# Design Solutions for Seasonal Water Scarcity in the Comarca Ngäbe-Buglé

*Mujeres Fuertes Consultados*

*Michigan Technological University*

*iDesign Panama 2010*

Jacquie Blom, Alye Hannum, Natalie Helms, Sara Maihofer, Beth Shears

# Outline

- Introduction
- Background
- Site Assessment
- Design Alternatives and Analysis
- Cost Estimate and Construction Schedule
- Design Recommendations

# iDesign Panama 2010

# Comarca Ngäbe-Buglé

**Erin Kelley**

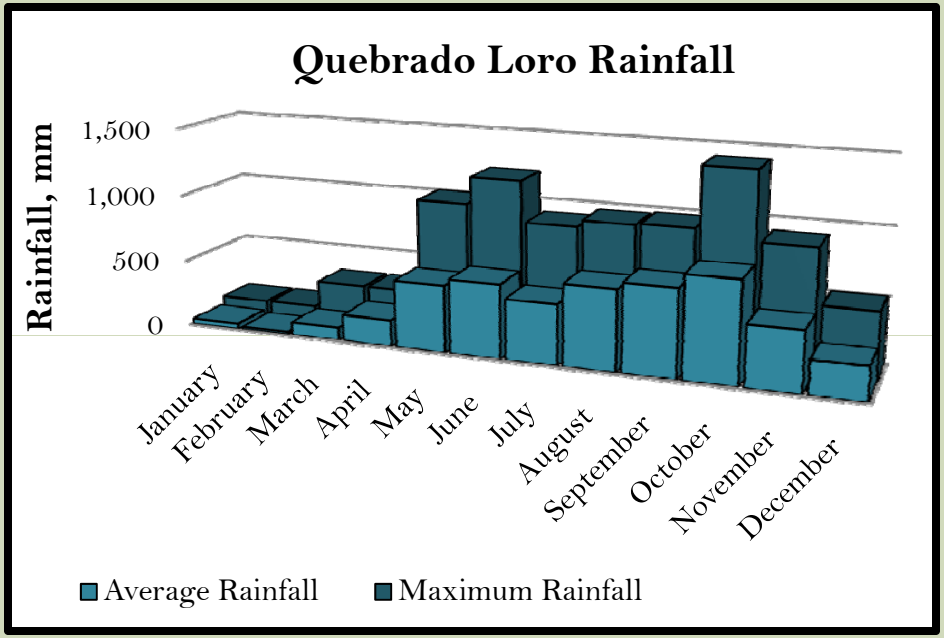
- University of Kentucky
  - Foreign Language and International Economics
- Peace Corps Volunteer
  - Agro-business
- Salto Dupí in the Comarca Ngäbe-Buglé
- Counterpart: Alvaro Bejerano

# Comarca Ngäbe-Buglé

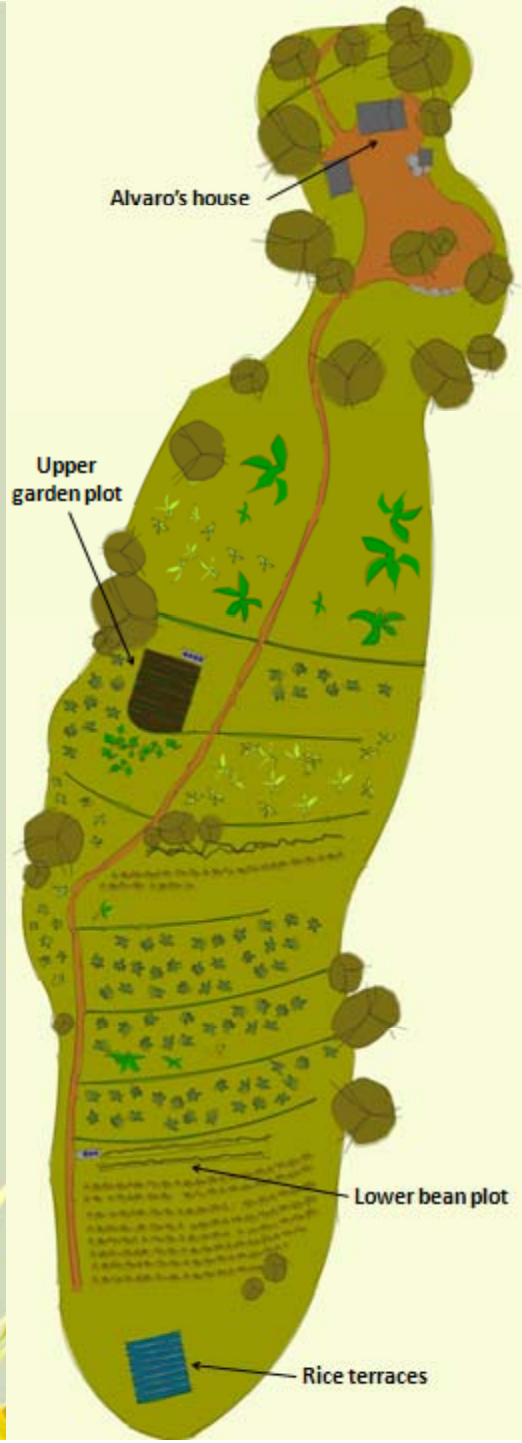
**Ngäbe-Buglé People**

- Comarca: "reservation"
- Language: Ngäbere and Buglére
- Livelihood: Subsistence farmers, shop owners
- Income: $10/week
- Religion: Seventh-Day Adventist
- Crafts: Chacaras, Naguas

# Farming on the Comarca




- Seasons
  - Rainy: May – November
  - Dry: December – April
  - "Famine": May – July
- Farming adversities
  - Poor soil
  - Steep slopes


Alvaro's house
Upper garden plot
Lower bean plot
Rice terraces

# Farming on the Comarca


- OPAMO: *Organization of Agricultural Producers with Organic Methods*
  - mulch
  - compost
  - soil conservation plants
  - plants to slow runoff

- Design Needs
  - Rainwater Collection
  - Rainwater Storage
  - Irrigation

# Designing for the Developing 80%

**Considerations**

- Technical Aspects
  - Construction skills
  - Material availability
  - Maintenance
- Social Aspects
  - Willingness to use the technology and show other farmers the technology
- Economical Aspects
  - Capital and financial management
  - Market opportunities for the produce and pay back time for the technology

# Site Assessment

- GPS
  - Coordinates of property line
- Surveying
  - Elevations and distances of vegetable plots and property

# Site Assessment

- Plant Identification
  - Photographs for guidebook
- Soil Investigation
  - Characteristics to estimate soil properties: cohesion and unit weight


# Design Alternatives

- Dam river
- River water pumping
  - Electric pump
  - Treadle pump
  - Windmill pump
- Rainwater storage
  - Water bladder
  - 50-gallon polyethylene barrel
  - Ferrocement tank

http://news.cnet.com/2300-1008_3-6209770-10.html?tag=mncol

# Proposed Design

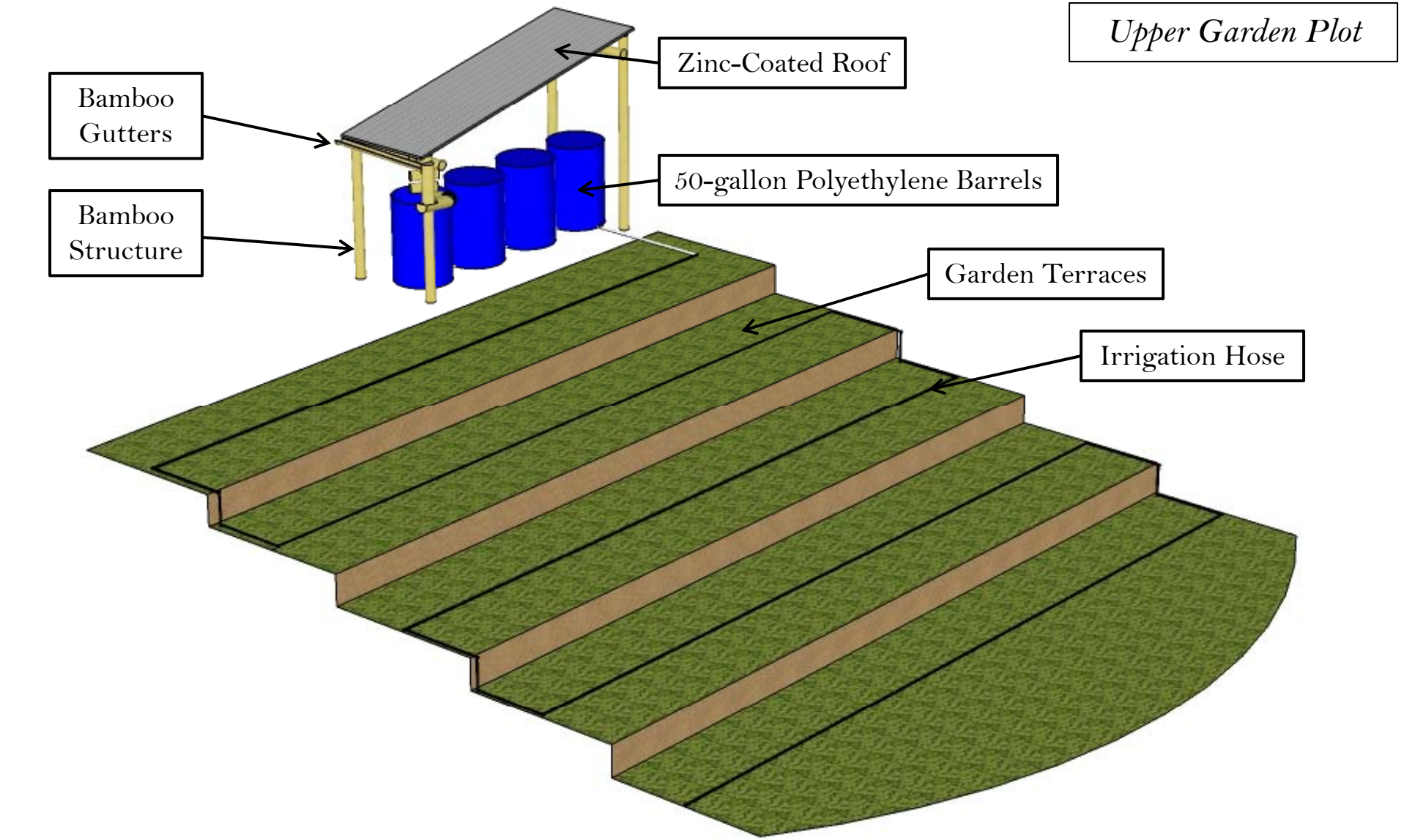
**Developing 80% Considerations**

- Economically feasible
- Materials available in Salto Dupí or San Felix
- Minimal technical training
- Adaptable for other farms
- New technology for the area – easily accepted

# Proposed Design

- Rainwater Collection and Storage System
  - Zinc-coated roof
  - Bamboo gutters
  - 50-gallon polyethylene barrels
- Drip Irrigation System
  - Garden hose
- Rice Terraces

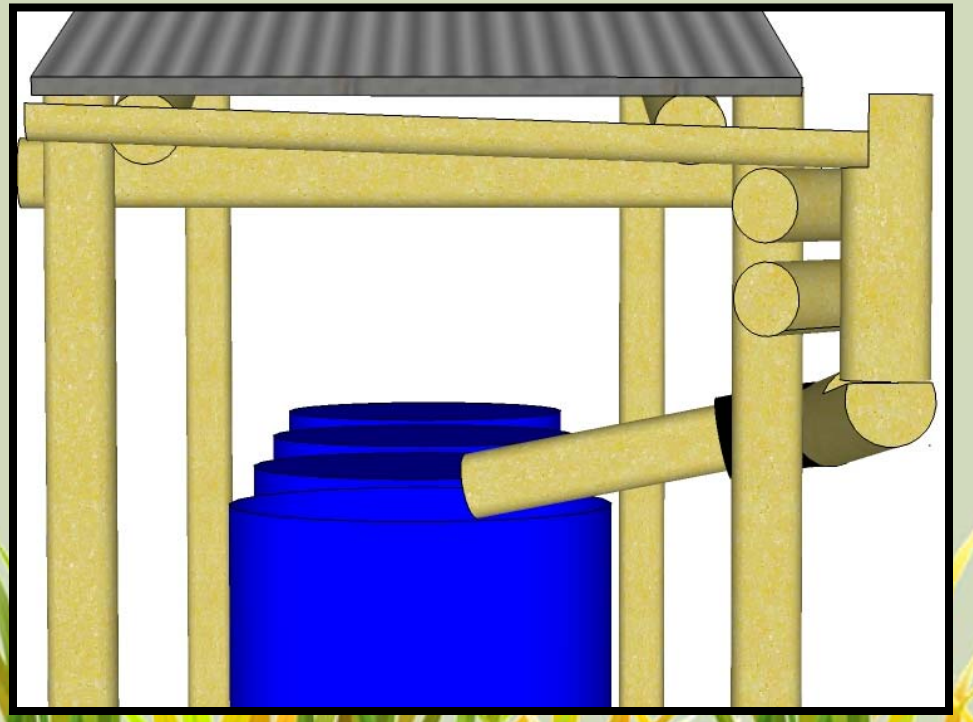
# Proposed Design

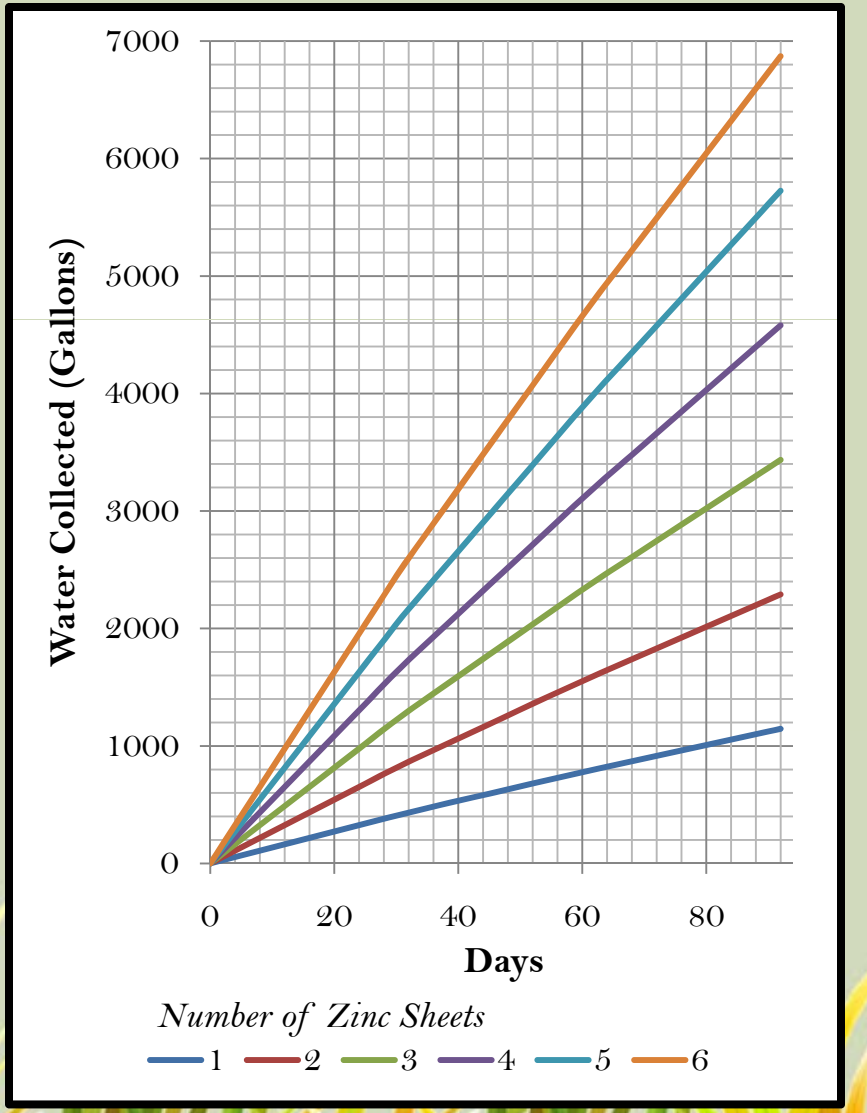


# Design Analysis

**Rainwater Collection System**

- Zinc roofing
- Bamboo gutters

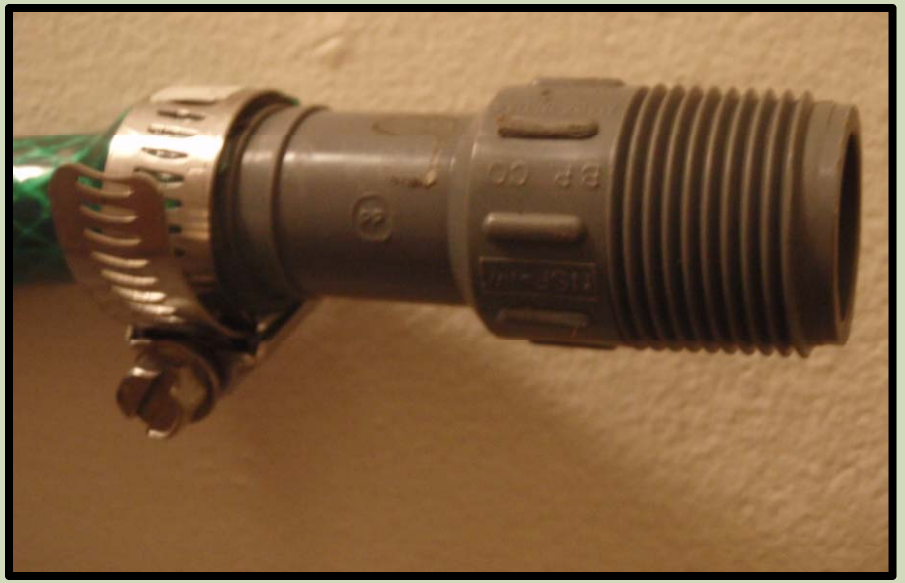




# Design Analysis

**Rainwater Storage System**

- 50-gallon polyethylene barrels
- PVC connections




# Design Analysis

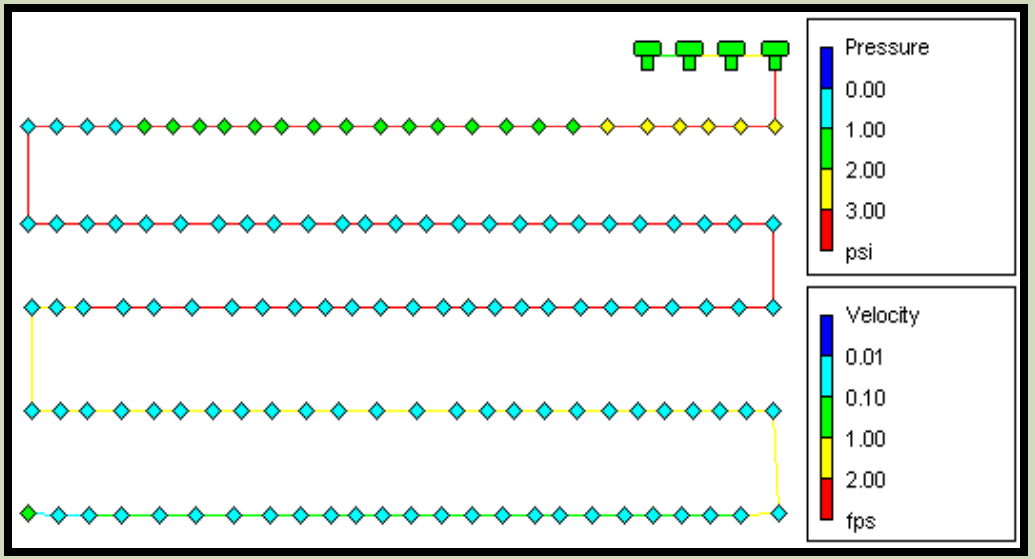
**Drip Irrigation System**

- Experiment
  - Determined flow through emitters
  - Various elevation changes

# Design Analysis

**Drip Irrigation System**

- EPA Net 2.0 Model
  - Flow: 0.026 GPM
  - Pressure: 2-4 psi



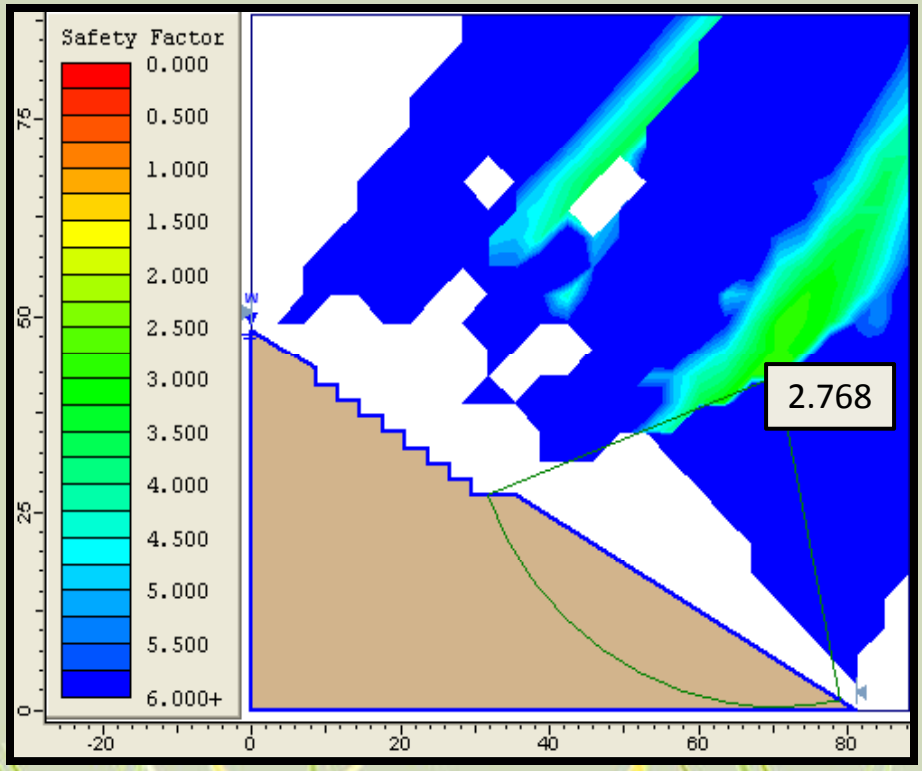

# Design Analysis

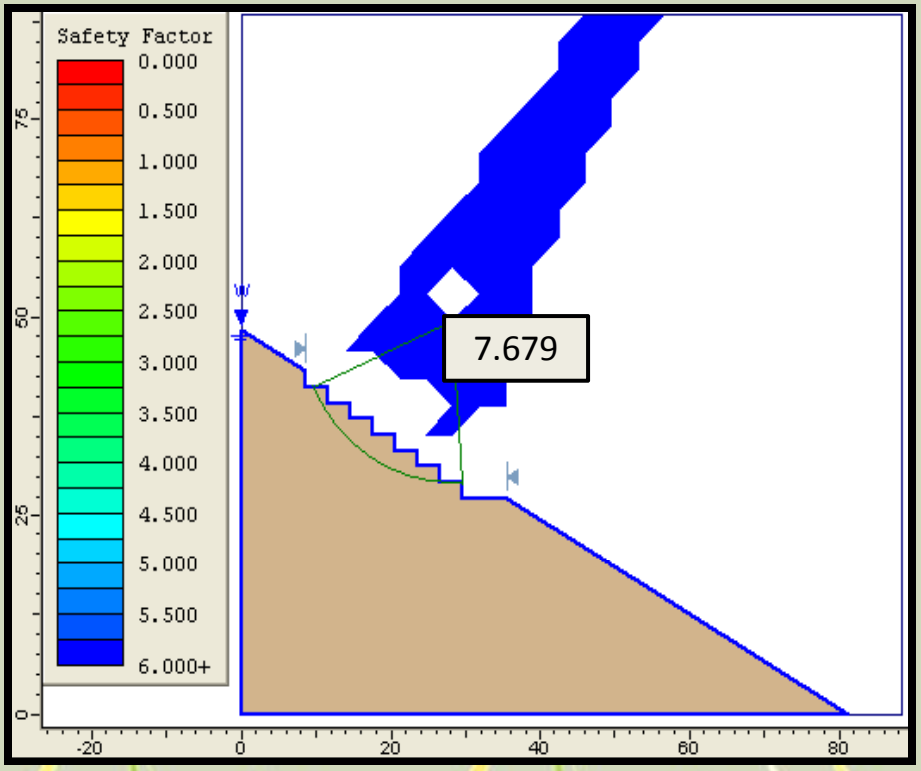
| Rice Terrace Water Budget | |
|---|---|
| **Month** | **Irrigation Need (mm/month)** |
| May | -116 |
| **June** | **34.0** |
| July | -19.6 |
| August | -186 |
| September | -33.2 |
| October | -236 |

www.images-photography-pictures.net/China_rice_terraces_terracotta_soldiers.htm

# Design Analysis

## Rice Terrace Slope Stability Analysis in SLIDE 5.0

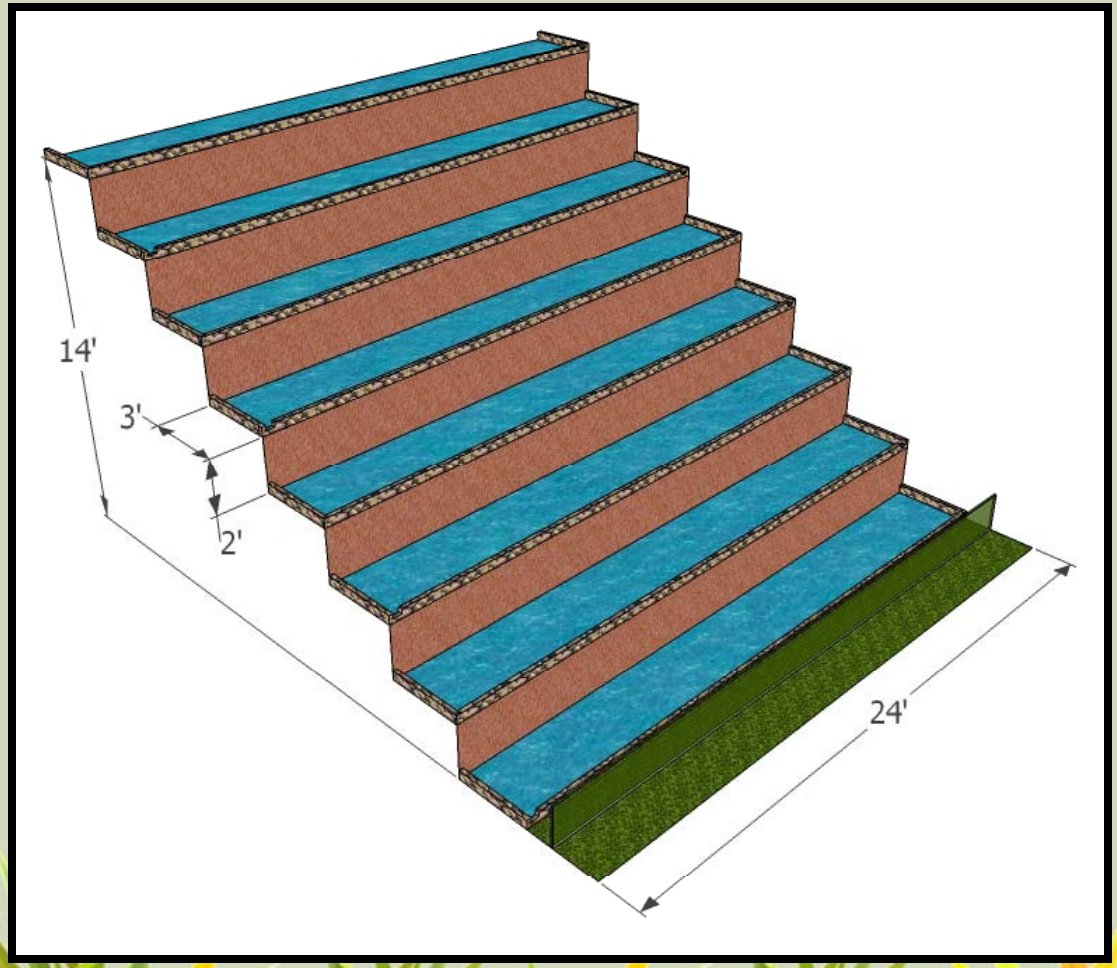


# Design Analysis

## Rice Terrace Dimensions

- Height: 2 ft
- Width: 3 ft
- Length: 24 ft
- Number of terraces: 8
- Construction Time: 16 days



# Cost Estimate

| Detailed Cost Estimate for Rainwater Collection, Storage and Distribution System | | | |
|---|---|---|---|
| | Quantity | Unit Cost | Total Cost |
| Zinc Roofing (3.5'x10' sheet) | 2 | $ 8.00 | $ 16.00 |
| Nails (box) | 2 | $ 2.30 | $ 4.60 |
| Rubber Sheeting (12”x36”) | 1 | $ 17.50 | $ 17.50 |
| Barrels | 7 | $ 25.00 | $ 175.00 |
| PVC Pipe (1" diameter) (20 ft) | 1 | $ 3.50 | $ 3.50 |
| PVC Threaded Nipple (1” diameter) | 12 | $ 0.50 | $ 6.00 |
| PVC Valve (1" diameter) | 2 | $ 3.50 | $ 7.00 |
| Caulk (1 tube) | 1 | $ 4.00 | $ 4.00 |
| Garden Hose (75') | 3 | $ 17.50 | $ 52.50 |
| Hose connections | 3 | $ 1.00 | $ 3.00 |
| Hose caps | 2 | $ 1.00 | $ 2.00 |
| Transportation of Materials | - | $ 40.00 | $ 40.00 |
| | | | **Total Cost: $331.10** |

# Construction Schedule

| Activity | Duration (Days) |
|---|---|
| Site Prep | 5 |
| Material Acquisition | 14 |
| Roof and Gutter Construction | 9 |
| Storage System Construction | 5 |
| Irrigation System Construction | 7 |

| | |
|---|---|
| Early Finish | 21 |
| Late Finish | 39 |

# Recommendations

- Rainwater collection, storage, and irrigation system
  - Screen collected water before storing
  - Test irrigation system water flow at various elevation changes
  - Cover irrigation lines with mulch
  - Maintenance
    - Clean gutters and screen
    - Clean out irrigation lines
    - Clean emitter holes
- Rice terraces
  - Place rocks at water spouts to prevent erosion
  - Plant vetiver to filter waste water

# Next Steps

- Maintain communication with Peace Corps volunteer
  - Funding opportunities
  - Materials already obtained
  - Design questions and adaptations
- Follow up with Comarca farmers for design feedback

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