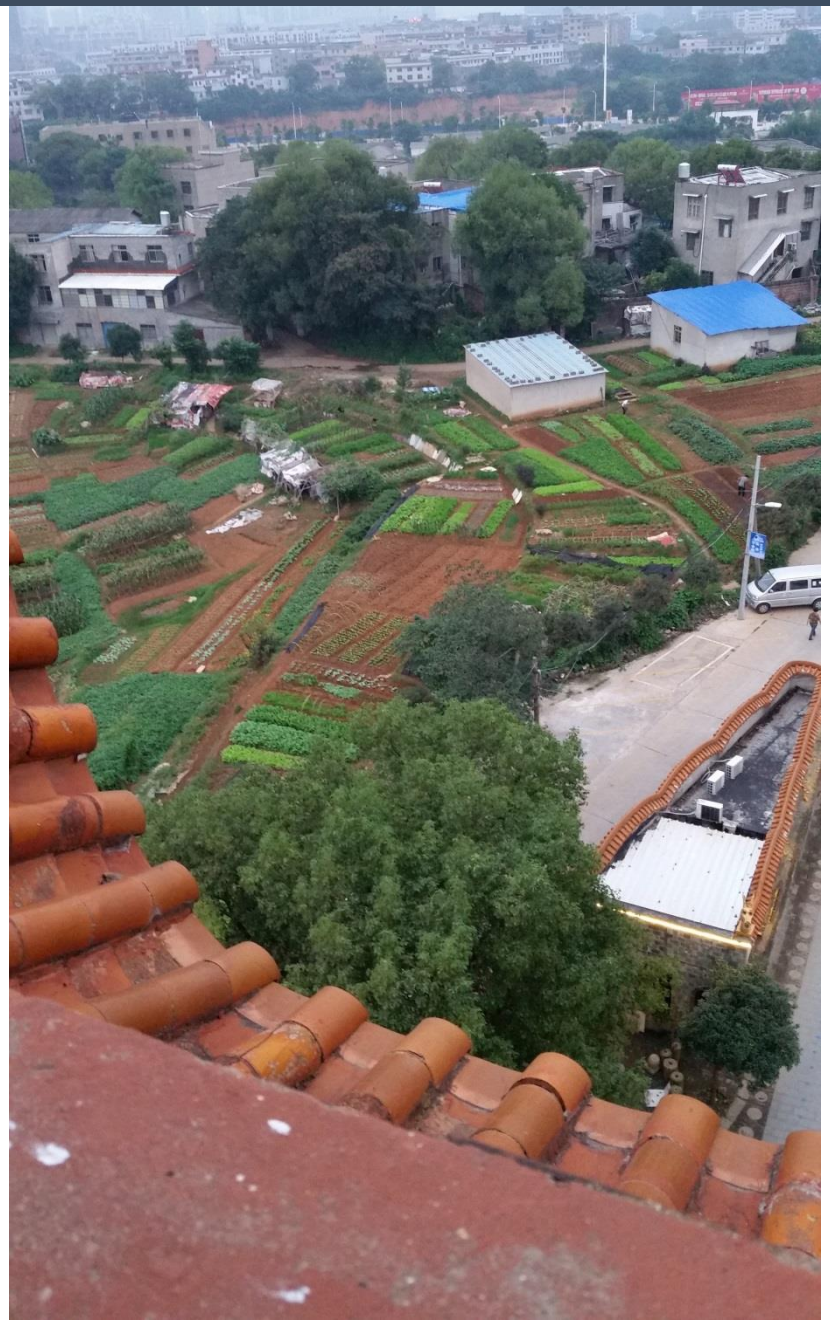
Cancer Villages In 2013, the MEP officially mentioned "cancer villages" and linked it to heavy metal discharge from industry.

51% of China's rice output comes from provinces which account for over half of the national discharge for arsenic (52%), mercury (58%) and chromium (72%)
>> The Right Crop Mix

Hunan is particularly exposed with 13% of China's rice production but also ~30% of heavy metal discharge
>> Yangtze Water-nomics

https://www.chinawaterrisk.org/the-big-picture/pollution-crops/ (accessed 27/10/2022)

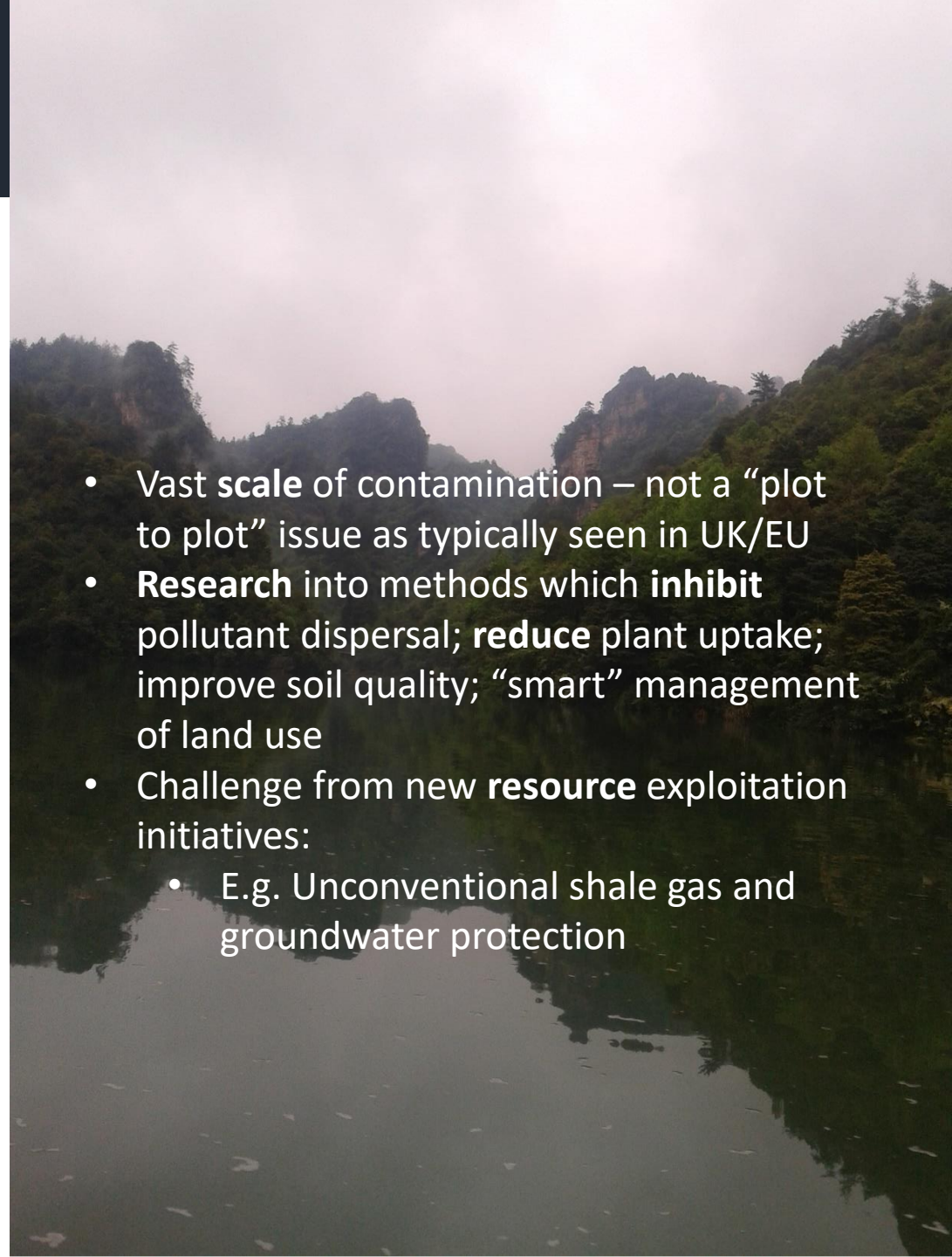
"Three-fifths of China's sown area is exposed to 85% of the nation's heavy metal discharge – with rice the most exposed grain and Hunan the most exposed province" HSBC No Water, No Food, March 2014



Regulatory reform planning from 2014 survey

- **2015** enhanced Environmental Protection Law
  - Economic, and social development coordinated with environmental protection and control of impact on human health
  - Local implementation supported
- 28 January, **2016** – China's top priorities for 2016
  - implementing new concepts of development,
  - boost modern agriculture and
  - ensuring a well-off society including the rural population,

http://chinawaterrisk.org/notices/2016-no-1-doc-new-development-concepts-modern-agriculture-well-off-society/#sthash.Gq0bC1Fc.dpuf



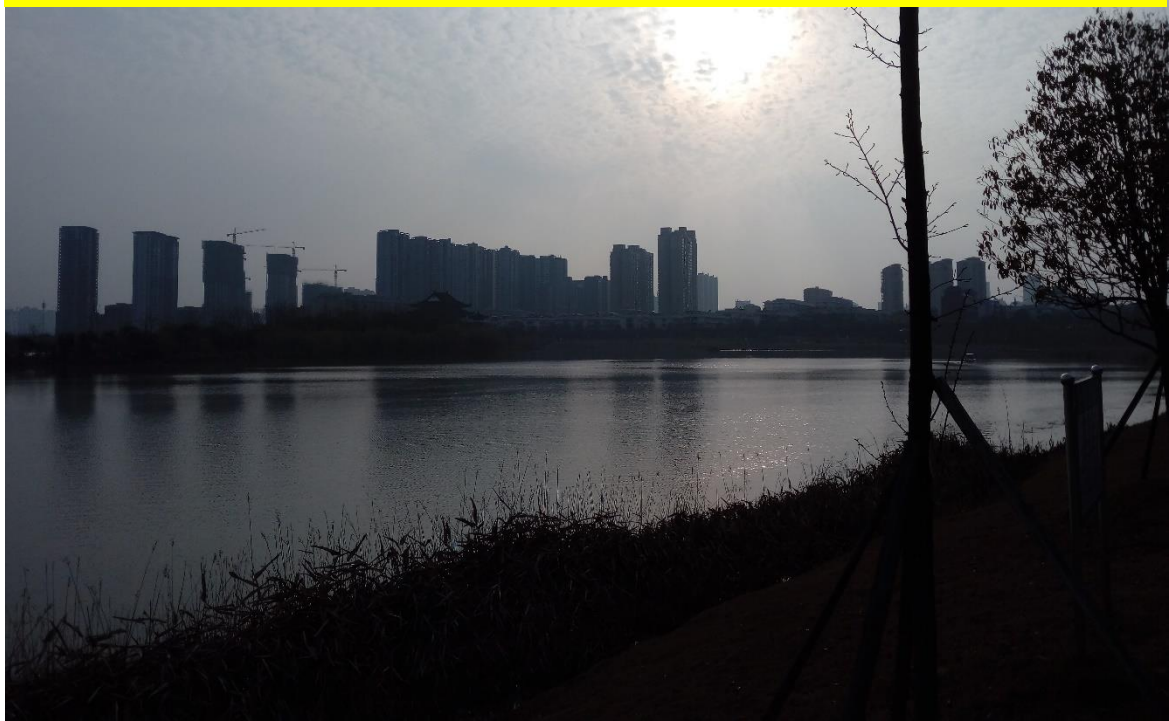
- Vast **scale** of contamination – not a "plot to plot" issue as typically seen in UK/EU
- **Research** into methods which **inhibit** pollutant dispersal; **reduce** plant uptake; improve soil quality; "smart" management of land use
- Challenge from new **resource** exploitation initiatives:
  - E.g. Unconventional shale gas and groundwater protection

Soil pollution Prevention & Remediation Action Plan: prevention and control of site contamination

- **Policy:** multiple ministry responsibility and limited regulatory understanding
- **Institutional and capacity:** definition of responsibility and clear management process
- **Technology:** treatment methods widely demonstrated but limited concept of risk based approach
- **Finance**: scale and responsibility, up-front funds
- **Information**: tracking and control of hazardous materials, processes dealing with wastes – information disclosure = poor public awareness

Soil pollution standards

- to give priority to protect arable lands,
- pollution sources control,
- risk management of contaminated sites,
- pilot sites for soil remediation,
- to strengthen monitoring and management of the soil environment.



http://chinawaterrisk.org/notices/new-soil-pollution-standards/#sthash.FjmG2zjP.dpuf

Regulatory action (2021 onwards)

'Carrying out the construction of 'zero waste cities' achieved practical results as a method to prevent and control contamination'*

- Soil remediation mentioned for the first time since the launch of government funding for the remediation of soil pollution in 2011.
- A final goal of soil remediation is waste control and sustainable management, and the overall reduction of environmental pollution.

Measures for Funds Management of Soil Pollution Prevention and Control (2021) Ministry of Finance of the People's Republic of China No. 42, became effective on 2 June 2021.

http://bj.mofgov.cn/ztdd/czysjg/zcfg/202108/t20210802_3742309.htm (accessed on 1 July 2022).

Yangtze Plate

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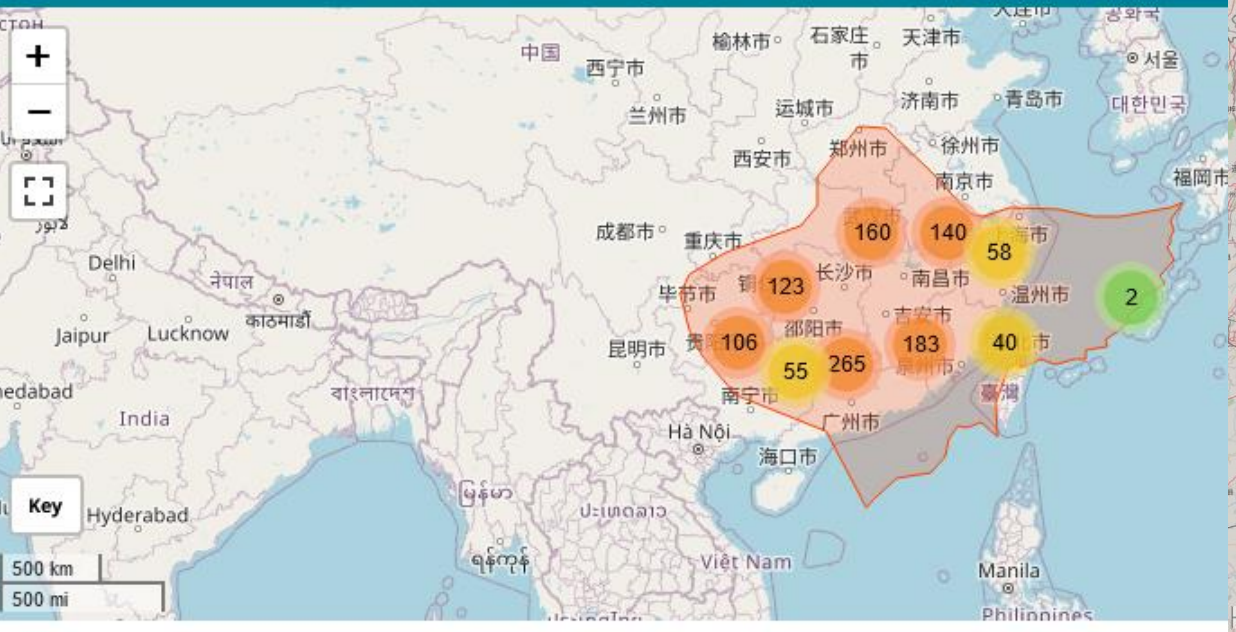
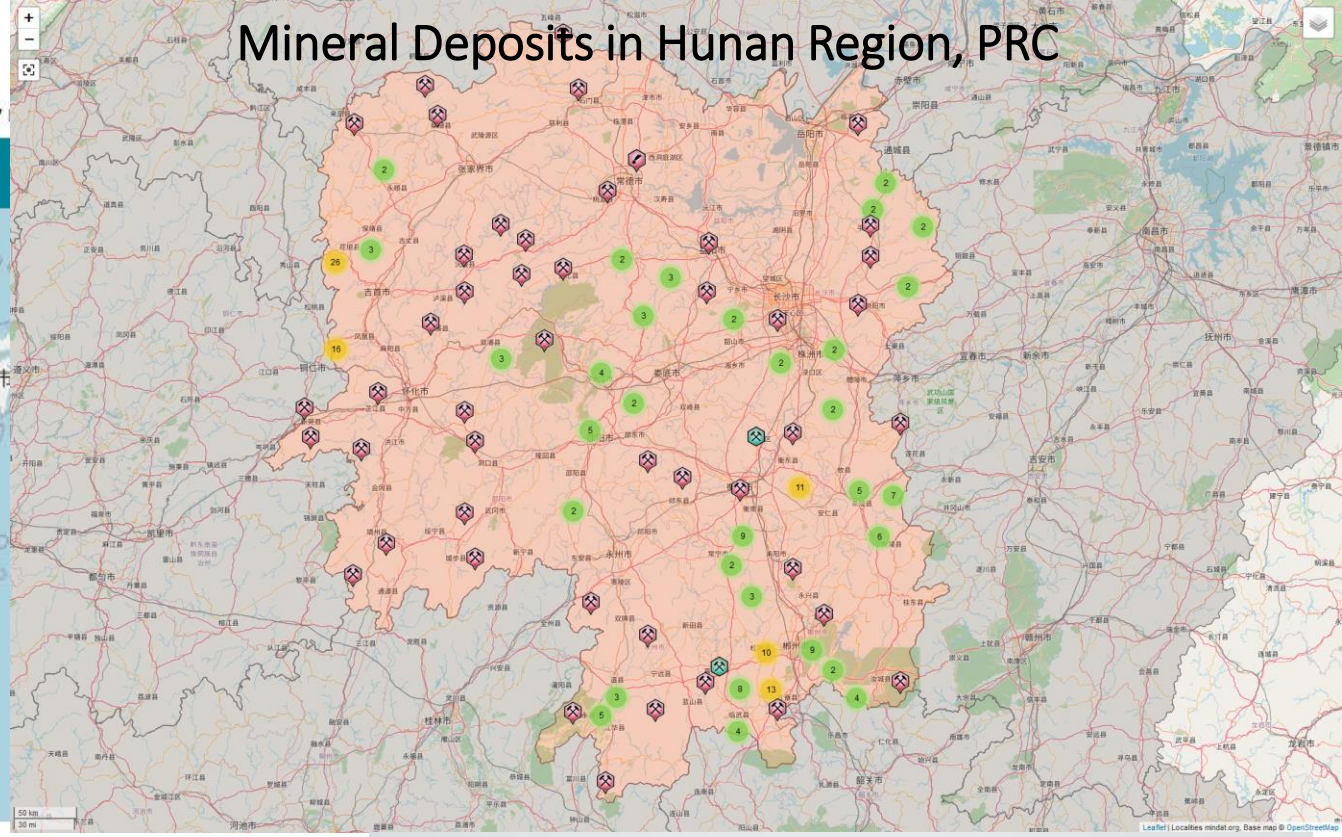
Photos Search



Mineral Deposits in Hunan Region, PRC



Commodity List

This is a list of exploitable or exploited mineral commodities recorded from this region.

Antimony	Gallium	Manganese	Tellurium
Beryllium	Germanium	Mercury	Tin
Bismuth	Gold	Molybdenum	Tungsten
Cadmium	Gypsum & Anhydrite	Niobium (Columbium)	Uranium
Coal	Indium	Phosphorous/Phosphate	Vanadium
Cobalt	Lead	Silver	Zinc
Copper	Lithium	Tantalum	

https://www.mindat.org/

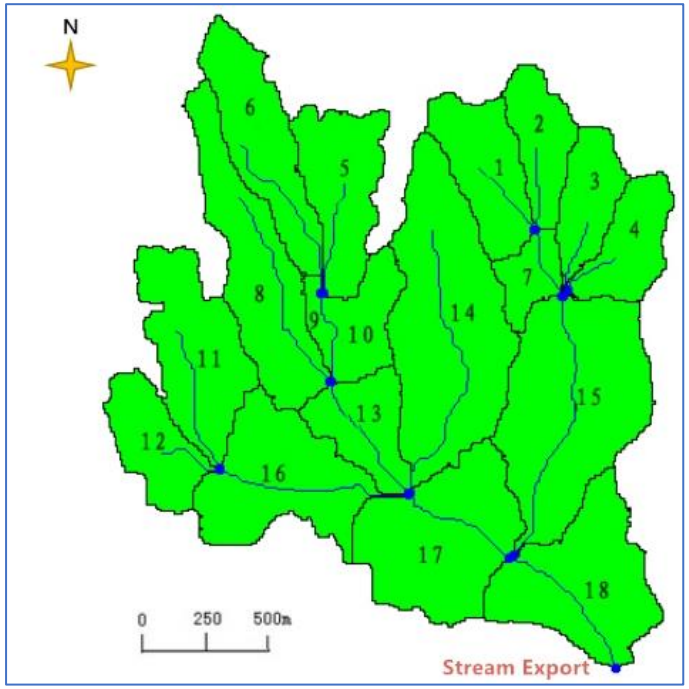
Addressing drainage system/catchment migration of pollutants

Yao Zhang, Bozhi Ren*, Andrew S **Hursthouse**, Renjian Deng, Baolin Hou, (2018) *An Improved SWAT for Predicting Manganese Pollution Load at the Soil-Water Interface in a Manganese Mine Area*, Polish Journal of Environmental Studies 27(5) 2357-2365 DOI: https://doi.org/10.15244/pjoes/78618

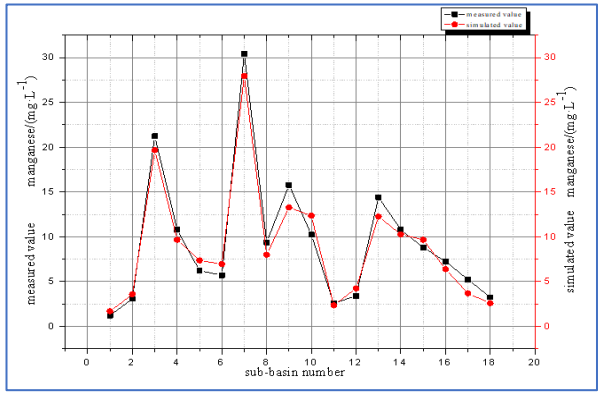
The operational results show that the improved SWAT model can simulate, with a high degree of agreement, manganese load flow in soil-water interface at the mine.

The key areas identified are consistent with the spatial distribution of mine pollution from field survey.

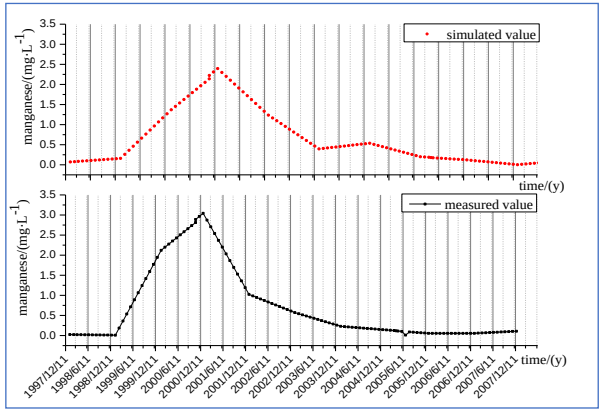
Proxy for other associated contaminants



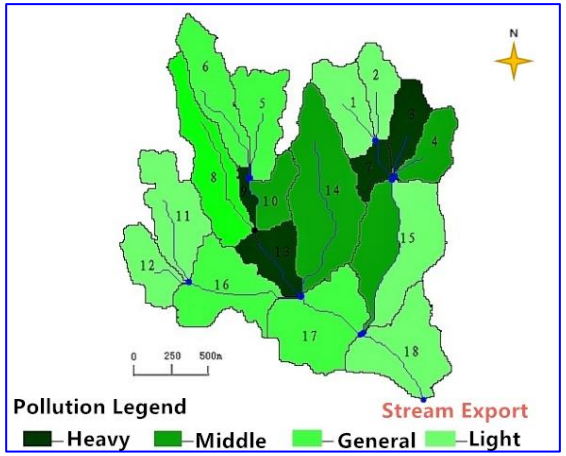
Definition of sub basins used in description of the mining area



The measured values and simulated values of manganese pollution load for every sub-basin in 2012



Simulated v measured values of manganese pollution load from 1998 to 2007 for the 4th sub-basin in the study area



Extent distribution of manganese pollution in the study area

Improved conversion kinetics model of manganese migration

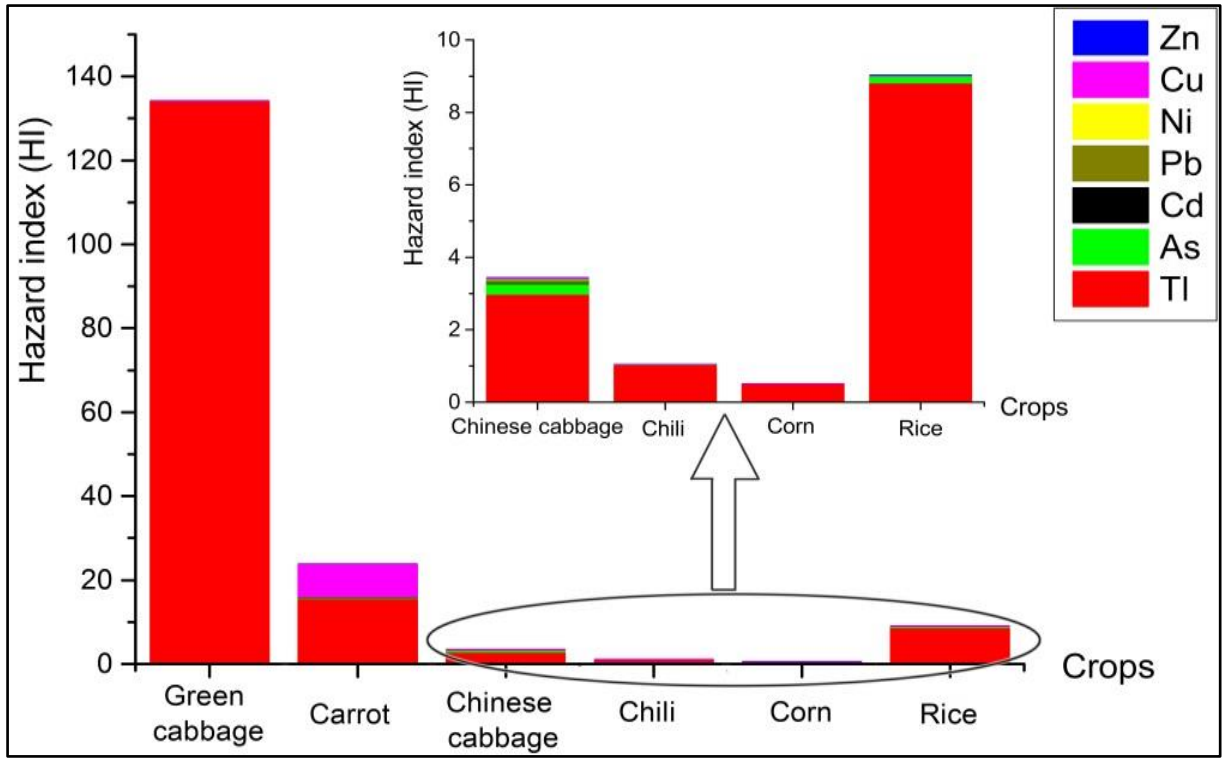
$$k\delta\left[\frac{\partial C^*}{\partial t}+u\frac{\partial C^*}{\partial x}\right]=\frac{1}{A}\frac{\partial}{\partial x}\left[D_x A\frac{\partial C^*}{\partial x}\right]+\frac{N}{H_i}$$

$k=C_s/C_w$

Contamination in the food chain:

Jiang, F, Ren, B, Hursthouse, A & Deng, R 2020, *'Evaluating health risk indicators for PTE exposure in the food chain: evidence from a thallium mine area'*, Environmental Science and Pollution Research, vol. 27, pp. 23686-23694. https://doi.org/10.1007/s11356-020-08733-0

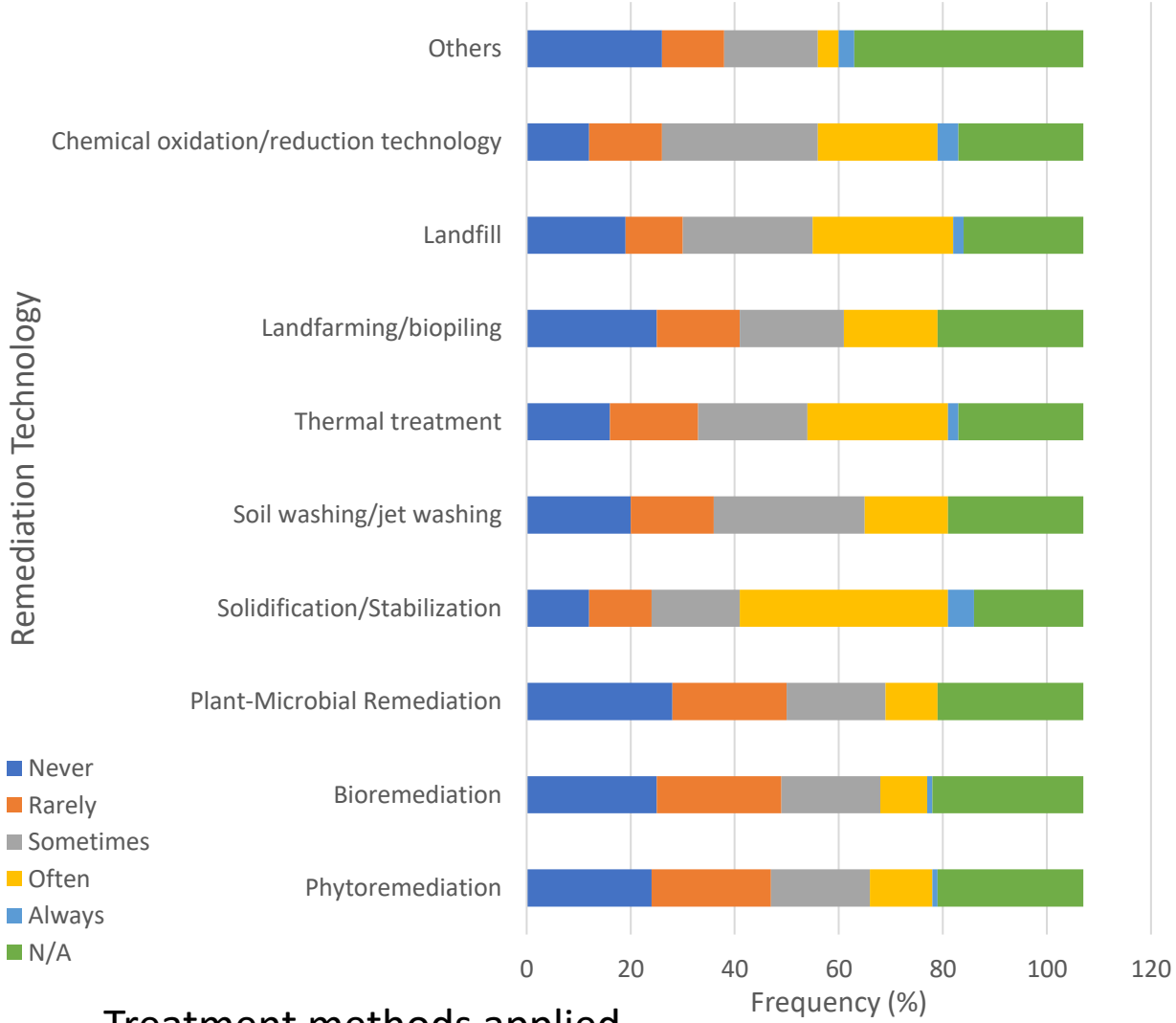
Hazard index for consumption of subsistence crops grown in a thallium mining area.



The Emerging Environmental Professional In The Contaminated Land Sector In China

Professionals responding to survey & interview

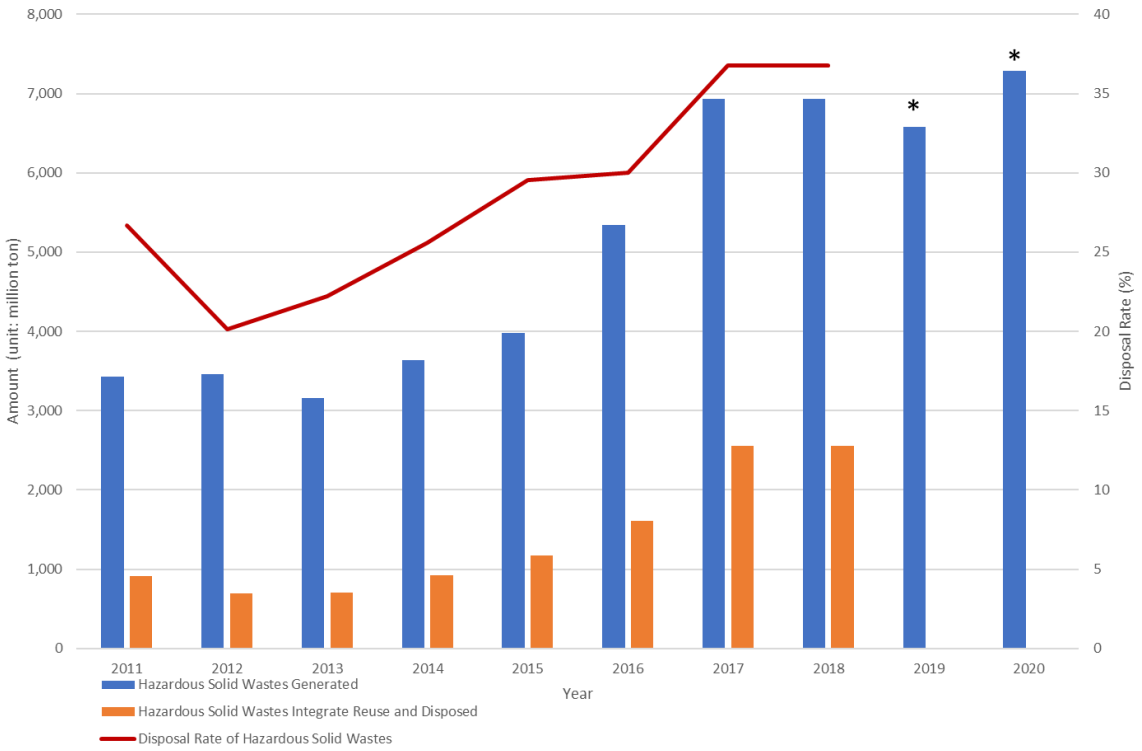
- >80% male
- Well educated (>50% MSc/PhD)
- Young (>70% 26-35 yr)
- Recent recruitment to this emerging sector (>80% < 6 years)

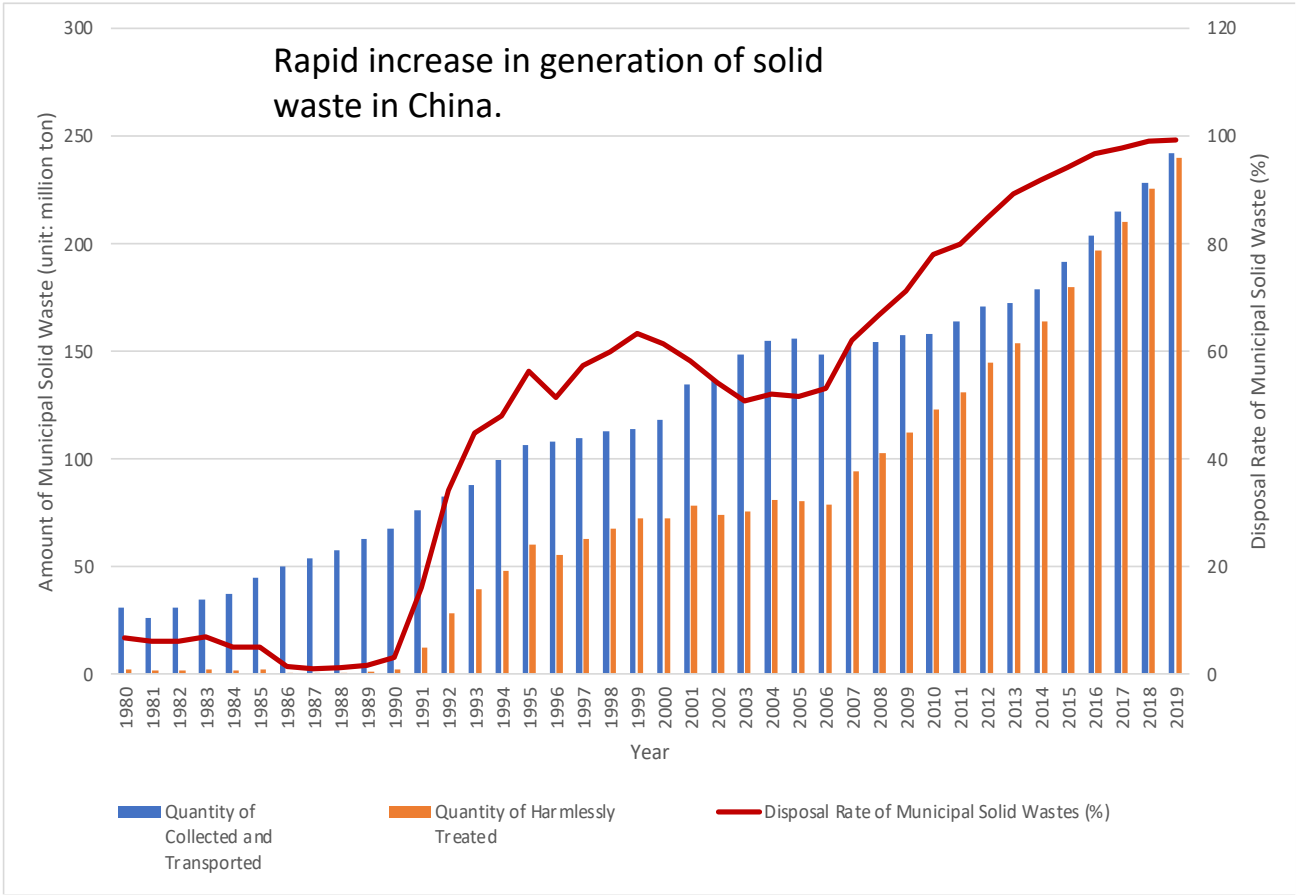


Treatment methods applied

Song, N.; Hursthouse, A.; Mclellan, I.; Wang, Z. *Decision Support Models for Site Remediation: An Evaluation of Industry Practice in China*. Sustainability **2022**, *14*, 11811. https://doi.org/10.3390/su141911811

Hazardous Waste treatment <50%





- Legacy accumulation
- Challenge for large spatial scale treatment
- Devolution to regional level
- Implementation of standards, material audit/control

Amount of municipal solid waste collected, rendered harmless (treated) and % finally disposed in the PRC, 1980-2019 (All annual data are collected from the National Bureau of Statistics of PRC http://www.stats.gov.cn/tjsj./ndsj/)

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THANK YOU FOR YOUR ATTENTION!

Summary article in The Environmental Scientist
https://www.the-ies.org/resources/unearthing-global-megatrends