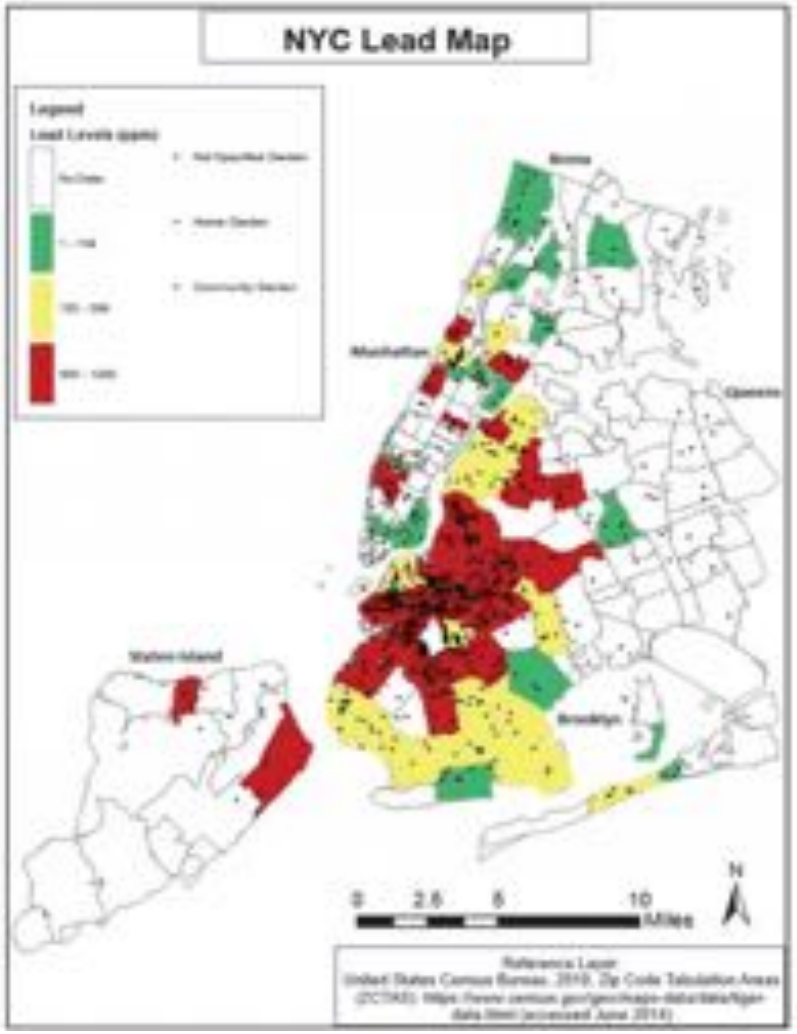
Organic Waste in Urban Agriculture: The New York City Clean Soil Bank Pilot Study

Sara Perl Egendorf
Zhongqi Cheng

The Graduate Center and Brooklyn College of the City University of New York
Department of Earth and Environmental Sciences
NYC Urban Soils Institute

Urban Soils are Highly Contaminated with Lead (Pb)

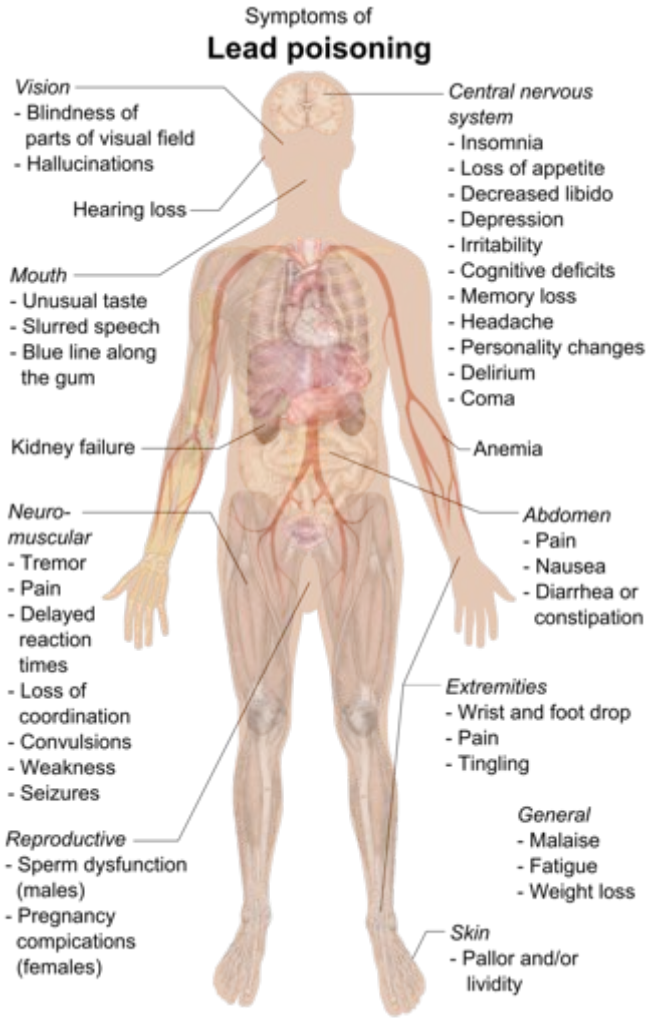
- Community gardens and backyards have Pb levels above EPA standards
- Pb cannot be broken down or leached from soil
- Community gardeners and all urban residents are at risk for exposure



(Cheng et al., 2015)

Pb: 2nd Most Toxic Substance

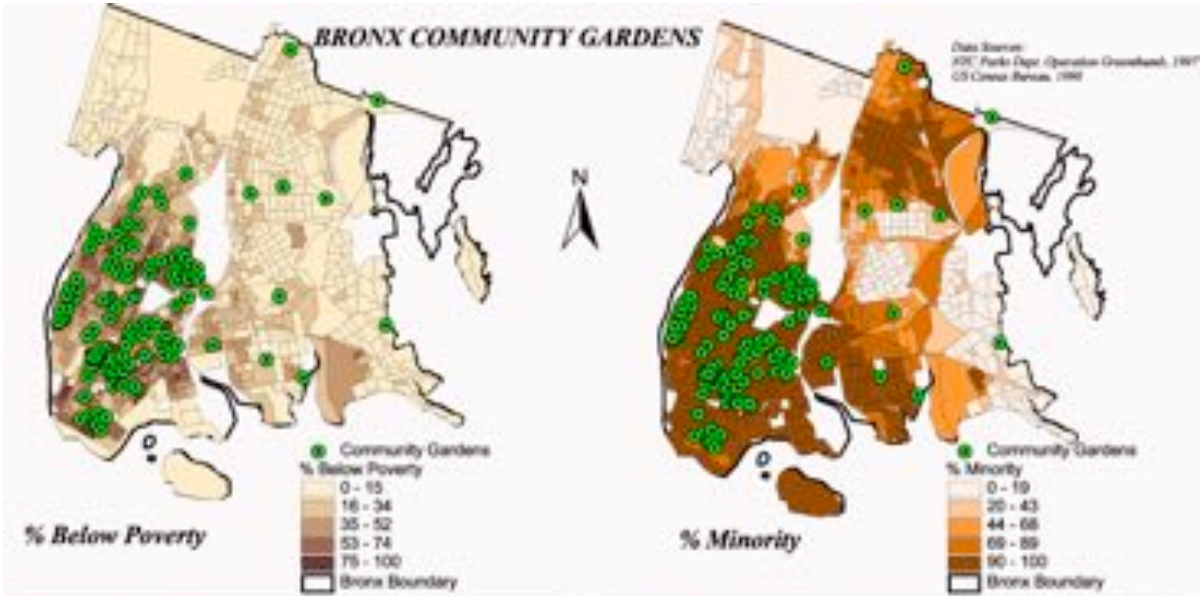
- The Agency for Toxic Substances and Disease Registry (ATSDR) ranks Pb as second priority toxic substance
- Toxicity can cause learning disabilities, ADHD, seizures, coma, and death
- Children are most at risk
- In 2012, over 1,000 NYC children were newly identified with blood Pb toxicity (blood lead levels over 10ug/dL)



Mikael Häggström, https://commons.wikimedia.org/w/index.php?curid=40804069

Community Gardening and Environmental Justice

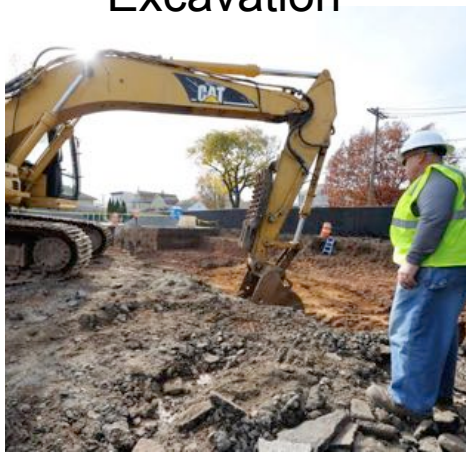
- Many urban community gardeners are people of color from low income backgrounds
- Community gardening provides access to healthy produce, physical activity, and community building
- Soil Pb contamination puts vulnerable populations at greater risk



http://www.lehman.edu/deannss/geography/images2/Gardens2.png

Remediation Options for Pb-Contaminated Soil

Excavation



Pro:

- Effective

Con:

- Expensive
- Placement in landfill
- Requires new soil

Cap and Cover

Pro:

- Effective
- Less expensive

Con:

- Requires new soil
- Soil is finite and needed in native settings

Can we construct new soil
to remediate contamination and promote community gardening?

http://www.northjersey.com

The NYC Mayor's Office of Environmental Remediation (MOER) Clean Soil Bank (CSB)

Since 2013, MOER has exchanged 255,000 cubic yards of pristine glacial outwash sediments from NYC for development projects

CSB Sediments are extensively tested for contaminants pre- and post-transport

Historically, excavated sediments were deposited in landfills

CSB Sediments used for study

CSB has eliminated 985,000 miles of truck travel, 245,000 gallons of diesel combustion, and 2,750 tons of CO_2 emissions

But can they be used for gardening?

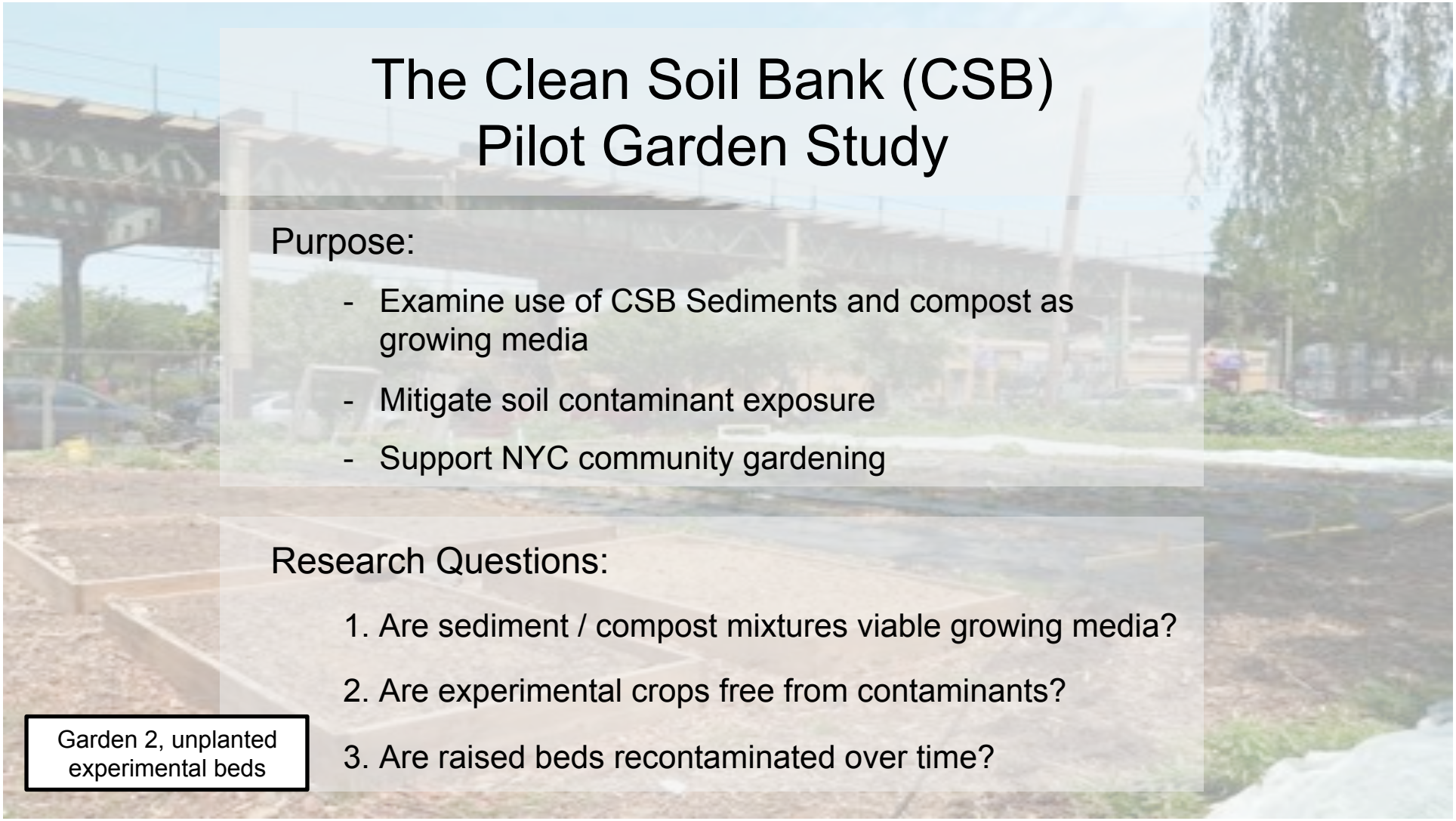
The Clean Soil Bank (CSB) Pilot Garden Study

Purpose:

- Examine use of CSB Sediments and compost as growing media
- Mitigate soil contaminant exposure
- Support NYC community gardening

Research Questions:

1. Are sediment / compost mixtures viable growing media?
2. Are experimental crops free from contaminants?
3. Are raised beds recontaminated over time?



Garden 2, unplanted experimental beds

CSB Pilot Study: A Collaboration

Sediments + Compost → Community Gardens → Experimental Design & Testing

- Created CSB
- Excavated sediments
- Tested sediments through certified York Analytical Laboratory

- Creates food scrap compost used for study
- Compost was tested for contaminants prior to use

- Manages NYC community gardens
- Provided space, materials, and gardener outreach for study

- Created experimental beds
- Grew crops
- Conducted soil and plant analyses
- Conducted data analyses

Limiting Factor: Clean Compost

1st mulch / manure compost sampled 5/13/15:

230 mg/kg Pb

2nd mulch / manure / yard waste compost sampled 6/3/15:

200 mg/kg Pb

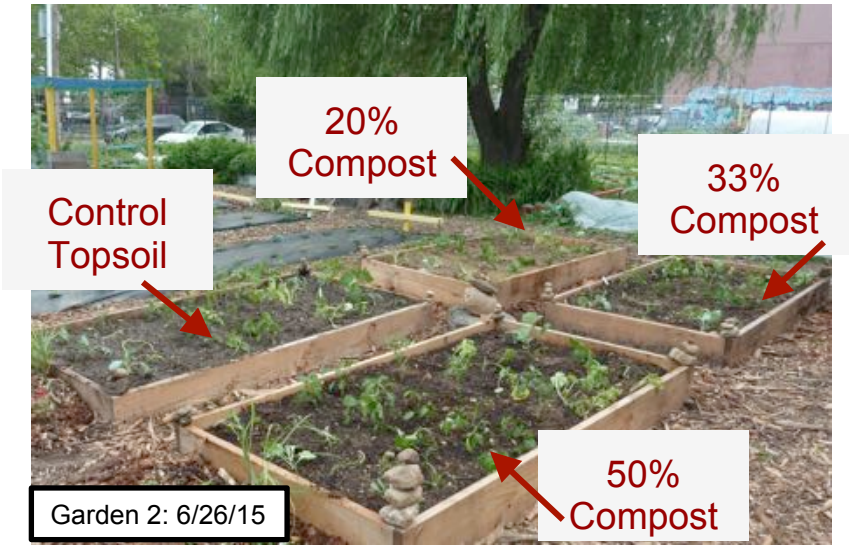
3rd mulch / food waste compost sampled 5/5/15:
40 mg/kg Pb

Field Methods

1. Built 4 raised beds in 2 community gardens; 1 bed in 3rd garden; placed landscape fabric between garden and raised bed soil

2. Mixed sediments with compost at three ratios (50%, 33%, 20%) and established control topsoil bed (soil used by GreenThumb for other garden beds)

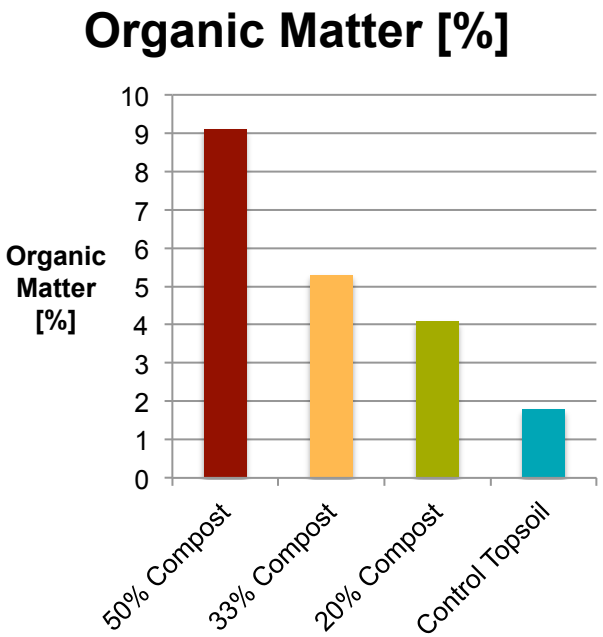
3. Planted consistent number and variety of crops in each bed, watered and tended to plants

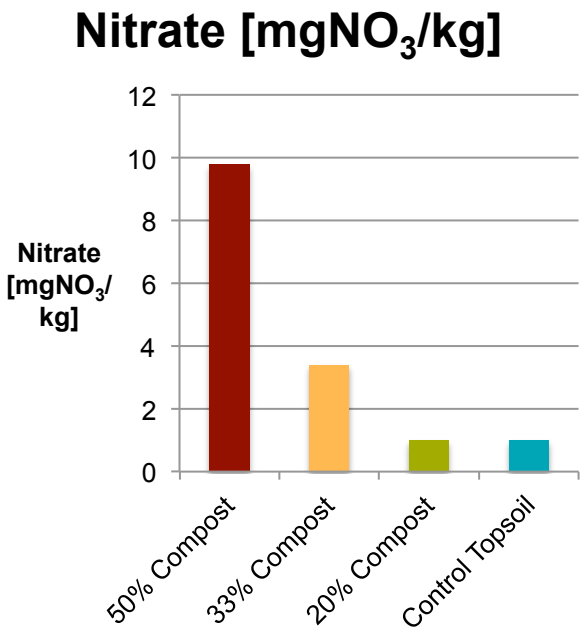


Lab Methods

June, 2015:	July-August, 2015:	September, 2015:	October, 2015:	July, 2016
Soil contaminant analyses, organic and inorganic	USDA Standard Soil Analyses	Plant tissue analysis for trace metals	Second soil contaminant analyses Plant tissue analysis for organic contaminants	Second USDA soil and trace metal analyses
EPA Methods 8260C, 8270D, 8081B, 8082A, 8151A, 6010C, 7196A, 7473	pH (1:1), Salts (1:2), Organic Content (LOI), Macronutrients (KCl extract), Micronutrients (Modified Morgan)	EPA Methods 3052, 6010C	EPA Method 8270D	
YORK ANALYTICAL LABORATORIES INC	Brooklyn College The City University of New York	Brooklyn College The City University of New York	YORK ANALYTICAL LABORATORIES INC	YORK ANALYTICAL LABORATORIES INC Brooklyn College The City University of New York

Results: Soil Organic Matter and Nitrate for Garden 1 [July, 2015]





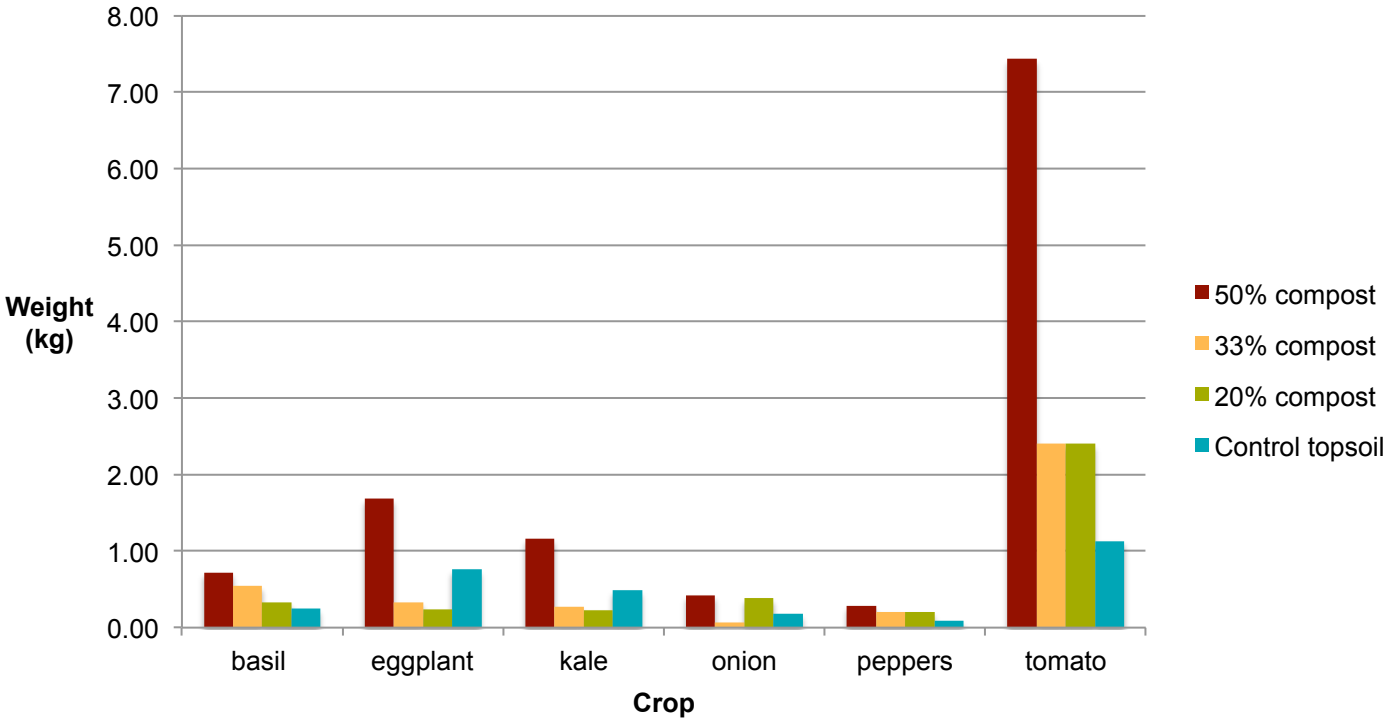
Higher initial nutrient availability in beds with greater percentages of compost

Results: Soil Parameters for Garden 1 [October 2015]

	pH	Conductivity (dS/m)	Texture (% Sand)
CSB Sediments	7.0	0.2	Sand (90%)
50% Compost	7.5	0.1	Sandy loam (70%)
33% Compost	7.0	0.15	Sandy loam (60%)
20% Compost	7.0	0.1	Loamy sand (80%)
Control Topsoil	8.0	0.16	Sandy loam (75%)

Texture, pH, and salts are within acceptable ranges for selected crops

Results: Total Agronomic Yield
Gardens 1 and 2 [June-October, 2015]



50% compost beds produced higher yield than all others, including control soil

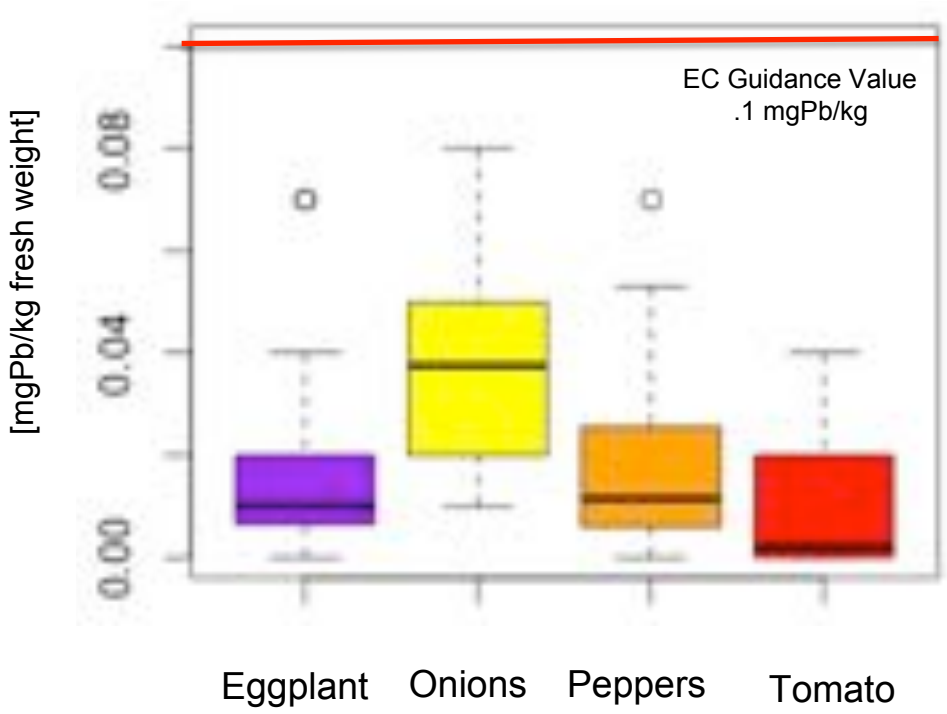
Results: Fruit / Root Crop Tissue Metals

Guidance Value set by European Commission:

.1 mg Pb /kg for fruits and non-leafy vegetables

All tissue samples are well below this standard

Lead Concentration in Fruit / Root Crop Tissues
[mgPb/kg Fresh Weight]



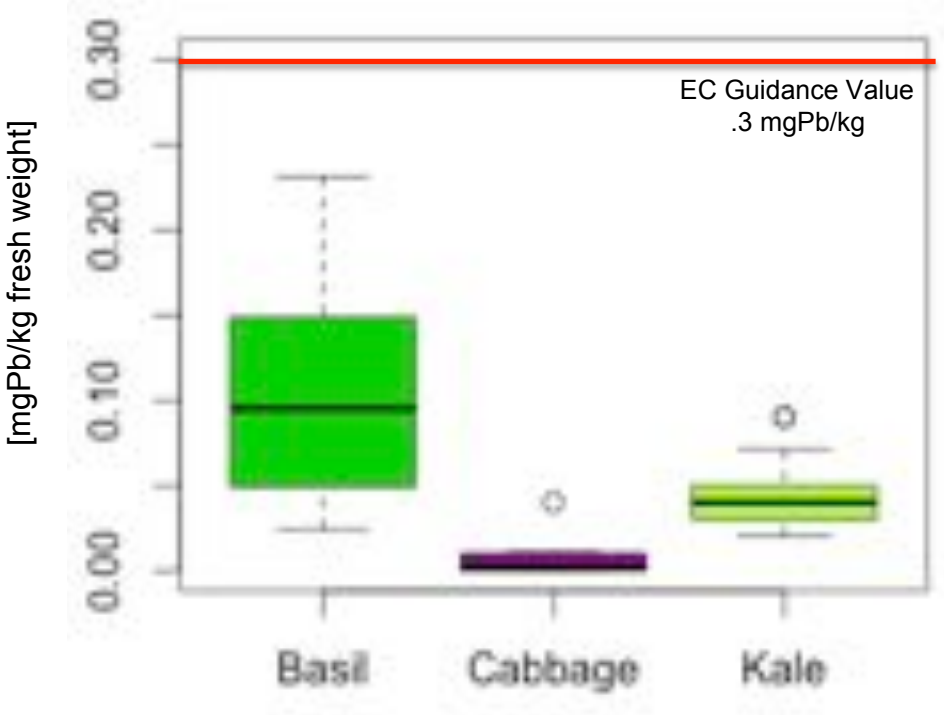
Results: Vegetable Crop Tissue Metals

Guidance Value set by European Commission:

.3 mg Pb /kg for leafy vegetables

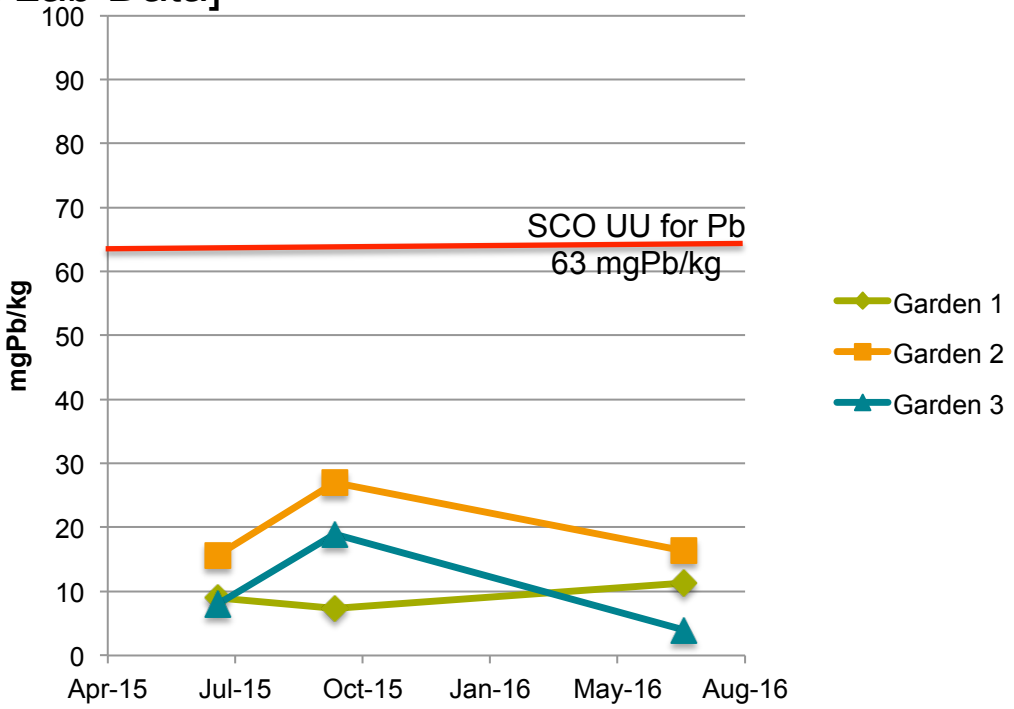
All tissue samples are well below this standard

Lead Concentration in Leafy Vegetable Crop Tissues
[mgPb/kg Fresh Weight]



Garden 1, 8/20/15

Results: Soil Pb Concentrations Over Time [York Lab Data]



26 Target Metals Tested:
All well below NY State Department of Environmental Conservation (NYSDEC) Soil Cleanup Objectives Unrestricted Use (SCOUU) Criteria

160 VOCs, SVOCs, PCBs, and Pesticides Tested:
All well below NYSDEC SCOUU Criteria

Project Significance

- CSB sediments can not only cover contaminants, but with compost they also support edible crops
- 50% compost mixtures produce higher yield than control topsoil
- Soil parameters are suitable for edible crops
- Crops show no evidence of contamination
- Soil metal concentrations remained very low over first year

Garden 2, 7/20/15

Benefits and Next Steps:

- The Clean Soil Bank is a viable way to cap and cover contaminated soils, minimize associated risks, support edible plant growth, and enhance the many benefits of community gardening

- This program is being expanded. 66% of new buildings in NYC generate ~6,500 tons of clean soil on average

- There are sufficient clean native sediments to remediate ALL gardens in less than 1 year – with the correct logistics in place

- These sediments can be mixed with other organic residuals and biosolids

- More research is needed on CSB / organic residual blends

Acknowledgments

MOER:

Daniel Walsh
Shana Holburton
Samantha Morris
Alysha Alfieri
Lee Ilan

GreenThumb / NYC Parks

Nancy Kohn
Rasheed Hislop
Shawn Spencer
Isak Mendes

Brooklyn Queens Land Trust:

Demetrice Mills

Community Gardeners:

Stanley Jones
Katherine Bryant
Yolanda Belcher
Rochelle Sanders
Lakecia Davis-Flueck
Deborah Greig

Gowanus Canal Conservancy:

Richard Kampf
Natasia Sidarta

Brooklyn College / Urban Soils Institute:

Hermine Huot
Danielle Wagner
Anya Paltseva
Zulema Garcia-Blanco
Igor Bronz
Jan Mun
Michael Grishtein
Tatiana Morin

Project Interns:

Victor Flores
Lisa Bloodgood
Tamar Saimbert
J.D. Rachid
Tiffany Mai
Fanny Mai
Shruti Singh
Jocelyn Chen
Kelly Yuen
Uero Liang
Sophia Khoja
LiLin Liu
Zainab Salahudin
Zenab Jamil
Marzana Rafa
Jasleen Kaur

Thank you for your attention…

Organic Waste in Urban Agriculture:

The New York City Clean Soil Bank Pilot Study

Sara Perl Egendorf
Zhongqi Cheng

Brooklyn College of the City University of New York
Department of Earth and Environmental Sciences
NYC Urban Soils Institute

saraperle@gmail.com

Urban Soils Institute: www.usi.nyc