Testing the production of hydroponic fodder for cattle, supporting climate resilience

System Setup Guide

2024

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Our fifteen month pilot looked to explore if the application of technology, while minimal, can be viable in a rural context to help combat the effects of climate change and reduce conflict in Nigeria. Herders predominantly located in the north of the country are moving south due to desertification, creating conflict as there is frequent encroachment onto farm land.

The pilot team looked to develop a simplified hydroponic fodder system that could be used to ease the pressure on grazing lands and improve local livelihoods. Here we give you an overview of the system and how you might be able to implement something similar in your context.

Note: The following information refers to examples and resources available within Nigeria and countries with similar resources available.

Overview

What is soil-less farming?

As the title implies, soil-less farming is the practice of cultivating crops without soil. This can be done in a variety of ways depending on the crop and different environmental factors dictate which type of soil-less farming method is applicable

The difference between Aeroponics and Hydroponics

The major soil-less farming practices are Aeroponics, Hydroponics and Aquaponics. For the purpose of this technical playbook Aquaponics will not be included as it involves the practice of fish farming, in combination with Hydroponic or Aeroponic farming.

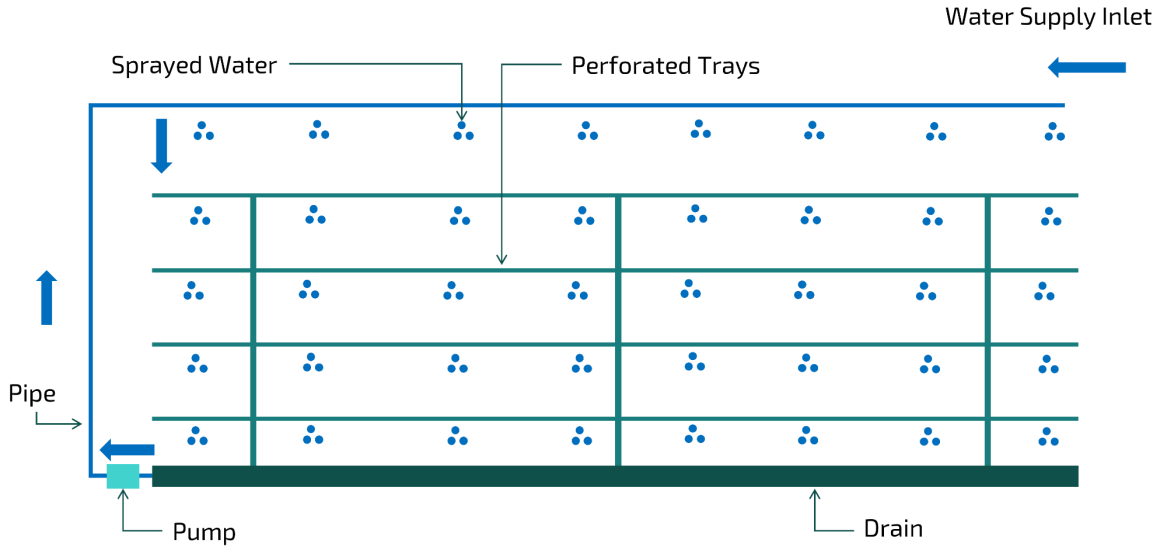
Aeroponics

The practice of Aeroponics involves plants being placed in a structure that will allow the roots to be suspended in the air with misters below to spray the roots at a specific interval.

Hydroponics

A hydroponic system involves plants being placed in a structure in which the roots are submerged in water continuously.

Hydroponic Fodder System



Type of crop and how the system has to be adjusted

Any crop can be cultivated in a soil-less system, however the system structure differs depending on the type of crop and its nature of growth.

Plants can be cultivated in trays, pipes, baskets etc. However, when planting for the purpose of cultivating fodder, a hydroponic system with trays is recommended as they are planted in high density and their own roots in that density are able to provide sufficient support to the grass. This would not be possible for crop such as lettuce or tomatoes, for example, as these plants must be individually planted as well as needing a support system such as a basket that can hold them in place.

Irrigation basics

Once the preferred “holding structure” has been selected (in this case trays for the purpose of growing grass,) the next and most important thing is irrigation. With soil-less farming, it is crucial to ensure seeds/plants are always kept moist while the water should never be stagnant due to risk of bacteria developing. The margin for error is smaller with soil farming as soil can absorb and keep moisture longer, especially underneath the surface, while with soil-less farming roots/plants are exposed to air which may dry out the plants faster.

However, in this system setup, an even distribution of water on the trays is crucial to ensure there are no dry spots anywhere, which would prevent germination in certain areas.

Depending on the size and scale of the system, water may be supplied through manual means such as a watering can. This can also be done at a larger scale by supplying water to a structure (pipe, tray, gutter, misters etc.) that has holes punctured through, with the main water supply coming from an overhead water reservoir enabling water flow through gravity.

Water flow and system setup

The priority for soil-less farming systems is the efficiency in irrigation and water saving. Due to fodder being best cultivated in trays, it provides the opportunity to build racks in various sizes that can accommodate the trays in layers horizontally. By layering the trays, the water flow can be designed to supply every layer, with each layer also having its own drain, or the water may pass from layer to layer through holes in the trays and with a drain at the bottom.

The purpose of the drain is to recapture the water at the bottom and guide it into an underground reservoir. Once the water has been recaptured, it may be reutilized by pumping it back into the overhead tank and the cycle starts again.

Materials that can be used

Due to the moist environment around the system, materials that are water resistant may be utilized to ensure there is a longevity of the structure. However materials with a shorter lifespan such as wood may be

used with the awareness of frequent replacement. Depending on the regions and experience of artisans, water resistant woods such as bamboo may be used as a cheaper and more sustainable option.

The racks may be constructed with metal. However, they will need to be treated with antirust and should then be painted over with waterproof paint. This may have to be repeated during maintenance to maintain the rack's longevity.

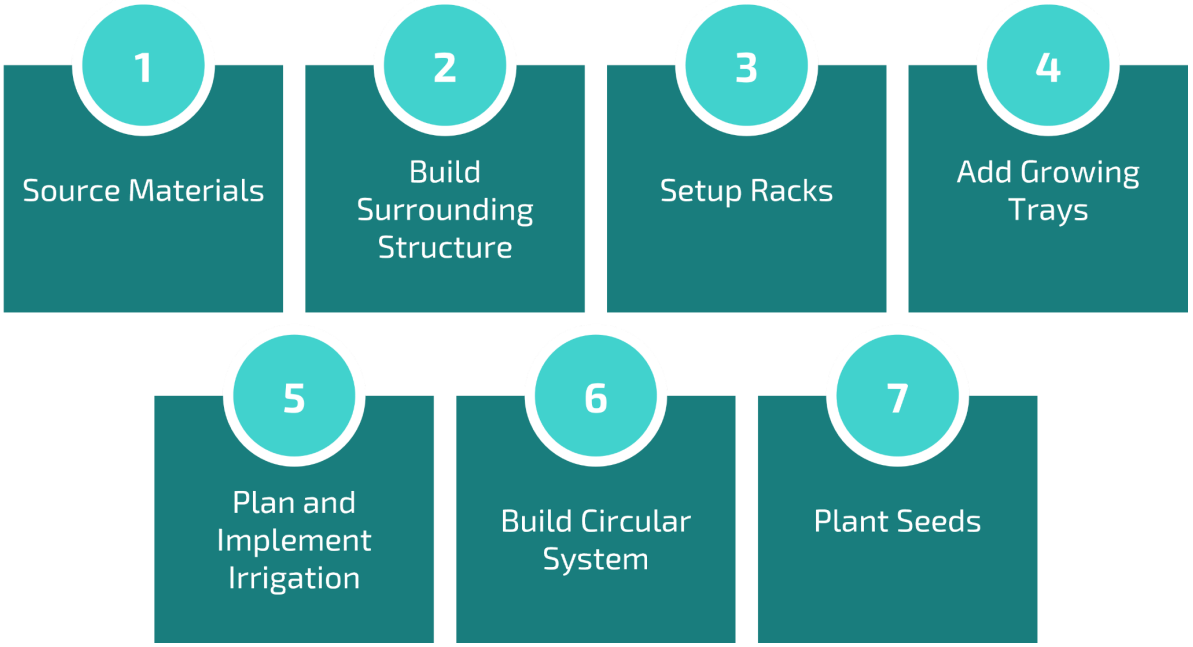
Depending on the resources available, racks made from hard plastic may be utilized, which can significantly increase longevity of the system. However, cost may be a factor as the plastic that will need to be utilized will require a high density to bear the weight, depending on the size of the system.

Grains in Hydroponics

For the purpose of feeding cattle, grains with the highest protein content are recommended. However, it is important to utilize seeds that are locally cultivated and are not directly relevant to human consumption. Barley is preferred but not cultivated in certain African regions due to the humidity which is not favorable for its cultivation, therefore varieties such as Sorghum may be preferred with sufficient results.

Step by Step Guide

We have seen that a hydroponic system can be built in a relatively low cost and relatively low maintenance way while still being significantly more efficient than traditional farming methods. This section outlines the broad steps that someone would need to take to build and run their own hydroponics system in seven steps.



Step 1 - Source Materials

We have deliberately looked to design and build using the most accessible materials available and these will differ based on context. As a basis you will likely need:

Racks These can be built using PVC Piping, wood or angle iron.	**Trays** These can be aluminum or plastic, but will need to be of a material that can have holes added, as mentioned below.
Irrigation This could be as simple as using a watering can or hose, or you could use more sophisticated approaches such as an irrigation piping.	**Seeds** Grains high in protein (i.e. Sorghum, Barley etc.) have performed best in our experience.

Step 2 - Build Surrounding Structure

While natural sunlight is crucial to plant growth, it may also be too harsh at times. Therefore it is recommended to have a “shed type” open structure that provides coverage at the top from sun and excessive rain. Roofing should be at least 1.5m above the first tray layer for there to be sufficient ventilation but also ensures sunlight getting to the plants.

Step 3 - Setup Racks

The rack should have multiple layers for water to flow through each level and irrigate the next. The sections where the trays will sit should be exactly the same and aligned in a way that each tray will be positioned exactly on top of the other in each level.

It should be sturdy enough to take significant weight due to the weight of the seeds, water and the increase in weight over the cultivation window.

Step 4 - Add Growing Trays

Source trays that are waterproof and won’t deteriorate due to the continuous presence of water. Either buy trays that already have holes punctured from the factory, or add these by using nails to make the holes. These holes will allow the water to flow through all the layers and ensure all seeds are wet. Make sure you test the flow of water between each level a few times to get the right number of holes.

Step 5 - Plan and Implement Irrigation

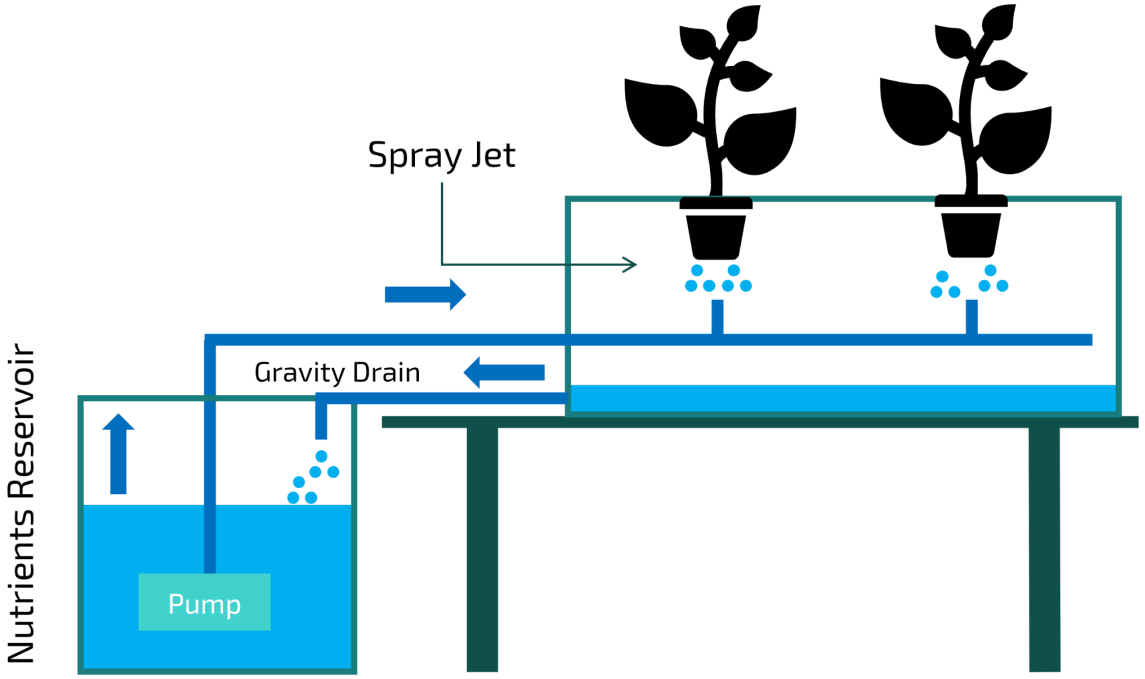
Select an efficient and easy watering mechanism. Depending on the size of the setup, this can be done with a watering can and hose for smaller setups, while larger ones can have pipes supplying water to the top trays through a water reservoir set up above the height of the racks. Gravity will allow the water to flow from the overhead tank but distribution to the other layers will then depend on the holes of the trays in each layer.

Step 6 - Build Circular System

You want to be able to recapture the water that is not absorbed by the plants (which is commonly a lot, as the plants actually absorb very little water). To do this, you can get a large plastic container or something similar and place it below the last set of trays at the bottom. Ensure that the container is bigger than the trays to ensure there is no spillage and waste of water.

Alternatively this can also be done by having a slight tilt of the trays on the bottom layer of the rack and putting holes only at the base where the water will gather due to the tilt. Then setup a gutter below this section and funnel it to an underground tank or any other container to ensure that the water is recaptured.

This water can then be pumped back into the overhead tank or manually poured into the watering cans for irrigation.



Step 7 - Plant Seeds

First wash the selected weight of seeds with water to remove any dust or other admixture. Proceed to soak them in water and hydrogen peroxide (35% hydrogen peroxide, 20 ml to 100 l of water), ensuring the seeds are well submerged. Leave them soaking in the solution for 12 hours, after which they should be washed with water and spread on a clean surface for approximately 2 hours to aerate.

Place seeds on the trays, ensuring sufficient density and no empty spots. Once the seeds are on the trays they must always be moist for good and even vegetation. Depending on the weather this may mean watering every hour or every two hours, till harvest. At night this is not required due to the low evaporation rate.

While they don't need fertilizer due to the short cycle of cultivation, the plants are susceptible to bacteria, fungi etc. As a preventative measure, the water should always contain the recommended dosage of hydrogen peroxide and should be added every week or every 5 days to ensure no harmful bacteria can grow.

Tips & Things to know

- When soaking seeds, place a large mosquito net in the water to make sieving the seeds out during the washing process easier.
- It is better to water more frequently than not enough.
- Some batches of seeds have a better germination rate than others
- Source materials and seeds that are locally available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