



# Utilization of food waste for agricultural applications in Guam

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**Practical Research and Education of Solid Waste Management  
Based on Partnership between Universities and Governments  
in Asia and Pacific Countries**



# Agriculture in Guam

A. Food Importation **90%+**

A. Farmers are the **Minority**

- Small scale farm
- Multi-crop production
- No large scale plantation





# Importation of Agricultural Supplies in Guam

Almost all of the following are imported.

- Fertilizers
- Seeds
- Potting mix (or soils)



# Problems of Food Waste Management in Guam

- ✓ No established system of food waste recycling (?)
- ✓ Food disposal - a part of culture (?)
- ✓ Limited land space for disposal on a small island



# Problems in food waste management in Guam

- **No rigid regulation** of food disposal management in Guam.
- Some pig farmers collect food waste from hotels and restaurants. But **no data are available**.



# Goals of our project

- Goal 1: Collect information on food waste disposal systems in Guam. *Year 1***
- Goal 2: Initiate collaborative research and educational activities in agriculture and food recycling between Okayama University and the University of Guam. *Year 1, 2 and 3***
- Goal 3: Construct a pilot food waste processing system to produce local animal feeds and composts in Guam. *Year 2 and 3***



## **Goal 1: Collect information on food waste disposal systems in Guam. *Year 1***

***Objective: Conduct a survey of food waste disposal systems in relation to agricultural application.***

- A. Survey potential food waste providers (hotels, restaurants, etc.) to find out how they dispose food waste.
  
- B. Survey pig farmers to find out who may be utilizing food waste generated from hotels, restaurants, etc.

***Method = by phone or by site visit***



## ***Survey A:*** **Potential Food Waste Providers**

***The number of respondents obtained =115***

- a) **Restaurants (46)**
- b) Hotels (19)
- c) Schools (17)
- d) Supermarkets and stores (17)
- e) Bakeries (10)
- f) Wholesalers (6)



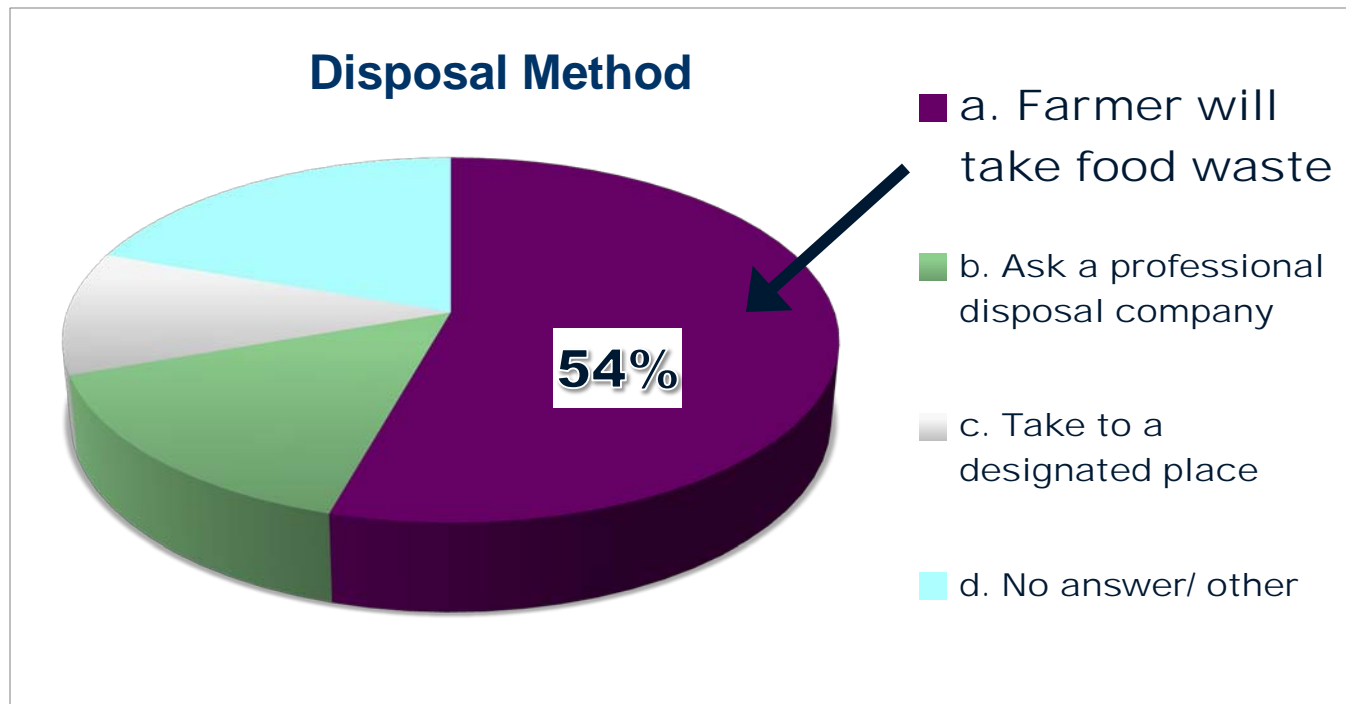


## Survey A:

More than 50% restaurants have pig farmers to take food waste

Restaurants (N=46)

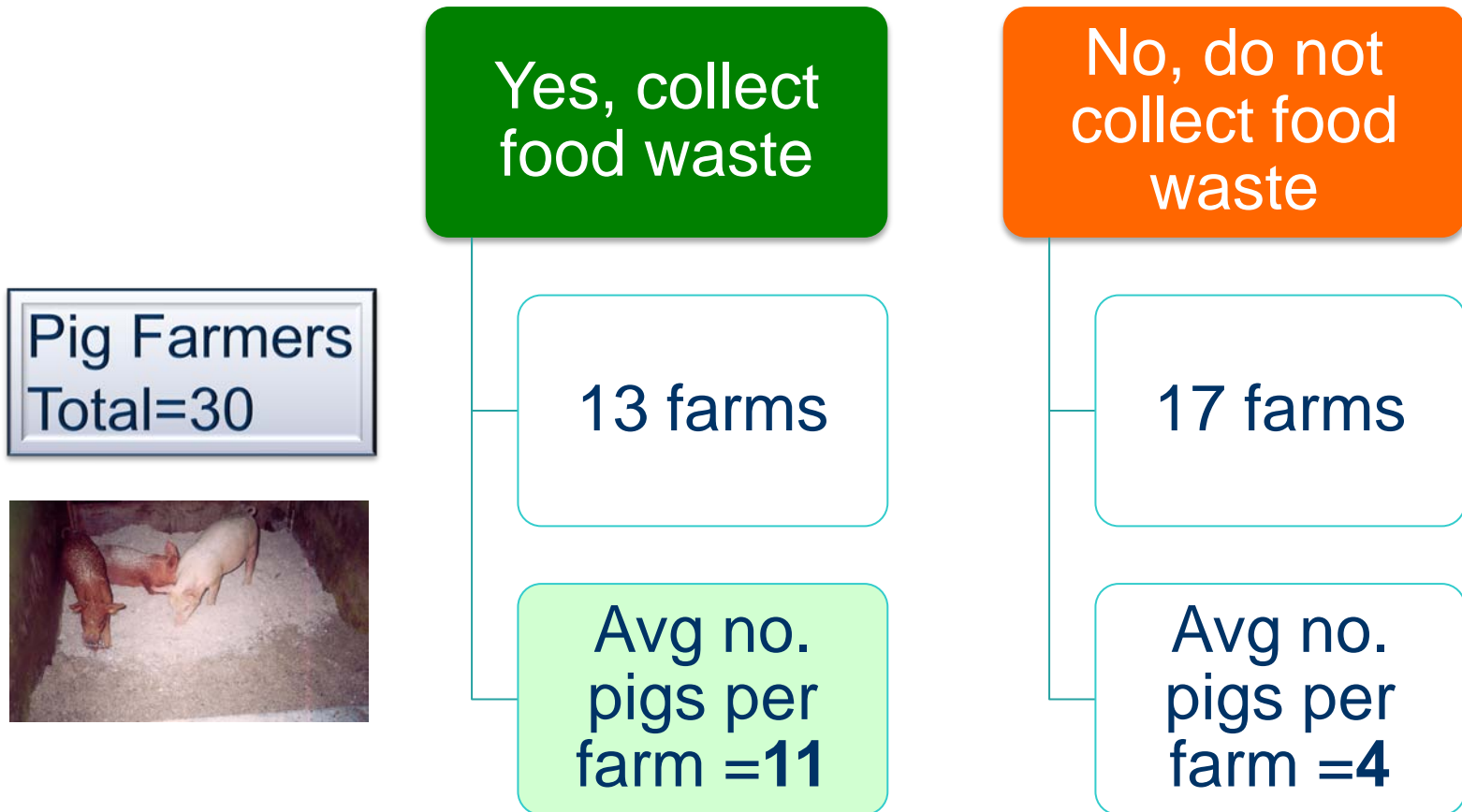
Estimated Total = 800 gal (3000 L)/day



## Survey B:



# Larger sized pig farmers collect food waste from hotels, restaurants, etc.



## Goal 2: Collaborative research and educational activities in agriculture and food recycling between Okayama University (OU) and the University of Guam (UOG).



### a. *OU Students –Interns at UOG:*

- *Assist surveying food waste use by pig farmers*
- *Work at UOG Triton Farm*
- *Work at Hamamoto Tropical Fruit World*





## **Goal 2: Collaborative research and educational activities in agriculture and food recycling between Okayama University (OU) and the University of Guam (UOG).**

- ***Guam representatives and OU faculty and student to visit food waste management system in Japan***
- **Production of animal feeds using food waste by fermentation methods (Niigata, Chiba, Mie, and Okayama)**
- **Production of compost using food waste (Mie, Osaka, Okayama)**
- **Recycling center (Mie and Okayama)**

# Making pig feeds using food waste in Niigata



# Making fish feeds using food waste in Mie



# Making **chicken feeds** using food waste in Okayama



# Making duck feeds using food waste in Chiba





# Making duck feeds using food waste in Okayama



# Todaya Hotel at Toba city, Mie

## Biodiesel Bus using Cooking Oil



# Toba City Recycle Park in Mie



# Food waste composting at Toba city Recycle Park in Mie

1



2



3



# Food waste composting at Toba city Recycle Park in Mie

4



5



6



# Daido Composing Operation in Mie



Large-scale system



# Everyone likes to smell and play with compost and animal feeds made from food waste with fermentation





**Goal 3: Construct a pilot food waste processing system to produce local *animal feeds* and **composts** in Guam**

**BIG challenge within a short time**



- 1. Focus on food recycling and composting in Guam**
- 2. Initiate genetic analysis of local inoculants for fermentation of food waste poultry feed production in Okayama**





## Collect waste cooking oils from households for bioenergy

### *Pilot Study at Dededo on February 4, 2012*

- ✓ **Event time: 4 hours**
- ✓ **No. of Participants: 126 people**
- ✓ **The amount of waste cooking oil collected: 234.25 gal (887L)**
- ✓ **Newspaper was the most effective way to send out the announcement of the event**
- ✓ **45% of people were the first time participant to this type of recycling program.**

# Compost system using food waste and local organic materials in Guam

## Objectives:

- ✓ Determine chemical characteristics of local materials which potentially become ingredients to make good compost. Chemical analysis at Okayama University (C/N ratio etc.)
- ✓ Examine combinations of local materials for composting.



## Materials studied for analysis in Guam

- |   |                          |
|---|--------------------------|
| 1. <i>Leucaena leucocephala</i> (tangan-tangan) | Leaves (most abundant)   |
| 2. <i>Plumeria obtusa</i> (plumeria)            | Leaves                   |
| 3. <i>Casuarina equisetifolia</i> (ironwood)    | Needles                  |
| 4. <i>Cocos nucifera</i> (coconut)              | Leaves                   |
| 5. <i>Moringa oleifera</i> (horseradish tree)   | Seeds/pods               |
| 6. <i>Jatropha curcas</i> (jatropha, tuba-tuba) | Exocarp                  |
| 7. <i>Calophyllum inophyllum</i> (Da'ok)        | Shells, leaves & exocarp |
| 8. <i>Crotalaria juncea</i> (sunn hemp)         | Pods, leaves & flowers   |
| 9. Spent grains after brewing beer              | Grains (FOOD WASTE)      |



# Making Compost

Woodchip



Chicken manure



Broad leaves



Mixing all materials





# Temperature (°C) of composts

|        | Compost A         | Compost B         | Compost C         |
|--------|-------------------|-------------------|-------------------|
| Day 1  | 31                | 30                | 45                |
| Day 2  | 40                | 33                | 57                |
| Day 3  | 42                | 35                | 64 (after mixing) |
| Day 4  | 39                | 38                | 44                |
| Day 5  | 40                | 48 (+rice bran)   | 58                |
| Day 6  | 58 (+rice bran)   | 50                | 58                |
| Day 7  | 55                | 39                | 59                |
| Day 8  | 46                | 38                | 64                |
| Day 9  | 40                | 41 (after mixing) | 65                |
| Day 10 | 47 (after mixing) | 42                | 59                |



# Compost C

|  |          |
|--|----------|
| Wood chips ( <i>Leucaena lecocephala</i> ) | 10 parts |
| Chicken manure (Partially compost)         | 2 parts  |
| Leaves (not specific)                      | 1 part   |
| Spent Grains from Beer making              | 1 part   |



## Materials collected for analysis in Guam:

### *Spent grains after brewing beer*





# Increasing size of Compost C



Mixing compost



Monitoring temperature



# Kitchen Food Waste for Compost

rice bran



Spent Grains (5 gal)  
Soil (0.5 gal)  
Leave (1 gal)

Making  
composting  
base



# Food waste for composting

Continue to add food waste to the original compost base  
Composts will be sampled for chemical analysis



# OUTCOME



- a) **Finding—Collection of hotel/restaurant food waste by pig farmers in Guam.**
- b) **Educational activities between OU and UOG.**
  - a) **OU Student interns at UOG**
  - b) **Tours to food waste management facility in Japan**
- c) **Collaborative research in agriculture and food recycling between OU and UOG.**
  - a) **Composting using food waste in Guam**
  - b) **Initiation of Genetic analysis of local inoculants for fermented animal feeds**



# FUTURE WORK

1. **Establish a system to process food waste from hotels and restaurants to produce animal feeds for farmers in Guam.**
  - a) Obtain **funding** to purchase food waste processing equipment to make animal feeds
  - b) Possibly place food waste processing equipment at hotels or restaurants or UOG Triton demonstration farm.
2. **Establish a food waste management system with a community (use Hashimoto method)**
3. **Promote composting and production of animal feeds using **fermentation method** in a farm.**

# FUTURE WORK (OTHERS)



- 1. Promote and establish a system to recycle waste cooking oils as biofuel in Guam.**
- 2. Continue collaborative work of University of Guam and Okayama University (and/or other academic institutions/industries/government agencies) in food waste management.**
- 3. Any suggestions and advice?**