ECO MOYO MUSHROOM FARM
PROCESS REPORT

MYKO STUDIO

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WHERE  Within Eco Moyo Educational Centre, in Kilifi, Kenya.
WHAT  Propose an expansion plan and a mushroom farm.
WHY  Provide farming facility for Eco Moyo Farm which can generate income for the Education Centre
HOW  Designing with local materials and building techniques, with the aim on partaking in the construction process in Spring 2018. The farm will be built partially underground in a slope to achieve climatic conditions required for cultivation of mushrooms.
This report will explore the outline of the work which has been carried out for this diploma project: Eco Moyo Mushroom farm and an expansion plan for Eco Moyo Educational Centre.
Content page:

Site
Eco Moyo Educational Centre
Why mushroom farm
Investigation to expansion plan

- The site in use by students
- Mapping vegetation
- Mapping routes and pathways
- Facilities needed for further expansion

Proposal for expansion plan

Investigation to mushroom production
- Interviews
- Diagrams of mushroom cultivation
- Estimation of budget and costs
- Reference projects
- Mushroom growing course

Exploring 3 concepts; The line, The circle, The Hall

Linear production line gives outline for a linear concept

Proposal for Eco Moyo Mushroom Farm
Eco Moyo Educational Center is situated in the outskirts of the coastal town Kilifi on the east coast of Africa. The town lies in the Kilifi Creek and has a population of 120,000.

The climate here is hot and humid, without huge variation between season due to its placement 3 degrees south of equator. Rainy seasons appear twice, long rainy season in mid March to May and October to December. The wind direction is dominant from south and south-east.

The study of climatic conditions has influenced the project as oyster mushrooms require specific climatic conditions. Wind direction and sun path has affected the orientation and placement of the mushroom growing facilities.

The images on the following page illustrates the rich variation in vegetations and soil conditions in Kilifi county. The rural ares consist of wild forests and cultivated land with field crops. There coastal area is green and lush after rainy seasons, but the ground water is salty and the soil is red consisting of sand and small amounts of clay.
Eco Moyo Educational Centre

Eco Moyo Educational Center is founded and run by Lindsey Sanner through voluntary engagement and fundraising by Eco Moyo Auction. The school consists of 4 classrooms and several outdoor teaching and growing areas. Currently 70 students are enrolled at the school in the age between seven and seventeen, with the aim of expanding to 200 students by January 2018.

The Education Centre consists of two parts: The first is Eco Moyo Primary School which is modelled on Green School Principals with emphasis on practical approaches to each subject together with ethics, ecology, training in individual thinking and communication skills.

The second part is Eco Moyo Farm which will be based on Permaculture Principals for the cultivation of food crops, timber and animal husbandry. The goal is to meet the consumption needs of students and staff, while functioning as a demonstration site for locals and visitors.

Eco Moyo Mushroom Farm aims to be a pilot project providing a farming facility for the school, while also generating an income for the Educational Centre. Situated in relation to adjacent classrooms and outdoor teaching facilities the ambition is to provide spaces where the students can interact and learn from the farm.
Investigation to expansion plan: how is the site being used?

The proposal for our expansion plan is based on the idea that the school would benefit from a more structured layout.

Therefore the first step is to define and establish a plan for developing further, and find a location for the mushroom farm to benefit the overall layout of the school. Several outdoor learning facilities are arranged around the site in relation to the compost and watering systems.

The mushroom farm will need to be integrated into this network to make it complete - and to improve the ecosystem. The aim is to provide a facility which can improve the overall eco-system of the land, in addition to allow the students to interact and learn from the farm.

Agriculture is an important part of the project to improve soil conditions, grow locally, be self sustained and teach Green.
Masterplan by Lindsey Sanner in 2015, with the ambition of divided the plot into linear zones, following the contour lines. Focus on food production, edible gardens and keeping animals.

Sun diagram. Being located 30 south of equator the sun radiation is mainly straight from above.

Dominant wind direction from south.

Rainwater harvesting and location of water tanks and well.

Mapping large and important trees on site, with the aim of preserving them and make them visible/accessable.

Roads and pathways on site, both mapping existing and proposed circulation routes.

The site is situated on a sloping hill with 10% gradient.

Facilities and buildings on site.

Areal photo showing the site green and lush.

Masterplan by Lindsey Sanner in 2015, with the ambition of divided the plot into linear zones, following the contour lines. Focus on food production, edible gardens and keeping animals.
Name: Cestrum nocturnum (Queen of the Night)
Dimensions: 2.5 - 3m meters tall - 1 meter in diameter
Description: Queen of night plant or night blooming jasmine is a perennial shrub produces tubular white bloom that emit intense, romantic, intoxicating and heavenly smell in night.

Name: Cocos nucifera (Coconut Palm)
Dimensions: 20 - 30 meters tall - 8 - 12 meters in diameter
Description: The coconut palm is a long-lived plant that may live as long as 100 years; it has a single trunk, 20-30 m tall, its bark is smooth and grey, marked by ringed scars left by fallen leafbases. The leaves, from 4 to 6 m long, are pinnate; they consist of linear-lanceolate, more or less recurved, rigid, bright green leaflets.

Maintenance: Provide sandy, well-drained soil for your coconut palm tree. The loose soil allows the roots of the palm to more easily absorb the necessary nutrients from the dirt. Coconut palms are heavily reliant on nutrients for their growth. Apply 3 to 4 inches of mulch to the area around the tree or on top of the soil in the container at the start of each growing season.

Name: Balanites aegyptiaca (Desert Date)
Dimensions: 10 meters tall - diameter varies depending on growth conditions
Description: The size of the leaves, thorns and even the whole plant is highly variable depending on the availability of water. The compound leaves appear paired at the end of a long petiole. Under xeric conditions the elyptic leaflets are relatively small and can turn rather scruffy and tough. At times the leaves seem secondary to the abundant, smooth, green thorns. The small, greenish flowers are arrayed along the woody twigs and give rise to a drupe with brownish-yellowish fruit.

Growth rate: Slow

Investigating existing vegetation on site
The expansion plan of the site is based on micro analysis of local conditions and minute observations of vegetation and local conditions. Without imposing of geometrical systems or network, we have analyzed the spacial structure determined mainly by vegetation. By studying in detail the location of mature trees and masses of bushes, this has lead to the location of specific buildings. The position of these buildings take into consideration climatic requirements and conditions such as need for shade or breeze.

Throughout the diploma project we have had frequent meetings and corespondent with our client Lindsey Sanner. Our studies, research and proposals has been deliberated and appreciated. Dividing the site in different zones; private areas, defining a central school court yard, teaching facilities and private area for staff has been important and will be followed in the future.

Sanner has expressed her ambitions of intergrating more agriculture projects at Eco Moyo to keep the community self sustained and to provide economic support. By proposing a mushroom farm we will improve the compost system, which will generate good soil conditions to allow for further growing projects. We imagine the Mushroom Farm to become a pilot project on site which can enable the school to evolve and expand.
Oyster mushrooms
Why mushrooms?

Initiated by our client Lindsey Sanner we defined the program for a mushroom farm based on the need for farming facilities on Eco Moyo. In 2016 Lindsey research the potential customers for mushrooms in the area of Kilifi. Due to a large number of Italian restaurant and hotels in this coastal region the demand for mushrooms is big.

Mushrooms are a great source of protein, copper, potassium, zinc, selenium and B vitamins. Mushrooms are also a great source of dietary fiber and are low in both saturated and unsaturated fat and can enrich the diet of the Eco Moyo students.

In addition a mushroom farm will contribute and strengthen the holistic approach for the school. The waste product from mushroom production is contributing to a rich compost which generate fertile soil. This again can generate further growing projects within the school.

There is also an economical aspect influencing the choice of program. Oyster Mushrooms are sold for 60 NOK per kilo, in Kenya and can contribute in keeping the school self sustained and have a regular income.
GROWING INTO HYphae  
MEET AND COMBINE  
CONTINUE GROWING  

FRUITING A PINHEAD  
(BABY MUSHROOM)  
INTO... MYCELium  
... AND GROWING  
CONTINUE GROWING  

Cycle of mushroom growing
Production cycle of cultivating mushrooms:
Commercial farming pushes the growing cycle to happen much faster.
Eco Moyo Educational Centre

300 000NOK

Budget/ annual cost for the entire school

Money from sponsors and Fundraising auction

&

Income from Eco Moyo Mushroom Farm can cover approx 1/6 of the annual budget for the school

Annually: grow and harvest 880-1000kilo of Oyster Mushrooms a year
Growing Cycle: 7 weeks. Starting every 5th week. 10 cycles annually.
Cultivation bags: 100-110 bags of mushroom per cycle
Substrate: Every cycle requires 430 kilo of substrate, 4300 kilo of substrate annually
Mushroom for sale: Every cycle will producing approx 80-100 kilo of mushrooms

Oyster Mushrooms are sold for 60 NOK per kilo in the Kenyan market

Annual income from mushroom production: 60 000NOK

Expenses (annual):
Substrate: 4000 kilo of Hay, 200 bales of hay = 4000 NOK
Bags: 1000 sterilized and filtered grow bag = 4000 NOK
Spores: 7% spores ration of substrate. 280kilo spores= 2800 NOK
Salary: 1 or 2 people will be working at the farm= Undefined

(According to calculations and guidelines from www.gruten.no and www.kuzabiashara.co.ke)
Initial sketch of mushroom farm
Program and farm facilities

**Hay Storage**
- Requirements:
  - Accessible from main road
  - Dry
  - Shaded

**Inoculation Room**
- Cut straw
- Soak in water
- Pasteurize
- Mix in spores & pack in bags

**Spores**
- Requirements:
  - Dark
  - Ventilated
  - Controlled light for insufficent floor area for clean
  - Lockable
WASTE MANAGEMENT

Used and left over hay substrate is gathered in a compost and turns into fertile soil for plants

WASTE MANAGEMENT

Requiemns:
- fresh air
- sufficient circulation

CROPPING ROOM

Store in light, ventilated room, 5-10 days

REQUIREMENTS

- Inspect for inspection
- light
- well ventilated
- high humidity
- water basin
- sufficient circulation
- lockable

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Drill holes in logs, grow outdoor

Place bags horizontal, one hole.

Large trays, one growing room

Hanging (and resting) bags, artificial lighting.

Blocks/bags placed on shelves. Not direct light

Bags stacked in angled structures
Atmospheric inspiration
Winery in Piemonte, Italy. Combination of industrial materials (floor tiles, tanks, pipes etc, and damp, dirt and strong smell of wine and acid. Photos by Jeff Bramwell.
Linear production line with four specific facilities:
1. Inoculation room.
2. Spore running room.
3. Office
4. Cropping room

Giving the linear building a curve, to introduce a direction to the line and to create a defined space adjacent to the farm.

Circular production:
- Splitting up all the facilities in a circular arrangement to define each production zone and the cycle of mushroom growing.

The Hall:
- Testing placing all facilities close to each other to cover the farm under one connecting roof.

Exploring a new arrangement by moving the office away from the curved circulation route.

The Line:
- Exploring a linear production line with a building stepping down and along the contour lines.

The new curved arrangement enabled us to explore space-making and to shape zones adjacent to the farm.
Situated in a slope with 10 percent incline the facilities of the farm need to stretch over 30 meter in length for the site drops with one level. How can we achieve to make growing room no. 1 - the spore running room, to be partly dug down or under ground?

By curving the wall and place it INTO the terrain rather than dug down.
Model to explore the space between the buildings
Section A, 1:50
Towards south, through spore running room and laboratory.

Section B, 1:50
Through inoculation room and cropping room.
External view
View from east

External view
View from south
Due to limited availability of electricity the project aims to utilize natural air ventilation and the heat retention property of the soil. The spore running room is therefore dug down to keep a stable temperature while improving the success for the biological process to occur.
PHASE I:
The farm can function only consisting of the incubation room, spore running room, cropping room and storage. Therefore we suggest that the construction of lab/office awaits till a later stage, when the business has developed.

PHASE II:
Full scheme including facilities for office and laboratory.

PHASE III:
As a wish from the client and the need for more educational facilities we suggest the inoculation room can be used as biology class room for students at Eco Moyo. Due to the cycle of mushrooms growing the facility will be in use at specific times. The spore running room will be occupied permanently, while the cropping room can function as plant germination and propagation space.
Mushroom growing course

To get an understanding of the process of cultivation mushrooms and the facilities needed we signed up for a oyster mushroom growing course with Gruten AS in Oslo.

The course gave an introduction on how to mix substrate, spores and prepare the cultivation bag. The substrate we used was coffee ground. The bag was prepared 30th September and the mushroom fruted in beginning of December.
Mushroom growing experiment on coffee grounds
After several weeks no
Mushroom growing experiment on hay

At Eco Moyo Mushroom Farm the mushrooms will be cultivated on hay substrate. Therefore we did a second test of cultivating oyster mushrooms with a similar procedure, but using pasteurized hay as substrate.

The choice of using hay as substrate is based on research on similar growing project done in hot and humid climate.

Hay is
- easily accessible in Kenya
- cheap
- easy to store
- generate rich and fertile compost as waste product