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Review Article

Management strategies for organic vegetable cultivation: potential and problems

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Abstract

Agriculture in the past is generally considered to be organic by default or tradition, but the modern organic farming combines traditional farming knowledge with different modern agro-technologies, such as the use of enriched composts, high yielding varieties suitable for growing under organic farming conditions, biofertilizers, green manuring, mulching, bioformulations, crop rotations, mixed cropping with systematic integration of leguminous crops, etc. Organic agriculture in India has a great potential as an important livelihood option for small and marginal farmers looking for low input cost, ecologically sustainable farming in rainfed areas. Besides, various ecological services and other benefits of organic agriculture, the organic crops also suffer less from the attact of insect-pests and diseases and give higher profitability. Excessive use of chemical fertilizers, pesticides and water resources have resulted in poor quality of food produced with heavy pesticide residues and overall environmental degradation. Keeping in view the great potential of organic agriculture, there is an urgent need to promote organic farming in the country, which requires strong financial support to the farmers and R & D activities.

Key words: Organic agriculture, strategies, potential, problems, India, Himachal Pradesh.

In India, agriculture is the single most important sector. Organic farming is getting popularized throughout the world because the people realized the hazards of consuming products with chemical substances. Vegetables are an important component of a healthy diet. According to the WHO Report 2002, low fruit and vegetable intake is estimated to cause about 31% of heart disease and 11% of stroke worldwide. However, these are highly contaminated amongst all the agricultural products. Organic vegetables are preferred by the consumers as these are safe and more nutritious to eat. The injudicious and indiscriminate use of chemicals particularly in vegetables has attracted worldwide attention. Only 2.6% of the total cropped area in India is under vegetable production, however, the total consumption of pesticides is 13-14%.

Strategies for organic vegetable management

Most of the farmers in developing countries like India are doing agriculture with traditional knowledge. Many traditional farming systems could be certified organic as they fulfill the requirement of not using synthetic inputs. However, the modern organic farming goes beyond this. It combines traditional farming knowledge with modern agro-technology, such as the use of enriched composts, high yielding varieties suitable for growing under organic farming conditions, biofertilzers, green manuring, mulching, bioformulations, crop rotations, mixed cropping with systematic integration of leguminous crops, etc. The strategies for organic crop management include the following components:

Composts

Growing concerns relating to land degradation, threat to eco-systems from over and inappropriate use of inorganic fertilizers, atmospheric pollution, soil health, soil biodiversity and sanitation have rekindled the global interest in organic recycling practices like composting. The potential of composting to turn on-farm waste materials into a farm resource makes it an attractive proposition. Composting offers several benefits such as enhanced soil fertility and soil health – thereby increased agricultural productivity, improved soil biodiversity, reduced ecological risks and a better environment. Even though the practice is well known, farmers in many parts of the world especially in developing countries find themselves at a disadvantage by not making the best use of organic

recycling opportunities available to them, due to various constraints which among others include absence of efficient expeditious technology, long time span, intense labour, land and investment requirements and economic aspects. There are different traditional methods of composting which includes The Indian Bangalore Method (*anaerobic decomposition*) and The Indian Indore Method (*aerobic decomposition*). Traditional composting procedures take as long as 4-8 months to produce finished compost. In modern organic farming, some rapid composting methods, which offer possibilities for reducing the processing period up to three weeks, have been developed. A variety of approaches and their combinations which include shredding and frequent turnings, use of chemical nitrogen activators, use of Effective Micro-organisms (EM), use of worms, use of celluloytic cultures, use of forced aeration and mechanical turnings etc. have been used to hasten the composting process. Now a day, vermicompost is becoming quite popular among the organic farmers. Vermicompost is a organic manure produced by earthworms. Vermicomposting is an appropriate cost effective and efficient recycling technique for the disposal of non-toxic solid and liquid organic wastes.

Varieties suitable for growing under organic farming conditions

There is need to evaluate the varieties suitable for growing under organic farming conditions. So far the recommended varieties have been developed and released under inorganic farming conditions. There is a need to check the performance of these varieties under organic input conditions. Local varieties/land races developed/maintained by the farmers over a long period of time are well adapted to local agroclimatic conditions. These varieties can do well under organic farming conditions. There is a need to collect and evaluate these varieties.

Biofertilizers

Biofertilizers are ready to use live formulates of such beneficial microorganisms which on application to seed, root or soil, mobilize the availability of nutrients by their biological activity in particular, and help in building up the micro-flora and in turn the soil health in general. With the introduction of green revolution technologies, the modern agriculture is getting more and more dependent upon the steady supply of synthetic inputs (mainly fertilizers), which are the products of fossil fuel (coal/ petroleum). Adverse effects are being noticed due to the excessive and imbalanced use of these synthetic inputs. This situation has lead to identifying harmless inputs like biofertilizers. Use of such natural products like biofertilizers in crop cultivation will help in safeguarding the soil health and also the quality of crop products. The use of biofertilizers increases crop yield by 20-30%, replaces chemical nitrogen and phosphorus by 25%, stimulates plant growth, activate the soil biologically; restore natural soil fertility and provide protection against drought and some soil borne diseases. These biofertlizers are cost effective, supplement to fertilizers, eco-friendly and reduces the costs towards fertilizers use, especially regarding nitrogen and phosphorus. Specific types of biofertilizer are used in specific types of crop. For nitrogen availability in leguminous crops, *Rhizobium* and in non-leguminous crops *Azotobacter/ Azospirillum* are recommended. PSB is recommended in all types of vegetable crop for phosphorus availability. These biofertilizers can be used as seed treatment, seedling root dip, or as soil treatment.

Green manuring

The practice of ploughing or turning into soil un-decomposed green plant material for the purpose of improving physical structure as well as fertility of the soil is referred to as green manuring and the manure obtained by this method is known as green manure. The practice increases the availability of plant nutrients that contribute to yield of the crop. The microbial activities are enhanced as the fresh organic material acts as a nutrient source for diverse soil flora and fauna. The structure of heavy, light and sandy soil is considerably improved and unproductive lands can be converted into fertile ones by green manuring. In hilly areas, green manuring prevents soil erosion on sloppy lands by providing very good soil cover.

Mulching

Mulches are the materials, which are used to cover the ground surface of cropped area to prevent it from direct exposure. There are different types of mulches used in agriculture. For mulching, leaves, bark, nut shells, weeds, grasses, wood chips, silage,

paper, pine and conifer needles, paddy and wheat straw, rice husk, coir dust, saw dust, banana, sugarcane leaf waste, etc., as available in the area can be used. In modern day agriculture, the use of plastic mulches is becoming popular, though there are environmental issues related to their production and disposal. Organic standards allow the use of polyethylene, polypropylene and other polycarbonate-based plastic mulches but only if they are not incorporated into the soil and that they are lifted off and disposed of in an environmentally responsible manner. After lifting the plastic, a soil building cycle must be completed to help rebuild soil health. Mulching protects the soil from erosion and helps to retain soil nutrients, mulching helps to prevent weed growth, mulching keeps the soil moist by reducing evaporation, in rainfed area mulching helps to conserve moisture, improve water retention, increases water use efficiency, moderates soil temperature, protects perennials and biennials during the winter and reduces soil compaction. Mulch acts as a protective mat over the ground, reducing compaction from footsteps or heavy rainstorms.

Bioformulations

Bioformulations are the different bioproducts used in organic farming. Some of the widely used bioformulations in organic farming include Bijamrut for seed dressing, Sanjivik and Jiwamrut for soil enrichment, Amritpani as instant soil enricher, Panchgavya for seed treatment, crop sprays etc. For plant protection, the most commonly used bioformulations are Fermented Butter Milk used as strong pest repallent, *Dashparni* extract (ten plants' extract) used against various types of pests, *Neemastra* useful against sucking pests and mealy bugs, *Brahmastra* useful against sucking pests, pod/ fruit borers and *Agneyastra* useful against leaf roller, stem/fruit/pod borer. Various other formulations are used against various biotic stresses in organic farming.

Biological pest control

With the use of synthetic chemical in conventional farming, there is decrease in the population of various predators/parasites/antagonists which feed on various harmful insects and pathogen. In organic agriculture, the population of these natural enemies increase naturally or sometime they are reared and released in the field to reduce the pest population. The role of microbial insect-pest management has been thoroughly reviewed by Sood *et al*. (2009).

Crop rotations/Cover crops/Trap crop/Mixed cropping

In organic farming, crop rotation is one of the keys to success. Crop rotation in organic farm is an essential component for higher yield and also to manage pests. Rotation of the crops involves either only two different crops or a multi-years plan of several crops and cover crops in a planned sequence to complement each crop in the rotation. Different considerations when planning the crop rotation include the needs of feed, straw and pasture on the farm, market opportunities, insect, disease, weed management opportunities and the soil quality needs. In organic farming, one or two trap crops are grown along with main crop to attract insects in order to protect cash crop from the pest. Unlike the major emphasis on monocropping in inorganic farming, the main focus in organic farming is given on mixed cropping with integration of leguminous crops. Many Africans were practicing companion or mixed cropping practice which is a highly successfully strategy for outwitting many bugs and diseases.

Field sanitation/crop residue management

Management of crop residue in an effective way help in controling a number of insects and diseases. The crop residue should be properly incorporated in the soil. There are different types of beneficial fungi and bacteria in the soil which hasten the decomposition of crop residue and destroy disease pathogens and many insects which either overwinter in crop residue or lay their eggs in the residue.

Potential of organic vegetables

Majority of farming communities in India comprising of small and marginal farmers have benefitted only to a limited extent from agricultural intensification. As a result, most of the small holding farmers in the country still live in poor conditions. Initially, the organic farming in the country was started

as supply of the products that could not be grown in developed countries. Now, the organic farming has gained increasing support in the country as an approach to overcome the problems in conventional agriculture.

In 2009-10, India exported 135 organic products under 18 categories (Anonymous, 2010). The total volume was 44,476 tonnes, realizing over $125 million. The overall growth of organic food exports, thus, was 50.31 per cent over the previous year. Organic foods offer more health benefits as compared to the conventional food. Government of India is leading from the front to ensure multi-folds growth in organic market. Exports of organic food products are expected to grow further in the near future. The interest in organic agriculture in India is growing because it places more reliance on the natural and human resources available and requires less financial input besides many other benefits listed below:

1. Scope in rainfed farming

In most of the developing countries, lack of irrigation and the use of chemicals in rainfed farming lead serious monetary losses. The losses in terms of crops are much higher, and sometimes, complete failure of the crop occurs under rainfed conditions. Droughts have been observed to be the single most common factor of food shortages in the world. Scientists at the National Centre for Atmospheric Research (NCAR) analyzed that the percentage of Earth's land area stricken by serious drought was more than doubled from the 1970s to the early 2000s. In 2006, recurrent droughts caused regular crop failures in different countries of the world namely, Ethiopia, Somalia, Kenya, etc. The economically poor farmers with low purchasing powers who cannot invest on these costly inputs will be relieved partly by adoption of organic farming. Farmers' suicides in news headlines in developing countries like India have always attracted worldwide attention. National Crime Records Bureau of India data indicated a total of 216,500 farm suicides from 1997 to 2010. Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh are the most affected states of India (Deshmukh, 2011).These states are suffering from drought more often. However, the use of organic practices without the use of any chemicals under rainfed conditions would be more profitable as these crops withstand drought conditions better than chemical farming. Studies till date seem to indicate that organic agriculture offers comparative advantage in areas with less rainfall and relatively low soil fertility levels.

Traditionally, rainfed farmers are small subsistent land holders integrating livestock with crop production. With continuing population growth, intensifying crop and livestock systems continue to play vital role in maintaining rural livelihoods. Under rainfed farming, there is need to shift from cropping system mode to the farming system mode, which emphasize on not only the raising of crops but also consider other agricultural entrepreneurships like fruit trees, animals including fisheries, piggery and duck farming, sericulture, mushroom, on a given unit of land to increase the productivity and profitability, to upgrade natural resource base and to achieve overall improvement in the environment (Singh, 2005).

2. Sustainability

Organic agriculture is a sustainable production system which can provide more food security in the developing countries. It is a more reliable production system that can sustain yield on the long-term. Organic agriculture can contribute to ecologically sustainable socio-economic development in the developing countries. The use of locally available material (seeds, manures, botanicals, etc.) in organic agriculture makes it more cost-effective. Organic agriculture system is more sustainable than conventional farming system, which can maintain the soil health to nourish plant growth for a longer period and balance our ecosystem.

3. Rural employment

In India, 58.4 per cent of the total population depends upon agriculture for their livelihood. Over 90% of the rural population is dependent on agro-based activities (www.youthforindia.org). According to many studies, organic farming requires more labour input than the conventional farming system. Most of the developing countries have a very large number of unemployed and under employed labour, which can be engaged in organic farming. Moreover, the problem

of periodical unemployment will also get mitigated because of the diversification of crops with different planting/ harvesting schedules resulting in relatively high labour input.

Most of the land holdings in India are small and marginal. More than 70 per cent of India's farmers own less than 2 ha of land. Their production level is limited by the small size of their holdings. Lack of resources, inadequate market access, poor knowledge of postharvest processing and value addition and weak infrastructure are some of the factors which are count for larger proportion of unemployment in rural area.

The poor farmers with such holdings can not invest on costly inputs (seeds, fertilizers, pesticides, etc.). Three-quarter of all the hungry people who live in rural areas of Asia and Africa, depend on agriculture for their food. They do not have any alternative source of income or employment. Migration from rural areas to cities is a vulnerable problem often seen in most of the developing countries. Cities are becoming overcrowded and unhygienic day by day. Different other rural enterprises linked with organic farming shall mitigate the problem of rural unemployment to a great extent in rainfed areas. Nehra *et al.* (1992) and Singh *et al.* (1993) reported that the sheep or goat rearing on grazing had always been profitable and also provided constant and uniform employment to farm labor family in dry land conditions. Similarly, beekeeping (apiculture), silkworm rearing (sericulture), mushroom cultivation and other enterprises can improve the economic status of these poor farming communities by providing them self-employment.

4. Safe food for healthy life

About 146 million children in the developing countries have been reported to be under-weight (UNICEF, 2009). Vitamins and minerals deficiency related symptoms are common in developing countries. Chronic hunger and under-nutrition are the worst ordeals of poverty, which continue to haunt millions of rural poor households in developing countries including India. Organic crops usually contain more beneficial compounds, including vitamins and antioxidants. Further, organic food is more nutritious than ordinary produce and has higher levels of minerals (Veena and Swamy, 2008). Secondary metabolites, which increase disease resistance in plants and human beings, are more in organic produce than in inorganic one. Flavanoids, which are important antioxidants are found in more quantity in organic than in inorganic produce. The presence of more quantity of antioxidants in organic vegetables saves our body from cancer. Organic vegetable are generally prescribed to the patients suffering from heart and asthma diseases.

Organic foods are not only nutritious but also they are safer to consume as these are free from the pesticide residue. The nutritional status of the farming communities in the developing countries is very poor. Most of the food items available in the market for consumption especially fruits and vegetables are highly contaminated with pesticide residues. Washing of fruits and vegetables is in general recommended before consumption, to decrease the chances of pesticide residues present on the produce surface, nevertheless, majority of the pollutants are absorbed into the inner portion and can not be just washed away. Some of the pesticides are specifically made to stick to the surface of the produce and can not come out even after washing. Peeling can help in the elimination of some of the chemicals, but while doing so, many a times, the important nutritional substances will also be discarded with the skin. Various studies have demonstrated that pesticides are associated with reproductive and developmental toxicity and immunotoxicity, in addition to the causation of neurological disorders and cancers (Bouvier *et al.,* 2005). However, Winter and Davis (2006) reported that it is too early to affirm that organic food is better than a conventional one, as regards safety and nutritional quality. However, interest in organic products is growing worldwide principally because consumers are concerned about the amounts of agrochemicals, pesticides, synthetic growth stimulants and antibiotics in foods, as well as in genetic modifications (Torjusen *et al*., 2001). Bearing in mind the principle of 'health improvement', organic product consumers are looking for a product free from pesticides and characterized by a higher nutritional quality (Luthria *et al*., 2010), that is, with good content of substances, such as proteins, carbohydrates, lipids,

vitamins (vitamin C, E and A) and other antioxidants.

Some research work has evidenced nutritional differences between organic and conventional products, where these differences involve basically vitamin C content and the amount of sulphur-containing compounds (Worthington, 2001). Furthermore, the differences were also observed regarding some micronutrients, and a higher content of nitrate was observed in products coming from conventional cultivation (Williams, 2002; Siderer *et al*., 2005). Davis *et al.* (2004) compared forty-three products (garden crops grown following traditional agriculture production, without modern methods) between 1950 and 1999. They found significant differences among six nutritional principles (proteins, calcium, potassium, iron, riboflavin and ascorbic acid), reporting a lower content in cultures. Authors attributed this difference (decrease in nutrients) mainly to cultivar selection by producers and not only to the cultivation procedures used in the field.

In relation to product quality, Barrett *et al.* (2007) reported on higher content of total soluble solids (SS), higher titrable acidity and firmness in organic tomatoes (*Lycopersicon esculentum*) when compared with conventional ones. Nevertheless, several researchers have reported a higher content of vitamin C in organic foods (Heaton, 2001; Worthington, 2001; Bourn and Prescott, 2002; Williams, 2002).

Guseppina and Vianello (2011) compiled results from different studies which showed that in organic foods, a higher content of calcium (+63%), iron (+59%), magnesium (+138%), phosphorus (+91%), potassium (+125%), zinc (+72.5%), sodium (+159%) and selenium (+390%) and a lower content of aluminum ("40%), lead ("29%) and mercury ("25%) were found.

Crops grown with fertilizers and pesticides are forced to mature early and are not tasty, whereas, the crops grown organically takes longer time to mature and are tastier than inorganic produce. Promoting organic agriculture in the developing countries not merely for export purpose but also for self consumption will certainly improve the nutritional status of the people and shall prove a step forward in building a healthy nation.

5. Higher profitability

Organic agriculture is a profitable venture because the market prices and premium for organic produce are higher even up to 400 per cent (IFAD, 2005). Even within cases of significantly lower yield in organic farming, prices premium made organic more profitable (Brumfield *et al*., 2000; Lyngboek *et al*., 2001, McBride and Greene, 2008). Most of the studies in developing countries, which are based on interviews with farmers, showed higher profitability in organic agriculture partly because of higher yield and reduced costs.

In organic agriculture, input-costs are lower due to the use of locally available material (local seed, composts and manures, botanicals, etc.). Lower production costs caused significant differences in net returns even without premium (Mendoza, 2002; Mahoney *et al*., 2004). Low production costs and higher premiums for organic produce was observed the prime reason for higher profit margins (IFAD, 2003; Gibbon and Bolwig, 2007; Setboonsasng, 2008; and Jalees, 2008).

Different workers showed that even without higher premium, profit from organic farming was better (Diebel *et al*., 1995; Smolik *et al*., 1995; Dobbs and Smolik, 1996; Hanson *et al*., 1997; Olson and Mahoney, 1999; Delate *et al*., 2003; Eyhorn *et al*., 2005; Pimental *et al*., 2005). Organic farming system is quite competitive with conventional farming system as the input-costs in organic farming are generally lower.

6. Environmental benefits/ecological services

Ecosystem services are "the benefits of nature to households, communities and economies." Adoption of conventional farming with the use of synthetic chemicals and fertilizers has degraded up to 60% of ecological services (Anonymous, 2005). Organic agriculture is a self supporting farming system which decreases production costs.

Organic farming leads to many improvements in the natural environment as mentioned below:

- Reduced pollution and health risks because of no use of agrochemicals and fertilizers
- Increased water holding capacity of soils
- Better pollination in cross-pollinated crops
- Potential to build farm resilience
- Rise in water table with more availability of drinking water in dry season
- Avoids nutrient exploitation
- Reduced soil erosion and soil compaction
- Improved organic matter in the soil
- Enhanced soil carbon sequestration through agricultural management practices (such as increased application of organic manure, use of intercrops and green manures, higher share of perennial grasslands and trees or hedges)
- Increased agro-biodiversity

7. Low incidence of pests and diseases

Diseases, particularly the soil borne root diseases are generally less severe on organic farms than conventional farms. With the use of long and diverse crop rotations, crop mixtures and regular application of organic amendments, the incidence of root rot diseases is comparatively low. In organic agricultural system, there is an increase in soil microbial activities, which increase the competition and antagonism in the rhizosphere. The presence of beneficial root-colonizing bacteria and increased level of vesicular-arbuscular mycorrhizal colonizaion of roots have all been identified as contributing factors in the control of root diseases.

Organic crops have been shown to be more tolerant as well as resistant to insect-pests attack. With the use of synthetic fertilizers and pesticides, there is an increase in the susceptibility of crops to pests. In organic farms, the use of any synthetic pesticides is not allowed, which results in the increase in the population of insect predators, and as such, there is natural control of the insect-pests.

8. Other benefits

Organic agriculture is a multi-output farming system and yield in a single output may not be an adequate indicator without taking into consideration the other benefits. To meet the food, fiber, fuel, fodder and other needs of the growing population, the productivity of agricultural land and soil health needs to be improved. Organic agriculture continuously improves the soil fertility and prevent loss of top soil, while the conventional methods have the opposite effects.

Productivity of vegetable crops in the country has been reported to be enhanced in the recent past with the adoption of conventional agricultural technologies such as the use of synthetic agrochemicals like fertilizers and pesticides, input responsive high yielding varieties, over exploitation of irrigation resources, etc. However, continuous and indiscriminate use of these high energy inputs has now led to decline in productivity of various crops, imbalance in social and economic status, extinction of gene pool, reduction in the quality of produce, increase in pesticide use, unscientific water management and distribution, increase in secondary and micronutrients deficiencies besides environmental pollution, etc. With the adoption of organic agricultural practices, these drawbacks of high input conventional agricultural practices are taken care of.

Problems of organic farming

1. Low initial production

The first and foremost hurdle in the adoption of organic farming on commercial scale is the low initial production. Until and unless there is strong support from Government to the farmers, they will not be ready to take the risk.

2. Lack of awareness

Majority of small and marginal farmers located in remote rural areas in India are using organic practices by default either due to limited access to modern agricultural inputs or due to their low purchasing power. Their produce can be easily brought under organic certification programme, but due to lack of awareness, most of the agricultural produce in these parts of the countries is either self consumed or available for sale in limited quantity in local market.

3. Lack of organized markets for certified organic produce

In India, there are still no organized markets for sale of certified organic produce. In the absence of organized markets for certified produce, farmers converting to organic farming shall not find good premium for their organic produce. Without higher premium of the certified organic produce, it will not be a profitable venture to convert to organic farming for the small and marginal farmers of developing countries.

4. Reluctance of progressive farmers to convert to organic agriculture

Most of the developing countries have some potential agricultural pockets on which the entire nation depend for food security, e.g., in India, Punjab and Haryana are food bowls for wheat and rice production. In these potential pockets and other urban/ periurban areas in the developing countries, intensive agricultural production activities can be seen. The use of fertilizers and pesticides is more in these areas (Anh *et al*., 2004). Pesticides also tend to be over used and abused. Converting to organic agriculture in such intensive cultivation area shall result in sharp decrease in production level, which the farmers will not ready to accept.

5. Less R & D activities

Much of the knowledge in organic farming is based on the traditional practices. Though, some R&D activities in the field of organic farming has been started in some parts of the world but these are not sufficient. More intensive efforts need to be initiated for the promotion of organic agriculture.

6. Complicated organic production procedures

Generally, the organic production prodedures are quite complicated. Many developed countries have started their organic standards, but in most of the developing countries, still the organic standards have to be developed. For global trade of organic produce, organic standards need to be formulated keeping in view the required standards of the importing countries.

7. Government support

Most of the developing countries have limited resources. They have to balance their resources against their needs. There is a need of strong government policies to promote organic agriculture in developing countries. Keeping in view the potential of organic farming in the developing countries, the government efforts with strong financial support are needed.

Concluding remarks

On one side, there are recent economic slowdown on many industries, on the other hand, organic agriculture sector not only sustained itself during last couple of years but also showed a growth. Fifty per cent increase in area under organic farming was registered from 2000 to 2009 with a total of 37.2 million hectares area being covered under organic farming in 2009 (IFOAM, 2011). Organic agriculture holds untapped potential for helping farmers and consumers and to protect the environment. There are many production challenges associated with organic farming of vegetables. Systematic research efforts on collection and validation of traditional farm practices are required. In organic farming, application of local resources and traditional knowledge is given special consideration.

It is the general notion that organic agriculture cannot contribute significantly to the global food supply due to low yields in organic farming system and also there is an insufficient quantity of organically acceptable manures and fertilizers. Consequently, there is insufficient quantity of naturally available nitrogen Badgleya *et al*. (2007) compared yield of organic verses conventional production from a global dataset of 293 experiments conducted both in developed and developing countries and estimated the average yield ratio (organic : non organic) of different food categories.

For most food categories including vegetables, they concluded that the average yield ratio was slightly less than 1.0 for the studies in developed world and more than 1.0 for the studies reported from developing

countries. The study indicated that organic method could produce enough food to sustain the current human population. However, some of the initiatives, which are urgently required, are as below:

- Government should facilitate the access to certification services, either by stimulating foreign certification bodies to open their offices or even better to support the development of local service providers.
- Special consideration should be taken for certification of small holders. Training programs for small groups to set up ICS (Internal Control System) should be supported.
- PGS (Participatory Guarantee System) in which one group of farmers certify the organic produce of other group of farmers should be made effective. This type of certification is quite cheap and effective for sale of organic produce in the domestic market.
- Government should actively contribute to awareness raising for organic on all levels. There is need to develop farmers friendly organic related literature.
- Organic exporters should be facilitated to promote their exports.
- Higher education in organic agriculture should be developed.
- There is a need for survey of traditional agricultural knowledge and its validation & refinement. More funding for research programs in organic agriculture are required.
- Organic seed sector should be strengthened.
- There is a need to regulate the market especially for organic produce.

Organic farming in Himachal Pradesh

Agriculture in Himachal Pradesh needs special focus, as it is the main occupation of the people of Himachal Pradesh, which accounts for 21.1 percent on the total domestic product, thereby providing direct employment to about 71 percent of the main working population in the State. Since 80% area of the state is rain fed, the organic farming shall provide a boon for sustainable agriculture through better moisture conservation for the growing of crops. Organic farming has been kept as one of the thrust area for the development of agriculture in Himachal Pradesh.

Organic farming programme has been taken up in Himachal Pradesh in a big way. So far, 24000 peasants have been registered for organic farming in HP and around 2,500 hectare of land in Hamirpur, Solan, Bilaspur, Mandi, Shimla, Kullu and Kangra is under organic farming. The certified organic produce for H.P. is being made available from August 2006 onwards in the State. The farmers have now started adopting organic farming and as such the demand of organic fertilizer and bio-fertilizer is increasing in the markets. Over 27000 vermicompost units have already been set up till 2009-10 and 15000 more are being set up during 2010-11. Necessary steps for developing brand for 'Himachal Organic' has been taken up in HP. Organic agriculture would also open new vistas of employment for Himachali youths. The un-employed youth can be engaged for Internal Control System leading to certification, providing consultancy services to the farmers, production and supply of organic inputs, marketing of organic products, etc. Organic Farming Promotion under Rashtriya Krishi Vikas Yojna (RKVY) aims at achieving 4% annual growth in the agriculture sector during the XIth Plan period, by ensuring a holistic development of agriculture and allied sectors.

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