IPRO 325
Designing Affordable Water, Energy, and Shelter Solutions for the World’s Poor
Problem
• 3 million people live on less than $3 a day worldwide.
• Malnutrition affects 792 million people in the world.
• 5 million children die from malnutrition in rural poor regions.

• Micronutrient malnutrition (MNM):
  A medical condition resulting from an insufficient consumption of nutrients
EVAPORATIVE COOLING SUBGROUP

Background

• 1 out of 5 people (158 million) suffering from MNM has access to needed fruits and vegetables, but are unable to store them.
• 20% of fruit and vegetable losses occurs during storage.
• Loses are primarily temperature and humidity related.
EVAPORATIVE COOLING SUBGROUP

REFRIGERATION FOR THE WORLD’S RURAL POOR

Goal
• Help combat Micro-Nutrient Malnutrition (MNM)
  • Provide better way to store food for extended periods of time

Objectives
• Improve on previous evaporative cooling designs
  • Continue research on effective prototype
  • Design prototype
  • Construct prototype
  • Test prototype
  • Provide plan for field implementation
INDIVIDUAL ROLES

Sara Wilde
Team Leader/
Research Manager/
Field Implementation

Abraham Akutagawa
Location Selection/
Lab Maintenance/
Field Manual

Young Ju Jo
Design Manager/
Project Plan/
Testing

Narciso Corral Jr.
Team Co-Leader/
Construction Manager/
Field Manual/
Testing

Andrew Rust
Engineering Notebook/
Field Workshop Lead
METHODOLOGY

BEGINNING OF SEMESTER

- RESEARCH
- EVAPORATIVE COOLING
- LOCATION
  - BRICK ‘N’ BRICK
  - POT ‘N’ POT
  - HYBRID

DESIGN

- BRICK ‘N’ BRICK
- POT ‘N’ POT
- HYBRID

CONSTRUCTION

- TESTING ENCLOSURE

TESTING

- BRICK ‘N’ BRICK
- POT ‘N’ POT
- HYBRID
- TESTING ENCLOSURE

END OF SEMESTER

- MANUAL
- WORKSHOP
Location Requirements

- Access to surface water
- Sand and Clay in the soil
- High Temperature, Mid-Low Humidity Season
- Population with pottery skills

Chosen Sites

Sincape, Peru
• Reduction in air temperature that occurs when water evaporates

• Cool an object or a liquid in contact

• Higher Temperature, More Wind, and Lower Humidity = more evaporation

http://techalive.mtu.edu/meec/module01/EvaporationandTranspiration.htm
RESEARCH

MATERIAL SELECTION

Adobe Bricks

Terra Cotta Pots
Zeer Pot System

Static Cooling System
DESIGNS

- IPRO 325 Introduction
- Cooling Subgroup
- Individual Roles
- Methodology
- Research
- Design
- Construction
- Testing
- Analysis
- Conclusions
- Obstacles
- Continuation Plan
- Acknowledgements
- Questions/Comments

Pot ‘N’ Pot

Hybrid

Brick ‘N’ Brick
CONSTRUCTING THE BRICK ‘N’ BRICK

• IPRO 325 Introduction
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CONSTRUCTING THE HYBRID

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CONSTRUCTING THE POT ‘N’ POT

CONSTRUCTING TESTING ENCLOSURE
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TESTING
TESTING

TESTING MATERIALS

• Pot ‘N’ Pot Structure
• Brick ‘N’ Brick Structure
• Hybrid Structure
• 3 Thermometers
• 2 Indoor Conventional Heaters
• 1 Humidifier
• Sealed Testing Enclosure
• 3 wet Clothes
• Water Bucket
• Barometer

• 5 days
• 16 hours combined
• In heated environment
• Varying humidity
• Brick VS. Hybrid
• Brick VS. Hybrid VS. Pot
ANALYSIS

Temperature distribution with (26%-48%) humidity
RESULTS

Built working prototype
  Local materials
  Sustainable

Tested in third-world conditions

Testing Performed
  Average temperature decrease 10-14°F
  Best result was a 17°F drop
  Pot in pot test average decrease of 7°F

CONCLUSIONS

VS.

• Cooler
• Large structure
• More expensive
• Hard to clean
• Hard to maintain

• Near same results as brick
• Smaller to build
• Same size storage chamber
• 1/3 the cost
• Easier to clean & maintain
### RESULTS

**Budget:**

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OBSTACLES

• Making Structures mobile

• Construction Site

• Transportation & Acquisition of Construction Materials

• Replicating target region environment for testing

• Equipment failure

• Testing equipment damage

• Updating Project Plan to meet Milestones & Objectives

• Coordinating with team and varying schedules

• Fundraising
CONTINUATION PLAN

• Additional testing
  • FOCUS ON DESIGN IMPROVEMENTS
    • Size and shape variations
    • Varying water levels
    • Different lid designs
    • Long term testing
    • Using food from the target region for storage tests

• Create Construction Manual

• Complete Educational Workshop

• Field Research
  • Can targeted region build our design, per our criteria?
  • Does our design actually work in the field?
  • How durable will it be in the field?
  • How long will it last?
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QUESTIONS / COMMENTS?