

The way to the future of self-sustainable agriculture

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Food is one of the most vital resources for a human being to survive. Therefore production and management of food in requisite proportions are necessary for a growing civilization. We, humans, are heterotrophs means we can't synthesize food for ourselves. Therefore we and other heterotrophs are merely dependent on the autotrophs that are the plants. Eating flesh is just like adding another step to the food chain, thus our main focus in this article is agriculture.

The problem with agriculture:-

Our methods of farming are too unstable and inefficient; it makes the soil infertile after cultivating a long period of time in the same farmland. We went heavily dependent on agriculture in the last decades. The need for self-sustainable farming is arising. So here in this article, you will get to know the ways to develop self-sustainable farmland.



Upholding the soil biome:- "Soil is alive, killing it would be lost in nature". The phrase refers here to the biome of the soil that makes it robust and stable for vegetation. Naked and dry soil (here naked refers to the absence of topsoil) is often eroded by exogenic forces. You may observe in a forest that the trees and vegetation are connected to each other either by their roots or by a type of fungus that

performs a symbiosis this overall solves the nutritional requirements. The soil also contains some microbes that are mutually

benefited by the plants. Furthermore the leaves in the canopy above decrease the force of water droplets during rain which stops it to erode the soil. So, we have discussed how the forest ecosystem protects, we have to imply the same process to some extent in our farmland. Using fertilizers is not necessary it is just a convenience, it just solves the problem of food shortage in an instant but it doesn't fit for the long

term. The microbes that we are going to discuss here are:-

Mycorrhizal fungi:- Fungi are heterotrophic organisms that extract food from the living plants and are mostly referred to as parasites, the plant from which they are sucking the food is known as the host. Most fungi species have the feature to extract minerals and other nutrients from the soil by the decomposition of organic matter. Some of these species also live in a mutual relationship with the host plant, such relationship or symbiosis is known as Myccorhizae. During myccorhizae thread-like structures called mycelium consisting of hyphae invade the roots of the host plant. The hyphae are much smaller than average-sized plant roots and it's only about 4 – 6 μm . So it goes deeper and extracts much more minerals than the roots of a plant, also it covers a large surface. The extracted mineral is then shared via mycelium with the plant with an exchange of a certain amount of food by the host plant. The plant produces more sugar when it needs more of its nutrients. About 10% of the plant species are capable of performing this kind of symbiosis. Grasses, flax, and legumes are the types of crops suitable for it. Don't worry the plant performing myccorhizae is not in scarcity of its own food it is a non-disease association, a plant is already

been genetically adapted to this for millions of years. It produces sufficient sugar to treat such fungi. Arbuscular mycorrhizae are the most commonly found mycorrhizal symbiosis that occurs in rice and other grasses. Mycorrhizal fungal spores are available today in the market but some may not be effective for certain plants. Researchers of Amsterdam found that mycelium also behaves like a network to plants under an area that performs the exchange of sugars, enzymes, nutrients, etc. They also termed these fungi "The traders of the soil". Therefore, mycorrhizal fungi seem to change the way of agriculture to an extent, more research and development in this field are required for controlling its growth, minerals exchange, etc. in cultivation.

Nitrogen fixers:- Nitrogen fixers are a class of bacteria that converts atmospheric nitrogen into soluble compounds that can be absorbed by the roots of plants. They are mostly found in the root nodules of leguminous plants such as gram, moong bean, etc but as well in grasses too. These microbes thus, play an important role in the nitrogen cycle and perform ammonification. The most common of its kind is the Rhizobium that is found in the legumes. In grasses such as sugarcane bacterium called

Gluconacetobacter diazotrophicus performs the nitrogen fixation.

Nitrifiers:- Nitrifiers are bacteria that perform nitrification. Nitrification is the conversion of ammonium into nitrites by certain bacteria. The most commonly known microbe here is the comammox bacteria, which have the capability to perform the two different processes of nitrification at once.

Denitrifiers:- The last piece of the nitrogen cycle is carried out by denitrifiers. They perform denitrification where nitrate and nitrite compounds are reduced to gaseous forms of nitrogen, mostly nitrous oxide (N_2O) and nitrogen (N_2).

Earthworms:- An earthworm is an invertebrate that lives mostly in soil and belongs to the phylum annelid. There are more than 3000 species of earthworms worldwide. They can be found in different layers of the soil. Their size can lie anywhere between 1 millimeter to the largest of about 25 cm! Earthworms play a very significant role in improving the physical and chemical nature of the soil. Earthworms are detritivore means they feed on the dead and decaying plants or animals as food. In doing so they break organic material into smaller and soluble fragments upon which fungi and bacteria can

act, releasing nutrients in the soil and increasing soil fertility. The burrows made by it make the soil porous and thus help it to retain more water. Earthworms also balance the carbon to nitrogen ratio indirectly improving the growth of plants lying on the soil. Earthworms also play an important role in the food chain. In farming thus an earthworm is necessary for the management of nutrients in the soil.

Cover crops:- A cover crop is a crop used in farming to fill up the vacant land. This ensures the protection from erosions strengthens the soil and prevents weeds. Till now we came to know that vacant and dry soil is no longer safe for cultivation, it is often eroded by rain or blown away by strong winds. Thus, the roots of a cover crop hold the soil tightly and the leaves decrease the force downpours. Also, many farmers face the problem of weeds, which are unwanted residues that suck nutrients from the soil. A cover crop covers empty landmass in farmland and thus the weeds get no space to colonize the area. In a cover crop plants like cabbage, wheat, barley oats are most preferred for a better profit as it provides food along with their given function.

Using a variety of plants during cultivation selectively:- Farmers often cultivate with the same kind of

plant collectively known as what we called a crop. But a crop is weak in defending against pests and insects. A forest in this case works together as a living body and has a better performance in shielding those pests and insects. A plant has a feature to make anti-pests and insect syrup that triggers the invaders to fight. But this might fail to a specie unknown to the plant and its kind.

While in a group of diversified plants there is a better defense to the cultivated lands as



different syrups by the different plant is produced and thus increasing the probability of its effectiveness.

Applying No-Tilling or Zero-Tilling Farming:- The term zero-tilling or no-tilling is an umbrella term that is often misleading, it is a process of tilling where tilling is done in a minimum amount as much as possible. During harvesting, the stems of harvested crops were chopped out for decomposition instead of burning. This leads to an automatic layering of the soil by humus year after year. Our farmers in the last few years were using the process of applying brute force to the soil, for the reason of removing weeds and insects. This definitely works in short term but ends the disaster. This is kind of like

damaging the soil ecosystem as it kills all the beneficial microbes and living creatures beneath the topsoil and also dries it rapidly. As a result, we fall into the requirement of fertilizers, manures, etc. Zero tilling also needs less effort and energy than conventional farming techniques. The idea of zero-tilling farming was first started in the 1940s by the author

named Edward H. Faulkner but was first demonstrated in 1961-62 on several farms in the united states. Today

the Indian govt. is subsidizing and providing training to the farmers. There are many tools developed in the past years and today it is easily available in the market. It is necessary for making such a revolution in farming for sustaining the growing population of the future. The idea of zero-tilling thus reached every farmer in our nation.
