2019

Low-Cost Waste Management Solutions for Small-to-Medium Scale Pig Farms in China

Liu, Lixi

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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

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

2017
- Project proposed

2018
- DOW award
- Assessment trip

2019
- Library mini grant
- Solution proposal
- Survey white paper

2020
?
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
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
Gas capture and processing

- Compressed Steel Wool to remove hydrogen sulfide
- Floating Drum Storage
- Biogas
- Bubbling the gas through Water reduces the CO2
- Water
- Fire Trap
- To Biogas Burner
- Water

Outlet Pipe
Drains fluid from the middle of the tank
31 inch Inlet Pipe deposits new feed at the Bottom
Covered lagoon
Biosand filter

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.

Filtration sand
< 0.7mm

Concrete sand
1mm

Separating gravel
6mm

Drainage gravel
12mm