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Sustainable Food Farming: A Study in a College Campus

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Abstract

This paper projects a methodology for sustainable food farming. It comprises of adopting practices like permaculture, irrigation with recycled Bio Remediated (Effective Microorganisms) waste grey water, use of organic fertilizers and pesticides and use of carbon enriched soil. To validate the effectiveness of the methods, the farming has been performed on a sample size land. The results of the sustainable food farming are compared to the national average production using conventional methods of farming with inorganic inputs. This paper can be useful to those who envisage a self-reliant community with healthy organic food grown locally, leading a healthy lifestyle and consequently an overall reduction of carbon foot print.

Keywords: Sustainable food farming, permaculture, effective microorganism, soil carbon.

1. Introduction

In order to create a sustainable food program, it is essential to first understand what actually is meant by sustainable food. Sustainability in food is anything from food production, transportation and to its disposal. It is not just one action, but a long lasting way of doing things. There is no legal definition for this, but basically sustainable food should be produced and processed by not damaging natural resources and contributing to negative climate change. Arguably sustainable food should also provide social benefits such as good quality food, safe and healthy products. In fact small steps taken in sustainable action will lead to huge environmental benefits. Low-input sustainable food gardening carried out on a small scale vacant or marginal land in urban and rural areas can provide huge benefits to the nation's environment, society and economy. When growing food on-site, food costs will also get reduced and composting provides free fertilizer. Sustainable food should be produced close to residential areas to a greatest possible extent, so that the food is fresh, seasonal and also supports local

economies. In addition, when food is produced locally, the need for transportation and energy use in food production is minimal, and thus pollution and contributing to climate change is minimized. Such a simple, zero technology sustainable food gardening of few square meters provides tasty fruits and vegetables with our kitchen organic waste and grey water.

Permaculture is a method for designing sustainable food gardening. It is based on an integrated and functional approach to design where the use of ecological principles guides the weaving together of earth, water, plants and animals into complex balanced landscape patterns. That have the diversity of natural ecosystems while providing food, energy, shelter and the recycling of wastes. Within the system the output of one component provides the resources for another and no component is included unless it has more than one function. Although mixed cropping (supposedly mimicking ecological diversity) can reduce disease, but other crop combinations can accelerate disease spread. There is a deep rooted common notion that organic crops take time to grow. Competitive organic farmers keep their fields clear of weeds through frequent mechanical weeding — a method that damages nesting birds, worms and invertebrates — and high use of fossil fuels, which greatly increases pollution from nitrogen oxides. The above scenario gave motivation to adopt a simple, scientific and zero energy method for high productive sustainable gardening.

The main contribution of this paper is the implementation of sustainable food gardening using simple, traditional and scientific methods for high productive sustainable gardening, which can be adopted by individuals or a community to meet their daily requirements and lead a sustainable living. The remainder of the paper is organized as follows. For easy presentation, the detailed description of the methods adopted with practical considerations and implementation are addressed in Section 3. In Section 4 the practical challenges encountered and the control measures undertaken are discussed. Finally, brief results and conclusions are drawn by comparing the obtained results with that of national average values in Section 5.

2. Background Study

Sustainable food gardening is the act of farming using principles of ecology, the study of relationships between organisms and their environment. The phrase was reportedly coined by Australian agricultural scientist Gordon McCLymont. It has been defined as an integrated system of plant and animal production practices having a site-specific application that will last over the long run.

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The no-tillage cropping system, a combination of ancient and modern agricultural practices, has been rapidly increasing in use. Soil erosion, the major source of pollutants in rural streams, is virtually eliminated when no-tillage agriculture is practiced. The no-tillage system reduces the energy input into corn and soybean production by 7 and 18 percent, respectively, when compared to the conventional tillage system of moldboard plowing followed by disking. In addition, crop yields are as high as or higher than those obtained with traditional tillage practices on large areas of agricultural land.

In 1982 Dr.Higa at the University of Ryukyus, Okinawa, Japan, discovered a specific group of naturally occurring beneficial microorganisms with an amazing ability to revive, restore, and preserve. He named this group E.M. (Effective microorganisms). Microorganisms are tiny units of life that are too small to be seen with the naked eye and they exist everywhere in nature. Microorganisms are crucial for maintaining the ecological balance. They carry out chemical processes that make it possible for all other organisms including humans to live. There are friendly guys of the microbial worlds known as beneficial microorganisms and a not so friendly group called pathogens that are harmful and capable of producing disease, decay and pollution.

Soil is complex and hosts a vast pool of living organisms and while it is not always clearly understood, the benefits of increasing organic matter (carbon) to soil function have long been known. These include preservation of soil structure, improved aeration, water infiltration and water holding capacity, encouragement of earthworms and other soil fauna. Soil biology remains, it seems, undiscovered although some practitioners appear to be moving forward by taking more care and applying biological principles and preparations to enhance soil organic matter and carbon levels.

3. Proposed Approach and Implementation

To implement any task successfully the key foundation steps are strategic planning and religious hard work. The general steps that should be followed in any farming are: plot selection, plot division, soil testing, watering, tilling and soil amendment, seeds selection, composting, embankment, sowing of seeds, fencing, transplantation of crops and crop monitoring. In addition to the conventional basic methods the additional steps that we proposed are: use of effective microorganism and earthworms, use of carbon enriched soil, Neem oil, garlic powder, turmeric powder and zero synthetic chemicals. A brief description of proposed methods and the implementation of each method is described below:

3.1 Land Selection-

A 10 ft. x 10 ft. land was selected to perform sustainable farming. The land was covered with thick bushes and very less amount of gravel/ stone content. The grey water (bio-remedied) outlet is about 30 meters far from the selected land. The sunlight is direct on to the field between 7:30 a.m. to 5:45 p.m. of the day.

3.2 Land Arrangement

All the unwanted plants, weeds, plastics and sticks were taken out using fork, pick axe and shovel. While removing the unwanted plants it was observed that there are many plants which are useful and they are the result of gardening of previous batch students. The disfigured land was leveled and modeled into rectangular shape, to save the area.

3.3 Soil Testing

Soil is tested for mainly two parameters – acidity and water holding capacity. The methods are described below:

(i) pH: The pH value of the soil which determines the acidic/ basic nature of the soil is determined using litmus paper. The litmus paper neither turned blue/ red, indicating that the soil is neither acidic nor basic i.e., the soil is fit for cultivation.

(ii) Water holding capacity: The water holding capacity of the soil is tested by watering the plot, around 8:00 am in the morning and calculating the time taken by the soil to get completely dried**.** During these days, the average temperature was about 32 degrees Celsius. The time taken to dry during day-hours was more than 9 hours 30 minutes.

3.4 Wetting of Soil

Embankment was made around the plot to hold water. The entire plot was kept wet using grey water. As the initial land was left uncultivated for months, it became hard. Wetting the land loosens the soil.

Totally 10 liters of water has been used in this process. This process is crucial as if not done the germinated seeds finds it difficult to grow.

3.4 Tilling and Soil Amendment-

A rake was used to loosen the soil. Its driven deep into the soil and pulled up. This increases the air flow into the soil and helps in maintaining the root health. This also allows the compost to mix well with the soil.

3.5 Seeds Selection

The factors that were considered while selecting the seeds are availability of water, sunlight, Climatic conditions, yielding time, rate of growth, pH value of soil and environmental factors. Taking into consideration of all the factors the seeds that are selected are ladies finger, spinach, amaranth, ridge gourd, tomato, brinjal and green chili.

3.6 Compost Selection and mixing

The organic compost prepared using dried leaves, lemon caps, coconut shells, food wastes etc. was spread over the soil and mixed. Their ratio was selected depending on the climate and the soil texture.

3.7 Embankment

As the seeds need more water during germination, a methodology must be chosen such that there will be a continuous supply of water. So, Embankments are made to ensure efficient and adequate water hold to roots.

I. Sowing of Seeds- Not every seed requires the same way of sowing. Some need them to be sowed in land directly and some needs to be sprinkled on the land. At most care must be taken while sowing the seeds as a wrong method may not let the seeds to germinate.

J. Fencing- To protect the crop from rodent and other animals, the plot was fenced. No artificial means were used. Thorns, sticks and jute wires were fastened together tightly on the front side of the plot.

3.8 Use of Effective Microorganism and Earthworm

In a view to increase the production E.M. and earthworms were used. 50ml of E.M. was mixed in a bucket full of water and the mixture is sprinkled all over the field. The living earth worms were mixed with soil and the field is watered to increase the microbial activity.

3.9 Relocation of Crops

\At start the tomato and brinjal seeds were sowed in a small temporary area. After the saplings have grown to 10 cm, the crops were relocated to a new location where they were placed with sufficient spacing. By doing this the yield is increased.

3.10 Crop Monitoring

The crop was monitored twice a day. Watering was done in orderly fashion. We made sure that fencing was strong so that no animal intrudes into the plot. Neem leaves were scattered all over the plot in order to prevent the plants getting infected. Garlic powder was spread around the plot to prevent from snakes.

4. Problems Faced and Control Measures

In implementing any idea there will always be some practical problems hindering the flow of the project. In this section the problems faced while implementing the proposed ideas and the control measures taken to overcome them are discussed.

4.1 Problems Faced

Since there was a huge distance between the pipe and the plot, extended pipe connectors were used for the watering of the plants. Due to wild animals, the plants in the plot got damaged and the plot had to be protected for the same. Due to insects and pests, the leaves of the crops got damaged. The weather fluctuations in Ettimadai affected the growth of the crops and aided in weed growth.

4.2 Control Measures

In order to overcome the problems faced the following methods are adopted:

4.2.1 Mulching

A 4 to 6 inch layer of mulch has been used to completely discourage the growth of weeds. Although a 2 to 3 inch layer is usually enough in shady spots where weeds aren't as troublesome as they are in sun, 4 to 6 inch mulch is used as the sun in the field is not consistent.

4.2.2 Neem Oil

10 ml of Neem oil was mixed in a half a bucket of water and is sprinkled on the field to avoid the pests and insects attacking the plants.

4.2.3 Garlic Powder

It's a traditional practice to used garlic powder to prevent the intrusion of snakes into the fields.

The garlic is dried and made into powder upon which it is mixed in water and sprinkled all around the field.

4.2.4 Fencing

To protect the crop from rodent and other animals, the plot was fenced. Natural material like thorns sticks and jute wires were fastened together tightly on the all side of the plot.

5. Results and Conclusions

After 8 weeks from sowing the seeds, the plants started to yield. The ridge gourd gave the yield in every one week, ladies finger after every two days, spinach in every one and half weeks. The tomatoes started to bear the fruits but had wait till the colour of it turns from dark green to light green. As the chillies were sowed just 4 weeks back it will take another 3 weeks for the fruits to come.

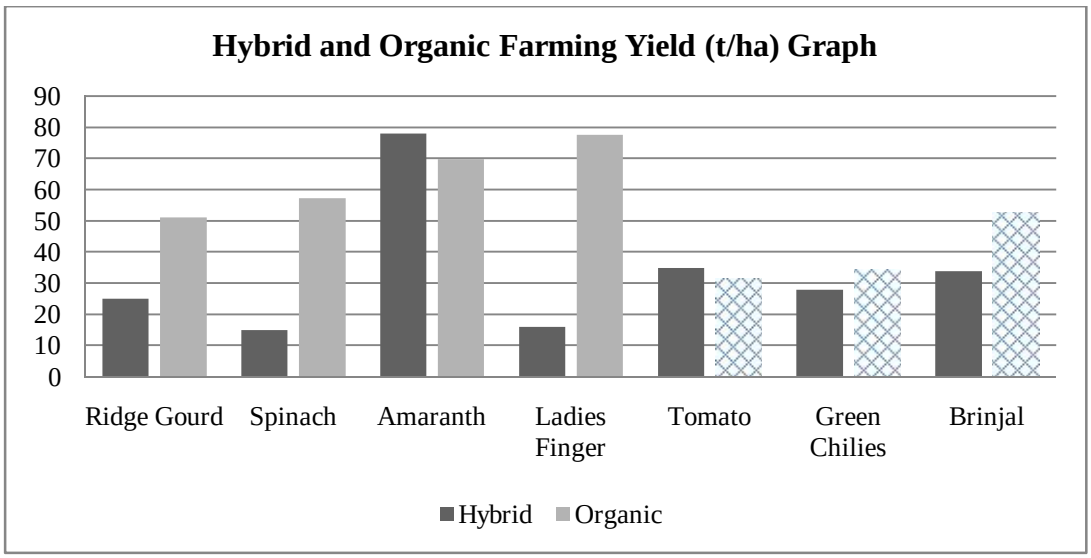
The yield is quantified and the output is shown in the table 1, with parameters like time taken to get yield, each yield and the total yield till date. The obtained output values and the time taken of both organic (obtained values) and conventional (national standard values) are tabled in table 2. The figures 2 and 3 show a graphical difference between the output of both organic and conventional farming.

Table 1: Organic Farming Yield Data.

S. No	Type	Time Taken For Full Growth (days)	1st Yield (Kg)	2nd Yield (Kg)	3rd Yield (Kg)	4th Yield (Kg)	Total Yield Till Date (Kg)
1.	Ladies Finger	35	0.487	1.413	2	2.1	6
2.	Spinach	30	0.183	0.310	0.340	0.469	1.2
3.	Amaranth	25	0.760	0.815	0.842	0.583	3
4.	Ridge Gourd	35	1.225	1.175	1.150	1.125	4.75
5.	Tomato	65	-	-	-	-	-
6.	Brinjal	65	-	-	-	-	-
7.	Green Chili	-	-	-	-	-	-

Table 2: Average Yield Data and time duration for Organic Farming and Conventional Farming.

S. No	Type	Hybrid Farming Yield (t/ha)	Organic Farming Yield (t/ha)	Hybrid Farming time (days)	Organic Farming time (days)
1.	Ladies Finger	16	77.73	90	70
2.	Spinach	15	57.4	45	35
3.	Amaranth	78	53.8	25	25
4.	Ridge Gourd	25	51.128	160	65
5.	Tomato	35	-	135	-
6.	Brinjal	34	-	150	-
7.	Green Chili	28	-	200	-



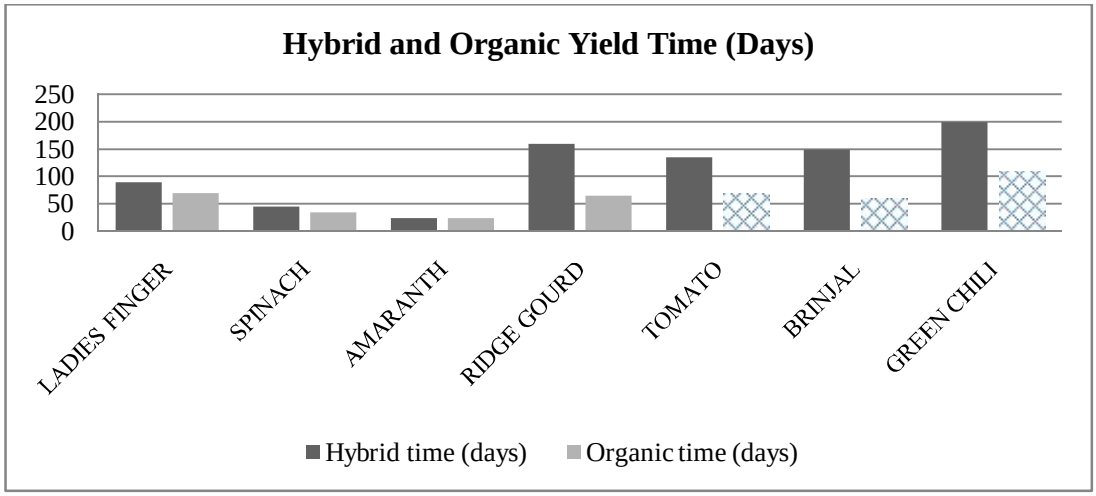


Figure 1: Comparison Graph of Organic and Hybrid Farming.

Note: 1) The tomatoes, chillies and brinjal didn't yield as on date, so their yield values are not mentioned in the table.
2) As the tomatoes, chillies and brinjal didn't yield as on date, the values for the graph are the estimated valuesbased on the number of buds to the plant and average weight of each vegetable.
3) Although the Farming was done on a sample land the output values are converted to per hectare so as to make a qualitative comparison.

The comparison shows that the organic farming is far way better than conventional farming. The proposed methods are well suited not only for large scale farming but also in small scale. Adopting green practices like this one as a community or as a nation at large will help the country to fight back the poverty, inflation, degrading economy and mother earth.

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