Design of Toilet Hygiene System in Rural Areas of Developing Countries

A Case Study in The Eastern Coastal Area of China

INTRODUCTION

Why Design Sanitary Toilets?

1 The United Nations Sustainable Development Goal for 2015-2030

NO.6 aims to ensure that all people enjoy adequate and equitable hygiene.

2 New challenges

2-1 Aging Most rural residents are elderly and they have special needs for toilets.

2-2 Sewer Most rural areas do not have well-developed sewage systems, so they cannot deal with the Feces and Urine(F&U).

Introduction to Village D

Village D is a representative of rural area on the east coast of China. This village underwent the toilet revolution three years ago. It has the following characteristics:

Natural Conditions

The climate has four distinct seasons and is rainy, with 120 rainy days throughout the year.

Economics

The annual income of residents is about ¥20,000(£2,388), and the main industry is efficient agriculture

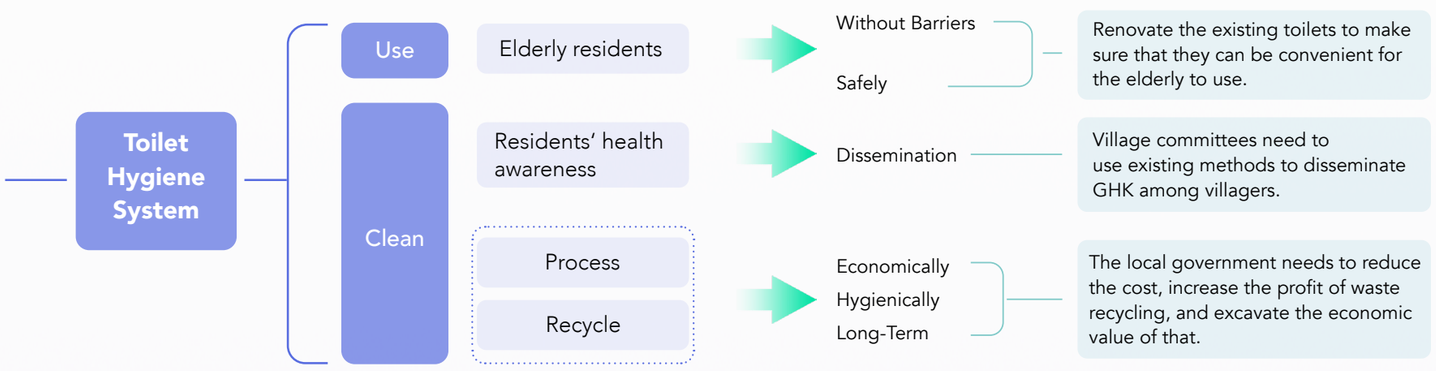
Population

70% of the permanent residents are over 60 years old.

Project Objective

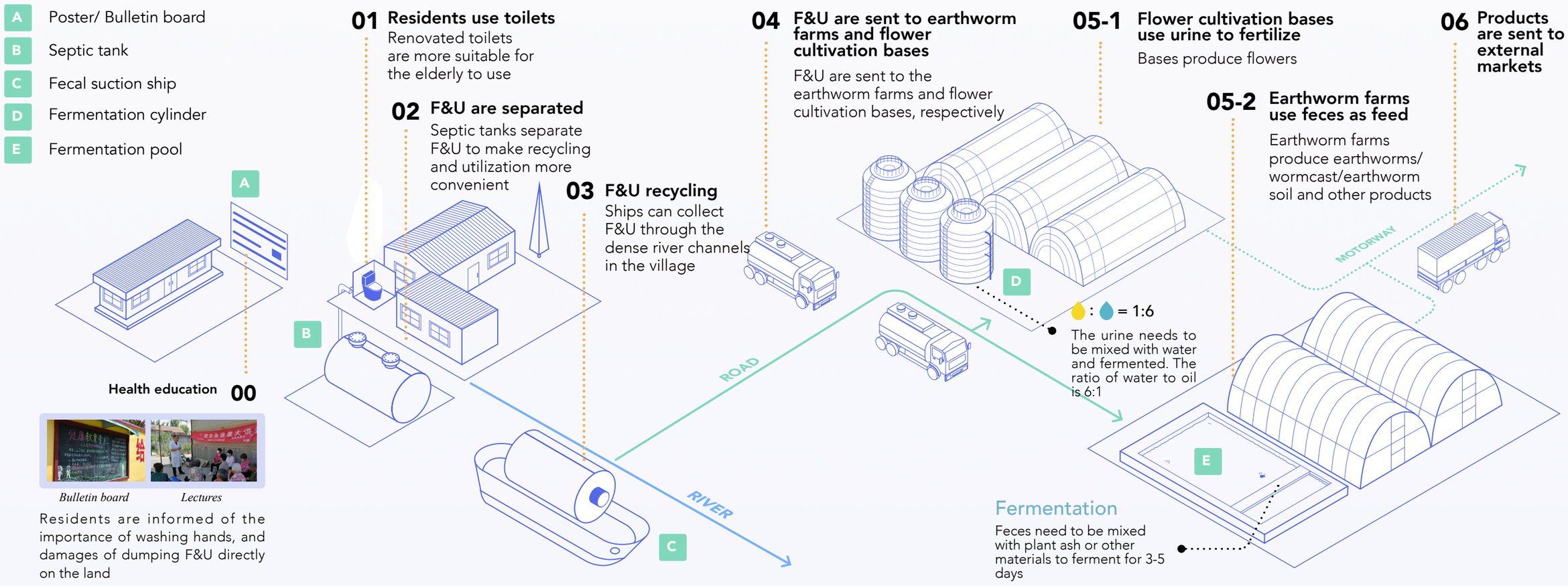
How might we help rural residents in Village D have easy access to sanitary toilets, and improve F&U recycling methods?

This design is a solution that can be **implemented in the next few years** and provide local residents with healthy and sanitary toilets that will last until 2030.



DESIGN

SYSTEM WORKFLOW

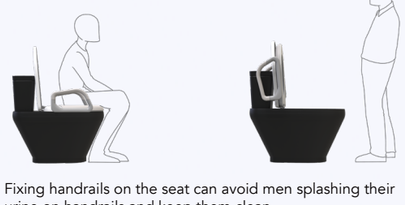


01- TOILET DESIGN

A *Extra Height*

To make it easier for the elderly to sit up, the height of the toilet is increased to 420mm.

B *When Male Uses* *When Female Uses*



Fixing handrails on the seat can avoid men splashing their urine on handrails and keep them clean.

C *Rotating Handrails*

Cost: ¥50 (£6)

Handrails can help old people stand up.

D *Materials*

Toilets are mostly semi-enclosed and significantly affected by climate, especially in winter, when the average temperature is -1°C (30.2 °F).

Polypropylene

cost: ¥100 (£12) *cost: ¥80 (£9.6)*

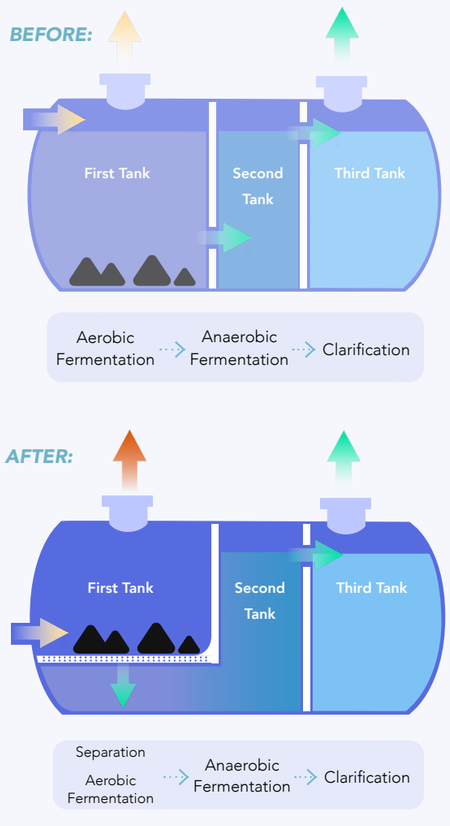
Costs are estimated based on similar products on the market

To protect the water in the toilet from freezing in winter, **a black polypropylene shell** is added to it.

The white polypropylene makes the toilet suitable for sit in the winter

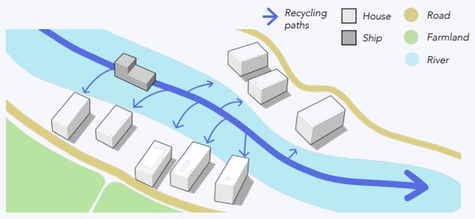
02- SEPTIC TANK DESIGN

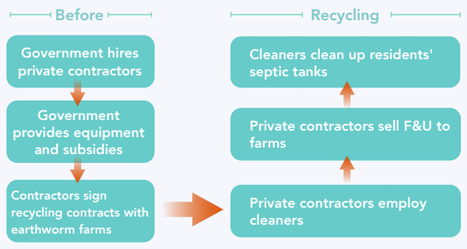
In order to achieve efficient recovery of F&U, the septic tank separates solid and liquid wastes through a new structure:



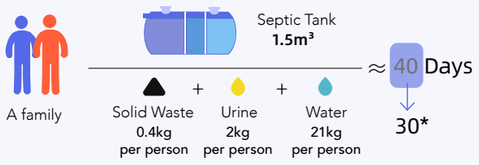
03- PATTERN DESIGN: RECYCLING

The recycling of F&U needs to consider the village environment. **Roads in village D are narrow** and cannot let fecal suction trucks run on them. However, t**he rivers in village D are very dense and wide**. Besides, the residential houses are basically built near the river. Therefore, I plan to use ships to recycle F&U.





F&U RECOVERY CYCLE:



**In order to avoid too close to the maximum volume of tanks*

04-06- MODEL DESIGN: UTILIZATION

Improving economic benefits can help the development of the F&U recycling pattern. So I studied some methods.

Method 1 Fruit Trees

Process: F&U —Fertilization→ Fruit trees —Fruit→ Sell

Method 2 Constructed Wetlands

Process: Urine + Water —Fertilization→ Plants → Sell

PROBLEM: Fruit trees and plants **do not grow in the winter**, so fertilizers are not needed in the winter, which hurts F&U recovery.

Final Method Cultivation of Earthworms & Flowers

Process: F&U —Separation→ Earthworms Feed / Flower Fertilizer → Sell

FEASIBILITY

- Since cultivation of earthworms and flowers are carried out in greenhouses and are **not affected by temperature**, this pattern can be operated all year round.
- Earthworm farming needs to change the soil every 10-15 days, and flowers need to be fertilized every 7-10 days. So this pattern can **digest the F&U of the residents very well**.

PROSPECT

- With the **development of fishing and bird & flower markets**, earthworm farming has a good prospect in the coming years.
- In recent years, the local government has been vigorously developing flower industry, and **there are 14 flower cultivation bases in the region**.

Flower market

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