ORGANIC FARMING OF VEGETABLES IN INDIA: PROBLEMS AND PROSPECTS

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Introduction

India is the second most populous country in the world. With the increasing population, the cultivable land resource is shrinking day to day. To meet the food, fibre, fuel, fodder 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.

Green revolution technologies such as greater use of synthetic agrochemicals like fertilizers and pesticides, adoption of nutrient-responsive, high-yielding varieties of crops, greater exploitation of irrigation potentials etc. has boosted the production output in most cases. However, continuous use of these high energy inputs indiscriminately now leads to decline in production and productivity of various crops as well as deterioration of soil health and environments. The most unfortunate impact of Green Revolution Technologies (GRT) on Indian Agriculture is as follows:

1. Imbalance in production
2. Dependency on synthetic chemical fertilizers
3. Increase in secondary & micronutrient deficiencies
4. Increase in pesticide use
5. Unscientific water management and distribution
6. Reduction in productivity
7. Reduction in quality of the produce
8. Extinction of gene pool
9. Environmental pollution
10. Imbalance in social and economic status

All these problems of GRT lead to not only reduction in productivity but also deterioration of soil health as well as natural ecosystem. Moreover, to day the rural economy is now facing a challenge of over dependence on outside inputs and day-by-day increase in price of these inputs. Further, Indian Agriculture will face the market competition due to globalization of trade as per World Trade Organization (WTO). Thus, apart from quantity, quality will be the important factor. Such varieties of concern and problems of modern Indian Agriculture gave birth to various new concepts of farming such as organic farming, natural farming, biodynamic agriculture, do-nothing agriculture, eco-farming, etc. The essential concept of these practices remains the same, i.e., back to nature, where the philosophy is to feed the soil rather than the crops to maintain soil health and it is a means of giving back to the nature what has been taken from it (Funtilana, 1990). Therefore, for sustaining the productivity of the crop, maintaining the soil health and healthy ecosystem, there is need for adoption of an alternative farming system, may be the Organic Farming.

The vegetable crops have been well advocated in solving the problem of food security. They are rich source of minerals, vitamins, fibre and contain a fair amount of protein as well as carbohydrates. In addition to local market demand vegetables have the potential for both domestic and export market. The vegetable production of our country before independence was merely 15 million tonnes (mt) and now it is about 88.6 million tonnes during 2001-02,accounting 11.4% share of World vegetable production (Rai and Pandey, 2005). Although India is the second largest producer of vegetables next only to China in World, the productivity of different vegetables in our country is comparatively lower than the World's average productivity. Again the per capita availability of vegetable (210g/head/day) is still behind the recommended quantity (285g /head /day). Our demand by 2020 will be around 250 million tonnes. Thus due to the rapid growth of the population with reduction in land, in order to feed the population, the only solution is the vertical expansion or by increasing the productivity per unit area per unit time as the potential available land and water resources and of technology still remain unexploited. Our strategy should be produced more vegetables from less land, less water with less pesticides and with less detrimental to soil and environment as well. Organic vegetable cultivation offers one of the most sustainable farming systems with recurring benefits to only long-term soil health but provides a lasting stability in production by importing better resistance against various biotic and abiotic stresses.

Organic vegetables fetch a premium price of 10%- 50% over conventional products. Market of organic products is growing at faster rate (20%) as compared to conventional ones (5%). This growth rate is highest in Japan, USA, Australia and EU. Export preference of organic vegetables offers a great scope to a country like India, which has inculcated the skill of growing organically since time immemorial.

Basic concept of Organic Farming:

The basic concepts behind Organic farming are:

1. It concentrates on building up the biological fertility of the soil so that the crops take the nutrients they need from the steady turnover within the soil nutrients produced in this way are released in harmony with the needs of the plants.
2. Control of pests, diseases, and weeds is achieved largely by the development of an ecological balance within the system and by the use of bio-pesticides and various cultural techniques such as crop rotation, mixed cropping, and cultivation.
3. 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.
4. In a situation, where conservation of energy and resources is considered to be important, community or country would 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 to "top up" soil fertility.

Definitions of Organic Farming

Many scientists at different levels have elaborated the concept of Organic Farming; the important descriptions are as follows:

Description offered by Lampkin (1990) has been found to be the most comprehensive one covering all essential features of Organic Farming. According to Lampkin,"Organic Farming

is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, growth regulators and live stock feed additives. To the maximum extent, feasible Organic Farming systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off farm organic wastes and aspects of biological pest control to maintain soil productivity and tilth to supply plant nutrients and to control insect pests diseases and weeds. Thus, the Organic Farming implies recycling of waste and residue to the native soil itself, replenishing the nutrients depleted from the soil during the crop growth, encouraging the growth of microorganisms which could regulates phased release of stored nutrients in the soil to the crop growth in right proportion, 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

Among the most stringent definitions is that of US Department of Agriculture, which defined Organic Farming as, "A system that is designed and mailed to produce to agricultural products by the use of methods, and substances that maintain the integrity of organic agricultural products until they reach the consumer". This is accomplished by using, where possible, cultural, biological and mechanical methods, as oppose to use substances to fulfill any specific fluctuations within the system so as to maintain long term biological activity, ensure effective management, recycle waste to return nutrients to the land, provides attentive cares for farm animals and handle the agricultural products without the use of extraneous synthetic additives or processing in accordance with the act and regulations in this part.

According to Funtilana (1990), "Organic Farming is giving back to the nature what is taken from it". It is not mere non-chemicalism in agriculture; it is a system of farming based on integral relationship. Therefore, one should know the relationship among soil, water, plant and micro flora and overall relationship between plants animal kingdom. It is the totality of these relationships, which is the backbone of the Organic Farming.

Above all, the success of organic farming depends to a great extent on the efficiency of agronomic management adopted to stimulate and augment the underlying productivity of the soil resources. All the managemental practices followed in organic farming are governed by the principles of ecology and are within the ecological means.

Characteristics of Organic Farming Systems

Management of Organic farming is focussed on the whole farm system and its interactions with climate, environment, social as well as economic conditions, rather than considering the farm as comprises of individual enterprises. The key characteristics of Organic Farming include:

- Protecting the long-term fertility of soils by maintaining organic matter levels, soil biological activity and careful mechanical intervention.
- 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 wastes.
- Weed, disease and pests control relying primarily on crop rotation, natural predators, crop diversity, organic manuring, use of resistant varieties and limited thermal, biological and chemical intervention.
- Supplementing crop nutrients, where necessary, by using nutrient sources which are made available to the plants indirectly but the action of soil micro organisms and chemical reactions of the soil.

- The extensive management of livestock, paying full regards to their evolutionary adaptations behavioural needs, and animal welfare issues with respect to nutrition, housing, health, breading and rearing.
- Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats (Padel and Lampkin, 1994).

Options in Organic Farming:

There are three options going for Organic Farming to alleviate the problems caused by conventional inorganic farming systems. They are

1. Pure Organic Farming*:* This accounts complete exclusion of inorganic fertilizers and pesticides, but advocates the use of organic manures and biological pest control methods.
2. Integrated Green Revolution Farming*:* Under this option, the basic trends of the green revolution such as intensive use of external inputs, increased irrigation, development of high yielding and hybrid varieties as well as mechanizations of labour are retained with much greater efficiency on the use of these inputs with limited damage to the environment and human health. For this purpose some organic techniques are developed and combined with the high input technology in order to create Integrated Systems such as, "Integrated Nutrient Management" (INM), "Integrated Pest Management" (IPM) and biological control methods which reduce the need for chemicals.
3. Integrated Farming System*:* This option involves low input organic farming in which the farmers have to depend on local resources and ecological processes, recycling of agricultural wastes and crop residues.

Hence, for improving the quality of the life and ensuring the reduction in depletion of natural resources needs a farming system, which results in viable and sustainable Agriculture production.

Organic Farming in India

India, only 30% of total cultivable area is covered with fertilizers where irrigation facilities are available and in the remaining 70% of arable land, which is mainly rain-fed, negligible amount of fertilizers is being used. Farmers' in these areas often use organic manure as a source of nutrients that are readily available either in their own farm or in their locality. The North Eastern region of India provides considerable opportunity for organic farming due to least utilization of chemical inputs. It is estimated that 18 million hectare of such land is available in the NE, which can be exploited for organic production. With the sizable acreage under naturally organic/default organic cultivation, India has tremendous potential to grow crops organically and emerge as a major supplier of organic products in the world's organic market. The report of the Task Force on Organic Farming appointed by the Government of India also observed that in vast areas of the country, where limited amount of chemicals issued and have low productivity, could be exploited as potential areas for organic agriculture (Anonymous, 2001).

In India, there are three main types of farmers engaged in organic production:

- Farmers who mostly follow the indigenous knowledge and technology developed over the past thousands of years. They normally grow for their own consumption and have little surplus.

- Farmers with small to medium sized holdings. These can be divided into two groups: those working to revive the Vedic practices, coupled with Ayurvedic tradition of health system with scientific exposition; and others who follow modern organic agriculture systems, like Steiner's biodynamic agriculture or Fukuoka's "nature farming", for example. They usually have market surplus and sometimes export their goods.
- Private companies that have responded to market demands in the North by organizing large scale conversions to organic systems. By going organic, they add more economic value to the crops, which are already cultivated in a manner similar to organic systems. They are actively engaged in promoting organic agriculture for export. India produces primary organic products and processed foods, are limited. Organic products grown in various agro climatic zones are coffee, teas, spices, fruits, vegetables and cereals as well as honey and cotton. Organic animal husbandry, poultry, and fisheries do not exist. Domestic organic markets and consumer awareness are underdeveloped in India, but interest is growing. On the domestic market, organic food is usually sold directly from the farmer or through specialized shops and restaurants. At present, a price premium of about 20-30%over conventional products can be received.

India is an exporting country and does not import any organic products. The main market for exported products is the European Union. Recently India has applied to be included on the "EU-Third-Country-List". Another growing market is the USA.

It is estimated that around 700 mt of agricultural wastes available in the country every year, but most of it is not properly used. This implies a theoretical availability of 5tonnes of organic manure/hectare arable land/year, which is equivalent to about 100 kg NPK/ha/yr (Tondon, 1997). However, in reality, only a fraction of this is available for actual field application. There are several alternatives for supply of soil nutrients from organic sources like vermicompost, biofertilizers, etc. Technologies have been developed to produce large quantities of nutrient-rich manure/compost. There are specific biofertilizers for cereals, millets, pulses and oilseeds that offer a great scope to further reduce the gap between nutrient demand and supply.

Organic Farming in India on specific situation:

Considering the above-cited facts, one has to be very rational and consider the use of organic sources alone only in cases where there are most economical and the produce needs to be of very high standards from health point of view. In India context, Organic Farming can be more profitable under the following situations, where instead of quantity, quality is more important.

- Fruits and vegetable crops where use of higher doses of chemical fertilizers (especially N may lead to higher NO_3 content) and imbalanced nutrition of crops
- Plantation crops like tea, coffee, cashew nut etc where the nutrient removal is less and recycling of these through leaf fall is high.
- Other horticultural crops having high export potential in International markets like spices
- Local varieties of different crops having high quality and export potentials.
- Neem, dried nuts, oilseeds, pulses, cottons, basmati rice etc with export potentials.
- Soils having high fixation capacity of the nutrients like the calcareous, acidic & alkali soils.

Technologies for Organic and Low Cost Agriculture

Organic agriculture with low-cost of production will have direct impact on Indian agricultural trade in global market. The application of resource conservation technology for the reduction in in-put application without sacrificing the yield should be the future target in technology development and its demonstration.

• There are some varieties in each crop, which perform very well under restricted resource availability and are resistant to biotic and abiotic conditions. Such varieties can be grown to reduce the cost of cultivation. Further such varieties can meet the standards of organic farming, as they do not need agri-chemicals. The breeders have to develop crop varieties, which can successfully compete with weeds and resist to insect-pests and diseases. It has been found that the crop varieties, which show early vigor, generally hamper the growth of weeds.

• The biofertilizers and bio-agents application in agriculture will have greater impact on organic agriculture and also on the control of environmental pollution, soil health improvement and reduction in input use. Inoculation by improved Azotobacter strains in addition to package of practices enhanced the productivity of wheat, cotton and paddy significantly. High ammonia extracting mutant of Azospirillum increased nitrogen uptake in wheat and it may help in reducing the dose of nitrogenous fertilizers. Increased level of P application increased significantly the yield of grain and straw of wheat. Use of PSB helps in increased availability of phosphorous. Application of dried biogas slurry at the rate of 15 to 18 tonnes/hectares resulted in to 6 to 9 q/hectares increases in wheat yield as compared to no manure plots.

• Recyclable nutrients (N, P, K, S, Zn, Mn, Fe and Cu) from plant and animal waste in Haryana alone have been estimated at 787 thousand tonnes equivalent to 30% of fertilizer usage. The technology for converting waste into compost has been developed but it needs refinement and large-scale verification for which provision of funds is required. This step would help in organic farming, reducing the cost of cultivation and improving the soil health. For increasing the productivity of cropping systems, integrated use of fertilizers and FYM is one of the better options. However, plant breeder would have to develop varieties, which respond to the integrated use of FYM, green manuring, fertilizers etc.

• Application of weedicides has to be stopped in organic farming. The effect of weedicides on soil health has been totally ignored which is causing serious changes in soil ecology. Herbicide resistant management needs to be effectively done otherwise it will become a major factor for yield losses as well as a major factor for failure of diversification. Control of weeds including *Phalaris minor* can be done to a larger extent through changing the crop dynamics and timely sowing. The application of weedicides is not only causing ecological and health problem but also increasing the cost of cultivation and therefore, the scientists have come out with the technology, which reduces the weed density and increases the crop competition with weeds. Some of the farmers have developed such tools but they need refinement. Mechanical weeding is highly beneficial for crop establishment. Weed management is becoming ineffective due to emerging herbicide resistance in weeds. Cultivation practices may be devised in such a way that help the crops in capturing the resources easily and grow vigorously in comparison to weeds.

• Biological control of weeds can be highly effective as summarized. However, under Indian conditions; this approach has to be evolved.

• Use of tractor drawn bed former-cum-seeder (FIRBS) in wheat saved irrigation water up to 35-40%. Sowing with cell type metering system saved 25% seed rate without affecting crop production. Such practices need popularization. It is well known that water and fertilizers utilization in crops is less than 50%. Emphasis on bringing break-through in enhancing the water

and fertilizer use efficiency through development of input efficient varieties and agronomic practices is required. Further, there is urgent need to develop efficient farm tools for small farmers. The gender friendly farm equipments are the need of the hour.

• Use of Green Manure is highly beneficial for organic production and maintaining soil health.

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

• Application of microbes in agriculture is one of the best options for organic agriculture. Soil contains 104 to 105 microbes/g of soil to perform various functions:

- Plant growth promoter
- Enhancement of nutrients availability
- Preparation of value added products
- Development of transgenics
- Bioremediation/removal of toxicants
- Can be used as bio-control agents

Certification and Legislation of Organic Food in India

Certification is an important prerequisite for the acceptability of organic products or foods as organic by Government Regulatory Authorities, exporters, importers, as well as consumers across the world. To satisfy their requirement, a sound system of certification and labeling of the produce by a competent agency is highly essential.

The organic certification is a procedure by which a third party between the producer and consumer gives written assurance that the product, process or service confirms to specific requirements. The farming unit for organic production has to be supervised and inspected at frequent intervals and at different stages of production before certification in order to ensure quality and authenticity.

The Certification Agency has to adopt very reliable methods such as Soil tests, Water tests, Food quality tests, and other natural quantitative indicators so as to ensure credibility of the system in order to prevent fraudulent labeling of the products. It is necessary to keep the records of all management practices and materials used in organic production for five years. The crops must be grown on the land, which has been free of prohibited substances for three years prior to harvest. Crops grown on land in transition to organic (during the last three years after switching from conventional farming) cannot be labeled as *ORGANIC*. Once the produce is certified as ORGANIC, the producer or the processors are entitled the symbol.

Worldwide, inspection and certification of organic foods is carried out on the basis of two largely overlapping sets of guidelines and norms namely, Statutory Certification Norms and the Voluntary/Civil Certification Norms. Generally the Voluntary/Civil Certification Norms are stricter than Statutory Certification Norms. Statutory Certification Norms are legal guidelines set by Government, which is related to certification of organic produce, regulatory governing import

of organic foods, rules regarding equivalence between countries etc. On the other hand, various National and International forums and association such as Soil Association of UK, Organic Growers Association in various countries etc, set Voluntary/Civil Certification Norms. The most highly accepted voluntary certifications are from agencies like CODEX, IFOAM, Naturland, Demeter, Soil Association etc.

In India, Statutory Certification Norms relating to organic foods regulates the organic exports only not the domestic organic food industries. Although in India, the External certification bodies have been introduced for inspection and certification programmes since 1987.But in March 2000, the Ministry of Commerce launched the National Programme for Organic Production (NPOP), designed to establish national standards for organic products, which could then be sold under the logo '*India Organic'*. To ensure the implementation of NPOP, the National Accreditation Policy, and Programme (NAPP) was formulated, with accreditation regulations announced in May 2001. These make it mandatory that all certification bodies, whether already engaged or proposing to engage in inspection and certification of organic crops and products, should be accredited by an accreditation agency. Foreign certification bodies operating in the country must also be accredited under the NAPP.

For Organic Certification Agency, International Federation of Organic Agriculture Movements (IFOAM), Germany has established the IFOAM Accreditations Programme. In India, IOAM (Indian Organic Agriculture Movement), a member of IFOAM, adopted the IFOAM International Standards, the basic production standards applicable under Indian condition were prepared, and farmers growing crops as per IOAM Standards are eligible to get the Certificate and the organic label. The farmers can sale the organic produce in the local as well as International markets on the basis of IOAM label.

The National Standard Committee has drafted both the concept and principles of basic standards of Organic Agriculture in 1996 in order to improve the socio economic condition of the farmers and also boost the International Trade.

At present in India, the following six authorized accreditation agencies has been approved by the Ministry of Commerce, Government of India. They are

- APEDA (Agricultural & Processed Food Product Export Development Authority)
- Coffee Board
- Spices Board
- Tea Board
- Coconut Development Board
- Cocoa & Cashew nut Board

In addition there are four Certification Agencies accredited by APEDA such as

- IMO Control Pvt. Ltd., Bangalore (Institute fur Marketecologie, Switzerland)
- Skal International (The Netherlands), India, Bangalore
- SGS (Societe Generale de Surveillance, Switzerland) India Pvt. Ltd., Gurgaon
- ESCOCERT (Ecological Certification, France) International, Germany

APEDA ((Agricultural & Processed Food Product Export Development Authority) is an export promotion organization, involved in publicizing Indian Organic logo globally. Expo-Import Bank in association with APEDA is engaged in promotion of organic agriculture products by creating awareness through active participation in International Conferences. It has also engaged

to identify exclusive Agri Export Zone (AEZ) for organic produce in some parts of country, such as organic pineapple in Tripura, where use of chemical fertilizers and pesticides is negligible.

NSOP (National Standards for Organic Production): It has been formulated by Dept. of Commerce, Govt. of India for National Program for Organic Production (NPOP). Any production certified as per NSOP may use the term, *"Organic"*. A product can be labelled as, *"For Export only"* when it has been produced in India to an Organic Standard other than NSOP for example EU Regulations, IFOAM etc. Truthful label claims are allowed for domestically produced organic products that meet the NSOP and an International Organic Standards. Organic Certificates remained valid for one year/until the next decision is made. Organic Certification Standards invalid incase where you voluntarily or your certification is suspended by the Certification Agencies. The frequency of inspection is generally done once in a year. Additional inspections are conducted wherever found necessary. NSOP also formulated rules for misuse of the term, *"Organic"*. Any operation that knowingly sells per labels a product as, *"Organic"* except in accordance with the National Standards may be subject to a civil penalty

India's first ever local Organic Certification Body, INDOCERT (Indian Organic Certification Agency), was established in March, 2002 with an objective to offer a reliable and affordable organic inspection and certification services to farmers, processors, input suppliers and traders. It is an independent, nationally operating nonprofit trust whose primary aim is in conducting inspections and granting certification for organic production methods. It provides certifications both for domestic as well as export market. INDOCERT also functions as a platform for training, awareness creation, information dissemination, and networking in the field of organic farming. It has been set up by a group of Indian NGO's and corporate organizations with the technical collaboration of FiBL, bio.inspecta, and the Swiss State Secretariat of Economic Affairs (SECO). INDOCERT has strong technical collaborations with two well-reputed organizations from Switzerland: FiBL (Research Institute of Organic Agriculture) and bio.inspecta (the leading Swiss certification agency). Bio.inspecta assists INDOCERT for certification according to USDA national organic program (NOP) and JAS (Japanese Agricultural Standard for Organic Agriculture) through a re-certification procedure. It evaluates inputs used in organic production and confirms their compliance with the Indian National Organic Standards and the European Regulation EC 2092/91. Presently INDOCERT restricts its input approval scheme to fertilizers and soil conditioners and to inputs related to plant protection (pesticides, repellents etc). According to the year of production, INDOCERT label the products as organic as follows,

Crops	***Year wise Label***			
	1st year	2nd year	3rd year	4th year
Annual	No label	In Conversion to Organic Agriculture	Certified Organic	Certified Organic
Perennials	No label	In Conversion to Organic Agriculture	In Conversion to Organic Agriculture	Certified Organic

- INDOCERT can provide applicants with sufficient information to enable the farmers to comply with the national standards. But it is prohibited from giving advice, or providing consultancy services to certification applicants or certified operations for the purpose of

overcoming barriers to certification. In other words certification agents must explain the regulations but they cannot tell operators how to correct a noncompliance

- In order to improve extension works at the field level, INDOCERT is initiating the set up of an Indian Organic Advisors Association to provide technical advice for farmers, the association will function as a platform for advice, information dissemination, and training in the field of Organic Agriculture

Conversion to Organic Production Systems

Conversion period is actually the time between the start of Organic management and certification of crops and / or animal husbandry. When traditional agricultural methods fulfill the principles of the Standards, no conversion period is required. When virgin lands are used for organic purpose, no conversion period is required. The whole farm, including livestock should be converted according to standards over a period of time. If a farm is not converted at once, it should be done on a field-by-field basis. The conversion plan shall cover all aspects relevant to these standards. The converted land and animals shall not get switched back and forth between organic and conventional management

Conversion requirements:

It should have clear conversion plan. It should include, History and existing situation of crops, fertilizing, pest management, animal husbandry etc, a schedule for the progression of conversion and the details of the aspects which is required for change during the conversion period .Usually the conversion period is calculated on the basis of date of application to the Certificate bodies or from the date of last application of unapproved farm inputs .In case where the whole farm does not get converted, then it should be ensure that a fixed demarcation between the conventionally & organically framed plots and the organically framed plots should be easily accessible for frequent inspections etc, all farm records and accounting is identifiable for both farming systems, no parallel production should take place and conversion area should not get switched back and forth between organic & conventional management.

Plant products from annual production can be certified organic when the standard requirements have been met for a maximum period of 12 months before the start of production cycle. Perennial plants can be certified organic at the first harvest after at least 18 months of management according to the standards. The Certification Agencies may allow plant products to be sold as "*produce of organic agriculture in process of conversion"* when the standards requirements have been met for at least 12 months. On farms with simultaneous organic and conventional production the use of genetically engineered organisms is not permitted on the conventional part. Certification of processing units can be done when there is clear documented evidence that organic and conventional streams of processing are separated

Details of Crop Production for conversion to Organic systems:

1. **Soil and Water Conservation**
    - Relevant measures should be taken to prevent soil erosion, conservation of water, prevent both excess & improper use of water & pollution of ground as well as surface water
    - Relevant measures should be taken to prevent salination
    - Cleaning of land by burning of organic matter should be restricted to the absolute minimum

2. **Choice of crops & variety**
    - Seeds & planting materials should be from traditional / certified organic production
    - Seed treatment should be made with permissible products
    - When certified organic seed not available, chemically untreated seed conventional materials may be used
    - New crop seed & plant material treated with synthetic pesticides, chemicals, related or micro waved can only be allowed in regions where organic agriculture is in the early stage
    - Use of genetically engineered seeds, transgenic plants should not allowed
3. **Crop rotations**
    - Certifying programmes should set minimum standards for crop rotations on arable land, taking into account the nature of the crop, presence of weeds & local conditions
4. **Manurial Policy**
    - Manurial policy should include green manure, leaf litter & Vermicomposting
    - Manure containing human faeces or untreated sewage should not be used on vegetables produced for human consumption
    - Any organic wastes should be applied in their natural composition & should not be rendered more soluble by chemical treatments
    - All the materials should be in accordance with the standards. All synthetic nitrogenous fertilizers including urea should be excluded
    - Organic farm should have manurial policy to include inputs based on microbial, plants or animal origin, provided they do not have adverse effects on the soil and local ecology
5. **Pests, diseases and weed management**
    - Products of traditional nature, preferably prepared at the farm from local plants, animals and microorganisms should be used
    - Both physical and thermic methods are permitted. Thermic sterilization of soil is allowed to combat both pests & diseases, whenever necessary
    - All the synthetic herbicides, fungicides, pesticides should be strictly prohibited

Latent needs of Organic Farming of Vegetable crops in India

1. Most of the vegetable crops are eaten fresh or used for health care; hence any contamination (chemical residue) may lead to various kinds of health hazards
2. In India majority of the vegetable growers are poor, small and marginal farmers
3. Decrease in land productivity due to ever increasing use of chemical fertilizers
4. There are not many scientific breakthroughs in improving quality and production of vegetable crops
5. 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.
6. High environment pollution
7. Due to globalisation, which affects every industry, there is needed to be competent and compete with the best in the World urges us to give the adequate weighages to Organic Farming of vegetable crops

8. Organic Farming of vegetable crops generates income through International exports or by saving production costs.
9. Organic Farming also able to secure a place of India on International markets by producing high value vegetable crops.
10. Excessive use of chemical fertilizers as well as pesticides not only increases the cost of production but also poses threat to the environment quality, ecological stability and sustainability of production. We have gained quantity but at expense of quality.
11. In developing countries like India, especially in low input traditional system, properly managed organic farming system can increase the crop productivity and restore the natural base.
12. The decision to go for Organic Farming seems partly financial, partly out of concern for the environment and partly because it made sense to threat the land and animal as well without chemicals.

Objectives of Organic Farming in Vegetable crops

1. To produce food of high nutritional quality in sufficient quantity
2. To encourage biological cycles within farming systems by involving the use of microorganisms, soil flora & fauna, plants and animals
3. To maintain and increase the long term fertility of soil and biodiversity
4. To use renewable resources in locally organized production systems
5. To work with a close system with regard to organic matter and nutrient elements
6. To avoid all forms of pollution that may results from Agricultural techniques

Technology packages for Organic Vegetables

1. Timely preparation of soil to a fine tilth with 2-3 ploughings to remove all debris, stubbles, stones etc and to avoid infestation of ants and termites. However, minimum tillage is considered as an important component of organic farming.
2. Use of organic manures as basal dose @ 25-38 t/ha through FYM, poultry manures, fish manures, sheep composts etc. Use of organic cakes from neem, groundnut, pongamia, and castor becomes imperative.
3. Raising of green manure crops like sesbania or dhanicha and incorporating into the soil, besides using biomass of other plant species.
4. Use of crop residues is essential in organic vegetable production, which increases the soil organic matter content, maintains soil fertility status, and in turn increases the crop yield. Studies conducted by Upadhayay and Sharma (2000) reported that application of five group of crop residues like bhang (*Cannabis sativus*) leaves, parthenium weeds, gulmohar and peepal leaves to the soil @ 15t/ha each before raising cowpea crop in a cowpea-potato-cucumber rotation and subsequently the crop residues of cowpea, potato (haulms) and cucumber were added in succession after harvest of each crop and before sowing of succeeding crop resulted a positive effect on the yield of crops and enriched the soil with organic matter.
5. Always include legume crop like beans, peas, cowpea etc in the crop rotation not only to improve the soil fertility by fixing atmospheric nitrogen but also to increase the yield up

to 30-35%. Inoculation of legume crop specific rhizobial strains can further improve their N- fixing ability. The quantity of N fixed by different crops is given in the Table. 1

6. Choice of vegetable varieties should be based on climate and market preference; adopting optimum spacing and timely planting, raising plants/seedlings with enough organic manures and bio-fertilizers and using only vigorous seedlings for better establishment, growth and yield.
7. Application of bio-fertilizer is of great significance in organic farming. As they play a nutritional stimulatory and the therapeutic role in improving growth, yield and quality of vegetable crops. Inoculations of vegetable crops with different bio-fertilizers have depicted an encouraging response both in terms of increasing yield, quality and soil fertility. The field response of *rhizobium* is encouraging as reported by a number of research workers. *Azotobacter* and *Azospirillum* depicted a significant influence on vegetable crops, resulting in nitrogen economy of 25-50% and increase in yield from 1-42 %(Table no.2 a). Similarly phosphorus solubilizers can also save in general 40% phosphorus fertilizers and can enhance the crop yields from 4.7-51% (Table no. 2b)
8. Use of locally available mulching materials or polythene sheets to reduce moisture loss and minimum weed growth.
9. Use disease resistant varieties that suit the eco-system controlling weeds and removing all infested parts with pests and diseases and raising trap plant to attract insects and to follow crop rotation. For example; cabbage head borer- trap plant as mustard potato/chilli/tomato rotated with cereals, oilseeds and other vegetables. Control of pests and diseases through use of resistant/tolerant varieties is indicated in Table no. 3
10. Use bio-pesticides and bio-control methods for control of various pests and diseases. Natural products like garlic extract are used as broad-spectrum pesticides. Neem, Sabadilla, and Pyrethrum extracts are also used as pesticides (Table no.4). Besides this, bio-fertilizers like *Azotobacter, Azospirillum*, PSM, and phosphorus mobilize have antifungal activities without any residual or toxic effect resulting in the sustainable quality vegetable production. Crop inoculated with *mycorrhizal* fungi exhibits increase resistance to *Rhizoctonia solani* and *Fusarium oxysporum*. Damping off of tomato caused by Phythium could be considerably prevented. Mycorrhized tomato plants were found more resistant to nematode infection.

Table no.1. Quantity of N fixed by legumes

Crop	**N fixed (kg/ha)**
Cowpea	80-85
Cluster bean	37-196
Fenugreek	44
Pea	52-57
Black gram	50-55
Chick pea	85-100
Pigeon pea	168-200

(Source: Palaniappan and Annaduari, 1999)

Table no. 2(a) Response of Vegetable crops to Bio-fertilizer inoculations (for nitrogen)

Bio-fertilizer	Crop	Increase in yield (%)	Nitrogen economy (%)	References
Rhizobium	Cowpea	4.09		Mishra & Solanki (1996)
	Pea	13.38		Kanaujia et al (1999)
	Pea	5.10		Choudhury *et al* (1982)
Azotobacter	Cabbage	24.30	25	Verma *et al* (1997)
	Cabbage	26.45	-	Lehri & Malhotra (1972)
	Garlic	14.23	25	Anonymous (2003)
	Garlic	14.80	25	Wange (1995)
	Knol khol	9.60	25	Chatto *et al* (1997)
	Onion	18.00	-	Joi & Shinda (1976)
	Tomato	13.60	50	Kumaraswamy (1990)
Azospirillum	Cabbage	7.00	25	Jeeva Jothi *et al* (1993)
	Cabbage	11.87	25	Verma *et al* (1997)
	Capsicum	9.98	25	Anonymous (2002)
	Chilli	26.70	25	Paramguru & Natrajan (1993)
	Chilli	15.10	25	Deka *et al* (1996)
	Knolkhol	14.90	25	Chatto et al (1997)
	Onion	9.60	25	Thiiackavathy & Ramaswamy (1999)
	Onion	6.20	25	Gurubatham *et al* (1989)
	Onion	21.68	25	Anonymous (2002)
	Garlic	6.42	25	Anonymous (2003)
	Okra	9.00	25	Subbiah (1991)
	Radish	9.00	-	Sundaravelu & Mutukrishna (1993)
	Sweet potato	8.50	-	Desmond *et al* (1990)

Table no. 2(b) Response of Vegetable crops to Bio-fertilizer inoculations (for phosphorus)

Bio-fertilizer	Crop	Increase in yield (%)	Phosphorus economy (%)	References
PSM	Garlic	14.23	25	Anonymous (2003)
	Onion	9.60*	25	Thiiakavathy & Ramaswamy (1999)
	Potato	30.50*	-	Gaur (1985)
	Pumpkin	51.00*	25	Karuthamani *et al* (1995)
VAM	Chilli	14.29*	-	Biswas *et al* (1994)
	Onion	4.70*	25	Gurubatham *et al* (1989)
	Potato	20.00*	-	Biswas *et al* (1994)

* Represents absolute control

Table no.3. Suggested varieties of vegetable crops tolerance/resistance to disease & pests

Crop	Pests/diseases	Varieties
Brinjal	Bacterial wilt	BWR12, Arka Nidhi, Utkal Tarini, Utkal Madhuri, Annamalai
	Phomopsis rot	Pusa Bhairav
	Shoot & fruit borer	SM 17-4,Punjab Barsati, ARV 2-C, Pusa Purple Round, Punjab Neelam
	Aphids, jassids, thrips, white fly	Kalyanpur-2, Gote-2, PBR-91, GB-1, GB-6
Chilli	Leaf curl virus	Pusa Jwala, Pusa Sadabahar
	Leaf curl virus CMV, TMV & leaf curl	Punjab Lal
	Mosaic, wilt & dieback	Punjab Sukh
	Virus complex	LCA 235
Cabbage	Black rot	Pusa Mukta
	Aphid	Red drum head, Sure head, Express mail
Cauliflower	Black rot	Pusa Shubra
	Stem borer	Early Patna, EMS-3, KW-5, KW-8, Kathamandu local

Cowpea	Bacterial blight	Pusa Komal
French bean	Common mosaic virus & rusts	Pusa Anupama
Musk melon	Downy mildew	Punjab Rasila
Okra	Yellow Vein Mosaic Virus	Varsha Uphar, Arka Anamika,Utkal Gourav
	Jassids	IC-7194, Punjab Padmini
Onion	Thrips	PBR-2, PBR-4, PBR-5, PBR-6, Arka Niketan, Pusa Ratnar
pea	Powdery mildew	JP-3, JP-4, NDVP-4
Pumpkin	Fruit fly	Arka Suryamukhi
Tomato	Bacterial wilt	Utkal Pallvai (BT1), Utkal Kumari (BT10), Arka Alok, Arka Vardhan
	Late blight	TRB1 and TRB 2
	Leaf curl virus	H-24, H-36, H-88
Water melon	Powdery mildew	Arka Manik

Table no.4. Natural or Botanical pesticides

Botanical pesticide	Source	Nature of the product	Against which pests
1.Allicin	Garlic	Broad spectrum pesticide	Act as antibacterial & antifungal bio-pesticide
2.Nicotine sulfate	Tobacco	Insecticides	Aphids, thrips, spider, mites & other sucking insects
3.Sabadilla	Sabadilla lily	Insecticides	Caterpillars, leaf hoppers, thrips, sink bug and squash bugs
4.Nemacide	Neem tree	Insecticides	Potato beetle, grass hopper, moth
5.Pyrethrum	Chrysanthemum	Insecticides	Aphids and ectoparasites of live stocks

Effective Bio-agents

Predators: Ladybird beetles on aphids and mealy bugs
Chrysoperla on aphids and other soft bodied insects
Carabids and staphylinid beetles on vast range of insect hosts

Parasitoids: *Trichogramma* sp. on Lepidopteran pests
Apanteles sp. on Lepidopteran larvae
Trichospilus pupivora on pupa of a caterpillar pest

Pathogens: Bacteria *Bacillus thuringiensis* (Bt) against DBM
Fungi *Beauveria bassiana* on various crop pests
Metarhizium anisopliae
Nomouraea rileyi on *Helicoverpa armigera*

Viruses	NPV (Nuclear Polyhedrosis virus)
	NPV of *Helicoverpa armigera*
	NPV of *Spodoptera litura*
Nematodes	*Steinernema glaseri* on soil insects

Response of Vegetables to Organic Farming

1. Potato: The long-term field experiment for seven years at Jalandhar (Sharma et al, 1988) revealed that FYM was more effective in increasing tuber yield than green manuring with dhaincha. Grewal and Jaiswal (1990) reported that the yield increase due to increased nutrients by increasing organic matter. From studies in different places, it was found that FYM to supply 100 kg P_2O_5.ha (about 30t/ha) not only met P and K needs of the crop but also kept the potato yield level at a higher than the combined use of P and K fertilizers (Sud and Grewal, 1990). Role of green manures in economizing P and K for potato has been evaluated in the field experiments at Jalandhar (Sharma et al, 1988; Sharma and Sharma, 1990).
2. Tomato: Application of oil cakes of margosa, castor, and groundnut (@0.2% W/W) is generally is found to reduce the intensity of root gall development. Thamburaj (1994) found that organically grown plants were taller with more number of branches. They yielded 28.18 t/ha, which was at par with the recommended dose of FYM and NPK (120:100:100 kg/ha).
3. Brinjal: Highest yield of brinjal was with 50 kg N/ha as poultry manure and 50 kg N/ha in the form of urea (Jose et al, 1988). By application of neem cake higher yield was obtained in brinjal (Som *et al*, 1992)
4. Okra: Okra responded to poultry manure @ 20 kg N/ha (Abusaleha and Shanmugavelu, 1989). There was increased in protein and mineral content of okra crop by application of FYM as compared to commercial manures (Bhadoria *et al*, 2002). Higher yield was also recorded by application of neem cake (Raj and Geetha Kumari, 2001). Application of bio-fertilizers with chemical fertilizers increases the availability of NPK in soil and fruit in okra (Subhiah, 1991).
5. Cauliflower: Singh and Mishra (1975) obtained highest returns of cauliflower by mulching with mango leaves.
6. Cabbage: Application of animal compost (cattle manures and chicken manure) to mineral soil of cabbage crop was effective in reducing the leaching out of mineral nutrients. The total carbon content was increased with the application of compost prepared with cattle manure. Nitrate content in the soil water increased with the amount of chemical fertilizers applied but remained low when only compost were applied (Nishiwaki and Noue, 1996).

Issues and strategies of Organic Vegetable Farming in India

The future success of organic vegetable production would largely depend upon size of the farm and supplies of non-chemical inputs, which have to be thoroughly backed up by well-proven package of practices addressing to the objectives of producing vegetable organically. These organic farming practices have to be turn to change in traditional concept of farming. The following issues and their viable strategies are suggested to make organic vegetable production more vibrant, dynamic, and responsive to changing consumer demand both locally and globally as well.

1. The research for Organic farming in vegetable crops must be on a system basis. It must be integrated one and must not be looking at in isolation.
2. The task of research would be to produce technologies, which can not only increase more food but also more jobs and more incomes. That means, research must aim at achieving triple goal of more job, more incomes and more food.
3. The research for organic farming should be focused on developing technologies which may attract the vegetable growers to adopt them, keeping in view of the requirements of small holdings of resource poor small and marginal farmers
4. The research should be in a holistic manner with long-term evaluation of different organic substrates
5. Identification of suitable cover crop and smother crop in a given cropping system
6. There should be strategy for monitoring of changes in groundwater quality with references to heavy metal toxicity, besides nitrate pollution.
7. Identification of soil improving crops under major agro-climatic zone
8. Evaluation of soil conservation practices of disease management, change in the habitat for beneficial insects and suitability of trap crops in organic culture and identification of nematode repellant cover crops especially from various vegetable crops should be given due emphasis
9. Development of techniques for modifying fertilizer recommendations for new crop rotations using different cover crops and full proof technology for transformation of traditionally used chemicals inputs farm into a successful organic farm.
10. Developing suitable varieties or hybrids for organic cultivation
11. Suitable packages of technologies are to be developed for organically grown vegetables
12. Large scale multiplication of bio-fertilizers, vermicompost, bio-control agents and distribution to the farmers at reasonable rates
13. There should be proper research efforts for production and commercialization of bio-pesticides and extension services to educate the farmers to use them.
14. Organic foods are proved superior in terms of health and safety, but there is no scientific evidence to prove their superiority in terms of taste and nutrition, as most of the studies are often inconclusive. Therefore, strategy should be made for proper evaluation of quality parameters and packaging of organic foods.
15. Efforts should be made to select suitable cropping systems or more precisely, farming systems specific to those agro climatic zones having higher productivity under Organic Farming. The Government should provide them adequate infrastructure facilities to make the Organic Farming, a profitable enterprise.
16. There is need for marketing research for organically produce for export potential. There should be proper planning for marketing of organically grown fruits, vegetables and food grains that should help farmers to get a better price for their produce. This, in turn, should motivate them to invest more in Organic Farming.
17. There should be incentives to the growers who produce organic vegetables
18. Extension scientists must develop strategy to create interest in small and marginal farmers to adopt organic farming technologies for growing vegetable crops

Why total adoption of organic Farming of vegetable crops is not feasible/ viable in India?

Though Organic Farming is one of the best approach to get sustainability in the crop production, still some constraints are there in adoption of Organic Farming in full fledge under Indian conditions. It is because of following reasons:

1. Organic farming is highly knowledge intensive farming. So one has to keep pace with the dynamics of nature to increase the biological productivity of the soil.
2. There is no organized extension machinery to disseminate the proven technologies and in many case the basic information itself is not available.
3. Reduction of yield in initial few years of conversion from pure chemical farming to organic farming, once the farmers switch over to Organic Farming.
4. Organic inputs may be difficult to generate on the farm.
5. The organic produce may not find an early market as most of the vegetables are perishable in nature
6. Shifting to pure organic farming is a very time consuming and laborious methods.
7. Number of cattle households decreased gradually day by day, causing scarcity of FYM.
8. Nutrient content is very low in organic sources. Varied nutrient content in organic materials, so it becomes difficult to farmers to calculate the actual amount of organic materials to be added in soil.
9. Collection and processing handling from wastes are most complicated.
10. Cattle dung, urine and farm wastes are to handle manually.
11. The consumer need protection, so the Certification and Inspection programme have to be Nationwide
12. Exporting of organic produce calls for adhering to predetermined organic standards, which should be confirmed to International Market demand also.
13. There is lacking of adequate research & development backup as well as training in Organic Farming in India.
14. There is problem in availability, transportation, and application of biological materials to meet the nutrient demand of the crops.
15. Biological pest control is very knowledge intensive.
16. Green manuring has also become uncommon as the farmers are more interested to grow as many crops of economic importance as possible and it has become difficult to have green manure crops in the crop sequences.
17. Green leaf manuring also has become limit due to over exploitation of shrubs and trees.
18. Lack of package of practices involving Organic-farming practices along with cost benefit ratio of different crops.
19. Lack of farmer's adoption without any financial help from government or other development agencies because of chances of yield loss in initial years of adoption.

Suggestions for promotion of Organic Farming in India

Some suggestions have been made for success of Organic Farming in India, which must be kept in the mind (Anonymous, 1998). They are as follows:

1. Establishment of centre of excellence and countrywide network for research on Organic Farming
2. Documentations of available indigenous technological knowledge (ITK) and other technologies developed by various public sector research centres/NGO/ individuals on different aspects of Organic Farming in India

3. Introduction of core courses on the concepts and practices in Organic Farming in the curriculum of Under graduate and post-graduate degree programmes at different SAUs and other Agricultural Institutes
4. Standardizations of mechanisms or methods for suitability or judging of Organic Farming practices
5. Formulation of appropriate package of practices of productions of different crops under Organic Farming Systems
6. Export groups, comprising of eminent agricultural as well as social scientists and progressive farmers may be constituted for visiting farms of successful farmers associated with organic farming practices
7. Dissemination of knowledge on Organic Farming through Krishi Vigyan Kendra (KVK), field demonstrations, TV programmes and other suitable mass media etc.

Conclusion

Organic Farming has the twin objective of the system sustainable and environmentally sensitive. In order to achieve these two goals, it has develops some rules and standards which must be strictly adhere to. There is very little scope for change and flexibility. Thus, the Organic Farming does not require best use of options available rather the best use of options that have been approved. These options are usually more complex and less effective than the conventional system.

With ever increasing population having huge requirements of vegetables and meager availability of organic resources, pure organic farming is not possible in India; rather some specific area can be diverted to organic farming for export of high quality vegetable crops. Thus, as a whole under Indian condition, only partial switching to Organic Farming of export oriented vegetable crops can be possible in recent times. In this context, it will relevant to quote Nobel Laureate Dr.Norman Borlaug (2002) who said that," Switching on food production to organic would lower crop yields. We can use all the organic that are available but we are not going to feed six billion people with organic fertilizers."

For Indian Agriculture, use of chemical fertilizers cannot be totally eliminated, rather can be reduced, or minimized. It has been proved by various experiments that by conjoint application of inorganic fertilizers along with various organic sources are capable of sustaining higher crop productivity, improving soil quality and soil productivity, besides supplying N, P and K, these organic sources also helps in alleviating the increasing incidence of deficiencies of secondary and micronutrients. The commercial mineral fertilizers will have to be bearing the main burden of supplying plant nutrients to meet the nutrients to meet the food requirements of increasing populations. Therefore, these organic resources should be used in integration with chemical fertilizers to narrow down the gap between addition and removal of nutrients by crops as well as sustain the quality of soil and achieve higher crop productivity. Nation wide adoption of Organic Farming is not possible due to its high cost, unavailability of organic resources, productivity etc which will leave many more people hungry. In this context, renowned Agricultural scientist and thinker Dr.M.S.Swaminanthan (2003) said that," a hungry man is an angry man" and," if the hungry man happen to a young man, then we have a potential terrorist amongst us" as stated by eminent Scientist Prof. Chhonkar (2003).

Thus, in India, adoption of Pure Organic Farming is possible partially, more specifically crops having high export potential in International markets .On the other hand, full adoption of Integrated Green Revolution Farming, another option of Organic Farming can be

possible to a large extent, where, the basic trends of the green revolution such as intensive use of external inputs, increased irrigation, development of high yielding and hybrid varieties as well as mechanizations of labour are retained with much greater efficiency on the use of these inputs with limited damage to the environment and human health. For this purpose some organic techniques are developed and combined with the high input technology in order to create Integrated Systems such as, "Integrated Nutrient Management" (INM), "Integrated Pest Management" (IPM) and biological control methods which reduce the need for chemicals.

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