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Organic farming in India: Prospects and practices

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Abstract
The desire of human being to get more and more from natural resources results in degradation of biodiversity and different portions of the environment. Sustainability is much more important at present to save the natural resources of the planet. Sustainable agriculture is the successful supervision of resources to satisfy the changing human requirements with enhancing the quality of environment and conserving natural resources. Organic farming is the tactic found to meet the objectives of sustainable agriculture for management of different aspects of the environment. Organic farming is a system of production that trusts on animal manures, organic wastes, crop rotations, legumes and aspects of biological pest control that are not strange to agriculture systems including the traditional agricultural practices. The use of pesticides, fertilizers and growth regulators prohibited in organic production system. It is the management production system that promotes and improves biodiversity, biological cycles and biological activity of the soil. Thus, making the soil capable of supplying all the essential nutrients to the crop for its proper growth and development. Farmer's hesitation towards organic farming in India is due to non-availability of sufficient bio fertilizers, organic supplements and local market for organic produce and non-awareness to certification and guidelines. An integrated effort is needed from government and nongovernment agencies to inspire farmers to follow the organic farming practices as a solution to sustainability of all integral parts of the environment.

Keywords: Organic farming, Prospects, practices

Introduction
"A hungry man is an angry man", M.S.Swaminathan (2003) and, "if the hungry man happens to a young man, then we have a potential terrorist amongst us", Chhonkar (2003) [8]. Organic agriculture has developed by the conscious efforts of inspired people to create the best possible association between the earth and men. It aims at sustaining and increasing the productivity by improving soil health and overall improvement of agro-ecosystem. The total area under organic certification in India is 5.71 M ha with a production of 1.35 MMT of certified organic products (APEDA 2015-16) [2]. Punjab has 6025 ha area under organic certification with a production of 68177 t (Shukla *et al*., 2013) [23]. India is the second most populous country in the world. With the rising population, the cultivable land resource is decrease day to day. To meet the food, fibre, fuel and other needs of the growing population, the productivity of agricultural land and soil health needs to be improved. Green Revolution in the post independence era has shown path to developing countries for self-sufficiency in food but sustaining agricultural production against the finite natural resource base demands has shifted from the "resource degrading" chemical agriculture to a "resource protective" biological or organic agriculture.

Organic Farming is a production system which avoids or largely excludes the use of synthetic fertilizers and growth regulators. To the maximum extent, viable organic farming systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off farm organic wastes and aspects of biological pest control. These practices result to maintain soil productivity and tilth to supply plant nutrients and to control insect pest diseases and weeds. Thus, the organic farming implies recycling of waste and residue to the local soil itself, replenishing the nutrients exhausted from the soil during the crop growth, encouraging the development of microorganisms. So, it helps to maintaining soil health by balancing the soil moisture and soil aeration and ensuring soil fertility by firmly binding the nutrient elements in the complex organic molecules.

Basic concept of organic farming
Organic farming endorses the concept that the soil, plant, animals and human beings are linked so to create an integrated, environmentally sound, safe and economically sustainable agriculture production system.

The basic concepts behind Organic farming are:

- It concentrates on building up the biological fertility of the soil so that the crops take the nutrients they need from soil in slow process.
- Use of bio-pesticides, bio-insecticides and various cultural techniques such as crop rotation, mixed cropping, results in development of an ecological balance within the system.
- Organic farmers recycle all wastes and manures within a farm but the export of the products from the farm results in a steady drain of nutrients.
- Conservation of energy and resources is considered to be important in organic farming, farmers make every effort to recycles to all urban and industrial wastes back to agriculture and thus the system would be only be a small inputs of new resources.

Principles of organic farming

These principles are the roots from which organic farming grows and develops. They express the contribution that organic agriculture can make to the world. Principles are composed as inter-connected to inspire the organic movement and guide our development standards. The principles of organic farming are as follows (Chandrashekar, 2010) [5]:

- To work within a closed system and draw upon local resources as much as possible
- To maintain long-term fertility of soils
- To avoid all forms of pollution that may result from agricultural techniques
- To produce food in sufficient quantity with high nutritional quality
- To minimize the use of fossil energy in agricultural practices
- To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human being

Negative effects of modern agriculture

Green revolution technologies such as greater use of synthetic chemicals like fertilizers and pesticides, high-yielding varieties of crops, greater utilization of irrigation potentials etc. has increased the production output in most cases. However, continuous use of these high energy inputs leads to decline in production and productivity of various crops as well as deterioration of soil health and environments. Following are few negative effects of modern agriculture which must be overcome with practices of organic farming.

- Imbalance in production
- Dependency on synthetic chemical fertilizers
- Increase in secondary & micronutrient deficiencies
- Increase in pesticide use
- Unscientific water management and distribution
- Reduction in productivity
- Reduction in quality of the produce
- Extinction of gene pool
- Environmental pollution
- Imbalance in social and economic status

So there is immense need of organic agricultural practices to eradicate the harmful effects of present day agricultural practices.

Need of organic farming of vegetable crops in India

Effects of high input intensive farming system increased awareness of environmental impact of this system and led to a move towards alternatives. At present, the biological or organic approach is one of the best alternative to conventional production system (Subbarao *et al.*, 2007) [26]. The potential environmental benefits of organic production and its compatible sustainability, it is considered as a viable alternative for sustainable agricultural development (Ramesh *et al*., 2005) [17]. The recent decade has seen a serious concern over the issue of environmental pollution. Consequently, attempts have been made by many institutions, both public as well as private, to promote sustainable growth especially in regards to health and ecology. So, there is need to raise crops organically for sustainability of health and environment.

- Most of the vegetable crops are eaten fresh or used for health care; hence any contamination may lead to various kinds of health hazards
- In India majority of the vegetable growers are poor, small and marginal farmers
- Decrease in land productivity due to ever increasing use of chemical fertilizers
- There are not many scientific breakthroughs in improving quality and production of vegetables
- The ever-increasing cost of production in chemical farming including investments in manufacturing fertilizers, pesticides, irrigation etc despite massive government subsidies is a major cause of concern, which is very low in organic farming
- High environment pollution in conventional agricultural practices

SWOT analysis for organic farming

SWOT analysis for evaluating the strengths, weaknesses, opportunities, and threats involved in Organic Farming.

Strengths

- Organic farming leads to sustainable agriculture with respect to health, soil, environment and wealth
- Principles of organic farming aligning well with the philosophy of Gross National Happiness
- Often similar to traditional farming practiced by farmers from old time
- As organic farming devoid of chemicals, results in safe environment
- Preservation of biodiversity in the form of soil microorganisms, flora and fauna and different beneficial insects
- Reduces risk of farmers as cost of cultivation is much less than the conventional farming practices
- Reduces risk of exposure to harmful pesticides

Weaknesses

- Complex and costly certification process which the small and marginal farmers can't afford
- Reduction of yield in early years of conversion results in economical losses
- Limited technical expertise for training to farmers about the techniques of organic farming
- Nascent research in organic farming by central organizations and state agricultural universities
- Irregular supply of organic produce due to limited production units of bio-fertilizers and bio-pesticides and decreasing livestock
- Weak government policy support regarding financial help and reward to farmers or farmer's group which practiced organic farming

- Shifting to pure organic farming is a very time consuming and laborious methods
- Limited plant protection options for pest and disease control in organic farming
- Lack of awareness about benefits of organic farming like organism and soil health, conservation of biodiversity, pollution free environment and more benefit: cost ratio as comparison to conventional farming practices
- Lack of coordination between different agencies for certification and marketing of organic produce
- Lack of quality planting materials like hybrids and varieties for cultivation in organic farming
- Lack of organic premium for organic produce in market
- Nutrient content in organic sources like NPK is very less

Opportunities

- Possibility for premium prices for organic produce if farmers get certification for their produce and by doing this they can get high price for organic produce than conventional produces
- Sustainable use of resources can conserve the natural resources for current and future generations
- Build up soil fertility through various organic practices like green manure, organic manures, crop rotation, bio-fertilizers and incorporation of crop residues in the field etc.
- Develop local organic manure suppliers by adopting additional entrepreneurs like animal husbandry and collecting biomass from fields and domestic waste
- Organic farming results in greater food security by enhancing the production and productivity
- Improve global export market by proper certification and maintaining the quality parameters of organic produces
- Conserve local crops which are common for farmers in their localities. These local crops are more resistance to biotic and abiotic stresses
- Self-sufficiency regarding food production and by producing more organic inputs in the country
- Employment generation by establishing production units of bio-fertilizers and bio-pesticides
- Opportunities for greater social contacts through project meetings and by providing training to farmers about organic farming

Threats

- Decreasing trends of all organic sources due decreasing number of livestock and forest area in the country
- Non-affordable certification cost for small and marginal farmers to get certification for their organic produce
- Belief in modernization make an obstacle to adopt the organic farming
- Global competition for export of organic produce from India
- New pest and disease incidence to organic crops, difficult to manage by organic practices
- National food security if adopt organic farming
- Variability in climate pattern

Prospects of organic farming

In India, a major component of food security comes from the irrigated areas and it is estimated that adoption of organic farming in these areas may reduce the production (PSFC, 2008) [16]. India with a total area of 142 million ha under cultivation, has 68 per cent area under rain fed cultivation. In these areas, the use of fertilizers not only enhances water demand but also reduces water holding capacity of already light soils. The rate of fertilizer application is very low in these areas as compared to national average. In these regions, farming systems are highly diversified with crops, trees and animals etc. There are about 2-5 farm animals for each family and 10-30 trees per ha (Faroda *et al.*, 2008) [10]. So, diversified farming systems and low fertilizer use make a strong point for organic cultivation in these areas which not affect the national food security.

Restoration of soil fertility and pest control traditionally in these areas further strengthens and provides strong infrastructure for organic system (Sharma and Goyal, 2000) [22]. In Indian, 74 per cent of farmers own less than 2 ha land. These small and marginal farmers can adopt the organic farming easily as well as can manage the organic inputs and labour more efficiently (Babalad *et al.*, 2008) [3].

Organic farming is labour intensive, which will help in proper human resource utilization in these areas. The crops of rain fed areas like cumin, fennel, ajwain, fenugreek, etc are in demand in organic food market. Almost entire forest produce and 80 per cent of horticulture are contributed by the un-irrigated ecologies (Samra, 2009) [19]. Approximately 50 per cent of the net sown area will continue to remain rain fed, even if full irrigation potential of the country is realized (Varshneya and Patel, 2009) [28].

Thus in the light of food security to the Indian population and non-availability of organic manures in required quantities, the organic farming is neither desired nor practicable as a state policy but can be practiced in specific areas and specific crops like:

- Vegetable crops which require higher doses of chemical fertilizers
- Plantation crops like tea, coffee, cashew nut etc. where the recycling of nutrients through leaf fall is high and nutrient removal is less
- Vegetable crops having high export potential in International markets
- Local varieties of various vegetable crops with high quality and export potentials.
- Soils having more fixation capacity of the nutrients like the acidic & alkali soils.

Effect of organic practices on growth of vegetable crops

The vermicompost application significantly improved available P, K and DTPA-extractable Zn, Fe ad Mn content in the soil after harvest (Singh *et al*., 1997) [24] while highest number of fruit weight, fruit length, fruits per plant and fruit diameter of chilli was obtained by applying vermicompost alone as compared to synthetic fertilizers (Yadav and Vijayakumari, 2003) [33]. Significantly higher chilli yield was observed with application of vermicompost@ 2.5 t/ha+ neem cake @250 kg/ha without application of RD of fertilizers (Gundannavar *et al*., 2007) [11]. Application of biogas slurry+FYM, vermicompost+FYM and vermicompost alone recorded maximum fruit size and more number of fruits/plant in tomato (Renuka and Ravishankar, 1998) [18]. The collaboration between bread yeast spray and humic acid in brinjal significantly increased plant height, total chlorophyll, branch number, mineral content (N, P, K) in leaves and total yield (Sarhan *et al*., 2011) [20] likewise humic acid source positively affected root length, germination, harvesting and biomass in broad bean and further it significantly increased fresh and dry weights of broad bean roots (Ahmet and Birsen 2009) [1].

A study on effect of FYM on soil pH revealed that with each increment of FYM, the soil pH reduced significantly from 7.99 to 7.65, due to organic acid production during its decomposition (Patil *et al*., 2003) [15]. Glyricidia lopping @ 10 t/ha, crop residues @ 10 t/ha along with FYM+organic solutions application significantly improved the growth factors of chilli compared to inorganic fertilizers (Yadahalli, 2008) [31]. Among the different organic sources, substitution of 100% N through FYM recorded higher plant height, number of branches/plant and yield which was comparable with that of 100 % RDN through urea (Kannan *et al*., 2006) [13]. Application of sunnhemp + neem cake @2 t/ha +*Azospirillum* @ 2 kg/ha + crop residue + phosphobacteria recorded higher growth parameters like plant height, number of branches per plant of chilli over Recommended Dose of Fertilizer (RDF) (Bharathi *et al*., 2011) [4]. Application of FYM@ 10 t/ha increased the infiltration rate and water holding capacity while decreased the bulk density of soil (Halemani *et al.*, 2004) [12]. Plant height and number of leaves per plant increased in brinjal when compared to RDN fertilizer due to inoculation of *Azotobacter+Azospirillum* with 75 kg N/ha (Wange and Kale, 2004) [30]. In soybean, growth parameters like plant height, leaf area index and dry matter accumulation were found to be higher with the use of crop residues @ 5 t/ha +FYM@ 5 t/ha than FYM@ 5 t/ha (Dash *et al*., 2005) [9]. The growth parameters of chilli were significantly higher with combined application of organic compost and FYM (Sunitha, 2000) [27].

The growth of chilli was significantly higher with the inoculation of *Azospirillum* and *Azotobacter* (Khan *et al.*, 2011) [14]. Plant growth parameters at 45 DAS were significantly increased due to inoculation of P solubilizing fungal strains along with rock phosphate application in greengram (Chandrashekhar, 2003) [6]. Along with organic manures, combined inoculation of *Azospirillum* and PSB isolate (PSB7) produced additive effect and resulted in increased root length, shoot length, stem girth, number of leaves and number of branches in solanaceous crop plants (Vasanthakumar, 2003) [29]. Dipping the seedlings root in beejamruth, soil application of jeevamruth (500L ha) at 10 DAT and foliar application of panchagavya @ 3% at the time of flowering recorded higher ascorbic acid and capsaicin content in chilli fruits (Sreenivasa *et al.*, 2010) [25].

Organic farming in india on specific situation

- The areas for promotion of organic farming should be like North East Region (NER) of India having about 365 lakh ha has great potential to be an organic center for the country due to its rich natural resources and less use of chemicals (Sema, 2009) [21].
- Organic farming with low-cost practices will have direct impact on Indian agricultural trade in global market. The reduction in in-put application without decreasing the yield should be the future goal in technology development for organic farming.
- Certification of organic farms is a complex and costly process which the small and marginal farmers cannot afford. Large farmers can afford the certification cost but their cost of production increases because of hired labour. Group certification is a viable option for small farmers for regulatory mechanism for organic production.
- Recyclable nutrients (N, P, K, S, Zn, Mn, Fe and Cu) from plant and animal waste in large quantity can overcome the synthetic fertilizer usage. The technology for converting waste into compost needs advancement and potential verification for which provision of funds is required. This step would help farmers to adopt organic farming, improving the soil health and reducing the cost of cultivation as compared to conventional farming practices.
- Organic food market in India is at a nascent stage, proper marketing network between different cities can helpful for developing domestic markets. Regular supply and consistency of quality necessary for premium price of the organic products. Further, the branding of organic products and easy paper work while dealing with export authorities can improve the export potential of organic produce.
- Cost of cultivation can be reducing by growing varieties which are resistant to biotic and abiotic conditions. Further, such varieties can meet the organic standards, as they do not need synthetic chemicals. Scientists have to develop varieties, which can successfully compete with insect-pests and diseases as well as to weeds. It has been found that the varieties, which show early vigor, generally overcome the growth of weeds.
- Application of bio-agents and biofertilizers will have greater impact on organic agriculture and also on the control of environmental pollution and improvement of soil health. Inoculation by improved *Azotobacter* strains enhanced the productivity significantly. Use of PSB helps in increased availability of phosphorous.
- For increasing the productivity of organic systems, Integrated Nutrient Management is one of the better options. However, breeder would have to develop varieties, which respond to the integrated use of organic inputs.
- Weedicide application is causing ecological and health problem as well as increasing the cost of cultivation. Scientists have to develop technology, which decreases the weed population and increases the crop resistance to weeds. Yield losses, failure of diversification and weed management is becoming ineffective due to emerging herbicide resistance in weeds. Cultivation practices should develop in such a way that help the crops in getting the resources easily and grow with more vigor in comparison to weeds.
- Popularization of such practices is required which saved irrigation water and seed rate without affecting crop production. Emphasis on developing input efficient varieties and agronomic practices which can enhance the benefit over cost in organic farming. Further, there is need to develop efficient farm tools for small farmers.
- Green Manure is highly beneficial for organic production and maintaining soil health as it enhances the nutrient content in soil as well as increases the yield up to 30-35% than conventional faming.

The way forward

The unfavorable effects of modem agriculture have not appeared all of a sudden and repetitive use of agro-chemicals was not predictable at the time of their introduction. Intensive cultivation of land without protection of soil structure and soil fertility would lead eventually to the springing up of deserts. Irrigation without arrangements would result in soils alkalinity or salinity. Unsystematic use of fungicides, pesticides and herbicides could cause unpleasant changes in biological balance as well as lead to an increase in the incidence of diseases, through the toxic residues present in the food. The quick replacement of many locally adapted

varieties with one or two high yielding strains would result in the spread of severe diseases capable of wiping out entire crops.

The environment safety can adequately be taken care of by adopting Good Agricultural Practices (GAPs). So there is a need to develop some mechanism and GAP certification does propose a viable alternative. In Good Agricultural Practices (GAPs) organic sources of nutrition and pest management are used which supplemented with need based pesticides and fertilizers. Crop residue recycling can be made obligatory on these farms. But the farmers adopting this mode of production will have to acquire some extra costs, mainly in terms of time and labor, than the traditional farmers so their role to the environment and humanity must be satisfied by a certain premium on their produce. The produce of these farms should be free from any pesticide residues. On the pattern of GLOBAL GAP certification 'INDIA GAP' certification can be developed which will help in building the customer assurance in agricultural produce and safeguard our national food security.

Food security sustainability solution lies in a moderate approach *i.e*. Good Agricultural Practices (GAP). However, the constantly increasing demand for organic foods has to be met by cultivating crops under organic farming. Organic farming must co-exist with conventional modes of agriculture for specific crops, specific regions particularly where the state is at an advantageous position, but of course, with the government support in certification, crop insurance and development of market infrastructure for organic produce. As the movement is easily spreading up and organic farming is attracting worldwide attention, and there is a potential for export of organic agricultural produce, this opportunity has to be tapped with adequate safeguards.

Table 1: Indian scenario: area & production under organic certification

Sr. No.	States	Area (ha)			Total production (t)
		Certified Area	Under Conversion	Total	
1.	Assam	2001	45	2046	14716
2.	Delhi	127	138	265	2172
3.	Goa	13044	259	13303	28262
4.	Gujarat	42267	6251	48518	191667
5.	Haryana	2343	12420	14763	119789
6.	Karnataka	9128	10400	19528	220901
7.	Kerala	3870	2727	6597	58177
8.	M. P.	270955	27407	298362	1220809
9.	Maharashtra	124547	50298	174845	694275
10.	Orissa	16883	6218	23102	166183
11.	Punjab	2118	3907	6025	68177
12.	Rajasthan	57566	9145	66712	265341
13.	Sikkim	1391	27	1418	5174
14.	Tamilnadu	3244	829	4074	41640
15.	West Bengal	5014	1110	6125	28393
16.	Other	45495	46322	91822	761510
	Total	600003	177513	777517	3887197

Shukla *et al* (2013) [23]

Table 2: Growth of area under organic development in India.

Year	Area in ha under organic certification process	
	Cultivated (Organic + in-conversion)	Wild harvest
2003-04	42000	NA
2004-05	76000	NA
2005-06	1,73,000	NA
2006-07	5,38,000	24,32,500
2007-08	8,65,000	24,32,500
2008-09	12,07,000	30,55,000
2009-10	10,85,648	33,96,000
2010-11	7,77,517	36,50,000

Yadav, 2012 [32]

Table 3: Green manure for organic production

Crop	Productivity (t/ ha)	Nitrogen %
Subabul	09.11	0.80
Sunhemp	12-13	0.43
Dhaincha	20-22	0.43
Cowpea	15-16	0.49
Clusterbean	20-22	0.34
Berseem	15-16	0.43
Green Gram	08-09	0.53

Table 4: Organic nutrient sources for soil health

Sr. No.	Source	N (%)	P (%)	K (%)
A. Organic manures				
1.	FYM	0.8	0.4	0.7
2.	Vermicompost	3.0	1.0	1.5
3.	Poultry manure	3.1	2.6	1.4
4.	Cattle dung	0.4	0.2	0.2
5.	Cattle urine manure	1.0	--	1.4
B. Oil cakes				
1.	Castor cake	4.4	1.9	1.4
2.	Neem cake	5.2-5.6	1.1	1.5
3.	Mahua cake	2.5	0.8	1.9
4.	Groundnut cake	6.5-7.5	1.3	1.5
C. Green manures				
1.	Neem	2.8	0.3	0.4
2.	Sunhemp	2.3	0.5	1.3
3.	Dhaincha	3.2	0.6	1.2
4.	Glyricidia leaves	2.8	0.3	4.6

Chatterjee and Thirumdasu (2014)

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