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ORGANIC FARMING: PERSPECTIVE IN SUSTAINABLE DEVELOPMENT

1. INTRODUCTION

Sustainable development is the ultimate destination of any program launched by any country at any period of time. Among others, deteriorating natural resources is the major concern that is conveying warning signals to the bio-world. Modern agriculture is mostly driven by non-renewable energy where billions tones of chemicals are consumed annually. That, it is working against natural balance and taking the human society from stable to instable position. In search of sustainable development, agriculture has been redefined and recommended in the form of organic farming systems.

Organic farming has its origin to ancient civilization like Mesopotamia, Indus Valley, Yangtze and Hwang Ho. Organic manures find mention in ancient Hindu religious scriptures (Rigveda 1, 161, 10: 2500-1500 B.C; Atharva veda, 2,83). However in the west idea was conceived by Steiner (1924) who proposed the farm as an organism where all its component parts, namely soil minerals, organic matters, microorganisms, insects, plants, animals and humans interact in a coherent manner. A range of structural features and tactical management practices are combined to keep up crop yields, livestock productivity, biodiversity and human nutrition at the farms with minimum pollution, non-renewable energy use and off-farm inputs.

Organic farming systems exist thoughout the world in diverse climates with wide range of management practices. The objectives are social well being, economic security and environmental sustainability. The systems have been modified and being recommended by different workers with term like ecological agriculture, biodynamic agriculture, organic biological agriculture, natural farming, precision farming, do-nothing farming, permaculture, low input agriculture, integrated farming, holistic management, alternative agriculture, prescription farming and site specific management (Stockdale *et al* 2001; Chhonkar 2003, Gold 1999). The essential feature or basic intention in all these farming systems is approaching towards nature's way. Many countries now encourage the organic farming and have given it proper legislation and certification to promote its adoption, production processing and marketing.

Increasing demand for organic products throughout the world reveals considerable promotional avenues of organic farming. It seems a valid alternative means to intensive or conventional agriculture and may act as an effective tool to usher a regime of sustainable development of the human society. Further the potential of organic farming can be substantially improved by investment in research and integrating it with other sustainable agricultural practices.

2. CONCEPT AND DEFINITION

Organic farming in its latest form is a philosophical agriculture system that has its own roots in ancient settled agriculture. It is now evolving in response to ecological crisis and has re-oriented itself into a movement across the world. In the beginning this movement objectively defined link of human health with healthy crops, healthy livestock and healthy environment. Earlier the emphasis was on cultivation of crops with organic fertilizers. later use of various agro-chemicals such as pesticides (insecticides fungicides, weedicides), growth stimulants and feed additives was also prohibited. Prohibition may be extended to genetically modified organism and their products because of some uncertainties being expressed over them. As more and more knowledge regarding interrelationship of soil, crop, livestock, natural ecosystems and human health, accumulates, organic farming will be refined and improved to suit the existing agro-ecosystem.

Organic farming as it literary conveys that raising of crops with organic manures with no use of synthetic chemicals. Chhonkar (2003) described it as dogma-driven movement that lays emphasis on avoiding or largely excluding the use of synthetic fertilizers, pesticides, growth regulators livestock feed additive and add to this use of genetically modified organisms (GMOs) too. Lord Northbourne (Gold 1999) conceived organic farming as **'A sustainable, ecologically stable, self contained unit, biologically complete and balanced – a dynamic living organic whole.** As defined by a USDA study team on organic farming (Gold 1999), **organic farming is a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives.** To the maximum feasible organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral bearing rocks and aspects of biological pest control to maintain soil productivity and tilth to supply plant nutrients and to control insects, weeds and other pests.

According to FAO's codex definition (Nanda *et al* 2003) **organic agriculture is a holistic production management system, which promotes and enhances agro-ecosystem health includes biodiversity, biological cycles and soil biological activity.** USDA, National Organic Standard Board (NOSB) considered it **a production system based on minimal use of off farm inputs and management practices that restore, maintain and enhance ecological harmony.**

Thus organic agriculture or organic farming aims to optimize the health and productivity of interdependent communities of soil life, plants, animals and people. It comprises all technologies that maintain the integrity of organic agricultural products namely production, handling, processing, transport, storage and retailing etc.

It is discernible that concrete guidelines on several aspects are still needed to make it more scientific and acceptable. Knowledge of when, why and where of organic farming is mandatory. How to execute it in the light of internationalization of the system i.e. specific package of practices in relation to agroecological requirements and market specification needs to be worked out. It is essential as organic farming seeks sustainable development of human society through integrated development of natural resources.

3. WORLD SCENARIO

The world of organic agriculture or organic farming has its origin in the west just recently (Steiner 1924) while in Asian countries including India it has been in practices over large area from the time immemorial. It has been associated with fallowing and shifting cultivation practices to realize good crop yields in wake of scarcity of organic manures. No specific recognition, identification and extra incentive was given or is being given to such produce or products developed there of. It was in the year 1972 on November 5 when an international body IFOAM (International Federation of Organic Agriculture Movements) was formed in France. The main thrust of IFOAM is to provide international framework for discussion. It also specifies basic principles for organic farming to facilitate its (organic farming) recognition at International level (table 1). These principles are not fixed but keep on changing as per the interaction at the fora of IFOAM, which has at present 600 organizational members from 120 countries including India.

Table 1. Basics of Organic farming systems (IFOAM)

(I)	To produce of high quality in sufficient quantity.
(II)	To interact in a constructive and life-enhancing way with natural systems and cycles.
(III)	To consider the wider social ecological impact of the organic production and processing system.
(IV)	To encourage and enhance biological cycle within the farming system involving microorganisms, soil flora and fauna, plants and animals.
(V)	To develop a valuable and sustainable aquatic ecosystem.
(VI)	To maintain and increase the long-term fertility of soils.

(VII) To maintain genetic diversity of the production system and its surroundings including protection of wild life habitats.

(VIII) To promote the healthy use and proper care of water, water resources and al life therein.

(IX) To use as far as possible resources in locally organized production systems.

(X) To create a harmonious balance between crop production and animal husbandry.

(XI) To give all livestock conditions of life with due consideration for the basic aspects of their innate behavior.

(XII) To minimize all forms of pollution.

(XIII) To process organic products using renewable resources.

(XIV) To produce fully biodegradable products.

(XV) To produce textiles which are long-lasting and of good quality.

(XVI) To allow everyone involved in organic production and processing a quality of life which meets their basic needs and allows an adequte return and satisfaction from their work includig a safe working environment.

(XVII) To progress towards an entire production, procession and distribution chain which is both socialy just and ecologically responsible.

Source : Stockdale *et.al.* 2001

Demand for organic food has been increasing. Consumers not only in the developed countries but also a section in developing countries are ready to pay more for healthier food. 70 per cent of the consumers are buying organic food because of safe food consciousness and increased environmental concerns. Organic products available in global market are dried fruits and nuts, processed fruits and vegetables, cocoa, spices, herbs, oilseed crops and their products, sweeteners, dried leguminous products, meat, dairy products, alcoholic beverages, processed food and fruit preparations. Non-food items are cotton, cut flowers, pot plants etc. This has led to development of international trade in organic farming with the result there has been rapid expansion in area under certified and policy supported organic production. Over the last 6 years, 80 per cent extension in organically registered area has been witnessed in Western Europe covering the countries like Austria, Italy, Denmark, Germany, UK and France. Several countries switching over to this system are Australia, Belgium, Canada, Czech Republic, China, Denmark, Estonia, Finland, France, Germany, Greece, Israel, Ireland, Italy, Japan, Latvia, Lithuania, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA and Oceania countries. India would adopt it for export purpose. Globally organically managed area is estimated to be 22 million hectares.

Market for organic produce has been growing modestly. Global retail sales of organic products are likely to touch $ 29-31 billion by 2005, which hover around $23-25 billion at present. Increase has been substantial over years 2000 and 2001. Statistics indicate that overall market size of organic product is limited except some countries like Canada where growth of market for organic produce was approx. 2.5 per cent per annum (Hill and Macrae 1992).

3.1 Asian Scenario

Good amount of arable area in Asia is under organic farming. However certified organic area is limited (table 2) with maximum area in China. India and Indonesia follows China. Organic area is taken as percentage of agricultural area, Israel ranks top with 1.25 per cent of area under organic management and Srilanka follows with 0.65 per cent area. Scope of international market for organic food products in Asia is also limited which is confined to China, Taiwan, Japan, Philippines and Thailand.

Table 2 : Area under organic farming in Asia

Countries	Year	Certified organic Area(ha)	Organic area as %age of agricultural area
China	2001	301,295	0.06
India	2001	41,000	0.03
Indonesia	2001	40,000	0.09
Isarael	2001	7000	1.25
Japan	1999	5083	0.09
Korea Rep.	1998	902	0.04
Malaysia	2001	131	0.002
Nepal	2001	45	0.001
Pakistan	2001	2009	0.08
Phillipines	2000	2000	0.02
Srilanka	2001	15,215	0.65
Thailand	2001	3429	0.02
Vietnam	2001	2	Negligible

Source : Yussefi and Willer (2003)

3.2. India Scenario

India is exploring prospects of organic farming in the country in response to international inclinations as internal market presents limited scope (Das and Biswas 2002). Moreover consumption of agrochemicals per ha in India is far below compared to western countries as already discussed in this volume. Even today India's 70 per cent arable area is rainfed where fertilizer application is nominal. Anonymous (2001) has described 50 districts comprising states Orissa, Jharkhand, Uttranchal, Himachal Paradesh, Jammu and Kashmir, Rajasthan, Gujarat, Madhya Paradesh and Chattisgarh, using low to no fertilizers for raising agricultural crops. According to Yussefi and Willer (2003) area under certified organic farming in India is 41,000 ha which involves 5661 farms. State of Sikkim, has been declared as chemical fertilizers free zone. The same can be extended to Ladakh region of Jammu and Kashmir and Lahaul-Spiti region of Himachal Paradesh where organic farming is the way of crop production.

Organic produce is expected to pay 25-30 per cent more than conventional produce (Das and Biswas 2002). Various horticultural crops, which are already managed either naturally or with limited use of chemicals, can be shifted to organic farming. Banana,

sapota, coconut and spices have been selected in south while citrus fruits can be selected in north east region. Guava, desi mango, ber, aonla, Jamun can be selected in northern plains whereas apple, pear, walnut and almond can be selected in north temperate region and apricot can be selected in cold arid region for certified organic production.

Jammu and Kashmir state indicate large potential for organic farming for various fruits, vegetables as well as field crops. Ladakh has scope for organic production of apricot, vegetables like cabbage, cauliflower, radish, turnip, potato, palak, methi, Lettuce and fodder like barley, Zanskari pea, wheat and buckwheat. Kashmir valley has potential for apple pear, almond, walnut, zeera and saffron. Jammu has scope for organic production of dairy products, anardana, peach, plum, ber, jamun, aonla, rajmash, mash (urd bean) and basmati rice subject to creation of congenial marketing environment.

3.2.1. India organic production programme.

India is member of IFOAM and is optimistically planning to venture into the field of organic products. The logo 'India Organic' will be assigned to such products. National Accreditation Policy and Program (NAPP) have been formulated. NAPP regulates export, import and local trade of organic products. Now all the certification bodies engaged in production, inspection and development of organic crops and products must be accredited by Indian Accreditation Agency. National Program for Organic Production (NPOP) has been launched by Govt. of India. It aims to promote sustainable development, environmental conservation, reduction in use and import of agrochemicals, promotion of export and rural development.

National Institute of Organic farming (NIOM) is being set up at Ghaziabad with Rs 100 crore of funds for promoting organic farming during the tenth five year plan (Nanda *et.al.* 2003.). The institute will impart training in organic farming and will conduct awareness program on production development and marketing of organic products. It will also integrate agricultural research, education and extension to promote organic agriculture and lay down norms as required from time to time.

4. ELEMENTS OF ORGANIC FARMING

Organic farm management in its analytical perspective is not only technique for raising of crops with organic manures rather it is an interactive enterprise that seeks maximization of nutrient recycling among its different constituent elements. The main objective behind the whole exercise is to infuse sustainability in the system. The focus certainly has to be on strengthening of resource base namely soil, crop, livestock and environment. Hence the organic farming exhibits the following features.

(i) Conserve the soil workability indefinitely by mechanical and physical interventions and by addition of organic matter.

(ii) Improves soil fertility status by addition of animal wastes, crop residues, decomposition and biological nitrogen fixation.

(iii) Enhancing nutrient availability by accelerating soil transformation processes and soil microbial activities.

(iv) Insect pests, diseases and weeds are controlled by eco-friendly techniques such as resistant varieties, crop diversification, crop rotations, natural predators, and organic manures and rarely by chemical intervention.

(v) Manifestation of self-sustainability due to high degree of nutrient recycling.

(vi) Amicably accommodate different biological and non-biological components.

Key elements to operationalize organic farming sustainably are described here under.

4.1. Livestock

Livestock production at the organic farm has been proposed as an essential practices in IFOAM principles (IFOAM 1998). Livestock provides additional diversifications at the farm and becomes source of regular income to an organic farmer. Moreover it increases recycling of nutrients at the farm, central to the theme of organic farming. Organic stock farming is land related activity and livestock production without land in organic farming is ruled out as per European communities' regulations (CEC, 1989).

Livestock rearing has been essential characteristics of traditional Indian farming systems. Animals are reared intentionally for the purpose of draught power, dairy products, wool, and fiber or meat product. In all cases manure components has been unconsidered bonanza. This makes the India to sustain 15 per cent global cattle population on 2.5 per cent world land resources and practices animal manuring regularly for crop cultivation. More than 73 per cent rural households in the country maintain live stock as a source of subsiding income generation which accounts for upto 40 per cent of their annual income (Sen 2003).

Livestock standards for organic farming are species-specific husbandry and include all animal welfare cares. Appropriate breed, housing nutrition and health cares are well described (Stockdale *et al.* 2001). A productive, well adopted disease resistant breed suitable to optimize production system, adequate housing space for normal behavior, expression and organically grown feeds are recommended for livestock production. IFOAM recommends use of natural medicines and remedial measures. In case of allopathic treatment, a prolonged withdrawl period for livestock product is enforced.

4.2 Crops

Crop production in organic farming involves several tactical practices to ensure products of considerable hygienic quality to suit to human and livestock consumption. It is almost a closed system for nutrients and organic matter except some external nutrient inputs allowed in case of export of products. External inputs may be derived from renewable resources.

4.2.1 Crop diversification

Crop diversification has economic and ecological dimensions. It is achieved at the farm by adopting cropping patterns and or crop rotations. The system can be made more effective by including nitrogen-fixing crops in cropping pattern, long crop rotation of high rotational intensity. Crop cafeteria approach can be followed to meet internal minor product requirements. Characters such as nitrogen fixing vs. nitrogen demanding, shallow vs. deep rooted crops, low water requiring vs. high water requiring, tap root vs. fibrous root system guide in appropriate designing of crop system.

Global spread of intensive agriculture offers limited variety choice to organic farmers. Plenty of plant genetic resources are now available. They have huge amount of genetic variability for maturity duration, nutrient response and quality parameters. Augmentation of breeding efforts focused at organic manuring response can lend more diversity, profitability and sustainability to organic agriculture.

Stockdale *et.al.* (2001) have compiled benefits arising out of crop diversification from investigations carried out by different workers such as

- Increased yield in crop mixtures
- Increased yield stability
- Reduction in disease incidence and severity
- Reduced pest incidence
- Increased arthropod diversity
- Improved weed control
- Reduced soil erosion
- Recycling of nutrient reserves from depth of soil
- More transfer of nitrogen from nitrogen fixing species

4.3. Organic manures

Organic manures form the fundamental characteristics of organic farming and are chief sources of crop nutrition in the system. Nitrogen, the major crop nutrient is made available to required level by inclusion of process of biological nitrogen fixation through addition of biofertilizers. Further organic farming permits limited import of nutrients through animal feeds and allows use of fertilizers that release nutrient through chemical weathering or soil microorganism activities. Organic farming thrust upon to fully reap the potential of different organic manures.

(i) Farm yard manure

It is the major organic manure available at the farm. In Asian countries much of it is used for fuel purpose, which needs immediate attention from promoters of organic farming. Average national value of FYM is 0.5 per cent nitrogen, 0.2 percent P_2O_5 and 0.5 per cent K_2O. An application of 25 ton of FYM per ha supplies to soil 112 kg of N, 56 kg of P_2O_5 and 112 kg of K_2O with plenty of organic carbon and several micronutrients. It is recommended 25 ton/ha for heavy nutrient feeding crops and 10-12 ton/ha for rainfed or low nutrient requiring crops.

Composting of crop remains twigs, stubbles, bhusa, kitchen refusal, water hyacinth, sawdust, bugasse and vegetative part of crop remains, weeds may be done by standardized methods. Nutritional composition of compost is more or less same as that of FYM (Gaur *et.al.* 1984). Droppings of sheep and goat are excellent organic manure. Average nutrient composition is 3 percent N, 1.0 percent P_2O_5 and 2 per cent K_2O. Poultry manure availability is also increasing rapidly with catching up of poultry farming in rural areas. Floor litter manure contains 3.03 percent N, 2.63 percent P_2O_5 and 1.4 K_2O.

(ii) Sewage sludge

Sewage is another source of organic nutrients for crops. Rapid expanding urbanization is generating huge quantity of sewage waste available for agriculture use. Sewage has two components, solid sludge and sewage water. Sewage water can be used for irrigation purpose after treatment. Sludge is collected, dried and used as manure. Sludge on average contains 1.5 to 3.5 per cent N, 0.7 to 4 percent P_2O_5 and 0.3 to 0.6 per cent of K_2O. Caution must be taken in using municipal sewage as it may contain high concentration of heavy metals such as B, Cd, Co, Cr, Cu, Hg, Ni, Pb and Se.

iii) Green manure

Green manuring is the practice of raising a legume crop for 50-60 days then incorporating it into soil. It has favorable effects on soil physical, chemical and biological properties. Sun hemp, dhaincha, cluster beans, cowpea, senji, mungbean, urdbean, berseem and alfalfa etc. are used as green manuring crops. Decomposition of legume crop residues is very fast and benefits are realized in succeeding crops. Berseem, senzi and pea green manuring leaves 89.4, 53.1 and 20.7 kg of N per ha respectively.

Several wild legumes and tree leaves can also be used to improve fertility status of soil. **Agroforestry with legume trees should be encouraged for green leaves manuring.**

iv) Other sources of organic manures

Agro-industrial wastes are available from processing of crops produce of rice, sugarcane, jute, tea, coffee, fruits and vegetables. Sea food canning industry generates organic wastes of prawn, fish and frog food processing wastes are converted into fish meal and fish manure. Manure algae and seaweeds form organic manures amounting to 10,000 to 15,000 tons annually in India

4.3.1. Organic Manure: Indian Perspectives

India abounds with biological diversity. Richness of vegetation cover and animal resources indicates considerable scope of exploitation of different resources for organic manure production. Venkateshwarlu (2004) has provided estimates of biomass availability in India for use in production systems (table 3). Huge quantity of solid and liquid wastes is available in cosmopolitan and metro cities. They are causing environmental pollution. Recycling of these wastes through composting would be an excellent eco-friendly system of organic manure production. Balasubramaniam (1996) estimated the potential of N, P and K available from organics (table 4). It comes to be 28 million ton and nitrogen alone is 15 million tons. Assuming only 50 per cent of the total resources will be utilized then by 2006, 14 million organic tons organic nutrients will be utilized with probability of 54 per cent organic farming and 2021 the potential is projected to be 28 millions tons organic nutrients with probability of 73.9 per cent organic farming. However by 2020, demand for nutrients will be 46 millions tons which seeks inclusion of some additional nutrient resources.

Table 3. Biomass availability in India for organic manures

Biomass	Quantity
Animal wastes	2018 million tones
Crop residues	407 million tons
Municipal wastes	29 million tones
Sewage	292,000 million gallons
Blood meal	55,000 tons
Bone meal	45,000 tons
Leather wastes	N.A
Forest litter	30 million tones
Non edible cakes	0.3 million tones
Rice husk	15 million tones
Rice bran	2.5 million tones
Bagasse	5.3 million tones
Press mud	2.0 million tones
Saw dust	2.2 million tones
Vegetable and fruit processing waste	0.25 million tones
Cotton stalks	12 million tones
Cotton dust	33,000 tons
Distillery effluent	4 billion litres
Tea wastes	10,000 tons
Tobacco wastes	62,000 tons
Jute sticks	2.5 million tones
Fish meal	N.A
Marine algae and sea weeds	15,000 tons

Source : Venkateshwarlu (2004).

Table 4. N, P and K availability potential from organics (million tons)

Source	N	P_2O_5	K_2O	Total
Livestock and human Waste	9.90	2.84	3.35	16.09
Rural and urban compost	4.30	2.10	3.60	10.00
Green manures	0.67	0.07	0.80	1.54
Distillery effluent	0.008	0.053	0.48	0.54
Total	14.878	5.062	8.23	8.17

Balasubramaniam (1996); Joshi et.al. (1998)

4.4. Human health

All our efforts in agriculture production system converge at a single objective –the safe food. The safe food is one component of human health, other being air, water and

atmosphere. Today the agriculture production system is dominated by chemical applications right from germination to post harvest processing and storage. Is this food safe to eat? What are its residual effects on our environment? Are these practices are sustainable? These are the questions, which needs immediate redressal. Chemicals, which should have been last resorts in safe food production, are now find indiscriminate use. The practices are not knowledge based and for the sake of profits there has been continuous poisoning of soil, plant, environment and human fellows. Wastes from human activities are flaring the natural resources. The emerging situation demands an immediate plausible action plan to check this expanding vicious cycle of chemicals (Fig. 1).

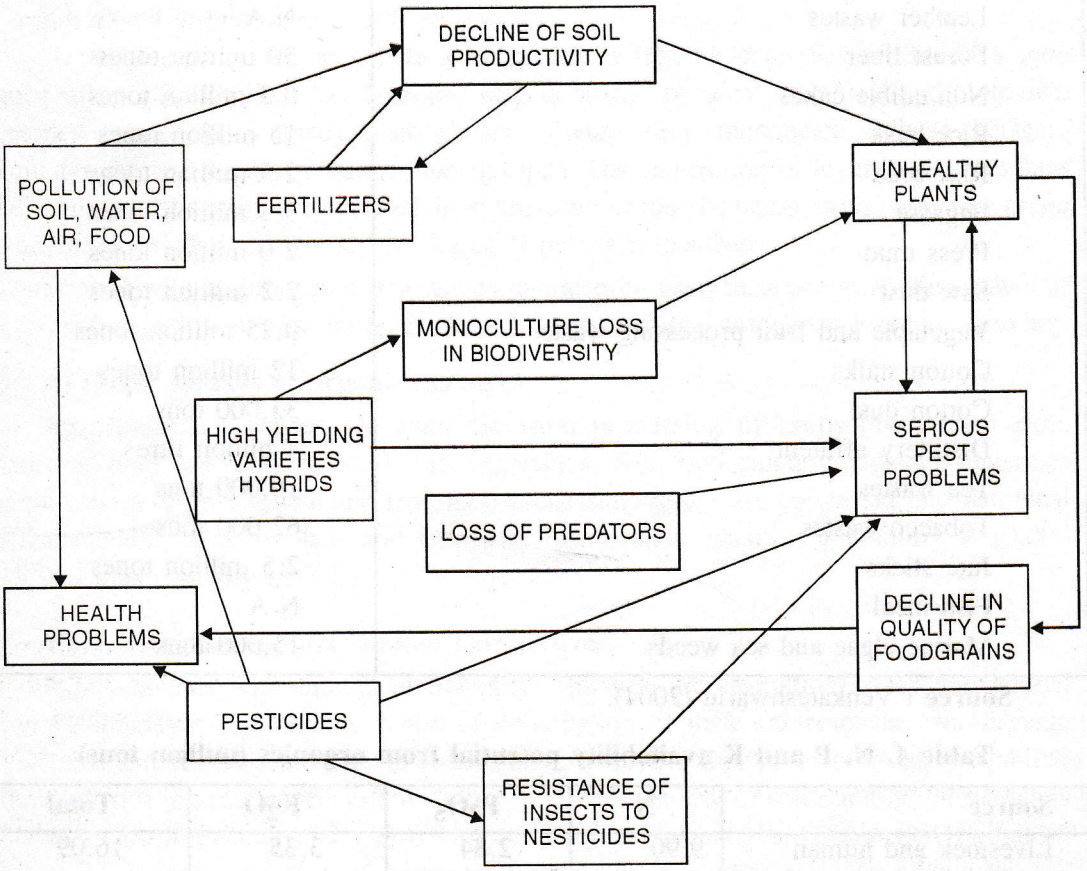

FIGURE1. AGRO-CHEMICALS IN INTENSIVE FARMING (VENKATESWARLU, 2004)

Organic farming is one such tool that has all the essential features of restraining further spread of chemical agriculture. Organic farming instead of adding pollutants, it recycles many of them after appropriate processing (composting) into food chain. Organic produce is comparatively safer and in certain cases better in quality and taste (Gaur *et.al.* 1986; Authors personal experience). Intensive agriculture assures survival of many but under medical care. Organic farming is more closed, self-sustaining and tenable system that takes care of man and his environment. More research investigations are needed to substantiate the role of organic farming in human health.

4.5. Soil and Soil health

It is the healthy soil where practices of organic farming are recommended. In fact soil is often referred and treated as living and dynamic component of farming in this system where application of every input is analyzed in term of its effect on soil physical, chemical and biological properties. Soils have developed in response to precipitation and vegetation patterns. Normally a soil consists of four major components, namely mineral matter (45%), organic matter (5%), soil air (25%) and soil water (25%) but another minor, however important component is soil biota. One gram of soil may contain billion of spores of microorganisms inhabiting it. Soil biota consists of plants, animals and micro-organisms (soil microflora ad soil microfauna). Soil microorganisms are important in development of soil profile and soil fertility. They are directly associated with biological activities.

Increased soil biota activities are managed organically (Gunapala and Scow 1998). Bacterial, fungal, nematode and earthworm populations show vertical growth with shift from conventional farming to organic farming but interesting observation was pronounced increase in non-parasitic soil organisms with the application of compost and manures (Ritz *et. al.* 1997).

Effects of organic management on physical properties of soil are seen as follows :

- Increased ease of cultivation.
- Increased aggregate stability.
- Increased porosity.
- Enhanced soil aeration.
- More water holding capacity.
- Lower rates of run off and soil erosion.
- Increase in depth of the A horizon of soil.

Chemical properties of the soil that showed recorded favorable trends were availability of nutrients like phosphorus and potassium, pH of soil remained optimal and stabilized under organic management. Nutrient losses due to percolation and run-off assumed to be low because of increased nutrient retention capacity. Nutrient budget were attained easily balanced and were very positive in mixed farming (Watson *et. al.* 1994). However soil health standards can be achieved only when organic management is followed in combination with sustainable cropping patterns and integrated disease, weed and insect-pest management.

4.6. Socio-economic acceptability

Socio-economic acceptability of the system is fundamental to its adoption by farmers. Organic farming systems have been modeled on maximum on-farm input where 20-60 per cent off-farm inputs cost may be reduced. Similarly in diary products cost of production may be down by 20-25 per cent. Organic farming systems are witnessed by some decrease in productivity with the results overall profits may be marginal unless the enterprise is endowed with 'safe food and safe environment' designation so that some additional premium price is available upon marketing. This has been possible in European countries, Austria and USA because of growing awareness about chemical pollution (Stockdale *et.al.* 2001).

Important socio-economic parameters in successful running of organic farming enterprises are

- People awareness about benefits of organic products.
- Masses awareness about chemical free agriculture in wake of deteriorating environment and degradation of biological resources.
- Marketing avenues.
- Effective management of on-farm resources (Maximum nutrient recycling).
- Reduced dependency on external inputs.
- Incorporating high value low volume crops in cropping patterns.
- Over the period, shows a sustainable soil-plant- animal –human continuum.

5. PRACTICES IN ORGANIC FARMING

Organic farming remodeled through latest global organic movement, earlier strongly focused on human diet, nutrition and health as well as promotion of soil fertility through use of compost and organic fertilizers. Later pesticides or any chemicals that leave harmful effects on environment and non–target organisms were also included. Crop production practices in organic farming have been accordingly modified to fall within the permissible limit. Basic elements are the backbone upon which whole system is interwoven (Fig. 2). Sowing, ploughing, intercultural operations, plant protection, nutrient management, water management, harvesting, threshing and storage require attention in context of organic farming.

Some more relevant practices are enumerated briefly.

5.1. Nutrient management

Synthetic fertilizers are not recommended for crop nutrition in organic farming. As far as possible nutritional requirements are met from farm sources such as animal manures, green manuring, crop residues, legume cultivation and biofertilizers. Limited inflow of nutrients is allowed from off-farm organic wastes such as sewage sludge, agro-industries, wastes, seaweeds etc. Heavy metals contamination is a concern in municipal and agro–industries wastes and thorough analysis is necessary before using it in organic farming. Nitrogen is brought into cycle via biological nitrogen fixation. Some nutrients enter the system through dry dust deposition and rainfall water.

Animal manures obtained from livestock at the farm are the major source of nutrients. 15-20 ton/ha of such manure is recommended. India with 479 million livestock including 197 million cattle and 88 million buffaloes has the huge potential to generate animal manures for organic farming but much part of it is used in meeting domestic fuels requirements as cooking gas facilities in remote rural areas are lacking. Cattle excreta can be fermented anaerobically to produce fuel (gober) gas without sacrificing its manurial value (Chhonkar 2003). Rather biogas waste has more manurial value than FYM on dry weight basis (FYM, N 0.78 %, P_2O_5, 0.72 %, K_2O 0.65 %, O.C. 24.4 %, C: N ratio 31.3, Biogas waste, N 1.41 %, P_2O_5 0.92 %, K_2O 0.84 %, O.C. 27.3, C: N ratio 19.4). Urban dairying is another issue that needs attention of policy makers. Thousand-tons of animal excreta is either thrown into drains or is not available for agricultural use. Animal housing, nutrition

and use of milk stimulants are the other aspects that need consideration on development of urban dairying. In many ways it does not fulfill criteria laid down for livestock farming and must be banned in the prevailing management scenario.

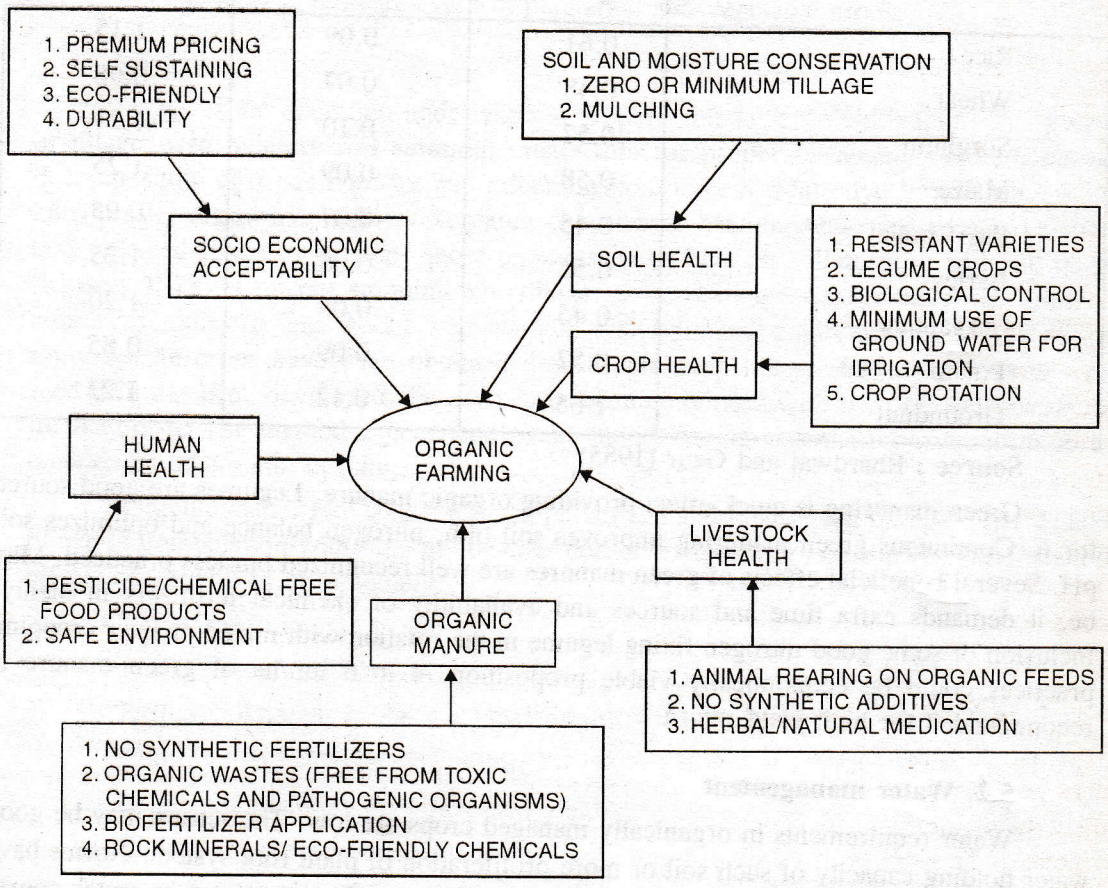

FIGURE2. COMPONENTAL CONNECTIVITY TO ORGANIC FARMING

Biofertilizers are competent source of organic farming in different situations (see chapter on biofertilizers). They are available for different crops both legumes as well as non-legumes. As yet they are not much popular with the farmers due to various reasons. And the big one is more research, recommendation and popularization efforts are concentrated on chemical fertilizers than on biofertilizers.

Crop residues are also important source for organic manure. Almost 50 per cent of them are fed to animals and rest is used as fuel or burnt. They contain NPK in good amount (table 5). Practices of crop residue burning are also observed all over the world. It is against ecological interest and should be abandoned. Compost technology should be disseminated in such areas for beneficial utilization of crop residues in absence of livestock. However in organic farming livestock is an indispensable component.

Table 5. N, P and K content in residues of some crops

Crop	Nutrient content%		
	N	P	K
Rice	0.61	0.09	1.15
Wheat	0.48	0.07	0.98
Sorghum	0.52	0.10	1.21
Maize	0.58	0.09	1.25
Paerl millet	0.45	0.07	0.95
Barley	0.52	0.08	1.25
Surgarcane	0.45	0.08	1.20
Potato	0.52	0.09	0.85
Groundnut	1.65	0.12	1.23

Source : Bhardwaj and Gaur (1985)

Green manuring is quick effect providing organic manure. Legumes are good source for it. Continuous green manuring improves soil tilth, nitrogen balance and optimizes soil pH. Several beneficial effects of green manures are well recognized but less practiced. May be, it demands extra time and sources and availability of chemical fertilizers in plenty. Inclusion of some good nitrogen fixing legume in the rotation with mixed or inter cropping practices could be economically viable proposition. 4 to 6 ton/ha of green manure is recommended for high yield return.

5.2. Water management

Water requirements in organically managed crops are low. The reason may be good water holding capacity of such soil or more proliferation of plant root system. Norms have been laid for water quality to be used in organic farming. Sewage water or water course having discharge of industrial effluent should not be used for irrigation as they have been found to be contaminated with heavy metals such as Co, Ni, B, Pb, Cd, Se, Cu and Zn. This type of water can be permitted for irrigation only after appropriate treatment. Disadvantages of excess irrigation must be well appreciated in terms of ill effects such as

- Excess irrigation leads to water logging, results in leaching of nutrients.
- Adversely effects soil biological properties.
- Increases incidence of diseases and pests.
- Leads to ground water pollution.

Organic farming favors more crop per drop and recommends technologies that enhance water use efficiency and maintains water quality.

- In sandy soils or rainfed areas, drip irrigation is optimal for water utilization.
- Preferably avoid ground water use for irrigation.

- Saline water may be used for irrigation after treatment.
- Irrigation requirements will be lesser under organic management systems.
- Mulching with crop residues, FYM or paper can be used to check evaporation losses. It is more relevant in plantation and vegetable crops.

5.3 Tillage

Tillage is the operation undertaken to prepare soil for crop cultivation. The purpose of tillage is to increase soil aeration, create tilth for proper placement of seed, enhance decomposition of organic matter and mineralization process. Many types of tillage are now known (Venkateswarlu 2004). Research experiences accumulated over time have shown that repeated tillage operations show repercussive effects on soil fertility and soil quality (Russell 1978). Concept of minimum tillage or zero tillage has given good results. It conserves moisture and works well even in water limited environments. Yields in post rainy season crops have been obtained higher than deep tillage. In response to this zero seed drill has been developed. Farmers have been convinced with the performance of zero till seed drill. The method is ecofriendly and energy saving and qualify to be an important component of organic farming.

Organic matter rich soils are much pulverized and favors zero till operation. Shallow tillage in combination with organic mulches conserves moisture and show several desirable effects on growth of crop namely

- Faster seedling emergence
- Fulfill partial nutritional requirement
- Extensive rooting in the top layer of soil
- Conserve soil surface temperature.
- Better plant canopy and increased yields
- Control/suppress weeds.
- Organic mulches may reduce soil erosion (Tejwani and Bhardwaj 1982)

5.4. Crops and their varieties

Organic farming does not hold good for all the crops in all the situations. Suitable crops and their appropriate varieties, particularly those responsive to the system must be identified to make the approach viable. However globally plant breeding efforts have been diverted to develop varieties for intensive management. It is well known fact that enough genetic variability for nutrient requirement exists between as well as within the crops. In our evaluation study on local wheat cultivars of Ladakh region, it was observed that these cultivars could yield equal to high yielding varieties even at half the dose of recommended nutrient package in disease and pest free environment. Some farmers in the Leh locality reported wheat yield of local wheat cultivars with organic management at par with high yielding varieties, managed inorganically. It infers that scope exists to identify genetic resources that will do well under organic management systems. Stockdale *et. al.* (2001) proposed that breeding efforts directed specifically at organic production would substantially

improve the quality of crops profitability and sustainability of organic agriculture. Some tips for selection of crops are as follows

- High volume crops should replace low volume crops
- Grow disease and pest resistant varieties
- Multipurpose crops be prioritized i.e., legumes
- Short duration varieties to increase crop productivity per unit area.
- Physiological efficient varieties in response to organic manuring be grown.

5.5. Weed control

Weeds are identified as the key problem in organically managed farming than the chemical agriculture. As organic manures may act as carrier of weed seeds. Weed control strategies begin with tillage, intercultural practices or to follow a suitable cropping system. Timely sowing and good crop establishment also reduce weed populations proliferation. In case of severe weed infestation cultural practices may be integrated with some herbicidal application.

Mulching the soil surface with black alkathene suppresses weed seed germination and emergence (Sharma 2002). Solarization of soil is often carried to kill all the sorts of pests in it. Horowitz *et. al.* (1983) reported that solarization could be used to heat field to 65°C or above by covering soil surface with plastic sheet. It destroys weed seeds. In organic farming weed control aims to avoid serious competition of weeds with the crop and weed free conditions are rarely achieved.

Mechanical and manual weedings are often recommended even in combination with chemical control measures. Manual weedings are eco-friendly and have several advantages (Sharma and Mir 2000). As it is labor consuming, proper understanding of crop weed instructions is essential for economical weed management in organic farming.

5.6. Insect-pest control

Pest control is by and large preventive. Several cultural, mechanical and biological tactics are adopted to keep the pest population below threshold level. Operations begin with summer ploughing to kill hibernating insect-pests in the field. Field sanitation, pruning and manual collection can also be practised depending upon the pest, pest population and crop. Adoption of diverse crop rotations at the farm disrupts pest life cycle and it checks build up of pest population. Intercropping has considerable scope in organic farming to control pests. Use of trap crops is effective in control of several pests (see IPM chapter). Thus pest control measures in organic farming include cultural practices, crop rotation, crop species, variety, trap cropping and biological pest control. Alice *et. al.* (2003) obtained 3.6-ton/ha yield of rice with application of 12.5 ton FYM/ha and brown plant hopper pest population was low compared to NPK treatment.

5.7. Disease Control

Organic farming desists from making any recommendations of chemicals to control diseases. Cultural techniques are routinely practised. Disease problem is expected less in organic systems over conventional system because of restricted amount of soluble nitrogen

available from organic manures. At the same time beneficial soil flora is also activated upon application of organic manures. Healthy seed or propagating material is important in organic farming. Various botanicals may be used for this purpose. Methods and approaches applied in organic farming are:

- Diverse crop rotations
- Crop mixtures or intercropping
- Use of various organic amendments (Van Bruggen 1995)
- Treating seed or soil with beneficial rhizosphere flora to increase antagonistic activity
- Using resistant crops or resistant varieties
- Using sulphur or botanicals for control of diseases as a last resort
- Limited application of biological control is permitted in organic farming
- Windbreaks or hedgerows may also be used to check wind–transported pathogens.

5.8. Crop rotation

The purpose of crop rotation is to increase net return at the farm by increasing cropping intensity. But in organic farming intentional motives are to build up soil fertiity, to reduce build up of harmful flora and to maintain diversification at the farm. The objectives of crop rotations are realized as under

- Increasing crop intensity in rotation by including short duration varieties.
- Improving soil fertility by including a legume in the rotation.
- Grain, vegetable, fruit, pulses and fodder rotations provide complete food and nutritional requirement at the farm to both human being as well as livestock.
- Build up of pests is checked due to disruption in life cycle.
- Soil sickness problem is overcome.
- Nutrient use efficiency is increased.
- Diversification supports life of many pollinators and predators.

5.9. Post harvest processing and storage

In view of human health and environmental quality as pre-requisite, storage of organic products is to be done in eco-friendly structures. Chemicals whether protectants or preservatives are usually not permitted. Botanical pesticides are permissible under prescription. Synthetic colors or additives or other chemicals used in preparation of post harvest products are discouraged as these may pose difficulties in registration of products. Sugar, table salts, edible oils should be used as preservatives. Synthetic coloring agents are replaced by natural or herbal colors.

6. IMPLICATIONS OF ORGANIC FARMING

Principles outlined by IFOAM for organic farming plead for maintenance of eco-environment and avoidance of all those practices that spread any kind of pollution. Production standards and economic feasibilities are also included as key issues so that it is accepted by farmers.

6.1. Soil health

Organic farming cares more for soil than crop. Addition of manures to soil is scheduled according to soil needs. Build up of soil organic matter increases (Clark *et. al.* 1998). It brings stability in soil pH and enhances organic carbon, so essential for good soil biological environment. Antagonistic microorganisms increased and nutrient transformation processes were accelerated upon addition of organic manures (Stockdale *et. al.* 2001). Physical properties of soil were enhanced in terms of porosity, aggregation stability, soil aeration, nutrient retention and water holding capacity.

Micronutrient status remains quite better under organic farming. Macronutrients like N and P availability and uptake are enhanced by adoption of appropriate practices like green manuring, addition of rock phosphate and VAM fungi.

6.2. Water pollution

Prohibition of synthetic pesticides in organic farming establishes its edge in risks of contaminating water compared to intensive /conventional agriculture. In livestock production use of antibiotics, organophosphates and feed additives are not permitted which reduce risk factors over conventional (livestock systems).

Nitrate leaching losses are related to nitrate load in the soil, crop production activities and type of crop grown. Nitrogen budgets are reported positive for some organic farming systems. There may be the possibility of nitrate leaching (Nguyen *et. al.* 1995). Other factors that can result in nitrate leaching are method of storage, compositing and disposal of farmyard. Organic manures incorporation and demand of N by crops also determines nitrate leaching. Matching of organic manure incorporation in soil must match with nitrogen demand of the crop. It is only the mishandling of fertilizers and their mismatching with crop requirement that can cause water pollution, otherwise risk factors associated with organic farming are very low.

6.3. Air pollution

Emission of carbon dioxide, nitrous oxide and methane from a system indicate its contribution to global warming. Limited work has been carried on this aspect (Stockdale *et. al.* 2001). Sources of methane emissions are rice fields and ruminants in an agricultural system. Carbon dioxide and nitrous oxide result from urea transformation. Following observations reveal superiority of organic farming over conventional one.

- Carbon dioxide emissions are generally lower in organic farming systems. It is due to prevention of chemical use.
- Nitrogen surpluses are low in organic system and indicate lower potential for gaseous nitrogen emissions. Ammonia losses may occur during handling and spreading of farmyards manure.
- Methane emissions are at par with conventional system. However low stocking rates may result in lower methane emission/ha.
- Organic farming reduces air pollution as it permits use of many off-farm wastes which otherwise may result in air, water and soil pollution.

6.4. Biodiversity conservation

Influence of organic farming is expectedly favorable for weed flora, arthropods, birds, other wildlife and soil flora and fauna. Eco-friendly weed control measures provide livelihood rights to many untargeted plants. Besides field boundaries and margins exhibit floral species richness. Insect diversity has correlation with floral diversity. Crops, cropping systems, agronomic practices followed and their interactions determine abundance, diversity and distribution of insect species (Stockdale *et. al.* 2001).

Butterflies respond to changes in plant communities and structural features in the landscape.

Birds' number and species show more density on organic farms. Three reasons have been attributed to it

(a) Bird populations change in response to habitat structure that is physical and biological topography.

(b) Organic farming systems are structurally more diverse and provide greater livelihood opportunities in term of habitats and food resources.

(c) Greater arthropod and floral biodiversity make available diverse bird –food sources. Animal like mice, rabbit and other herbivores flourish in response to food sources available and likely to show abundance in organic farming systems.

6.5. Food security

Global population is expected to touch the mark of 8.5 billion by the year 2025. A continuous increase in food production is required to feed the expanding human population. Swaminathan (2002) has proposed bent up of mind for evergreen revolution to ensure food security to all while FAO estimates 60 percent increase of the present level of production by 2025 to feed 8.5 billion populations. These increases are expected to come from intensive agriculture.

Organic farming is likely to reduce 20-40 per cent yield in crops and 10-30 per cent production in livestock (Padel and Lampkin 1994). However, it doesn't apply to all the crops. Most of the fruit crops, vegetables and grain legumes may fit well with some increment in yield as well as profit over conventional systems. Further the system is only choice for resource poor farmers and farming in remote areas or areas associated with fragile ecosystem. More shrinking natural resources have it mandatory for human society to find out a technology which increases net food supply with lower levels of resource used per unit of produce and says no to environmental pollution. Organic farming has demonstrated its capacity to do this.

7. ORGANIC STANDARDS, LEGISLATION AND CERTIFICATION

Plants while biosynthesizing various products hardly discriminate the raw material whether coming from inorganic or organic resource. To establish the organic nature of finished products is thus a tedious job but has to be carried by valid, reliable and accurate techniques so that the claim of the farmer, middleman processor and retailer is taken into guarantee. Technique such as Kirlian photography and some microbiological and biochemical tests are available to assess organically produced foods (Thompson 1995). But these techniques need to be refined, improved and simplified to facilitate ease of testing.

Organic farming has been given a shape by the provision of permissible practices and technologies (Lampkin and Measures 1999; Palaniappan and Annadurai 1999). Production standards are still blend of ethics, traditions, experiences, sentiments, environmental concerns and pragmatism and much less based on scientific knowledge. Production, processing, storage, transport, inspection and certification have to be given a sound system of recommendation, restriction and prohibition regarding practices and inputs. Nanda *et. al.* (2003) described **organic product is that which is raised, grown, stored or processed without the use of synthetically produced chemical or fertilizers, herbicides, insecticides, fungicides or any other pesticides, growth hormones or growth regulators.** Similarly all products of animal origin such as meat, milk, other dairy products, poultry and eggs must be produced using feeds in which no growth stimulants, antibiotics, synthetic medicines, synthetically produced vitamins or mineral have been supplemented.

Until recently no international system existed for accreditation of organic agricultural programme. United Nations Organization has come forward to give boost to organic farming. Food and Agricultural Organization (FAO) in collaboration with World Health Organization (WHO) has developed 'Codex Alimentarius' for organic products to gear up international trade.

International Federation for Organic Agricultural Movements (IFOAM) is providing global facility for accreditation. It is developing basic standards and harmonizing organic certification programmes in different countries. IFOAM has 600 organizational members from 120 countries including India. It communicates latest on organic standards and educates organizations involved in organic farming through seminars, symposia and magazines.

To get organic certification, a conversion or transition period of 3 years is needed. Close monitoring of plant nutrient dynamics is recommended to check mining of the soil. Besides regular input tests and food quality tests are also required.

India Organic Agricultural Movement (IOAM) has developed production standards applicable to Indian situation in association with IFOAM. Govt. of India also aims to promote organic farming through national Programme for Organic Production. Indian Council of Agricultural Research proposes to replace All India Coordinated Project on organic manures with organic farming. National Accreditation Policy and Programme (NAPP) formulated and Logo "India Organic" established for products originating from organic farming. Funds worth Rs100 crores have been allocated during 10^{th} five year plan to set up National Institute of Organic farming at Ghaziabad. It will conduct research and training besides production and marketing development for organic farming.

There are six authorized accreditation agencies approved by Ministry of Commerce, Govt. of India at present (Anonymous 2002). These are:

(i) Agricultural and Processed Food Products Export Development Authority (APEDA).
(ii) Coffee Board
(iii) Spices Board
(iv) Tea Board

(v) Coconut Development Board

(vi) Cocoa and Cashew nut Board

Four certification agency accreditated by APEDA are

(i) Institute of Marketology (IMO), Banglore.

(ii) SKAL, India, Banglore.

(iii) ECOCERT International, Germany.

(iv) SGS India Pvt. Ltd., Gurgaon.

India has good avenue in organic production for a number of spices such as Black pepper, White pepper, ginger, turmeric, cardamom, clove, nutmeg, zeera and coriander, various fruits like banana, mango, apple, guava and jamun etc and various other crops like tea, coconut, herbal aromatic products, cut flowers and numerous medicinal plants. These are already grown either on organic manures or with limited application of synthetic fertilizers and are obviously easy option to venture with ensured initial success.

8. ORGANIC FARMING: FACTS AND FICTIONS

Organic farming lays emphasis on application of nutrients or other chemicals of organic origin. This is what the human being practicsed about 10,000 ago when he started settled agriculture. Synthetic chemicals were not known. Recycling of nutrients through livestock was known. Many scientists call organic farming a process of going back where one has to thrust upon recycling of nutrients as much as possible. The biggest puzzle with the system is whether the human world with population of about 7.0 billion can sustain on organic farming. Despite intensive farming, 850 million persons are starving or getting inadequate food to survive. If human population continuous to grow like this by 2025 another green revolution will be needed to provide sustenance to about 8.5 billion people. Decrements of about 30-50 per cent in crop yields and 20-40 per cent in livestock productivity are expected by shift from intensive/conventional farming to organic farming. It questions about the sustainability of the system.

What made the man to think back, overhaul and revitalize the system is not his option but compulsion arising out of surmounting fragilzation of world ecosystems. Later owes to mushrooming of human crowds, shrinking natural resources, environmental deterioration and increased dependence upon non-renewable sources of energy. Adopting organic farming as an alternative agriculture has reasons with intensive agriculture on following grounds

- Decline or stagnation in crop productivity per unit area in spite of high doses of fertilizers
- Higher chemical pesticides rates are now needed to control the pests
- Many pests are displaying resistance to chemical pesticides.
- Chemicals find use in seed treatment, crop growth, fruit settling, fruit ripening, storage of produce and processed preparations.
- Increased use of fossil fuels energy in agriculture because of chemicalization and mechanization.

- Drastic reduction in biological diversity.
- Increased agro-chemical pollution due to imbalance use of various inputs.
- Increased use of ground water in agriculture is leading to drinking water scarcity (FAO, 2002).
- Micronutrient deficiencies in soil have emerged as a global problem. They have effect on human nutrition, too.

Chhonkar (2003) have elaborated the pros and cons of organic farming

Especially in context of populous countries like India and China. He has given scientific treatment to various myths attached with superlative claims of organic farming. His derivations cannot be refuted in absolute but seem to have not been given consideration in totality. For instance

- Taste and quality both are parameters of polygenic nature. A number of chemical reactions participate in the synthesis and accumulation of chemicals responsible for taste and quality. These reactions in many cases are known to involve micro-nutrients while in intensive agriculture only NPK supply predominate with no to little use of micro-nutrients. For flavor, aroma and palatability, cooking, and edibility is the only science and it is positive for organically grown products.
- Mineral nutrition of crops have role in human nutrition also (Graham et al 2001). Zinc and iron deficiency in the world are being planned to be tackled by developing Zn and Fe rich varieties of rice (Swaminathan 2002). There is need to look for a complete plant food source to have nutritious but safe food. Hazards and safety are concerns in both organic and inorganic farming systems depending upon prevailing agro-ecological situations.
- Eco-friendly nature of organic farming cannot be ruled out. It is friendly to soil, water, and air, animal and human being. Undesirable gases emission is comparable or even more inorganic farming but even otherwise if this organic waste is not recycled through crop use, it will become an environmental menace. Moreover recycling of nutrients is the natural principle that sustains biological communities and organic farming has a plus point in this respect over chemical agriculture.
- Above all chemical poisoning cannot be compromised any further and ecofriendly systems like that of organic farming have to be promoted.

Both the crop productivity and soil productivity can be sustainable only when balanced nutrition is available. They won't distinguish the origin of nutrition whether organic or inorganic. Balanced fertilization is the option but it must come out of utilization of huge organic waste available in the country (table 3).

9. OPPORTUNITIES IN ORGANIC FARMING

Productivity at organic farms is limited by putting restriction on use on-farm resources. Taste of organic products often quoted better however overall quality may not excel conventional ones, particularly the livestock products because of dependency on homegrown feed and prohibition on micronutrient supplementation. Pesticide residues in food commodity

are expected less. On this account, organic products are becoming the choice of millions. Demand for organic products is growing at the rate of 25 % annually. Therefore considerable opportunities exist in organic farming for economic upliftment of organic farmers. A swot analysis about prospects in organic farming has been given by Nanda *et. al.* (2003). Some salient features of these aspects are enumerated below :

(i) Health consciousness is growing among people and for pesticide residue free food they are ready to pay extra price up to 25 % or more over the products through conventional farming.

(ii) Conservation of natural resources is the top priority worldwide to save some for the generations to come.

(iii) Today water, air, soil and food commodities are contaminated with chemical residues. Health and environmental hazards associated with synthetic fertilizers and pesticides are numerous including deterioration of human systems. Organic farming ensures chemical free environment.

(iv) World trade organization (WTO) is adopting stringent standards on pesticides residues in agricultural products through sanitary and phytosanitary standards (SPS). This opens trade avenues in organic farming.

(v) Huge amount of organic wastes are available in India. These can be recycled through organic farming. Furthermore vermicompost, compost and biofertilizers are good alternative sources for supply of plant nutrients. These will reduce cost of cultivation.

(vi) Internal market though limited yet demand for organic products in European countries and USA is increasing at the rate of 20-25 per cent per annum. Hence export potential exits for the enterprise.

(vii) Varied agro-climatic conditions provide more opportunities through development of varietal organic products.

(viii) Plenty of laborers and similarity of the system with traditional farming practices in India predicts ease of adoption by the farmers.

(ix) *Organic* farming entails more employment opportunities in rural areas. It ensures local food security and may improve household nutrition.

(x) Organic farming stresses upon use of on-farm resources, indigenous technology and ecological knowledge to sustain natural balance. It has socio-economic perspective.

9.1. Problems or constraints

(i) Certified organic farming requires strict adherence to standard laid down by IFOAM for international trade.

(ii) Organic farming make use of organic manures, biofertilizers and biopesticides where marketing sector is still less developed

(iii) It is knowledge intensive system.

(iv) Higher biomass production and livestock rearing are essential requisite to make a lot of material available for organic manure preparation.

(v) Complete standardization of parameters of quality of organic products and various input is still lacking.

(vi) It may not be advantageous in case of heavy nutrient feeding crops such as wheat, maize and rice.

(vii) Fluctuation in premium price of organic products may occur seasonally.

(viii) Govt. policies and incentives to organic farmers are still elusive.

(ix) Organic zonalization regarding crops, livestock and their processed products is lacking.

(x) General consensus among agricultural scientists about scope of organic movement in national and international context is ambiguous.

10. EXTENSION IMPLICATIONS

Organic farming is emerging as innovative agricultural technology at the international level. It has set rules and regulations. Any one interested in this venture has to adhere to production, storage, processing and transport norms laid down by IFOAM or National Accreditation Agency. These norms are not fixed but keep on changing and evolving continuously depending upon the feed back from various agricultural and health organizations. A responsive extension set up is must to make organic farming economically viable and get firm foothold in international market. An extension worker has to execute his skill in motivation, training, popularization, dissemination and demonstration on following aspects of organic farming

10.1. Production technologies

Rearing of crops and livestock is based on specific production practices in organic farming. It includes agronomic practices, soil management, water management, plant protection measures and animal rationing etc. Extensive education training and demonstration through on-farm activities is required so that products meet the certification standards.

10.2. Establishing Input sector

Organic farming recommends use of various inputs, which are of organic origin such as organic manures, pesticide botanicals, biofertilizers and permissible off-farm resources. People have to be awared of business opportunities in this area. Govt. incentives, policies and developing prospects will have to be conveyed through extension programmes so that organic industry comes parallel to chemical industry.

10.3. Natural resources conservation

Main objective behind popularization and commercialization of organic farming is its favorable impact on natural resources conservation and environmental protection. Time has come when every human being must be elaborated on shrinking natural resources, environmental deterioration and threatening human existence because of human activities. It will create a sense of responsibility and adoption of sustainable living practices and consumption of organic products is one of them.

10.4. Promotional strategies

They include developing producer cooperative associations, zonalization of crops and crop products, establishment of post harvesting and processing industries to help farmers in marketing of their produce. Keeping in view, varied agro-climate, location, national and international demand for organic products, zonalization of agriculture, livestock and their products should be done to avoid glutting and transport problems. For instance, south Indian region can be selected for spices, coconut, north east for tea, citrus and northern Himalayan region for apple, walnut, almond and apricot. Processing units should be prioritized near metro or coastal cities for ease of export.

10.5. Empowerment of extension agencies

Mere training and motivation should not be the job of extension agencies. Besides communicating new reforms, documenting success stories, solving organic growers problems on spot, inspection and certifications rights may also be vested with these agencies. Expert from multi –disciplines have to work in unison to give a turn to agriculture from chemical to bio-organic where sincere efforts in research, education and extension are demanding factors.

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