

Review on changing scenario of technological interventions under organic farming in India

SHIVAM SINGH, JAGANNATH PATHAK, MAHENDRA PRATAP SINGH¹ AND J.K. TIWARI
Department of Soil Science and Agricultural Chemistry, Banda University of Agriculture and
Technology, Banda, 210001 (U.P.)
Corresponding author email: shivamsinghnsacademy@gmail.com

Abstract

Agricultural crop management of the India is facing the various challenges like the lack of co-ordination between the different components of the agricultural practices and inputs such as irrigation water, fertilizers or agro-chemical. The long-term effects show the nutritional dis-orders, low profit, environmental pollution, pesticide persistence etc. towards an alarming situation of soil and environment. The use of high yielding varieties with huge application of the inputs i.e. fertilizers and agrochemicals results in the surplus food grain production as well as deterioration of soil and environmental health, pesticide residues and reduced sustainability of agricultural production. After achieving a certain limit in growth of the food grain production, agricultural scientists and policy makers emphasized to re-evaluate the agricultural practices and agro input management technological interventions on the basis of sustainable crop production and maintain or improve soil health and relied more on biological inputs rather than use of the heavy fertilizer dose and other agro-chemicals. Adoption of organic farming management agro practices is the most important technological intervention for obtaining the optimum quality of the crop produce without deteriorating the physical, chemical and biological conditions of the environment on the large scale. In India, certified organic products include the food grains crops and daily need products such as Basmati scented rice, pulses, honey, tea, spices, coffee, oilseeds, fruits, cereals, herbal medicines, and their value added products are produced. Thus, a review is made on the comprehensive study on the organic-farming practices and technological interventions recently being used in the Indian Sub-continent.

Keyword: Agro-chemicals, organic farming, pulses, honey, soil health

Introduction

During the era of late 1930s, organic farming was first scientifically studied by Sir Albert Howard in 1939 by conducting two experiments i.e. in Hughley Green and Suffolocks in England in the field of two farmers i.e., Lady Eve Balfour and Alice Debenham respectively. Lady Eve Balfour produces product organically while Alice Debenham produces conventionally. From the data of the parameters of yield Sir Albert Howard did the comparison between the quality of products and soil he published first paper titled "The Living Soil Based On Initial Finding of Haughley's Experiment" which led foundation of key

in the international organic advocacy group (Balfour, Lady 1982). Due to his valuable contribution he is known as the father of organic farming. In 1940's Lord Northbourne who was inspired from Sir Albert Howard's work was first to coin word organic farming in his written book "Look into Land" in the chapter "Farm as Organism" in which he described a holistic approach of balance farming (Northbourne, 2005).

In 1950's India's scenario was different from the other developed countries, as India was facing problem of hunger due to malnutrition, lack of HYVs, various kinds of the diseases which can now be easily curable and many more which were exempted by the use of HYVs, high dose of fertilizers and new chemical approaches resulting loss of soil health, pesticide

¹KVK Sonbhadra, Narendra Dev Univ. of Agriculture and Tech., Kumarganj, Faizabad (U.P.)

toxicity, sustainability of agricultural production and environment pollution. Hence, in India sustainable agriculture was the topic of scientific research but the researches tended towards developing new chemical approaches. Organic farming endorses the concept that organism & plants (i.e. soil, plants, animal & human being) are linked to each other. In the philosophy, organic farming means the farming in the spirit of organic relationship (Stockdale EA *et al.* 2001). This system is acquainted with various merit and demerit but the major emphasis is given to the nutrient recycling which restore the soil fertility by compost formation with the minimum loss (Chhonkar PK, 2002). Currently, the rate of population increases with the increasing rate which needs the technical skill for enhancing the production and productivity to meet the requirement of the burgeoning populations. The prolong use of the chemical and other inorganic fertilizers let the human and soil health hazards and pollute the environment which ultimately disturbs the ecological balance. Farmers are therefore encouraged to convert their own land into organic farm. The organic produce is good in taste and rich in nutrient content, and health conspicuous. Hence, it is spurred by strong consumer demand and having generous price premium. Conventional farming in India was reported to come under organic as mentioned in the Arthashastra (Sofia PK *et al.* 2006).

Organic Sources, Prospective and Overview

At present, around 25-30% of the nutrients indices by the organic sources can be meet by the raw material in the environment which seems to be derived from the organism. However, a small proportion of the inorganic fertilizers mixed with the organic fertilizers the yield and its attributing character approaches up to a maximum extent (Chhonkar *et al.*, 2002). Along with the yield and its character, this method improved the soil health for long term use. The organic sources enhance the fertilizer use efficiency as it prevents the N, P, K from its loss and made available for the plants. The organic source acts as the food material for the soil micro-organism hence they are the energy source for the soil biota. Therefore, it increases the availability of primary or secondary micro-organism. An experiment results the increase the population of the VAM fungi sharply (Nambiar *et al.*, 1992).

Concentration of nutrient in the organically manures are generally low. Such as in FYM, NPK content widely ranges from 0.01-1.9% on dry matter

basis (Zhu ZI *et al.*, 1984; Inoko, 1984). Tandon, 2010, reported that the nutrient composition of the well-rotted FYM is 0.5, 0.25 and 0.5% NPK respectively. The experimental facts conclude that straw of the harvested crop is generally used for trapping the urine of animal sheds and are collected for the nutrient recycling. The straw is then composted and applied either immediately or used for next proceeding crop (Timsina *et al.*, 2001). Due to domestic, national and international market the farmers can get good ruminant from organically produced crop in the crop rotation VIZ, scented rice, table pea and onion (Kalyan, 2005).

Effect on organic nutrient on the plant growth parameter

Organic nutrient due to its chelating action and good water holding capacity helps the nutrient to be retained and results the increase of crop yield. The different formulation of organic nutrients resulted the variable performance in yield and its attributing character. For instance, simply application of FYM in the field increase the grain and straw of paddy up to some extent but when spent mushroom and urinated rice straw is intermixed with FYM the considerable increase in the yield of 20% had been found (Singh *et al.*, 1998). Choudhary *et al.* (2003), obtained increase in the yield and available N of tomato and cabbage in the treatment of Vermicompost and fertilizer @200 gm/plant and 250 gm/plant, while maximum K and soil organic carbon @ 100 gm/plant and 800 gm/plant respectively. Gaur A.C. *et al.*, 1992, observed that, an application of well-rotted FYM @ 25t/ha⁻¹ supplies 112 kg N, 56 kg P₂O₅, and 112 kg K₂O ha⁻¹. It had also been reported that paddy cultivation under the continuous organic farming achieved remarkable quality and quantity compared with the conventional farming system (Tamaki *et al.*, 2002). Baswana *et al.*, 2007, reported that highest yield of the pod (93.96 q/ha) of pea were recorded when FYM and poultry manure in the ratio of 1:1(t/ha) along with mulch treatment of FYM (2t/ha) and bio-fertilizer. Organic farming with dhaincha (*Sesbania aculeata*) had been found to give a positive result in grain yield of chickpea and paddy (Singh *et al.*, 1998; Singh *et al.*, 2001). Top dressing of liquid manure and compost on the growing maize grain yields 11-17% more than those of conventional practice (Onduru *et al.*, 2005). In the organic management system, the productivity accelerates in the subsequent year as soil fertility level increases over the time period as organic material are added (Surekha, 2007 and Yadav *et al.*, 2013).

Earthworm activity on phyllosphere and rhizosphere found to be more strengthened in organically manured field than inorganic fertilized field (Edwards, 1974). This earthworm and soil minerals both acts on the raw materials simultaneously underlying on soil surface results Vermicompost (which now can be manufactured artificially) which are the efficient source of major nutrient (N, P, K, Ca and Mg) and minor nutrient (Fe, Mo, Zn and Cu) (Amir *et al.*, 2011). The NPK content in Vermicompost is 0.74, 0.97 & 0.45% respectively (Pal, 2002). Vermicompost provides raw dairy manure with some other compost which is nutritive and its nutrition is assimilated in the root and shoots of dry matter (Hashemimanjal *et al.*, 2004). The facts reveal that vegetable due to short life span are more responsive towards the organic nutrients than crop. It had been experimented that optimum doze of Vermicompost have positive impacts on potato, tomato, chilli, brinjal, sweet pepper, carrot, groundnut, pea and cabbage crop yields. Along with the yield and its attributing character Vermicompost has direct positive results on the physiological factors such as number of branches, root size, leaf area, size of fruit, nodulation, dry matter content etc. (Onduru *et al.*, 2005; Rao *et al.*, 2001; Arancon *et al.*, 2003; Singh, 2000, and Silwana *et al.*, 2007;). Vermicompost in the green house condition also gives positive results with certain vegetative crops such as tomato, chilli, sweet Response to applied sludge

pepper (Manjarrej *et al.*, 1999; Atiyeh *et al.*, 2000). Dayal *et al.*, 1999, had reported that seed yield of the sunflower is highest by application of the Vermicompost @10t/ha. Datta *et al.*, 2006, confirmed that the rhizobium inoculated and FYM incorporated seeds increases the yield in Rajma and due to chelating activity, the nitrogen gets fixed which results the 42kg/ha of nitrogen was remaining in the field for proceeding crop. Sarangthem *et al.*, 2008, reported that the compost prepared by the urban waste contains NPK about 0.58-1.9, 0.45-0.67 and 1.4-1.8% respectively when it had been applied to the bean the yield of the bean tremendously increases from 53gm/plot to 228gm/plot.

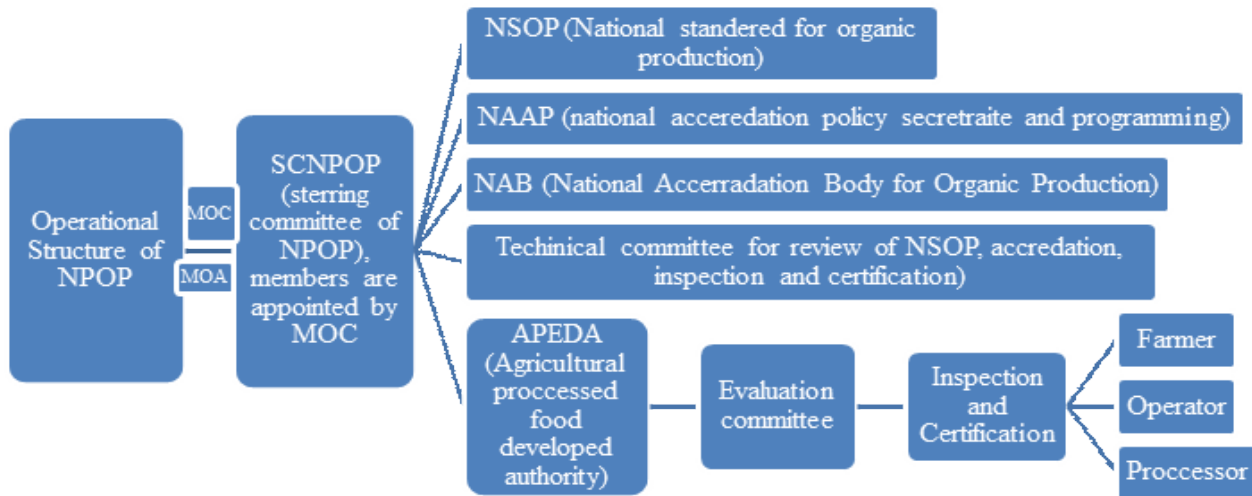
Organic farming in India: -

During the era of green revolution in India, it had been found in certain especised area, agrochemical such as chemical fertilizers, pesticides, genetically modified organism were not in use, such system of farming does not have any influence on green revolution. Such type of farming system is known as Traditional type farming system.

But over few decades focus on agriculture enterprise shifted from subsistence production to marketable production with profit gain. Due to increase in population tremendously, people have to meet yield exceptions. Overgrazing, exploitative cultivation & introduction of HYVs which are most prone to disease

S.No.	Study	Reference
1.	Continuous sludge application as granulated digested manure in Yakohama resulted in high nutrient values in soil in available form as compared to fertilizer	Noguchi and Ito, 1992
2.	Net increase in NO ₃ concentration by raw sewage application	Smith <i>et al.</i> , 1992
3.	Four years' study of sludge application resulted in increased PO ₄ -P availability	Brendecke <i>et al.</i> , 1993
4.	Increased N uptake by crops due to sludge application	Serna and Pomares, 1992
5.	Increased in grain yield of wheat by sludge application @ 20 t/ha	Al-mustafa <i>et al.</i> , 1995
6.	Seven-year application of digested sewage sludge increased organic carbon from 0.85 to 1.63, N content from 0.7 to 0.15 and CEC from 14.18 to 16.28 meq/100 g soil	Hinesly <i>et al.</i> , 1979
7.	Application of sewage sludge released longer NH ₄ salts, which where were nitrified quickly in calcareous soils of Spain	Verdu <i>et al.</i> , 1992
8.	Application of 6.6 Mg/ha of bio-solid wastes in Wisconsin (USA) for 15 years could consistently improve available N status to 200 kg N/ha and available P status to 200 kg/ha besides increasing the corn yields by 3.3 t/ha	Peterson <i>et al.</i> , 1999
9.	Application of sewage sludge resulted increased availability of P, total P in soil depths up to 60 cm	Akhtar and Mc Callister, 1999
10.	Maize crop yields were improved by 1000 kg/ha, bulk density decreased upto 0.71 g/cc water holding capacity increased from 70 to 150 percent	Greenwood <i>et al.</i> , 1999
11.	Compost provides slow release N for many years after application, as mineralization rate for residual compost N was 2 to 6 per cent per year	Crammer <i>et al.</i> , 1999

STRUCTURE OF NPOP



resulting many traditionally areas face severe problems regarding to health, ecology, fairness & care for future. In those cases, organic farming plays very important tool to maintain health, ecology, fairness & care for future generations.

India is empowering various programme for organic production at national level and international levels named “NPOP” (National programme for organic production) & “NATURLAND” respectively. NPOP is apex body of our country and is being governed by two ministries i.e. ministry of commerce & ministry of agriculture.

MOC and MOA are the ministry of commerce and agriculture respectively.

Internationally, Indian farmers of the NATURLAND have been grounded breaking global pioneers over 30 years. The world’s first ever conversion to organic agriculture to the gardens in Srilanka and India in 1980’s. Currently over 5400 farmers in 52 countries manage an area of some 40000 ha to NATURLANDS standards. These standards were improvised by Germans which are as follows: -

- Sustaining and improvement of soil.
- Realization (recycling) of nutrients near farms.
- Intensive use of legumes/ leguminous plants.
- Biological plant protection through prevention.
- Permission/prohibition of genetic engineering & their products.
- Least possible consumption of nonrenewable source of energy & resources.
- Strict ban on agrochemical.

Impact on qualitative parameter on soil biota and soil fertility

Minhas *et al*, 1994, reported that organic matter

is the reservoir of macro and micro nutrients and releases it in available form in the soil solution. It had been found that Organic farming improves the organic content of the soil besides this; it improves the P content, exchangeable K, pH and E.C. in the four years of the practice (Subbiah *et al.*, 2000 and Gaur *et al.*, 2002). The chelating nature of the organic matter makes the soil stable and therefore decreases the soil reaction (Laxminarayana *et al*, 2006). As chemical, the physical properties of the soil are also improved by the addition of organic matter such as water holding capacity, soil structure, bulk density, particle density, porosity, binding capacity of the soil etc. (Subbiah *et al*, 2000).

Biologically, compost is a living body as it contains bacteria, actinomycetes, fungi and other micro-organism and provides the shelter them (Gaur *et al*, 1976). Composting increases organic carbon which increases the activity of heterotrophic organism and ultimately enhances the enzymatic activity up to a large extent. On the other hand, compost and some organically rich material control the population of the nematodes and microbes responsible for the soil borne diseases in plants. It also mitigates the residual effect of the pesticide via adsorption resulting restriction in the mobility from the molecular level by its chelating action (Gaur, 1975).

Potential of the Organic Farming

Several researchers show that organic farming plays an important role in balancing the agro-ecosystem of the soil with respect to soil biota, production and productivity. In USA Dr. J.I. Rodale began to popularize the method approaches and advantages of organic farming. But his approach was not taken into

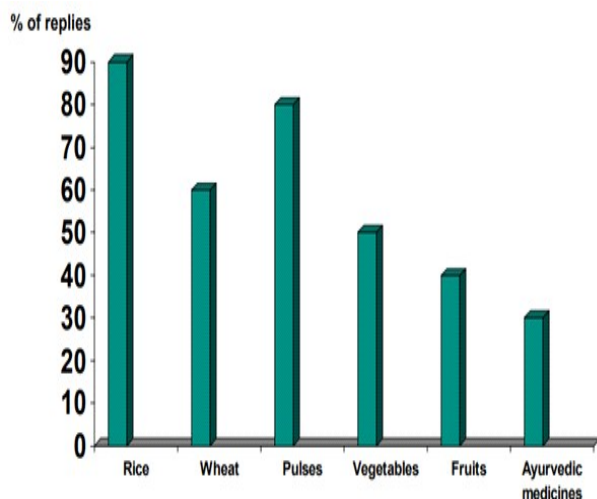
consideration by the peoples during those days. In 1962 Rachael Carson a prominent scientist and naturalist published a SILENT SPRING on chronic effects of DDT & other pesticides which were often credited with launching the world wide environmental movement. These movements reached to advance stages in late 1970's concerning with pollution & environmental increase on organic farming. As the difference between organic & conventional food clear among the people with one goal of organic movement, it was promoted with the slogan "KNOW YOUR FARMER, KNOW YOUR FOOD". In the developed countries the organic farming protects the environment, enhance the biodiversity and reduces the use of energy and carbon dioxide whereas, in the developing countries the organic farming makes the judicious use of the natural resources (i.e., sustainable resource use), increase in the crop yield without over reliance on costly inputs and maintain ecological balance (Stockdale *et*

In particular soil the reduced tillage and use of raised beds that avoid the deleterious effect on the puddling on the soil structure and fertility, the organic matter improves the water holding capacity, nutrient use efficiency and enhances the quality of the crop (Prabhakar RT *et al.*, 2010). The key characteristics include protecting the long-term fertility of soils by maintaining organic matter levels, fostering soil biological activity, careful mechanical intervention, nitrogen self-sufficiency through the use of legumes

and biological nitrogen fixation, effective recycling of organic materials including crop residues and livestock wastes and weed, and diseases and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, and resistant varieties (Yadav *et al.*, 2013). An experiment was conducted in three different regions for the comparative study of the organic farming and conventional farming. The yield from the conventional farming comes to be 55, 92 and 84% while from organic field 46, 25 and 22% respectively in the first 2-3 years of the cultivation but the economic value of the organic manured products was much higher than conventionally produced products (Chan *et al.*, 2008). Organic amendments found to caste the earth-worms which indirectly proved to be more effecting in controlling disease in various plants such as pea, mustard, chickpea etc. and nutrient accumulation increases with the increasing rate of application of the Vermicompost (Tripathi *et al.*, 1999). However organic food is economically more expensive than conventional farming because of high labor cost and the conversion of organic land from the conventional land is time taking process which won't be able to meet the global food requirements. Keeping in the view of the agro-ecological balance and global food requirements we recommend practicing conventional and organic practice within various permutation and combination remaining other variables in equilibrium.

Efficacy of plant extract and bio-agents

S.N.	Name of efficacy of plant extract/bioagents	Reference
1.	Neem products reduced fruit borer attack (Erias spp.) of okra	Ambedkar <i>et al.</i> , (2000)
2.	Methanol extract of Azadirachta indica and hexane extract of Thevetia nerifolia leaves showed antifeedal and insecticidal effects against Achaea janata (on castor)	Babu <i>et al.</i> , (1997)
3.	Spider population in rice was worst affected with monocrotophos and least affected by neem seed kernel extract	Baitha <i>et al.</i> , (2000a)
4.	Neem oil (2-4%) controlled the larvae of peaf roller of rice to the tune of 56-60 %	Baitha <i>et al.</i> , (2000b)
5.	Powdered neem leaves were found effective in controlling the population of beetle Callosobruchus chinensis on green gram	Dayakar and Ray (1999)
6.	Chloroform extract of Pongamia pinnata @ 5 percent controlled the damage by the mosquito bug (Helopellis theivara). Antifeedant property of lantana camera extract on tea mosquito bug was also demonstrated.	Deka <i>et al.</i> , (1998)
7.	Growth disrupting effects of hexane extract of neem seed kernel resulted in delayed development and mortality of Spodoptera litura	Kaur <i>et al.</i> , (2001)
8.	Treating pigeon pea seeds with neem seed kernel powder (4% w/w) prevented egg laying of Collosobruchus chinensis (pulse beetle)	Singhal and Chauhan (1997)



Source: Interviews of 50 upper-middle class farmers at Mumbai. (Tiwari, et al 2000).

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