The Dorothy Byrne Girls’ Vocational Training Center, Mbita, Kenya

Introduction

We have been asked to design a master plan and building layout for a 30 acre site bordering the shores of Lake Victoria in Kenya. Currently the site is undeveloped and it is being fenced with a concrete and barbed wire fence. Native thorn bush is being planted on the boundaries to create a natural fence in the long term. The only project that may proceed prior to the completion of the project will be a water tower and solar pump. The Dorothy Byrne Women’s Vocational Training Center will serve as a training ground for young women who will receive training as nursing assistants, hospital administrators, hospitality/hotel management, fish farming, agriculture and tailoring. The campus and associated programs are designed to become self sufficient in their agricultural production. Solace International is helping to develop micro businesses at the site to cover most of the operating costs. The land, purchased in 2008, is located on the shore of Lake Victoria within the confines of a former banana plantation. The proximity to a main road, power lines, and the water from the lake offers a good opportunity for income from services at the center, which will include, among other things, a bicycle repair, tailoring, and a seafood restaurant which we will locate and design.

We will be meeting early in the semester with Nate York, the executive director and founder of Solace International. We will use this time with Nate to get additional information and get clear as to the nature of the project we are embarking on. The listing of the buildings and site functions currently are basic and open to revision, so we can discuss with the client in detail what additional information you would like to have. Be aware that this is a country with a very different approach and level of information and not everything will be specific and clear cut. Nate travels extensively and continuously to nine countries and this first client meeting is critical. You need to be prepared with questions. He will not be available again in Prescott until the date of your final presentation, but he will be available through email and potentially internet/phone.

The current construction method is Stabilized Soil Block (SSB), manufactured by Solace International students and interns. A mixture of 1 part wet cement to 14 parts soil are compacted in a metal press to form a strong and low-cost brick which can be used in 1 and 2-story construction. Solace and Young Generation Center (YGC) have constructed ten structures in 2 years using SSB, and plan for six more in 2009-2010. SI is searching for an affordable eco-friendly alternative to wood construction for roofs etc.

Description

Excerpted from Solace International’s annual report.

Note: It is important that all participants read the full report available in the Kenya folder in the studio.

Dates and schedules may not be current.

This information below, particularly the dates, is tentative and has been revised to work with our schedule. The descriptions of the projects are not formalized in terms of the actual layout of the buildings and we will propose alternative approaches to the layout determined by sustainability and environmental considerations. It is important that the location and basic design of the girls’ dorm is set early in the process.

The dormitories will consist of six workroom structures arranged in a circle, much like a traditional Kenyan village. Once the clinic is built, doctors who volunteer will be providing training in nursing assistance and hospital administration. They will live at the girls’ campus but commute 5k to the clinic at the boys compound.

Manager: Simon Okelo: email - jahvoh@gmail.com: Phone : +254 720 446 807, Mobile : +254 733 506 6813
Costs/Finances:
• $65,000 budget ($50,000 committed) for Phase I.
• $8,000 for cost of the land (purchased in 2008)
• $8,000 for fencing the property (30 acres)
• $4,000 for on-site secure storage container (to be converted into part of the power storage facility)
• $3,000 power converters, facility and storage
• $1,000 land survey and government permits
• $40,000 for girls dormitory buildings (6 2-bedroom houses) kitchen, and bathrooms
• Student housing may be admitting students January 2010.

Lake Victoria borders the northern boundary of the property and the Mbita-Homa Bay road borders the southern boundary.

Projected benefits:
• Campus will provide training and jobs for young women graduates from YGC.
• Access to local main road, water, and the electric grid make the site a good choice for mechanical and engine service center.
• Proximity to Lake Victoria and topography make it an ideal site for catfish farm.
• Associated Micro Businesses
• Tailoring
• Agriculture
• Sale of fingerlings from fish farm

Labor: Students at the Mbita Vocational Center are currently fabricating cement fence posts and will be overseeing fishpond excavation, SSB and ferrous-cement construction. Challenges: The first priority will be to fence the property, both for security and to keep grazing animals away from crops.

Fish Farm, Mbita

The Mbita fish farm could be a great financial benefit to the Women’s Vocational Center. While startup costs are 40% higher than similar projects in Malawi, the market is more established. The farm will focus on producing catfish fingerlings for fishermen’s bait, and Tilapia for export to markets in Nairobi and Kisumu. The location of the property on a main road will ensure easy access to power lines for running irrigation pumps, and a steady flow of customers. Fishing is a major source of food and income for the area, and there is an established and hungry market for bait production. As water supply is a major step in the construction process for the girl’s dormitory, the [fish farm] project will fit well within the building schedule of the site and likely be one of the earliest sources of income for the center.

Manager(s): Banze Odera, Steven Hannington with Ayub Azizi as technical consultant
Costs/Finances: Cost estimated at $15,000 (within Solace’s budget for 2009)
Current state: Site will be on the land not currently under banana cultivation
Projected benefits: $500 a month from the sale of fingerlings and market-grade fish

Labor:
• Three weeks to dig 8 ponds = 2400 sq meter of production space
• One month to install irrigation system

Challenges:
• Building the pump house and water line prior to other construction by early July.
• Converting power from phase two to phase three current for pumping water
• Finding a reliable surveyor for land survey
Part 1 – Research

Prior to the design of the project, research into precedents and examples of how others have approached this unique challenge is required. This work will be done in teams, and presented to the group as a whole. Aspects of the project that will need to be researched include precedents, local resources, climate (temperatures, rainfall, prevailing winds, etc), vegetation, agriculture, permaculture, aquaculture, integrated systems, biology and geographic data. In a project such as this cultural awareness and sensitivity is necessary, so research on the culture of Kenya and this area in particular is essential. Each group will make a presentation of 30-45 minutes on what they have found to the class as a whole. This presentation should address the aspects of the project noted in the description. The following is from the web and needs to be confirmed and refined:

Kenya enjoys a tropical climate. It is hot and humid at the coast, temperate inland, and very dry in the north and northeast parts of the country.

The average annual temperature for the coastal town of Mombasa (altitude 17 metres) is 30.30 Celsius maximum and 22.40 Celsius minimum, the capital city, Nairobi (altitude 1,661 metres) 25.20 Celsius maximum and 13.60 Celsius minimum, Eldoret (altitude 3,085) 23.60 Celsius maximum and 9.50 Celsius minimum, Lodwar (altitude 506 metres) and the drier north plains 34.80 Celsius maximum and 23.70 Celsius minimum.

The long rains occur from April to June and short rains from October to December. The rainfall is sometimes heavy and when it does come it often falls in the afternoons and evenings. The hottest period is from February to March and coldest in July to August.

Simon our contact in Kenya, has sent additional temperature and weather information (see Kenya project folder in the studio)

Part 2 – Design

After the research phase, you will take on the design of the project in groups (to be defined), with interim presentations of your progress along the way to the final completion date. The design includes a master plan for the site and recommendations for locations relating to the interactions between all the various building, landscape and agricultural elements to be included in the completed project.

Deliverables

Part 1 (research):

• Presentation, with any supporting documents your team acquired and conclusions drawn in written form.
• All documentation to be placed on the studio’s main drive, and made accessible to everyone.

Part 2 (design):

• Site plan at an appropriate engineering scale.
• Details of special landscape features necessary for a permaculture landscape and fish farm.
• Building plan(s) and sections at 1/4" = 1'-0".

Challenges

As this is a project in a developing nation, we will need to transform our thinking in terms of what is considered an appropriate level of development for this site. American standards of housing are not necessarily part of this project and we will discuss these differences as the project progresses. We are attempting to get more specific information on the site and we hope to have a rough contour map before we begin the design. The Executive Director of Solace International, Nate York, will visit at the beginning of the semester and we will develop a communication system
for questions during the semester. He will return for the final presentation in December so good communication in the interim will be essential. As you will learn, understanding a site is essential to sustainable design so getting as much information about the location as possible will be key and a challenge. Apart from taking the whole class to Kenya, this is the best we can do under the circumstances. However, there is no reason that, with careful and complete research, we cannot become familiar with the site conditions.

*Map showing the approximate location of our project*

*Map provided by Solace International. The lot numbers are 1352 and 1349.*
Dorthy Byrne Vocational School

A collaboration between Solace International and the Ecosa Institute
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This is a short representation that will hopefully provide some insights into our process and introduce you to the ideas that we will elaborate on throughout this final compilation of our work. We were first introduced to the site when we met with you in mid September. We listened to what your goals and potential issues were for the site. After the initial meeting we divided into small research groups based on interest, personal skills and knowledge so that we could educate each other in precedence’s such as Kenyan culture, aqua-culture, appropriate technologies, Push Pull Agriculture, native plants, and local building systems. Each group than presented their information to the class which aided in our initial creation of three different integrated site plans. With the continuing flow of feedback from questions from your team and other professionals we were able to revisit our research and combine the three designs into one village. At our second meeting our discussion clarified the groups understanding for the site and its specific needs. After the meeting we divided the tasks to be accomplished, collaborated on integration strategies and focused on the specific buildings and systems that were needed for the site. These systems were: the bath house, the guest house, the dormito-ries for residents, the fish ponds and processing, landscaping strategies, composting toilets and the agricultural needs of the site. We also compiled an appendix on a data CD to further your understanding of why we did what we did and to provide you with more in depth information to be used during construction and kept on file for future development and needs. We all enjoyed the opportunity to partner with your organization to further our education, and hope that this may be the first of many collaborations.
Site Specifications

The site was surveyed to be in the range of 6 to 7 hectares, (or approximately 14 to 17 acres). The dimensions of the site are approximately 100 meters by 650 meters. This includes an upper section of approximately 100m x 500m of open pasture land, bordered above by the roadway. At the other end of the site, which borders Lake Victoria, there is approximately 100m x 150m of densely covered banana plantation. The site drops from the road to the lake approximately 10 meters in elevation.
Main Village - Dorothy Byrne Vocational
Design Objectives of the Main Village

- The sole objective of the main village is to create three micro-villages for guests, girls and anything work related, but still create a large, inviting village atmosphere.
- The guest micro-village creates a space where the guests have their own privacy, but don’t feel disconnected from the main village. Guest housing has optimum views looking towards Victoria Lake and shares a bath house with the girls, saving resources on two separate bath houses. With natural grass roofing the guest houses will be aesthetically pleasing and provide a porch for late evening socializing. The guest housing can allocate water from the roofs to plantings around the buildings making them even more appealing for guests.
- The girls micro-village creates a relaxing atmosphere away from any of the work related buildings (i.e. kitchen, workshop, maintenance building and classrooms) while still maintaining their presence in the central village. This allows a space for the girls away from all the training and work that they will be undertaking during their enrollment at the vocational school.
- Workers are located in the “working” micro-village where all non-residential buildings are located with exception of the girls and guest bath house. Workers housing is located on the “Lake Trail” side of the working village. This allows the workers quick access to the “Lake Trail” leading to the fish farm, animals, and crops. Workers pass the maintenance building on their way to the Lake Trail.
- The girls housing, boys housing, guest and girls shower house, kitchen and dining area and workshop and classrooms are all combined buildings. This cuts the cost of building materials and creates larger catchment areas saving resources for numerous small cisterns, guttering and down spouts.
- Composting toilets are located around the perimeter of the main village where they are easily accessible by truck for moving compost and supplying cover material (i.e. sawdust). Each compost-ing toilet has a small cistern for washing hands. A moveable deck on each toilet cuts down on resources (wood) and allows for easy access to the compost bins when covering and cleaning.
- The classrooms and workshop are combined and the classrooms are located behind the workshop to produce a more conducive learning environment free from distractions.
Girls Village
Girls Butterfly Housing and Workers Housing

- Butterfly design captures and directs water to a cistern on the back side of each dorm. This design eliminates the need for excess gutter and down spouts by directing all water to one location.
- When doors are open cross ventilation occurs, this pushes warm air through the screens in the upper portion of the exterior walls.
- Front and rear entrances allow for easy access to composting toilets and drinking water cistern located on the backside of each building. This also creates access to a private area located on the back of each building.
- Buildings will be made of ferro-cement. Area of rooms is approximately the same area as requested by Nate, but includes a flat wall for location of bunk-beds and/or desks and dressers.
- Girls butterfly housing creates a small micro village with shared bath house centrally located between guest housing and girls housing. Girls housing is separate from workshop and classrooms, allowing for separation from work and relaxation.
- Workers housing is located in the “working” micro village.
Guest Village
• The rain drains off the steep roof more quickly prolonging life of roof.
• The sun does not heat up the roofing materials as much; a sloped surface is less affected by the sun’s rays than a flat surface. This will also prolong the life of the roof.
• The air space in the high area of the roof is a buffer from the penetration of heat.
• The ventilation opening is partly closed with wood lathes or louvers, angled to prevent the rain from entering.
• Buildings have natural thatching and exposed roof on the interior. This is aesthetically pleasing to the guests.
• Guests have porch space 5.6m x 1.8m (18.5’ x 6’) for relaxation while having prime village views of Victoria Lake.
• Guest housing forms own micro-community from larger village.
The combined bath house model utilizes less material than building two bath houses while also giving the girls the amenities of the tourist bath house.

The layout is fairly similar on both sides however each side caters to the needs of both demographics.

The guest showers are considerably larger and have a separate changing room from the shower stall so that their belongings will not get wet.

The guest side has two sinks and counter space to emulate some of the amenities of home.

There are many windows surrounding the bathhouse and strategically placed windows in each shower stall to alleviate the daytime use of lights.

The passive hot water heating system utilizes industrial steel tanks that are low cost and a simple system whose only mechanical apparatus is a small solar powered pump.

The pump room, located in a central location in the bath house, also doubles as a maintenance access to the solar hot water system.

On the girls side there is a large wash basin that can be used for general hygiene as well as laundry.
If the current solar hot water system does not meet the hot water expectation this panel is an easy and cheap to build retrofit. For the easy 6 step instructions see appendix.
Humanure Composting Toilets

• The toilet bins will consist of ferro-cement on four walls roughly 5cm (2") thick. The floor will be left open to expose the compost to beneficial microorganisms in the soil. Four posts of wood or concrete will be placed inside each corner of each bin. The posts will be wrapped with chicken wire to form a 5cm (2") space between the ferro-cement wall and the collected human manure in the toilet center. The 5cm (2") gap will be filled with a dense layer of organic material such as hay, straw and/or weeds. This 5cm (2") buffer allows for air circulation/ventilation and insulation. Erect the compost bin on a soil base dished out like a shallow bowl, starting the bottom of the bin with an 45cm – 60cm (18"-24") thick, dense layer of organic material such as hay, straw and/or weeds – this is the “biological sponge.” This “sponge” soaks up any excess moisture in the compost pile, and keeps fecal material from coming into contact with the ground.

A moveable deck will be built on one of the two toilet platforms per toilet. This toilet deck should be light enough for four men to lift to the adjacent toilet bin, or it should be built on a track so it will easily slide to the empty bin. The hole which one defecates through, centrally located on the deck, should be covered when not in use.
A vent will protrude from the back of the compost bin venting air from both bins. Or a separate vent can be built venting each side. Doors that slide straight up and can be removed will provide easy waist height access to each compost bin when compost needs removing.

- Six wood or con-crete posts will hold a roof over the two bins (as show on the draw-ings). The top is left open for ventilation. Rainwater harvested off each two-bin toilet roof can be collected into a small cistern and used for hand washing adja-cent to the toilet bins.
Bin Sizing Twenty-four Girls (3 toilets)

- 1 person will produce 100 gallons/yr of fecal material and urine with a carbon material (sawdust) added.
- 100 gallons = 13.36 cubic ft/yr
- 24 vocational girls x 13.36 cubic feet/yr = 320.64 cubic ft/yr
- 320.64 cubic ft/yr x 2 yrs = 640 cubic ft (this is the amount of cubic feet needed for a two year period).
- 640 cubic ft / 6 bins = 106 cubic ft per compost bin
- (1) 1.5m x 1.5m x 1.5m = 119 cubic ft (six bins this size will have a large enough capacity to host the 24 vocational girls).
- The twenty-four Kenyan girls will need three toilets. Each toilet will have two bins with six bins total. The interior space of each toilet receptacle should be (1.5m x 1.5m x 1.5m).

Ten Workers (1 toilet)

- Using the same math as above, the ten Kenyan workers will need one toilet consisting of two bins. The interior space of each toilet receptacle should be 1.5m (width) x 1.8m (length) x 1.5m (height).

Six Guests (1 toilet)

- Again, using the same math as above, the six guests will need one toilet consisting of two bins. The interior space of each toilet receptacle should be the same as the girls toilets (1.5m x 1.5m x 1.5m).

- (6) 1.5m x 1.5m x 1.5m bins
- (2) 1.5m (length) x 1.8m (width) x 1.5m (height) bins
- (2) 1.5m x 1.5m x 1.5m bins
- With a total of 5 toilets and 10 bins. Each toilet consisting of two bins.
This is a Humanure Composting Toilet

(PLEASE READ THIS INFORMATION SHEET)

This environmentally-friendly toilet eliminates water pollution while recovering soil nutrients vital for plant growth.

Proper use of this toilet requires these important steps:

1) COVER THE TOILET DEPOSITS - Always thoroughly cover the toilet contents with a clean cover material such as raw sawdust, peat moss, etc. (but not woody materials such as wood chips or shavings) after each use. A supply of cover material must be kept handy to the compost toilet at all times. There should be enough cover material used in the toilet to completely eliminate unpleasant odors. All urine, fecal material and toilet paper should be deposited into the toilet.

2) AFTER ONE YEAR OF USE COVER COMPOST - After one year of use (at minimum of one year of use or when bin is full) the toilet deck should be lifted or slide over to the empty compost bin. Always cover the used compost bin with a thorough layer of coarse cover material such as hay, straw, weeds, leaves or other bulky material. The cover material must be adequate enough to prevent the release of unpleasant odors from the compost bin. If animals are present and the used toilet bin has been covered thoroughly, place a piece of chicken wire over the cover material to keep animals out during the composting phase. Before use of the empty toilet bin, cover the bottom of the bin with a 45cm - 60cm (18"-24") thick, dense layer of organic material such as hay, straw and/or weeds – this is the “biological sponge.” This “sponge” soaks up any excess moisture in the compost pile, and keeps fecal material from coming into contact with the ground.

3) ALLOW COMPOST ONE YEAR OF DECOMPOSITION - Collect the toilet material in an active bin for at least a year, then allow the material to age in that bin, now passive, for another year while the next active bin is filling. In any case, allow the compost bin contents to age for approximately one year after collection before applying to soil. If the temperature of the compost is monitored and consistent thermophilic (hot) conditions are observed, the finished compost may be used for food production. If in doubt, use the finished compost for horticultural purposes.
Site Plan
Companion Planting and Polyculture

Companion planting is the selection and grouping of plants within a guild of plants and animals. Each element in the guild benefits another through the exchange of nutrients and bacteria. For example: In the corn/beans/squash guild, the corn provides a stalk for the nitrogen fixing beans to grow on while the big leaves of the squash hold moisture close to the ground and provide shade for the other plants. Experimentation and experience with newly introduced plants, locally adapted and native plants will be the best indicator of success of a guild in local environments.

Polyculture is the propagation of multiple crops in the same place in order to emulate the biodiversity in nature. Utilizing polycultures in agriculture help increase food security by shifting reliance from single crops to multiple crops.

Vertical and seasonal planting: Planting vertically saves space and can create additional shade but planting large leaved plants like squash on trellised arbors. The leaves provide shade and the fruits are easily harvested. Rotating and growing a diverse plant selection makes food harvesting all season possible.
Pest and weed barriers: In the tropics weeds are often a problem. A weed and invasive grass barrier can protect the garden from invasion. Plant the perimeter of gardens with a deep rooted broadleaf like comfrey, a clump grass that does not seed or need to be grazed like lemongrass or vetiver, and a carpeting plant like sweet potato and a bulb like canna edulis. Thorny bushes can also be planted along edges of areas needing protection from pesky animals like monkeys.

Earthworks: mounds shed water during the monsoon season. They create a more complex and diverse landscape in the flatlands with varying microclimates. Ridges permit deep mulching. Ridges 0.5m x 1m increase yields in cassava, sweet potato, potato and yam crops. In basins the soil is more easily saturated and deep mulch keeps them from drying out.
Animals have many benefits and functions on a farm. When their behavioral characteristics are taken into account they can be powerful tools on the farm. Animals provide fertilizer as manure, they are pollinators and aid in pest control, they can be used as draft animals, they are good for clearing and fertilizing difficult areas before planting, and they provide protein and fiber.

Chickens Produce meat, feathers and eggs. They scratch and break up earth looking for food, they eat insects and pest pupae and eggs in fallen fruit and create manure.

Ducks clean the waterways of green algae, waterweeds, and tubers. They also fertilize the waterways. Ducks eat snails, slugs and insects aiding in pest control.

Geese produce meat, feathers and eggs. They are cheap to feed and live on grasses, clover, lucerne and weeds. Geese are excellent watchdogs and have been trained to herd sheep and keep orchard grass short and weed free.

Sheep produce fiber, milk, and meat and create manure. Sheep graze and fertilize the orchard with less impact on mature trees than goats.

Goats produce milk, skins and meat. They are useful for clearing new land and eat otherwise useless scraps. (Chickens can aid in goat parasite control.) Goats are very destructive when they browse and will debark trees.
AGROFORSETRY

Silviopasture is a system in which animal grazing pastures are intercropped with multipurpose trees that produce timber, fuel wood, natural soaps and medicine. Grazing can enhance tree growth while controlling grass, and reduces habitat for gnawing rodents. Ngitili is a traditional rotational grazing system in Africa where the animals graze in wooded pastures during the dry season.

Alleycropping is a method of planting in which Nitrogen fixing trees are planted between rows of staple crops like maize, sorghum, barley and cassava. When the trees begin to shade out the taller crops, the trees are coppiced and used as mulch in the surrounding growing area.

Food forests are guilds that simulate the beneficial relationships in the forest. They produce food, and forage for beneficial insects, pollinators and birds. Food forests are made up of seven layers: Canopy layer (Large fruit and nut like avocado), Low tree layer (banana, papaya and coffee), shrub layer (currants and berries), Herbaceous layer (comfrey, beets and herbs), soil surface layer (turmeric and ginger), root layer (cassava, and sweet potato) vertical layer (winged bean and other climbing vines).

All Drawings on Page by: Bill Mollison in Permaculture: A Designer Manual
Integrated Aquaculture is a practice of biomitigation in which the by-products from one species are recycled to become inputs for another. Aquaculture in an important part of environmental stewardship, and creates a balanced system for environmental sustainability, economic stability (product diversification and risk reduction) and social acceptability (better management practices). This polyculture system proposed aims to cultivate Tilapia and Catfish species, through semi-intensive, integrated, passive, and ecologically beneficial cultivation practices.
Catfish Incubation Tanks

Table Size Production pond/ Grow-out Pond/ Recreational Pond

Catfish Holding/ Brood Stock

Catfish Nursery

Constructed Wetlands

Tilapia Breeding Tank

Tilapia Race Way

Catfish Nursery for sale within 14 days

Tilapia Nursery Ponds

Tilapia and Catfish Holding Tank

Catfish and Tilapia Holding Tanks

Catfish and Tilapia Incubation Tanks
Plants for the wetland purification system (non-invasive natives)

a. Cyperus papyrus, Egyptian Paper Reed, Giant Papyrus (Native to Lake Victoria)
b. Miscanthidium violaceum, (Native to Lake Victoria)
c. Phragmites mauritanius, Common Reed, (Native to Lake Victoria)
d. Typha domingensis, Narrow Leaf Cattail, (Native to Lake Victoria)
e. Sparganium erectum, Bur Reed, (non-native)
f. Nymphaea nouchali var. zanzibarensis, Water Lily, (non-native)
g. Schoenoplectus lacustris, Common Club Rush, (non-native)
h. carex bequaertii, Sedges, (native variation of originally non-native species)
i. BAMBOO! Arundinaria Alpina (Best choice for constructed wetlands)

BAMBOO (for wetlands/rec pond and potential cash crop)
It absorbs water faster than most plants and is used in some parts of the world for cleaning sewage. Even more important, it soaks up heavy metals. It is a potential answer to polluted waters. It is nature's fastest growing woody plant, with some species achieving the phenomenal growth rate of one metre a day! Its culms (poles) are the strongest, lightest natural material known to humankind. A square meter of flooring derived from this “wonder plant” will sell for as much as US$ 100, while in Southern Asia it is used for reinforcing concrete and for scaffolding on skyscrapers. No other woody plant matches bamboo’s versatility in environmental conservation and commerce. It is a viable replacement for both hardwoods and softwoods. Its growth rate is three times that of eucalyptus, and it matures in just three years. Thereafter harvests are possible every second year for up to one hundred and twenty years. India has some twenty million acres of commercial bamboo that account for 60% of the country's massive paper requirements and much of its commercial timber needs. Over two million tons of edible bamboo shoots - rich in vitamins and low in carbohydrates, fats and proteins - are consumed around the world every year, mostly in Asia. However, bamboo remains an untapped resource in Africa, a state of affairs that the World Agroforestry Centre (ICRAF) hopes to help remedy through a pilot project in Kenya and Tanzania, in collaboration with the Kenya Forestry Research Institute (KEFRI) and the Jomo Kenyatta University of Agriculture and Technology. The project aims to create awareness on the environmental and economic benefits of bamboo in the Lake Victoria basin, and hopefully popularise it throughout the region. Lake Victoria is the world’s second-largest fresh water lake. Its shores are dotted with large urban centres that discharge domestic and industrial waste into its waters. Interestingly, this member of the grass family is not new in Kenya. “Kenya’s water catchments were once covered in bamboo,” says Prof Chin Ong, a hydrologist with ICRAF. “However, most of these forests have since been cleared”. ICRAF has taken a first step towards the revival of the plant by introducing the giant bamboo (Dendrocalamus giganteus) into selected pilot sites in Kenya (Nairobi, Western Kenya) and Tanzania (Musoma). This commercially attractive species can grow in areas traditionally used for sugar cane and coffee cultivation, thus providing an alternative or additional cash crop. Arundinaria alpina, a species of bamboo native to Kenya, will yield as many as 20,000 culms per hectare per year, with each culm growing to a height of 12 metres (40 feet). Most species in fact grow to over 30 metres (90 feet) at full maturity.

Constructed Wetlands

- Subsurface-flow wetlands move effluent (agricultural or mining runoff, tannery or meat processing wastes, wastewater from sewage or storm drains, or other water to be cleansed) through a gravel lavastone or sand medium on which plants are rooted; surface-flow wetlands move effluent above the soil in a planted marsh or swamp, and thus can be supported by a wider variety of soil types including bay mud and other silty clays. In subsurface-flow systems, the effluent may move either horizontally, parallel to the surface, or vertically, from the planted layer down through the substrate and out. Subsurface horizontal-flow wetlands are less hospitable to mosquitoes, whose populations can be a problem in constructed wetlands (carnivorous plants have been used to address this problem). Subsurface-flow systems have the advantage of requiring less land area for water treatment, but are not generally as suitable for wildlife habitat as are surface-flow constructed wetlands. Plantings of reedbeds are popular in European constructed wetlands, and plants such as cattails, sedges, Water Hyacinth (Eichhornia crassipes) and Pontederia spp. are used worldwide. Recent research in use of constructed wetlands for subarctic regions has shown that buckbeans (Menyanthes trifoliata) and pendant grass (Arctophila fulva) are also useful for metals uptake.

Wetlands under construc- Constructed Wetlands - One year later
In a review of both surface flow and subsurface flow wetlands it has been concluded that effluent nitrate concentration is dependent on maintaining anoxic conditions within the wetland so that denitrification can occur. He found that subsurface flow wetlands were superior to surface flow wetlands for nitrate removal. The 20 surface flow wetlands reviewed reported effluent nitrate levels below 5 mg/L; the 12 subsurface flow wetlands reviewed reported effluent nitrate ranging from <1 to < 10 mg/L. Results obtained from the Niagara-On-The-Lake vertical flow systems show a significant reduction in both total nitrogen and ammonia (>97%) when primary treated effluent was applied at a rate of 60L/m²/day. Calculations made showed that over 50% of the total nitrogen going into the system was converted to relatively harmless nitrogen gas. Effective removal of nitrate from the sewage lagoon influent was dependent on medium type used within the vertical cell as well as water table level within.

**Oxygenating Plants for Recreation Pond**

- Submerged: Crowfoot, water violet, monkey tail, hortwart, parrots feather
- Shallow water/bog plants (5cm deep): Marsh marigold, and watermint
- Marginal Water Plants (15cm deep) Iris, Arum Lily
Grey Water System:
Water from sinks and showers will be directed from wash rooms and kitchen outside into plantings. Since the greywater will flow into plantings it is very important that no chemicals of any kind be poured into sinks and drains.

Products and Ingredients to Avoid:

- harsh chemicals such as chlorine and drain cleaners
- bleaches and fabric softeners
- detergents with whiteners, softeners, and enzymes
- sodium-based bar soaps and laundry detergents (salt accumulation in soil will harm plants)
- borax and boron
- soaps and detergents with: peroygen, sodium perborate, sodium tryochlorite, petroleum distillate, alkylben-zene, salt
- disinfectants

(check out www.owue.water.ca.gov for a complete list)
There is a tree called the Chinese Soapberry (Sapindus mukorrossi) people in Asia have been using as soap and detergent for a long time. There is an East African species (Sapindus trifoliatus) called “mmwaka-mwaka” or “tia sabuni” in Swahili or simply soapberry or soapnut in English. Neem oil is also used a soap made from the Neem Tree (Azadirachta indica), which is: Mkilifi, Mwarubaini, Mwarubaini Kamili in Swahili. Also, “Endod” (Phytolacca dodecandra) has been a really popular soap plant in Ethiopia. Also called Gopo Berry and African Soapberry.
**Appropriate Technologies**

- This is a 19 liter (5 gallon) bucket used as a portable shower. A plug is inserted at the base of the tubing and a small drill bit is used to drill numerous holes in a rubber stopper acting as a shower head. Also when “soaping up,” one can turn the water off with the red lever and conserve water. Hot water can be used in this system.

- This is a simple solar oven in Brad Lancasters back yard. It is a metal lined, insulated, wooden box with mirrors above to reflect light through the window into the closed box. The front of the oven lifts open for easy access to baked goods. This simple design in Tucson, Arizona can reach temperatures 148 C (300 F). The oven is positioned to maximize solar gain. In Kenya the oven’s window should be horizontal for maximum gain year round.

- This is the Gaviotas Manual Sleeve Pump. Instead of using energy lifting the piston inside of the pump past the sleeve Gaviotas engineers constructed this pump that lifts a light-weight PVC sleeve leaving the heavy piston at rest. Twenty minutes of operation provides 700 liters of water to the community. The pump increased pumping depth by six times compared to other hand pumps. Pump depth is 20-25 meters and it’s easily operated and maintained. You can view a manual of the Gaviotas sleeve pump (bomba de camisa) in Spanish at this link: [http://www.scribd.com/doc/7940968/Gaviotas-Sleeveless-Pump-Bomba-de-Camisa](http://www.scribd.com/doc/7940968/Gaviotas-Sleeveless-Pump-Bomba-de-Camisa).

- These are two solar hot water tanks painted black, boxed in with a window on the aspect with most sun. These solar hot water heaters should also face the direction of maximum sun. Hot water from these tanks can be used in the 19L bucket showers.

- Below an outdoor shower, where one would stand, are three drains with two drain stoppers. These drains direct the water to three different trees planted around the shower. Every time one takes a shower they can chose which tree to water by plugging the other two drains. Always try and use water as many times as you can! Use biodegradable soap!

- Unglazed clay pots can be used for drip irrigation as a cheap alternative to other systems. The pot is buried in the soil with the neck of the pot accessible to be refilled. A cover stone is kept on the lid to keep evaporation down and rodents out. Unglazed clay pots are porous allowing for moisture to slowly escape, moistening the surrounding soil. Bottom image shows the neck of the pot sticking out of the soil. These clay pot irrigation systems can be used on a large scale with a cistern attached two hundreds of pots gravity feeding water whenever they empty.

- Rocket stoves. This simple stove design cut fuel use by more than 50 percent and was the fastest cook stove of hundreds in Guatemala. It’s core is a terra-cotta elbow 10.2 cm diameter (4") which created a heat riser (where the flames are in this photo) about 50 cm tall (20” ) with a horizontal feed tube of 25.4 cm long (10”). The elbow is cast into a lightweight pumice concrete cylinder and cooking happens on top of the heat riser. This design, with a long heat riser, causes a strong draft. This burns the wood more faster, hotter, and more efficiently. These stoves save half of the wood that would be used on an open fire. These stoves can be found online or made relatively easily. [http://weblife.org/capturing_heat](http://weblife.org/capturing_heat)

- [http://www.oas.org/usde/publications/Unit/oea59e/ch28.htm](http://www.oas.org/usde/publications/Unit/oea59e/ch28.htm) this site has large scale information on these systems.
This is a solar hot water heater stored inside of an old refrigerator. A window lets sunlight in while the insulation from the refrigerator holds the heat. The refrigerator door can be closed at night to minimize heat loss. This should be oriented to maximize solar gain. The hot water tank and the interior of the refrigerator should be painted black.

This is a solar cooker used to cook food or pasteurize water or milk. There are many designs on the internet, they can be easily built using cardboard, tin foil, a canning jar, plastic bag and a block of wood (http://www.solarcooking.org/PLANS/funnel.htm). “Solar Cookers International” has an office in Nairobi, Kenya. They would be worth consulting with if you are interested in solar cooking.

RAM PUMP
How does it work? Water is run into a feed pipe (with a screen to keep out debris) from a river or stream. As the water runs down the pipe it picks up speed and, therefore, momentum. As the flow builds up to a fast rate, it overcomes the mechanical spring pressure on the main valve, causing the valve to close. This stops the flow of water through the feed pipe, but since it has built up momentum, the pressure inside the pump increases. This forces water through the check valve which then momentarily compresses the air in the air chamber. The air then decompresses, pushing the water through and out of the delivery pipe, while the check valve prevents water from moving backwards through the pump. As the water flows through the delivery pipe and out of the pump, the pressure inside the pump drops, allowing the main valve to open again. This allows the water in the feed pipe to begin flowing again, starting the cycle all over again.

All that is required to make a pump like this function is a minimum of about two feet of drop in the feed pipe, although more drop is desirable as it provides increased flow rates and greater maximum delivery heights.

FLOW FORMS
Harmonic, rounded river shaped water sculptures move water through vigorous cascades. The flow form will be fed by the water inlet to each pond, bringing movement into the entire pond as well as oxygenating and energizing the water. This bio-mimicry technology can be used effectively to oxygenate and energize water for the benefit of fish, whose health depends on good quality water. These can be moulded from a concrete mix using a pre cut/formed mould.

SHEEP/GOAT FEEDER
Proves a safe, easy to clean, easy to fill, accessible feeder. Quite simply, a barrel like container is split lengthways and the two halves a secured to vertical posts which provide it's structure and and stance. The bottom section contains the feed and the top section provides protection from the elements.

SHEEP/GOAT MINERAL FEEDER
As above. Take a plastic barrel, cut through the centre in a half lap joint fashion. Cut a front shelf to hold in the food, and attach. Finally, make a simple ribar stand and attach. The overhanging lap provides protection from the elements.

JUKALI LAMP
Take an empty can, punch 3 appropriately sized holes. The hole on the lid of the can houses the bulb fixture, two holes in the side provide the battery and the switch. Simple circuitry couples the components together.
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