The Journey of Organic Farming

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PREFACE

Over the past decades, the pressure towards finding an organic approach towards safe food production has been unprecedented. This is not only to find natural ways to improve human health, but also to save the earth from catastrophic climate changes.

For most, the word organic symbolizes food. A conscious move towards an alternative pathway to make a new and better world – one where the approach would be for nature, of nature and with nature is now a big discussion across social classes. Covid-19 has magnified this intention to move, globally. People are becoming aware of the environmental situation, health and food safety and the importance of food security as climate changes continue to happen.

There might be many alternative pathways but most certainly the number one pathway is organic and natural cultivation. Because this is the only pathway which doesn't need new inventions, new technology, new or unknown knowledge. It simply needs us to change our habits, maybe return to some old practices while taking lessons from recent history and our mistakes as a species. This is an achievable pathway and when we achieve it we will ensure our long term healthy survival and our world's survival too.

But changing is difficult. Hopefully this discussion and the ones to follow will help with this change and influence others to change.

1. What is this Organic

Theoretically, a compound without any carbon bondage is defined as inorganic. But we cannot simply claim all carbon compounds are organic. Well yes! So instead of understanding what is organic agriculture we will understand the holistic meaning of the organic approach, how meaningful is this practice where nature gives all the components to us not only for our survival but also for the betterment of all life forms.

1.1. A Look Back

Just about a hundred years ago, there was no concept of this fancy word, ‘organic farming’ because no inorganic components were discovered and used for farming. But we couldn't produce as much as the growing human population! Possibly, after WWII, the ruling class understood that until and unless the food , the main component for survival, is controlled properly one cannot rule the people.

Top most agriculture scientists were given the responsibility to find out productive options to increase crop production. Ultimately, these scientists developed the first inorganic fertilizers from naturally found raw components. It was applied in the fields and it produced massive results. First, it was applied in the USA and they found remarkable achievements considering profitability. The main reason behind this immediate success was that the plants were being given minerals in inorganic forms, as in artificially.

1.2. The Impact of Inorganic Fertilizers

Nitrogen (N), which is available 78% in nature but cannot be directly consumed by plants,, was one of the primary nutrients in the fertilizers. Other nutrients like phosphorus, potash, calcium, magnesium, sulphur as primary and secondary chemical nutrients were also developed. Like many other invented pharmaceutical

products, it was not tested thoroughly because the science behind the nature of nutrient intake in plants naturally and artificially is mostly the same.

Plants extract N only from Ammonium (NH_4) or Nitrate (NO_3) whether from nature or from chemical fertilizers. N is responsible for protein and amino acids which are needed for plant growth and cell formation. In nature, the process of mineralization to ammonification is done by microbes which produce NH_4 and also a byproduct is NO_3. The excess amounts are again converted to minerals (immobilization process). Thus, a balance is maintained on how much plants can consume and how excesses are recycled.

In contrast let's take the example of Urea–$CO(NH_2)_2$. Urea is converted to NH_4 by the microbes. But during this conversion it releases hydro carbonate (HCO_3), which ultimately releases Carbon Di-oxide (CO_2) and you have global warming! Further, if the total NH_4 is not utilized properly by the plants, it is converted to NO_3 which is a negative ion. The colloids, the smallest particle of soil, cannot hold NO_3.

The amount of NO_3 is more when created from chemical fertilizers., This excess mixes with groundwater and contaminates it or it becomes Nitrous Oxide (N_2O). N_2O is extremely potent even more than CO_2, and it also depletes the ozone layer. N_2O has a shorter life span; so reducing it could have a faster and significant impact on global warming.

So the natural practice (made by the microbes) somehow maintains ecology whereas the industrially produced practice disrupts the whole ecological balance within the soil by the absence of microbial activity which ultimately affects the atmosphere through GHG like NO_3, CH_4, CO_2, N_2O and others.

1.3. The Gradual Downfall of Nature

The problem is that we still do not know how confident we are in understanding agriculture sciences. It is variable from place to place, climate to climate, the character of land, availability of natural resources and multiple other daily factors which cannot be captured or measured. Even with tech integration, the absence of historical data to train machines to analyze the present condition, prepare reports and maybe predict the right moves is a mammoth task. On a large scale, globally such a network of interconnected data might be able to help in the future. So let's look at how we reached a state of innumerable factors influencing agriculture.

Fortunately initially our country was not affected with chemical hazards in the same time as the West as this secret recipe was not shared with other agro-based countries to maintain monopoly and earn profit without competition.

Chemical fertilizers were introduced in India with the green revolution movements in the sixties. Dr. Swaminathon, the agriculture scientist, took the responsibility for its promotion. Since it is a ready food for the plants, a massive crop production proved the authenticity of the new practice. The state itself promoted it by giving solid subsidies to the corporates. Consequently within a decade our socio- economic structure was impacted. But not all impacts were positive. Until then the primary condition has been the unique and sustainable integration and management of all rural activities. This had changed in the absence of the natural biological cycle.

(Livestock played an important role in the agrarian countries and more so in India because of our small land holdings and a large population possessing no or minimal land. The Indian livestock sector

contributes close to 4% of the Indian GNP compared to agriculture's 42.4%. For the ecological balance, especially in agrarian countries, Animal Husbandry (A&H) plays a vital role in agriculture)

The chemical fertilizers are basically salt in nature. When it is applied in the field, non-utilized chemicals form anaerobic conditions. Therefore the condition of ideal soil (25% air, 25% water, 45% mineral and 5% humus) is disrupted by the absence of air. At the same time primarily the soil is also disrupted by the absence of microbes (ideal soil is 1.11 cr microbes per one gram of soil) because of anaerobic conditions.

With the fertilizer based farming approach, there was an absence of natural fertilizers, which naturally come-off from the excreta of livestock animals (which is also considered as microbes feed) because of **fast deterioration of A&H activities**.

With this total disorder of the natural atmospheric condition, farmers faced a new **problem of pests** which was absolutely unforeseen and difficult to manage at the heightened scale. Generally, in natural conditions the percentage of pests should be 5% maximum. In the new chemical set up , farmers found so many pests in the field which were unknown till now. Ultimately a new chapter was opened by the agriculture Department, namely Integrated pest management which ultimately supported the corporates and their fertilizer based solutions.

They instantly developed numbers of **poisons** to manage these pests and the farmers had no other alternatives but to use them knowing nothing of its impact.

Day by day, the cost of cultivation increased resulting in a decreasing percentage of profit.

Before the chemical era, Indian farmers were considered a **multipurpose field force**. Now most of them even do not know what is the function of urea. Initially, the application of urea in the crop was 650 gm in one hectare which ultimately was approved up to 1.65 kg by the scientists. Now there is a strong debate among the farmers considering application of urea– whether it is forty or fifty kg per bigha or more.

What followed repeated fertilizer applications was **heavy metals** accumulation in the soil. Cadmium is the heavy metal of most concern because it may affect human health . Other heavy metals used in chemical fertilizers are arsenic, chromium, lead, mercury, nickel, vanadium etc. Though these mostly are easily available in the soil their increased amount have created other life threatening life risks.

Even some acids like sulfuric are used to produce Diammonium phosphate (DAP) and Monoammonium Phosphate (MAP).

In the chemical era, we are much concerned about **mineral availability** for the plants. But if we analyze the plants by dissection, we will find that the carbon and oxygen contained is nearly 45% each with hydrogen 6%. Therefore out of 100%, 96% is from the non-mineral part and the rest 4% is from minerals. But the entire chemical fertilizer focuses on minerals and creates a huge issue with excess which lead to the harmful effects.

Before the chemical era, farmers were not supposed to understand so many complications of agriculture sciences. They would know naturally which plant needs how much light, heat, air, water and which nutrients come from nature. They knew their land and tasted the acidity using their tongue. But the mathematical calculation needed to safely and sustainably practice inorganic farming is too complicated for any farmer and too difficult for any state to

implement without the factors discussed in the beginning of this section. Even at this stage, no agriculture scientists can forecast the exact amount of chemical inputs for any particular crop cultivation for any land without a thorough and long-drawn analysis. There are so many factors related as discussed before! Science could have progressed on this route but the immediate benefits, especially of the corporates, have till now eluded the long term benefits of human life.

In contrast, there are so many natural fertilizers available for organic practices from the wastes generated from the biological crop cycles and animal outputs. Out of only five components needed for the plant growth(discussed before), only the development of nutrients for plants, both in chemical and biological, are different. Other four components are more or less the same as before as there is no scope of human interference.

As per government. data, in 1952-53, chemical nutrients needed was only 70,000 tonne for 52 million tonne crops, whereas in 1999-2000 for 206 million tonne crop production, chemical fertilizers needed was 18 million tonnes, 250 times more within five decades. Basic science behind the utilization of chemical fertilizer is that during chemical changes, some enzymes/hormones must be available in the fertile soil. For example, urease (hormone) is needed for the chemical changes of urea.

With the increasing volume of production in chemical practice, **absence of microbes** is responsible for excess chemical application which ultimately pollute either ground water or atmosphere. Before the chemical era, the farmers would not only conserve manure for the future but also had the knowledge and home grown technology for **seed conservation** that increased productivity through continuous reproduction. In the chemical era, the farmers were wrongly guided by the **hybrid seeds** which have no reproductive capacity. As a result

after three to four decades, farmers were habituated to using seeds from corporates which ultimately converted them from the multi-skill to bonded workers with no control on input factors.

Recently, the terminology of hybrid has been used for **GMO** (Genetically Modified Organisms) which is a technology practised by the insertion between plant and animal kingdom gene which is absolutely against natural ecology. If we study ecological physiology, physiological ecology, environmental physiology, evolutionary physiology, the difference in the biology of plant and animal kingdom makes them capable of coexisting. It will be unfortunate for human civilization if we want to develop a living organism where the gene is incorporated from animal to plant, especially if the holistic impact on crops, soil, air, humans, livestock is not studied over a long period of times across geographies. But even with limited data sets GM crops are now common and we don't know what long term effect awaits us.

Today the farmers treat cultivation as a **processing technology** which is to provide a formula of nutrients for the specific crops and this is absolutely unscientific. Just for example, if we follow any guideline published from the agro industry, intelligently they just give information of nutrient balance. Now, technically the guide just trains the farmers on chemical practice following the formula given by the corporate. At the same time it is not possible for the Government to provide real-time soil testing data before every crop planning to every farmer. So they don't know the nutrient condition of their soilis. The agro-retailers also have a role and vested interest in pushing excess fertilizer as they are considered the doctor of agriculture by the farmers. As a result, within four to five decades, volume of chemical inputs have increased by 250 times and the unused fertilizer is continuously polluting the environment in an endless cycle.

1.4. Soil – The Primary Medium of Plants

Soil is the main medium in which crops grow to feed and clothe to the world. To understand soil fertility, every farmer should understand the basic needs of crop production. Only a productive soil does not give productivity if other factors do not complement it properly. We also deal with other mediums like water, sand, coco-peat, water hyacinth for crop production which come under hydroponic, aquaponic and aeroponic methods. These are applied on a static principle. Soil is the only medium where the planning should be done based on the character of land. In West Bengal, India, there are eight characters of land declared by the soil scientists — hill soil to Ganges based silt soil. They have also detected at least 20,000 characters of soil in this state. Its fertility mainly is influenced by PH(presence of hydrogen. There are several factors, depending on soil characters:

1. parent material (developed from acid or basic rocks),
2. precipitation(heavy rainfall leeches ,minerals like calcium and magnesium and replace acid like aluminium, hydrogen and magnesium),
3. decomposition of organic matter(by micro organisms into organic acid),
4. native vegetation(tends to be more acid than those developed under grasslands),
5. crops grown(more acidic at the time of harvesting),
6. soil depth(loss of topsoil),
7. nitrogen fertilization and
8. flooding.

Therefore in organic farming, farmers should select those crops which will get plenty of support from nature and not be dependent on artificial factors..