Exploring lime ($Ca(OH)_2$) treatment of sludge: household and agricultural trials

Irina Chakraborty, Rachel Pringle, Chris Nicoletti, Yi Wei, Cordell Jacks

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BOLD IDEAS
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Background

- Latrine usage growing in Cambodia, but limited sludge management options
  - Pump trucks expensive or not available
  - Users/professionals empty pits with no protection
  - Both dispose of sludge unsafely

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winnipegfreepress.com

businessfightspoverty.org

Background

- Hydrated lime $Ca(OH)_2$ for wastewater treatment
  - inactivate pathogens
  - reduce odors
- Widely available
- Users familiar with lime's disinfectant properties
  - animals shelters
  - fish ponds

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Background

- Some fecal waste reuse in agriculture accepted
- Acidic soils around Cambodia limit productivity
- Lime-treated waste: potential for a soil amendment that adds nutrients and raises pH, reducing risk of untreated sludge application

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Objectives

Evaluate the feasibility of

1) applying lime to pits on a household level,

2) resource recovery and usage,

3) marketing lime to households

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Study components

1. Benchscale fecal waste and lime tests (WEDC 2014)
2. Agricultural trials: treated waste-amended soil, effect on corn yield
3. Household tests with lime

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Objective

- Demonstrate use of lime-treated sludge for agriculture
- Quantify effect on crop growth and yield

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Method

- Lime mixed with sludge
- Clear supernatant applied to soil
- Corn planted
  - used as animal fodder
  - less resistance to reuse, not for direct human consumption

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L+S	L+S	L
L	L	L+S
C	C	C
L+S	L	L
C	L+S	L+S
L	C	C

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Control
Treatment

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Objectives

- Compare lime application protocols to be used by households
- Interview households on attitudes towards lime and reuse

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Study parameters

- 1.5 % (w/v) lime based on benchscale results and research by others
  - 1.5 % (w/v) raises pH to 12, which eliminates most pathogens given sufficient contact time
- Sufficient liquid required
  - Mixing – distribution of $Ca(OH)_2$ in sludge
  - Higher concentrations of solids require higher concentrations of $Ca(OH)_2$ to increase pH

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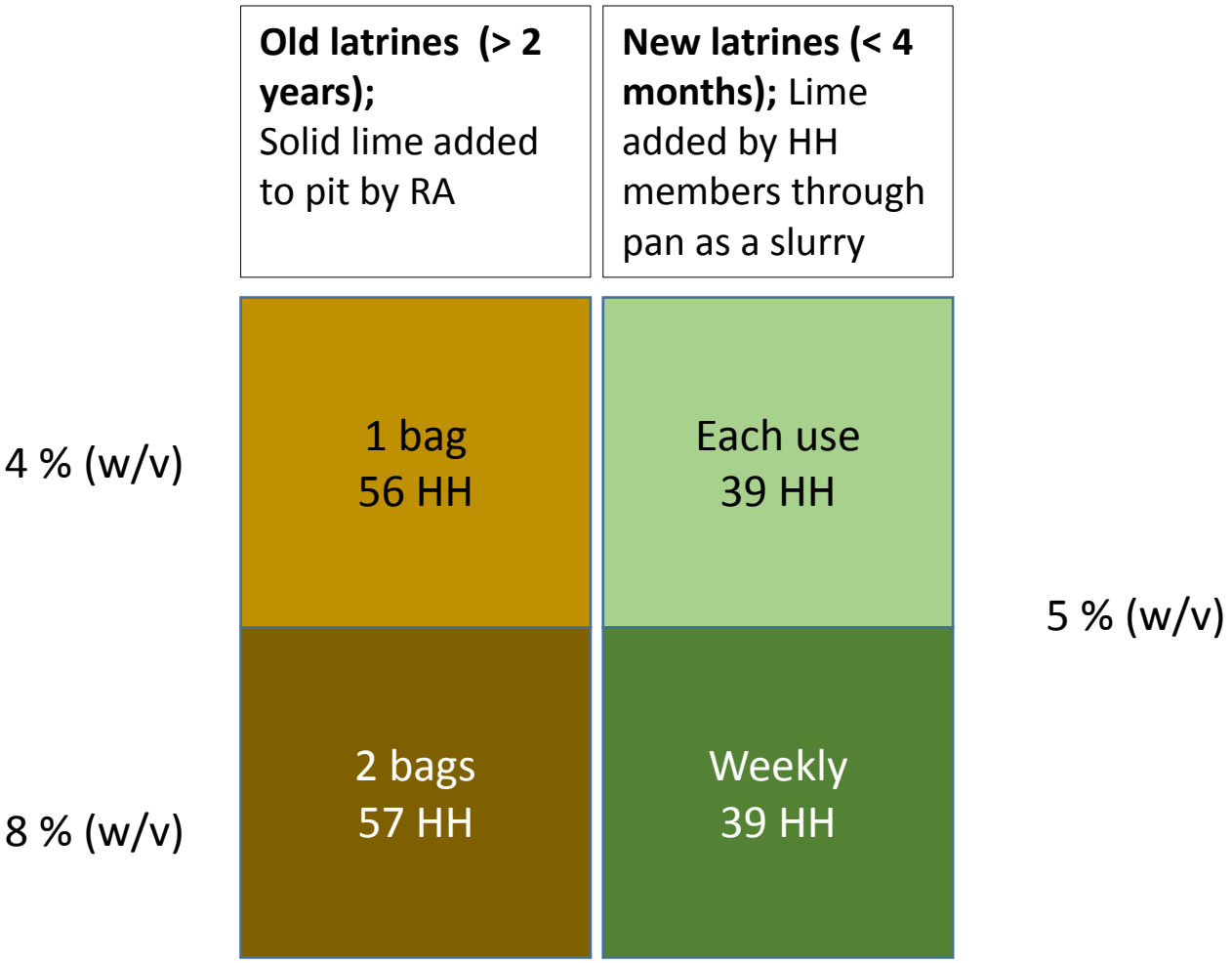

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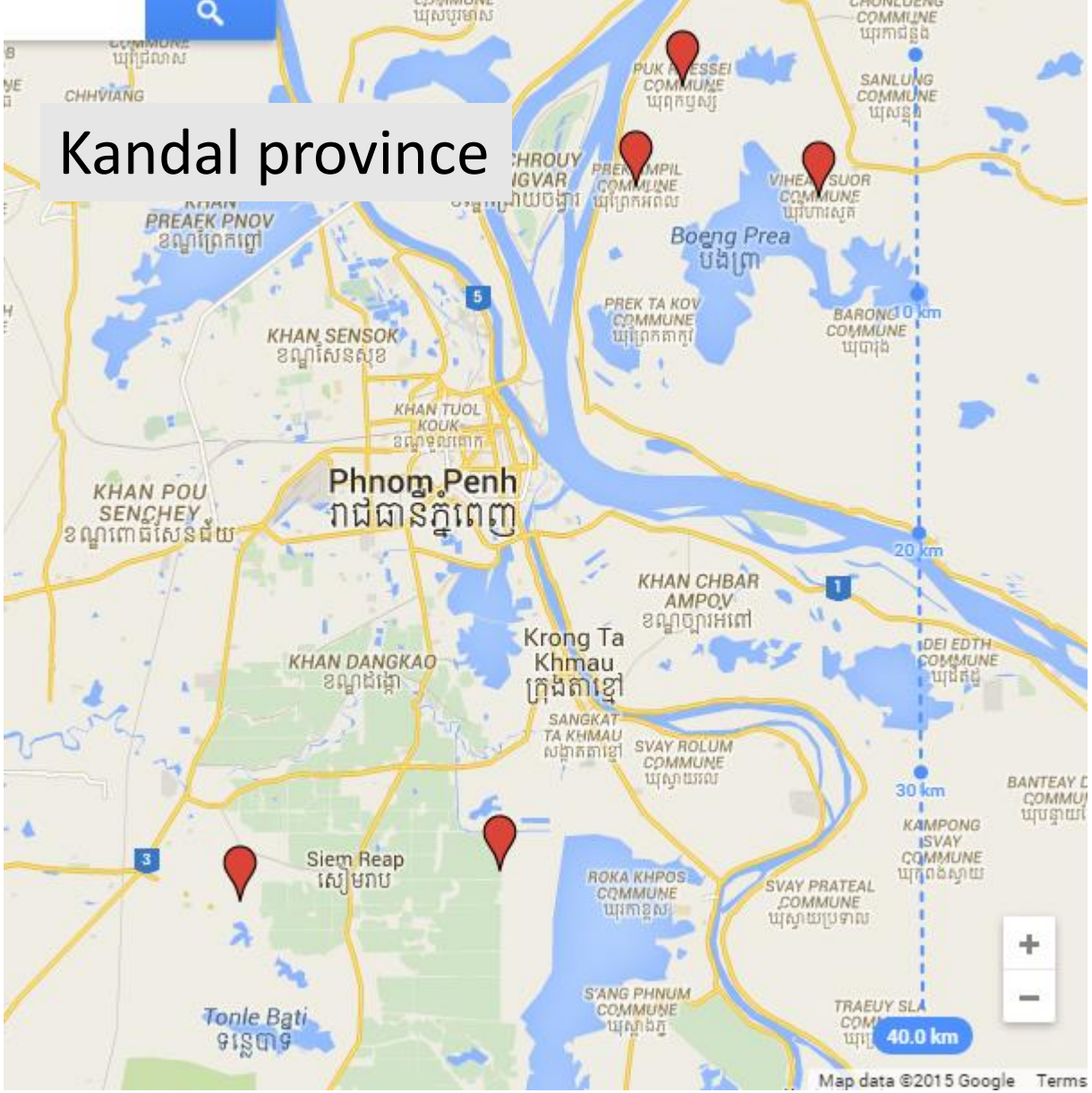

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1. Conduct intake interviews with households
2. Apply lime or provide instructions on lime use
3. Return weekly
    1. measure pH in the pit
    2. measure amount of lime applied by HH (volume and weight remaining)
4. Conduct second interview with households on experience and impressions of lime

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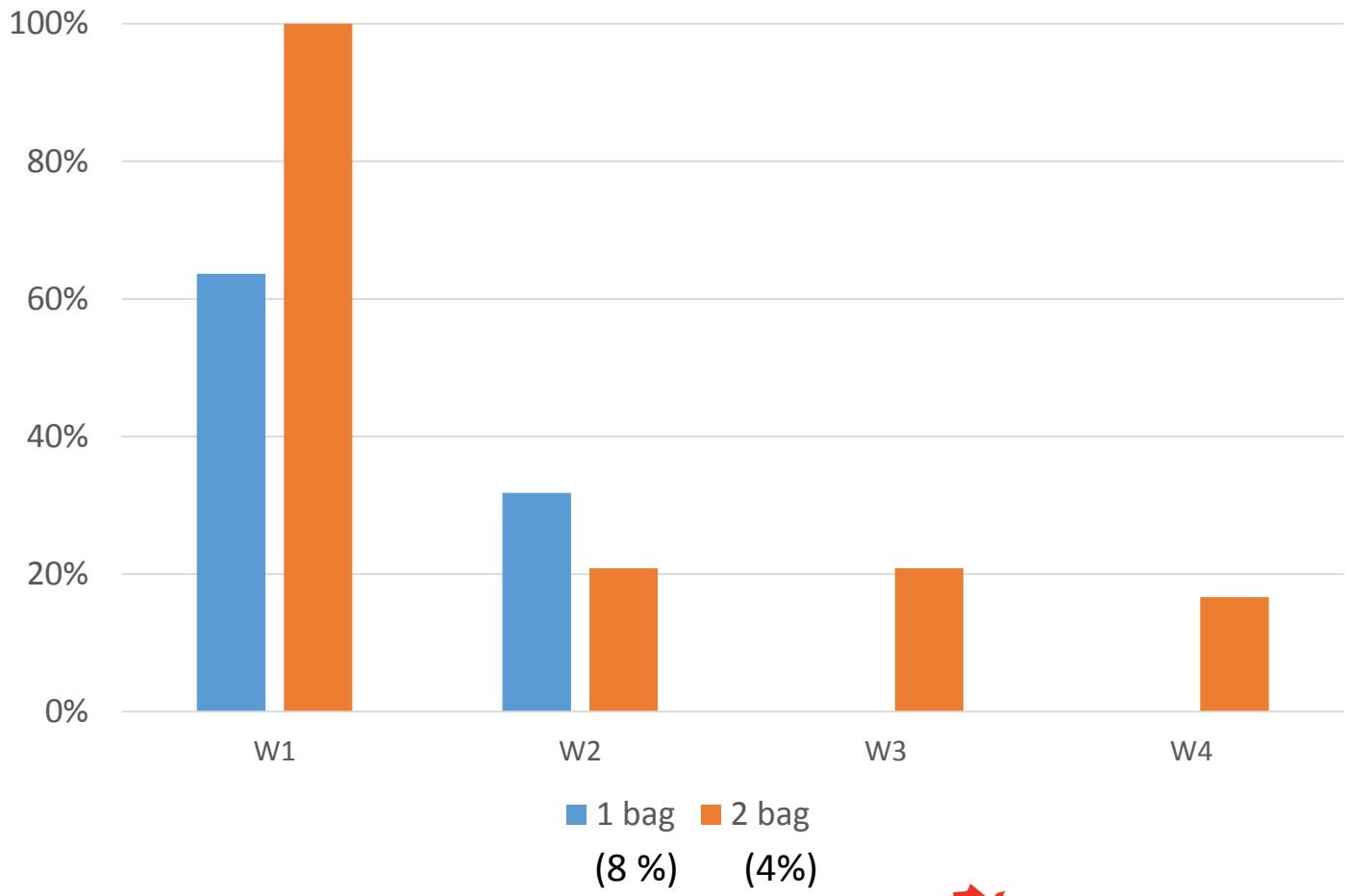
Pits pH ≥12
Pit addition



n=23

(8 %) (4%)

Kandal Stueng district

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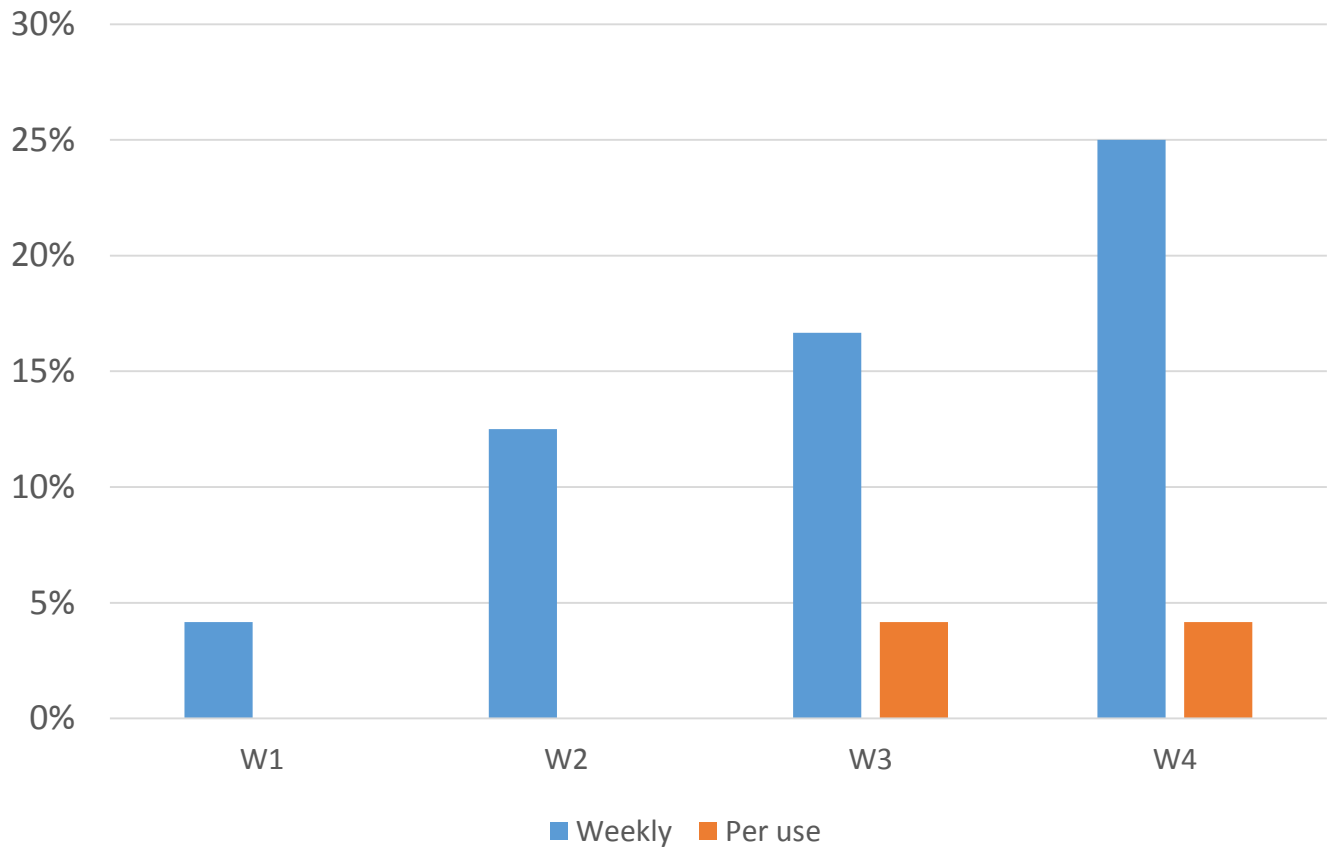
Pits pH ≥12
Pan addition

n=24



Ksach Kandal district

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- Top of pits sealed completely during installation, including small lid
  - Safety
  - Overflow
- Most households prepared to break pits
- Very low levels of solid waste, tho some “secret wastes”

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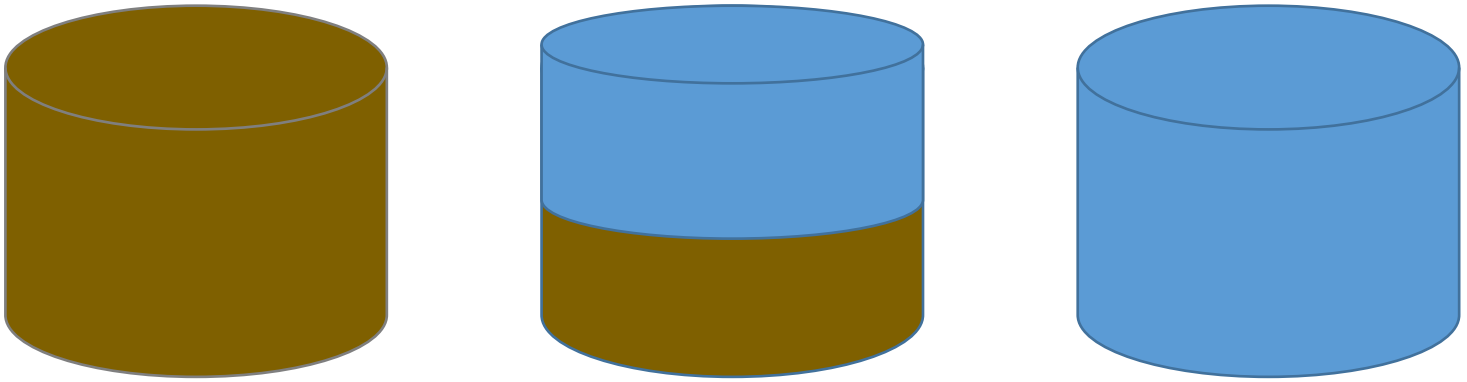
- Content of pits varies widely, based on exfiltration/infiltration rates
  - Completely solid, unmixable by hand (“shovelable”)
  - Thick sludge at the bottom of pit, liquid on top
  - Completely liquid content with no solid layer at bottom



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Conclusions

Technical

- Mixing: challenge for adding to pits
- Weekly addition most promising
- Potential for technological intervention to improve compliance

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Conclusions

Users

- Very positive impressions of lime use
  - Less smell
  - Kills germs
- Users are comfortable handling lime
- Wary of lime dust; slurry important
- Risk of inaccurate dosing due to settling of lime slurry
- Cost of materials per household: 2 USD/month

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Conclusions

- Potential for non-infiltrating (completely sealed) systems
  - Effective treatment of liquid phase
  - Reduces need of emptying
- Reuse of liquid phase – promising
  - Easy to apply, high N content (200 – 1000 mg/L NH_3)
  - Low risk
  - Clear liquid -> less disgusting

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On-going

- Supply chain research
- Detailed characterization of lime-treated sludge
- Quantify effect on yield and growth
- Market research and product design (iDE's HCD lab inCompass)

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Further work

- Considerations for eventual disposal of sludge
- Better characterization of existing pit sludge properties

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