Food and Food Forests for Southwest Gardens

A Residential and Small Farm Approach
The Problem: Food Insecurity

Modern and even organic farming practices destroy the soil 18 to 80 times faster than natural soil formation rate (Jeavons 2005).

In fact, leading scientists suggest that only 40 to 80 years of top soil remain worldwide (UN Report 2000).

History told, the fall of every great civilization was often marked by their failure to take care of their soils (Berry 2002).
The Problem: Food Insecurity

Much of the problem is scale.
- **Groundwater withdrawal exceeds recharge in most cases.**
- **1.75 billion tons of soil are lost annually to erosion.**

Much of the problem is cultural-based

- **Farmers account for less than 1% of our population.**
- **Factory farming and factory food (fast food) has created an obesogenic nation,** 75 billion in medical expenditures to taxpayers.
- **26% of the edible food wasted at consumer level**

7.3 units of (primarily) fossil energy are consumed for every unit of food energy produced.
Promise of Alternatives

Small scale farming and sustainable farming can have the following benefits:

- May use **10% of the water** consumed in conventional agriculture.
- Produce **4 to 8 times more food per area**.
- Improve soil formation rates 10 times more than in nature.
- Mitigates or reverses soil erosion.
- Focuses on local and diverse economies and food distribution systems.
- Reduces energy consumption and fossil fuel use.
Promise of Alternatives

• In 2006, 53% (by value) of Russia’s total agricultural output came from household plots accounting for 2.9% of agricultural land.

• Accounting for nearly all of 90% of potato production and 70% of vegetable production.

• One difference is that Russians spend on average 17 hours a week gardening, while Americans spend 32 hours a week watching TV.

Philosophical Framework

According to Wendell Berry, at the right scale, small scale, farms were and still are enjoyable places to live.

In fact, some cultures were so successful at small scale farming that researchers found that they spent nearly half the year in festivity (Chayanov 1986).
The Research Question

How can design make food more sustainable and accessible to our local community?
Literature Review

- Sustainable Food Approach
- Local Ecology
- Sustainable Systems: Strategies and Tactics
Sustainable Design

1. Permaculture Design Principles
   Permaculture principles highlight the need for functional and beneficial relationships of all elements in the design.

2. Edible Forest Garden Design Process
   Edible forest garden design will bridge the gap from permaculture principles to implementable plans.
Design Approach

Goal Articulation

Base Mapping:
Grading

Analyze and Assess Site:
Sector Analysis

Design Concept:
Vision Statement
Sketches

Schematic Design:
Zonation
Scale
Bubble-e

Detail Design:
Infrastructure
Ecology
Residential Principals

Patch Design
Vegetation
architecture, dynamics
ansd social structures

Implementation & Evaluation

Introduction | Literature Review | Analysis | Design | Conclusions
Local Ecology

1. Foodsheds and watersheds
   Multiple scales of food production increase resiliency

2. Regional ecology
   Organized in the language used in edible forest garden concepts: vegetation architecture, vegetation dynamics, and social structure.
Guild Architecture: The Mesquite

Nurse Plant Qualities

1. Nitrogen fixation
2. Microclimate
3. Hyraulic Lift (Sowell 2001)

During day, shallow soil drys
Guild Architecture: The Mesquite

Nurse Plant Qualities

1. Nitrogen fixation
2. Microclimate
3. Hyraulic Lift (Sowell 2001)

By night, hydraulic lift of water from deep to shallow soil and water exudation tend to moisten the soil.
The Mesquite Guild

A possible native food forest guild

A higher water use food forest guild
Sustainable Systems

1. Water and production efficient gardening systems
   Small scale systems, larger scale systems

2. Food forest concepts
   Vegetation architecture, vegetation dynamics, and social structure.
Elements of the Food Forest

Architecture

Plant Selection

Water Guilds
Living Habits and Soil Fertility

Figure 9.9 High-Quality, Low-Cost Methods of Maintaining and Improving Soil Fertility
Active and Passive Water Storage
Active and Passive Water Storage
Integrating Elements
Plant Location & Ecology

Over 300 different species of plants thrive on this 1/3 acre property in N. California. 4 humans, 2 dogs, insects, birds, lizards, even mole co-exist in harmony within these gardens. Next animal needed: CHICKENS! Expected food crop yield this season is approximately 1000 lbs.

www.gaiacreationsecoland.com
Case Review

1. Greening the Desert, Jordan
2. 2,000 year old food forest, Morocco
3. Traditional Mexican Garden, Tucson
4. Zvishavane Water Resources Project
5. Food production in Russia
Greening the Desert

Location: Jordan, 5 miles from the Dead Sea

Annual rainfall: 4 to 6 inches

Site conditions: highly saline soils, unproductive agricultural land

Regional conditions: one of the most water deprived countries in the world, only 41,000 gallons per capita per year. (compare to 62,000g per capita in Tucson)
Greening the Desert
Greening the Desert

The same principles applied on a Jordanian residence.

Greening the desert site in 2000 during construction.

The site a few years after the initial design and implementation.
Greening the Desert

10 swales on 10 acres harvest every drop of water to support a forest of legumes and fruit trees.

Results:
Crop yields with respect to water efficiency was high. 13.3 ton/ha

Used a 1/5 of the water conventional agriculture would have used.

Drastic soil improvement

Methods:
Permaculture design
Rainwater harvesting
Greywater
Animals
Food forest and ecology

Source: Ayesh, Mohammed. Use of permaculture for holistic water resources management under salinity and drought conditions.
Site A: Site Analysis

**Goal:** design a productive permaculture landscape at the small farm scale

Sector diagram developed from GIS analysis, neighbor & staff testimonials, onsite observation, and general knowledge of region.
Watering Systems (in order of use priority)

1. Active and passive rain water
2. Greywater
3. Municipal Water
Water Systems as Guilds

Infiltrator
Mulch Basin
Water Distribution
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Family</th>
<th>Native to</th>
<th>Successional Stage</th>
<th>HeigtxWidth</th>
<th>Form</th>
<th>Habit/Root Habit</th>
<th>Light</th>
<th>Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>carob</td>
<td>fabaceae</td>
<td>mediterranean</td>
<td>Climax</td>
<td>30x30</td>
<td>E tree</td>
<td>Deep, adaptable</td>
<td>Full to part</td>
<td>Fairly salt tolerant</td>
</tr>
<tr>
<td>Miracle tree</td>
<td>moringaceae</td>
<td>subtropic to tropic</td>
<td>Climax</td>
<td>30x20</td>
<td>bush/small tree</td>
<td>Deep</td>
<td>Full to part</td>
<td>dry, sandy to heavy</td>
</tr>
<tr>
<td>olive</td>
<td>mediterranean</td>
<td>Climax</td>
<td>25x25</td>
<td>E tree</td>
<td>Deep</td>
<td>Full</td>
<td>Full to part</td>
<td>Dry, rocky, well-dr</td>
</tr>
<tr>
<td>passion vine</td>
<td>passifloraceae</td>
<td>baja california</td>
<td>hot, rocky, sandy</td>
<td>10' sprawl</td>
<td>Vine</td>
<td>Full</td>
<td>reflected to part</td>
<td></td>
</tr>
<tr>
<td>jojoba</td>
<td>simmontaceae</td>
<td>Sonoran Desert</td>
<td>Climax</td>
<td>6x5</td>
<td>E shrub</td>
<td>Shallow, Runner</td>
<td>Full to part</td>
<td>Native, sandy to rx</td>
</tr>
<tr>
<td>chiletepine</td>
<td>Sonoran Desert</td>
<td>Any</td>
<td>3x3</td>
<td>D shrub</td>
<td>Shallow, Fertile</td>
<td>Partial shade</td>
<td>Fertile</td>
<td></td>
</tr>
<tr>
<td>wolfberry</td>
<td>Sonoran Desert</td>
<td>Any</td>
<td>3x5</td>
<td>D shrub</td>
<td>Shallow, Dry</td>
<td>Part full to part</td>
<td>Fertile</td>
<td></td>
</tr>
<tr>
<td>Mexican elderberry</td>
<td>caprifoliaceae</td>
<td>Arizona</td>
<td>Any</td>
<td>10-20x8-20</td>
<td>D shrub</td>
<td>Deep fertile</td>
<td>Full to part</td>
<td>Native, sandy to rx</td>
</tr>
<tr>
<td>agave</td>
<td>caprifoliaceae</td>
<td>Arizona</td>
<td>Any</td>
<td>3x3</td>
<td>Succulent</td>
<td>Shallow, Dry</td>
<td>full</td>
<td>Dry, rocky</td>
</tr>
</tbody>
</table>

**Plants: Vegetation Architecture**

**Introducion**

**Literature Review**

**Method**

**Design**

**Conclusions**
Patterns

Instant Succession
Mulching
Cross Pollination Clusters
Edge Effect
Dynamic Patches
Keyhole Gardens
Farm Design by Zone

**Zone V:** Wilderness

**Zone II:** Demonstration plots, staff core

**Zone II:** Community garden plots, intensive food forest belts

**Zone I:** Garden Plots, courtyard, water harvesting - cistern and microbasin

**Zone II:** Community garden plots, greenhouse, intensive food forest belts

**Zone III:** Compost operation

**Zone IV:** Broad-acre farm incubator plots, hardy food forest belts, larger earthwork swales

**Zone V:** Wilderness
Intensive Food Forest Belt

Mesquite Layer
Date Palm
Fruit Trees
Shrubs and Groundcover

Mesquite Date Palm Fruit Trees Shrubs
Hardy Food Forest Belt

Farm ~15'  Native Harvest ~20'  Native Hedge ~20'  Santa Cruz River Trail ~20'

0' 5' 10' 20'

Fence

Tree

0' 5' 10' 20'
Between Forest Belts

0' 10' 20' 30'

Diagram of forest belts with measurements.
Intensive Food Systems

**Zone I:** Integrated living systems including: outdoor living, perennial and annual food gardens, indoor living areas

**Zone II:** Intensive forest garden and energy storage for excess resources water, carport and storage

**Zone III:** Farm zone for larger scale food production, chicken coops and tractors, composting, greenhouse

**Zone IV:** Low water use native gardens for habitat

**Zone IV:** Minimal management, hardy food producing species, pollinators and habitat, right-of-way greenway
Residential Forest Guild

- Terrace
- Greywater
- Annual Bed
- Bridge
- Cistern Overflow
- Cistern
Residential Food Systems

- Chicken Coop
- Mini-Orchard
- Annual Gardens
- Chicken Tractors
- Low Water Edible Hedge
Water Flow
Outdoor Room

- Seating wall
- Flexible multiuse space with useful hardscape surface
Canopy Layer

- Edible deciduous canopy layer
- Nitrogen fixing trees
- Part shade canopy cover
Vertical Layer

- Vertical elements to create intimacy
- Vertical stacking of food production in microclimate
Perennial Layer

• Part shade tolerant vegetables and herbs
• Full sun perennials, vegetables and fruit trees
Annuals

- Part shade tolerant vegetables and herbs
- Full sun vegetables and fruit trees
- Square foot gardening
Human Comfort

- Furniture, art, and personal touch to create an oasis
Zone I: Oasis
Zone II: Intensive Food
Zone II: Intensive Food
Zone III: Lower Water Edge