

Sunflower Power: Phytoextraction in Action

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Problem

Heavy metal is polluting soil in the Pearl River Delta, South China

- Food is still grown
- Significant health risks

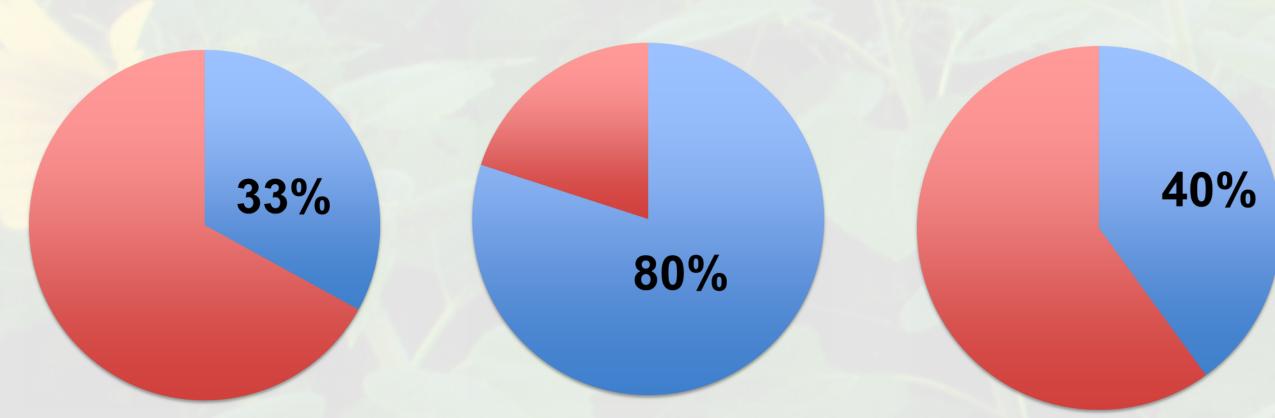
Causes

Rapid development of agriculture, industrial, and traffic practices

Background

Contaminated Vegetables Consumed in PRD

Contaminated **Vegetables Consumed** Farmland/ Vegetable in Hong Kong, Fields in PRD **Grown in PRD**



Heavy Metals: Concentrations in PRD

| Heavy Metal | Current Concentration (mg/kg)* | Non-Polluted Concentration (mg/kg)* |
|--|--------------------------------|-------------------------------------|
| Cadmium | 1.4 to 1.8 | < 0.3 |
| Copper | 11.0 to 41.0 | < 25 |
| Lead | 23.0 to 83.0 | <40 |
| Zinc | 36.0 to 149.0 | <40 |
| Mercury | 0.29 ± 0.26 | < 0.42 |
| Chromium | 46.7 ± 27.7 | < 25 |
| Arsenic | 20.0 ± 20.8 | < 20 |
| *Taken from (Hu, 2013), (Chang, 2013), (Bai, 2011) | | |

Solution: Sustainable Phytoremediation

Using sunflowers to remove heavy metal from soil

Sunflower seeds donated to

Farmer donates a portion of seeds to neighboring farm

Plant waste is sold to recycling companies as biofuels

Sunflowers harvested after about 100 days farmers in PRD

Farmers plant sunflower seeds alongside their existing crops

Sunflowers pull nutrients from soil through their roots...

...While naturally extracting heavy metals in the process

Costs

Takes 5-10 years

Labor cost ↑

Seed transportation

Sunflower seeds:

≤ \$30 per acre

Benefits

Yield ↑

Sunflowers can be recycled as biofuel

ALL polluting metals are remediated

> Aesthetically pleasing

Economically feasible

Productivity 1

Soil Testing

Cost of test covered by selling

Inexpensive: \$12-\$100

sunflowers for biofuel

Test

Cost

 Soil tested for heavy metals biannually at professional labs

Results

Compile data to evaluate solution

Conclusions/Recommendations

- Goal: concentrations of the heavy metals decrease by 50% after 10 years
- Expand use of phytoextraction crops, such as the sunflower, to other affected locations
 - 12% of worldwide soil is polluted

Acknowledgments

Our team would like to thank WPI Professor José Argüello, WPI Professor Robert Dempski, and Research Librarian Laura Hanlan

References

Ecological Engineering Group. (n.d.). Retrieved November 18, 2014,

Bai, J., Xiao, R., et. al. Assessment of heavy metal pollution in wetland soils from the young and old reclaimed regions in the Pearl River Estuary, South China, Environmental Pollution, Volume 159, Issue 3, March 2011

Kötschau, A., Büchel, G. et al. (2014). Sunflower(Helianthus annuus): Phytoextraction capacity for heavy metals on a mining-influenced area in Thuringia, Germany. Environmental Earth Sciences, 72(6), 2023-2031. Retrieved December 30, 2014,

Wuana, R. A., Okieimen, F. E., "Heavy Metals in Contaminated Soils: A Review of Sources, Chemistry, Risks and Best Available Strategies for Remediation," ISRN Ecology, vol. 2011, Article ID 402647, 20 pages, 2011