Growing Water-efficient Organic Non-foodgrain Trees in Arid India: A Pilot

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Contents

1. Background

I have been inspired by late Peter Hoff of Holland. He was a very innovative man, and a keen observer of nature. Once, he asked himself, "*How did trees grow all by themselves before people started to grow them?"* His answer was that trees learn to dig deep into the soil with their roots till they found sub-soil water.

He converted his insights into an invention named WaterBoxx. His claim was that when you plant a tree with the Water Boxx, there was over a 90 percent chance that it would survive with no watering after the first bucket of water at the time of planting.

In India, BAIF, Pune, got good results with 40 WaterBoxxes. boxes but did not push ahead for two reasons.

First, the Water Boxx is too costly to be used on a large scale. Second, the Water Boxx generates no employment during the year-long plantation activity.

In 2019, I offered to work with BAIF to make a low-cost, alternative system that would not have these two problems.

2. My system

I started with a question similar to Peter Hoff's question. What does a tree need to grow without irrigation in areas like rocky hills or arid plains in India? My answer:

- About 1 litre of water per month delivered to its roots.
- Initial planting in such a manner that the sapling is isolated from surface soil up to a depth of 12 inches 30 cms, preferably up to 18 inches 45 cms.
- Either a photo-tunnel, a device that blocks side-ways sunlight and encourages the plant to grow straight up, or a single stem approach so that up to four feet height, the tree does not branch, and its central root learns to go straight down. I believe that the planted trees should be grown on a single-stem basis so that the roots mimic the tree above and initially grow deep into the soil. A picture of a tree grown by Peter Hoff on a single-stem method is shown below.

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A tree grown with a single stem/ no canopy till over human head**.**

Apart from just growing the trees, I am also thinking about how to get high yields from the land. I am also looking for ways to further reduce costs and improve the output.

3. First trial – November 2019

In November 2019, BAIF agree to implement my ideas in the rain shadow area of Pune amid the Western Ghats rocky terrain.

Planting in November meant that the saplings would not get any monsoon rain. Further, they would face the harshest part of the year from mid-December to mid-April.

A mixed set of saplings that were leftover in the BAIF nursery were planted in the rocky terrain. The workers at the farm were sceptical of the system, particularly of my direction to give the plants a maximum of 1 litre per month by a bottle with a drip feed.

Here are some photos of the initial planting on November 7, 2019.

Land where saplings were planted. Wagholi Centre of BAIF. November 2019.

A hole about 10 inches 25 cms diameter, 18 inches 45 cms deep for the sapling.

A sapling of a tree with a water bottle attached.

A close-up of a sapling with a water bottle attached.

Overview of the planting method implemented.

Many saplings planted.

Results

Some bamboo saplings were included in the planted group. Quite early in the trial, all the bamboos wilted away. For the time being, we are not further planting any bamboos by this method. Possibly, bamboos being grass, they are not suitable for tree growing methods.

In the middle of March 2020, a pandemic struck India. So, there were no workers left to provide any water to the plants just five months after planting.

The first visit to the plantation took place in November 2020, a little over one year after the planting. In this period, the saplings had received water from the monsoon, as would any other plant in the area.

All the trees, apart from the bamboo, had not only survived but were thriving! Hundred percent success.

A tree being measured. Trees had become about 4 feet 1.3 m tall. November 2020.

On August 14, 2021, some 22 months after the saplings had been planted, some trees had grown to be over 5 feet 1.5 m tall.

All watering was stopped after the first year and the trees are now growing by drawing sub-soil water.

The success does not imply that water table is just 4 to 5 feet below the surface; there may not be a water table at all over large areas of rocky/arid terrains. Instead, the tree roots are able to gather their needs from traces of sub-soil water and thrive while digging further down the terrain.

A tree 22 months after planting. August 2021

4. Second trial - a scientifically valid trial

While the results from the first trial were excellent, they were not scientifically valid because there was no control group of trees to which these trees could be compared.

The experience in planting these species by traditional methods in hostile rocky terrain is that the survival rate is just around 10% , and the growth is stunted. Neither reforestation is sustained by these species, nor is the yield satisfactory for horticulture.

The trial is designed to test the survival rate and growth by my method against the traditional plantation.

The second trial began in Wagholi August 2021. A senior scientist at BAIF, Dr. Takawale, designed the second trial, which is being implemented by Dr. K.K. Singh. Dr. Takawale has designed a 150-tree trial, with 75 saplings planted by my method, and another 75 saplings planted by conventional method. The trial will last a year but an interim report will be released. The objective is to measure the comparative survival rate and growth rate of same species trees planted by the two methods in hostile rocky terrain.

Dr. Takawale has designed a 150-tree plantation with 75 being control and 75 being by my method. There are five species:

- Neem *Azadirachta indica*
- *Karanje Millettia pinnata*
- Jamun *Syzygium cumini*
- Tamarind *TamaTrindus indica*
- Shisham *Dalbergia sissoo*

They are advocated for agroforestry and horticulture activities. The saplings, 60 cm to 90 cm tall, were procured from a government nursery and were planted in 2 X1 meters spacing in 3 replications.

These have been planted from August 14th to August 22nd.

5. My method

Photo
Step 1 Dig a circular hole 18 inches 45 cms deep. 
Step 2 Cut PVC pipes of 18 inches 45 cms length, diameter 4 inches 10 cms 

Step 3

Put the PVC pipe is put into the hole

Step 4

Fit wicks in Recycled Water bottles.

Step 5

Connect Water Bottle with drip to the hole with the PVC pipe

Step 6 An important step is not illustrated here.

When the saplings grow in plastic containers, they develop some circular/bent roots. Some such roots curve inside into the potting soil. Before planting, the potting soil is to be loosened around the central trunk, and all curved roots are to be ruthlessly pruned.

Step 7

Sapling is inserted on top of a four-inch layer of soil

Step 8

The tree planting is complete

All trees are planted

6. Conventional method

A hole 12 inches deep is dug; filled with a mix of good soil and vermi-compost and the sapling is planted into the hole.

7. Additional cost of my method

Capital Costs: There are no capital costs associated with my method.

These are the additional operational costs of my method.

Operational costs are divided into material costs and labour costs

Material costs:

1) 4 Inch PVC pipe 15/18 inches in length — Rs 40
2) Recycled water Bottle — Rs 2-3
3) Wick 1.5-meter length — Rs 3
4) Plastic cover for wick — Rs 3

Labour Costs:

5) Labour cost — Rs 24 per year

Assumption One labourer can fill some of the bottles each day and look after 3,000 trees planted in a 1 kilometre long by 15 meters wide strip.

Daily MNREGA Rates for Maharashtra * 300 days/ = 238*300 =Rs 71,400

The total production cost is about Rs 70-80 right now.

An experiment is on to reduce this cost to Rs 40-50 per tree.

Further experiments may reduce the cost to Rs 30 per tree.

Right now, everything is designed to last just one plantation.

8. Benefits of my method

- Near hundred percent chance of survival for agroforestry and forestry species. No money wasted in repeated plantation year after year.
- Forests can be regenerated rapidly at low costs with local employment benefiting the country as a whole.
- Tree planting season is de-coupled from the monsoon and can be done throughout the year. Many more trees can be planted so that critical mass for trees to pull down the clouds is reached quickly. Small animals and insects can also re-generate in favorable environment.
- By disconnecting the source of water from the plantation method, my method frees me to explore cost efficient, off-grid ways of generating water such as active dew condensation by a variety of technologies. It also allows rain water harvesting technologies to be used.
- Economical income can be generated for arid area farmers from horticulture.Within horticulture,may fruits like pomegranate, Seethaphal, apple ber, dragon fruit, etc. will be tried out so that the farmer has a wide choice for income generation. The income can be increased by inter-cropping of pulses and shrubs that goats eat.

- Holes, in orchards with irrigation, can be filled with fresh trees and yield improved. Presently this is not practiced as the soil below the hole is rocky and a sapling does not survive.This will also yield additional income.

9. Ongoing planning

Soil-testing and growth treatment of soil at plantation stage is to be implemented.

I am planning to inoculate the starting soil with suitable mycorrhizae. The technology of growing mycorrhizae is well known to BAIF. The **inoculation** will allow the tree to draw nutrients from the roots as they **go** deep into the soil without any nutrient being added at the top.

At the start, in arid zones, where feasible, intercrop areas are to be covered with a layer of vermi-compost and dug three feet deep with a JCB. Most likely, the arid soil has never been turned over and is devoid of any air and micro-organisms. Traditional tractors will not turn over the rocky terrain economically, but a JCB will **breathe** life into the soil, and vermi-compost will help it to grow. Pu**l**ses and shrubs will nurture the soil further. For level terrain, this looks economical. Addition of baggase ash along with vermi-compost is also planned to be tried.

By disseminating the method widely and openly, other more knowledgeable people can improve the process of planting, nurturing, and getting the benefits.