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Benefits of organic farming on soil and crop health: A case study

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Abstract

Organic farming system in India is not new and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment. It was observed that the regular application of vermicompost improved the pH status from acidic to normal. Initially the majority of the soil samples were deficient in organic carbon, nitrogen, phosphorous and potassium, the application of vermicompost over a period of three year improved the fertility status to sufficient.

Keywords: Organic farming, organic carbon, vermicompost, productivity, economics

Introduction

With the growth of Indian economy, the share of Agriculture in GDP has declined over the years and even today productivity of some agricultural products is lower compared to countries like USA & China. The growth in Indian agricultural sector has had its moments of glory, nonetheless. Green Revolution (Pioneering work by agriculture scientists and the efforts of farmers, popularly known as the "Green Revolution", had helped achieve a breakthrough in the agriculture sector in the 1960) has been the major success story of free India. The nation that was frequently plagued by famines and chronic food shortage before green revolution, today faces surplus. The Agriculture Sector occupies centre stage in Indian economy embodying three thrust areas as (a) to promote inclusive growth, (b) to enhance rural income, and (c) to sustain food security. It accounts for nearly 14% of GDP, about 13% of exports and supports half of the country's population as its principal source of income^[1]. Though it was largely a win-win for the economy, this development faced criticism. The overuse of fertilizers and pesticides diminished the soil's nutritional value and destroyed important insects and wildlife organisms. In addition, poor farmers who lived in remote regions lacked adequate infrastructure to properly apply the revolution process. The Green Revolution was not perfect, but visible results were job creation, increased incomes and self-reliance.

The scientists have realized that the 'Green Revolution' with high input use has reached a plateau and is now sustained with diminishing return of falling dividends^[2]. Certain health problems, environmental degradation, contamination of surface and groundwater, and global warming are some of the issues which aroused due to extensive use of chemicals^[3]. Thus, a natural balance needs to be maintained at all cost for existence of life and property.



Fig 1(a): Organically grown paddy



Fig 1(b): Organically grown wheat

Organic farming system in India is not new and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco-friendly pollution free environment. There are four principles behind the organic farming are

1. The principle of health: Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.
2. The principle of fairness: Organic agriculture should build on relationships that ensure fairness with regard to common environment and life opportunities.

3. The principle of ecology: Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
4. The principle of care: Organic agriculture should be managed in a precautionary and responsible manner to protect the health and wellbeing of current and future generations and the environment [6].

FAO suggested that “Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs [2]”.

Key Characteristics of Organic Farming Include (2)	
1	Protecting the long-term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention
2	Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms
3	Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures
4	Weed, disease and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, resistant varieties and limited (preferably minimal) thermal, biological and chemical intervention
5	The extensive management of livestock, paying full regard to their evolutionary adaptations, behavioural needs and animal welfare issues with respect to nutrition, housing, health, breeding and rearing
6	Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats

Ayurved Research Foundation (ARF) a public charitable trust, undertakes various initiatives for the sustainable integration of livestock and agriculture for the benefit of farmers and society at large Fig:1(a) and (b). Our Organization has demonstrated the importance of Biogas technology and Vermicomposting to the rural youth through awareness and training program. ARF provides inhouse vermicompost to the farmer, helped to construct vermicompost pits at farmer’s fields and also provides soil testing facility to enriching Soil Fertility and improve the productivity, hence to improve rural economy.

In Year 2016-17, ARF introduced Organic farming project in collaboration with NABARD to demonstrate the benefits of Organic farming over conventional farming towards safe food, better soil and human health with farmer of kisan club in Panipat District. A study was conducted at ARF R&D Centre to analyses the importance of organic farming over conventional in economic and environmental terms. The

objective of the study is to evaluate the productivity and environmental aspects of organic farming towards more sustainable production.

Methodology

The study was implemented at 10 villages of District Panipat, Haryana with group of farmers who adopted the organic farming over conventional farming to provide safe food, better soil and human health.

Diagnostic Survey

In order to develop a better understanding of the demography conditions of Panipat district, a diagnostic survey was conducted. During the survey following observations were recorded at the field level shown in Table 1:

Table 1: Observation during diagnostic survey

Parameters	Observation
Facility of irrigation water	River or tube well are the main source of water being used for irrigation.
Procurement of organic seed	The purchase of organic seed turns out to be very expensive and, in few cases, contaminated with seed borne infections on the land of the farmers.
Technology	Lack of knowledge and awareness about the GAP
Marketing	Improper marketing facilities
Bioformulation	Procurement of low-quality product from the market

Selection of villages

Group of farmers were selected from 10 villages of Panipat i.e. Didwari, Naultha, Balana, Buana Lakhu, Urlana, Chhichrana, Dahar, Kaith, Shahpur, Israna, Waisri, Sodhapur who grow vegetables and cereals in large scale. 1 acres of land was used by each farmer for organic farming demonstration and 2 vermicompost pits were constructed at each farmer’s field.

Training and demonstration program:

ARF organized 8 training programs with 400 farmers on importance and benefit of organic farming, importance of soil and water health, use of appropriate amount of bioformulation, vermicomposting, seed percentage germination determination at ARF R&D Centre Chidana as shown in Fig: 2. Organization established 12 demonstration plots of 1-acre demonstration plot, 2 vermicomposting units at each farmer’s field.



Fig 2: Training programs at ARF R&D center, Chidana

Vermicompost Production:

Vermicomposting is the scientific method of making compost, by using of earthworms which are commonly found living in soil, feeding on biomass and excreting it in a digested form. Earthworms feed on the organic waste materials and give out excreta in the form of “vermicasts”

that are rich in nitrates and minerals such as phosphorus, magnesium, calcium and potassium. These are used as fertilizers and enhance soil quality. The farmers (beneficiaries) used pit method to make Vermicompost Fig 3.



Fig 3: Vermicompost pit at farmer’s site

Quality analysis of organic seed

After procurement of seeds by farmers, its physical and germination rate were studied in Seed germinator at 30°C, 65% RH for 5 days at ARF R&D Centre Chidana. More than 95% germination rate was considered to be good for seed sowing. Physical parameters such as fungal or bacterial infestation, size, foreign matters, etc. were also examined.

Quality analysis of Soil

Soil Samples were taken generally two times in a year, after harvesting of Rabi and Kharif

Crop. Soil Samples were collected by a trained person from a depth of 15-20 cm by cutting the soil in a "V" shape as shown in Fig:4. It was collected from four corners and the center of the field and mixed thoroughly and a part of this picked up as a sample and then be transferred to laboratory for analysis. Air-dried the soil samples in shade, discarded the plant residues, gravels and other materials, crushed the soil lumps lightly and grounded with the help of wooden pestle and mortar, passed the entire quantity through a 2 mm stainless steel sieve, for organic carbon grounded the soil further so as to pass it through 0.2 to 0.5 mm sieves, remixed the entire quantity of sieved soil thoroughly before analysis [5].



Fig 4: Collection of soil samples

Result and discussion

The results of different parameters were compared against the conventional method.

Table 2: Nutrient content of the soil

Parameter	Conventional method	Organic farming		
		1st year (2017-2018)	2nd year (2018-2019)	3rd year (2019-2020)
pH	6.43-8.99	6.56 - 8.59	7.10- 8.45	7.21- 8.19
OC%	0.1-0.45	0.20- 0.70	0.21- 0.78	0.28- 0.82
Nitrogen (Kg/ha)	50-227	100-350	115-390	140-410
Phosphorus (Kg/ha)	2.51-17.95	1.23- 35.3	1.39- 39.5	3.4- 49.5
Potassium (Kg/ha)	120.6 -250	119.8- 343	122- 356	130- 380

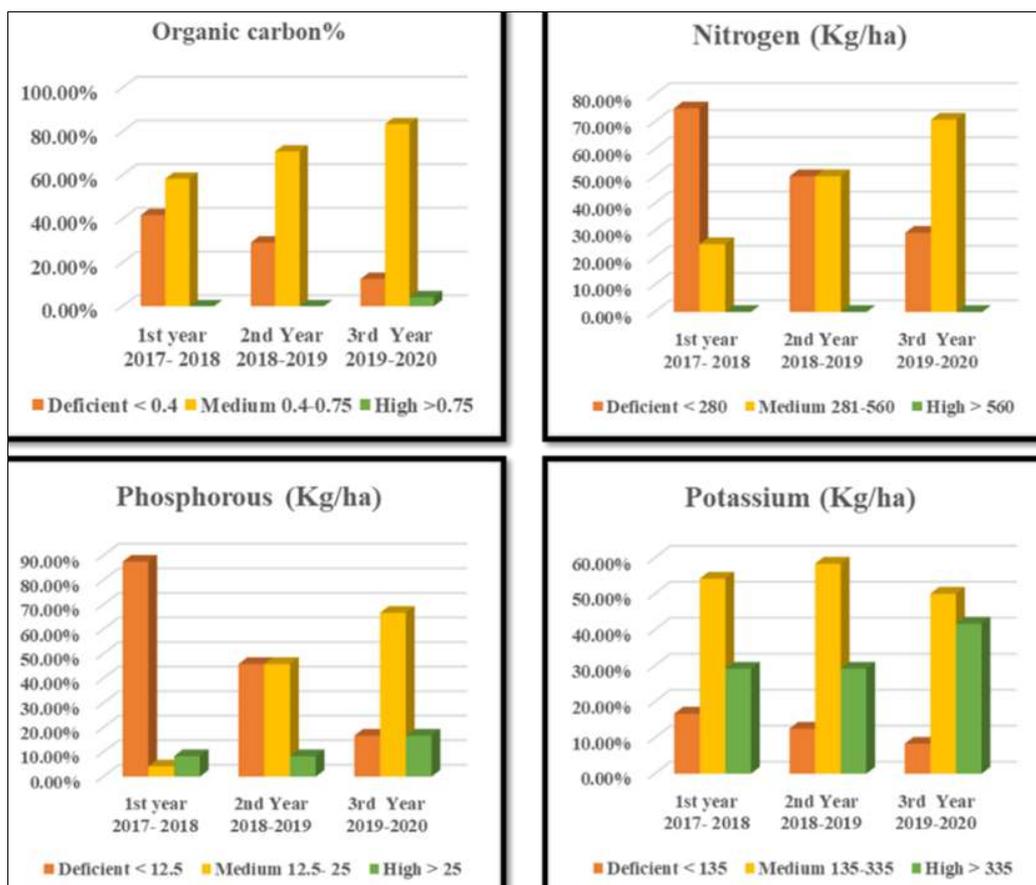


Fig 5: Graphical representation of improved soil nutrients profile

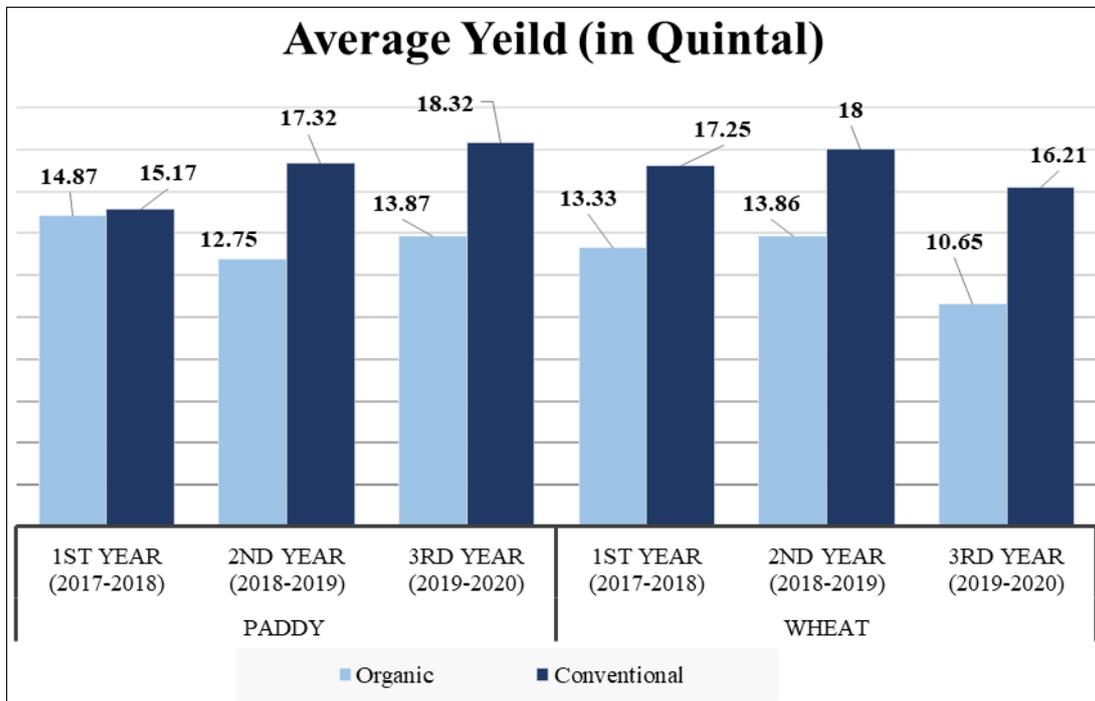


Fig 6: Average Yield (Organic vs Conventional)

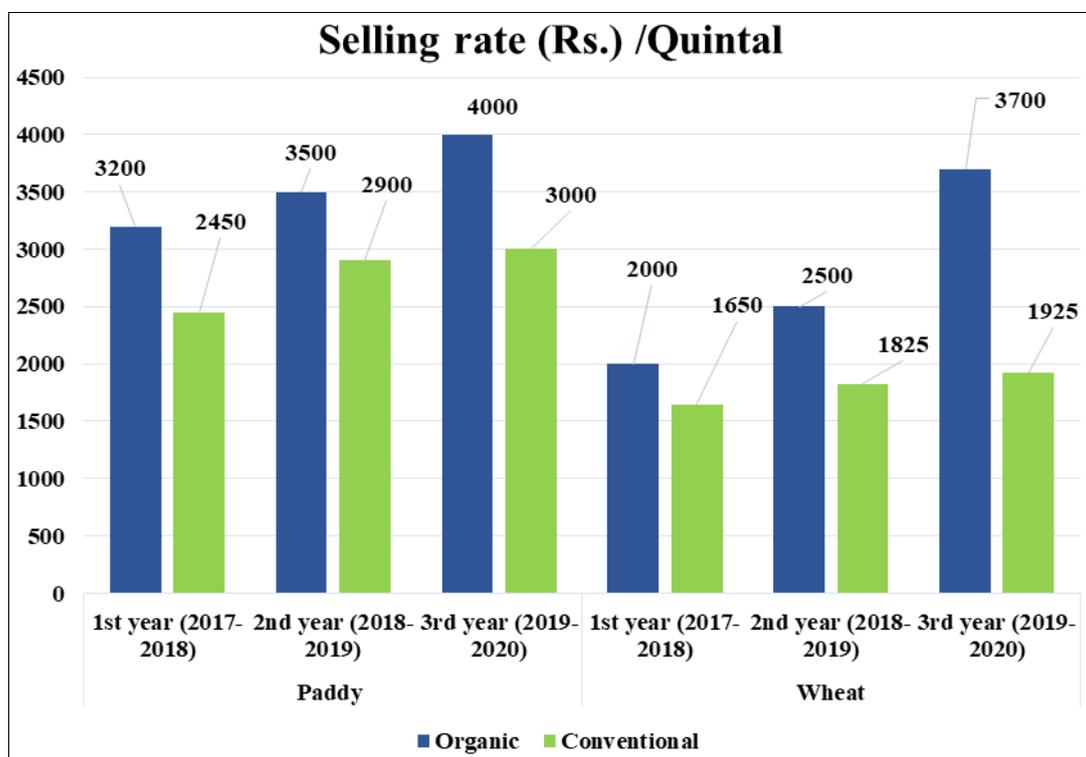


Fig 7: Comparative Economics (Organic vs Conventional)

Soil health and its fertility are most important criteria for sustainable farm profit through its productivity. The impact analysis was understood in term of three factors- soil health, productivity and economics.

Soil health impact

In organic farming, the soil health start rejuvenating itself by increasing the OC, N, P and K content in the soil which were depleted due to over use of chemical fertilizers. Vermicompost and Jeeva Amrit were used instead of chemical fertilizer which enhance soil nutrient and increased the beneficial microbial population. As a pesticide, neem

oil, humic acid, mustard cake liquid, etc. were used. In organic farming, crop rotation was performed due compensate the soil with the nutrients. Dhancha, Mung, lobia were cultivated between the kharif and rabi crop so, that nitrogen get accumulated.

It was observed that the regular application of vermicompost improved the pH status from acidic to normal. Initially the majority of the soil samples were deficient in organic carbon, nitrogen, phosphorous and potassium, the application of vermicompost over a period of three year improved the fertility status to sufficient, as shown in Table-2 and Fig 5.

In terms of soil health, it was found that organic farming was more beneficial than conventional farming. It not only enhanced the soil nutrient contents, but also increased the rate of microbial activities which in turn increased the fertility of the soil it also improved biomass availability, enhanced water retention, lesser soil erosion as compared to conventionally farming.

Productivity

Paddy and wheat are mostly grown in different district of Haryana. During the study, it was observed that due to the pattern change from conventional farming to organic farming, there was a downfall in productivity. Two seasonal crops were selected for the studies. Paddy as a kharif crop and wheat as Rabi crop were selected to compare the productivity. In paddy crop Productivity was decrease in the range of 1.98%-24%, whereas in wheat it was a decrease by 22.72% - 34.30% (Fig-6).

Economics

Owing to people becoming health conscious, organic produces are great in demand. Though the yield was less in both paddy and wheat, but there was a huge difference in the selling price as shown in (Fig-6 and Fig 7).

In the year 2017-2018, the selling rate for organically grown paddy was Rs.3200 per quintal in comparison to Rs. 2450/per quintal as MSP for conventionally grown. In 2018-2019 and 2019-2020, selling price for organically grown paddy were Rs. 3500 per quintals and Rs. 4000 per quintals, whereas MSP set for the conventionally grown paddy were Rs. 2900 per quintals and Rs. 3000 per quintals respectively. Market for organically grown wheat has showed huge difference as compared to wheat using conventional method. In 2017-2018, MSP for wheat was Rs. 1650 per quintals and in 2018-2019, it was Rs. 1825 per quintals whereas organically grown wheat was sold at a price of Rs. 2000 per quintal and Rs. 2500 per quintal in respective year. In 2019-2020, the price drastically increases with organically grown wheat. The selling price per quintal was Rs. 3700 and for conventionally grown wheat, it was Rs. 1925 per quintals as shown in (Fig-7).

Conclusion

Organic farming is more beneficial in comparisons to conventional farming. It set a healthy interaction between the agriculture and ecosystem. It increased the organic content, microbial activity, enhanced long term fertility, aeration which leads to good soil health. Adoption of organic farming avoids all form of pollution which generally is caused due to heavy use of synthetic fertilizers, pesticides, etc. Organically produces are rich in nutrients, free from harmful pesticide residuals which commands premium price, also helps in doubling the farmer's income by reducing the input cost.

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