

# 生態廁所



BIO-TOILET  
FOR GIRLS

LOVE BINTI

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王福裕@大王里山生活學校

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THE LIGHT  
MUKONO

## An Educational Manual on the Bio-Toilet

一本關於生態廁所的教育手冊

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# INTRODUCTION OF THE BIO-TOILET

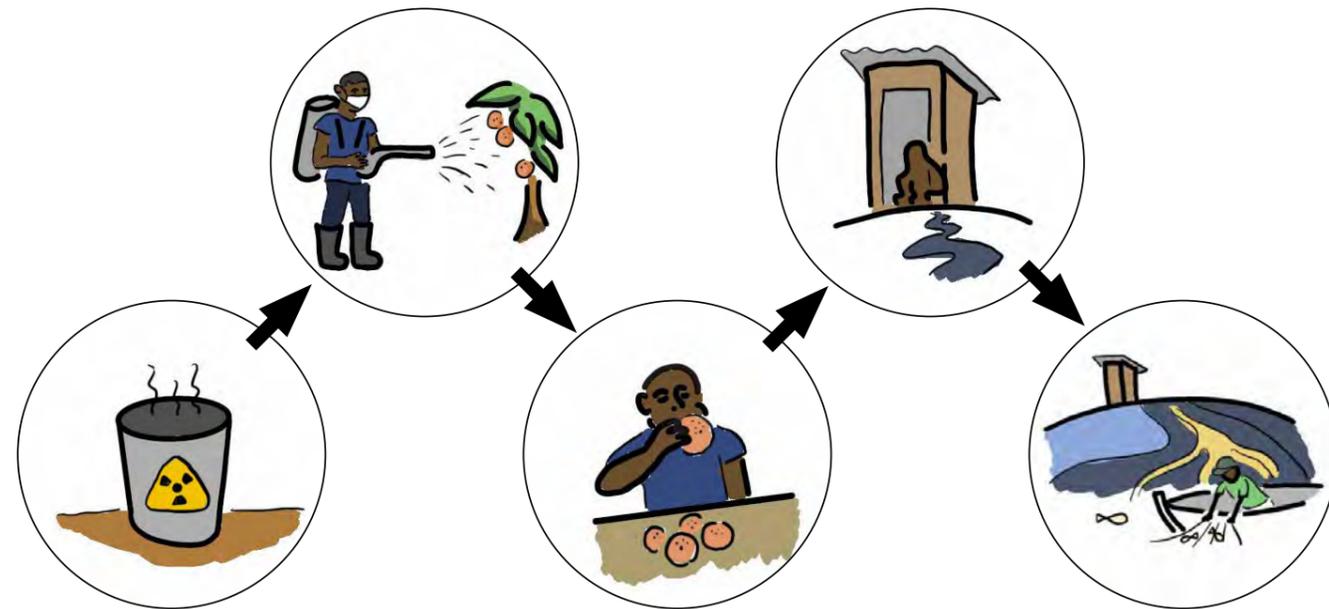
## 生態廁所介紹

### Why ?

There is no real sewerage system for villagers who live in the rural places of Uganda, Africa, which can be an issue when you want to build a sustainable toilet. So, the way to normally build toilet in these areas is basically to dig of 6 meter deep hole. Then when this hole has been filled with the human waste, the villagers will then push down the whole toilet, and build new one toilet another place. This way of digging a toilet is often the reason for diseases to spread easily and it is one of the biggest challenges that people are facing everyday in the rural areas.

### 為什麼要用生態廁所？

在非洲烏干達的偏鄉，由於沒有完善的汙水處理設備，蓋廁所的方式往往是建立在往下挖約 6 公尺深的大洞上，一旦此坑被排泄物填滿後，將會把廁所推倒，在另闢新地建廁所，這種蓋廁所的方式非常容易造成疾病的產生及傳染，常常為偏鄉所面臨到的困境之一



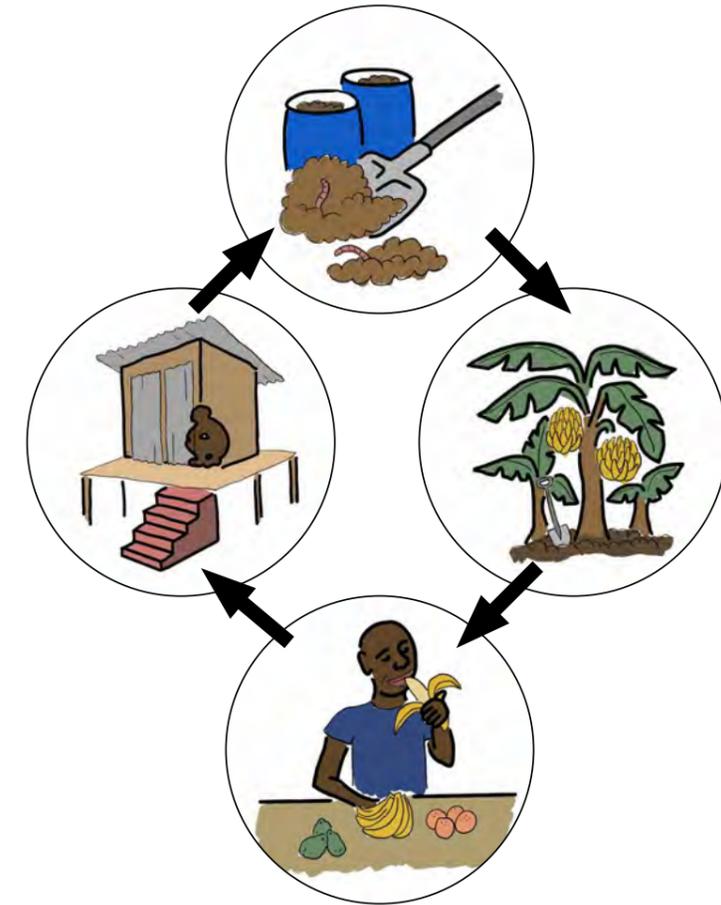
**A broken human nutrient circle**  
不良的食物循環:

### What is the bio-toilet ?

The bio-toilet is a type of toilet that treat the human waste through a biological process called composting. This process leads to the decomposition the organic matter and turns the human waste into compost-like material. The result can be applied to our farms as natural fertilizer, and the bio-toilet doesn't have to rebuild can be used longer than the traditional toilet.

### 什麼是生態廁所？

生態廁所是指能夠透過設計將尿液和糞便有效的分離，搭配木屑或腐植土與糞便的混合，經過微生物固態發酵原理將糞便轉換成能夠回歸到土壤的肥料，此生態廁所也不會有使用年限上的困擾



**A closed human nutrient circle**  
良好的食物循環:

### The advantages of the Bio-Toilet

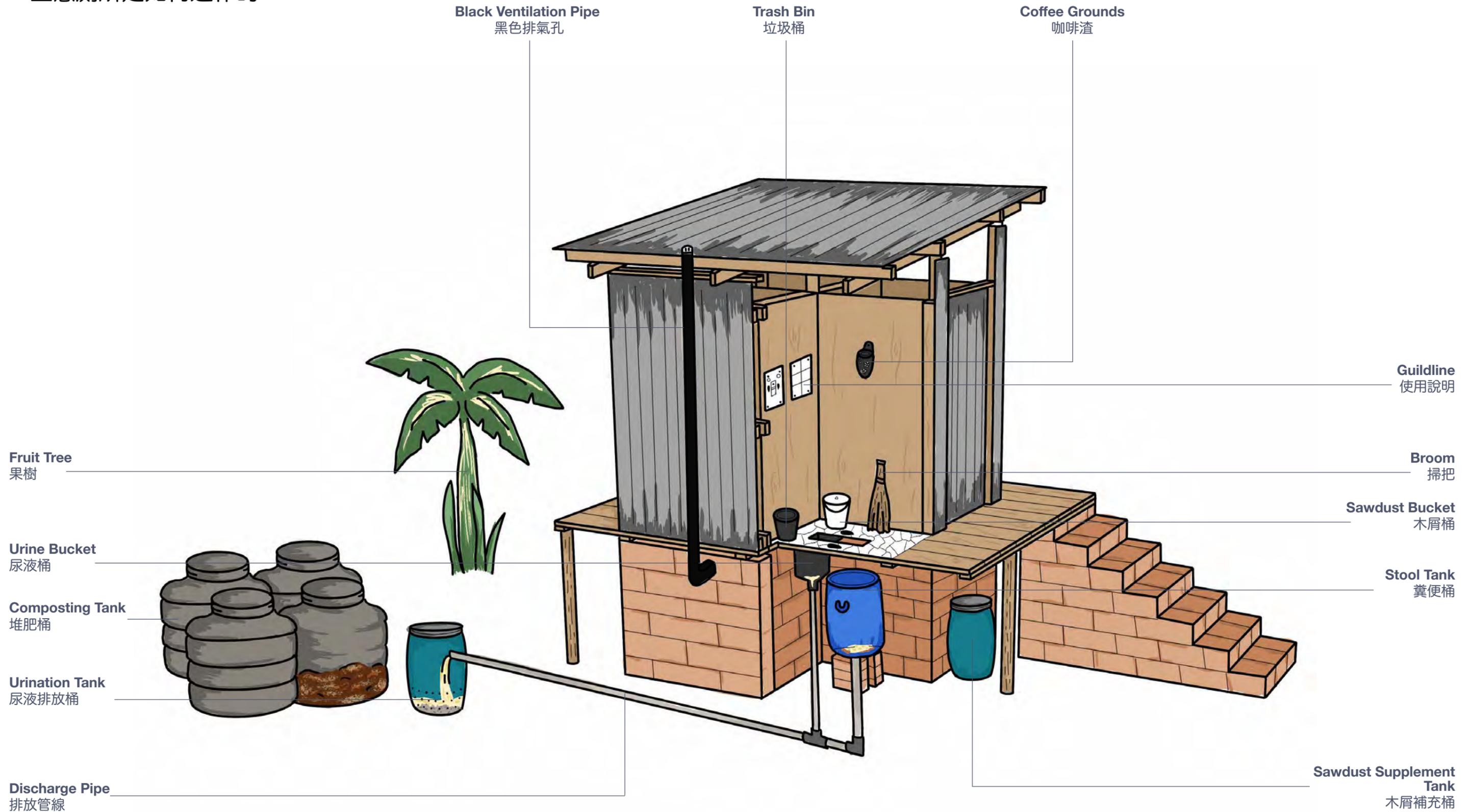
1. The bio-toilet dose not need to be flushed with water after using.
2. The bio-tioilet will not cause bad smell.
3. After the composting process, the human waster can be applied as fertilizer.
4. The bio-tioilet is easy to be maintained.

### 生態廁所的好處

1. 不需要沖水
2. 不容易有異味產生
3. 堆肥後，可成為能夠使用的肥料
4. 維護容易

# HOW THE BIO-TOILET WORK

生態廁所是如何運作的



# DESIGN HIGHLIGHTS

## 生態廁所設計重點

### Sustainable Design

Incorporating circularity model, reducing the environmental impact and prolong life cycle

#### 1. Locally Sourced

- Cooking Ashes & Sawdust can be easily collected from households

#### 2. Recycled material

- Plastic Bottles
- Gallon Water Bottles

#### 3. Clean Energy

- Solar Powered
- Water reduction

#### 4. Modularity & Easy Repairability

- All parts are visible and easily replaced

### 永續設計

以達成生態循環為目標，利用最少的新材料與能源，減少廢棄所產生的環境影響，同時提升建築的模組化，易於修理及延展生命週期

#### 1. 就地取材

- 儘可能利用當地環境因子特色，例如泥土，牛糞

#### 2. 資源回收再利用

- 許多零件是使用廢棄的水瓶
- 廢棄火灰與木屑作為覆蓋物

#### 3. 乾淨能源

- 太陽能發電
- 減少水資源的使用

#### 4. 拆解重組

- 建材像樂高積木一樣可以輕易拆解、重組，因應不同需求重複利用



### Focus on Health & Sanitation

Priority remains with the improvement of sanitation conditions, thus below are included to prevent bad odor, controlling of vector-borne disease, and poor environment

#### 1. Proper Ventilation

#### 2. Covering material

#### 3. Proper Waste Management

### User Friendly

Think about the background of the users, little details could improve the convenience and the ease of use

#### 1. Painted Footprint on the floor helps guide direction

#### 2. Coffee Ground as odor eliminator

#### 3. Guiding poster helps people to use bio-toilet correctly

### Community Participatory

Allowing joint creation of the bio-toilet will allow greater sense of ownership, beneficial for maintenance and management

#### 1. Painting and drawing

### 健康與衛生

以達成生態循環為目標，利用最少的新材料與能源，減少廢棄所產生的環境影響，同時提升建築的模組化，易於修理及延展生命週期

#### 1. 通風管設計

#### 2. 排泄物掩蓋中和物

#### 3. 廢棄物管理

### 人性化設計

以使用者為出發點，考量建築所在地的人文特質，加以提升舒適度與便利性

#### 1. 地上腳印引導使用

#### 2. 咖啡渣當作除臭劑

#### 3. 指引海報輔助設計

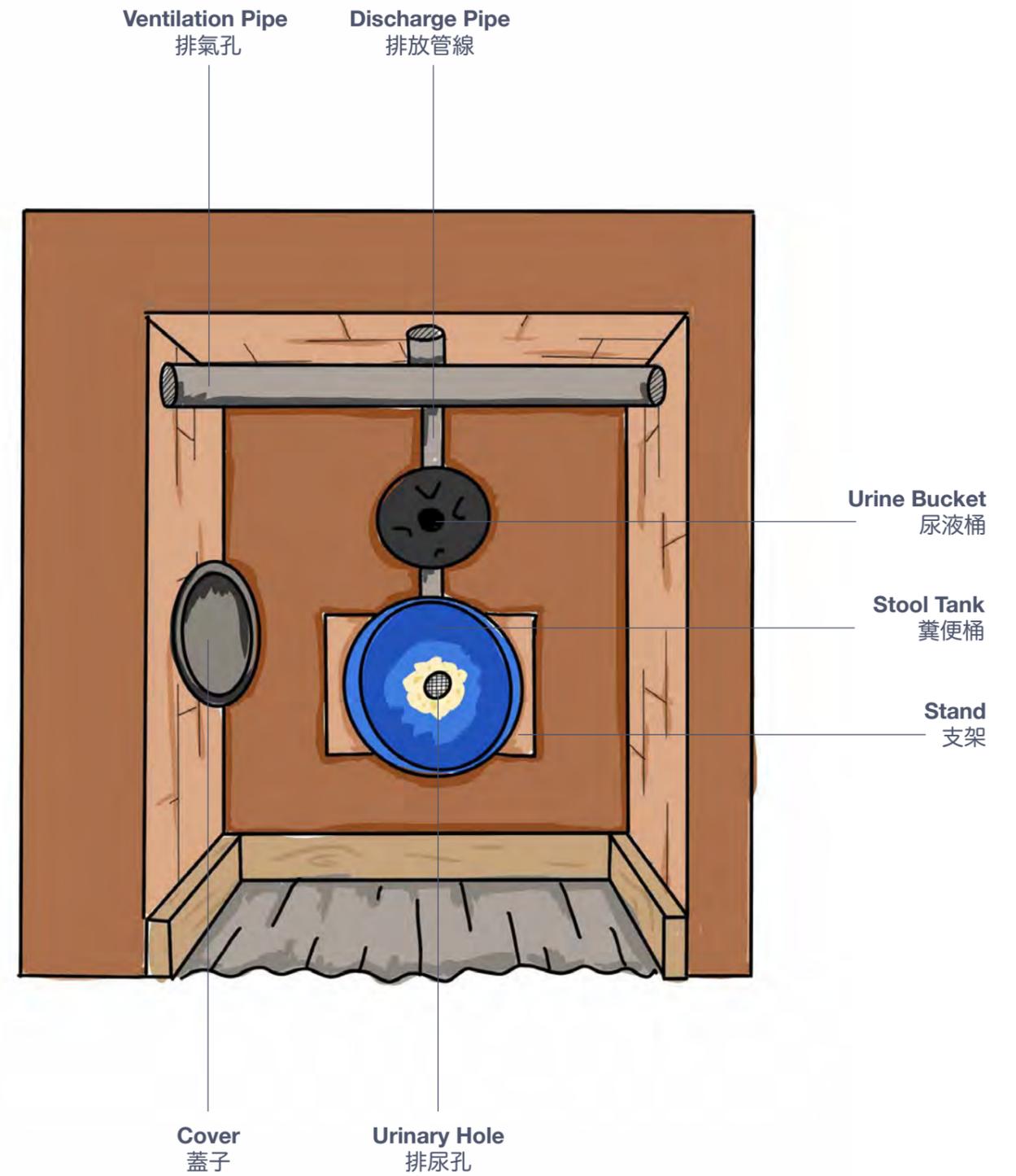
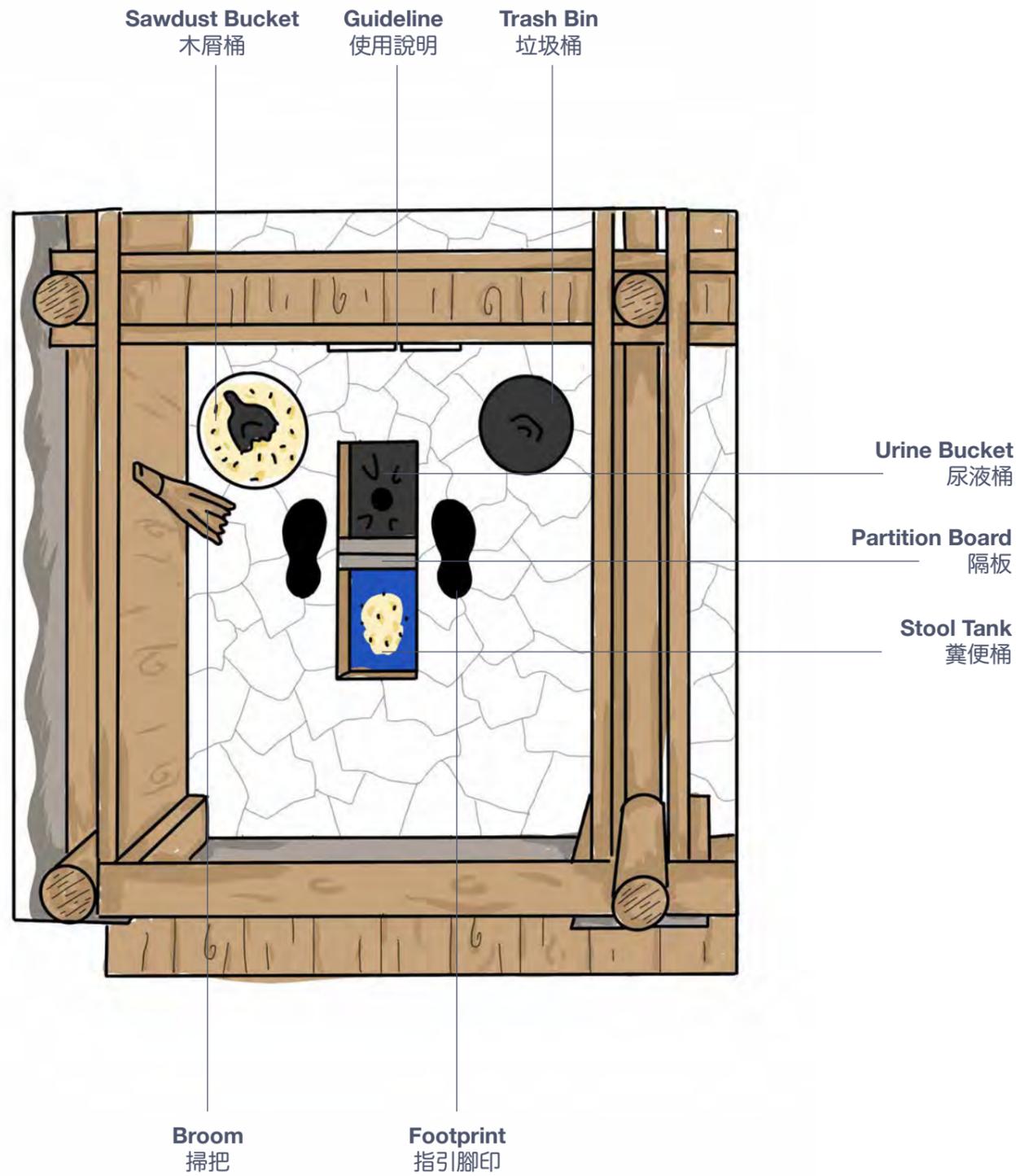
### 參與式設計

透過使用者的共同參與，增加對建物的認同、與擁有感，加強後續維護管理機制的運作

#### 1. 居民可以參與彩繪及油漆

# DETAILS OF THE BIO-TOILET

## 生態廁所設計細節



# INTRODUCTION OF THE COMPOSTING SYSTEM

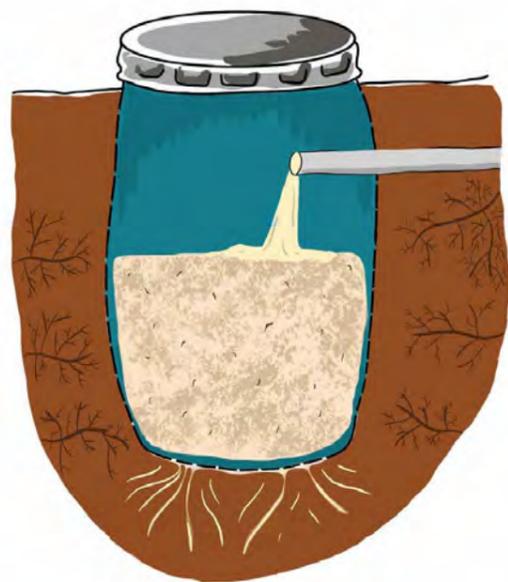
## 堆肥系統介紹

### How to deal with urine:

#### 如何處理尿液:

The urine from the urine bucket will flow to the urination tank, through the infiltration process, the urine will be back to the nature from soil. The urine could provide some nutritions to crops, but need to have more than 1 meter distance.

尿液會順著尿液桶沿著管線流入至廁所外的尿液收集桶，藉由滲透效應回歸到自然，此尿液可以幫助農作物生長，但離收集桶一公尺以上



### How does the composting tank work:

#### 堆肥桶是如何運作的:

The human waste will be collected to the stool tank and be mixed with sawdust and humus. The mixed excreta will be poured to the composting tank, and wait for 24 months for composting process. The human waste will turn to be the fertilizer which can be used in the farm.

將排泄物排至管道間下的收集桶，混合木屑或腐植土，待滿了之後倒入堆肥桶，利用微生物固態發酵原理，將堆滿後的堆肥桶靜置24個月後，將可成為可以回歸自然的肥料



#### Step 1

Read the guide posters carefully, and follow the footprint to use the facility.

#### 步驟一

閱讀牆面上的使用說明，順著索引腳印使用此設備



#### Step 2

After use the stool tank, the excreta should be covered by sawdust.

#### 步驟二

使用完糞便桶後，用木屑桶裡的木屑覆蓋住糞便

#### Step 3

Remember to wear rainboots and gloves before to move out the stool tank.

#### 步驟三

在拿出糞便桶前，穿上手套和雨鞋，並將糞便桶用蓋子蓋上再拿出



#### Step 4

After move out the stool tank, use the tools to load the mixed excreta to composting tank.

#### 步驟四

移出糞便桶後，使用工具將與木屑混合後的糞便移入至堆肥桶



#### Step 5

After 24 months, the mixed human waste can be applied to the farm as fertilizer.

#### 步驟五

靜置 24 個月後，即可將堆肥桶內的物料當作肥料使用在農作物上



# MATERIAL LIST FOR THE BIO-TOILET

## 生態廁所的材料清單

### Material list 材料清單

#### Item 物品

1. 10cm x 6m wooden pillar / 半徑 10 公分木頭圓柱, 6 公尺
2. 2 by 4 inches timber, 3m / 2x4 英寸木條, 3 公尺
3. 2 by 3 inches timber, 3m / 2x3 英寸木條, 3 公尺
4. 2 by 6 inches timber, 3m / 2x6 英寸木條, 3 公尺
5. Cement, 50kg / 50 公斤水泥
6. Dump roofing course / 防水布
7. Sand / 沙
8. Ventilation pipe / 通風管
9. Connector for pipe / 通風管配件
10. Plywood 3mm, 4 by 8 feet / 3 毫米合板, 4x8 英尺
11. 3m x 90cm Iron sheet / 3 公尺 x 90 公分鐵片
12. Brick / 磚
13. Tile / 磁磚
14. Trash Can / 垃圾桶
15. Bucket for sawdust / 木屑桶
16. 500 Liter Water Tank / 500 公升水桶
17. 63mm PVC PIPE PN.10 / 63 毫米 PVC 管
18. 63mm PVC TEE PN.10 / 63 毫米 PVC T 配件
19. 63mm PVC 90 D. ELBOW PN.10 / 63 毫米 PVC L 配件
20. 135 Liter Bucket / 135 公升水桶
21. Broom / 掃把
22. Plastic bucket / 塑膠桶
23. Fine net, 30cm x 30cm / 30 公分 x 30 公分網子
24. 0.5cm Gravel / 0.5 公分碎石
25. 25mm connector / 25 毫米轉接頭
26. 25mm PVC male adapter / 25 毫米 PVC 轉接頭

#### Tools 工具

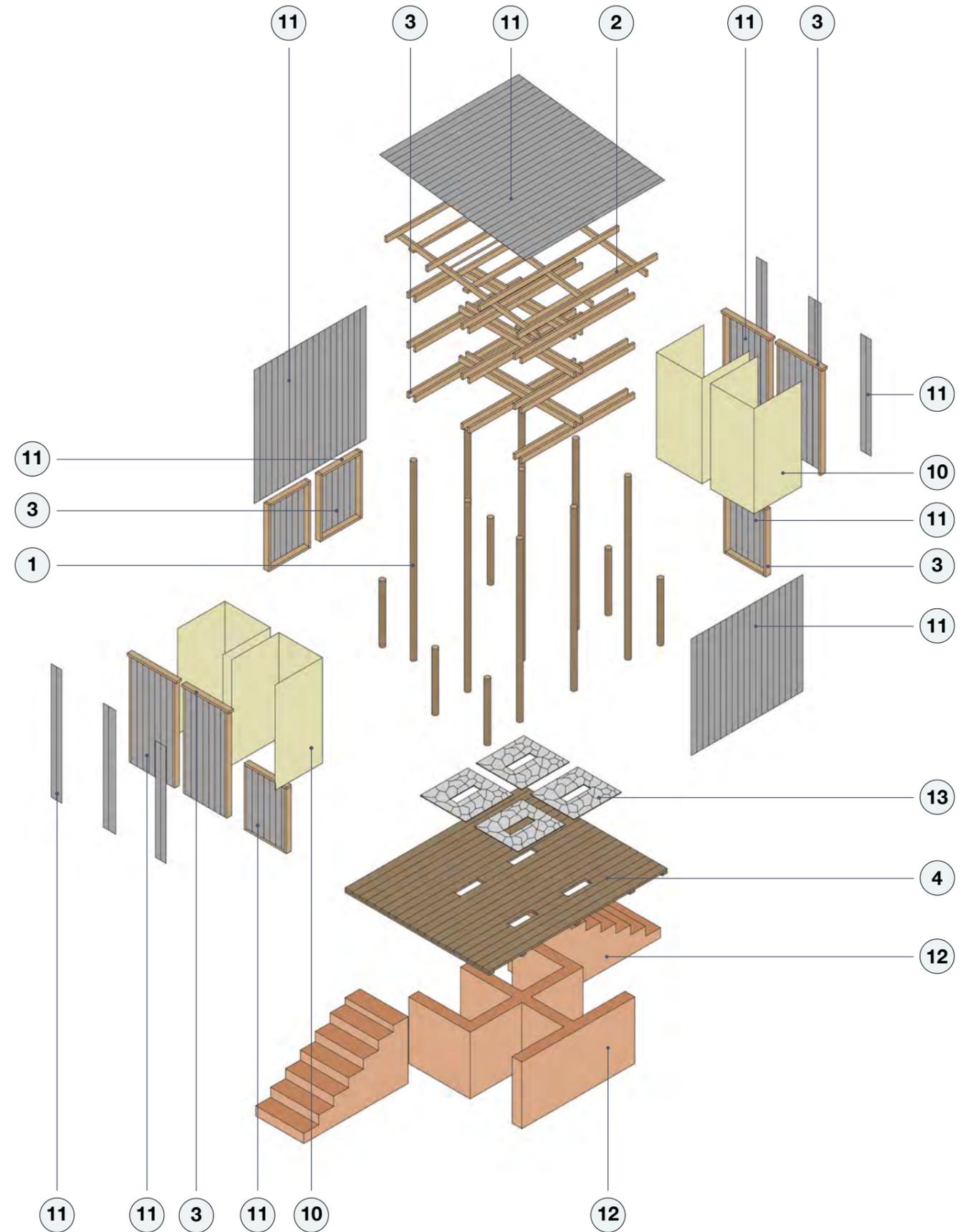
- Roofing nail / 屋頂鐵釘
- Used engine oil / 廢棄機油
- 8cm nail / 8 公分鐵釘
- Hinch / 門框鐵片
- Measurement Tape / 捲尺
- Shovel / 鏟子
- Hoe / 鋤頭
- Bowsaw / 鋸子 (木頭)

- Brush / 刷子
- Trowel / 抹刀
- PVC Pipe Glue / PVC 管黏著劑
- Hacksaw / 鋸子 (PVC 管)
- Thread Seal / PVC 管防水膠帶
- Drilling Machine / 電鑽
- Scissor / 剪刀
- Pipe Wrench / 板手

#### Quantity 數量

- 9 Pieces / 9 根
- 20 Pieces / 20 根
- 20 Pieces / 20 根
- 45 Pieces / 45 根
- 12 Bags / 12 包
- 6 Meters / 6 公尺
- 1.2m<sup>3</sup> / 1.2 立方公尺
- 12 米 / 12 公尺
- 4 Pieces / 4 個
- 12 Pieces / 12 片
- 16 Pieces / 16 片
- 5.2m<sup>3</sup> / 5.2 立方公尺
- 4m<sup>2</sup> / 4 平方公尺
- 4 Pieces / 4 個
- 4 Pieces / 4 個
- 4 Pieces / 4 個
- 12 米 / 12 公尺
- 6 Pieces / 6 個
- 8 Pieces / 4 個
- 4 Pieces / 8 個
- 4 Pieces / 4 個
- 4 Pieces / 4 個
- 1 Pieces / 1 個
- 0.1m<sup>3</sup> / 0.1 立方公尺
- 4 Pieces / 4 個
- 4 Pieces / 4 個

- Silicone / 矽利康
- Ladder / 梯子
- Waterproof Tape / 防水膠帶
- Hammer / 鐵鎚
- Level measurement / 水平尺
- 90 degree ruler / 90 度尺
- String / 細繩
- Trowel / 鏟刀





# 建造過程

## BUILDING PROCESS

### 1) Laying off the foundation

### 1) 放樣基礎



**1. Follow the dimensions on the drawing** and loft the foudation on the ground. **2. Make sure every corners are 90 degrees.** **3. Dig down to 100 CM form the ground** to let the wooden pillars can stand

**1. 放樣基礎**，按照圖面上的尺寸，標記在基地上 **2. 確認各處的轉折處必須是直角** **3. 下挖50公分的落柱孔**，為了能夠讓木頭柱子能穩固的站立，必須確保往下埋入的深度是足夠的

### 2) Pre-work

### 2) 前置作業



**1. Cut the wooden pillars to precise lenth.** **2. Paint the wooden pillars for 100 CM from bottom** with used fuel oil. **3. After painting, use the waterproof fabric** to cover the wooden pillars for 100 CM from bottom.

**1. 將圓形木柱裁切至預定的高度** **2. 圓形木柱的底端至100公分處，用廢棄機油上色** **3. 上色後再用防水布包覆**，以保護及延長木頭的使用年限

### 3) Fixing the foundation with concrete

### 3) 將混凝土倒入洞口內



1. Put the wooden pillars to the holes. 2. Mix concrete and put it into the holes. Then, use trowel to flatten the surface of the concrete. 3. Make sure every pillars are vertical to the ground.

1. 將圓形木柱放入置已挖好洞口內 2. 將水泥、石頭、沙、水，攪拌成混凝土後，倒入至洞口內 3. 需確認每根木柱是否垂直於地面

### 4) Installing the ground beam system

### 4) 鋪設地梁系統



1. Make the 50 CM height of ground beams around the wooden pillars 2. Fill in the spaces between beams with soil. 3. Put the waterproof fabric on the top of ground beams.

1. 在圓形木柱周圍用磚塊鋪設高50公分的地樑 2. 完成地樑後，在地樑內填土及壓實 3. 在地樑上鋪設防水布

### 5) Installing the roof beams and roof

### 5) 架設屋頂樑與屋頂



1. Cut the wooden pillars with right slope for roofing. 2. Put the roof beams on the wooden pillars. 3. Installing the iron sheet on the beams as roof.

1. 確認好需要的屋頂斜度後，將圓形木柱裁切 2. 在圓形木柱上架設屋頂樑系統 3. 安裝屋頂浪板至樑上，確認好浪板確實釘在樑上

### 6) Installing and making doors

### 6) 製作與安裝門



1. Measure the size of openings, then, cut the timbers in the precise length. 2. Install the iron sheet on the wooden frame. 3. Install the door to the structure.

1. 良好開口尺寸，裁切好需要的門框木料 2. 在門上安裝浪板 3. 將門鎖固至門框上 4. 再將整組安裝置結構上

## 7) Installing the wooden floor

## 7) 架設地板



1. Follow the drawings and cut the timber to the precise length. 2. Cut the piece of from the timber to fit to the wooden pillars. 3. Installing the wooden floor and leave the empty spaces for toilet.

1. 將木頭裁切至需要的長度 2. 在與圓形木柱接口處切下卡槽 3. 依順序安裝地板 4. 記得須預留馬桶的開口

## 8) Installing the supporting wooden pillars

## 8) 架設圓形木柱至地板前端



1. Install the wooden pillars to the front part of the floor. 2. Cut the unnecessary roof beams. 3. Install the support of the walls.

1. 架設圓形木柱至地板前端，以提供地板的支撐 2. 將過長的木樑給切除 3. 架設安裝牆面的結構

## 9) Installing the iron sheet on the walls

## 9) 架設浪板牆面及廁所門



1. Remove some of the sand from the Filter Tank if necessary. Too much sand in the Filter Tank can reduce the speed/pressure of the water going through to the Clean Water Tank. 2. Make sure the cover of the Filter Tank is tight enough. It can be the main reason for the pressure leaking which is pushing the water to go on to the Clean Water Tank.

1. 鋪設3毫米的木合板在廁所內部 2. 鋪設鐵浪板在廁所牆體外側 3. 安裝廁所門

## 10) Use the bricks to build staircase

## 10) 用磚砌樓梯



1. Use cement, stones, sand and water to mix to concrete. 2. Use bricks and concrete to build the staircase up to wooden floor. 3. Make sure it is flat in every steps.

1. 將水泥、石頭、沙、水，攪拌成混凝土 2. 用磚頭砌成樓梯至可達木地板的高度 3. 需確認整體的平整度以及是否適合行走

## 11) Installing the fourth part of the Rainwater Filter System

## 11) 鋪設磁磚至廁所內



1. Paint the wooden floor with old fuel oil. 2. Use concrete to fix the tiles on the wooden floor. 3. Make the partition of wood and iron sheet. 4. Use the plastic bucket to make urine bucket.

1. 用廢棄機油上色至木地板，延長使用年限 2. 在廁所內部鋪設磁磚 3. 製作尿液與糞便的隔板 4. 製作收集尿液的收集桶

## 12) Installing the urine bucket and stool tank

## 12) 架設尿液桶與糞便收集桶



1. Install the partition board under the hole. 2. Install the urine bucket in the pipe room. 3. Fix the accessory with net on the bottom of the stool tank. 4. Connect the pvc pipes to urine bucket and stool tank. 5. Use brick to make the stand. 6. Place the stool tank on the stand.

1. 安裝隔板至洞口下方 2. 安裝尿液桶至管道間 3. 在糞便收集桶下方安裝可將尿液分離的配件，需加上細網阻擋木屑 4. 安裝PVC管至管道間 5. 用磚頭架設收集桶的支架 6. 放置收集桶

## 13) Connecting the pvc pipe to the urination tank

## 13) 連接PVC管至外部集尿桶



1. Dig the pathway for pipes. 2. Put the pipes in the pathway and connect to all pipes from pipe rooms. 3. Drill the holes to the bottom and side of urination tank. 4. Fill the tank with sawdust to the half of the tank. 5. Dig the hole for placing composting tanks.

1. 開挖預設管線的路徑 2. 安裝PVC至路徑內部 3. 放置外部及尿桶及在四周和底部挖洞 4. 在外部集尿桶內填充木屑，尿液會跟木屑在一起，並被微生物分解 5. 開挖放置堆肥桶的洞

## Commissioning to the community

## 交接給社區使用



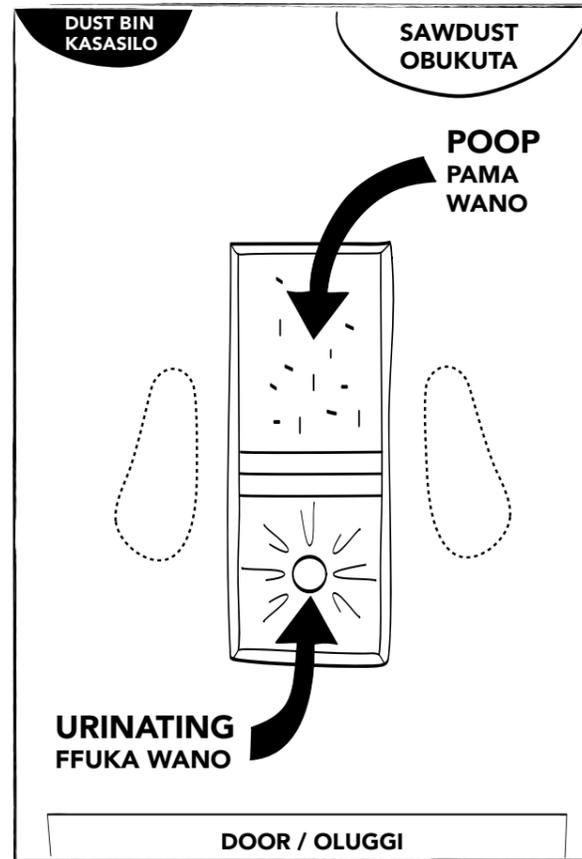
1. Drill the holes on the bottom and side of the composting tanks. 2. Fill the hole with soil. 3. When the one of the composting tank is full, switch to next one, and wait for 24 months. 4. Explain every details to the community. 5. Commission to the community.

1. 在堆肥桶四周及底部開洞 2. 將土回填 3. 4個堆肥桶互相交替著使用 4. 解釋如何使用生態廁所 5. 交接給社區使用

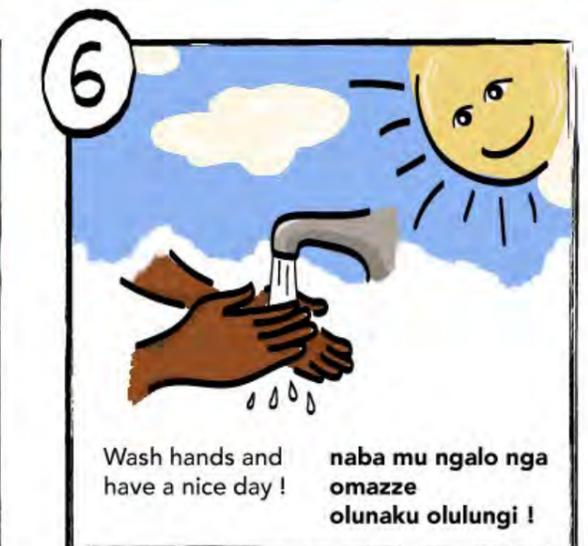
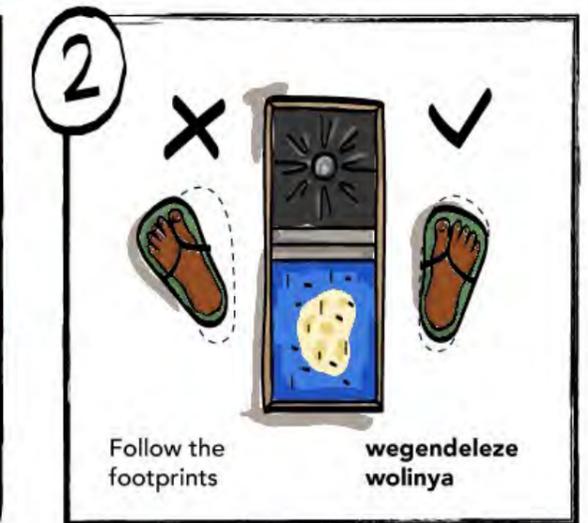
# HOW TO USE THE BIO-TOILET

## 如何使用生態廁所

1. Before use the facility, make sure there is sawdust in the bucket, if not, refill it from the sawdust tank.
2. Check the position of urine bucket and stool tank. (Follow the footprint)
3. Do not throw any trash to the bucket or tank, place the trash to trash bin.
4. After use the facility, use sawdust to cover excreta.
5. Sweep the sawdust which remain on the floor to the stool tank.
6. Clean the hands with soap after using.



1. 確認木屑桶內有木屑可使用，若沒有請至木地板下的木屑收集桶填滿
2. 確認糞便收集桶和尿液收集桶的位置 (跟著腳印使用)
3. 將使用後的垃圾放置垃圾桶，請勿丟進排泄桶內
4. 使用完糞便桶後，請用木屑覆蓋住排泄物
5. 將地板上多餘的木屑掃入至糞便桶
6. 離開後將雙手清洗乾淨

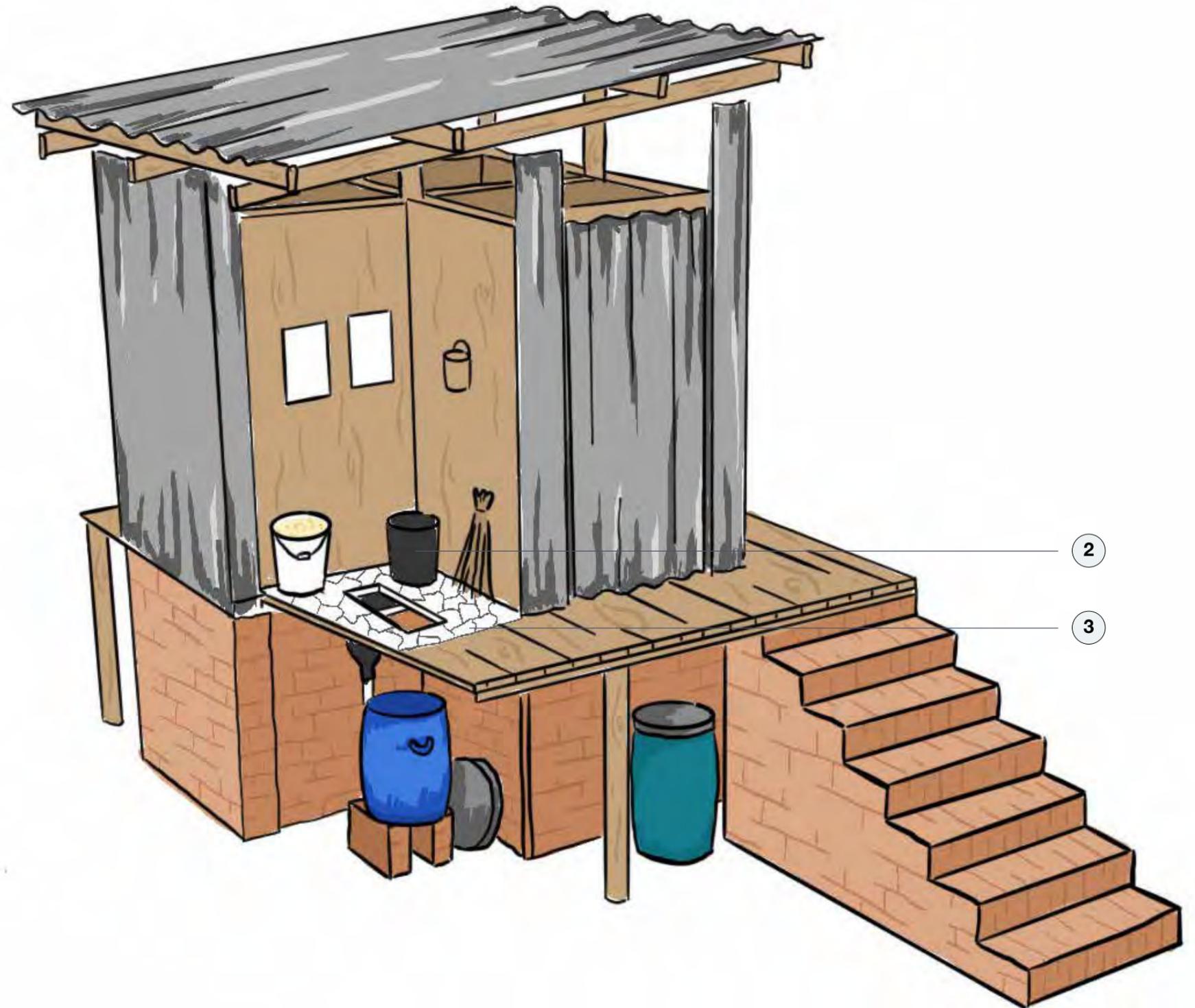


# HOW TO MAINTAIN THE BIO-TOILET

## 如何維護生態廁所

1. Check there is sawdust in the sawdust bucket.
2. Clean the trash bin when it is full.
3. Make the floor dry and clean, wash the floor every week.
4. Use clean water to flush the urine bucket every two weeks.
5. Check the stool bucket need to be emptied or not.
6. Make the pipe room clean and dry.
7. If the composting tank is full, lock the tank and wait for 24 months to empty it.

1. 隨時確認木屑桶內有木屑
2. 清空垃圾桶當滿的時候
3. 地面保持清潔，一段時間需清洗地面
4. 用清水清洗尿液桶，確認無異物堵塞
5. 確認糞便收集桶是否滿至該到入堆肥桶
6. 管道間保持清潔
7. 確認堆肥桶是否已滿，如果堆肥桶已滿需改使用其他桶，此桶需封閉靜置24個月



# TO KEEP IN MIND

## 注意事項

1. When there is bad smell in the bio-toilet, check there are any places be blocked or not. (Urine bucket, stool tank, ventilation pipe.)
  2. When one of the composting tank is full, need to use other one.
  3. Check the guide posters are placed on the visible position.
  4. Clean the bio-toilet with clean water when it becomes dirty.
  5. Before use the facility, check the position of urine bucket and stool tank.
  6. Do not throw any trash to urine bucket and stool tank.
  7. Put 3 CM sawdust on the bottom of stool bucket after emptying.
1. 當廁所開始有異味，確認是否有任何地方堵住（尿液桶、糞便桶、通風管）
  2. 當堆肥桶滿了之後，請改用其他堆肥桶
  3. 確認使用說明放在任何人都能看到的的地方
  4. 當廁所變髒時，用清水清洗廁所
  5. 使用廁所時，確認排尿桶與糞便桶在正確的位置
  6. 勿將異物丟至尿液桶或糞便桶內
  7. 每次清空糞便桶後，倒入3公分的木屑在底部

## Safety & Privacy

Privacy and safety considerations are vital to make sure that the facility protects and reduce the risk of violence against women and girls. Moreover, perception of risk often forces women to choose the less hygienic alternatives

1. Clear Signage
  - Separation of Boys and Girls
2. Secure Structure
  - Cubicle Locks
3. Solid Structure for Privacy
4. Good Lighting in Entrance, Exits and Cubicles
5. Safe Location

## 安全與隱私

公共廁所常常會有安全性的隱憂，特別是對於女性們。所以此設計著重於增強女性使用者的安全性與隱私

1. 清楚的標示
2. 隔間都有上鎖
3. 單獨完整的隔間設計
4. 出入口皆有良好的燈光
5. 挑選安全的地方，避免偏僻的角落

## Contact for consultation:

顧問聯繫資訊:

**Cheng-Han Lee, Architect**  
Based in Taiwan  
han.lee@lovebinti.org

**Justus Juma, Project Manager**  
Based in Uganda  
justus.juma@lovebinti.org

**Elle Yang, CEO of Love Binti**  
Based in Taiwan  
elle.yang@lovebinti.org

**Love Binti International**  
www.lovebinti.org

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Anne Sofie Nordlund, Denmark

**Illustration**  
Cheng-Han Lee, Taiwan

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