

Low-cost waste management solution for a medium-size pig farm in China

Sustainability Without Borders - China

Lixi Liu

lixiliu@umich.edu



About Me

- Ph.D. candidate, Mechanical Engineering and SEAS
- SWB-China: 2017-present
- Research interests:
 - life cycle management and design optimization problems in renewable energy systems and building energy efficiency

Project background

Pig farming in China

- China - world's largest pork producer
- Important source of income to rural population

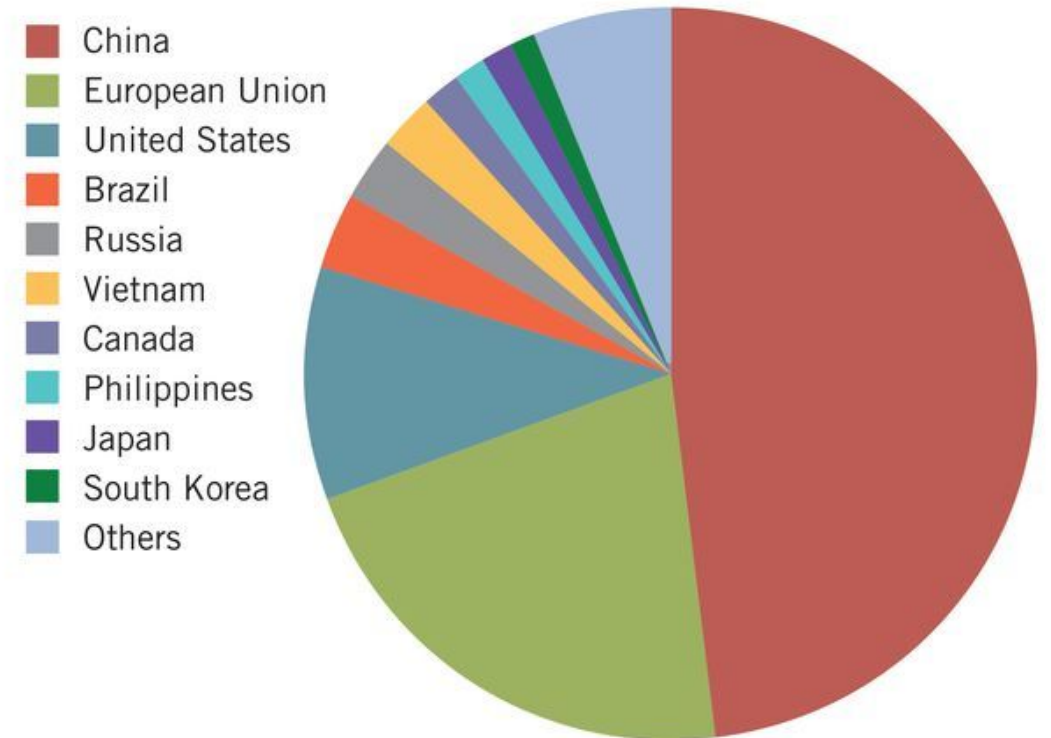
New waste discharge regulation

- Zone type: allowed, restricted, prohibitive
- restricted household production
- Government subsidies available for large farms

Problem

- Little assistance for small-medium farms

Top 10 Pork-Producing Countries – 2017



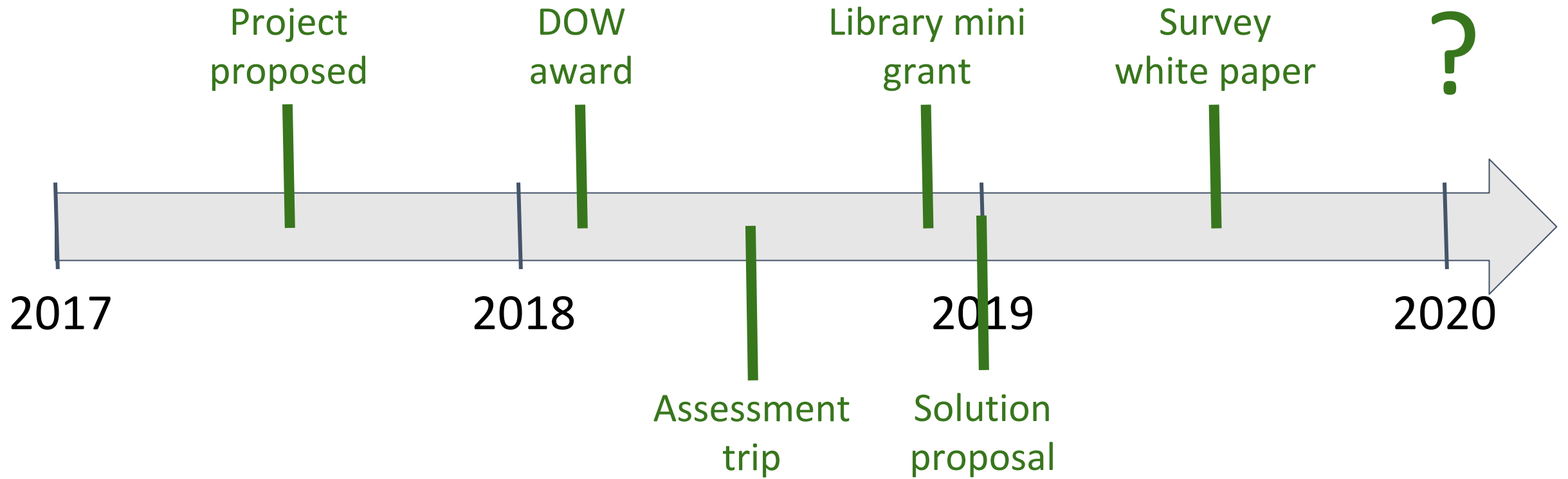
Source: USDA Foreign Agricultural Service. Updated: 5.5.18

Project Goal

- Provide **low-cost, regulation-compliant** waste management solutions for Mr. Zhu's farm **by the end of 2018**
- Provide strategies for community-building and wastewater runoff and odor prevention



Project Timeline



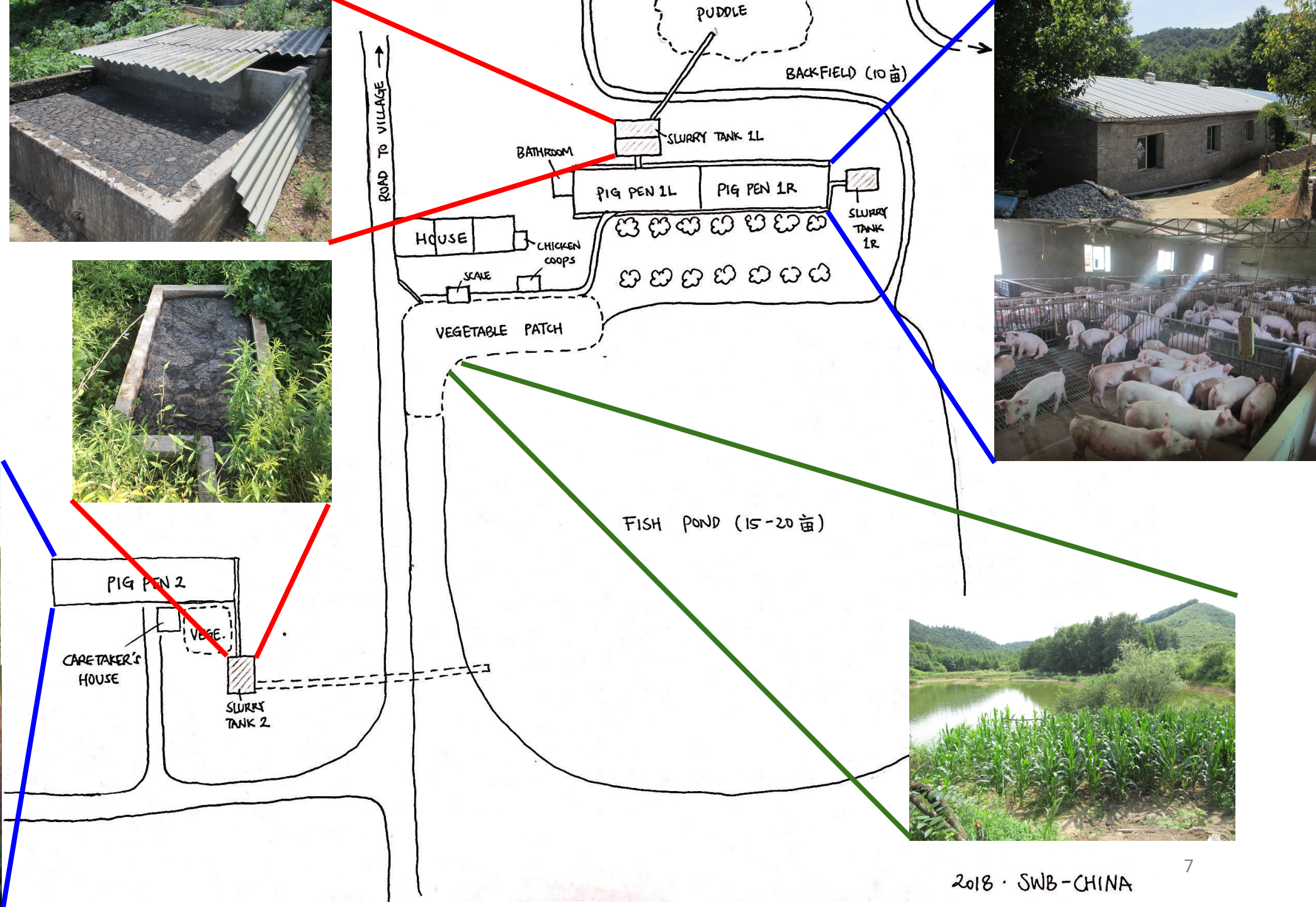
Assessment trip (Summer 2018)

- Conducted site assessment of Mr. Zhu's farm
- Sent manure samples for lab-testing
- Collected 60 community surveys on broader perceptions of pig farming practices and new regulations
- Conducted interviews with 4 former pig farmers whose farms have been shut down
- Consulted with local EPA and village officials
- Toured a biodigester plant in Jiangxi

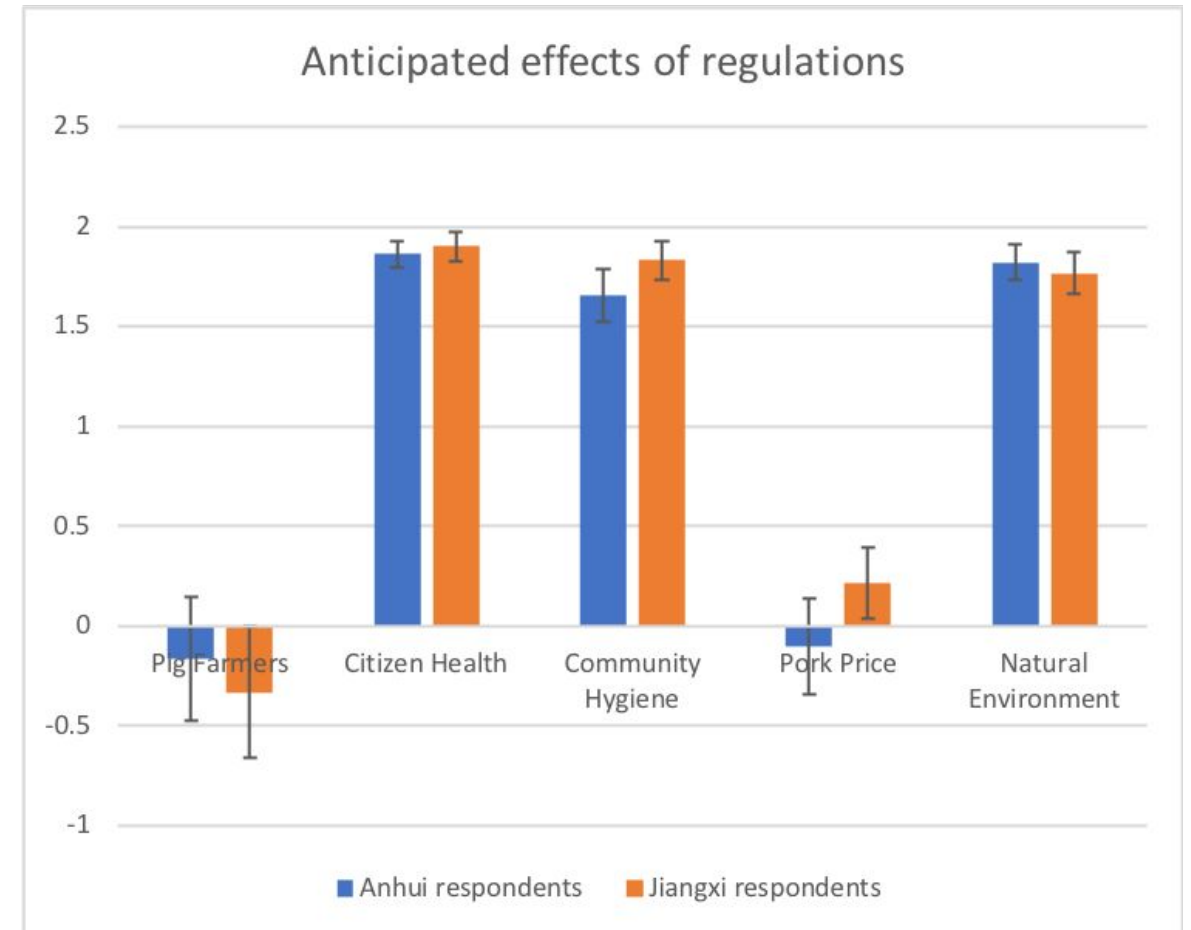
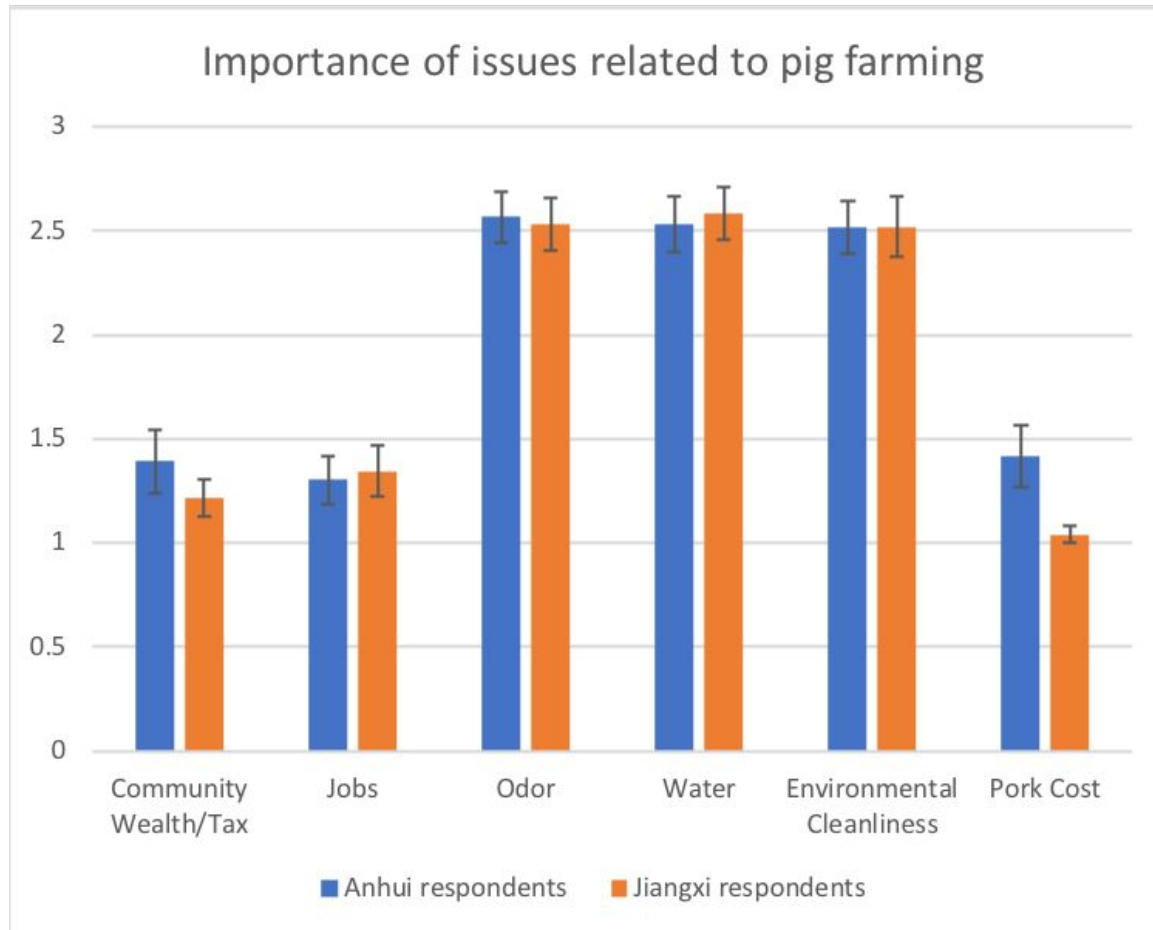


Mr. Zhu's Farm

- Farrow-to-feed
- ~ 2,000 piglets
- Restricted zone



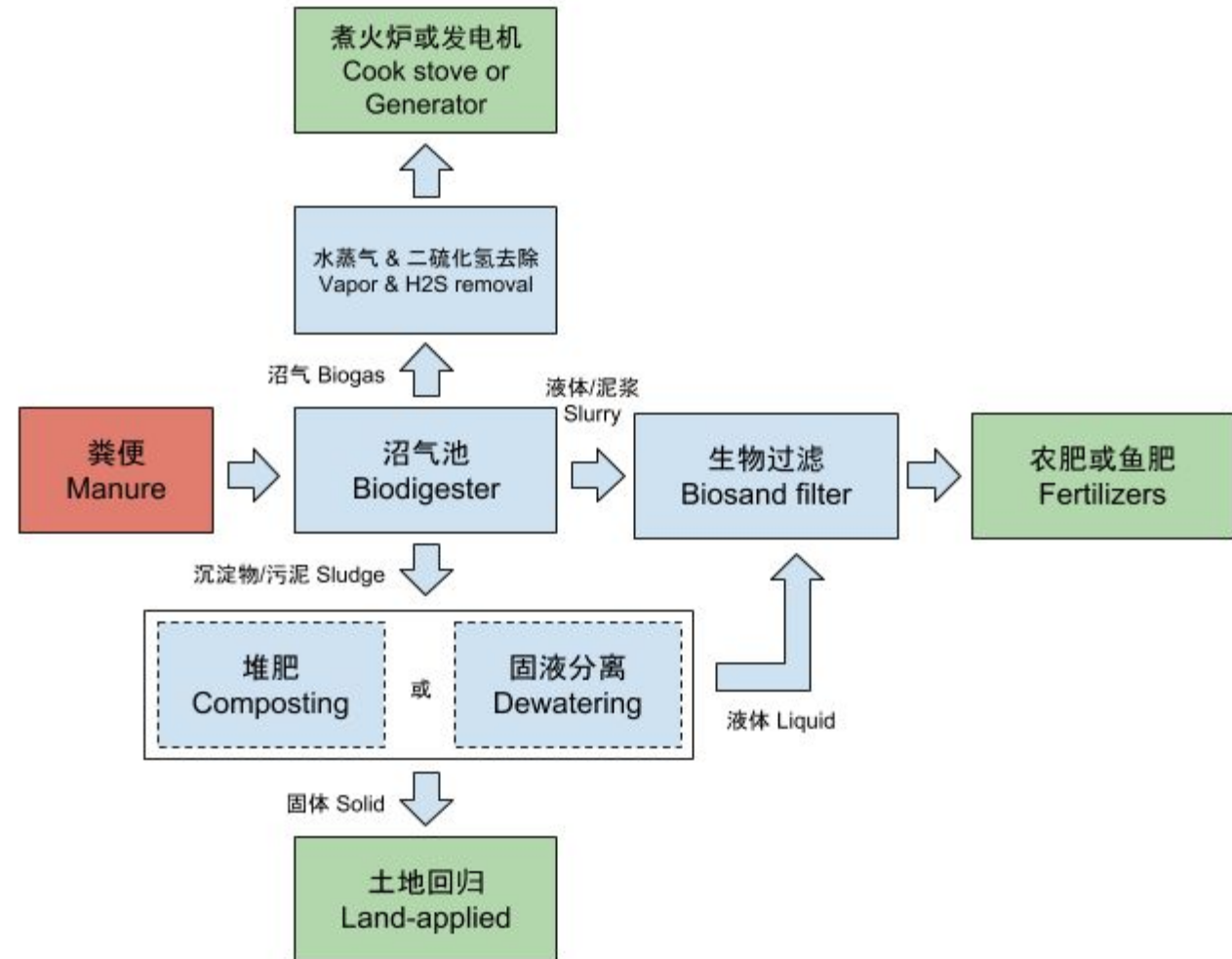
Insights from surveys



N_Anhui = 30, N_Jiangxi = 30, error bars represent standard errors of mean (SEM)

Waste management proposal

- Library search engine to find relevant literature
- Online retailers to find product specs and quotes
- Completed Dec. 2018



Update

Nov. 2018 - Mr. Zhu's farm infected with African Swine Fever (ASF)

- ASF in China first reported in Aug. 2018, spreaded through animal feeds
- Exterminated all pigs on farm
- At least 9-month ban on operation

Mar. 2019 - experiment with goose farming

China reports new African swine fever outbreak in Anhui province



China has reported more than 50 cases of African swine fever since the first detected outbreak in early August. PHOTO: AFP

PUBLISHED NOV 11, 2018, 12:13 PM SGT

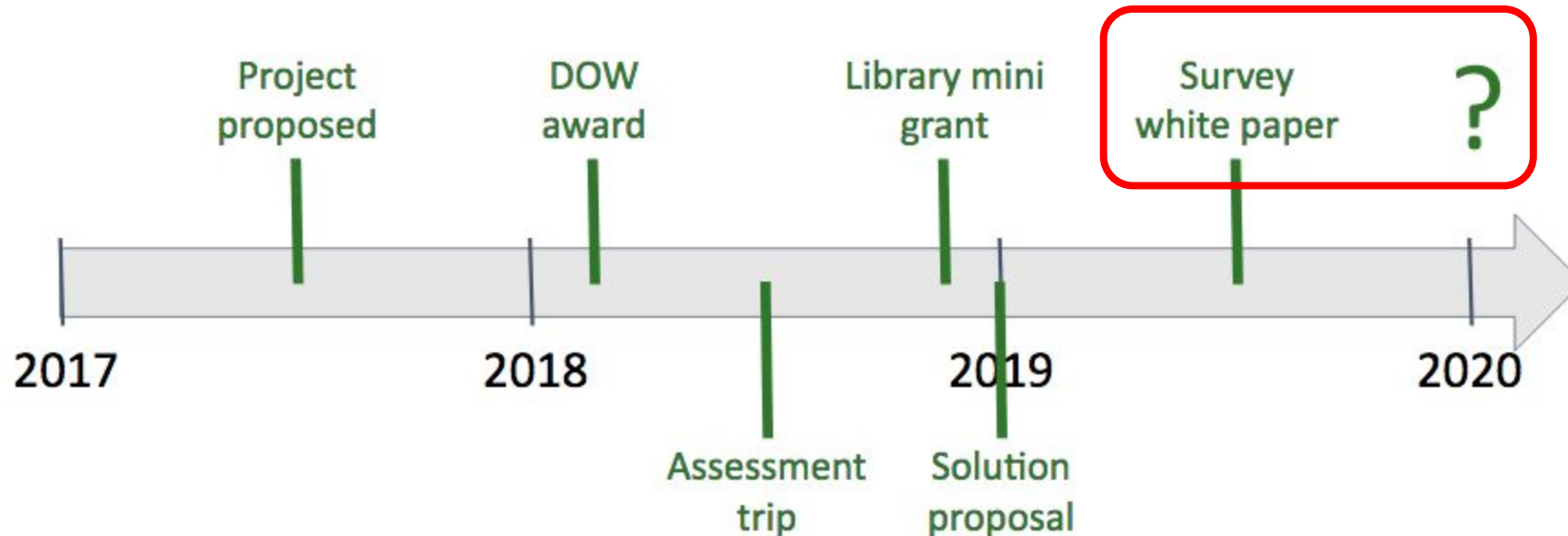
Next step

Report on survey results and interviews by end of mid-April

- Library search engine for literature review

Further work depends on Mr. Zhu's future plan

- Waste management proposal may still be useful for geese production



Acknowledgement

Library Mini Grant 2018-2019

DOW Sustainability Project Award 2017-2018

SWB - officers and advisory board

Past and current members of SWB-China

Community partner - Mr. Zhu & family

Contact:

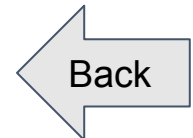
Lixi Liu | lixiliu@umich.edu



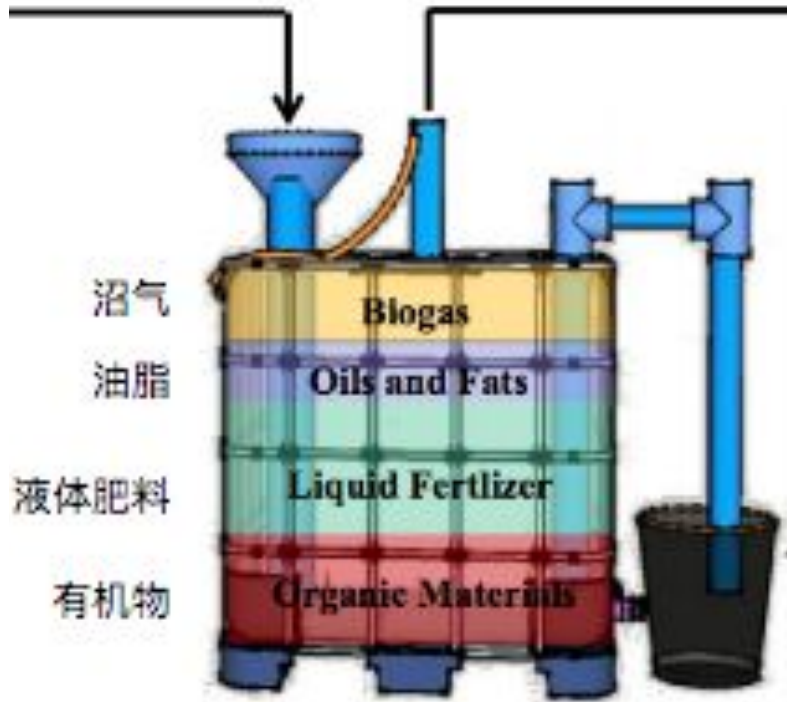
Extra slides

Biodigester - SolarCities

with gas capture



Biowastes



发电机

沼气管

Biogas Generator Biogas Car Biogas Stove

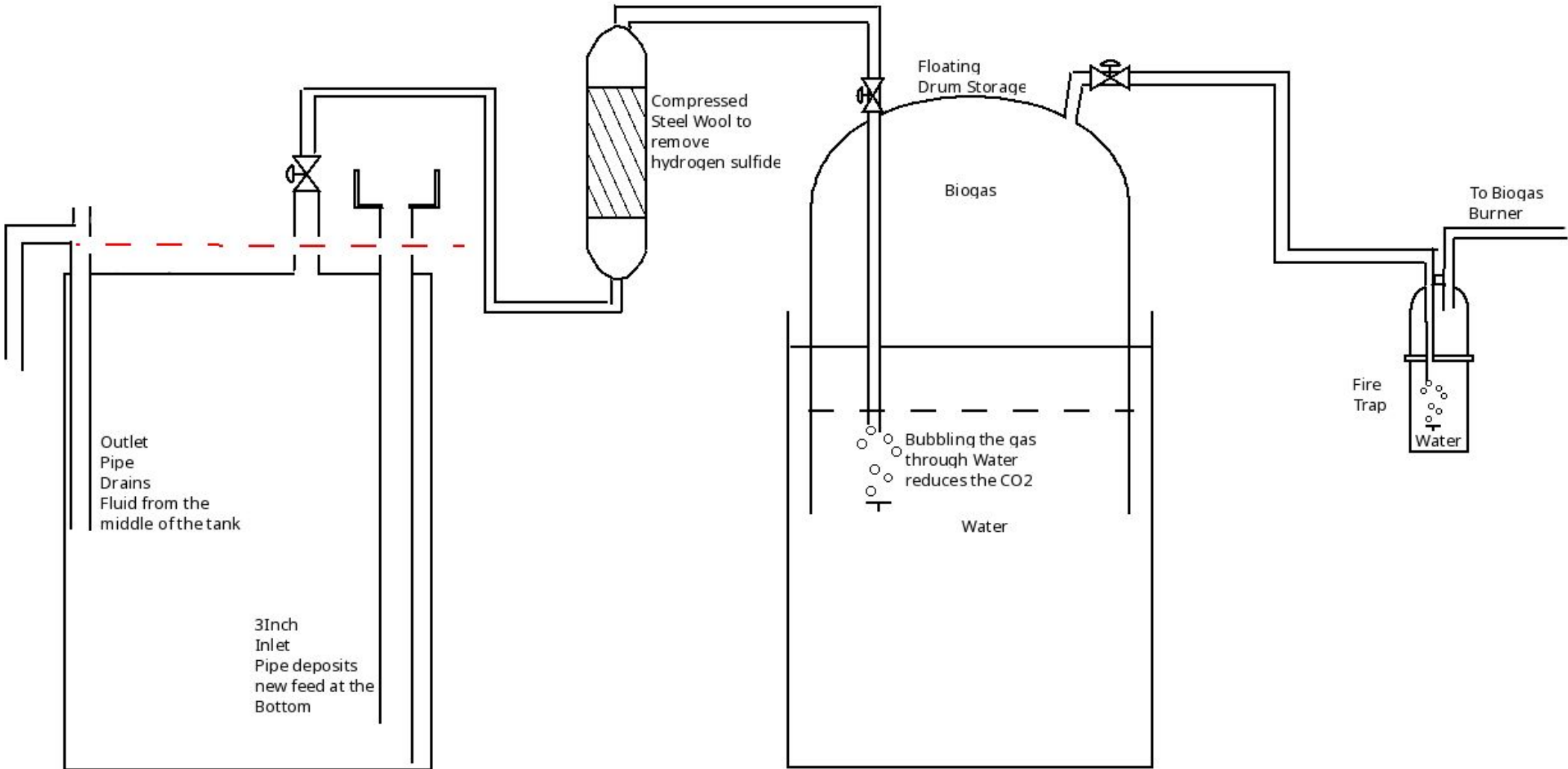
Biogas Generator: A green and black portable generator.
Biogas Car: A small, green and white vehicle.
Biogas Stove: A white and blue portable stove.

Organic Liquid Fertilizer

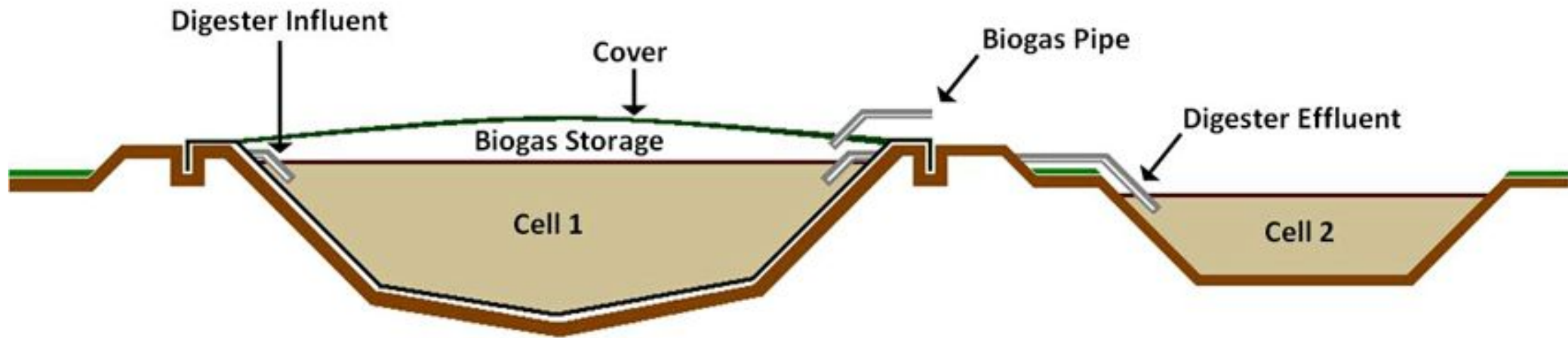
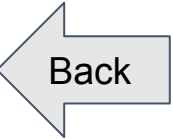
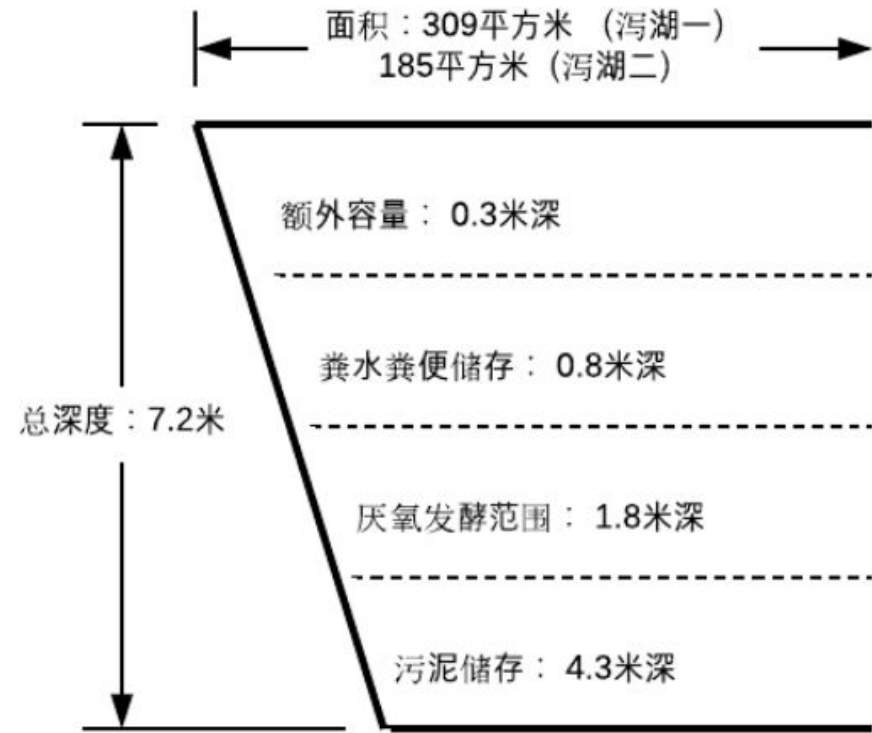
有机液体肥料

Organic Liquid Fertilizer: A photograph showing a green watering can pouring a brown liquid onto a garden bed.

Gas capture and processing



Covered lagoon



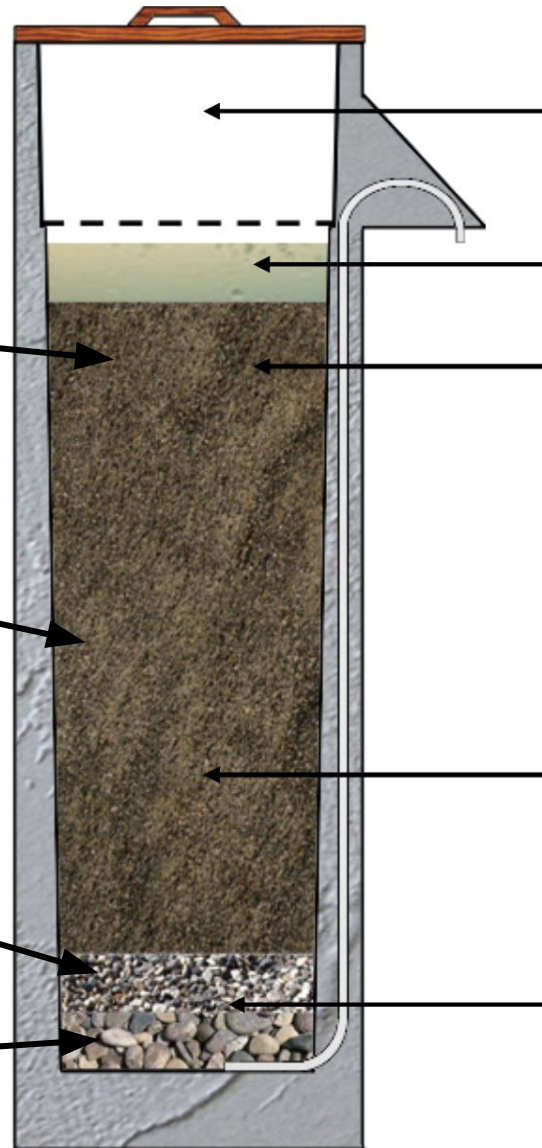
Biosand filter

Filtration sand
< 0.7mm

Concrete sand
1mm

Separating gravel
6mm

Drainage gravel
12mm



1. Inlet Reservoir Zone - Where water is poured into the filter.

2. Standing Water Zone - This water keeps the sand wet while letting oxygen pass to the biolayer.

3. Biological Zone - Develops at the top 5-10 cm (2-4") of the sand surface. The filtration sand removes pathogens, suspended particles and other contaminants.

As in slow sand filters, a biological layer of microorganisms (also known as the biolayer or schmutzedecke) develops at the top 1-2 cm (0.4-0.8") of the sand surface.

4. Non-Biological Zone - Contains virtually no living microorganisms due to the lack of nutrients and oxygen.

5. Gravel Zone - Holds the sand in place and protects the outlet tube from clogging.