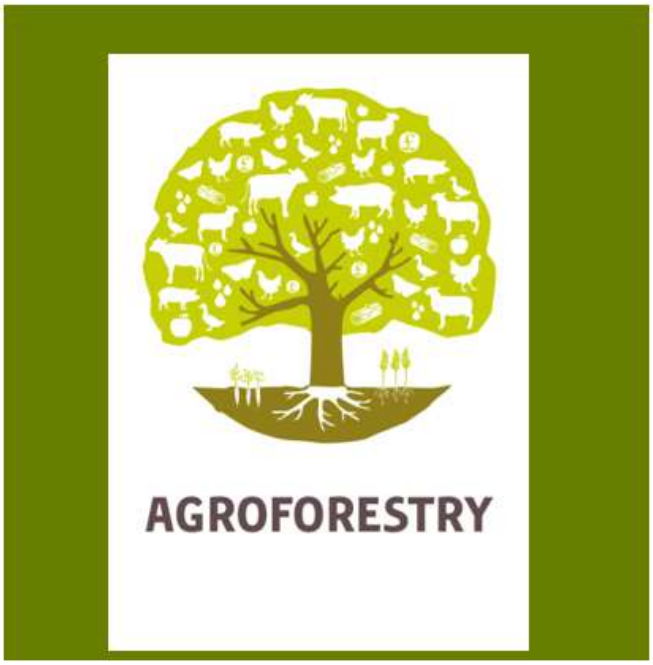
Aqua-Agroforestry



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Coach: Mr Firth
SDG 15

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Introduction:

What is big ideas:

Big Ideas is new and innovated way of project and research learning which is based on the sustainable development goals. Where we chose what SDG, we wanted to base our project on. You might ask what exactly are the SDG's. The SDG's are a set of goals made by the United Nations set to improve certain aspects of the earth to make them more sustainable. Sustainability is producing or doing something but without harming the future

Daniel Thom: I am from Pinelands, known for its beautiful green areas and a flat, calm suburban landscape. I have been to many places with wonderful nature and places where land is damaged and sad. I feel that if the world wants to save its land and stay beautiful, then we should start with the places that use the most land, namely farms. I have seen how poorly used land is when it comes to farming and want others to see this as well.

Sebastiaan Terblanche: I am from Oranjezicht, I was born into a family with different cultures. My dad, a farm boy from South Africa and my mom, a city girl from Belgium. When I was young, I had a real interest in Soccer and played for my local club. I played alongside people a lot less fortunate than myself and they struggled to pay for food. Our agroforestry plan will make food far more affordable as it has a more cost-effective method of farming.

Kiran Pillay: I am from Newlands, but my mom lives in Oranjezicht. I was born into a mixed culture family with my mom from Port Elizabeth and colored, my dad an Indian man from Pretoria. As a young boy. I was extremely privileged as I had the opportunity to travel the world and see different cultures, but the one thing in common wherever I went was my love for going to the Zoo's and seeing the animals. I have always loved animals and almost everything nature based except for cockroaches. I feel the first way we can start making the world a better place is through farms and agriculture as everyone is connected through food.

The problem:

Our project is a new take on agroforestry to improve agriculture in Cape Town and South Africa as a whole. South Africa seems to struggle with droughts an large amounts of unused or unusable land that could be used to farm on, this is plane to see if you just look at the country side. Our agroforestry method aims to improve soil stability and water retention with the use of trees. Our project requires a rather large investment and will be rather expensive short term but will be far more cost effective in the long term. This will lower costs of food which will lead to more people being able to buy food for less. This should allow more people to be fed and to thrive economically as they are paying less for food. Agroforestry addresses SDG 2, 3, 7,8,12,13 and most importantly SDG 15, as agriculture specifically is part of this goal.

We will propose the idea to multiple farmers. The land we aim to use is in Stellenbosch as it is a sloped area, making it ideal for our idea. Our agroforestry design uses dams, trees and a slope. Large amounts of land are not considered for farming as it is on a slope and has poor water retention as well as poor land fertility. Agroforestry will improve all these aspects and uses the slope as an advantage. We see many issues with the current unsustainable way of farming and know that the world needs new ways of agriculture.

Body:

Background information to us and our project:

SDG 15 is the SDG of life on land the SDG focuses on the preservation of land ecosystems, The saving of endangered species, the eradication of invasive species and the implementation of sustainable agriculture.

Initially the group decided to look at the SDGs individual aims and objectives. We saw four problem areas: Invasive fauna and flora, soil and land issues like soil erosion, deforestation and the sustaining of endangered animals and agricultural practices. The group wanted to work with the animal side of the SDG's.

We looked at invasive species of plants and animals such as the bug weed (Solanum mauritianum) and the Himalayan Thar (Hemitragus jemlahicus). These both are problems in South Africa as (Saturday Star, 2011)

Himalayan Thar

Bugweed

The Himalayan tahr was harming the Table Mountain Ecosystem by eating an enormous amount of fynbos which many animals rely on. the lack of fynbos resulted in soil erosion These were our main focus areas and unfortunately used a large amount of our time. We tried to develop an idea using these aspects of the SDG's. We used almost all of our energy in the beginning to find a way to get rid of the Himalayan tahr.

We then investigated poaching and endangered species. We looked at Rhinos, elephants and leopards but realized that it wasn't a topic that we found as captivating and unique.

Sebastiaan Terblanche: The Himalayan Tahr and Bugweed was an idea we just couldn't get out of our heads. The extermination of invasive animals and plants seemed to be the main focus of our project. We struggled to implement this extermination idea into something practical and this seemed to be where we arrived in the cloud.

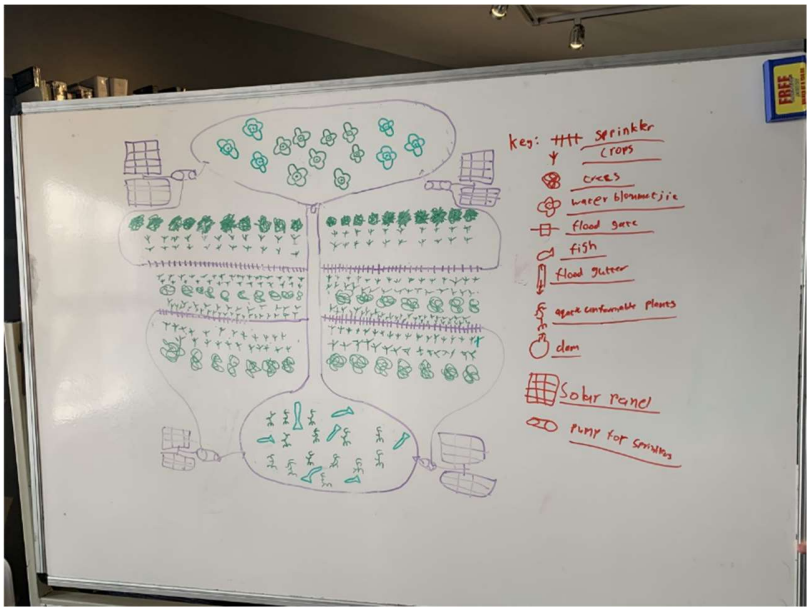
Kiran Pillay: We were going through some ideas and we had found out about how the Himalayan tahr was invasive and was living on Table Mountain. We had also looked at a species called bug weed which was only causing harm to the environment.

Daniel Thom: the group were still looking for ideas and inspiration. We followed the path of invasive animals which took us on a journey through the cape's fauna and flora. The group realized that the tahr idea was full of problems and issues that made any plans for it insanely difficult, so we decided to move on and proceed onto agriculture.

This new idea came completely out of the blue. Just by chance we heard the word agroforestry thrown around. Suddenly, the pieces fell in place. We knew that the idea of agroforestry was nothing new. when going on an outing to the sustainable institute we found an interest in how they had designed their garden and how they were able to save water by planting the plants on a slope. We made a rough draft of what we wanted our farm to look like. We made it so that agroforestry could have a biodiverse closed ecosystem. Agroforestry is the use of trees in farming to stabilize the soil stability in places outside of Cape Town such as Stellenbosch, where large amounts of the farming in the western cape taking place uses basic agriculture. Stellenbosch has a very uneven and

hilly environment making Stellenbosch an excellent place for our design to work. (Wikipedia, 2019)

Rough Draft



Birds Eye View Rough Draft

Our Project:

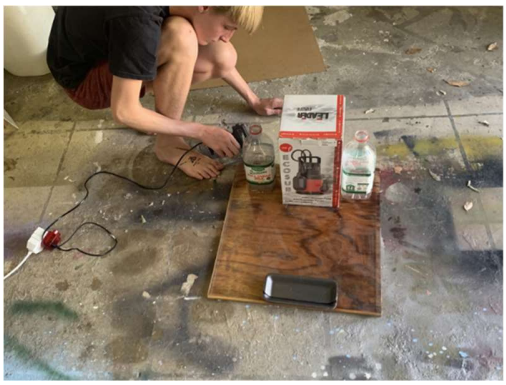
Our project is a design of how one could farm by using dams and agroforestry. Our project would be mostly sustainable, but droughts could make our idea obsolete as with too much time without rain it would cripple the aquatic side of the farm. Our project starts off with a slope with one dam at the top and another at the bottom. It uses two dams so that minimal water is lost or wasted. It is based around a biodiverse closed ecosystem. In between the two dams we will have crops which will benefit with the usage of agroforestry. We will have the trees surrounding the crop patches to create a wind break. The trees will be in alternating rows with the crops with a row of trees for every 10 rows of crops. We are going to be using plum, olive trees as well as apple trees. Plum and olive trees are indigenous and don't require vast amounts of water. We plan to have an ecosystem incorporating aquatic life in both dams. The introduction of aquatic life will make the water more fertile because of all the microorganisms in the water. This water will use solar power to be pumped up to the sprinklers to water the plants.

Our project is going to use the aspects of basic agroforestry. The two main components are trees and crops. The crops and trees are in a one-way relationship with the crops being the only ones benefitting. The trees provide the crops with an improved soil quality (water retention, soil fertility and soil stability) making it a better environment for crop growth. The trees also serve as a wind breaker making it a safer environment for the plants to grow as their topsoil won't be blown away and the plants won't be damaged by the wind. The trees can also be harvested as they will provide a food source. these aspects are all things that have been done before or just scientific facts.
In event of a drought our farm would make use of aquifer. With the use of agroforestry, it will also help the refilling of aquifers when there is a decent rain fall. (Langford, FEBRUARY 25, 2016) in the situation we cannot use a natural aquifer we will be forced to boreholes and natural springs. The initial filling of the dams will use up a lot of water so the aquifer might be strained, or heavy rainfall will be needed. Mulch is also a very important part of agroforestry as it is all the leaves and the scraps of plants. This is

effective as this organic matter has many nutrients that make the ground more fertile and bugs also eat the mulch and their organic matter is packed with nutrients which makes the soil fertile as well.

Agroforestry is the use (Wikipedia, 2019) of trees in farming to stabilize the soil stability. places outside of Cape such as Stellenbosch, where large amounts of the farming in Cape takes place uses basic agriculture. Stellenbosch has a very uneven and hilly environment making Stellenbosch an excellent place for our design to work.

Our model:



Making the base.

Using chicken wire to make the slope.

Sebastiaan Terblanche:

The making of This model was very draining both physically and mentally. The group worked liked a well-oiled machine without the oil as constant basketball, drinks and sword fighting breaks stopped our momentum. The group when doing work worked well and hard and managed to make a beautiful model. It took 2 days to finally complete the project. Those two days were the longest 2 days of my life.

Daniel Thom:

The group spent 2 days at my house building the model. This was very mentally exhausting as we needed to find a way to make the slope and the structure. The group while waiting for either the plaster, paint or glue to dry would be playing with a basketball or with some prop swords. The group actually made progress with the model thanks to the help of my mother.

Kiran Pillay

We had a very efficient weekend as we build the project, it pushed us both physically and mentally as we had to find a way to make the hill the right steepness and the chicken wire to actually fit around the board as the gluing of the wire was challenging but in the end the project wasn't as hard as we thought. We all had a good time as in between the dry time we had fun playing basketball, Call of Duty and prop sword fighting which mainly dominated. The project was a success as we put a lot effort in it.

Wrapping hessian around chicken wire and our project

Soaking the hessian in plaster

First coating of plaster on project

Painting over plaster with spray paint and acrylic paint for water

Adding the trees to the plaster

Final model with the grass, trees, solar panels and resin water.

Research:

Water Security:

In India agroforestry has helped water scarce areas. The major rivers only receive a refill of water during the monsoon which is when big storms of rain hit India. The main rivers in this area could kept flowing for the full cycle of a year if the banks hold but if the banks don't the water will only last about a month. Plants roots will give the soil in the banks a structure and make the soil more solid. This will make the soil harder to wash away so the water has lasted longer in the rivers. This could help Cape Town as we have recent drought problems, and this could help with the saving of water in farm areas. Date 21 October 2019, published date 29th September 2019 05:00 AM

Soil Quality

When tree leaves are introduced to soil, the amount of Carbon and Nitrogen increased which are to key elements for all living animals. "This practice will improve soil chemical, physical, and biological structure."

Most soils that are exposed to all the harsh effects of wind and rain and get washed and blown away. the plants that were growing in that soil end up lacking massive amounts of nutrients. If you plant trees into the soils, you end up with more benefits than you would ever think. One of them being the roots. The trees roots spread out in a wider area than you can see and far more than what the branches do. This means that they can stabilize the soil as the soil stays in place around them. The roots also help the soil absorb water, rather than letting the water wash it away. A reason that trees work better than most plants is that their roots grow a lot deeper than most other plants which provides better stability than other plants.

Climate Action

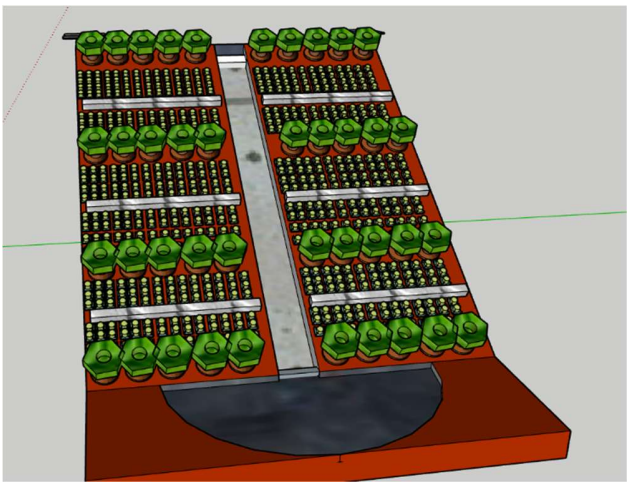
Trees help with oxygen production and help regulate the CO2 in the air. The crops and trees combined will produce more oxygen, but our new design involves an aquatic ecosystem. The algae in water also helps with the CO2 in the air and the flowers on the dam will help prevent evaporation. There will be fish in these dams to help control the pests such as mosquito larva. This nutrient rich water will be used partially to water the crops and trees. This will make the unused water flow back down into the dam at the bottom. The design involves: 2 dams, a slope, fish, fruit trees e.g. plumbs apples and olives, crops, rocks at the bottom to filter the water entering the lower damn, water blommetjies and solar panels to power the pumps. These all involve a natural aspect which will in turn help with making less pollution and helping biodiversity.

The use of solar panels in our project means that we will be completely off the grid for energy. This would help climate action as the producing of energy produces a lot of CO2, especially in South Africa were coal is our main producer of electricity. Coal is very bad for our environment as it produces a huge amount of CO2 when burned.

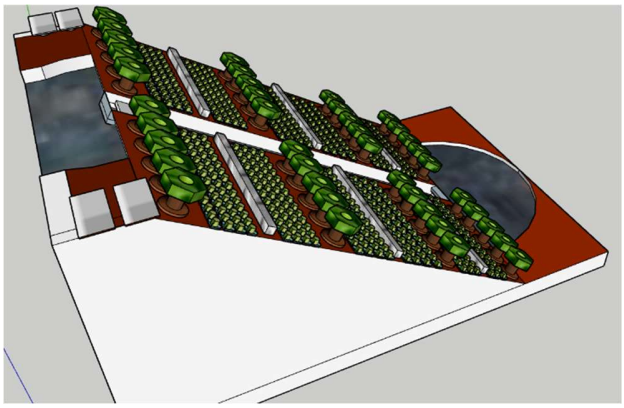
Personal research:

Agroforestry is nothing new, we are not pioneering in the sense that we invented it or popularized it. We have just decided to add on to agroforestry, making it a closed ecosystem by including solar power, an aquatic ecosystem in a damn and a diverse group of tress and crops. We know that there is no agroforestry in cape town or the large farming areas in the cape. The only place in South Africa with agroforestry is in Johannesburg. We have seen how a hill-filled place such as Stellenbosch, with poor farming conditions on hills and slopes, would be a perfect place for our design of agroforestry.

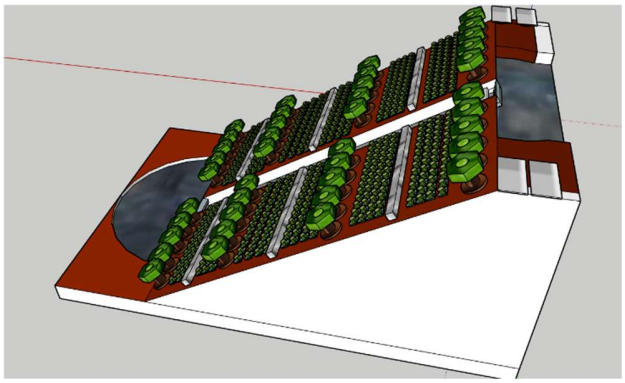
Graphs and drawings



SKETCHUP DESIGN 1



SKETCHUP DESIGN 2



SKETCHUP DESIGN 3

Interview with Sustainable Institute

1. The use of plants as a mulch has been described as useless as it is presumed to not affect the number of nutrients in the soil. What is your opinion on the topic?

   We do not agree with the statement. Plants have a relationship with soils, where both the plant and the soil benefit. Plants are able to build the soil biota and nutrients, that in turn help feed the plant. Plants help reduce erosion, water evaporation, and can also work as green manure to feed the life of the soil.

2. We saw that you used a slope instead of a pump. Would this type of system be effective in a much larger design?

   In our design, the garden is situated on a slope where the garden beds are designed with contour lines in order to catch and store water (apply **water management principles)**. Naturally land is not flat, and regardless of the size of the land, these principles can apply.

3. The use of pesticides is horrible for the environment and can harm our aquatic ecosystem. What pesticide substitute do you use?

   The use of natural farming principles that borrow from nature to understand the ecosystem relationships among all organisms, the same principles are used in what is called an **integrated pest management plan.** We do not use any harmful, synthetic pesticides.

4. What Harvestable trees are best to use in agroforestry? We would prefer them to be indigenous trees that don't use a lot of water.

   In the Western Cape the natural biome is Fynbos and Renosterveld, and therefore does not have trees. This does not mean that it does not have beneficial plants**/shrubs** that can be cultivated, such as rooibos, honeybush, etc. Because there are no natural, indigenous trees, agroforestry can only be doen with non-indigenous(non-endemic) trees. Eg, Num num, Kai apple (indigenous to South Africa, not Western Cape). Find other example.

5. Our project is the use of agroforestry in crop farming with the use of a slope allowing the water to run down into a dam at the bottom of the slope. Do you have any suggestions or ideas that we should implement in our design? (we are trying to make it as sustainable as possible.)

   Unfortunately we cannot advise as we have no experience in this.

The Sustainable Institute were very helpful in the fact that we now have more information to work with but were unhelpful with the fact that the information came so late. We were under pressure as the narrative is due in 3 days and we now have a lot of information to work with but not a lot of time to implement it into our narrative.

Interview with Agroforestry

This was a complete waste of our time as 'the agroforestry people' have shown absolutely no interest in us. I think as a group we have concluded that they will not be helping us, regardless of much we would have wanted them to, with our big ideas journey. Since there is not a trace of Agroforestry being used anywhere but Johannesburg in the country, we had to rely on our own research regarding our project.

We have no information from this interview as we have received nothing from the respective Agroforesters in Johannesburg.

We heard from a fellow Big Ideas student that their dad had a few contacts that were involved with agroforestry. We were so excited to finally get some insight from a group of people have worked in this field specifically in South Africa. We sent our contact details and have be waiting ever since. It is extremely frustrating as our group was looking forward to receiving some firsthand experience from people who work in the agroforestry business in South Africa

Sebastiaan Terblanche: Research was a very hard thing to do particularly with our project as Agroforestry is not very well known and there are not a lot of studies that focus on agroforestry. The contacting of people proved very difficult as agroforestry is once again not very known and Finding the right people to contact proved difficult once we finally found the right people and contacted them, we received nothing. This was very hard to handle as we struggled to deal with something we could not control.

Daniel Thom: we all where avoiding contacting people with this idea as we felt that general knowledge, online research and book research was enough, which in the long run it was. When we finally did contact some people we initially got no response so we essentially gave up until we realized how valuable external first hand experience could be. We continued to ask for a response so we would get the information. When the info came it was too late and essentially useless.

Kiran Pillay: Even though agroforestry is a old practice there was nothing local that was implanting it so we were to

Conclusion:

Even though it was a long road to finding an idea, we eventually realized the way we could impact the SDG with agroforestry. the problem with agriculture in South Africa is that it is very unsustainable. We then looked in Cape Town for agroforestry and realized that there was nothing in Cape Town regarding Agroforestry. We are all very excited about our project and how it can impact farming. Our project is linked with many other SDG and could solve a lot of problems which most people wouldn't usually associate with agroforestry. Our project helps with SDG 2, hunger, as we will be harvesting both fruit from the trees and the main crops. It is also connected to SDG 14 as our dams will have a natural aquatic ecosystem. There are only two main problems with our project: initial costs and a dependence on rainfall. In the event of a drought or a lack of rainfall the dams are at risk and the farmer would need to use spring water or aquifers to keep the dams full or to water the crops and trees. our project will be self-sustainable for the long term as we will be off the grid with water due to the use of our dams, aquifers and rainfall, we will also be off the grid in terms of electricity due to the use of solar panels. Extra income will be brought in by selling the fruit from trees used in our project. We are all immensely proud of our project and happy that we managed to find this idea. Agroforestry can help in areas were the soil lacks quality by having poor water retention for example. in some places in Stellenbosch the land is very rocky. Even though there is a small issue with the weakness to drought the project should be fully sustainable if there is constant rain. We feel that when going forward the main problem would be working around South Africa's Issues with water. We hope that the aquatic plants and shade from the trees help with evaporation.

When designing and making or model we made the executive decision to rather not include the gutter down the center. Its use won’t be necessary as the chances dams that the dam will overflow is incredibly small. The projects stages went over 2 days where the first day involved building its structure and the second, decorating. Everybody contributed to the model where necessary

Kiran Pillay: This group at times has been the absolute opposite of productive and there was a lot of procrastination. There many times in the process that we weren't working and were just messing around, but we needed Mr. Firth to make us aware that we actually had deadlines. Then when aware of those deadlines we pulled ourselves out of it and when pressure was applied we started working hard and become an extremely productive group. One of the problems that our group faced was Basti being sick and when he was at home our group just didn't do any work and switch off. Even though the cloud is a good idea I think that most of us took it as a free ride to doing no work and as nice as the fat sacks are, they made easier to do no work.

Daniel Thom: the group was honestly a mess. I believe that in the big ideas course saying boys cant work with their friends is a bad idea as when working with one's friends you know their work ethic. When working with those you don't particularly know or like you need to learn how they work and maybe if you didn't even know the person you might end up hating the person. I believe that telling the boys about 'the cloud' was a poor decision as it almost gives them an excuse for avoiding finding an idea. Some boys say that they couldn't leave the cloud, but I believe if they didn't have that excuse, they would have a far better idea than no idea.

Sebastiaan Terblanche:
When Mr. Noel and countless other Big Ideas teachers said that just because we were doing Big Ideas we mustn't think that there is less work. Clearly most boys weren't listening including our group. As we lied on bean bags all day without a care in the world. Myself being sick and our narrative due the next week the tension could be cut with a knife everyone was stressed and on edge. If it wasn't for Kiran's constant enthusiasm and Daniel's hardworking nature. The project would have turned out a lot worse than it is now.

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